A+ Part 1 (220-1001)
Project Workbook

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Project Workbook

First Edition

LK LearnKey®

LearnKey
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Using This Workbook

This project workbook contains practice projects and exercises to reinforce the knowledge you have gained through the video portion of the A+ Part 1 (220-1001) course. The purpose of this workbook is twofold. First, to get you further prepared to pass the first of the two exams needed to get your A+ certification. Secondly, to get you job-ready skills and increase your employability in the IT field, specifically for a computer technician or similar position.

This project workbook is versatile in that the projects follow the order of the video portion of this course. You can complete the workbook exercises as you go through each section of the course, complete several of these at the end of each session, or complete them after viewing the entire course. The key is to go through these projects as they will help strengthen and solidify your knowledge of this course.

Each project is mapped to a specific video (or videos) in the course and specific test objectives. The materials you will need for this course include:

- Hardware to practice with, including a smartphone, tablet, laptop, and desktop.
- Computer tools, namely a screwdriver.

Benefits:
- Learn what it takes to be a computer technician while getting the first half of your A+ certification.
- View your online courseware anytime and anywhere.
- Put your skills to the test with dozens of Pre/Post test questions and practice labs.

Best Practices Using LearnKey's Online Training

LearnKey offers video-based training solutions which are flexible enough to accommodate the private student, as well as educational facilities and organizations.

Our course content is presented by top experts in their respective fields and provides clear and comprehensive information. The full line of LearnKey products has been extensively reviewed to meet superior standards of quality. The content in our courses has also been endorsed by organizations, such as Certiport, CompTIA®, Cisco, and Microsoft. However, it is the testimonials given by countless satisfied customers that truly set us apart as leaders in the information training world.

LearnKey experts are highly qualified professionals who offer years of job and project experience in their subjects. Each expert has been certified in the highest level available for their field of expertise. This provides the student with the knowledge necessary to also obtain top-level certifications in the field of their choice.

Our accomplished instructors have a rich understanding of the content they present. Effective teaching encompasses not only presenting the basic principles of a subject, but understanding and appreciating organization, real-world application, and links to other related disciplines. Each instructor represents the collective wisdom of their field and within our industry.

Our Instructional Technology

Each course is independently created, based on standard objectives provided by the manufacturer for which the course was developed.

We ensure that the subject matter is up-to-date and relevant. We examine the needs of each student and create training that is both interesting and effective. LearnKey training provides auditory, visual, and kinesthetic learning materials to fit diverse learning styles. The following are three levels of implementation:

Course Training Model

The course training model allows students to proceed through basic training, building upon primary knowledge and concepts to more advanced application and implementation. In this method, students will use the following toolset:

Pre-assessment: The pre-assessment is used to determine the student's prior knowledge of the subject matter. It will also identify a student's strengths and weaknesses, allowing the student to focus on the specific subject matter he/she needs to improve most. Students should not necessarily expect a passing score on the pre-assessment as it is a test of prior knowledge.

Video training session: Each course of training is divided into sessions that are approximately two hours in length. Each session is divided into topics and subtopics. As this is a test prep course, there is only one session in this course.

Practice Labs: In addition to the video training, there are practice labs available for students to use to reinforce the skills learned in the video training portion of the course.

Post test: The post test is used to determine the student's knowledge gained from interacting with the training. In taking the post test, students should not consult the training or any other materials. A passing score is 80 percent or higher. If the individual does not pass the post test the first time it is taken, LearnKey would recommend the incorporation of external resources, such as the workbook and additional customized instructional material.

Skills Assessment

Instructions: Rate your skills on the following tasks from 1-5 (1 being needs improvement, 5 being excellent).

Skills	1	2	3	4	5
Given a scenario, install and configure laptop hardware and components.					
Given a scenario, install components within the display of a laptop.					
Given a scenario, use appropriate laptop features.					
Compare and contrast characteristics of various types of mobile devices.					
Given a scenario, connect and configure accessories and ports of other mobile devices.					
Given a scenario, configure basic mobile device network connectivity and application support.					
Given a scenario, use methods to perform mobile device synchronization.					
Compare and contrast TCP and UDP ports, protocols, and their purposes.					
Compare and contrast common networking hardware devices.					
Given a scenario, install and configure a basic wired/wireless SOHO network.					
Compare and contrast wireless networking protocols.					
Summarize the properties and purposes of services provided by networked hosts.					
Explain common network configuration concepts.					
Compare and contrast Internet connection types, network types, and their features.					
Given a scenario, use appropriate networking tools.					
Explain basic cable types, features, and their purposes.					
Identify common connector types.					
Given a scenario, install RAM types.					
Given a scenario, select, install and configure storage devices.					
Given a scenario, install and configure motherboards, CPUs, and add-on cards.					
Explain the purposes and uses of various peripheral types.					
Summarize power supply types and features.					
Given a scenario, select and configure appropriate components for a custom PC configuration to meet customer specifications or needs.					
Given a scenario, install and configure common devices.					
Given a scenario, configure SOHO multifunction devices/printers and settings.					

Skills	1	2	3	4	5
Given a scenario, install and maintain various print technologies.					
Compare and contrast cloud computing concepts.					
Given a scenario, set up and configure client-side virtualization.					
Given a scenario, use the best practice methodology to resolve problems.					
Given a scenario, troubleshoot problems related to motherboards, RAM, CPUs, and power.					
Given a scenario, troubleshoot hard drives and RAID arrays.					
Given a scenario, troubleshoot video, projector, and display issues.					
Given a scenario, troubleshoot common mobile device issues while adhering to the appropriate procedures.					
Given a scenario, troubleshoot printers.					
Given a scenario, troubleshoot common wired and wireless network problems.					

A+ Part 1 (220-1001) Time Tables

Domain 1	Actual Time
Laptop Hardware and Components	00:12:56
Install Laptop Display Components	00:02:05
Laptop Features	00:05:37
Types of Mobile Devices	00:03:35
Mobile Device Accessories and Ports	00:05:56
Mobile Device Networks and Apps	00:15:22
Mobile Device Synchronization	00:10:24
Total Time	00:55:55

Domain 2	Actual Time
Ports, Protocols, and Their Purposes	00:07:34
Networking Hardware Devices	00:06:26
SOHO Networks	00:14:38
Wireless Networking Protocols	00:05:35
Server Types	00:10:09
IP Addressing	00:08:07
Internet Connection Types	00:06:07
Networking Tools	00:02:47
Total Time	01:01:23

Domain 3	Actual Time
Cable Types, Features, and Purposes	00:13:05
Common Connector Types	00:03:37
RAM Types	00:04:26
Install and Configure Storage Devices	00:12:26
Internal PC Parts	00:21:17
Peripheral Types	00:06:52
Power Supply Types and Features	00:02:10
PC Configurations	00:04:49
Install and Configure Common Devices	00:06:17
Configure Printers and Settings	00:08:36
Install and Maintain Printers	00:18:34
Total Time	01:42:09

Domain 4	Actual Time
Cloud Computing Concepts	00:11:14
Client-Side Virtualization	00:03:37
Total Time	00:14:51

Domain 5	Actual Time
Troubleshooting Methods	00:07:35
Troubleshoot Hardware Problems	00:10:39
Troubleshoot Hardware Drives and RAIDs	00:07:01
Troubleshoot Video and Display Issues	00:06:38
Troubleshoot Mobile Device Issues	00:14:55
Troubleshoot Printers	00:09:56
Wired and Wireless Network Problems	00:08:55
Total Time	01:05:39

A+ Part 1 (220-1001)
Project Workbook
Domain 1: Mobile Devices

Presented By

LK LearnKey®

Fill-in-the-Blanks Domain 1

Instructions: While watching Domain 1, fill in the missing words according to the information presented by the instructor. [References are found in the brackets.]

Laptop Hardware and Components

1. An _____ drive has no cylinders, is much faster than a magnetic hard drive, and is virtually indestructible. [Hard Drive Types and Sizes]

2. If a laptop is not getting power, the _____ may need to be replaced. [Other Laptop Parts]

3. If speakers are not working, the speakers may not be the problem, but the _____ might be the problem. [Other Laptop Parts]

Install Laptop Display Components

4. Most laptops have _____ monitors, while smartphones have _____ displays. [LCD and OLED]

5. If you are installing a webcam or microphone, it will more than likely be an _____ installation. [Media Parts]

6. _____ are circuit boards located behind an LCD screen, while a _____ fits on top of a screen. [Media Parts]

Laptop Features

7. On different laptops, the special function keys will often be in different places along the _____ row. [Special Function Keys]

8. If you lose your wireless connection, check the _____ key to see if it was accidentally turned off. [Special Function Keys]

9. _____ will give expansion slots and make a laptop work like a desktop, while a _____ just adds ports and nothing else. [Expanders and Locks]

Types of Mobile Devices

10. _____ are replacing PCs and laptops as they have the capabilities to do the same things and are convenient. [Tablets, Smartphones, Wearables]

11. Smart watches, fitness monitors, and VR/AR headsets devices are three types of _____ technology. [Smart Watches and Fitness Monitors]

12. _____ have apps that are replacing E-Readers and GPS devices. [VR/AR Headsets, E-Readers, and GPS]

Mobile Device Accessories and Ports

13. A USB-C connector supports the _____ standard and has a transfer speed of 10 Gbps. [Connector Types]

14. Most Bluetooth wireless connections have a signal range of _____ meters. [Wireless Connection Types]

15. Headsets, speakers, and _____ chargers are commonly used mobile device accessories. [Headsets and Speakers]

Mobile Device Networks and Apps

16. A smartphone with a hotspot can be tethered to a laptop if the laptop does not already have a ⸻ connection. [Hotspots, Airplane Mode, and Bluetooth]

17. Two devices that have Bluetooth enabled can be ⸻ so that the two devices are connected. [Hotspots, Airplane Mode, and Bluetooth]

18. Your web provider will determine if a POP3 or ⸻ account is needed to connect a mobile device to a corporate email account. [Email Settings]

19. Three types of updates on mobile devices that happen automatically or through a user prompt are ⸻ updates, PRL updates, and baseband updates. [Baseband and Other Updates]

20. IMEI and IMSI are two types of mobile device unique ⸻. [Radio Firmware and IMEI vs. IMSI]

Mobile Device Synchronization

21. Data can be synchronized between the ⸻ and a desktop. [Cloud Synchronization]

22. ⸻authentication will allow you to sign in once and access several services or several apps. [SSO]

23. Some synchronization apps require a lot of ⸻ and need to be checked before using the app. [Software Requirements, Connection Types]

Installing Laptop Hardware

When installing laptop hardware, some of the components can be reached through removing one or more parts of the cover at the bottom of the laptop. On other occasions, installing laptop hardware is a far more arduous task. In some cases, the keyboard has to be removed in order to expose the part which needs replacing. For each hardware piece to be replaced, there is a typical set of steps to follow, as seen in the table below:

Hardware Piece	Information on Replacing it
Keyboard	The bottom cover often needs to be removed to access a large screw holding the keyboard in place. Then, a plastic wedge can pop the keyboard out and a new one can be put in. Pay close attention to the way in which the keyboard is connected to the motherboard.
Hard drive	Make sure the hard drive fits in the spot in which it will be installed. Laptop hard drives are typically 1.8 inches wide or 2.5 inches wide. Pull the old hard drive out and then place and secure the new hard drive.
Memory	Make sure to have the correct SODIMM chips and that there is room for expansion. RAM chips are usually kept under a cover at the bottom of the laptop. SODIMM chips are often inserted at an angle and then snapped into place.
Smart card reader	Usually found under the palm rest, meaning that many parts have to be moved in order to replace a smart card reader.
Optical drive	Most are held in place with one screw. It should be easy to remove and upgrade.
Wireless card/ Bluetooth module	Will have two or three wires attached to use and will usually be in a mini-PCIe slot. Label the wires before replacing a wireless card so that the new card will be properly connected. If there is an extra cable available, it is most likely a multiple input multiple output (MIMO) cable.
Cellular card	If a laptop has one, locate it and replace it, taking notes of whatever cables are connected to the original cellular card.
Video card	These cards fit into a mini-PCIe expansion slot so you need one in order to put a video card into a laptop.
Mini-PCIe card	Similar to a PCIe expansion slot except it is smaller. These offer a rare expansion opportunity for a laptop.
Screen	Replacing the screen almost always involves first removing the keyboard. Make sure everything is disconnected before attempting to remove a screen.
DC jack	This is often hard to reach. Keep track of every piece moved to reach the DC jack.
Battery	Batteries are usually locked in with a latch. Move the latch, remove the old battery, and replace it with a new battery. Lithium-ion (Li-ion) batteries are the most common laptop batteries.
Touchpad	On the inside of a laptop, this is usually nestled near the keyboard and held in with a clip. Again, document every piece and screw taken out before the touchpad is reached.
Plastic wedge	This is not a hardware piece. Rather, it is often used to pry something open (like a keyboard). Technicians often use a flathead screwdriver to pry something open. Screwdrivers scratch areas. Plastic wedges do not scratch areas.
Speaker	Speakers are usually placed behind a keyboard.
System board	Start with removing the components from the back of the laptop. Then, remove the components from the front of the laptop, keeping track of every step and every screw.
CPU	Usually, the CPU is soldered to the motherboard, thus making it not replaceable. If it is replaceable, consult the motherboard manual for instructions.

Specific to hard drives, a common upgrade is from a traditional hard drive disk (HDD) to a solid-state drive (SSD). Or, a solid-state drive is added to the laptop, sometimes replacing the optical drive. Solid-state drives perform much faster and much more efficiently than that of hard disk drives. Hybrid hard drives are drives that have both SSD and HDD characteristics, with the most frequently used data stored in the SSD area.

Purpose:

After completing this project, you will be able to identify needs for hardware installations in a laptop.

Steps for Completion:

1. What is the most important consideration for upgrading memory on a laptop?

   _____

2. What is an important consideration for upgrading a hard drive?

   _____

3. Which laptop component is the least likely to be upgraded?

   _____

4. What should be used when lifting a laptop keyboard? _____

5. Besides RAM, which upgrade stands to have the best chance of improving overall

   laptop performance? _____

Install Display Components

With laptops, many components have to be crammed into a smaller physical space than the space available in desktops. For this reason, a few components are either inside of the display or connected to the display. This makes replacing these parts difficult as usually the laptop has to be taken apart to the extent to where the display is accessible. When working with laptop hardware components, here are the parts to be aware of which are most likely in close proximity to the display or connected to the display, along with the purpose they serve in a laptop:

Laptop Part	Purpose
Wi-Fi Antenna Connector	Usually located inside the display and contains wires which run to a laptop wireless card. The wireless card is usually situated near the bottom cover of the laptop.
Webcam	Usually built into the top part of a laptop display. Webcams are used for video chats, demonstrations, online meetings, and similar activities.
Microphone	Used to record audio and is usually attached to the display.
Inverter	A circuit board located behind an LCD screen.
Digitizer	Input device inside of a touch screen display and responds to touch.

As part of this, we also need to understand the difference between an LCD display and an OLED display. LCD displays are found in most laptops as they are not as expensive as OLED displays, which are prevalent on mobile devices.

Purpose:

Upon completing this project, you will be able to identify the component being used inside of a laptop display to perform a particualr task.

Steps for Completion:

1. Which type of display is this?
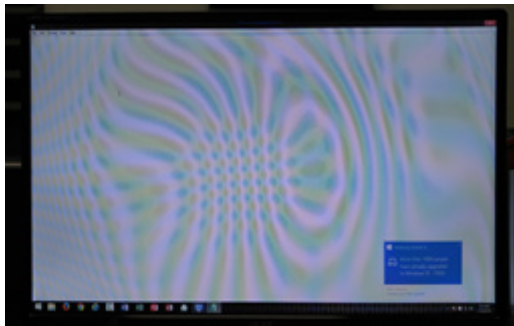
2. _____

3. Which type of display is often found in mobile devices due to its lack of need for a

   backlight? _____

4. For each situation, identify the laptop component being used:

5. A manager is conducting a video-based online meeting: _____

6. A brush stroke gets larger as a graphic designer holds a finger down on the screen:

   _____

7. A salesperson records a verbal reminder to call a client the next day:

   _____

Laptop Function Keys and Features

Many laptops and full-sized keyboards for tablets have extra functionality options using the function keys (F keys) on the keyboard. With some keyboards, there is a function (fn) key which needs to be held down to take advantage of the special function. With other keyboards, the function key needs to be held down for the key to have normal functionality (such as for help using the F1 key, for example). The placement of special function keys from the F1 key to the F12 key will vary depending upon the keyboard present. Not every function is available on every keyboard, but here are the most common functions possibly found on the function keys:

Function Key	Purpose
Dual displays	Controls the behavior of a dual display, in similar fashion to a desktop with multiple monitors.
Wireless (on/off)	Quickly enables or disables a device's wireless adapter. Sometimes, this key is pressed by accident.
Cellular (on/off)	Not a very common key on a keyboard. This will enable or disable a device's cellular connection.
Volume settings	Keys which raise or lower the volume or toggle the volume between muted and unmuted.
Screen brightness	Keys which raise or lower the brightness of a device display.
Bluetooth (on/off)	When pressed, the key enables or disables Bluetooth.
Keyboard backlight	Turns on a light that shows through the keyboard keys, helping a user see the keys when the room is dark.
Touchpad (on/off)	A key which enables or disables the touchpad.
Screen orientation	A key which will change the screen orientation from landscape to portrait and vice versa. On a Windows device, Ctrl+Alt+ an arrow key will manipulate the direction of the display.
Media options	Keys that play, stop, fast forward, or reverse a video.
GPS (on/off)	A key which turns GPS and/or location awareness on or off.
Airplane mode	A key which disables all network connectivity for a device. Often, this is pressed by accident.

For controlling a dual display, there are four usual options for rendering the external display, with the external display most commonly a monitor or projector:

Computer only: Display shows on laptop but not an external display.

Duplicate: The display is the same on both the laptop and the external display.

Extend: The display stretches across both the laptop and the external display.

Projector only: The display only appears on the external display.

In addition to expansion options, laptops have a number of available features to help improve laptop capabilities, security, and performance. To make the laptop have the look and feel of a desktop, the laptop can connect to a docking station. A docking station usually has ports that allow for the plugging in of an external monitor, full-size keyboard, mouse, network connectivity, and other expansion slots. Docking stations are built specifically for the laptop models they support.

A lesser type of expansion device available for a laptop is a port replicator. Similar to a docking station, a laptop plugs into a port replicator. Port replicators usually include USB ports, sound ports, and network ports, but do not include expansion slots or a place to plug in an external monitor.

To better secure a laptop in an office, a laptop can use a cable lock. A cable lock functions in a similar manner to a bicycle lock. To use a cable lock, connect the laptop to something that cannot be moved, plug the cable into the laptop, and set the combination.

Lastly, many laptops have rotating and/or removable screens, giving the laptop the same capabilities as that of a tablet.

Purpose

After completing this project, you will be able to identify function keys on laptop keyboards and be able to choose the correct laptop feature for a user based on a need.

Steps for Completion:

1. A user calls a technician to explain that all network connectivity has been lost. The user was just typing up a Word document.

   Which special key may have been pressed? _____

2. For each function key displayed, briefly explain what happens if the key is pressed:
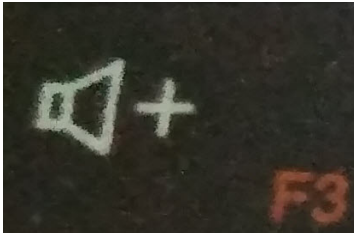
a. _____

b. _____

3. For each situation, identify the best laptop accessory for a customer request:
   a. A customer wants to be able to use a 27-inch monitor and a full-size keyboard

   with a laptop: _____
   b. A customer wants to make sure a laptop is safe when the customer leaves the

   laptop in the office: _____

Characteristics of Other Mobile Devices

Laptops are far from the only mobile devices available for computing. Computing has become far more personalized with devices which can track just about anything desired, including, for example, steps one walks per day. The device closest in look and performance to a laptop is a tablet. A tablet is a device which does not require the use of a keyboard or mouse as interaction is done through gestures on a touch screen.

Tablets usually range in size from a 7-inch diagonal screen to a 13-inch diagonal screen. Tablets use solid-state drives to consume less power and thus extend battery life. Most tablets have Wi-Fi capability. Some tablets have cellular capability. With the exception of microSD cards for expanded storage, tablets tend not to be upgradable, and they do not have serviceable parts.

Smartphones are mobile devices that do much more than just make calls. Most smartphones can browse the Internet, manage contacts and calendars, take pictures and video, synchronize with other personal devices, take notes, and obtain a wealth of information through the use of apps. Smartphones are basically hand-held mini computers. Smartphones have a screen size of up to 6.6 inches.

In addition to tablets and smartphones, many mobile devices fall into the category of wearable technology devices. There are three main types of wearable technology devices:

Fitness monitor: An app on a smartphone which tracks items such as steps taken, miles jogged, time on a bicycle, and other fitness aspects.

Smart watch: A watch with smartphone-like capabilities, including the ability to talk on the phone, set reminders, and listen to music. Many smart watches also possess fitness monitoring capabilities.

VR/AR headsets: Virtual reality (VR) headsets are used primarily in gaming. Augmented reality (AR) headsets are used primarily in training. Both are designed to give a user an experience as if the user is right there in the game or other situation to where some training or other type of education is taking place.

Other types of mobile devices have singular, unique features, such as storing books and navigating one through traffic from their homes to their workplaces. Here are two other types of mobile devices and their descriptions:

E-Reader: A mobile device with a main purpose of storing electronic copies of books and periodicals. Most E-Readers have a screen which tolerates sunlight well so people can read outside.

Global Positioning System (GPS): A standalone device which routes one from a starting point to a destination. Many GPS devices can route multiple stops on a trip.

Purpose:

Upon completing this project, you will be able to identify the mobile device needed given a customer situation.

Steps for Completion:

1. For each situation, identify the best fit for a mobile device for a customer situation:

   a. A game player wants to simulate playing tennis from anywhere: ―――――――――

   b. A salesperson needs a hand-held device which allows for note-taking and for running basic apps:

   ―――――――――

   c. A retiree wants to read magazines electronically: ―――――――――

   d. A person wants to keep track of the number of steps per day and be able to answer the phone while on a walk:

   ―――――――――

Mobile Device Ports and Accessories

Mobile devices need to be able to connect to other mobile devices and, occasionally, desktop computers in order to send and receive information from other devices. With many different types of mobile devices (iOS, Android, and Windows), some mobile device connection types are common to all three while some are proprietary.

Here are the most common types of mobile device connections, along with a description of each:

Connection Type	Description
Wired	
Micro-USB	A five-pin connector used mostly on mobile devices and carries a transfer rate of up to 480 Mbps.
Mini-USB	A four-pin or five-pin connector and often used on digital cameras.
USB-C	A reversible design connector with a transfer speed of up to 10 Gbps.
Lightning	An Apple-proprietary eight-pin connector, used to connect devices to host computers, external monitors, cameras, battery chargers, and other peripherals.
Tethering	The use of a USB connection from a mobile device to a laptop or desktop. The laptop or desktop then uses the mobile device's cellular connection for Internet access.
Wireless	
Near-Field Communication (NFC)	Used with two NFC-enabled devices. The devices need to be within 10 centimeters of each other in order to communicate with each other.
Bluetooth	A wireless connection between two paired devices. A typical maximum distance between the two devices is 10 meters (33 feet).
Infrared (IR)	A line-of-sight communication between two devices, usually with a distance of six or fewer feet.
Hotspot	An app on a mobile device that, when turned on, allows other devices to connect to the Internet through the device's cellular connection.

In addition to the common connection types mentioned above, there are a host of proprietary, vendor-specific ports used for communication. Most of these are prevalent on Apple devices but some Android devices have proprietary ports to use for tasks such as charging a device battery.

The capability of mobile devices is enhanced through the use of one or more mobile device accessories. These accessories can enhance a user's audio, video, gaming, and working experience with a mobile device. Here are some of the most common accessories used with mobile devices along with the main uses for these accessories:

Accessory	Purpose
Headsets	Used to listen to audio.
Speakers	Used to listen to audio at a higher quality than that of the built-in speakers on a mobile device.
Game pads	Used for game-playing. Most game pads have multiple joysticks and multiple buttons.
Extra battery packs and chargers	Provides for a backup battery in case the original battery fails to work or simply runs out of battery life.
Protective covers	Used to help waterproof a device. Sometimes this is a thin sheet of covering on a mobile device screen. Sometimes this is a back cover on a smartphone.
Credit card readers	A small device that plugs into the speaker port on the phone and then allows one to swipe credit cards and record transactions in a credit card app.
Memory/MicroSD cards	Used to expand storage capabilities on a mobile device.

Purpose:

After completing this project, you will be able to identify the type of mobile device connection being used and choose a mobile device connection type given a customer situation. You will also be help customers choose the proper accessories for mobile devices.

Steps for Completion:

1. Identify the mobile device connections in each picture:

    a. _____   b. _____

2. For each situation, identify which mobile device connection would be best for the situation:

    a. The Internet service shuts down in a five-person office but the manager still has

       Internet via a cell phone: _____

    b. A connector used to charge an iPhone: _____

    c. A wireless keyboard needs to pair up with a tablet: _____

3. For each customer situation, indicate which mobile device accessory best fits the situation:

    a. A customer has a tendency to drop smartphones and wants to minimize the

       risk of damage: _____

    b. A customer is not happy with the sound quality of the music playing on a tablet:

       _____

    c. A customer has 8 GB of storage on a smartphone but wants to be able to

       download more music files: _____

Cellular Network Features and Bluetooth

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Cellular devices, such as smartphones and some tablets, can often share their cellular connections with other devices to give other devices Internet access. The two main ways this happens are:

Mobile hotspot: A mobile hotspot is configured on the mobile device. Then, other devices such as laptops and desktops can find the mobile hotspot and use the credentials configured on the mobile hotspot to use the hotspot to access the Internet. A secure password should be set for the mobile hotspot. In addition, hotspots can restrict which devices can use it through MAC address filtering.

Tethering: A USB cable is connected from the mobile device to another device, such as a laptop. The laptop can then directly use the mobile device's cellular network for an Internet connection.

Sometimes, a mobile device needs to be completely isolated from any networks, as is often the case when one is traveling on an airplane. For this, the device can be set to Airplane mode. In Airplane mode, the device will have no network connectivity.

With the increase in use of mobile devices, the need for mobile device accessories has increased as well. People need to be able to get music on their smartphones to play over speakers. People with tablets sometimes want to use wireless keyboards with those tablets. For many of these accessories, a Bluetooth connection is needed in order for a device to pair with an accessory. With Bluetooth, devices can see each other from up to about 30 feet apart for a Class 2 Bluetooth connection and about 300 feet apart for a Class 3 Bluetooth connection.

Pairing devices using Bluetooth involves a five-step process:

Enable Bluetooth: To pair two devices, Bluetooth needs to be enabled on both devices. On mobile devices, this is usually found in the Settings area.

Enable pairing: A device will have a setting to make it discoverable. This scans the area for other Bluetooth devices.

Find device for pairing: Once scanning has taken place, a list of devices which can be paired will appear.

Enter appropriate PIN: For most pairing situations, a four-digit PIN needs to be entered. If a PIN is not needed, a simple acknowledgement of wanting to pair devices is all that is needed.

Test connectivity: Once the devices are paired, test the pairing to make sure it works.

Purpose:

Upon completing this project, you will have a better understanding of how to enable and disable cellular network features and you will know how to go through the five steps needed to pair two devices using Bluetooth.

Steps for Completion:

1. For each situation, identify which cellular network feature should be enabled or disabled:

   a. A user needs to isolate a device from the network:

   _____

   b. A user wants to allow several other devices to use the user's

   cellular network connection: _____

   c. A user has a laptop and needs Internet access but there are no wireless access points around. However, the user's smartphone is getting a strong cellular signal:

   _____

2. If you have an Android or iOS device, look in the Settings area for the ability to turn Airplane mode on or off, set up a hotspot, and, if you have a USB cable, set up tethering. The screen for enabling or disabling these features should look like the example on the right:
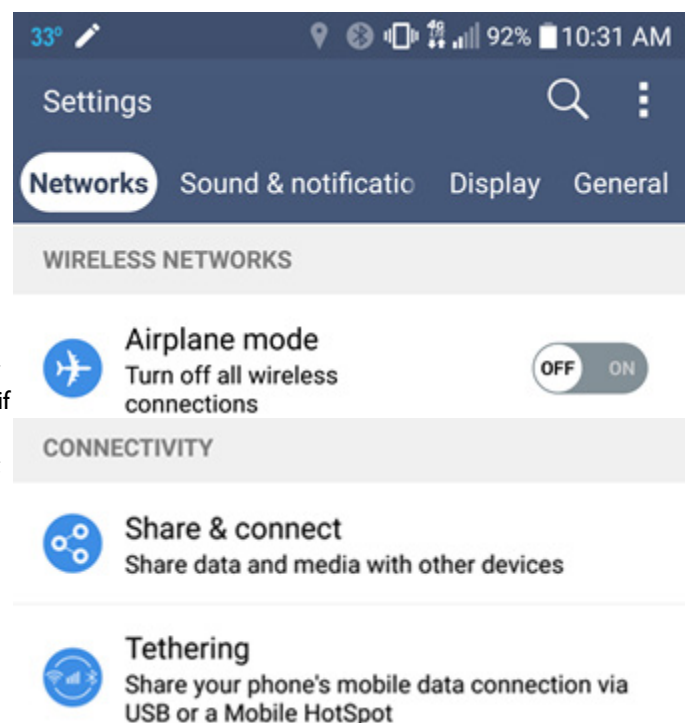
3. For Bluetooth, on the two devices you wish to pair, make sure Bluetooth is enabled and the devices are discoverable.

4. Look for a list of devices to pair with the mobile device. Your device should show as available.

5. Tap the device you wish to pair with your current device. You will see a message similar to this:

Bluetooth Pairing Request

Enter the code "3373" on "Bluetooth Keyboard", followed by the return or enter key.

6. Follow the instructions given to pair the devices. When the pairing has completed, you should see a confirmation message that the devices have been paired

7. Test the connection to make sure it works.

Corporate Email Configuration

A skill a technician must have to support users and their mobile devices is to be able to configure email for corporate accounts, Internet Service Providers (ISPs), and commercial email accounts. Configuring these email accounts used to be a manual, laborious process. Most of the time, the process is now at least somewhat automated. A technician should be able to find instructions from an ISP, for example, on what to enter for information when configuring an ISP email account on a mobile device. When configuring these email accounts, some incoming and outgoing email server information needs to be known just in case the information needs to be entered manually. These terms are:

Post Office Protocol Version 3 (POP3): POP3 is one of two protocols used to receive email. Users have the option of downloading email messages directly to their devices or to keep a copy of email messages on the email server. A technician needs to check this setting while configuring POP3. Most devices default to keeping email messages on the email server.

Internet Message Access Protocol (IMAP): IMAP is the other, and now more common protocol used to receive email. Unlike POP3, IMAP always keeps a copy of email messages on their hosting email servers.

Simple Mail Transfer Protocol (SMTP): SMTP is used to send outgoing email.

When configuring a corporate or ISP email account on a mobile device, a technician may need to enter POP3 or IMAP and SMTP servers manually. In addition to entering email server information, port numbers may need to be entered manually as well. A technician needs to know if the email account is using Secure Sockets Layer (SSL) encryption or Transport Layer Security (TLS) as that will affect the port numbers entered when configuring the email account. The port numbers for email protocols are as follows:

SMTP: 25

POP3: 110

IMAP: 143

SMTPS (SMTP over SSL): 465

POP3S (POP3 over SSL): 995

IMAPS (IMAP over SSL): 993

Many corporate email accounts use Microsoft Exchange as an email server. For this information, the username and password information to access one's email may be enough to get the account configured. If not, a technician will need to manually enter some of the information mentioned earlier in this project. Exchange server uses Secure/Multipurpose Internet Mail Extension (S/MIME) as a standard for public key encryption of email data.

Purpose:

Upon completing this project, you will have a better understanding as to how to set up a corporate email account on a mobile device.

Steps for Completion:

1. On a mobile device, open the email program.
2. Find the settings area and then tap the option to add an email account. Tap Microsoft Exchange (or, if this is an ISP email account, tap Other).
3. Enter the username and password information used to log on to the email account.
4. Tap the Next button.
5. When you see the server settings screen, check to make sure the information is accurate, change any information necessary, and tap the Next button.
6. After several moments, your connection to your email account should be complete and email should start to appear in the email app.

Project Details

Project Files:
N/A

Estimated Completion Time:
10 minutes

Video Reference:
Domain 1
Topic: Mobile Device Networks and Apps
Subtopic: Email Settings

Objectives Covered:
1 Mobile Devices
1.6 Given a scenario, configure basic mobile device network connectivity and application support
1.6.3 Corporate and ISP email configuration
1.6.3.1 POP3
1.6.3.2 IMAP
1.6.3.3 Port and SSL settings
1.6.3.4 S/MIME

Commercial Email Configuration

In addition to knowing how to configure a mobile device to receive email from a corporate or ISP account, a technician also needs to know how to configure a mobile device to receive email from a commercial email provider, such as Gmail, Yahoo!, Outlook, or iCloud. Here are the specifics for what a technician typically needs to do to configure each of these commercial email accounts:

Account	Specifics
iCloud	Turning on mail in iCloud settings gets a user an iCloud email account (if the user does not already have one). Email will then be synchronized with iCloud.
Gmail	The username and password of the Gmail account is needed. If one has to enter the SMTP server manually, the address is smtp.gmail.com.
Exchange Online	The username and password of the email address to set up over Exchange is needed.
Yahoo!	The username and password of the Yahoo! account is needed. If one has to enter email server information manually, the server addresses are as follows: POP3: pop.mail.yahoo.com IMAP: imap.mail.yahoo.com SMTP: smtp.mail.yahoo.com

Note that for some of these commercial email providers (especially Gmail), some mobile email programs will not be considered secure enough for the providers and thus an attempt to use the email program could be rejected. If this happens, the user will get an email notification from the commercial email provider, notifying the user that the app they attempted to use to configure email has substandard security.

When configuring these email accounts on an iOS device, all of these providers can be found under the Add Account setting in the Mail, Contacts, and Calendars settings area. For Android devices, email apps and settings will vary from brand to brand.

Purpose:

After completing this project, you will have a better understanding as to how to configure a mobile device to receive email from a commercial email provider.

Steps for Completion:

1. On a mobile device, open the native email app.
2. Tap Add Account.
3. From the list of email providers, choose an email provider.
4. Enter the username and password for the email account.
5. Tap the Next button. If the information has been entered correctly, you will see a confirmation message that the email account has been added and incoming mail will start to arrive in the email app.

Project Details

Project Files:
N/A

Estimated Completion Time:
5 minutes

Video Reference:
Domain 1
Topic: Mobile Device Networks and Apps
Subtopic: Commercial Email Providers

Objectives Covered:
1 Mobile Devices
1.6 Given a scenario, configure basic mobile device network connectivity and application support
1.6.4 Integrated commercial provider email configuration
1.6.4.1 iCloud
1.6.4.2 Google/Inbox
1.6.4.3 Exchange Online
1.6.4.4 Yahoo!

Other Mobile Device Network Concepts

To work successfully with users and their mobile devices, A+ technicians need to know how to set up hotspots, connect accessories via Bluetooth, and set up corporate and commercial email accounts. There are some other basic underlying network concepts for mobile devices a technician needs to know in order to best understand how mobile devices interact with networks. These concepts, along with a description of each concept, are listed here:

Concept	Description
PRI, PRL, and baseband updates	**Primary Rate Interface (PRI) line:** A type of ISDN line in which each channel provides 64 Kbps for data transmission. Telecommunications providers may have occasional updates for these lines. **Preferred Roaming List (PRL):** A list of radio frequencies for phone use in geographic areas. A PRL update can update phone coverage. This is not used in all cellular networks. **Baseband updates:** These update the chip which controls the Global System for Mobile Communication (GSM) and radio firmware. These updates are often packaged with system updates.
Radio firmware	Hardware in a smartphone or tablet which controls network connectivity such as Wi-Fi and GPS. This is usually updated as part of a regular firmware update.
IMEI vs. IMSI	International Mobile Equipment Identity (IMEI): A unique number for every mobile phone. This number is usually located behind the battery. International Mobile Subscriber Identity (IMSI): A unique identifier for a wireless subscriber. This identifier consists of a mobile country code + a mobile network code + a sequential serial number and is stored on a SIM card.
VPN	A virtual private network (VPN) is a private tunnel connection using a public network. To set up a VPN, the name of the server and authentication information is needed. Common protocols used for VPN tunnels include: **Layer Two Tunneling Protocol (L2TP):** L2TP uses IPsec to encrypt data in the tunnel. **Point-to-Point Tunneling Protocol (PPTP):** PPTP is commonly used with Microsoft VPN connections. It is not considered as secure as L2TP.

Purpose:
After completing this project, you will have furthered your understanding of these basic mobile device network concepts.

Steps for Completion:
1. For each situation, identify the mobile device network concept being described:
   a. A SIM card stores a unique identifier for a wireless subscriber:

   _____

   b. A user wants to use a mobile device to get a secure connection to the

   workplace: _____

   c. A list of radio frequencies for use in geographical areas: _____

Synchronization Data Types and Methods

It is very important that data on a mobile device be synchronized either with a storage app in the cloud or with a regular desktop computer through a desktop synchronization app. The exact types of data which synchronize from a device to the cloud or a desktop app will vary. Here are the most common types of data to synchronize, along with a description of the data which synchronizes for each data type:

Data Type	Description
Contacts	Email and phone contacts are synchronized.
Applications	Data from applications can synchronize across devices. An example of this is visited websites in a web browser such as Safari or Google Chrome.
Email	Email, when synchronized, is available both on mobile devices and desktop computers. With IMAP, email is always kept on the email server. With POP3, email could download to a device.
Pictures	Pictures from a device can be easily sent to a desktop with a USB cable.
Music	Music is often selected through a desktop app and then downloaded to mobile devices.
Videos	Videos are synchronized in the same fashion as for pictures and music. One caution to take is that video synchronization can use a large amount of mobile bandwidth.
Calendar	Appointments can be made using a desktop application and then synchronize to mobile devices, or, they can be made on mobile devices and synchronize to a desktop application.
Bookmarks	Favorites on websites can be synchronized across devices.
Documents	The most common apps for document synchronization are OneDrive, Google Drive, and Dropbox.
Location data	Location data is often synchronized across devices to make each device more user-friendly regarding anything location-dependent. For example, Google Maps often saves searched locations, so one can search on a desktop but then be able to pull up the location easily in the maps app on a device.
Social media data	This data can be synchronized but data is usually simply stored in a social media app and then viewed from a mobile device.
eBooks	Purchases are usually synchronized to devices but often the eBooks still need to be downloaded on each device.
Passwords	Passwords for websites can be synchronized across devices. Users need to be careful as to which devices this feature should be prevalent as passwords on websites should not be saved on shared devices.

To synchronize this data, three main synchronization methods are used:

Synchronization to the cloud: Data on the mobile device is synchronized with a cloud app. Examples include iCloud for iOS and OneDrive for Windows. Synchronization apps for Android devices will vary depending upon the device. Google Drive is a cloud storage app which is commonly used with Android devices.

Synchronization to the desktop: Data on the mobile device is synchronized with a desktop app. Examples of desktop apps include iTunes for iOS, Google Drive for Android devices, and OneDrive for Windows. Another common app used across multiple platforms is Dropbox. The requirements for these desktop apps usually include enough disk space to hold the data being synchronized and at least 1 GB of RAM.

Synchronization to an automobile: Using Bluetooth, contacts and call information and in some cases text messages can be synchronized between a mobile device and a built-in app inside of an automobile.

The advantage of synchronizing data to the desktop is that most desktop versions of apps are more robust than the mobile device versions of these apps. For example, Microsoft Office for the desktop is far more robust than Microsoft Office for iOS or Android devices. When synchronizing data with the desktop, the mobile device will usually connect to the desktop through a cable with a USB-A connector on one end and either a mini-USB or proprietary connector on the other end. While not as likely as a USB connection, a mobile device can, under some circumstances, synchronize with a desktop through Bluetooth or an infrared connection.

Some synchronization services use mutual authentication, also known as two-way authentication. In this authentication process, a client authenticates with the synchronization app and the app authenticates with the client, thus ensuring that data is being synchronized with the correct device.

Purpose:

After completing this project, you will have a better understanding of how to control data which synchronizes from a mobile device to a cloud application. This project uses iCloud as the synchronization app.

Steps for Completion:

1. Which are important system requirements to note when installing a desktop app for the purpose of synchronizing data with mobile devices?

   _____

2. Which type of cable is most commonly used for synchronizing mobile device data

   with a desktop computer? _____

3. If you have an iOS device, open the Settings app.

4. Navigate to and tap the iCloud settings. If you have an iCloud account, you will see some synchronization choices.

5. Make any adjustments necessary to the data types you wish to synchronize or not synchronize.

6. To see synchronized data in iCloud, open a web browser and navigate to http://icloud.com.

7. Log on to the iCloud site with your Apple ID.

8. Click on an app to see the data which has synchronized with your iOS device.

9. Close the web browser.

Project Details

Project Files:
N/A

Estimated Completion Time:
10 minutes

Video Reference:
Domain 1
  Topic: Mobile Device Synchronization
  Subtopics: Cloud Synchronization; Other Synchronization Types; Contacts and Applications; Email; Pictures, Music, and Videos; Calendar; Bookmarks; Documents; Location Data; Social Media Data and E-Readers; Passwords; SSO; Software Requirements, Connection Types

Objectives Covered:
1 Mobile Devices
  1.7 Given a scenario, use methods to perform mobile device synchronization
    1.7.1 Synchronization methods
      1.7.1.1 Synchronize to the cloud
      1.7.1.2 Synchronize to the desktop
      1.7.1.3 Synchronize to the automobile
    1.7.2 Types of data to synchronize
      1.7.2.1 Contacts
      1.7.2.2 Applications
      1.7.2.3 Email
      1.7.2.4 Pictures
      1.7.2.5 Music
      1.7.2.6 Videos
      1.7.2.7 Calendar
      1.7.2.8 Bookmarks
      1.7.2.9 Documents
      1.7.2.10 Location data
      1.7.2.11 Social media data
      1.7.2.12 E-books
      1.7.2.13 Passwords
    1.7.3 Mutual authentication for multiple services (SSO)
    1.7.4 Software requirements to install the application on the PC
    1.7.5 Connection types to enable synchronization

A+ Part 1 (220-1001)
Project Workbook
Domain 2: Networking

Fill-in-the-Blanks Domain 2

Instructions: While watching Domain 2, fill in the missing words according to the information presented by the instructor. [References are found in the brackets]

Ports, Protocols, and Their Purposes

1. File Transfer Protocol is commonly used to ————————— and ————————— files to and from a server and runs on port 21. [21 - FTP]

2. Secure Shell ————————— data that connects to devices like routers and runs on port 22. [22 – SSH and 23 – Telnet]

3. Simple Mail Transfer Protocol runs on port 25 and should only be opened on ————————— servers. [25 – SMTP and 53 – DNS]

Networking Hardware Devices

4. A router controls traffic ————————— multiple networks, while a switch controls the flow of traffic ————————— a network. [Routers and Switches]

5. Access points accept wireless clients but also have routing and ————————— capabilities, so when you go to buy one, they may be called a wireless router on the box. [Access Points]

6. Ethernet over Power uses ————————— to take and send data over power lines, while Power over Ethernet is the opposite and sends electrical power over Ethernet cables. [Ethernet and Power]

SOHO Networks

7. A Network Address Translation takes data requests from private IP addresses that are not ————————— and translates them to a public address so that they can communicate with public networks or the Internet but still remain private. [NAT]

8. Universal Plug and Play is not enabled by default on most access points because it is a known conduit for —————————. [UPnP]

9. MAC filtering will limit ————————— that are allowed on your network, while a blacklist will allow you to limit IP addresses or domains on your network. [MAC Filtering]

10. ————————— is the strongest encryption available because it uses Advanced Encryption Standard which is a U.S. government standard for encryption. [Encryption]

Wireless Networking Protocols

11. 802.11n is a newer standard that runs on 2.4 and 5 GHz frequencies, while 802.11ac runs only on the ————————— frequency. [Frequencies]

12. The 2.4 GHz frequency needs to use channels ————————— to lessen its interference problems. [2.4 GHz Channels]

13. The Zigbee protocol is used in remote controls and home automation, while the ————————— protocol is used for home automation and security. [Bluetooth, NFC, RFID, and IoT]

Server Types

14. Shared devices should not use Dynamic Host Configuration Protocol because if the address lease expires and the device gets a different IP address, the device will be —————————. [DHCP Server]

15. The intrusion detection system will only ———————————— an administrator of a possible attack, while the intrusion prevention system can prevent an attack. [UTM, IDS, and IPS]

16. A legacy system is an application or system that is out of ————————————, while an embedded system is hardware or software designed for a specific function that is inside a device. [Legacy/Embedded Systems]

IP Addressing

17. Static IP addresses are assigned ————————————. [Static]

18. If a ———————————— server is not assigning IP addresses, an Automatic Private IP Addressing address will be assigned and starts with 169.254. [APIPA and Link-Local Addresses]

19. The equivalent of an APIPA address for IPv6 is a link-local address starting with four hexadecimal numbers:

    ————————————. [APIPA and Link-Local Addresses]

20. ———————————— allow for logical separation of networks across physical devices without the need to run cable connections. [VPN, VLAN, NAT]

Internet Connection Types

21. Cable, ————————————, and satellite are the most used connection options available. [Cable, DSL, Dial-Up, and Fiber]

22. ———————————— are confined to a building and can be wired and/or wireless, while a WAN has devices over a wide area. [Network Types]

Networking Tools

23. A ———————————— is a tool that tests electrical current within a cable when the resistance is set to ohms and reads close to zero. [Crimper, Cable Strpper, Multimeter]

24. A loopback plug is a tool that determines if the network card with an ———————————— jack is working. [Cable and Connector Testers]

Ports and Protocols

When data packets transmit from a source to a destination on a network, two parts of the packet that identify the packet are the destination address and the port number of the destination. The port number helps to determine the type of data being transmitted. Most data transmissions occur over Transmission Control Protocol (TCP) or User Datagram Protocol (UDP). TCP is a connection-oriented protocol to where every data packet sent from a source to a destination is acknowledged by the destination as being received (assuming the data is received). By contrast, UDP data is sent as a common stream with no acknowledgement. UDP is known as a connectionless protocol.

To understand this further, think about data that needs acknowledgement when transmitted. If a Word document is broken up into packets and then transmitted, the sender needs to know that all of the packets were received. If not, some of those packets will be resent. On the other hand, for live audio or video streaming, a loss in the signal for a half-second will not trigger a demand to resend the stream of audio or video. Thus, live streaming is better-suited for being transmitted over UDP, as UDP, with the lack of a need for a receipt acknowledgement, has less overhead than does TCP.

It is important for an A+ technician to know the most common ports and the data they represent, because many network administrators will allow or block traffic based on the port number. For example, a network administrator can block outgoing email traffic on every computer except for a mail server simply by blocking the port number for traffic on every computer except for the mail server.

Network traffic can use one of a possible 65,535 ports for network traffic. As a general guideline, here are the three categories of port numbers and their uses:

Numbers	Name	How they are used
0 to 1023	Well-known	Used for specific protocols and services. Assigned by the Internet Assigned Numbers Authority (IANA).
1024 to 49151	Registered	Used for applications. Some are assigned by the IANA.
49152 to 65535	Dynamic	Used for internal services and processes. As an example, many of these ports are used for Internet connections.

For an A+ technician, here are the common ports one needs to know, along with the protocol which operates on the port, the type of data which transmits on the port, and an explanation of what the protocol does:

Port	Protocol	Type	What it does
21	FTP	File Transfer	Used to upload and download files from FTP servers. Port 20 could also be used.
22	SSH	Encryption	Used for secure transmission of data between two systems. An example of this is secure FTP (SFTP).
23	TELNET	Remote Connectivity	Used to connect to remote systems. This protocol is not used much as data is not encrypted, meaning a username and password is sent as clear text.
25	SMTP	Email	Used for outgoing email.
53	DNS	Name Resolution	Maps hostnames to IP addresses.
80	HTTP	Web	Primary protocol for unencrypted web traffic.
110	POP3	Email	Used for incoming mail. The original default was to delete the message from the server once a device downloaded it.
143	IMAP	Email	Used for incoming mail. Email stays on the server even after a device has read it.
443	HTTPS	Encryption and Web	Used for Secure Sockets Layer (SSL) for encrypted web traffic. Transport Layer Security (TLS) is SSL's replacement
3389	RDP	Remote Desktop	Microsoft network protocol used for Remote Desktop Connection and Remote Assistance.
137-139	NetBIOS/NetBT	Naming	NetBIOS is a non-routable protocol to where devices use names to communicate with each other. NetBT is NetBIOS over TCP/IP to allow TCP/IP networks, which are routable, to use NetBIOS.
445	SMB	File Transfer	SMB is a Windows file and print sharing service. CIFS is an implementation of SMB.
427	SLP	Discovery	Used to discover services on older versions of MacOS and NetWare.
548	AFP	Services	Used for file services on MacOS. This can also use port 427.
67/58	DHCP	Services	Used to assign IP addresses to devices on a network.

Port	Protocol	Type	What it does
389	LDAP	Services	A directory service protocol used for domains such as Active Directory domains.
161/162	SNMP	Messaging	Queries network devices for their statuses and statistics.

Purpose:
Upon completing this project, you will identify a port number and protocol used given a network traffic event. You will also be able to identify the network protocol being used given a network situation.

Steps for Completion:
1. For each network traffic event, indicate which port and protocol are being used:

Event	Port	Protocol
A user enters http://companyweb in a web browser and gets taken to http://10.1.1.3:		
An administrator connects remotely to a user's desktop computer:		
A web server administrator hosts a server to where clients can download files:		
A customer places an order via a secure webpage:		

2. For each network situation, identify the protocol in use:
    a. A webmaster securely transfers files to a web server:

    b. A user obtains an IP address automatically when logging on to a network:

    c. An administrator receives a message from a router that a port has stopped working: _____

    d. A software app accesses a user's group membership in Active Directory to see if the user has sufficient app permissions: _____

Networking Hardware Devices
Networking Hardware Devices

Computers rarely connect directly to each other in order to exchange data. Rather, they go through a network device. The network device used depends upon the size of the network and the desire to transmit data to and from the network (like the Internet, for example). For networks using wired connections, there are two major types of devices used:

Switch: Whereas a hub does not know where data should go on a network, a switch is far more intelligent in that role. A switch identifies and remembers devices connected to it and then can send data from a sender to a recipient on the network. Thus, data is not broadcast unnecessarily to every device on the network. Switches can be managed, meaning they can be configured, or they can be unmanaged, meaning that they are plug and play switches and cannot be configured.

Router: Switches help to control traffic within a network but only within a network. Routers connect and route traffic between networks. For example, a computer trying to retrieve data from the Internet can only do so if the computer has a connection to a router. Routers build tables to direct traffic as data passes through them.

Some physical devices can act both as switches and routers. All of these devices have activity lights on each port. For these lights, a green link light typically means a connection to another device has taken place. A fast-blinking green light indicates activity, such as a data transfer. For devices which can transmit data at different speeds, activity lights can change color depending upon the speed of the activity. As an example, an orange light can indicate a 100 Mbps connection while a green light can indicate a 1000 Mbps connection.

These devices can have anywhere from 4 to 48 (or more) ports for connecting different computers, printers, other devices, and neighboring hubs, switches, or routers. If a physical port malfunctions, the port can be disabled.

Switches and routers are very important devices in a network infrastructure, but they are not the only devices which help make up a network infrastructure. For example, hubs, switches, and most routers are great for wired aspects of networks, but not so much for networks which are mostly or completely wireless. Here are several other types of network devices and the roles they fill in a network infrastructure:

Network Device	Role
Access Point	Provides wireless network access to devices. Also known as a wireless router. Most wireless access points have wired ports for Ethernet cables.
Cloud-Based Network Controller	A virtual network appliance, stored in the cloud. Examples include virtual switches, virtual routers, and virtual firewalls.
Firewall	A hardware-based device or software-based app that controls network traffic though filtering ports, protocols, and programs.
Network Interface Card	An adapter in which an Ethernet cable is plugged in and then connected to a switch or router. These provide devices with network connectivity.
Repeaters	Also known as extenders. These boost network signals so they can travel a longer distance. Repeaters can be wired or wireless.
Hub	An outdated device that takes network signals and sends them to every device connected to it. These have been replaced by switches in the vast majority of networks.
Modem	Used to reach an external network. Modems used to be mostly dial-up through phone lines but now are mostly dedicated DSL or cable connections.
Bridge	Bridges isolate groups of devices on a network and then bridges communicate with each other. Wireless access points can serve to bridge two ends of a LAN where wiring the two ends would be difficult.
Patch Panel	A device in which cables used in a network converge. This is usually located in a network closet. Patch cables connect from a hub or switch port to the patch panel. Patch panels provide a connection point between hubs or switches and the ports to which computers are connected.

In addition to these network architecture devices, Ethernet networks can use, when needed, existing electrical wiring in order to transmit data. Conversely, devices needing power can sometimes use Ethernet cables instead of electrical wiring for their power. There are two specific devices which allow Ethernet and electrical power to share the same medium:

Ethernet over Power: An adapter which allows for an Ethernet connection using existing electrical wiring in a building.

Power over Ethernet injector: A device which uses Power over Ethernet (PoE) to transmit electrical power over Ethernet cables. For example, a camera may need power and an Ethernet cable may be nearby but not an electrical wall plug. If the camera supports PoE, an Ethernet connection can supply power to the camera. PoE can be done over an adapter known as an injector, or a PoE switch can double as both a switch and a PoE source.

Purpose:

Upon completing this project, you will be able to identify which networking hardware device should be used in a given situation.

Steps for Completion:

1. For each situation, identify whether a switch or router should be used:

   a. A network with three desktop computers and a printer:

   _____

   b. A network with two laptops, four desktops, and a file server:

   _____

   c. A network with four desktops and a need to connect this network to another

   network in the building: _____

2. Identify each of these network architecture devices:

a. _____

b. _____

3. For each customer situation, name the network architecture device needed:

   a. A customer needs to make sure unwanted network traffic does not enter the

   business: _____

   b. A customer needs power to a voice over IP (VoIP) phone but does not have an

   electrical outlet nearby: _____

   c. A customer needs to connect two switches using twisted-pair cable. The

   switches are 450 feet apart: _____

Setting Up a Wireless Network

A technician needs to know the fundamentals of setting up a wireless network, specifically a small office/home office (SOHO) wireless network, which by standard has 10 or fewer devices. More than likely this will be set up on a wireless access point that has both router and switch functionality.

For this project, you will need a wireless access point and a device that can connect to it. Ideally, you will want a wireless access point that has been reset to factory settings. Most every wireless access point's default settings can be found on the device manufacturer's website. If you do not have a wireless access point you can use, use an emulator online through a wireless access point manufacturer's website.

Purpose:

Upon completing this project, you will better understand how to set up a wireless network.

Steps for Completion:

1. Connect a device to a wireless access point.
2. Obtain the IP address of the default gateway of the wireless access point.
3. Using the IP address you obtained, use a browser to log in to the wireless access point configuration page.
4. If desired, change the IP address of the wireless access point.
5. On your device, navigate to your wired network card settings.
6. Make sure your wired network card is set to obtain an IP address automatically.
7. Using the network icon in the notification area, connect to your wireless network using the wireless access point you have set up.

Project Details

Project Files:
N/A

Estimated Completion Time:
10 minutes

Video Reference:
Domain 2
  Topic: SOHO Networks
    Subtopic: Router/Switch Functionality; Access Point Settings; Wired; Wireless and End-User Configuration

Objectives Covered:
2 Networking
  2.3 Given a scenario, install and configure a basic wired/wireless SOHO network
    2.3.1 Router/switch functionality
    2.3.2 Access point settings
    2.3.3 IP addressing
    2.3.4 NIC configuration
      2.3.4.1 Wired
      2.3.4.2 Wireless
    2.3.5 End-user device configuration

Other Wireless Settings

Not every wireless network consists of just a wireless access point and devices. There are other types of wireless networks and settings within those wireless networks a technician needs to know about. These concepts also need to be known for the exam.

A newer type of networking is known as the Internet of things (IoT). IoT is the interconnection of everyday devices, such as light switches, security cameras, thermostats, and door locks, to allow them to send and receive data, often over the Internet. These devices can often be controlled with a voice-enabled digital assistant.

A cable or DSL modem can double up as a wireless router. While it is fine to configure the router settings, the modem settings are best left alone unless there is a compelling reason to change them.

As part of a wireless network, you should have a firewall to protect the network from unwanted traffic. Several items may be set within the firewall, including:

Firewall Setting	Description
Demilitarized zone (DMZ)	An area of the network which contains devices that need to communicate directly with both private machines on the network and public-facing machines. For example, a web server needs to send information to public requests yet also be accessible by the webmaster in a private network.
Port forwarding	Allows an outside device to connect to a specific device in a network. For example, port 3389 (remote desktop) can be set to forward to a specific machine on the network.
Network Address Translation (NAT)	Translates private IP addresses in data packets to a public IP address so information can be routed to and from other networks. When more than one public address is used, this is known as Dynamic NAT (DNAT).
Universal Plug and Play (UPnP)	Allows for automatic discovery of network devices and then, basic services of those devices. For example, a UPnP media server provides media library storage and streaming to network clients.
Whitelist	A list of entities from which traffic is allowed.
Blacklist	A list of entities from which traffic is denied.
MAC Filtering	The act of allowing or denying a device on the wireless network based on the device's MAC address. The allow portion of this is effective only on small wireless networks. Otherwise, an administrator will have to update the allowed list every time a legitimate device wants to join the network.

Note that some of these settings may appear outside of the firewall.

Quality of Service (QoS) should also be a consideration for a wireless network. QoS allows one to control bandwidth, usually by apps but also possibly by user. For example, you may decide that anyone signed in as a guest has low priority on bandwidth. You may also decide to lower the bandwidth on non-essential apps, such as games (unless you are a gamer, of course).

Wireless networks should always be encrypted. This protects data being transferred from being intercepted by unwanted intruders. Types of protocols for encryption in wireless networks include:

Wired Equivalent Privacy (WEP): An older encryption standard that has been cracked. It may be available, but it should not be used.

Wi-Fi Protected Access (WPA): Newer than WEP. On older wireless access points, a firmware update may be needed in order for WPA to be available. WPA uses Temporal Key Integrity Protocol (TKIP).

Wi-Fi Protected Access 2 (WPA2): The newest and strongest encryption protocol. This should be used whenever possible. WPA2 uses Advanced Encryption Standard (AES), a very strong encryption standard.

As mentioned earlier, if the wireless network is on a 2.4 GHz frequency, channels 1, 6, and 11 are the preferred channels to use.

Purpose:

Upon completing this project, you will better fulfill requests for configurations on a wireless network.

Steps for Completion:

1. What is often used to manage IoT devices?

   _____

2. For each situation, identify the aspect of a wireless router that needs to be configured:

   a. The wireless router should not give out IP addresses to devices connecting to it: _____

   b. A store owner needs to access a specific computer when connecting to the network from home: _____

   c. A network administrator wants to discourage game playing during work hours:

   _____

3. If you have a wireless router and access to the configuration page of it, log on to the wireless router and see how many of these wireless router aspects are present on your wireless router. Not every wireless router will have every aspect to configure.

Project Details

Project Files:
N/A

Estimated Completion Time:
10 minutes

Video Reference:
Domain 2
  Topic: SOHO Networks
    Subtopic: IoT Device Configuration; Cable/DSL Modem Configuration; DMZ; Port Forwarding; NAT; UPnP; Whitelist/Blacklist; MAC Filtering; QoS; Encryption; Channels; More QoS

Objectives Covered:
2 Networking
  2.3 Given a scenario, install and configure a basic wired/wireless SOHO network
    2.3.6 IoT device configuration
      2.3.6.1 Thermostat
      2.3.6.2 Light switches
      2.3.6.3 Security cameras
      2.3.6.4 Door locks
      2.3.6.5 Voice-enabled, smart speaker/digital assistant
    2.3.7 Cable/DSL modem configuration
    2.3.8 Firewall settings
      2.3.8.1 DMZ
      2.3.8.2 Port forwarding
      2.3.8.3 NAT
      2.3.8.4 UPnP
      2.3.8.5 Whitelist/blacklist
      2.3.8.6 MAC filtering
    2.3.9 QoS
    2.3.10 Wireless settings
      2.3.10.1 Encryption
      2.3.10.2 Channels
      2.3.10.3 QoS

Wireless Networking Protocols

Most wireless networks are based on the 802.11 standards as developed by the Institute of Electrical and Electronics Engineers (IEEE). Wireless standards determine the frequency, speed, and distance in which wireless networks operate. The most important compatibility factor with wireless networks is the frequency on which the wireless networks operate. For example, if a wireless access point is an 802.11ac access point operating on the 5 GHz frequency, any device connecting to it must also operate on the 5 GHz frequency. The two frequencies on which wireless networks operate are:

2.4 GHz: Works with the 802.11b, g, and n standards. This frequency is susceptible to interference from cordless phones and microwave ovens. To avoid overlap in wireless signals, only channels 1, 6, and 11 should be used on devices connecting to a wireless network. Most wireless access points will set the proper channel automatically, but for the exam be aware of these channels.

5 GHz: A frequency which is mostly interference-free but does not travel as far as the 2.4 GHz frequency.

Here are the different 802.11 wireless standards, their frequencies, and speeds.

Standard	Frequency	Speed
802.11a	5 GHz	54 Mbps
802.11b	2.4 GHz	11 Mbps
802.11g	2.4 GHz	54 Mbps
802.11n	2.4 or 5 GHz	300 Mbps but up to 600 Mbps on a dual link
802.11ac	5 GHz	Up to 6.9 Gbps

802.11n uses multiple antennas, known as multiple-input multiple-output (MIMO) technologies to achieve higher speeds. 802.11ac also uses multiple antennas, each with speeds of up to 400 Mbps. Most devices have between one and four antennas. Smartphones typically have one antenna, while desktop wireless network adapters typically have four antennas. The actual likely top speed of an 802.11ac network is 1 Gbps.

The 802.11 standard is not the only available wireless standard. Here are some wireless standards used in personal area networks and in IoT:

Standard	Description
Bluetooth	A personal area network (PAN) technology to where devices connect through pairing with each other, usually at distances of 10 meters or less.
NFC	A PAN to which two devices that are NFC-enabled and 10 centimeters or less apart can communicate with each other.
RFID	A type of wireless communication that uses electromagnetic fields within tags to track objects.
Zigbee	An IoT technology that uses the 2.4 GHz frequency over 10 meters or less and is used often in remote controls and home automation.
Z-Wave	An IoT technology that uses the 908.42 MHz frequency over 30 meters or less and is used for home automation and security.

Cellular networks are wireless networks as well. There are four of these standards you need to know about for the exam. They are:

Standard	Description
3G	One of the first cellular technologies and ran at 4 Mbps.
4G	A cellular technology that runs at up to 10 Mbps.
5G	A cellular technology due to become commercial in 2020 and run at up to 490 Mbps or, in some cases, 1.4 Gbps.
LTE	A cellular technology with speeds approaching 50 Mbps.

Purpose:

Upon completing this project, you will be able to identify the wireless standard needed given a customer situation for a wireless network.

Steps for Completion:

1. A small business owner has been working on an 802.11a wireless network but realizes most new machines on the business network do not have the 802.11a standard. Which standard should the business owner switch to for maximum

    compatibility? ───────────────

2. A small business owner hears that an 802.11ac wireless router would make for a fast wireless network. Which standard(s) do the machines on the network need in order to be compatible with the new wireless router?

    ───────────────

3. A small business owner wants to upgrade the wireless router from 802.11g to 802.11n. Will the network's devices, mostly in the 802.11g standard, see the new

    802.11n router? ───────────────

4. A user is getting 22 Mbps speed on a cellular phone. Which network is the user on?

    ───────────────

5. Which IoT technology runs on the same frequency as that of an 802.11n wireless

    network? ───────────────

Server Roles

Though an A+ technician is not usually called upon to perform major server administrator tasks, a technician still needs to be aware of the most common types of servers and the roles they play in a network infrastructure. Here are those server roles, along with an explanation of each role:

Role	Explanation
Web server	A server which hosts websites and web services. Two prominent web servers are Internet Information Server (IIS) and Apache.
File server	A server which serves as a central access point for files of all types.
Print server	A server which hosts printers. Devices can then connect to the print server, download drivers, and install printers.
DHCP server	A server which allows for the setup of IP address pools for the purpose of using DHCP to distribute IP addresses to clients joining the network.
DNS server	A server which maps hostnames to IP addresses. DNS servers use Host entries (known as A files) to store matching hostnames and IP addresses. 13 root DNS servers worldwide store the vast majority of host entries.
Proxy server	Used to control Internet traffic. When a client machine in a private network goes through a proxy server to get to the Internet, the data packets have the IP address of the proxy server, not the client machines. Some proxy servers can also serve as content filters.
Mail server	A server which hosts email. This can be either an on-premises server or a server in the cloud. Microsoft Exchange is an example of a mail server.
Authentication server	A server which validates a user and device claim to a network. An example of this is a RADIUS server which authenticates someone trying to connect to a network through a VPN.

In addition to knowing these server roles for the exam, you also need to know the concept of a syslog. A syslog is a log that tracks system errors on a server. In many cases, these errors can be assigned a severity. On some systems, the lower the number, the more critical the error. On other systems, the higher the number, the more critical the error.

Purpose:

Upon completion of this project, you will know which server role fulfills a given customer need.

Steps for Completion:

1. For each situation, identify the server role which is either in use or needs to be implemented:
   a. An administrator creates an entry to map a server named SharePoint to an IP address of 10.1.1.4: ⸺⸺⸺⸺⸺
   b. A user needs to install a printer without having to navigate through a manufacturer's website: ⸺⸺⸺⸺⸺
   c. A server which will block some social media sites from company employees needs to be set up: ⸺⸺⸺⸺⸺
   d. A server needs to validate an attempt from a user to get into a corporate network through a VPN: ⸺⸺⸺⸺⸺.

Internet Appliances and Other Systems

In addition to understanding server roles, a technician needs to have a basic understanding of software and devices which help protect a network from threats. These devices are known as Internet appliances. Three appliances used to protect networks from threats are:

Unified Threat Management (UTM): A security appliance and/or software tool which contains a combination of any of the following: antivirus/antimalware, firewall, proxy server, content filtering, spam filtering, intrusion detection system, intrusion prevention system, and network access control. The more robust the tool, the higher the number of features available.

Intrusion Detection System (IDS): A hardware and/or software device which monitors network traffic and detects attacks. It can then notify an administrator of a possible attack. Most IDS devices are pre-configured to look for abnormalities in network traffic. An administrator can customize an IDS configuration to suit a company network's protection needs.

Intrusion Prevention System (IPS): A device which is similar to an IDS but can actually prevent an attack. For example, an IPS can restart a router if the router has a spike in overall traffic or a spike in traffic for a given protocol.

A technician also needs to be aware of legacy systems and/or embedded systems present in a company infrastructure. Here is a definition of each of these systems:

Legacy: A system and/or application which has aged to the point to where it is no longer supported by the manufacturer. For example, Windows XP is no longer supported by Microsoft. Thus, there are no more available security updates. For this and other legacy systems, this is a large risk in that when support is dropped, there is no more protection against malicious attacks.

Embedded: Hardware and/or software designed for a particular function. Examples include Smart TV and Industrial Control Systems (ICS).

Finally, for the exam, you will want to know what is meant by an endpoint management system. An endpoint management system manages clients for network compatibility. For example, an endpoint management system can examine a client device trying to join a network to see if it has an operating system new enough for the network and adequate antimalware protection. Without this, the endpoint management system can deny the client device access to the network.

Purpose:

Upon completing this project, you will have a better understanding of network protection devices, legacy systems, and embedded systems.

Steps for Completion:

1. For each situation, identify the type of network protection device in use:
    a. Software which detects a high number of ICMP packets and notifies an

    administrator: ——————————

    b. A hardware device which detects a high number of TCP requests and resets

    the affected router: ——————————

2. For each description, identify whether a legacy or embedded system is in use:

    a. Windows Server 2003: ——————————

    b. A device which controls temperature gauges: ——————————

Project Details

Project Files:
N/A

Estimated Completion Time:
5-10 minutes

Video Reference:
Domain 2
Topic: Server Types
Subtopic: Web Server; File Server; Print Server; DHCP Server; DNS Server; Other Servers; Syslog

Objectives Covered:
2 Networking
   2.5 Summarize the properties and purposes of services provided by networked hosts
      2.5.2 Internet appliance
         2.5.2.1 UTM
         2.5.2.2 IDS
         2.5.2.3 IPS
         2.5.2.4 End-point management server
      2.5.3 Legacy/embedded systems

Network Configuration Concepts

Though an A+ technician is not normally a full-fledged network administrator, a technician is still expected to understand the basics of network configuration concepts. This includes the concepts of IP addressing, server roles, and types of virtual networks.

Regarding IP addressing, on a network, devices have two ways in which to receive an IP address:

Static: The IP address is physically assigned to a device. Any device which will be accessed by multiple devices in a network should have a static IP address. For example, all servers, routers, access points, and printers should have a static IP address assigned to them.

Dynamic: The IP address is assigned through a Dynamic Host Configuration Protocol (DHCP) service on either a DHCP server (more common in larger networks) or an access point (as in the case of a SOHO network).

When using DHCP, a device will lease an IP address for a defined period of time and then attempt to renew the lease during the lease duration. If the lease expires, the device could get a new IP address the next time it logs on to the network. If a device such as a printer uses DHCP and then has an IP address which changes, network users will lose their connection to the printer. This is the main reason devices such as printers should get a static IP address. If a device is supposed to get an IP address through DHCP and cannot do so, the device will get an IP address starting with the numbers 169.254, also known as an Automatic Private IP Address (APIPA). For IPv6, the equivalent is a link-local IP address, which starts with the hexadecimal numbers FE80. Every device with IPv6 does have one of these addresses, however.

IPv4 addresses are 32-bit IP addresses, represented as four sets of octets with numbers between 0 and 255. For example, 10.1.1.1 is a legitimate IPv4 address. 256.256.256.256 is not. IPv6 addresses are displayed in eight blocks of four hexadecimal numbers each, for a total of 32 hexadecimal numbers. Hexadecimal numbers count from 0 to 9 and A through F. Here is an example of an IPv6 address: 2001:34ea:89ac:d001:0000:0000:e421:0001.

IPv6 addresses seem long and unwieldy. Fortunately, there are two significant addressing shortcuts which can be used for IPv6 addresses. They are:

Omitting leading zeros: In any block of four hexadecimal numbers, leading zeros can be omitted. For example, 0001 can become 1.

Multiple groups of zeros: A single group of four zeros or consecutive groups of four zeros can be rewritten as two colons (::). This can only happen once per IPv6 address. Having two :: in an IPv6 address would be ambiguous as one would not know how many zeros were replaced for each :: in an IPv6 address. Thus, the IPv6 address displayed above can be written as 2001:34ea:89ac:d001::e421:1. The 0001 can become 1 through eliminating the leading zeros. The two blocks of 0s can be replaced with a double colon.

Each IP address has a subnet mask. This determines the size of a network. The most common subnet mask for a network is 255.255.255.0. In this type of network, the 255s represent pieces of the IP address that are the same, while the 0 represents the difference in each IP address. To illustrate, take an IP address of 10.1.1.1 with a subnet mask of 255.255.255.0. On this particular network, all devices will have an IP address starting with 10.1.1.

One way in which an IP address can be permanently assigned to a device through DHCP is through a DHCP reservation. To do this, an administrator needs to know the MAC address of the device which needs a reserved IP address.

In order to have DHCP set an IP address on a client machine, the network adapter needs to be configured to find a DHCP server. Furthermore, in order for computer names and Internet addresses to resolve correctly to the IP addresses of those computers and websites, the DNS settings for the network adapter need to be correct. Normally, a DNS server is located automatically, but depending upon the desired network configuration for a network environment, a DNS server address may be set manually as a network administrator may want a machine to point to a specific DNS server with specific DNS entries.

In order to reach computers on other networks, including the Internet, a network adapter needs to point to a default gateway, which is usually the IP address of a router or, in the case of a small business or home office, a wireless access point. Again, this IP address can be set automatically or manually. In this project, you will configure the IP address and DNS server address for a network adapter.

Finally, under the exam topic of common network configurations, there are three additional network features you need to know about. They are:

VPN: Virtual private network. This is a private, encrypted network done over a public network, like the Internet.

VLAN: A virtual LAN is a type of network in which a physical device, such as a switch, can host multiple logical networks through assigning different network IDs to different ports.

NAT: Network Address Translation. This allows for devices with private IP addresses, which cannot be routed between networks, to request data and have the data request receive a public IP address, so that the request can be routed to other networks. Upon receipt of the data, the IP address is changed back to the private IP address that made the request.

Purpose:

Upon completing this project, you will be able to better understand IPv4 and IPv6 addresses and be able to utilize common networking configuration concepts.

Steps for Completion:

1. For each of the following IP address situations, indicate whether the IP address is legitimate or illegitimate:

   a. 128.127.0.256: ───────────────

   b. 14.242.23.111: ───────────────

   c. 2001:32g3:1029:52a3:0010:1505:aab3:f325: ─────────────────

   d. ::1: ───────────────

2. Rewrite the IPv6 address 2000:5352:1304:0000:0000:0000:aa32:0002 using addressing shortcuts:

   ───────────────────────────────

3. Open a command prompt on a Windows device.
4. Type **ipconfig** and press the Enter key.
5. Use the information on the screen to answer the following:

   a. What is the IP address of your device? ─────────────────

   b. What is the subnet mask? ─────────────────

   c. What is the default gateway address? ─────────────────

   d. Do you have any IPv6 addresses? ─────────────────

Project Details sidebar

Project Details

Project Files:
  N/A

Estimated Completion Time:
  15 minutes

Video Reference:
  Domain 2
   Topic: IP Addressing
     Subtopics: Static; Dynamic; APIPA and Link-Local Addresses; DNS; Reservations; IP Addresses and Subnet Masks; Gateway; VPN, VLAN, NAT

Objectives Covered:
  2 Networking
   2.6 Explain common network configuration concepts
    2.6.1 IP addressing
      2.6.1.1 Static
      2.6.1.2 Dynamic
      2.6.1.3 APIPA
      2.6.1.4 Link local
    2.6.2 DNS
    2.6.3 DHCP
      2.6.3.1 Reservations
    2.6.4 IPv4 vs. IPv6
    2.6.5 Subnet mask
    2.6.6 Gateway
    2.6.7 VPN
    2.6.8 VLAN
    2.6.9 NAT

Internet Connection Types

When homes and offices first started connecting to the Internet, the two main ways of connecting were either through a slow dial-up phone line connection or an expensive leased line from a telecommunications company.

Fortunately, there are many high-quality and reasonably priced ways to connect to the Internet. The choice one makes make for an Internet connection depends on availability, reliability, and pricing. Here is a list of the most common Internet connection types and details on each:

Type	Details
Cable	Internet service through a cable TV company. The signal is split between TV and Internet. The speeds tend to be high but vary as the bandwidth is shared with other cable Internet customers in the area.
Digital Subscriber Line (DSL)	Uses digital signals over phone lines for a high-speed Internet connection. The speed is not typically as high as that of cable Internet but tends to be more consistent than cable Internet. The closer the connection to the phone company equipment, the higher the speed. Asymmetric DSL (ADSL) is the most common DSL subscription, with much faster download speeds than upload speeds. Symmetric DSL (SDSL) has the same upload and download speeds.
Dial-up	Older type of connection using a modem with a phone line (RJ-11) cable. Maximum speed is 56 Kbps.
Fiber	Newer, higher-speed connection. Not available in all areas.
Satellite	Used when other avenues of high-speed Internet are not available. Quality is subject to latency (delay). A clear line of sight to the satellite is needed.
Integrated Services Digital Network (ISDN)	The first upgrade over a dial-up connection. Uses two 64 Kbps channels for a Basic Rate Interface (BRI) or 23 64 Kbps channels for a Primary Rate Interface (PRI).
Cellular	Uses a cellular subscription. 4G LTE is the most common cellular network. Speeds are often comparable to cable Internet speeds.
Tethering	The use of a USB cable with a cellular connection to obtain Internet access.
Hotspot	An app on a smartphone or a standalone device that, when activated, allows others to use the smartphone's cellular connection to get Internet access.
Line-of-sight	Internet service with a modem which uses a wireless connection from a wireless tower. The signal varies based on interference from outside sources.

Purpose:

Upon completing this project, you will determine the best possible Internet connection for a customer given the knowledge of a customer's situation.

Steps for Completion:

1. For each customer situation, determine the best possible Internet connection type:

    a. A customer wants high-speed Internet but cannot get cable or DSL in the area: _____

    b. A customer can get Internet via a smartphone but is in a building with no wired or wireless Internet:

    _____

    c. A home office customer has a satellite dish for TV and is close to the local phone company equipment headquarters:

    _____

Network Types

When networks are built, the networks themselves have a network type. The network type designation for a network will depend on the network's size and area of coverage. When working on an existing network, a technician needs to know if the network is confined to a single building, for example, or if the network encompasses several offices, located in different cities, states, or even countries. There are four well-defined network types. As you read through these, remember for the A+ exam to focus on the network types and their definitions as many real-life networks could fall into more than one of these types. Here are the four network types, their definitions, and examples of each:

Network Type	Definition	Example
Local Area Network (LAN)	A network in which devices are connected together through wired and/or wireless connections in a single area (like a building).	A SOHO network, which usually has 10 or fewer devices. Another example could be a 1000-device network in a single building.
Wide Area Network (WAN)	A network consisting of multiple LANs in separate locations.	A company with LANs in three major cities, all connected through WAN links, usually leased from a telecommunications provider.
Personal Area Network (PAN)	A short-distance connection between two personal devices.	A Bluetooth connection between a tablet and a keyboard or a smartphone and an earpiece.
Metropolitan Area Network (MAN)	A connection of multiple LANs in a metropolitan area, such as a city.	A university with multiple locations within a city. Another example is a city-wide wireless network.
Wireless Mesh Network (WMN)	A WAN-like wireless network with multiple connections among endpoints.	A metropolitan area filled with cellular towers, each with multiple connections to each other.

Many people argue a MAN is a form of a WAN. Technically, that is correct. For definition purposes, a MAN is kept within the confines of a city or similar municipality while a WAN covers a much larger territory.

Purpose:
Upon completing this project, you will be able to identify a network type given a network description.

Steps for Completion:
1. For each network description, identify the network type (LAN, WAN, PAN, or MAN):
   a. A network covering three buildings for a business campus with offices in the same city, six blocks apart: ———————————

   b. A two-story office building with 100 devices: ———————————
   c. A network with a headquarters office in Dallas, connected to satellite locations in Denver and Tampa: ———————————

Project Details

Project Files:
   N/A

Estimated Completion Time:
   5-10 minutes

Video Reference:
   Domain 2
      Topic: Internet Connection Types
         Subtopic: Network Types

Objectives Covered:
   2 Networking
      2.7 Compare and contrast Internet connection types, network types, and their features
         2.7.2 Network types
         2.7.2.1 LAN
         2.7.2.2 WAN
         2.7.2.3 PAN
         2.7.2.4 MAN
         2.7.2.5 WMN

Networking Tools

When working on desktop computers, a technician's tools will consist of a screwdriver with multiple non-magnetic heads (or multiple non-magnetic screwdrivers), a pair of pliers, a pair of tweezers, and not much more. When working on networks, another set of tools is needed. Sometimes these tools will be used to build components and sometimes they will be used to troubleshoot components. Here is a list of tools needed for building and troubleshooting networks and the purposes these tools serve:

Tool	Purpose
Crimper	Used to attach an RJ-45 connector onto the end of a twisted-pair cable.
Cable (wire) stripper	Strips the jacket off of a twisted-pair cable and then strips the insulation off of each wire. Ideally, 2 inches of the jacket should be stripped and ½ inch to ¾ inch of each wire should be stripped.
Multimeter	Used to test for electrical current. A multimeter can be used to test two ends of a cable for continuity. It can also be used to test voltage for a voltage wire on a power supply connector.
Tone generator and probe	Used to find an opposite end of a cable and the signal strength of the cable. The generator sends a signal from one end of a cable. The probe receives the signal and if it is a good signal, sounds a tone.
Cable tester	Used to test the twisted-pair wires in a twisted-pair cable and can identify any pairs which do not work, thus allowing a technician to focus on a specific part of a cable to repair.
Loopback plug	Plugs into a network jack and loops signals from output pins to input pins. Once this is plugged in, a machine can be pinged to make sure the NIC is working.
Punchdown tool	Used to connect a cable to a punchdown block and to the back of an RJ-45 jack.
Wi-Fi analyzer	Used to reveal Wi-Fi hotspots and detect wireless network access. It does this through scanning for 2.4 GHz and 5 GHz RF signals.

Purpose:
Upon completing this project, you will be able to identify network tools and the situations in which those tools are used.

Steps for Completion:
1. Identify each of these hardware tools:

a. ——————————— b. ——————————— c. ———————————

2. For each situation, name the hardware tool that should be used to troubleshoot the situation:

   a. A NIC needs to be tested to see if it is working: ———————————
   b. A technician needs to know which cable in a patch panel connects to a wall port in a manager's office:

   ———————————

   c. A power supply wire may or may not be functional: ———————————

A+ Part 1 (220-1001)
Project Workbook
Domain 3: Hardware

Fill-in-the-Blanks Domain 3

Instructions: While watching Domain 3, fill in the missing words according to the information presented by the instructor. [References are found in the brackets.]

Cable Types, Features, and Purposes

1. On the 568B standard for wiring cables, pins 1 and 2 use the color ——————————. [Types of Twisted Pair and Connectors]

2. DVI to HDMI, USB to Ethernet, and DVI to VGA are all adapters that will allow you to connect two devices even if one of the devices does not have the needed —————————— in order to make the connection. [DVI to HDMI, USB to Ethernet, DVI to VGA]

Common Connector Types

3. The most commonly used network connector is the —————————— connector, which has four pairs of wires that is used at the end of every twisted-pair Ethernet cable. [Ethernet and Coaxial Connectors]

4. —————————— is the cable of choice on current mobile devices. [Types of USB Connectors, DB-9, Lightning]

RAM Types

5. The smallest RAM chip available for laptops is a —————————— chip. [SODIMM, DDR2, DDR3, DDR4]

6. A —————————— motherboard has two distinct groups of RAM chip slots. [Types of Memory Channels]

7. For RAM, Error-Correction Code uses additional circuitry to detect and correct errors, while —————————— uses 9 bits per a byte instead of 8 so that the binary numbers will always add up to an odd number unless there is an error. [Types of Error Checking]

Install and Configure Storage Devices

8. M2 drives, NVME, and SATA 2.5 are all small —————————— drives, but the SATA 2.5 is the traditional type of drive. [M2 Drives, NVMe, SATA 2.5]

9. A RAID 0 requires two hard drives, RAID 1 requires —————————— hard drives, RAID 5 requires at least three hard drives, and RAID 10 requires four hard drives. [RAID 0, 1, 5, 10]

Internal PC Parts

10. The Advanced Technology eXtended motherboard is the desktop standard and has the most available connections, but the —————————— is a smaller common motherboard. [Motherboard Types]

11. A dual-core processor is a processor that has two cores, not two ——————————. [CPU Features]

12. A fan sits on top of the CPU and cools it while the —————————— sits on top of the fan and dissipates/removes the heat. [CPU Cooling]

Peripheral Types

13. —————————— microphones tend to have the best quality among microphones. [Input Devices and Speakers]

Power Supply Types and Features

14. Before installing a new peripheral, check the PC power supply to determine if you have enough —————————— to handle the new peripheral. [Power and Power Supplies]

PC Configurations

15. If a client needs to run multiple —————————— on a machine, they will need a virtualization workstation. [Virtualization Workstation]

16. A network attached storage device should have a ———————— network card in order to help move files quickly. [NAS Devices]

Install and Configure Common Devices

17. Most mobile devices only allow apps from the ———————— for an Android device and the App Store on an iOS device, but Android devices have a setting that allows third-party apps to be downloaded to the device. [Touch Screen, App, and Install Settings]

Configure Printers and Settings

18. When configuring multifunction printers, start with getting the latest ———————— from the manufacturer's website. [Configuration Settings]

19. For sharing printers, if there is no wired connection available, the ———————— based infrastructure connection is the most common way to connect with a wireless network. [Wireless Configurations]

20. ———————— printing allows a smartphone or tablet to print to a printer even if you are not close to the printer. [Integrated Print Server]

Install and Maintain Printers

21. The last step of the printing process on most laser printers is ————————. [Laser Printer Process]

22. ———————— prints are exported electronic files and are not a physical printing machine. [Print to FIle]

23. A 3-D printer will print physical objects using a plastic ————————, metal wire, or ceramic powder. [3-D Printers]

Twisted-Pair Cables

Twisted-pair cables are the most common cables used for wired networks which cover the inside of a building. There are two types of twisted-pair cables: shielded twisted-pair (STP) and unshielded twisted-pair (UTP). UTP cables are far more common than STP cables as they are less expensive than that of STP cables. There are three main types of STP cables:

STP: Shielding is around all four pairs of wires.

S/UTP: Shielding is around each pair of wires.

S/STP: Shielding is around each pair of wires and then another shield is around all four pairs of wires.

One drawback of UTP cable is that, due to a lack of shielding, UTP cable is more susceptible to electromagnetic interference (EMI), especially if the cable is exposed to light, near a power cable, or near magnets or motors. In addition to EMI, crosstalk can be a problem if two cables are too close to each other as data from one cable can cross over to another cable.

There are two main types of twisted-pair cables:

RJ-11: These cables are standard phone line cables. There are two pairs of wires used for the cable, with the wires surrounded by a jacket which protects the wires from signal interference.

RJ-45: The standard cable for Ethernet networks. There are four pairs of wires used for the cable. The wire configuration determines the type of cable and where it can be used, as we will cover in detail during this project.

RJ-45 cables have two wiring standards: T568A and T568B. The wiring standards determine where the wires will line up in relation to the pins on the RJ-45 connectors. The two standards for wire colors and pin locations are found in the table below:

Pin	T568A	T568B
1	Green/White	Orange/White
2	Green	Orange
3	Orange/White	Green/White
4	Blue	Blue
5	Blue/White	Blue/White
6	Orange	Green
7	Brown/White	Brown/White
8	Brown	Brown

If both ends of the cable use the same standard (usually T568B), the cable is a straight-through cable. Straight-through cables are the most commonly used cables in Ethernet networks and are used to connect computers to wall ports, computers to switches, and computers to routers. If one end of the cable uses the T568A standard and the other end uses a T568B standard, the cable is a crossover cable. Crossover cables are used to connect computers to computers, switches to switches, and switches to routers.

Sometimes, a straight-through cable can be used where a crossover cable would be otherwise needed. This is possible if the port on the switch or router receiving the cable is a Medium Dependent Interface Crossover (MDI-X) port. This port will take a straight-through cable and mimic a crossover cable.

Twisted-pair cables have two types of jacket coverings:

Plenum: A jacket for cable which needs to be run through open space (between walls, through raised floors, or through ceilings). In case of fire, this type of jacket does not give off toxic fumes.

PVC: A cable with a jacket made of polyvinyl chloride (PVC). This type of jacket gives off toxic fumes when burned.

For UTP cables, the standard distance a signal will travel without losing quality is 100 meters (328 feet). If two devices are further apart than that and need to be connected, a repeater needs to be between those two devices. Repeaters boost signals. For example, if two switches 500 feet apart need to be connected, a repeater is needed no more than 328 feet from one of the switches. One twisted-pair cable will connect a switch to the repeater and another twisted-pair cable will connect the repeater to the other switch.

While there is one standard for distances for UTP cables, there are several standards for speeds and transmissions. Speeds and transmissions are defined by categories. Here are the most common UTP categories, their speeds, frequencies, and characteristics:

Category	Speed	Frequency	Characteristics
CAT 5	100 Mbps	100 MHz	Used for equipment capable of 100 Mbps transmissions.
CAT 5e	1000 Mbps	100 MHz	Used for equipment capable of 1 Gbps transmissions.
CAT 6	10 Gbps	250 MHz	Used with 10GBase-T networks.

With some network setups, splitters are used to split data over two connections. For example, with a DSL Internet connection, a splitter is used to split voice frequencies from data frequencies and thus avoid signal interference and increase the quality of both voice and data transmissions. However, if a data transmission alone is split, the two entities sharing the split also share the frequency, thus lowering the overall quality of data transmissions.

Purpose:

In this project, you will identify characteristics of twisted-pair cable. You will then choose the correct type of twisted-pair cable given a customer situation.

Steps for Completion:

1. Identify this T568 standard:

2. Go get the nearest twisted-pair cable you can find. Which standard is it using?

3. A customer has gigabit NICs in a company's computers and gigabit switches to use in the company's network. What category of twisted-pair cable is the minimum standard needed to take full advantage of the speed of the equipment?

Fiber and Coaxial Cables

Fiber cables (also known as fiber optic cables) offer the fastest and longest data transmissions over a network. Fiber optic cables are usually used for wide area networks (WANs) as the cables are far more expensive than that of twisted-pair cables, cables normally used for a network inside of a building.

Data signals travel through fiber cables as light pulses, thus making fiber cables immune to electromagnetic interference (EMI) and radio frequency interference (RFI). Most fiber cables use a glass core, so care must be taken to make sure not to bend fiber cables too much when laying down the cable in a network. This is another reason fiber cables are not used nearly as much inside of buildings as they are outside of buildings. Fiber cables have several types of connectors, with these three being the main connector types:

Square connector (SC): Connector is shaped like a square.

Lucent connector (LC): A miniature version of the SC connector.

Straight tip (ST): Round-shaped connector.

There are two modes of fiber cables:

Single-mode (SMF): A single signal travels through the cable at a time, through a glass core.

Multimode (MMF): Multiple signals can travel through a cable simultaneously, using a plastic core which is larger than the glass core used in single-mode fiber cable. Because multiple signals pass through at once, multimode fiber cables typically do not carry a signal as far as that of single-mode fiber cables.

There are several different standards for fiber cables, each with a maximum speed and distance. Most standards use either MMF or SMF with the exception being the 1000Base-LX standard, as seen in this table:

Standard	Speed	Distance	Cable
100Base-FX	100 Mbps	2 km	MMF
1000Base-LX	1 Gbps	5 km	MMF/SMF
1000Base-LH	1 Gbps	10 km	SMF
1000Base-ZX	1 Gbps	70 km	SMF
10GBase-SR	10 Gbps	26-82 m	MMF
10GBase-LR	10 Gbps	10 km	SMF
10GBase-ER	10 Gbps	40 km	SMF

Coaxial cables used to be the primary cables used in networking. With the advent of faster twisted-pair cables and even faster fiber cables, the role of coaxial cables in networking has been greatly reduced. However, coaxial cables still have a role in networking, especially as it pertains to Internet service providers and cable TV providers. There are two main types of coaxial cables:

RG-6: An RG-6 coaxial cable has a large center conductor. It is the current standard for cable and satellite systems and is very efficient at transmitting digital signals. RG-6 cables are used in home networks with multiple TV boxes. This setup allows for recording a program in one room and then watching it in another room.

RG-59: The original standard for cable TV. Though this is an older standard than is RG-6, RG-59 cable is still efficient in transmitting data between a TV and VCR or a TV and DVD player.

In addition to cable standards, there are two main types of connectors used with coaxial cables:

F-connector: Resembles a cylinder and is a screw-on connector. This connector is used with RG-6 cables.

Bayonet Neill-Concelman (BNC) connector: This connector has a neck and is a push-and-turn connector. This connector is used with RG-59 cables.

Another primary role for coaxial cables is to connect a cable modem with a unit that leads to a cable Internet service provider. To split the TV signal from streaming data, a coaxial splitter is used. This helps the signal quality of both the TV and Internet data streams as the split helps to prevent signal interference.

Coaxial cables have two basic standards for speeds and transmissions:

Standard	Speed	Distance
10Base2 (Thinnet)	10 Mbps	185 meters
10Base5 (Thicknet)	10 Mbps	500 meters

Note that the 2 in 10Base2 represents a distance of approximately 200 meters but the actual signal distance is 185 meters.

Purpose:

Upon completing this project, you will be able to better identify usage and standards for fiber and coaxial cables.

Steps for Completion:

1. Name at least one disadvantage of using fiber cables in a small office network environment:

   _____

2. Which fiber standard carries signals over longer distances?

   _____ .

3. Which coaxial connector is used mainly with RG-59 cables?

   _____

Video and Multipurpose Cables

There are three main types of video connectors: Video Graphics Array (VGA), High-Definition Multimedia Interface (HDMI), and Digital Visual Interface (DVI). Here are the standard data types and resolutions for these video connectors and their variations:

Connector	Data	Resolution
VGA	Analog	640 x 480 is the standard, but can go higher depending upon what a monitor/video card will support
HDMI	Digital	HDMI 1080 supports up to 1920 x 1080 HDMI 720 supports up to 1280 x 720
DVI	Analog for DVI-Analog (DVI-A) Digital for DVI-Digital (DVI-D) Both Analog and Digital for Integrated (DVI-I)	Single-link DVI supports up to 1920 x 1200 Dual-link DVI supports up to 2560 x 1600

DVI connectors are identified through their pin configuration. DVI-I connectors have all pins in use, while DVI-D connectors do not have the four analog pins on the left in use. Single-link connectors do not use the middle six pins of the DVI connector. Here are examples of the five types of DVI connectors:

DVI-A	DVI-D Single Link	DVI-D Dual Link	DVI-I Single Link	DVI-I Dual Link
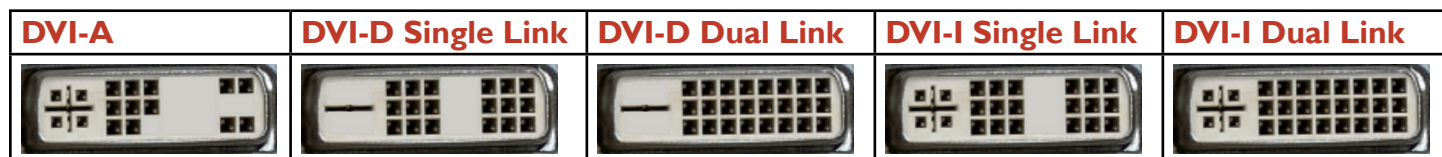
HDMI connectors are unique in that they can digitally transfer both video and audio. They come in full-size or in a mini-HDMI version, which are often used to connect mobile devices to displays, A newer type of digital cable is a DisplayPort cable. This cable replaced DVI cables on MacBooks and is now used on some Windows devices as well. It is considered to be more favorable than DVI as the connector is far smaller than DVI. Plus, it supports both audio and video signals.

Multipurpose cables can connect devices to perhiperals of all types, including hard drives, network adapters, headsets, and even displays. Three types of multipurpose cables you need to know about for the exam are:

Cable Type	Purpose
Lightning	Used on Apple devices to connect devices to chargers, earbuds, and headphones.
Thunderbolt	Resembles a mini DisplayPort cable, has a lightning bolt, and can be used on devices such as displays and Gigabit Ethernet adapters.
USB	Universal Serial Bus (USB) connectors are used to connect all kinds of devices: drives, printers, network adapters, game controllers, and other types of devices. Basically, practically anything can be connected through USB. Three USB standards you need to know about are: **USB 2.0:** Can transmit at speeds of up to 480 Mbps, but at half duplex (one direction at a time). **USB 3.0:** Can transmit as speeds of up to 5 Gbps at full duplex (both directions at the same time). **USB-C:** The newest standard and has a connector that is a little different than the 2.0 and 3.0 standards. Can support speeds of up to 10 Gbps.

Before USB, users connected peripherals to devices using serial cables. Serial cables are not in use much these days as they have been replaced, for the most part, by USB cables.

Purpose:

Upon completing this project, you will be able to better identify video cables and be able to differentiate among multipurpose cables.

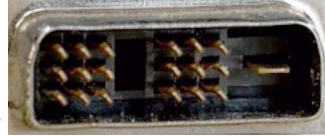## Steps for Completion:

1. For each connector, identify the connector type:

     a. _____

     b. _____

2. Which connector(s) will this plug fit into?

_____

3. Which USB standard runs at half duplex? _____

4. Which type of multipurpose cable has been replaced by USB cables in most cases?

_____

Adapters and Hard Drive Cables

Hard drive cables are used to connect hard drives to motherboards. There are three of these types you need to know about for the exam:

SATA: Serial ATA, a thin, L-shaped cable that can transmit data at up to 600 Mbps. This is the most common cable used for hard drives in desktops and laptops.

IDE: The older standard and uses parallel ATA (PATA) cables, which are thin, wide cables.

SCSI: A standard used mostly in servers that allows multiple drives to daisy-chain onto a single connector.

In addition to hard drive cables, technicians need to be able to realize when an adapter is needed as, for example, monitors may have a VGA slot and the back of a PC may have a DVI slot but no VGA slot. Three of the most common adapters are:

Adapter	Description
DVI to HDMI	Connects a DVI-D cable to an HDMI cable (or port).
USB to Ethernet	This plugs into a USB port on a device and then allows for an Ethernet cable to connect to the other end to provide network connectivity. This is useful when a device has a USB port but no Ethernet port and needs to establish a network connection through Ethernet.
DVI to VGA	Connects a DVI-A cable to a VGA cable (or port).

Purpose:

Upon completing this project, you will be able to better understand the use of both hard drive cables and adapters.

Steps for Completion:

1. Identify this adapter:

_____

2. Which hard drive cable supports daisy-chaining? _____

3. Which hard drive cable has an L-shaped connector? _____

Project Details

Project Files:
N/A

Estimated Completion Time:
5-10 minutes

Video Reference:
Domain 3
Topic: Cable Types, Features, and Purposes
Subtopics: SATA, IDE, SCSI; DVI to HDMI, USB to Ethernet, DVI to VGA

Objectives Covered:
3 Hardware
3.1 Explain basic cable types, features, and their purposes
3.1.5 Hard drive cables
3.1.5.1 SATA
3.1.5.2 IDE
3.1.5.3 SCSI
3.1.6 Adapters
3.1.6.1 DVI to HDMI
3.1.6.2 USB to Ethernet
3.1.6.3 DVI to VGA

Common Connectors

There are connector types for networking, peripherals, displays, and hard drives. As a technician, you need to be able to distinguish among these connectors, know their characteristics, and be able to choose the correct connector given a situation.

Here is a table of common connectors mentioned in the exam topics. Some of these have been covered as we have covered cables, but use this table as a reference point for these connectors:

Connector	Used for	Definition
RJ-11	Networking	A phone jack connector with two pairs of wires and is used primarily with dial-up modems.
RJ-45	Networking	A connector with four pairs of wires and is found on the end of every twisted-pair Ethernet cable.
RS-232	Networking	A serial connector that used to be used to connect modems to PCs.
BNC	Networking	Used to connect coaxial cables.
RG-59	Networking	Coaxial cables used for cable TV.
RG-6	Networking	Coaxial cables used for cable TV and cable modems.
USB	Multipurpose	Used to connect peripherals of all types to devices.
Micro-USB	Multipurpose	A smaller version of USB and used mainly to connect devices to smartphones and tablets.
Mini-USB	Multipurpose	A smaller version of USB and used mainly to connect devices to digital cameras and some external hard drives and USB hubs.
USB-C	Multipurpose	A USB connector which represents the USB 3.1 standard, which can carry data at speeds up to 10 Gbps.
DB-9	Multipurpose	Used to connect peripherals to a computer, but has been replaced by USB for the most part.
Lightning	Multipurpose	Used to connect peripherals to Apple devices.
SCSI	Hard drives	Used to daisy-chain hard drives to a single controller.
eSATA	Hard drives	A type of SATA connector used to connect external hard drives to devices. In many cases, the port supplies power to the external hard drive.
Molex	Hard drives	A 4-pin connector that supplies power to IDE hard drives.

Purpose:

Upon completing this project, you will better understand the use of common connectors.

Steps for Completion:

1. Which connector connects coaxial cables? _____

2. What can an eSATA supply to an external hard drive? _____

3. How many pairs of wires are in an RJ-11 connector? _____

4. Which version of USB does USB-C support? _____

Project Details

Project Files:
N/A

Estimated Completion Time:
5-10 minutes

Video Reference:
Domain 3
Topic: Common Connector Types
Subtopics: Ethernet and Coaxial Connectors; Types of USB Connectors, DB-9, Lightning; SCSI, eSATA, Molex

Objectives Covered:
3 Hardware
3.2 Identify common connector types
3.2.1 RJ-11
3.2.2 RJ-45
3.2.3 RS-232
3.2.4 BNC
3.2.5 RG-59
3.2.6 RG-6
3.2.7 USB
3.2.8 Micro-USB
3.2.9 Mini-USB
3.2.10 USB-C
3.2.11 DB-9
3.2.12 Lightning
3.2.13 SCSI
3.2.14 eSATA
3.2.15 Molex

RAM Types

Random access memory (RAM) is memory that is volatile in nature in that RAM temporarily stores instructions a computer needs to process. RAM, unlike data on a hard drive, is erased when a system is turned off, hence the volatility of RAM. RAM has a lot of physical characteristics to be aware of for your being able to choose the correct RAM to install in a system, and choose the RAM that will provide the best performance enhancements for a system. Most modern RAM modules are synchronous dynamic RAM (SDRAM) modules. SDRAM modules synchronize with a system clock for faster speeds.

To enhance the speed advantage of SDRAM modules, double data rate (DDR) modules were created. DDR modules operate at double the speed of SDRAM modules. DDR2 modules then came to fruition, with their speeds doubling that of DDR modules. DDR3 modules, found in many recently built computers, operate at double the speed of DDR2 RAM (four times the speed of DDR RAM). DDR4, which operates at double the speed of DDR3, is the newest SDRAM module on the market.

The type of SDRAM module needed will be based strictly on the motherboard. The pin configurations in the bottom of the RAM modules differ among the main types of DDR-based RAM. For example, a DDR3 RAM module will not fit in a DDR2 RAM slot on a motherboard. Here are some specifics about the types of DDR RAM you could be asked about on the exam:

Type	Characteristics
DDR2	240 pins (120 on each side) with 64 pins on one side of the notch and 56 on the other side.
DDR3	240 pins (120 on each side) with 48 pins on one side of the notch and 72 on the other side.
DDR4	288 pins (144 on each side) with the pins being slightly curved.

SDRAM modules come in two main forms:

Dual inline memory module (DIMM): RAM modules that are installed primarily in desktop computers.

Small outline dual inline memory module (SODIMM): Smaller than RAM modules and are usually installed in laptops and similar devices.

Memory can also be single-sided or double-sided. For single-sided RAM, the chips are all located on one side of the memory module. Double-sided RAM will have chips on both sides of the module. Single-sided RAM actually performs faster than double-sided RAM because, in double-sided RAM, only one side of the module can be accessed at a time.

One other area of compatibility to look for is the amount of channels contained in a motherboard. Motherboards can be single-channel, dual-channel, or triple-channel in nature. Each channel has a 64-bit communication line. A dual-channel motherboard will double the efficiency of the RAM in the system. For example, DDR3 RAM, as documented earlier, is eight times faster than SDRAM for a single-channel motherboard. With a dual-channel motherboard, however, the DDR3 RAM efficiency doubles to 16 times faster than that of a single-channel motherboard holding SDRAM.

A dual-channel motherboard will have two different colors for RAM slots. A triple-channel motherboard will have three different colors for RAM slots. Each color will have a pair of RAM slots. These two same-colored slots make up a bank. For maximum efficiency, make sure to match PC modules within a bank. For example, if you are holding two DDR3-PC3 14900 modules and two DDR3-PC3 12800 modules, install the two PC3-14900 modules in one bank (color) and the other two modules in the other bank. Otherwise, you will get single-channel performance instead of dual-channel performance.

In order for RAM to process data properly, error-checking needs to take place. There are two main types of error checking:

Parity: Data transfers eight bits at a time. In a parity situation, a ninth bit is added. If the bits have an even number of ones (such as 10101010), the parity bit needs to be a 1. If the bits have an odd number of ones (such as 10101000), the parity bit needs to be a 0. This ensures that all bytes have an odd number of ones and if a byte does not, an error has occurred.

Error Correction Code (ECC): ECC uses additional circuitry to detect and correct errors. ECC memory is expensive, thus it is normally used only in high-end computers.

The final characteristic for RAM to discuss in this project is buffered RAM vs. unbuffered RAM. Buffered RAM has an extra chip on the RAM module to handle large amounts of processing. Though this does help with processing, it slows overall performance. Thus, buffered RAM is usually only found in high-end servers.

Purpose:

After completing this project, you will be able to identify types of RAM and also answer questions pertaining to real-life RAM situations.

Steps for Completion:

1. Identify the different types of RAM (DIMM vs. SO-DIMM and type of DDR RAM):

a. _____
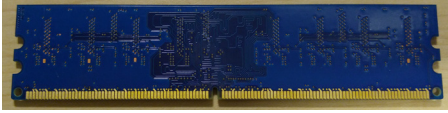
b. _____

2. Obtain a DDR2, DDR3 and DDR4 RAM module and compare both the location of the notch and the density of the pins. This will help identify the types of DDR RAM modules.

3. Which method of error checking involves using circuitry?

_____

4. Which type of memory module is most often found in laptops?

_____

Installing an Optical Drive

Most computers will come with an optical drive. An optical drive is a drive that can play CDs and/or DVDs and/or Blu-ray Discs. Sometimes, a computer user needs a higher-performing optical drive than the one in the computer. For example, the computer may have a CD player and a DVD or Blu-ray player is needed. Or, a computer user may need to be able to record onto DVDs and the installed optical drive may not have that capacity. Most optical drives have labels designating the media the optical drive can play and use for recording. Here are the common types of optical drives, along with their characteristics:

Optical Drive Type	What it Does
CD-ROM	Plays CDs but has no recording capability. ROM stands for Read-Only Memory.
CD-RW	Plays CDs and can record data onto CD-R (recordable) or CD-RW (rewritable) discs.
DVD-ROM	Plays CDs and DVDs but has no recording capability.
DVD-RW	Plays DVDs and can record data onto DVD-R (recordable) or DVD-RW (rewritable) discs.
Blu-ray	Can play CDs, DVDs, and Blu-ray Discs but has no recording capability.
BD-R	A Blu-ray Disc Recordable optical drive. Can play CDs, DVDs, and Blu-ray Discs and can record to Blu-ray Discs and usually to CDs and DVDs. Each disc can have data recorded onto it just once.
BD-RE	A Blu-ray Recordable Erasable optical drive. Can play CDs, DVDs, and Blu-ray Discs and can record data to Blu-ray Discs and usually to CDs and DVDs and erase data from rewritable discs.

Note that with DVDs, some DVDs could be have a DL designation, meaning double layer, in which case they can hold 9.4 GB of data instead of the standard 4.7 GB amount of data.

Another reason to install a new optical drive is to get one which performs faster than the drive currently installed in the computer. The base speeds for data transfer for optical media are as follows: CD: 150 KBps (1200 Kbps); DVD: 1.39 MBps (11 Mbps); Blu-ray: 4.5 MBps (36 Mbps).

Optical drives also have a multiplier to increase the speeds of data transfer. For example, a DVD-RW 4x can transfer speeds at 1.39 x 8 MBps or 5.56 MBps. Many optical drives will have different multipliers for different optical media and speeds will often vary between playing and recording data. Thus, before getting a new optical drive, make sure the speeds of the new drive are faster than the drive being replaced.

Installing an optical drive is a relatively easy process, and, unlike the installation of expansion cards, a driver is not usually needed, though before installing an optical drive you should obtain drivers for it just in case the drivers are needed. For installing an optical drive, here is the pre-installation checklist:

- A space to place and properly mount the optical drive into the system.
- Screws to mount the optical drive and a screwdriver to use for the mounting step.
- A SATA cable to connect the optical drive to the motherboard, assuming the optical drive has a SATA and not a Parallel ATA (PATA) slot. Virtually all optical drives use SATA cables now.
- The computer needs to have a SATA port on the motherboard in order to plug in the SATA cable connected to the optical drive into the motherboard.
- The power supply needs an available power cable to plug into the optical drive.
- If there is a front-side audio port associated with the optical drive, make sure the audio cable can connect from the optical drive into the motherboard.

In addition, a technician needs to know whether this installation is meant to provide for an additional optical drive or if it is going to replace the existing optical drive.

Purpose:

After completing this project, you will be able to identify optical drive needs given a customer situation and calculate data speeds of optical drives given a multiplier. If you have an optical drive and a computer to install it into, you will do that task as well.

Steps for Completion:

1. For each situation, identify the type of optical drive needed to fulfill a customer need:

   a. A customer needs to play Blu-ray movies but does not need to duplicate any discs nor record material to new Blu-ray Discs:

   _____

   b. A business owner needs to back up data weekly to DVD discs that can be reused each month:

_____

    c. An upstart record company needs to create music CDs that cannot be

        overwritten: _____

2. What are the speeds for an optical drive that has the following specs: CD 24x DVD 8x DVD-RW 8x?

    a. CD: _____

    b. DVD: _____

    c. DVD-RW: _____

3. If you have an optical drive, the supplies needed to install it, and a computer in which you can install one, install the optical drive into the computer. Make sure the computer can see the new optical drive once you restart the computer.

Project Details

Project Files:
N/A

Estimated Completion Time:
10 minutes

Video Reference:

Domain 3
  Topic: Install and Configure Storage Devices
    Subtopic: Install an Optical Drive; Optical Disc Types

Objectives Covered:

3 Hardware
  3.4 Given a scenario, select, install and configure storage devices
    3.4.1 Optical drives
      3.4.1.1 CD-ROM/CD-RW
      3.4.1.2 DVD-ROM/DVD-RW/DVD-RW DL
      3.4.1.3 Blu-ray
      3.4.1.4 BD-R
      3.4.1.5 BD-RE

Types of Hard Drives

For the A+ exam, there are three categories of hard drives you need to know about: solid-state, magnetic, and flash drives. Solid-state drives and flash drives store data on non-volatile RAM. Magnetic hard drives store data in cylinders and platters. As a technician, you need to know how to install these drives. For the exam, know when and where each of these types of drives are used. Specifically, there are three types of solid-state drives you need to know about:

M2: Tiny hard drives that usually go inside of laptops. These are 22 millimeters wide and generally either 60 or 80 millimeters tall.

NVMe: These look similar to M2 drives and can be installed in PCI Express x4 slots.

SATA 2.5: A more traditionally shaped hard drive and can be installed in laptops or desktops.

For magnetic hard drives, you will want to make sure you have a SATA cable and a SATA slot available in a motherboard (unless you are using IDE drives, in which case you would need a PATA cable and slot). Hard drive speeds tend to range 5,400, 7,200, 10,000 or 15,000 RPMs. The faster the hard drive, the better it will perform.

SATA connectors on a motherboard are numbered, usually starting with SATA 0. The lowest numbered SATA drive will be the first drive in a computer's boot order unless the boot order is changed in the BIOS. For example, take a computer with a CD drive plugged into SATA 0 and a magnetic hard drive plugged into SATA 1. If a bootable disc is in the CD drive, the computer will attempt to boot to that disc rather than the operating system on the magnetic hard drive. Thus, pay attention when installing hard drives using SATA cables to the SATA connector being used on the motherboard.

Flash drives are tiny drives that usually go into devices such as smartphones, tablets, and cameras. Here are some details on flash drives you need to know about for the exam:

Type of Drive	Size	Characteristics
Secure Digital (SD)	24 mm x 32 mm	Can hold up to 2 GB of data. SD High Capacity (SDHC) can hold up to 32 GB of data while SD Extended Capacity (SDXC) can hold up to 2 TB of data.
Compact Flash (CF)	43 mm x 36 mm	Type 1 is 3.3 mm thick while Type 2 is 5 mm thick. CF drives can hold up to 512 GB of data (CF5.0 drives can hold up to 128 PB of data).
MicroSD	15 mm x 11 mm	Smaller version of SD card and often used in a smartphone or tablet.
MiniSD	21.5 mm x 20 mm	Smaller version of SD card.
xD	20 mm x 25 mm	Older flash card used in some digital cameras.

In addition to the solid-state and flash drives available, a solid-state drive can be combined with a magnetic hard drive. This is known as a hybrid drive (or hybrid drives) in a system. In many cases, the solid-state drive (SSD) is used as the operating system disk while the magnetic hard drive (HDD) is used for storage. Here are some specific types of hybrid drives:

Dual-drive hybrid system: A logical drive is created through the combination of a physical SSD and a physical HDD.

Solid-state hybrid system: Both SSD and HDD technologies are in a single physical drive.

Purpose:

Upon completing this project, you will be able to identify the type of hard drive used given a situation. If you have a solid-state drive to install and a place to install it, you will perform a solid-state drive installation.

Steps for Completion:

1. For each situation, identify the type of solid-state or flash drive present or needed:

    a. Which type of SD card is seen on the right? _____

    b. Which type of flash drive is often used in a smartphone? _____

2. Name at least one advantage of using an SSD over an HDD:

3. On this motherboard, in which SATA port would you plug in a hard drive so that it is the first drive in the boot order?
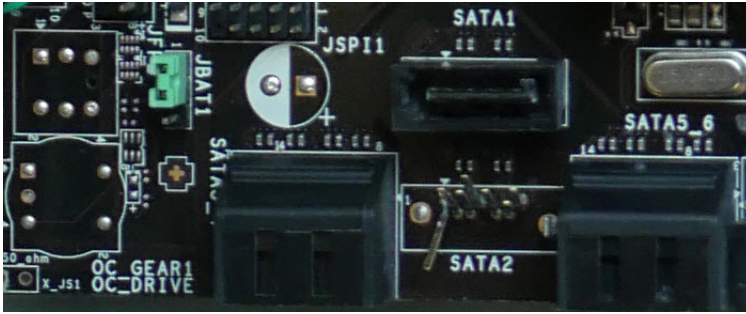
4. If you have a solid-state drive and the proper tools necessary to install it, install a solid-state drive into a system. Make sure the system can see the solid-state drive once the system is rebooted.

5. If you have a SATA magnetic hard drive, a computer in which to install the hard drive, and the equipment needed to install the drive, install a SATA magnetic hard drive into a computer. Make sure the computer can see the hard drive when the computer is rebooted.

Project Details

Project Files:
N/A

Estimated Completion Time:
10 minutes

Video Reference:
Domain 3
Topic: Install and Configure Storage Devices
Subtopics: M2 Drives, NVMe, SATA 2.5; Magnetic Hard Drives; Hard Drive Speeds; Hard Drive Sizes; Hybrid Drives; Solid-State Drives

Objectives Covered:
3 Hardware
  3.4 Given a scenario, select, install and configure storage devices
    3.4.2 Solid-state drives
      3.4.2.1 M2 drives
      3.4.2.2 NVME
      3.4.2.3 SATA 2.5
    3.4.3 Magnetic hard drives
      3.4.3.1 5,400 rpm
      3.4.3.2 7,200 rpm
      3.4.3.3 10,000 rpm
      3.4.3.4 15,000 rpm
      3.4.3.5 Sizes:
        3.4.3.5.1 2.5
        3.4.3.5.2 3.5
    3.4.4 Hybrid drives
    3.4.5 Flash
      3.4.5.1 SD card
      3.4.5.2 CompactFlash
      3.4.5.3 MicroSD card
      3.4.5.4 MiniSD card
      3.4.5.5 xD

RAID Types

A Redundant Array of Independent Disks (RAID), also known as a Redundant Array of Inexpensive Disks, is a disk system by which overall disk speed and/or fault tolerance is improved. Fault tolerance is the means by which a failing device does not compromise an entire system. For example, a computer with a single hard drive is at risk given that if the hard drive fails, the data on the hard drive is most likely lost and the computer will be inoperable until a new hard drive is installed. A RAID adds one or more additional hard drives. In most, but not all cases, a second hard drive will prevent a catastrophic data situation should a single hard drive fail. Here are the RAID types and their characteristics:

RAID	Known As	Disks	What it Does
0	Striping	2+	Data is written to both disks at once. This increases speed but there is no fault tolerance. If one drive fails, the entire RAID is useless.
1	Mirroring or Duplexing	2+	Data is written to one disk and then mirrored (if using the same disk controller) or duplexed (if using a different disk controller) to another disk. If a single drive fails, the mirror takes over until another hard drive is installed, thus restoring the RAID.
5	Striping with parity	3+	Data is striped to two disks and then a parity bit is stored on a third disk. This parity bit will restore data on either disk should a disk fail.
10 (1+0)	Striping with mirroring	4+	Data is striped to two disks (as in a RAID 0) and then mirrored to another set of two disks (as in a RAID 1).

For any RAID, be sure to use disks of the same storage capacity. Otherwise, you will lose the ability to use some disk space. For example, in a RAID 1 with two 500 GB hard disks, you will have 500 GB of available storage. But, in a RAID 1 with one 500 GB hard disk and one 2 TB hard disk, only 500 GB are available as a 2 TB hard disk is too large to mirror to a 500 GB hard disk.

In order for a RAID to work in a computer, the computer itself must support a RAID. Sometimes a RAID will be hardware-based and will show in a system BIOS. Sometimes, it will be software-based and created using Disk Management in Windows or a third-party software application. In this project, you will identify RAID types needed given a customer situation.

Steps for Completion:

1. For each situation, identify the RAID type needed:

    a. A customer needs data to be backed up automatically when it is saved:

    _____

    b. A customer needs the best possible performance in a database application:

    _____

    c. A customer needs data written as quickly as possible to disks and is fine with a

    backup to an external drive once a day: _____

An Introduction to Motherboards

Motherboards (also known as system boards) are the electrical circuit boards which sit inside of computers of all types. Motherboards are found in desktops, laptops, home theater systems, tablets, smartphones, and many other types of computing devices. Motherboards get their power from the power supply in a computer. With that power, other peripherals, such as memory, hard drives, video cards, network cards, and other expansion cards can function. Without a functioning motherboard, a computer will cease to operate. There are four basic types of motherboards currently used in computing devices. These four types are also the focus of types of motherboards covered in the A+ exam. They are:

Advanced Technology Extended (ATX): The most common motherboard for desktop computers. These will typically have several expansion slots for video, network, and similar types of expansion cards. ATX motherboards are typically 12 x 9.6 inches dimension but can vary based on the case for which they are designed.

Micro-ATX: A smaller form of the ATX motherboard, typically 9.6 x 9.6 inches size. Because these motherboards are smaller than full-size ATX motherboards, they typically do not have as many expansion slots as the full-size ATX motherboards.

Information Technology eXtended (ITX): Small-form factor boards, also known as embedded boards. The main characteristic of these motherboards is their use of passive cooling. Passive cooling is a fanless cooling system. ITX motherboards do not use much power, thus the lack of a need for cooling using fans.

Mini-ITX: Small-form factor ITX motherboards. These motherboards are usually found in home theater systems and thin client machines. Thin client machines are mini-computers that have the bare minimum needed for computing.

Purpose:

After completing this project, you will be able to identify the motherboard needed for a given type of system.

Steps for Completion:

1. Which type of motherboard is typically 12 x 9.6 inches in size?

   _____

2. Which type of motherboard would be used in a home theater system?

   _____

3. Which type of motherboard is usually square in size? _____

Motherboard Connectors

One of the main characteristics of motherboards is the amount of expansion capability a motherboard possesses. The type of expansion slots which hold network cards, video cards, USB cards, and other expansion cards all belong to the Peripheral Component Interconnect (PCI) family of expansion slots. Here are the four types of PCI expansion slots, along with their characteristics:

PCI: Mostly found on older motherboards but most modern motherboards will have one or two PCI slots for backward compatibility purposes. PCI slots are either 32-bit or 64-bit in architecture and can transmit data at speeds of up to 533 Mbps. The notch on a PCI slot tends to be more toward the center of a motherboard, further away from the edge of the case.

PCI Express (PCIe): The newer-generation of PCI expansion slots. Data transmissions can reach speeds of up to 2 Gbps. Unlike PCI, data is sent in a stream instead of in 32-bit or 64-bit blocks. PCIe slots also come in multiple sizes, designated as x1, x2, x4, x8, x16, and x32. This allows for flexibility in expansion slots conducive to the size of a motherboard. The notch for a PCIe slot is close to the edge of the PC case, not closer to the middle of the motherboard (as is the case with a PCI slot). Note that the slot size does not change on the left side of the notch but the size changes dramatically on the right side of the notch (hence the x1 vs. x16 size). In the x1, the space to plug in the expansion card is actually smaller on the right side of the notch than the left. An x16 slot is the same size as a 32-bit PCI expansion slot. A characteristic of PCIe is that a smaller-sized card can plug into a larger-sized slot. For example, an x1-sized card can plug into an x16-sized slot.

miniPCI: The laptop version of a PCI slot. Its dimensions are smaller than that of a desktop PCI expansion slot. In addition to miniPCI, miniPCIe slots are available on most modern laptop motherboards.

PCI-Extended (PCI-X): A PCI-type slot that has a 64-bit architecture and is backward-compatible with PCI. PCI-X slots are found mostly in servers, not regular desktops.

The other type of expansion slot is a Random Access Memory (RAM) slot. RAM slots hold RAM chips. RAM was covered in an earlier project.

In addition to PCI-type slots, there are other connector types you need to know about for the exam. Here they are:

Connector	What it Does
Riser card	A card with expansion slots. This is used when the motherboard lacks expansion slots on its own.
CPU	A socket type that holds the processor chip in a PC or laptop.
SATA	A slot that holds a connector for a hard drive.
IDE	A slot that holds a connector for a hard drive using a PATA cable.
Front panel connector	Connectors for USB cables, audio, and in some cases flash drives. All are located on the front of a PC or on top of a PC.
Internal USB connector	Connectors that connect to the USB slots on a PC. If they are not connected properly or active in a BIOS, they will not work.

Purpose:

After completing this project, you will have a better understanding of motherboard connectors.

Steps for Completion:

1. Look at the following expansion slots. For each picture, identify the type of PCI expansion slot, including for PCIe slots the size (x1 through x32).

   a. _____

   b. _____

   c. _____
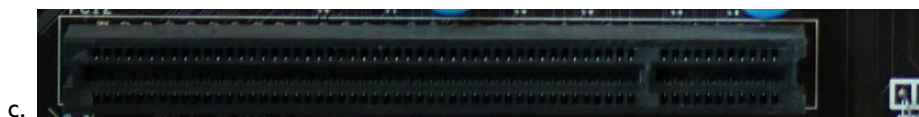
2. Which two motherboard connectors are used for hard drives? _____

3. A technician wants to add both a new sound card and a new video card but has only one expansion slot available. What could the technician install to be able to then add two more expansion cards? ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

BIOS/UEFI Settings and the CMOS Battery

The Basic Input Output System (BIOS) is code, embedded into a computer's hardware, which provides a computer with basic startup instructions. The BIOS is responsible for making sure a computer has the hardware it needs (CPU, RAM, hard disks, video, and in most cases, a network card) in order to start up and then load an operating system.

Occasionally, the BIOS needs to be configured. Sometimes, it is a matter of enabling a new hardware device or disabling one no longer in use. Sometimes, it is a matter of setting a password just to start up a computer or deleting a password when one is no longer needed just to start up a computer.

In lieu of a BIOS screen, you may see a United Extensible Firmware Interface (UEFI) screen. This screen functions like a BIOS but you usually have more flexibility in how you use the configuration screen. For example, most UEFIs allow the use of a mouse while pure BIOS screens do not. Either way, most computers have a key one can press and hold while booting up a device in order to reach the BIOS. They key is usually F2 or F12 but can vary.

Some of the configurations you may need to change on a BIOS screen include:

Feature	Description
Boot options	This mainly controls the boot order, as in attempting to boot first to a hard drive and then optical media, external media, or perhaps even a network drive.
Firmware updates	This updates system hardware code. A firmware update will need to be downloaded before it can be applied.
Security settings	This can include both user passwords, which are required to boot up a machine, and supervisory passwords, which are required in order to enter a BIOS. Most computers do not have these enabled by default, but they are available if needed.
Interface configurations	This controls which interfaces (audio, video, network) are enabled. For example, if you install a new video card, you may want to disable the onboard video card.
Secure boot	This is a setting that is on by default in Windows 8 and later. It prevents one from being able to hold down the F2 or F12 or similar key and then boot into a device. In these cases, one must boot into Windows RE (Recovery Environment) before accessing the BIOS.
TPM	Trusted Platfrom Module, or TPM, is encryption done via a chip inside the computer. This helps protect data from being stolen.
LoJack	A feature that, when available and enabled, can alert someone if a drive is removed from a machine.

A computer can be off and unplugged for a long period of time, yet, when it is plugged in and turned on, the system date and time is accurate. This is made possible through a complementary metal-oxide semiconductor (CMOS) battery, a battery which plugs into the motherboard and is usually round and silver (similar to a watch battery). The CMOS battery stores date, time, and startup information for a computer. The BIOS uses this information as a part of its role in starting up a computer.

If a CMOS fails (or is removed from the computer), a computer's date and time will revert back to the original date and time for the BIOS. Another sign of a failing CMOS is a computer system date and time falling behind the real date and time. This is especially noticeable if the computer is off for any appreciable length of time. In either case, the CMOS battery just needs to be replaced.

Purpose:

Upon completing this project, you will have a better understanding of BIOS features and how to configure them. You will also be able to identify the location of a CMOS battery.

Steps for Completion:

1. On the picture of the motherboard on the right, where is the CMOS battery?

   _____

2. Which BIOS feature needs to be updated in order to update system hardware code?

   _____ .

3. A user is holding down F2 while booting but cannot get into the BIOS that way. Which

   feature is enabled on that device? _____
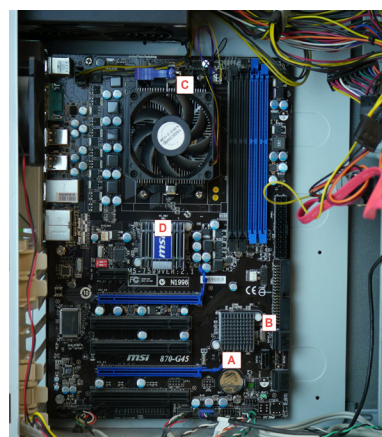
4. A mananger wants to make sure that any hard drives that are moved alert administrators that the drives have been moved. Which feature should a technician look to enable? ————————

5. Reboot a system into the BIOS. You should see the following:

```
                    PhoenixBIOS Setup Utility
   Main     Advanced     Security     Boot     Exit
 ┌─────────────────────────────────────┬──────────────────────────┐
 │                                      │    Item Specific Help    │
 │ System Time:            [09:58:53]   │                          │
 │ System Date:            [12/15/2015] │                          │
 │                                      │  <Tab>, <Shift-Tab>, or  │
 │ Legacy Diskette A:      [1.44/1.25 MB 3½"]│ <Enter> selects field.│
 │ Legacy Diskette B:      [Disabled]   │                          │
 │                                      │                          │
 │ ▶ Primary Master        [None]       │                          │
 │ ▶ Primary Slave         [None]       │                          │
 │ ▶ Secondary Master      [None]       │                          │
 │ ▶ Secondary Slave       [None]       │                          │
 │                                      │                          │
 │ ▶ Keyboard Features                  │                          │
 │                                      │                          │
 │ System Memory:          640 KB       │                          │
 │ Extended Memory:        2096128 KB   │                          │
 │ Boot-time Diagnostic Screen:  [Disabled]│                       │
 │                                      │                          │
 └─────────────────────────────────────┴──────────────────────────┘
 F1   Help   ↑↓  Select Item   -/+   Change Values    F9   Setup Defaults
 Esc  Exit   ↔   Select Menu    Enter Select ▶ Sub-Menu F10  Save and Exit
```

6. Take a moment to discover some (if not all) of the features covered in this project.

Project Details

Project Files:
N/A

Estimated Completion Time:
10-15 minutes

Video Reference:
Domain 3
   Topic: Internal PC Parts
      Subtopic: BIOS/UEFI Settings; Boot Options and Configurations; Security Settings and BIOS Passwords; TPM, LoJack, Secure Boot; CMOS Battery

Objectives Covered:
3 Hardware
   3.5 Given a scenario, install and configure motherboards, CPUs, and add-on cards
      3.5.3 BIOS/UEFI settings
         3.5.3.1 Boot options
         3.5.3.2 Firmware updates
         3.5.3.3 Security settings
         3.5.3.4 Interface configurations
         3.5.3.3 Security
            3.5.3.5.1 Passwords
            3.5.3.5.2 Drive encryption
               3.5.3.5.2.1 TPM
               3.5.3.5.2.2 LoJack
               3.5.3.5.2.3 Secure boot
      3.5.4 CMOS battery

CPU Characteristics and Cooling

CPUs have several characteristics which define their speeds and overall processing capabilities. When choosing a CPU, besides making sure it is compatible with the socket and RAM channels on a motherboard, the CPU also needs to be compatible with the speeds allowed on the motherboard. The speed of a CPU is defined as: Crystal speed x multiplier = total speed. For example, a 133 MHz processor with a multiplier of 20 constitutes a 2.66 GHz processor. In some instances, the speed and/or multiplier can be manipulated in the BIOS. Doing so, however, can make the cooling in the computer ineffective.

CPUs also have one or more cores. Each core can run a task. Thus, a dual core processor can run two tasks at once while a quad core processor can run four tasks at once. Understand that multiple cores do not equate to multiple processors. CPUs have a cache. A cache stores instructions that the CPU thinks it will need again. These instructions are stored in static RAM (SRAM). Without SRAM, instructions need to be stored in dynamic RAM (DRAM). There are three main types of caches for CPUs:

L1 cache: Fast and located closest to the CPU. An L1 cache is present on each core in a processor. L1 caches are small (32 KB to 64 KB).

L2 cache: Cache which is shared by all cores of the CPU. L2 caches are a little slower than an L1 cache. L2 caches range in size from 256 KB to 1 MB.

L3 cache: Cache for which its use is processor-dependent. L3 cache sizes range from 2 MB to 8 MB.

In addition to speed, the number of cores, and caches, here are other characteristics which define the overall performance of a CPU:

Characteristic	Definition
Virtualization support	Known as VT-x for Intel CPUs and AMD-V for AMD-V CPUs. When enabled (sometimes manually in the BIOS), 64-bit virtual machines are supported.
Hyperthreading	Doubles the number of instructions to be processed at once. This is present on some Intel CPUs and can be enabled or disabled in the BIOS.
Overclocking	The act of changing a BIOS setting to get a processor to run faster than originally intended.
Integrated Graphics Processing Unit (GPU)	Also known as an accelerated processing unit (APU) on AMD processors. A GPU/APU is located on the CPU and processes graphics instructions.

For the exam, you also will want to know the characteristics of the two most popular chip makers, Intel and AMD. The lower-end Intel chips are Celeron chips, i3 and i5 are considered to be middle of the road, and i7 and i9 are the higher-end processors. Xeon processors are geared toward servers. For AMD, the Opteron series is used in servers, the FX brand is used in high-end desktops, Athlon and Sempron are your mid-range desktop CPUs, and the A-series is found in laptops geared toward the basic home user.

In order for a CPU to function properly, the CPU and the computer it is in must avoid overheating. Several possible methods are used to keep a CPU from overheating. The method used depends upon the type of computer a CPU is running. For most desktop computers, there are three pieces of equipment which work with the CPU to keep the CPU from overheating. They are:

Heat sink: A piece of metal which draws heat from the CPU and dissipates the heat. Air flows through flared fins.

Fans: Attached to the heat sink. The hotter the CPU gets, the more the fans spin. In laptops, the CPU will often throttle down when the temperature rises, thus slowing down the laptop's performance.

Thermal paste: A compound that helps fill gaps in the metal on the CPU and heat sink to help draw heat from the CPU into the heat sink.

For high-end systems, such as gaming systems, fans may not be sufficient to properly cool a CPU and the computer as a whole. For those systems, liquid cooling is used. Liquid cooling uses a pump to flow cooling liquid through the heat sink. One who uses a liquid cooling-based system needs to make sure the cooling mechanism is leak-proof. Other systems, such as thin client machines and home theater systems, use fanless cooling, also known as passive cooling. In fanless cooling, metal attached to any part that needs cooling performs the needed cooling instead of a fan or fans doing the cooling.

Purpose:

After completing this project, you will be able to identify the CPU characteristics present given a description. Then, you will be able to discover the number of cores in a CPU. And, you will be able to identify the type of cooling needed given a computer description.

Steps for Completion:

1. A CPU has a crystal speed of 166 MHz and a multiplier of 15. What is the CPU speed? ——————

2. Which CPU characteristic, when enabled, doubles the number of instructions which can be processed at once?

——————————

3. What needs to be enabled in the BIOS on an Intel processor in order for a computer to host a 64-bit Windows 8.1 virtual machine?

———————————

4. What determines the amount of tasks a CPU can perform simultaneously?

———————————

5. On a Windows machine, click the Start button and type: **msinfo32**
6. Press the Enter key. The System Information screen will appear.
7. Look for the Processor item. It will look like this:

Intel(R) Core(TM) i7-5500U CPU @ 2.40GHz, 2394 Mhz, 2 Core(s), 4 Logical I
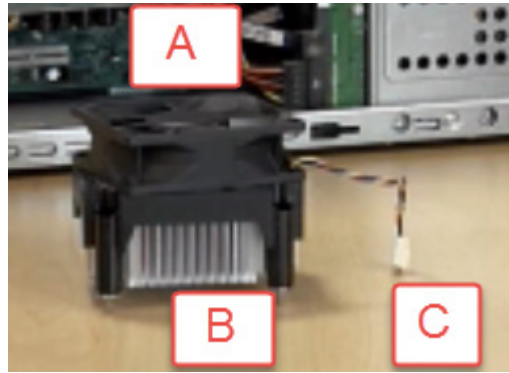
8. For each type of system, identify what is needed to ensure the CPU does not overheat:
   a. A computer used for gaming and intensive graphics programs:

   ———————————

   b. A home theater system used to catalog and play movies:

   ———————————

   c. A desktop computer used for business purposes: ———————————
9. In the photo on the right, which letter represents a heat sink?

———————————

Installing PC Expansion Cards

One of the best ways to increase performance in a desktop computer is to install an expansion card. With many PCs, motherboards will have onboard (built-in) sound, video, and network components. Often, a PC user will want better performance than what the integrated card offers. With expansion cards, performance can be improved, sometimes dramatically. There is a checklist to go through before installing an expansion card, however. Before installing an expansion card, make sure to do the following:

- Make sure there is a slot available for the card you want to install (usually a PCI or PCIe slot).
- Make sure the power supply has enough wattage for the expansion card you wish to add. There are several websites which can help calculate wattage based on the motherboard and expansion components.
- Have the drivers necessary for the expansion card to be installed. These can usually be found on the card manufacturer's website.
- Make sure the expansion card will not harm the cooling functions inside of the computer. Often, this will not be known until well after the card has been installed. Consider getting an app to monitor the temperature inside of the computer.

For any expansion card meant to be an upgrade over an integrated component, you may need to disable the integrated component in the BIOS after the installation is complete. This will ensure that there is no conflict between the integrated component and the expansion card. Here are the types of expansion cards an A+ technician could be called upon to install on a computer along with the reasons for installing these expansion cards:

Card Type	Reason for Installation
Video	To increase the quality of graphics and video for both viewing and for working with photo-editing and other graphics programs. This will also provide better graphics for gaming. Most modern video cards have their own RAM, Graphics Processing Unit (GPU), and fan for cooling.
Sound	To increase the sound quality for both playback and recording.
Network	To increase network speed and throughput. In some cases (especially servers), a second network card will provide for fault tolerance. In fault tolerance, one card failing will not cause a loss of network connectivity as the second network card will take over the workload.
USB	Most USB cards have at least four USB ports. This will allow for more USB devices to be connected to the computer. The USB expansion card will not use the bandwidth of any integrated USB ports.
eSATA	Used for when one wants to be able to plug an external hard drive into an eSATA port.

Purpose:

After completing this project, you will be able to identify expansion cards needed given a customer situation. You will also have an opportunity to install an expansion card onto a computer so long as you have an expansion card to install and a computer on which to install it.

Steps for Completion:

1. For each situation, identify the type of expansion card to best fit the customer need:
   a. A graphics designer wants to be able to edit videos effectively:

      _____

   b. A narrator wants a better quality recording when doing promotional

      recordings: _____
2. If you have a computer and an expansion card to install (and an available expansion slot for the installation), install the expansion card and make sure it functions after rebooting the computer.

Types of Peripherals

An A+ technician needs to know how to work with peripherals of many types. There are over 20 listed as exam topics and specifically, you will want to know:

- The function of each peripheral
- Whether the peripheral is used for input, output, or both.

Here is the list of peripherals, their types, and their functions:

Peripheral	Type(s)	Purpose(s)
Printer	Output	These render information on paper. Common types of printers include laser printers, inkjet printers, impact printers, and thermal printers.
Scanner	Input	Used to make copies of paper documents and pictures. Many scanners can digitize text and make it editable through optical character recognition (OCR). Some scanners are flatbeds while others are automatic document feeders (ADFs) and can feed multiple pages at once.
Barcode reader/QR scanner	Input	Reads and processes information from barcode. An example of this is the Quick Response (QR) code reader on a smartphone, which, when scanned, leads to more information.
Monitor	Output	A device that displays text, images, apps, videos, and anything else a computer outputs.
VR headset	Output	Used in virtual reality situations, such as in gaming.
Optical drive	Output	Used to play CDs, DVDs, and Blu-ray Discs
Mouse	Input	Controls activity on a computer. Left-clicks usually select items or create action, right-clicks display shortcut menus, double-clicks open a file or folder, and click and drag or hover actions perform specific operating system or application tasks.
Keyboard	Input	Inputs information into a program. Windows and function keys perform specialized operations. Drivers are only needed for unique keys (such as a key that connects to the Internet, for example).
Touchpads	Input	Used in lieu of a mouse on a laptop.
Signature pad	Input	Used to capture a signature and digitize it.
Game controllers	Input	Used as gaming devices. Most have multiple buttons and joysticks. Before game pads existed, single joysticks were used to control game action.
Digital camera	Input	Camera which stores pictures on a flash memory device and then allows for those pictures to be transferred to a computer.
Webcam	Input/Output	A camera attached to a computer or built into a mobile device. Used for recording audio and video and for conducting live meetings.
Microphone	Input	Used to record information for input into a program. Many computers have built-in microphones. Some headsets have microphones. Usually, a desktop microphone or studio microphone provides for the best recording quality.
Speakers	Output	Provide sound output. Speakers can be built into a computer or speaker sets include a two-speaker setup, a 2.1 setup (two speakers and a subwoofer for deep bass sounds), a 5.1 setup (five speakers and a subwoofer) or a 7.1 setup (seven speakers and a subwoofer).
Headset	Output	Used to listen to sounds emanating from a device.
Projector	Output	Used to show a display to a large audience. The amount of lumens in the projector indicate the projector's brightness.
External storage drives	Input	Used to save and share files and folders between devices.
KVM	Output	Allows for multiple computers to share a keyboard, monitor, and mouse. A button on the KVM switch or a keyboard combination switches the focus from computer to computer. A common use for a KVM switch is for an administrator managing multiple physical servers in close proximity.
Magnetic reader/chip reader	Input	Used to get encrypted information off of a card. Often used for purchases or authentication purposes.
NFC/tap pay device	Input	Uses NFC to connect a device, such as a smartphone, to a pay device for the purpose of conducting a transaction.

Peripheral	Type(s)	Purpose(s)
Smart card reader	Input	Processes information on smart cards. For example, a smart card reader can be installed on a laptop and then an employee can use a badge as part of a login process.

Purpose:

Upon completing this project, you will be able to better identify peripherals and the situations in which they are used.

Steps for Completion:

1. Identify each of these input devices:

    a. _____   b. _____

2. For each situation, name the device needed:

    a. A small business owner needs to easily switch back and forth between two computers: _____

    b. Video from a conference needs to be recorded and then uploaded to an intranet site: _____

    c. An executive is giving a presentation at a conference:

    _____

Project Details

Project Files:
N/A

Estimated Completion Time:
10 minutes

Video Reference:
Domain 3
  Topic: Peripheral Typess
    Subtopic: Printers and Scanners; Monitors, VR, Optical Drive Types; Input Devices and Speakers; Other Peripherals

Objectives Covered:
3 Hardware
  3.6 Explain the purposes and uses of various peripheral types
    3.6.1 Printer
    3.6.2 ADF/flatbed scanner
    3.6.3 Barcode scanner/QR scanner
    3.6.4 Monitors
    3.6.5 VR headset
    3.6.6 Optical drive types
    3.6.7 Mouse
    3.6.8 Keyboard
    3.6.9 Touchpad
    3.6.10 Signature pad
    3.6.11 Game controllers
    3.6.12 Camera/webcam
    3.6.13 Microphone
    3.6.14 Speakers
    3.6.15 Headset
    3.6.16 Projector
    3.6.16.1 Lumens/brightness
    3.6.17 External storage drives
    3.6.18 KVM
    3.6.19 Magnetic reader/chip reader
    3.6.20 NFC/tap pay device
    3.6.21 Smart card reader

LearnKey
Power Supply Types and Features

When installing a power supply into a computer, there are a number of factors to take into consideration. In the previous project, you learned that a power supply needs to have enough power connectors of each type (SATA for example) in order to be compatible with the computer's motherboard and peripherals. There are several other specifications to consider for power supply specifications when obtaining and installing a power supply. Here are these specifications, along with specification details:

Specification	Detail
Dual voltage options	If the power supply is going to be in a machine that may be shipped overseas, a dual voltage switch to allow the power supply to operate at either 115V (U.S.) or 230V (Europe) is needed.
Size	The new power supply has to match the size of the power supply being replaced so that it fits properly in the case.
Number of connectors	The new power supply should have the same number of connectors (and for each type of connector) of the power supply being replaced. At the very least, there needs to be enough connectors for the peripherals and motherboard connections to be used. One should also know if the motherboard holds a 20-pin or 24-pin adapter for the power supply.
Output	For the exam, know that 5-volt outputs are on red lines within a power cable and 12-volt outputs are on yellow lines within a power cable.
Wattage	Must be sufficient to handle all peripherals and motherboard connections.

Most ATX-based power supplies need 300-1000 watts of power while most Micro-ATX-based power supplies need 180-300 watts of power. In addition to making sure a computer has the proper voltage for its location if it is leaving the U.S., a proper plug adapter is also needed. This especially applies to laptops as they are more likely than desktops to travel overseas.

Purpose:

After completing this project, you will be able to identify an important part of a power supply and know how to find out how much wattage you need on a power supply given a machine specification.

Steps for Completion:

1. Identify the location of the dual voltage switch in the power supply on the right:

   _____

2. Using a search engine tool, search for a website that hosts a power supply calculator. Then, using the calculator, calculate the power supply unit (PSU) wattage needed a computer with the following specs: Intel Core i7 quad-core processor, desktop motherboard, integrated video, 8 GB DDR3 RAM, a DVD-RW optical drive, and a 10,000 RPM HDD. What is the recommended wattage?

   _____
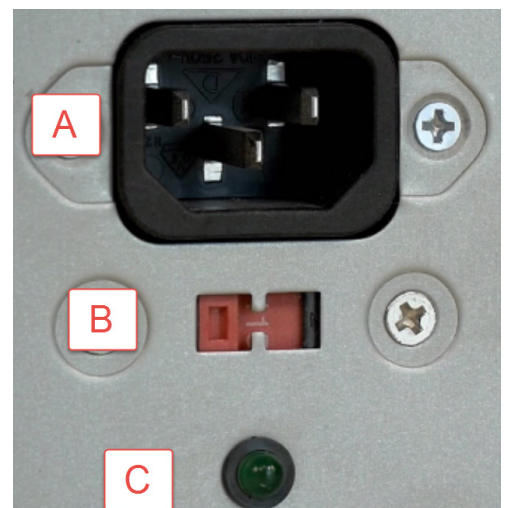
Custom PC Configurations

An A+ technician needs to properly analyze customer needs for a computer and then be able to recommend one or more possibilities for a computer that will suit a customer. The customer could be an individual, a small business with several computer needs, or a department in a medium to large-sized company.

Specific to the A+ exam, you need to be able to match up computer parts with recommended configurations. For example, you need to know that a quad core i7 processor is needed for a CAD workstation while an i3 processor is sufficient for a thin client.

Here are eight possible PC configurations, needs specific to those configurations, and examples of equipment which will satisfy those needs:

Configuration	Needs	Examples
Graphic/CAD/CAM design workstation	Solid-state hard drive High-end video card Maximum RAM	Solid-state hard drive Video card w/GPU and 2+ GB of RAM 16GB DDR3 RAM or more
Audio/video editing workstation	Specialized audio and video card Large fast hard drive Dual monitors	High-end sound card Video card w/GPU and 2+ GB of RAM 15,000 RPM 2TB hard drive
Virtualization Workstation	Maximum CPU and RAM cores	Quad-core i7 or i9 processor 16GB DDR3 RAM or more
Gaming PC	Solid-state hard drive High-end video/specialized GPU High definition sound card High-end cooling	Solid-state hard drive Video card w/GPU and 2+ GB of RAM HD sound card Liquid cooling
Home Server PC	Media streaming File sharing Print sharing Gigabit NIC RAID array	1G or higher-speed NIC Two hard drives for RAID 0 or RAID 1 Three hard drives for RAID 5 Four hard drives for RAID 10
Standard thick client	Desktop applications Recommended OS requirements	Dual core processor 4 to 8 GB RAM Integrated video is sufficient
Thin client	Basic applications Minimum OS requirements Network connectivity	i3 processor 2 GB RAM NIC for network connection

Purpose:

After completing this project, you will be able to better identify specific parts to be loaded inside of computers geared toward satisfying customer needs.

Steps for Completion:

1. A customer needs to purchase two computers. Computer #1 will be located in a living room and needs to be able to run an Office suite, the Internet, and a few low-end games. Computer #2 will be located in a home office and needs to be able help create high-quality commercial videos as the customer is a self-employed video production artist. For each computer part type, indicate which part will be installed in computer #1 and which part will be installed in computer #2:

Parts	Computer #1	Computer #2
4 GB RAM 8 GB RAM	_____	_____
500 GB 7,200 RPM HDD 2 TB 15,000 RPM HDD	_____	_____

Parts	Computer #1	Computer #2
Two 26-inch monitors One 21-inch monitor	_____	_____
3 GB video card with a GPU Integrated video	_____	_____

Project Details

Project Files:
N/A

Estimated Completion Time:
10 minutes

Video Reference:
Domain 3
  Topic: PC Configurationss
    Subtopic: Types of Workstations; Audio/Video Editing Workstations; Virtualization Workstation; Gaming PCs; NAS Devices; Thick Clients; Thin Clients

Objectives Covered:
3 Hardware
  3.8 Given a scenario, select and configure appropriate components for a custom PC configuration to meet customer specifications or needs
    3.8.1 Graphic/CAD/CAM design workstation
      3.8.1.1 SSD
      3.8.1.2 High-end video
      3.8.1.3 Maximum RAM
    3.8.2 Audio/video editing workstation
      3.8.2.1 Specialized audio and video card
      3.8.2.2 Large, fast hard drive
      3.8.2.3 Dual monitors
    3.8.3 Virtualization workstation
      3.8.3.1 Maximum RAM and CPU cores
    3.8.4 Gaming PC
      3.8.4.1 SSD
      3.8.4.2 High-end video/specialized GPU
      3.8.4.3 High-definition sound card
      3.8.4.4 High-end cooling
    3.8.5 Network attached storage device
      3.8.5.1 Media streaming
      3.8.5.2 File sharing
      3.8.5.3 Gigabit NIC
      3.8.5.4 RAID array
      3.8.5.5 Hard drive
    3.8.6 Standard thick client
      3.8.6.1 Desktop applications
      3.8.6.2 Meets recommended requirements for selected OS
    3.8.7 Thin client
      3.8.7.1 Basic applications
      3.8.7.2 Meets minimum requirements for selected OS
      3.8.7.3 Network connectivity

Install and Configure Common Devices

Once a user chooses which type of device to obtain, it is often up to a technician to make sure the device is configured properly. This set of topics covers a basic checklist that can apply to both desktops and common mobile devices such as laptops.

For desktops, be able to tell the difference between a thick client, which can run most applications, and a thin client, which can only run the most basic of applications. Set up those PCs accordingly. And, when setting up accounts, know whether you are setting up a local user account or a Microsoft account.

For mobile devices, here is a list of configuration settings you may be responsible for and examples of what to do for those settings:

Setting	What to Look for
Touchpad	Settings are normally in the Control Panel in the Mouse area.
Touch screen	Look for a calibration app. Some mobile devices have settings to where the display turns off when the device is in a dark area.
Apps	Found in Play Store on an Android device and App Store on an iOS device.
Synchronization	Apps vary on Android devices. iCloud is the prominent app for iOS devices. For files, one could use Google Drive, OneDrive, or Dropbox.
Account setup	Recommendations are to use a Microsoft account on a Windows device, an iCloud account on an iOS device, and a Gmail account on an Android device.
Wireless settings	Make sure the device can connect to a wireless network but that it does not join unknown networks automatically.

Purpose:

Upon completing this project, you will be able to better understand basic configurations on devices.

Steps for Completion:

1. If you have a laptop, configure the touchpad for settings such as pointer and spped.
2. If you have a tablet or smartphone, set up an account using the recommended account type for the device.
3. If you have any type of mobile device, connect it to a wireless network.

Installing and Configuring Printers

Installing a printer is a straightforward process. As with installing other devices, the key to a successful installation is to have the correct drivers for the printer as the printer is being installed. While many printer drivers are built into Windows, they are very unlikely to be the most recent drivers. There are two types of printer drivers:

Universal: Drivers that work for many printers from the same manufacturer but lack printer-specific features such as paper tray features or eco-printing features.

Specific: Drivers specific to the printer being installed and the operating system for which it will be installed. All available features for the printer will be present.

The steps for a successful printer installation vary slightly among manufacturers, but the basic steps for installing a printer are:

1. Obtain the latest drivers for the printer from the printer manufacturer's website.
2. If there is a readme file, read it to find out whether the printer should be connected before the drivers are installed or after. If that information is not present, you will find out the sequence of steps when running the installation file.
3. Run the installation file. At the point you are asked to connect the printer or find the printer on the network, perform the task.
4. The installation will complete. If you have the option to print a test page and wish to do so, print the test page.

Having the correct driver for a printer installation is essential. An incorrect printer driver can cause the printer to output garbled text, disable printer features, or just prevent the printer from being installed properly. When installing a printer, any computer user can install the printer if the printer uses drivers provided in Windows. For downloaded drivers or drivers on installation media such as a CD or DVD, administrative privileges are needed for the installation.

Once the printer is installed, configuration settings will be available on the printer. The exact configuration settings available vary among printers, but these configuration settings will fall into one of these categories:

Duplex: The ability to print to both sides of a page.

Collate: The ability to print pages in sequence (1, 2, 3) for multiple copies rather than all the page 1s, then all of the page 2s, and so forth.

Orientation: The ability to control whether a print job is portrait (tall) or landscape (wide). These settings are often controlled within the application trying to print.

Quality: The ability to choose a high-quality print, which uses more toner, or a lower-quality print, which uses less toner.

Purpose:

After completing this project, you will know how to install and configure a printer. The steps for the printer may vary from the printer used in the project.

Steps for Completion:

1. For the printer you are going to install, navigate to the manufacturer's website and find the drivers page for your printer.
2. Download the driver to match your printer and operating system. It will go to your Downloads folder unless you specify others.
3. Run the installation file and follow the directions during the installation.
4. Open Notepad.
5. Type a phrase of text.
6. Start to print the document and then access your printer preferences.
7. See if the printer has each of the four configuration settings covered in this project (duplex, collate, orientation, and quality).
8. Cancel the print job and then close Notepad.

Project Details

Project Files:
N/A

Estimated Completion Time:
10 minutes

Video Reference:
Domain 3
  Topic: Configure Printers and Settings
    Subtopic: Configuration Settings; Print Settings

Objectives Covered:
3 Hardware
  3.10 Given a scenario, configure SOHO multifunction devices/printers and settings.
    3.10.1 Use appropriate drivers for a given operating system
      3.10.1.1 Configuration settings
        3.10.1.1.1 Duplex
        3.10.1.1.2 Collate
        3.10.1.1.3 Orientation
        3.10.1.1.4 Quality

Printer and Device Sharing

Once a printer is installed, there is a good chance multiple devices will need to connect to it and use it to print documents. By default, when a printer is shared, everyone who can see the printer can print to it but cannot manage the printer. Several types of both wired and wireless connections will allow for a printer to be shared with others. Any one of these wired connections will allow for printer sharing:

USB: A printer is connected to a computer using a USB cable, with the end connected to the printer most likely a USB B connector and the end connected to the computer a USB A connector.

Serial: A printer is connected to a computer using a DB9 or DB25 cable. With the advent of USB, this type of connection is rare.

Ethernet: A printer is connected to a server, router, or switch using an Ethernet cable.

In the case of a USB or serial connection, a local share can be set up. The drawback to this setup is that should the computer be turned off or disconnected from the network, the printer will be unavailable.

These types of wireless connections will allow for printer sharing:

Bluetooth: A device within 10 meters of the printer can pair itself with the printer.

802.11: Using a standard wireless network, a printer can connect to a wireless access point and then share itself on the wireless network. This is also known as an infrastructure connection.

Ad hoc: A printer can make a wireless connection to a device without the need of a wireless access point.

For larger networks with several printers, an integrated print server is often used as a central management point for setting up printers and their permissions. A print server role is available in Windows Server. For Windows desktop editions, a Print Management console can be used to manage printers a computer is sharing.

Many printers also offer remote printing, also known as cloud printing. Once remote printing is turned on, anyone with a connection to the printer can print from a remote device, including a mobile device such as a tablet or smartphone in many cases. For example, a person with an iPad at a remote workplace can print to a printer back at a main office even if the person does not have a direct connection to the corporate network.

There are three main types of networks on which printers and other devices (such as scanners) can be shared from a local connection or a network connection:

TCP: The standard for sharing printers in most Windows and Linux environments.

Bonjour: An Apple service for locating devices on a network.

AirPrint: An Apple feature used for printing in a wireless local area network (LAN) through a wireless access point to AirPrint-compatible printers, or, through non AirPrint-compatible printers through a Mac, Windows, or Linux computer.

Once a device is shared, a user must authenticate to the device in order to be able to use it. Authentication is the process by which a server or device obtains proof the account logging on to the device is what the account claims to be. For example, a user may have to enter a username and password to access a scanner which has been shared on the network. If the username and password match a combination stored on the device, the user is logged on to the device.

As a computer interacts with a device, certain tasks can be stored in a hard drive cache on the computer. Hard drive cache is embedded memory in a hard drive which acts like a buffer between the computer and the storage disk. A cache can range from 8 to 128 MB for a magnetic hard drive and up to 1 GB in a solid-state drive. Data in any cache is lost if there is a system failure.

Purpose:

After completing this project, you will know how to share a printer and view the print management console on a Windows system. In order to best complete this project, make sure you have installed a printer on the computer being used for this project. Refer to the previous project on installing and configuring printers should you need to install a printer.

Steps for Completion:

1. On a Windows computer, click the Start button.
2. Type: **Control Panel**. Press the Enter key. The Control Panel will appear.
3. If the Control Panel view is set to Category, click the drop-down arrow on the View by field and click Large icons.
4. Click Devices and Printers.
5. Find the printer you installed in the previous project or a different installed printer.
6. Right-click the printer and click Printer Properties. The Printer Properties dialog box will appear.

7. Click the Sharing tab.

8. If the Share this printer check box is not selected, select it.

9. Click the Security tab.

10. In the Group or user names field, click the Everyone group.

11. In the Permissions for Everyone area, make sure the Allow check box is selected for the Print permission.

12. Click the OK button to finish the process of sharing the printer.

13. To view the Print Management console, click the Start button and type: **Administrative Tools**. When the Administrative Tools link appears, click it.

14. In the Administrative Tools window, double-click Print Management to open the print management window.

15. Click the Custom Filters folder on the left side of the screen.

16. Click the All Printers folder on the left side of the screen. You will see all of the installed printers on the computer, each printer's status, and the number of jobs being processed for each printer.

17. Close all open windows.

Laser Printer Technologies

Laser printers are widely considered to be the fastest and highest-quality printers used in most homes and businesses. The role of an A+ technician, as it relates to laser printers and all other types of printers, is to understand the parts of each type of printer and the processes needed to render a print job. Some basic terms that apply not only to laser printers but all types of printers are:

PPM: Pages per minute.

DPI: Dots per inch. The higher the dots per inch, the higher quality the output from the printer.

Duplexing assembly: A hardware piece, usually located on the back of the printer, which allows for printing on both sides of the page.

Print queue: A list of print jobs currently processing. On a server, this can be a list of print jobs for all printers on a network. On an individual user's device, the print queue shows print jobs the user is currently processing.

Though individual parts among laser printers vary, most laser printers have a set of common parts, inside the printer, which are used to process a print job. Here are those parts, in the order in which they are needed to process a print job:

Pickup rollers: Rollers which pick up a sheet of paper and start to feed the paper through the printer.

Separate pads: Tabs which ensure that the pickup rollers only pick up one piece of paper at a time.

Imaging drums: Light-sensitive rotating cylinders. A laser writes an image onto the drum using light.

Transfer rollers: Rollers that charge the paper so the paper attracts the toner needed to write the image onto the paper.

Transfer belts: On color laser printers, colors go onto the transfer belt and then the paper. This mostly applies to high-end color laser printers.

Fuser Assembly: Heats the toner and melts it onto the paper.

These parts of a laser printer employ a seven-step process to render a printed sheet of paper. If one of these steps fails, the output will have a very low quality or no print at all. The seven steps, in the order in which they happen, are:

1. **Processing:** Stage that determines how the dots on the page should be printed for color and brightness. For example, for a 600 x 600 dpi print job, 360,000 dots per square inch need to be rendered. If a computer is low on memory, the printer may not have enough memory to process that high-quality of a print job and the dpi setting may need to be lowered.

2. **Charging:** A roller first removes a residual charge from a previous print job and then applies a high-voltage negative charge to the imaging drum to prepare it to accept the image from the laser.

3. **Exposing:** The laser beam hits the drum with the image and in doing so neutralizes the negative charge previously applied to the imaging drum. This step is also known as writing.

4. **Developing:** Toner is applied to the imaging drum. This is done through giving the toner a negative charge. The toner then is applied to the parts of the imaging drum containing a negative charge.

5. **Transferring:** The toner is applied to the paper. The pickup rollers start the paper process here. Transfer rollers then charge the paper so that it will pick up the toner. The static charge is then eliminated.

6. **Fusing:** The toner is heated and then melted onto the paper.

7. **Cleaning:** Excess toner is scraped off of the drum and an erase lamp neutralizes the charge on the drum.

On some printers, the cleaning step is actually the first step in the print process, not the last.

Printers, no matter what type, require regular maintenance. This maintenance can range from replacing toner when needed to cleaning print heads or aligning print cartridges. The most common maintenance tasks on laser printers include:

Replacing toner: Most laser printers will give an indication when the toner is running low and/or has run out. Remove the old toner cartridge and dispose of it properly (usually through recycling). Unwrap the new toner cartridge, remove any strips that seal the toner, shake the cartridge slightly, and then install it.

Cleaning: Follow the manufacturer's directions for the printer you wish to clean. One standard cleaning method is to use isopropyl alcohol with a lint-free cloth and/or cotton swabs. Use a toner vacuum to remove extra toner from inside the printer.

Applying a Maintenance Kit: If a message appears indicating maintenance is needed on either the printer or the printer's home page, follow the directions given to complete the maintenance task.

Calibration: A common maintenance task for color laser printers as with multiple colors the colors can get misaligned. As part of a printer installation, calibration software is usually included.

When in question, follow the manufacturer's instructions for performing maintenance tasks.

Purpose:

In this project, you will identify which printer parts are being used and which processes are taking place during a print job, both on a laser printer. The steps for completion are on the next page.

Steps for Completion:

1. Identify which printer part is being used, given a description of the part's role:

    a. Without these, pickup rollers can easily pick up multiple pages of paper:

    _____

    b. These charge the paper so that toner can properly write to the paper:

    _____

2. For each situation, identify which part of the printing process is taking place:

    a. Excess toner is being scraped off of the drum: _____
    b. The printer is determining how the dots should render to the page:

    _____

3. How many dots per square inch are needed for a 300 x 300 dpi print job?

    _____

Inkjet Printer Technologies

Inkjet printers provide for high-quality color and grayscale printouts. Though the quality and speed of inkjet printers is typically below that of laser printers, inkjet printers are normally lower in price and maintenance costs when compared to laser printers and the quality of prints they produce is usually just fine for most home and office users. When inkjet printers print, tiny streams of ink are sent from the print head to the paper. This is usually done in one of two ways:

Thermal: Ink heats up and creates a small bubble which then ejects onto the paper.

Piezoelectric: A crystal vibrates when voltage is applied and causes the ink to break into minute droplets which are either charged and stuck to paper or dropped into a reservoir and recycled. Piezoelectric heads rarely clog as ink is sent through the print head in a constant stream.

Print heads for inkjet printers can either be fixed into the printer for the life of the printer, or disposable, in which case they are built into an ink cartridge. These print heads are attached to a carriage located on a belt inside of the inkjet printer. This carriage and belt are controlled with a stepper motor and pulley with sensors which detect the position of the print head and paper.

The detailed process for inkjet printing varies from printer to printer but the basic steps are as follows:

1. Paper, kept in a tray or inserted into a feeder, is pulled into the printer using rollers.
2. As the paper rolls through the printer, an assembly moves the print heads side to side. Ink cartridges eject the ink onto the page as the sensors on the pulley detect the position of the print head and paper.
3. If duplex printing is taking place, the duplexing assembly runs the paper back through the printer and the other side of the page gets the ink it needs.
4. Ink cartridges, which consist of a black ink cartridge, color ink cartridges for color inkjet printers, and often a photo ink cartridge, frequently need to be replaced. Always replace the cartridge. Never refill the cartridge with ink as this can produce a poor quality in print.

When cartridges are replaced, a printer is first installed, or when the lines on a printout are uneven, the print heads need to be calibrated. Many inkjet printers have a button on an LED panel (if one is present) to run calibration. Otherwise, the software installed with the printer should have a calibration function. When white lines appear on printouts, the print heads need cleaning. Again, there should be a button on an LED panel or a setting in the printer's software available to run the cleaning process. In this project, you will identify the part of an inkjet printer used for a part of a print job. Common maintenance tasks for inkjet printers include:

Cleaning heads: This is usually done through pressing a button on the printer or running an app in the printer's software. If the print heads are still clogged, follow the manufacturer's instructions to attempt to unclog them.

Replacing cartridges: When a cartridge has run out of ink, remove it and replace it with a new cartridge. Never attempt to refill a cartridge, as for many inkjet printers, this will void the printer's warranty.

Calibration: Over time, print heads can get misaligned. Run the calibration software on the printer (or press the calibration button on the printer if it is available) to realign the print heads.

Clearing paper jams: If paper jams become a common occurrence, check the paper rollers to see if they need cleaning. Usually, isopropyl alcohol and a soft, lint-free cloth will clean them.

As with any printer maintenance tasks, follow the manufacturer's instructions for maintaining inkjet printers, especially when it comes to cleaning any parts of any inkjet printer.

Purpose:

After completing this project, you will have a better understanding of the process of a inkjet printer. Steps for completion are on the next page.

Steps for Completion:

1. For each part of a print job, identify the part of an inkjet printer being used:

    a. Printing occurs on both sides of the paper: ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

    b. This part controls the manner in which the paper moves through the printer:

    ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

    c. The tool run to align the print heads on a printer: ⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯⎯

2. If you have an inkjet printer available, run the calibration tool on the printer.

Project Details

Project Files:
N/A

Estimated Completion Time:
5-10 minutes

Video Reference:
Domain 3
  Topic: Install and Maintain Printers
    Subtopic: Inkjet Printer Processes

Objectives Covered:
3 Hardware
  3.11 Given a scenario, install and maintain various print technologies
    3.11.2 Inkjet
      3.11.2.1 Ink cartridge, print head, roller, feeder, duplexing assembly, carriage, and belt
      3.11.2.2 Calibrate
      3.11.2.3 Maintenance: Clean heads, replace cartridges, calibrate, clear jams

Thermal and Impact Printer Technologies

Description:

Two other types of printers used in home and business offices are thermal printers and impact printers. Though these printers are not as common as laser and inkjet printers, thermal printers and impact printers each have a defined role in fulfilling the printer needs of an office. Thermal printers use a special, chemically covered, waxy-like paper. These printers are usually used to print receipts and tickets. This same paper used to be prevalent on fax machines before the advent of plain-paper fax machines. Thermal paper is usually kept on a roll and feeds through the printer as a print job is being rendered.

Here are the steps which make up the printing process of a thermal printer:

1. A feed assembly feeds the paper through the printer.
2. Paper is advanced through the sprocket in the center of the roll.
3. Print heads have a heating element to heat the paper to get it to change color and render a print.

The most common maintenance tasks on thermal printers include:

Replacing paper: Most thermal paper is on a roller. Open the printer, remove the empty roll, and replace it with a full roll of paper.

Cleaning the heating element: When the heating element needs cleaning, use isopropyl alcohol and a lint-free cloth.

Removing debris: Use compressed air and/or an electrostatic discharge (ESD)-safe vacuum to clean out the printer.

Make sure the thermal printer has been turned off and had a chance to cool off before attempting any cleaning maintenance on the printer.

Another type of printer is an impact printer. Impact printers used to be the most common printers used before laser and inkjet printers became prominent. One advantage of an impact printer is that it allows printing on multi-part forms. Whether the paper is in a single part or multiple parts for duplication purposes, paper for impact printers often has holes on the side, known as sprocket holes. When loading impact paper, the holes need to fit around the teeth on the rollers on the sides of the paper rollers. These teeth make up what is known as a tractor feed. The major components of an impact printer are:

Platen: A hard material that serves as a back for the print head.

Ribbon: A long strip of cloth with ink.

Print head: A mechanism with pins which hammer the ribbon to press ink from the ribbon to the paper. The functionality of a print head is similar to that of a typewriter.

To render a print job, the tractor feed grabs the paper and advances the paper line by line. As this is happening, a motor-and-carriage assembly moves the print head side-to-side while it prints.

The most common maintenance tasks on impact printers include:

Replacing the ribbon: When the ink on the ribbon runs out, remove the old ribbon and replace it with a new ribbon.

Replacing the print head: If too much dust collects in the print head, it can become jammed. Use compressed air to clean the area out. If the pins on the print head stop working, replace the print head.

Replace paper: If the printer uses paper with perforated holes on the side, make sure the paper fits correctly into the sprocket holes.

In addition to these maintenance tasks, the platen can get dirty over time. Use isopropyl alcohol to clean it.

Purpose

In this project, you will identify whether a thermal or impact printer should be used for a customer requirement. Steps for completion are on the next page.

Steps for Completion:

1. For each customer requirement, identify whether a thermal printer or an impact printer should be used:

    a. A retail business needs to print receipts: _____

    b. A construction company needs to print multiple copies of invoices:

        _____

    c. A mail-order firm needs to print orders received via fax:

        _____

Virtual and 3-D Printing

Printing, by definition, used to always result in a printout, output onto paper coming from a printer. Now printing can mean two possibilities: either a traditional print on paper, or the information printed is actually printed digitally and saved to a file. There are four main possibilities for printing not to a printer, but to a file:

Print to file: The file being printed actually saves as a text file. This option will work if the file is a basic text file. But if the file contains graphics or is heavily formatted, the text result will be unreadable.

Print to PDF: The file being printed saves as an Adobe PDF file and can be read with Adobe Acrobat Reader or similar PDF reader application.

Print to XPS: The file being printed saves as an XML Paper Specification (XPS) file. This is a Microsoft technology that behaves similarly to Adobe PDF for print rendering. XPS is natively available with Windows, so those without a PDF reader will tend to use this format.

Print to image: The file being printed saves as a GIF, JPEG, or PNG file and can then be opened in any picture-displaying app.

Some apps, when installed, install a virtual printer driver allowing files to be printed to that app's format. This will add to the four virtual printing capabilities described above. In this project, you will test some of these virtual printing capabilities.

3-D printers are printers that use plastic filament, metal wire, or ceramic powder to take what is built in a 3-D modeling app and bring it to life, using one of four fusing methods:

Fused Deposition Modeling, or FDM: Plastic or metal is fed into an extrusion nozzle, melted, and then pushed onto the model.

Stereolithography, or SLA: In this, plastic, metal, plaster, or ceramic granules are applied and then fused to a layer.

Laminated: Each layer in the object is cut from paper, foil, or plastic and then applied and fused to the previous layer.

Light polymer: Polymer is either applied or sprayed onto an object and then hardened to make it stick.

Steps for Completion:

1. On a Windows computer, click the Start button.
2. Type: **WordPad** and press the Enter key. WordPad will launch.
3. In the blank file, type a phrase.
4. Click the File tab.
5. Click Print.
6. Click the Microsoft XPS Document Writer printer.
7. Click the Print button. A Save As dialog box will appear.
8. Name the file and save it to your Documents folder.
9. Close WordPad without saving your changes.
10. Open Windows Explorer (File Explorer for Windows 8 or 8.1) and navigate to your Documents folder.
11. Locate the file you saved and double-click to open it. It will open in the Windows XPS reader.
12. When you are done viewing the file, close the XPS reader.

Project Details

Project Files:
N/A

Estimated Completion Time:
10 minutes

Video Reference:
Domain 3
Topic: Install and Maintain Printers
Subtopics: Print to File; Print to PDF; Print to XPS; Print to Image; 3-D Printers

Objectives Covered:
3 Hardware
3.11 Given a scenario, install and maintain various print technologies
3.11.3 Thermal
3.11.3.1 Feed assembly, heating element
3.11.3.2 Special thermal paper
3.11.3.3 Maintenance: Replace paper, clean heating element, remove debris
3.11.4 Impact
3.11.4.1 Print head, ribbon, tractor feed
3.11.4.2 Impact paper
3.11.4.3 Maintenance: Replace ribbon, replace print head, replace paper

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A+ Part 1 (220-1001)
Project Workbook
Domain 4: Virtualization and Cloud Computing

Presented By

LK LearnKey®

Fill-in-the-Blanks Domain 4

Instructions: While watching Domain 4, fill in the missing words according to the information presented by the instructor. [References are found in the brackets.]

Cloud Computing Concepts

1. Virtual servers, networks, switches, and data ———————————— are all found in the IaaS cloud platform. [IaaS]

2. A ———————————— cloud contains the scalability of a public cloud and the security of a private cloud. [Types of Cloud Infrastructures]

3. In rapid elasticity, a cloud resource can be ———————————— in or out. [Internal vs. External, Rapid Elasticity]

4. Measured service is the act of ———————————— resources within a cloud subscription. [Measured Service]

Client-Side Virtualization

5. The most important resource for hosting virtual machines is to make sure plenty of ———————————— is available. [Resource Requirements]

6. A hypervisor gives virtual machines access to a physical host's RAM and ————————————. [Hypervisor]

Types of Cloud Infrastructures

Cloud computing is a type of computing in which at least part of a company's infrastructure moves from physical, on-premises computing to hosted computing from a centrally managed location. The advantages of cloud computing include easier scalability (expansion) and the lack of a need to administer equipment physically. Disadvantages include the need to rely on a stable and fast Internet connection for most cloud services and the knowledge that a different entity is managing company data. There are three main types of cloud services:

Software as a Service (SaaS): Instead of software being purchased and installed, software is licensed via a subscription and is centrally hosted. Examples of this include Office 365 (a subscription-based model for Office) and Office Online.

Infrastructure as a Service (IaaS): A cloud service which provides storage capacity and management tools. Examples include System Center Virtual Machine Manager (VMM) and Hyper-V Cloud Server.

Platform as a Service (PaaS): A cloud service which hosts development, service hosting, and service environments. Examples include Azure and SQL Server with a database that can be accessed.

In addition to determining which types of cloud services best suit a company, choosing the correct cloud type is very important. There are four main cloud types:

Public: Cloud computing hosted through a service provider. Examples include Amazon Web Services, Office 365, and Google Apps.

Private: Cloud computing hosted and controlled solely within an organization. One example of this is System Center VMM.

Hybrid: Cloud computing with both public and private aspects. This combines the scalability of a public cloud and the security of a private cloud. For example, a company can use a public development platform (like Amazon Web Services) but can then send the data from that environment to a private data center.

Community: Similar to a private cloud but is accessible by two or more organizations. A community cloud could also use a public cloud while still having the security and privacy of a private cloud. An example of this would be a dedicated Amazon Web Services platform with a healthcare app which has the security of a private cloud.

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Project Details

Project Files:
N/A

Estimated Completion Time:
5-10 minutes

Video Reference:
Domain 4
  Topic: Cloud Computing Concepts
    Subtopic: IaaS; SaaS; PaaS; Types of Cloud Infrastructures

Objectives Covered:
4 Virtualization and Cloud Computing
  4.1 Compare and contrast cloud computing concepts
    4.1.1 Common cloud models
      4.1.1.1 IaaS
      4.1.1.2 SaaS
      4.1.1.3 PaaS
      4.1.1.4 Public vs. private vs. hybrid vs. community

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Purpose:

After completing this project, you will be able to identify which types of cloud infrastructures are needed given a customer situation.

Steps for Completion:

1. For each customer situation, identify the type of cloud service (SaaS, IaaS, or PaaS) and cloud type (Public, Private, Hybrid, or Community):

Situation	Service	Type
A business wants to transfer its secure data storage to the cloud	a. _____	b. _____
A company wants to subscribe to Adobe Creative Cloud	c. _____	d. _____
A financial services company wants to develop its major business app and make it public but keep the data private	e. _____	f. _____

Other Basic Cloud Concepts

In addition to understanding cloud services and cloud types, a technician also needs to know about cloud concepts involving scalability, resources, and reporting. Here are those basic cloud concepts, along with a description of each:

Concept	Description
Shared resources	Interal resources are resources owned, such as a local printer. External resources, such as those in a community cloud, are not owned. Both types can be shared.
Rapid elasticity	This is also known a scalable provisioning. Scalability is the ability to expand an infrastructure quickly. Rapid elasticity, then, involves the ease in which a cloud infrastructure can be scaled up or down. An example of rapid elasticity is the ability to provision additional servers immediately in a cloud infrastructure such as Azure or Amazon Web Services.
On-demand	A concept in which users have access to cloud resources as needed. For example, it takes a mere few minutes to provision a new server in the cloud.
Resource pooling	The ability to combine resources in a cloud computing infrastructure. Three categories of resource pooling are: **Compute:** A collection of all of the CPU capabilities in servers. **Networks:** These can be set up and configured in such a way as to allow anytime, anywhere access for data. **Storage:** With elasticity, storage can be increased easily. Often, this is done through storage pools.
Measured service	Measuring and monitoring from a cloud provider. This will usually include reports for billing and resource use. In some cases, a cloud provider will suggest an infrastructure plan on a report.
Metered	Connections to cloud services that have limitations set, such as a monthly hours limit for a free-tier cloud account.
Off-site email	Email apps that make it easier for users to reach email. Examples include Gmail and Outlook Online.
Synchronization apps	Apps that make files available across multiple devices. Apps include OneDrive, Google Drive, and Dropbox.
Virtual/cloud-based apps	These are versions of destkops users can use in a web browser or as apps on mobile devices. A prime example is Office Online.
Virtual NIC	A network card added to a virtual machine. As an example, a virtual server could have one NIC with a private IP address and one with a public IP address.

Purpose:

At the end of this project, you will better understand how basic cloud computing concepts are applied in cloud computing situations.

Steps for Completion:

1. For each situation, identify the cloud computing concept in use:

    a. A database server is provisioned for testing purposes. When the testing is done, the server is deleted: ⎯⎯⎯⎯⎯⎯⎯

    b. A 3 TB storage pool is created for a large data warehouse: ⎯⎯⎯⎯⎯⎯⎯

    c. A report is generated showing the number of hours each cloud server was up in the last month: ⎯⎯⎯⎯⎯⎯⎯

    d. Four servers which will serve as a server farm for SharePoint are up and running in a matter of an hour:

    ⎯⎯⎯⎯⎯⎯⎯

Client-Side Virtualization

A virtual machine is a software-run complete operating system which resides inside of an operating system on a physical machine. For example, a computer with Windows 10 installed could have virtual machines for older versions of Windows, Linux, and even Windows Server. This allows a computer user several additional computing options, including:

Learning: With multiple operating systems installed, a computer user can train on multiple operating systems.

Testing: A user or technician can test applications in different operating systems and test patches and fixes for existing operating systems.

Legacy applications: Having a virtual machine allows an app which is incompatible with the user's current operating system to run on a different operating system. For example, a computer with Windows 10 installed can run, through virtualization, Windows 7 and apps that only run in Windows 7.

Virtual machines are managed by hypervisors. Hypervisors are software apps which manage the virtual machines and the hardware they are allocated. Examples of hypervisors include Hyper-V (Microsoft's hypervisor), VMware, and VirtualBox. With virtualization comes requirements. Here are some of those requirements, along with a description of each requirement:

Requirement	Description
Resources	Processors: Multi-core processors are needed so that virtual machines can be set to use one or more cores. RAM: To run virtual machines effectively, at least 8 GB of RAM is needed on the physical computer. The more RAM, the better. NIC: A NIC should be Gigabit Ethernet as virtual machines will share the network card resources. Disk space: Though virtual machines can be set to use disk space dynamically (meaning use disk space as needed), virtual machines will still take a large amount of disk space.
Emulator	Allows for running an operating system that is incompatible with the host operating system. An example of this is an Android emulator on a Windows device. Emulators use a high amount of RAM.
Security	The same security requirements one would enforce on physical machines need to be enforced on virtual machines, especially if those virtual machines will be on any network. The folder hosting the virtual hard disks needs to be secure as well.
Network	Virtual machines will usually use a virtual network card created by the hypervisor on the host machine. One administering virtual machines needs to make sure the machines have different MAC addresses as to avoid conflict on a network.

Purpose:

At the completion of this project, you will have a better understanding of how client-side virtualization works.

Steps for Completion:

1. For each situation, identify what is needed for a solid client-side virtualization environment.

    a. Which are factors that determine the viability of a physical machine hosting virtual machines?

    b. What are examples of hypervisors? _____

    c. Which NIC will a virtual machine most likely use? _____

    d. Which folder on a host machine needs to be secure when the host machine hosts virtual machines?

2. To try out a hypervisor, download VMware Player or VirtualBox or activate Hyper-V if it is available on your machine. You will also need installation media for an operating system to install an operating system on a virtual machine.

A+ Part 1 (220-1001)
Project Workbook
Domain 5: Hardware and Network Troubleshooting

Presented By

LK LearnKey®

Fill-in-the-Blanks Domain 5

Instructions: While watching Domain 5, fill in the missing words according to the information presented by the instructor. [References are found in the brackets.]

Troubleshooting Methods

1. A problem must be _____ before a theory of probable cause can be established. These are the first two steps of the CompTIA troubleshooting theory. [Establish a Theory of Probable Cause]

2. Once a theory of probable cause has been tested and confirmed, the problem needs to be resolved and it is important to

    _____ every step of the implemented solution. [Plan of Action to Resolve and Solve]

Troubleshoot Hardware Problems

3. A bad fan or an _____ CPU will cause unexpected shutdowns or system lockups. [Shutdowns and Lockups]

4. If a PC beeps instead of booting up or shows a blank screen on bootup, it could mean a component like RAM or the video

    card is not _____ properly. [POST Code Beeps]

5. If you cannot solve a hardware problem, check the system and application logs in the _____ for error messages that can be researched online. [Log Entries and Error Messages].

Troubleshoot Hard Drives and RAIDs

6. If a disk is performing slowly, the first place to check is the _____ to see if the disk is almost full or needs to be defragmented. [Slow Performance]

7. When a RAID _____ drive fails you will know right away because no drives will work. [Boot Failures, Missing Items, Crashes]

8. The S.M.A.R.T tool can be run using the command prompt and typing _____ to launch the tool. [S.M.A.R.T. Errors]

Troubleshoot Video and Display Issues

9. If the resolution is set too high for a monitor and there is no display picture, reboot the machine in either Safe Mode or

    _____ mode. [Common Symptoms]

10. With a _____ problem you will see an image when the monitor is off. This happens on plasma monitors and old CRT screens. [Common Symptoms]

Troubleshoot Mobile Device Issues

11. If there is no wireless connectivity, check to make sure Wi-Fi is turned on and that the device is not in

    _____ mode. [No Wireless Connectivity]

12. If apps will not load on a mobile device, first check the device to see if there is enough available _____ on the device. [Other Mobile Device Issues]

13. When disassembling a mobile device keep the parts organized and labeled and use the _____ resources/manual. [Disassembly Procedures]

14. Do not use _____ screwdrivers on computers because they can delete data from a hard drive should it get too close to one. [Correct Hand Tools]

Troubleshoot Printers

15. If you print a very dark image, it is a good practice to print a _____ page after the dark image to

prevent a ghost image. [Common Printer Problems]

16. If you can't install a printer, make sure you have the correct printer ————————— and that user rights on the machine do not prevent a printer installation. [Other Common Printer Problems]

Wired and Wireless Network Problems

17. Limited connectivity could be caused by a router having an incorrect routing —————————. [Connectivity and Resource Issues]

18. To fix an IP address conflict, set the DHCP scope to exclude all ————————— IP addresses. [Email, IP Address, and Signal Issues]

19. Lowering the ————————— so that it does not escape the building will also affect the speed of your wireless network. [Email, IP Address, and Signal Issues]

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The Troubleshooting Theory

With troubleshooting taking a large percentage of a technician's work time, and troubleshooting being a prominent feature on both A+ exams, it is important to know and be able to put into practice the CompTIA Troubleshooting Theory. This troubleshooting theory has six distinct steps:

Identify the problem: When faced with a troubleshooting situation, a problem needs to be identified. Ask questions of users to narrow down the problem. Use open-ended questions to identify any changes made to a computer. If data is involved, perform backups before making any changes.

Establish a theory of probable cause: If necessary, conduct research (look at previous trouble tickets, do online searches) to narrow down the problem based on the symptoms given.

Test the theory to determine the cause: This is the point at which you confirm the problem and determine the steps to solve it, or, you re-establish a new theory. In some cases, you will want to escalate the problem to a higher-level technician. This is a far better alternative than spending precious time trying to figure something out when a co-worker already has the answer.

Establish a plan of action to resolve the problem and implement a solution: At this point, you know exactly what the problem is and you have determined the steps necessary to solve the problem. When solving the problem, always consider corporate policies, procedures, and impacts before implementing changes.

Verify full system functionality: Part of solving a problem is making sure one's system has full functionality. When applicable, test the solution with the user to make sure everything works. If applicable, implement preventative measures to avoid the problem in the future.

Document findings, actions, and outcomes: Most troubleshooting situations in the workplace will involve a trouble ticket or help desk ticket with the original problem and the user(s) with the problem. Take the time to document what you have done to solve the problem. Even documenting something as small as "Reset user's password" is far more beneficial than indicating "Done" or "Closed" when a troubleshooting problem is solved.

Purpose:

Upon completing this project, you will be able to identify which troubleshooting step should be taken given a customer situation, and you will have sharpened your skills as they relate to the CompTIA troubleshooting theory.

Steps for Completion:

1. For each troubleshooting situation, identify which of the six CompTIA troubleshooting theory steps should be taken:

   a. A user calls, complaining that the Internet is not working:

   _____

   b. A user could not access files on a shared drive. You determined this was a permissions issue, verified with the manager that the user needs those permissions, and added the user to a group which has those permissions:

   _____

   c. A user needed a password reset. You have reset the password:

   _____

   d. A user is getting error messages when trying to install an application. You look at the Event Viewer and see messages but cannot figure out what the problem is by looking at the messages:

   _____

Common Hardware Problems

Most common hardware problems in a computer will affect the ability of the computer to start up properly. Some hardware problems manifest themselves as a computer is running. With any hardware troubleshooting, there are some basic starting principles. First, always follow the warranty. If opening the computer case is going to break the warranty, keep the case closed and use the warranty to your advantage. Second, never try to fix a power supply. Electricity conducts well after a power supply is unplugged, causing a risk. Replacing a power supply is much easier than trying to fix one.

For the A+ exam, many questions revolve around the best first step to take when troubleshooting a problem. Use the troubleshooting exercises in this domain as a solid guide, but when you get a test question on troubleshooting, picture yourself in the situation and think through the best first step to take. With those concepts, let's take a look at some of the most common computer hardware problems and the best first step to take to troubleshoot the problem:

Problem	First Step
Unexpected shutdowns	Usually due to heat. Make sure the system is cooling properly.
System lockups	Similar to unexpected shutdowns, this is also usually due to heat. Check to make sure the video card is not overheating.
Power on self-test (POST) code beeps	Beeps often mean faulty RAM but this is not always the case. Consult the motherboard manual for guidance on what the number of beeps indicate.
Blank screen on boot up	Try plugging in a different monitor. If that does not solve the problem, try a new video card. If there still is no screen, it may be the motherboard.
BIOS time and settings resets	The system goes back in time each time it is booted up. The CMOS battery is failing. Replace the battery.
Attempts to boot to incorrect device	This causes a "boot disk not found" error message. Make sure the DVD drive is empty and no flash drives are plugged in. If that does not solve the problem, boot into the BIOS or boot order setup and make sure the boot order is correct.
Continuous reboots	This usually happens before a system is completely booted up. See if any hardware has recently been added or software recently installed. Try booting into Safe Mode and then check Device Manager for any hardware abnormalities.
No power	If there is no light on the motherboard, the power supply is most likely the problem and needs to be replaced. If a light does appear on the motherboard, make sure the power is properly connected to the motherboard. If that is not the problem, it could be a bad CPU.
Overheating	Caused by a failing fan in the system. Clean the fans of any dust and debris. Check the CPU, video card, and case fans. Installing a new piece of hardware can affect the cooling in the system. Try uninstalling the new hardware piece to see if that alleviates the problem.
Loud noise	Check to see if a screw or other object is loose inside the case. A loud clicking noise usually indicates a failing hard drive. If that is happening, back up your data as soon as possible.
Intermittent device failure	Usually a sign of overheating or a loose connector. Check the connection on components which have just been installed on the computer.
Fans spinning but no other devices have power	This is usually an indication of a voltage problem or a bad power supply connection to the motherboard. Check the power supply connectors to make sure they are properly connected.
Indicator lights	If no indicator lights come on, either the power supply is not properly connected to the motherboard or the power supply has gone bad and needs replacing.
Smoke	Usually comes from the power supply. Unplug the machine and replace the power supply right away.
Burning smell	Similar to smoke, unplug the machine and replace the power supply right away.
Blue Screen of Death (BSOD)	A screen that shows an error message and then reboots the computer. When it reboots, use the Event Viewer to view the message and use that information to troubleshoot the problem. The Mac version of the BSOD is the Spinning Pinwheel of Death (SPoD)
Distended capacitors	Motherboard capacitors are bulging or worn. These need to be replaced.
Log entries and error messages	If you are having hardware problems but you cannot seem to figure out why, check the system and application logs in the Event Viewer. Look for errors and if you do see some, read the details of the errors and if needed, do an online search with the error number and description.

A general order for troubleshooting startup problems is to remember the order in which components start up on a computer (power supply, CPU, RAM, peripherals, and then bootable media).

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Purpose:

After completing this project, you will be well equipped to determine the best first step for troubleshooting a hardware problem.

Steps for Completion:

1. For each situation, identify the best first step for troubleshooting the hardware problem.

Situation	Best First Step
A user says a machine boots up but there is no display on the monitor.	
When booting a machine, an "Incorrect boot disk error" message appears.	
The fans spin when a machine turns on but that is all that happens.	
A system freezes up after being on for a few hours.	
A technician has checked a system for hardware problems but still cannot find any.	

Common Hard Drive Problems

Whereas hardware problems on a computer can affect the CPU, RAM, power supply, motherboard, or expansion cards or slots, hard drives have their own unique set of problems. For any hard drive problems, the key first step in troubleshooting is to back up the data as soon as possible. For many hard drive problems, a hard drive failure is soon to follow, at which point it will most likely be too late to retrieve data cleanly. Here are the most common hard drive problems and the symptoms that define these problems. Where applicable, a possible solution is also listed:

Problem	Symptoms/Possible Solution
Read/write failure	Usually the result of one or more bad sectors. Back up the disk contents and then run CHKDSK to either turn off or fix the bad sectors.
Slow performance	The drive could be close to full or it could be fragmented. If the drive is a magnetic hard disk drive, run the defragmentation tool.
Loud clicking noise	The hard drive is failing. Back up the data as soon as possible and replace the hard drive.
Failure to boot	Check to make sure the drive is properly connected to power and the motherboard. If the connections look good, the hard drive might be failing. Try putting the drive in another system to see if it is readable.
Drive not recognized	Check to make sure the cabling is correct and the SATA port the drive is plugged into is enabled.
Operating system (OS) not found	The computer could be booting to the wrong disk. Check the BIOS to make sure the boot order is correct.
RAID not found	The RAID may not be set up properly. The RAID functionality may not be enabled in the BIOS. RAID may not be supported on the system or RAID drivers may be needed.
RAID stops working	The most common cause is a failed hard drive, especially in the case of a RAID 0. For any other RAID, swap out the bad hard drive for a good one.
Blue Screen of Death (BSOD) or pinwheel	Check the error message to see what is causing the error, then boot into Safe Mode and replace the driver for the device causing the error. If this does not work, disk recovery may be needed.
Self-monitoring, analysis, and reporting technology (S.M.A.R.T) errors	S.M.A.R.T. is a monitoring tool which can notify a user of a hard drive problem. Research the message to see which actions should be taken.

Purpose:

In this project, you will identify the best first step to take to try to identify and solve a hard drive problem. Steps for completion are on the next page.

Steps for Completion:

1. For each situation, identify the best first step in troubleshooting a hard drive problem.

Situation	First Step
An error message appears indicating a drive in a RAID 5 array has failed.	
A hard drive is not recognized after it is installed.	
A hard drive is making a clicking noise.	
An "incorrect boot drive" error appears when starting up the system.	

Project Details

Project Files:
N/A

Estimated Completion Time:
10 minutes

Video Reference:
Domain 5
Topic: Troubleshoot Hard Drives and RAIDs
Subtopics: Read/Write Failure; Slow Performance; Loud Clicking Noise; Boot Failures, Missing Items, Crashes; S.M.A.R.T. Errors

Objectives Covered:
5 Hardware and Network Troubleshooting
5.3 Given a scenario, troubleshoot hard drives and RAID arrays
5.3.1 Common symptoms
5.3.1.1 Read/write failure
5.3.1.2 Slow performance
5.3.1.3 Loud clicking noise
5.3.1.4 Failure to boot
5.3.1.5 Drive not recognized
5.3.1.6 OS not found
5.3.1.7 RAID not found
5.3.1.8 RAID stops working
5.3.1.9 Proprietary crash screens (BSOD/pin wheel)
5.3.1.10 S.M.A.R.T. errors

Common Display Problems

When a display (a monitor or built-in display inside of a mobile device) fails to function or shows signs of degrading performance, the key for a technician is to determine whether the cause of the problem is the display itself or the video card on the device with the display. Furthermore, the technician needs to assess whether the display can be repaired or if it needs to be replaced. With that knowledge, take a look at the most common display problems, their likely causes, and the best first step in troubleshooting these problems:

Problem	Symptom(s)	Causes and First Steps
VGA mode	Display in 640 x 480 resolution with no option for change.	Usually a result of an incorrect video driver. Download and reinstall the correct video driver.
No image on screen	The screen displays nothing.	Check to make sure everything is plugged in. Try plugging in a different monitor. If the new monitor works, the original display has a failing backlight or inverter. For a system that has both an integrated and installed video card, make sure the video cable is in the correct port.
Overheat shutdown	Spontaneous shutdown and possible reboot.	Many video cards have sensors to shut down the system if the temperature is too high. Check the system cooling.
Dead pixels	A few monitor pixels are always black.	If this becomes a bigger problem, replace the monitor.
Stuck pixels	Pixels which always show one color.	Obtain a tool that flashes the screen. This will usually get the pixels unstuck.
Artifacts	Any of the following appear: lines that do not belong, repeating patterns of small rectangles, wobbly vertical lines, or random dots.	An overheating video card, a bad video card driver, or a faulty DVI interface could all be causes. The video card may need to be replaced. If the video card has two DVI interfaces, switch the interface.
Color patterns incorrect	Colors are not displaying correctly.	Re-calibrate the monitor using a test image or a calibration tool.
Dim image	Screen image is dim or faded.	Check the on-board brightness controls. If the brightness is set to a high level, the backlight is failing.
Flickering image	Image flickers in and out.	Typically just a problem on CRT monitors when the resolution is too low. Increase the resolution.
Distorted image	Image looks disproportional and somewhat fuzzy.	Make sure the monitor is set to its native resolution. If it is, try plugins in another monitor. If that does not work, check for overheating on the video card or an incorrect video card driver.
Burn-in	An image faintly appears on a screen even after the image is no longer displayed (as in the monitor is off).	On plasma and CRT screens, an image can burn into the screen when the same image is on the screen for too long. Use a screen saver to keep changing the image on the screen.
Oversized images	Images look very, very large.	Resolution is set too high for the monitor to display. Lower the screen resolution. You may need to boot the computer into VGA mode in order to do this.

One other problem that is prevalent in old CRT monitors is a monitor with distorted geometry. There are three forms of distorted geometry:

Pincushion Distortion: Lines bend inward.

Barrel Distortion: Lines bend outward.

Trapezoid Distortion: Vertical lines are straight but not parallel with each other. Adjusting the trapezoid settings on the monitor itself often fixes this.

Purpose:

In this project, you will examine a symptom with a display and then choose the best first step to take to try to resolve the problem.

Steps for Completion:

1. For each situation, identify the best first step to take to troubleshoot the problem. The choices are: obtain a tool that will flash

the screen, plug in a different monitor, check the monitor resolution, and monitor the system temperature.

Situation	First Step
A user states a monitor is on but shows no picture.	
A user states that the picture is slightly distorted and slightly fuzzy.	
A user's machine spontaneously shuts down on occasion.	
A user's monitor has parts of the screen that never change color.	

Common Mobile Device Symptoms

Mobile devices, just like desktop computers, have many common problems technicians need to be able to identify. However, unlike desktop computers, many of these problems cannot be easily fixed by a technician. In many cases, the mobile device needs to be sent back to the manufacturer for repair or replacement. This is especially true for smartphones, phablets, and tablets. Here are the most common types of mobile device problems, along with a description of each and a possible solution, where applicable:

Problem Type	Description/Possible Solution
No display	Plug in an external monitor. Make sure the display is not configured to show only the external monitor. If the display only works on the external monitor, the LCD has failed. If neither the built-in nor the external displays work, the most likely problem is a failed video card.
Dim display	Check the brightness setting. If it is high and the display is dim, the backlight or inverter could be failing.
Flickering display	Often, there is a loose connection within the laptop display area. Take apart the laptop and reconnect the display connectors. If that does not work, the CCFL or inverter is starting to fail.
Sticking keys	Usually the result of a dirty keyboard. Use compressed air and/or isopropyl alcohol to clean it.
Intermittent wireless signal	There could be interference with the wireless signal. The device could be too far from the wireless access point. A very unlikely cause is loose wireless connectors inside the device.
Battery not charging	Make sure the AC adapter is plugged in properly. If the battery still will not charge, replace the battery.
Ghost cursor/pointer drift	If the laptop has a pointing stick, it might be stuck and the area may need to be cleaned. If not, make sure the touchpad is not being touched accidentally. Lower the sensitivity of the touchpad, if necessary.
No power	For a laptop, make sure it is plugged in as the battery may be discharged. If needed, reseat the battery. If that does not work, the DC jack may need to be replaced.
Num lock indicator lights	Some mobile devices have a num lock indicator and some do not. A user just needs to be trained on what to look for if the numeric pad is not working.
No wireless connectivity	Make sure the wireless adapter has not been disabled as most laptop keyboards have a function key that, when pressed, disables the wireless adapter. Try reconnecting to a wireless connection. If the device cannot connect to any wireless network even though the wireless adapter is enabled, replace the adapter or use a USB-to-wireless dongle to get a connection.
No Bluetooth connectivity	Make sure Bluetooth is enabled on the devices trying to connect. Make sure that the two devices are not too far apart (33 feet in most cases). Try re-pairing the devices.
Cannot display to external monitor	Check to make sure projection settings are correct and that both monitors are showing in the display properties. Disconnect and reconnect the external monitor, if necessary.
Non-responsive touch screen	If the touch screen has a protective cover, try removing it. If that solves the problem, clean the screen and the cover before putting the cover back on the screen or replace the cover. Another remedy is to restart the device. If that does not work, the touch screen may need to be replaced.
Apps not loading	The app may need to be updated. Uninstall and reinstall the app. Check to make sure the device has enough memory for the app.
Slow performance	Too many apps may be running. Or, the device could be running low on RAM and/or disk space. Check for malware to rule out or discover malware as the cause.
Unable to decrypt email	A digital certificate and/or private key is missing. If these are stored on a smart card, insert the card into the device. Otherwise, get the needed digital certificate from the email server's certificate authority (CA).
Extremely short battery life	Try a different charger (if applicable) to discover or rule out a bad charger. The battery may need replacing. The more running apps on the device, the shorter the battery life.
Overheating	For a laptop, consider getting a laptop cooling fan. Avoid using the laptop on clothing or a carpet. Use a compressed air can to clean existing fans.
Frozen system	If a laptop freezes, make sure it is not overheating. If a smartphone or tablet freezes, plug it into a charger. Power off the device and restart it. Try uninstalling any recently installed apps. A last resort is to reset the device to its factory settings (after backing up the data, of course).
No sound from speakers	Check to make sure the speakers are plugged in properly. Make sure neither the speakers nor the device volume are muted. Try different speakers to ensure the speakers and not the sound card are the problem.
GPS not functioning	Device may be out of range for a GPS signal. Location services could be turned off. If the signal is on but not receiving anything, get and run an app which will flush the GPS data.
Swollen battery	Caused by battery cells being overcharged. Do not try to puncture the battery. If you can remove the battery, do so and then dispose of the battery properly and get a new battery.

Purpose:

After completing this project, you will be able to better identify the best first step to take in troubleshooting a mobile device problem.

Steps for Completion:

For each mobile device problem, identify the first best step to troubleshoot the problem.

Problem	Resolution
A user charges a smartphone for five hours but the battery is still at 10%.	
A user calls and says their Internet connection on their laptop is going in and out.	
A user brings you a smartphone and the display is so dark it is barely noticeable.	
A laptop will not power on.	
A user is typing into a document and the Internet connection suddenly stops.	
A laptop is not showing any kind of display.	

Mobile Device Disassembling Processes

Hardware repairs and upgrades are not as common on laptops as they are on desktops. Hardware repairs and upgrades on laptops, however, present a unique challenge in that laptops contain many small parts in a small amount of space and more disassembling is typically required on laptops than on desktops. Before opening any cover on a laptop, make sure to unplug the laptop and remove the battery to minimize any chances of electrical shock. Make sure to also take proper measures to avoid electrostatic discharge, such as wearing an anti-ESD wrist strap. Then, use these four major points as your guide to successfully disassembling and reassembling a laptop:

Document and label screw locations: Screws are different lengths, so make sure to mark each screw and location. Some laptops will have coded labels near the screws. Use those to your advantage. If needed, take pictures as you remove screws from the laptop cover.

Organize parts: One of the best ways to organize screws is to have an egg carton or similar tray, with labels, and to put screws with the matching labels. Other parts you remove should also be labeled.

Refer to manufacturer resources: Before attempting to work on the inside of a laptop, get as much documentation as possible from both the laptop manufacturer and the manufacturer of the laptop's motherboard. Print these out or have these up on another computer screen or tablet as you are working on the laptop.

Use appropriate hand tools: Most of the work done in disassembling a laptop will involve the use of one or more screwdrivers. Make sure to have the correct sizes for screwdriver heads. The screwdriver heads needs to be non-magnetic as to avoid damage to any laptop components, especially hard drives. Most laptops screws are tiny. Having the screws threaded due to the lack of the correct screwdriver will make it nearly impossible to remove a screw from a laptop cover.

In this project, you will explore disassembling and reassembling a laptop.

Steps for Completion:

1. Name at least two things that should be done before removing the cover of a laptop:

   _____

2. If you have a laptop that can be disassembled, remove the cover from the bottom of the laptop, using the steps given in this project. After exploring the inside of the laptop, reassemble the laptop.

Common Printer Problems

Description:
Every printer will eventually have one or more problems that either prevent the printer from working at its optimal capacity or prevent the printer from working at all. Fortunately, most of these printer problems fall into one of several common categories. Here are the most common types of printer problems, along with their symptoms and, where applicable, remedies to solve these problems:

Problem	Symptoms and Solutions
Streaks	On a laser printer, the most likely cause is scratches in the drum. Replace the drum. On an inkjet printer, the printheads need to be re-aligned and/or cleaned.
Faded prints	This is most likely due to low toner. However, on an impact printer this could signify a stuck ribbon. On a laser printer, the fuser could be malfunctioning.
Ghost images	On a laser printer, this can happen after printing a very dark page. Print a blank page in between the dark page and the next page. If that does not solve the problem, the drum may not be getting enough of a charge and may need to be replaced.
Toner not fused to the paper	Replace the fuser. A message will usually appear indicating the fuser needs replacing.
Creased paper	Usually caused by bonded paper (thicker than normal paper). Use the manual feeder instead of the paper tray.
Paper not feeding properly	Either no paper is being fed or multiple sheets are being fed from the paper tray. Check the rollers as they may need to be cleaned or replaced.
Paper jam	Make sure nothing is impeding the paper path when clearing a paper jam. If this happens consistently, either get higher-quality paper or check the rollers for damage. To help prevent paper jams, keep paper in a low-humidity area.
No local connectivity	Make sure the cables are connected properly. Try unplugging and replugging in the cables.
Garbled characters on paper	Make sure the correct driver is installed for the printer. Another cause is a cable that is too long (a USB cable over five meters long, for example).
Vertical lines on page	On an inkjet printer, the toner may be clogged. Try removing and shaking the toner cartridge. If that is not the solution, the drum could be scratched. On an inkjet printer, try re-aligning and cleaning the print heads.
Backed up print queue	Make sure the printer spooler service is running. Try restarting the service. If that does not work, restart the printer.
Low memory errors	If possible, add more RAM to the printer. If that is not a viable solution, lower the resolution of the print job causing the low memory error.
Access Denied	Make sure the printer is shared with the users and groups needing the printer.
Printer will not print	Check to make sure everything is properly connected and that the printer is not offline. Try printing a test page from the printer itself to make sure the printer is not the problem.
Colors print in wrong print color	Ink cartridges are most likely in the wrong spot. Note that even after putting the cartridges in the correct slot, it will take time for print jobs to look normal.
Unable to install printer	Make sure the correct printer drivers (operating system and version and 32-bit vs. 64-bit) and that the user installing the printer has sufficient permissions to do the installation.
Error codes	Check the error code on the printer's LED panel and/or look up the error code on the printer's webpage or via a search engine to obtain possible solutions.
Printing blank pages	The printer may be out of toner, the toner may have been installed without removing the toner seals, or the printer cannot render an image due to a problem with the charging process.
No image on printer display	Check to make sure the printer is properly connected, plugged in, and turned on.
Multiple failed jobs in logs	Check the Event Viewer for print errors and get details for each print error listed.

Purpose:
After completing this project, you will be able to better identify the best first step to take when a printer is exhibiting a problem.

Steps for Completion:

1. For each printer situation, choose the best answer for the first step a technician would take to try to solve the problem.

    a. Paper has jammed three times in the last hour:

    b. Print jobs are building on a user's machine but not printing:

    c. A network printer is on and will print test pages but users cannot print to the printer:

    d. Printer is printing garbled characters:

Project Details

Project Files:
N/A

Estimated Completion Time:
5-10 minutes

Video Reference:
Domain 5
  Topic: Troubleshoot Printers
    Subtopic: Paper Jam; Common Printer Problems; Other Common Printer Problems

Objectives Covered:
5 Hardware and Network Troubleshooting
  5.6 Given a scenario, troubleshoot printers
    5.6.1 Common symptoms
      5.6.1.1 Streaks
      5.6.1.2 Faded prints
      5.6.1.3 Ghost images
      5.6.1.4 Toner not fused to the paper
      5.6.1.5 Creased paper
      5.6.1.6 Paper not feeding
      5.6.1.7 Paper jam
      5.6.1.8 No connectivity
      5.6.1.9 Garbled characters on paper
      5.6.1.10 Vertical lines on page
      5.6.1.11 Backed-up print queue
      5.6.1.12 Low memory errors
      5.6.1.13 Access denied
      5.6.1.14 Printer will not print
      5.6.1.15 Color prints in wrong print color
      5.6.1.16 Unable to install printer
      5.6.1.17 Error codes
      5.6.1.18 Printing blank pages
      5.6.1.19 No image on printer display
      5.6.1.20 Multiple failed jobs in logs

Wired and Wireless Network Symptoms

Description:

Networks, both wired and wireless, will have failures at some point. The key in finding and fixing network problems is to figure out where the problem is happening. A network problem could be caused by a failing network architecture device, such as a hub, switch, router, or access point. A user's network card could be failing. In the case of a wireless network, there could be signal interference. A list of the most common network problems and suggested first steps to fix these problems are in the table below. Bear in mind that many A+ exam questions ask what the best first step is to take in troubleshooting a problem, hence the emphasis on first steps here. The most common network symptoms, then, are:

Symptom	Description	First Step(s)
Limited connectivity	A device can reach some but not all devices on a network.	Check for an outage somewhere in the network.
Unavailable resources	The Internet or a local resource might not be available.	If the Internet cannot be reached, check to make sure the default gateway is operational and reachable. If a local share is unavailable, check the permissions on the share.
No connectivity	Device cannot connect to any network.	Make sure everything is plugged in and that network adapters are enabled. Try to ping 127.0.0.1 to make sure the NIC is working.
APIPA or link local address	Device cannot reach a DHCP server as evidenced by a 169.254.x.x IP address.	Try setting a static address. If that works, the problem is with the DHCP server. Restart the DHCP server service.
Intermittent connectivity	A device experiences reduction or temporary stoppage in a network connection.	This is a common problem with wireless networks. Look for items which can cause signal interference, such as microwaves, cordless phones, magnetic devices, and water tanks. The device could also be too far from the wireless access point.
IP conflict	Two devices on a network have the same IP address.	The usual cause is a DHCP server assigning an IP address which has already been assigned statically. The DHCP scope should be fixed not to include any static IP addresses.
Slow transfer speeds	Network activity is slower than normal.	The main cause is interference. The wireless router may also not be set to the highest possible speed.
Low RF signal	A wireless signal is weak and slow.	The power level on the wireless access point may have been adjusted in order to shorten the range to the confines of a building. Doing this weakens the signal.
SSID not found	A network name cannot be located.	See if the SSID changed. If it has not, move the device colser to the wireless access point. Make sure the wireless access point is working.

Purpose:

After completing this project, you will be able to better identify the best first step to take given a network problem. Steps for completion are on the next page.

Steps for Completion:

1. For each situation, indicate the best first step to take to troubleshoot the problem.

Situation	Troubleshooting Step
A user can see a network printer but not the Internet.	
A user cannot see a network printer or the Internet.	
A user is seeing only two bars on a wireless connection instead of the normal five bars.	

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Project Details

Project Files:
N/A

Estimated Completion Time:
5-10 minutes

Video Reference:
Domain 5
Topic: Wired and Wireless Network Problems
Subtopic: Connectivity and Resource Issues; Shares and Printers; Email, IP Address, and Signal Issues

Objectives Covered:
5 Hardware and Network Troubleshooting
5.7 Given a scenario, troubleshoot common wired and wireless network problems
5.7.1 Common symptoms
5.7.1.1 Limited connectivity
5.7.1.2 Unavailable resources
5.7.1.2.1 Internet
5.7.1.2.2 Local resources
5.7.1.2.2.1 Shares
5.7.1.2.2.2 Printers
5.7.1.2.2.3 Email
5.7.1.3 No connectivity
5.7.1.4 APIPA/link local address
5.7.1.5 Intermittent connectivity
5.7.1.6 IP conflict
5.7.1.7 Slow transfer speeds
5.7.1.8 Low RF signal
5.7.1.9 SSID not found

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A+ Part 1 (220-1001)
Project Workbook
Appendix

A+ Part 1 (220-1001) Suggested Study Plan

Each block of content in this suggested study plan is approximately 30 minutes and includes video training, fill-in-the-blanks, labs, projects, tests, as well as the course support files to follow along with the instructor. There is also a notes section for customizable study plans and extra notes. By adhering to the lesson plan, it will take approximately 37 class hours to complete the course. For workbook projects, we recommend doing the fill-in-the-blank sections as you watch the course. Note that this time does not count any practice time on hardware, which you should do, if possible, before taking this exam.

Domain 1: Mobile Devices
12 lessons for approximately 6 hours

Day	Tasks	What Is Covered	Notes
1	Pre-Assessment		
2	Watch the following: 　Laptop Hardware and Components 　　Introduction 　　Hardware Device Replacment 　　Keyboard 　　Hard Drive 　　Hard Drive Types and Sizes 　　Memory 　　Smart Card Reader 　　Optical Drives and Wireless Cards 　　Cellular and Video Cards, Mini PCIe 　　Other Laptop Parts Workbook project:s 　Fill-in-the-Blanks Domain 1 Items 1-3 　Installing Laptop Hardware	1 Mobile Devices 　1.1 Given a scenario, install and configure laptop hardware and components 　　1.1.1 Hardware/device replacement 　　　1.1.1.1 Keyboard 　　　1.1.1.2 Hard drive 　　　　1.1.1.2.1 SSD vs hybrid vs. magnetic disk 　　　　1.1.1.2.2 1.8 in vs. 2.5 in 　　　1.1.1.3 Memory 　　　1.1.1.4 Smart card reader 　　　1.1.1.5 Optical drive 　　　1.1.1.6 Wireless card/Bluetooth module 　　　1.1.1.7 Cellular card 　　　1.1.1.8 Video card 　　　1.1.1.9 Mini PCIe 　　　1.1.1.10 Screen 　　　1.1.1.11 DC jack 　　　1.1.1.12 Battery 　　　1.1.1.13 Touchpads 　　　1.1.1.14 Plastics/frames 　　　1.1.1.15 Speaker 　　　1.1.1.16 System board 　　　1.1.1.17 CPU	

Day	Tasks	What Is Covered	Notes
3	Watch the following: Install Laptop Display Components LCD and OLED Media Parts Laptop Features Special Function Keys More Special Function Keys Expanders and Locks Rotating/Removable Screens Workbook projects: Fill-in-the-Blanks Domain 1 Items 4-9 Install Display Components	1 Mobile Devices 1.2 Given a scenario, install components within the display of a laptop 1.2.1 Types 1.2.1.1 LCD 1.2.1.2 OLED 1.2.2 WiFi antenna connector/placement 1.2.3 Webcam 1.2.4 Microphone 1.2.5 Inverter 1.2.6 Digitizer/touch screen 1.3 Given a scenario, use appropriate laptop features 1.3.1 Special function keys 1.3.1.1 Dual displays 1.3.1.2 Wireless (on/off) 1.3.1.3 Cellular (on/off) 1.3.1.4 Volume settings 1.3.1.5 Screen brightness 1.3.1.6 Bluetooth (on/off) 1.3.1.7 Keyboard backlight 1.3.1.8 Touchpad (on/off) 1.3.1.9 Screen orientation 1.3.1.10 Media options (fast forward/rewind) 1.3.1.11 GPS (on/off) 1.3.1.12 Airplane mode 1.3.2 Docking station 1.3.3 Port replicator 1.3.4 Physical laptop lock and cable lock 1.3.5 Rotating/removable screens	

Day	Tasks	What Is Covered	Notes
4	Watch the following: 　Types of Mobile Devices 　　Tablets, Smartphones, Wearables 　　Smart Watches and Fitness Monitors 　　VR/AR Headsets, E-Readers, and GPS 　Mobile Device Accessories and Ports 　　Connector Types 　　Wireless Connection Types 　　Headsets and Speakers 　　Game Pads and Other Accessories Workbook projects: 　Fill-in-the-Blanks Domain 1 Items 10-15 　Characteristics of Other Mobile Devices	1 Mobile Devices 　1.4 Compare and contrast characteristics of various types of other mobile devices 　　1.4.1 Tablets 　　1.4.2 Smartphones 　　1.4.3 Wearable technology devices 　　　1.4.3.1 Smart watches 　　　1.4.3.2 Fitness monitors 　　　1.4.3.3 VR/AR headsets 　　1.4.4 E-Readers 　　1.4.5 GPS 　1.5 Given a scenario, connect and configure accessories and ports of other mobile devices 　　1.5.1 Connection types 　　　1.5.1.1 Wired 　　　　1.5.1.1.1 Micro-USB/Mini-USB/USB-C 　　　　1.5.1.1.2 Lightning 　　　　1.5.1.1.3 Tethering 　　　　1.5.1.1.4 Proprietary vendor-specific ports (communication/power) 　　　1.5.1.2 Wireless 　　　　1.5.1.2.1 NFC 　　　　1.5.1.2.2 Bluetooth 　　　　1.5.1.2.3 IR 　　　　1.5.1.2.4 Hotspot 　　1.5.2 Accessories 　　　1.5.2.1 Headsets 　　　1.5.2.2 Speakers 　　　1.5.2.3 Game pads 　　　1.5.2.4 Extra battery packs/battery chargers 　　　1.5.2.5 Protective covers/waterproofing 　　　1.5.2.6 Credit card readers 　　　1.5.2.7 Memory/MicroSD	

Day	Tasks	What Is Covered	Notes

5	Workbook project:
	    Mobile Device Ports and Accessories
	Watch the following:
	    Mobile Device Networks and Apps
	      Hotspots, Airplane Mode, and Bluetooth
	Workbook projects:
	    Fill-in-the-Blanks Domain 1 Items 16-17
	    Cellular Network Features and Bluetooth
		1 Mobile Devices
		  1.5 Given a scenario, connect and configure accessories and ports of other mobile devices
		    1.5.1 Connection types
		      1.5.1.1 Wired
		        1.5.1.1.1 Micro-USB/Mini-USB/USB-C
		        1.5.1.1.2 Lightning
		        1.5.1.1.3 Tethering
		        1.5.1.1.4 Proprietary vendor-specific ports (communication/power)
		      1.5.1.2 Wireless
		        1.5.1.2.1 NFC
		        1.5.1.2.2 Bluetooth
		        1.5.1.2.3 IR
		        1.5.1.2.4 Hotspot
		    1.5.2 Accessories
		      1.5.2.1 Headsets
		      1.5.2.2 Speakers
		      1.5.2.3 Game pads
		      1.5.2.4 Extra battery packs/battery chargers
		      1.5.2.5 Protective covers/waterproofing
		      1.5.2.6 Credit card readers
		      1.5.2.7 Memory/MicroSD
		  1.6 Given a scenario, configure basic mobile device network connectivity and application support
		    1.6.1 Wireless/cellular data network (enable/disable)
		      1.6.1.1 Hotspot
		      1.6.1.2 Tethering
		      1.6.1.3 Airplane mode
		    1.6.2 Bluetooth
		      1.6.2.1 Enable Bluetooth
		      1.6.2.2 Enable pairing
		      1.6.2.3 Find a device for pairing
		      1.6.2.4 Enter the appropriate pin code
		      1.6.2.5 Test connectivity	

6	Watch the following:
	    Mobile Device Networks and Apps
	      Email Settings
	      Commercial Email Providers
	Practice lab:
	    Setting Up a Commercial Email Account
	Workbook projects:
	    Fill-in-the-Blanks Domain 1 Item 18
	    Corporate Email Configuration
	    Commercial Email Configuration
		1 Mobile Devices
		  1.6 Given a scenario, configure basic mobile device network connectivity and application support
		    1.6.3 Corporate and ISP email configuration
		      1.6.3.1 POP3
		      1.6.3.2 IMAP
		      1.6.3.3 Port and SSL settings
		      1.6.3.4 S/MIME
		    1.6.4 Integrated commercial provider email configuration
		      1.6.4.1 iCloud
		      1.6.4.2 Google/Inbox
		      1.6.4.3 Exchange Online
		      1.6.4.4 Yahoo!	

Day	Tasks	What Is Covered	Notes

7	Watch the following:
	  Mobile Device Networks and Apps
	    Baseband and Other Updates
	    Radio Firmware and IMEI vs. IMSI
	    VPN
	  Mobile Device Synchronization
	    Cloud Synchronization
	    Other Synchronization Types
	    Contacts and Applications
	    Email
	    Pictures, Music, and Videos
	    Calendar
	    Bookmarks
	    Documents
	    Location Data
	    Social Media Data and E-Readers
	    Passwords
	    SSO
	    Software Requirements, Connection Types
	Workbook projects:
	  Fill-in-the-Blanks Domain 1 Items 19-23
	  Other Mobile Device Network Conceptsh
		1 Mobile Devices
		  1.6 Given a scenario, configure basic mobile device network connectivity and application support
		    1.6.3 Corporate and ISP email configuration
		      1.6.3.1 POP3
		      1.6.3.2 IMAP
		      1.6.3.3 Port and SSL settings
		      1.6.3.4 S/MIME)
		  1.7 Given a scenario, use methods to perform mobile device synchronization
		    1.7.1 Synchronization methods
		      1.7.1.1 Synchronize to the cloud
		      1.7.1.2 Synchronize to the desktop
		      1.7.1.3 Synchronize to the automobile
		    1.7.2 Types of data to synchronize
		      1.7.2.1 Contacts
		      1.7.2.2 Applications
		      1.7.2.3 Email
		      1.7.2.4 Pictures
		      1.7.2.5 Music
		      1.7.2.6 Videos
		      1.7.2.7 Calendar
		      1.7.2.8 Bookmarks
		      1.7.2.9 Documents
		      1.7.2.10 Location data
		      1.7.2.11 Social media data
		      1.7.2.12 E-books
		      1.7.2.13 Passwords
		    1.7.3 Mutual authentication for multiple services (SSO)
		    1.7.4 Software requirements to install the application on the PC
		    1.7.5 Connection types to enable synchronization	

8	Workbook project:
	  Synchronization Data Types and Methods
	Review Domain 1
		1 Mobile Devices
		  1.7 Given a scenario, use methods to perform mobile device synchronization
		    1.7.1 Synchronization methods
		      1.7.1.1 Synchronize to the cloud
		      1.7.1.2 Synchronize to the desktop
		      1.7.1.3 Synchronize to the automobile
		    1.7.2 Types of data to synchronize
		      1.7.2.1 Contacts
		      1.7.2.2 Applications
		      1.7.2.3 Email
		      1.7.2.4 Pictures
		      1.7.2.5 Music
		      1.7.2.6 Videos
		      1.7.2.7 Calendar
		      1.7.2.8 Bookmarks
		      1.7.2.9 Documents
		      1.7.2.10 Location data
		      1.7.2.11 Social media data
		      1.7.2.12 E-books
		      1.7.2.13 Passwords
		    1.7.3 Mutual authentication for multiple services (SSO)
		    1.7.4 Software requirements to install the application on the PC
		    1.7.5 Connection types to enable synchronizations	

9	Post-Assessment		

Day	Tasks	What Is Covered	Notes
10	Post-Assessment		
11	Post-Assessment		
12	Post-Assessment		

Domain 2: Networking
15 lessons for approximately 7.5 hours

Day	Tasks	What Is Covered	Notes
1	Pre-Assessment		

2	Watch the following:
	    Ports, Protocols, and Their Purposes
	      Ports and Protocols
	      21 – FTP
	      22 – SSH and 23 – Telnet
	      25 – SMTP and 53 – DNS
	      Web and Email Protocols
	      3389 – RDP
	      137-139 – NetBIOS/NetBT
	      445 – SMB/CIFS
	      427 – SLP, 548 – AFP, 67-68 – DHCP
	      389 – LDAP and 161/162 – SNMP
	      TCP vs. UDP
	Workbook projects:
	    Fill-in-the-Blanks Domain 2 Items 1-3
	    Ports and Protocols
		2 Networking
		    2.1 Compare and contrast TCP and UDP ports, protocols, and their purposes
		      2.1.1 Ports and Protocols
		        2.1.1.1 21 – FTP
		        2.1.1.2 22 – SSH
		        2.1.1.3 23 – Telnet
		        2.1.1.4 25 – SMTP
		        2.1.1.5 53 – DNS
		        2.1.1.6 80 – HTTP
		        2.1.1.7 110 – POP3
		        2.1.1.8 143 – IMAP
		        2.1.1.9 443 – HTTPS
		        2.1.1.10 3389 – RDP
		        2.1.1.11 137-139 – NetBIOS/NetBT
		        2.1.1.12 445 – SMB/CIFS
		        2.1.1.13 427 – SLP
		        2.1.1.14 548 – AFP
		        2.1.1.15 67/68 – DHCP
		        2.1.1.16 389 – LDAP
		        2.1.1.17 161/162 – SNMP
		      2.1.2 TCP vs. UDP	

3	Watch the following:
	    Networking Hardware Devices
	      Routers and Switches
	      Access Points
	      Cloud-Based Firewalls and NICs
	      Repeater
	      Hub and Cable/DSL Modem
	      Bridge and Patch Panel
	      Ethernet and Power
	Workbook projects:
	    Fill-in-the-Blanks Domain 2 Items 4-6
	    Networking Hardware Devices
		2 Networking
		    2.2 Compare and contrast common networking hardware devices
		      2.2.1 Routers
		      2.2.2 Switches
		        2.2.2.1 Managed
		        2.2.2.2 Unmanaged
		      2.2.3 Access points
		      2.2.4 Cloud-based network controller
		      2.2.5 Firewall
		      2.2.6 Network interface card
		      2.2.7 Repeater
		      2.2.8 Hub
		      2.2.9 Cable/DSL modem
		      2.2.10 Bridge
		      2.2.11 Patch panel
		      2.2.12 Power over Ethernet (PoE)
		        2.2.12.1 Injectors
		        2.2.12.2 Switch
		      2.2.13 Ethernet over Power	

4	Watch the following:
	    SOHO Networks
	      Router/Switch Functionality
	      Access Point Settings
	      Wired
	      Wireless and End-User Configuration
	Practice lab:
	    Access Point Settings
	Workbook project:
	    Setting Up a Wireless Network
		2 Networking
		    2.3 Given a scenario, install and configure a basic wired/wireless SOHO network
		      2.3.1 Router/switch functionality
		      2.3.2 Access point settings
		      2.3.3 IP addressing
		      2.3.4 NIC configuration
		        2.3.4.1 Wired
		        2.3.4.2 Wireless
		      2.3.5 End-user device configuration	

Day	Tasks	What Is Covered	Notes

5	Watch the following:
	  SOHO Networks
	    IoT Device Configuration
	    Cable/DSL Modem Configuration
	    DMZ
	    Port Forwarding
	    NAT
	    UPnP
	    Whitelist/Blacklist
	    MAC Filtering
	    QoS
	    Encryption
	    Channels
	    More QoS
	Workbook projects:
	  Fill-in-the-Blanks Domain 2 Items 7-10
	  Other Wireless Settings
		2 Networking
		  2.3 Given a scenario, install and configure a basic wired/wireless SOHO network
		    2.3.6 IoT device configuration
		      2.3.6.1 Thermostat
		      2.3.6.2 Light switches
		      2.3.6.3 Security cameras
		      2.3.6.4 Door locks
		      2.3.6.5 Voice-enabled, smart speaker/digital assistant
		    2.3.7 Cable/DSL modem configuration
		    2.3.8 Firewall settings
		      2.3.8.1 DMZ
		      2.3.8.2 Port forwarding
		      2.3.8.3 NAT
		      2.3.8.4 UPnP
		      2.3.8.5 Whitelist/blacklist
		      2.3.8.6 MAC filtering
		    2.3.9 QoS
		    2.3.10 Wireless settings
		      2.3.10.1 Encryption
		      2.3.10.2 Channels
		      2.3.10.3 QoS	

6	Watch the following:
	  Wireless Networking Protocols
	    Frequencies
	    2.4 GHz Channels
	    Bluetooth, NFC, RFID, and IoT
	    3G, 4G, 5G and LTE
	  Server Types
	    Web Server
	    File Server
	    Print Server
	    DHCP Server
	    DNS Server
	    Other Servers
	    Syslog
	Workbook projects:
	  Fill-in-the-Blanks Domain 2 Items 11-14
	  Wireless Networking Protocols
		2 Networking
		  2.4 Compare and contrast wireless networking protocols
		    2.4.1 802.11a
		    2.4.2 802.11b
		    2.4.3 802.11g
		    2.4.4 802.11n
		    2.4.5 802.11ac
		    2.4.6 Frequencies
		      2.4.6.1 2.4 GHz
		      2.4.6.2 5 GHz
		    2.4.7 Channels
		      2.4.7.1 1 – 11
		    2.4.8 Bluetooth
		    2.4.9 NFC
		    2.4.10 RFID
		    2.4.11 Zigbee
		    2.4.12 Z-Wave
		    2.4.13 3G
		    2.4.14 4G
		    2.4.15 5G
		    2.4.16 LTE
		  2.5 Summarize the properties and purposes of services provided by networked hosts
		    2.5.1 Server roles
		      2.5.1.1 Web server
		      2.5.1.2 File server
		      2.5.1.3 Print server
		      2.5.1.4 DHCP server
		      2.5.1.5 DNS server
		      2.5.1.6 Proxy server
		      2.5.1.7 Mail server
		      2.5.1.8 Authentication server
		      2.5.1.9 Syslog	

Day	Tasks	What Is Covered	Notes

7	Practice lab:
	  Sharing Printers
	Workbook project:
	  Server Roles
	Watch the following:
	  Server Types
	    UTM, IDS, and IPS
	    Endpoint Management Server
	    Legacy/Embedded Systems
	Workbook projects:
	  Fill-in-the-Blanks Domain 2 Items 15-16
	  Internet Appliances and Other Systems
		2 Networking
		  2.5 Summarize the properties and purposes of services provided by networked hosts
		    2.5.1 Server roles
		      2.5.1.1 Web server
		      2.5.1.2 File server
		      2.5.1.3 Print server
		      2.5.1.4 DHCP server
		      2.5.1.5 DNS server
		      2.5.1.6 Proxy server
		      2.5.1.7 Mail server
		      2.5.1.8 Authentication server
		      2.5.1.9 Syslog
		    2.5.2 Internet appliance
		      2.5.2.1 UTM
		      2.5.2.2 IDS
		      2.5.2.3 IPS
		      2.5.2.4 End-point management server
		    2.5.3 Legacy/embedded systems	

8	Watch the following:
	  IP Addressing
	    Static
	    Dynamic
	    APIPA and Link-Local Addresses
	    DNS
	    Reservations
	    IP Addresses and Subnet Masks
	    Gateway
	    VPN, VLAN, NAT
	Workbook projects:
	  Fill-in-the-Blanks Domain 2 Items 17-20
	  Network Configuration Concepts
		2 Networking
		  2.6 Explain common network configuration concepts
		    2.6.1 IP addressing
		      2.6.1.1 Static
		      2.6.1.2 Dynamic
		      2.6.1.3 APIPA
		      2.6.1.4 Link local
		    2.6.2 DNS
		    2.6.3 DHCP
		      2.6.3.1 Reservations
		    2.6.4 IPv4 vs. IPv6
		    2.6.5 Subnet mask
		    2.6.6 Gateway
		    2.6.7 VPN
		    2.6.8 VLAN
		    2.6.9 NAT	

9	Watch the following:
	  Internet Connection Types
	    Cable, DSL, Dial-Up, and Fiber
	    Satellite, ISDN
	    Tethering and Mobile Hotspots
	    Line-of-Sight Wireless
	    Network Types
	Workbook projects:
	  Fill-in-the-Blanks Domain 2 Items
	  Internet Connection Types
	  Network Types
		2 Networking
		  2.7 Compare and contrast Internet connection types, network types, and their features
		    2.7.1 Internet connection types
		    2.7.1.1 Cable
		    2.7.1.2 DSL
		    2.7.1.3 Dial-up
		    2.7.1.4 Fiber
		    2.7.1.5 Satellite
		    2.7.1.6 ISDN
		    2.7.1.7 Cellular
		      2.7.1.1.1 Tethering
		      2.7.1.1.2 Mobile hotspot
		    2.7.1.8 Line-of-sight wireless Internet service	

Day	Tasks	What Is Covered	Notes

10	Watch the following:
	  Networking Tools
	    Crimper, Cable Stripper, Multimeter
	    Cable and Connector Testers
	    Punchdown Tool, Wi-Fi Analyzer
	Workbook projects:
	  Fill-in-the-Blanks Domain 2 Items 23-24
	  Networking Tools
		3.0 Format the user interface by using Cascading Style 2 Networking
		  2.8 Given a scenario, use appropriate networking tools
		  2.8.1 Crimper
		  2.8.2 Cable stripper
		  2.8.3 Multimeter
		  2.8.4 Tone generator and probe
		  2.8.5 Cable tester
		  2.8.6 Loopback plug
		  2.8.7 Punchdown tool
		  2.8.8 Wi-Fi analyzer	

11	Review Domain 2		
12	Post-Assessment		
13	Post-Assessment		
14	Post-Assessment		
15	Post-Assessment		

Domain 3: Hardware
24 lessons for approximately 12 hours

Day	Tasks	What Is Covered	Notes
1	Pre-Assessment		

2	Watch the following:
	    Cable Types, Features, and Purposes
	      Network Cables
	      CAT 5, CAT 5e, CAT 6, Plenum
	      Types of Twisted Pair and Connectors
	      Fiber, Coaxial, and Overall Limitations
	Workbook projects:
	    Fill-in-the-Blanks Domain 3 Item 1
	    Twisted-Pair Cables
	    Fiber and Coaxial Cables
		3 Hardware
		  3.1 Explain basic cable types, features, and their purposes
		    3.1.1 Network cables
		      3.1.1.1 Ethernet
		        3.1.1.1.1 CAT 5
		        3.1.1.1.2 CAT 5e
		        3.1.1.1.3 CAT 6
		        3.1.1.1.4 Plenum
		        3.1.1.1.5 Shielded twisted pair
		        3.1.1.1.6 Unshielded twisted pair
		        3.1.1.1.7 568A/B
		      3.1.1.2 Fiber
		      3.1.1.3 Coaxial
		      3.1.1.4 Speed and Transmission Limiations	

3	Watch the following:
	    Cable Types, Features, and Purposes
	      Connector Types
	      More Connector Types
	      Serial
	      SATA, IDE, SCSI
	      DVI to HDMI, USB to Ethernet, DVI
	      to VGA
	Workbook projects:
	    Fill-in-the-Blanks Domain 3 Item 2
	    Video and Multipurpose Cables
	    Adapters and Hard Drive Cables
		3 Hardware
		  3.1 Explain basic cable types, features, and their purposes
		    3.1.2 Video cables
		      3.1.2.1 VGA
		      3.1.2.2 HDMI
		      3.1.2.3 Mini-HDMI
		      3.1.2.4 DisplayPort
		      3.1.2.5 DVI (DVI-D/DVI-I)
		    3.1.3 Multipurpose cables
		      3.1.3.1 Lightning
		      3.1.3.2 Thunderbolt
		      3.1.3.3 USB
		      3.1.3.4 USB-C
		      3.1.3.5 USB 2.0
		      3.1.3.6 USB 3.0
		    3.1.4 Peripheral cables
		      3.1.4.1 Serial
		    3.1.5 Hard drive cables
		      3.1.5.1 SATA
		      3.1.5.2 IDE
		      3.1.5.3 SCSI
		    3.1.6 Adapters
		      3.1.6.1 DVI to HDMI
		      3.1.6.2 USB to Ethernet
		      3.1.6.3 DVI to VGA	

Day	Tasks	What Is Covered	Notes
4	Watch the following: Common Connector Types Ethernet and Coaxial Connectors Types of USB Connectors, DB-9, Lightning SCSI, eSATA, Molex RAM Types SODIMM, DDR2, DDR3, DDR4 Types of Memory Channels Types of Error Checking Workbook projects: Fill-in-the-Blanks Domain 3 Items 3-7 Common Connectors RAM Types	3 Hardware 3.2 Identify common connector types 3.2.1 RJ-11 3.2.2 RJ-45 3.2.3 RS-232 3.2.4 BNC 3.2.5 RG-59 3.2.6 RG-6 3.2.7 USB 3.2.8 Micro-USB 3.2.9 Mini-USB 3.2.10 USB-C 3.2.11 DB-9 3.2.12 Lightning 3.2.13 SCSI 3.2.14 eSATA 3.2.15 Molex 3 Hardware 3.3 Given a scenario, install RAM types 3.3.1 RAM types 3.3.1.1 SODIMM 3.3.1.2 DDR2 3.3.1.3 DDR3 3.3.14 DDR4 3.3.2 Single channel 3.3.3 Dual channel 3.3.4 Triple channel 3.3.5 Error correcting 3.3.6 Parity vs. non-parity	
5	Review 3.1 through 3.3		
6	Watch the following: Install and Configure Storage Devices Install an Optical Drive Optical Disc Types M2 Drives, NVMe, SATA 2.5 Magnetic Hard Drives Hard Drive Speeds Hard Drive Sizes Hybrid Drives Solid-State Drives Workbook projects: Fill-in-the-Blanks Domain 3 Item 8 Installing an Optical Drive Types of Hard Drives	3 Hardware 3.4 Given a scenario, select, install and configure storage devices 3.4.1 Optical drives 3.4.1.1 CD-ROM/CD-RW 3.4.1.2 DVD-ROM/DVD-RW/DVD-RW DL 3.4.1.3 Blu-ray 3.4.1.4 BD-R 3.4.1.5 BD-RE 3.4.2 Solid-state drives 3.4.2.1 M2 drives 3.4.2.2 NVME 3.4.2.3 SATA 2.5 3.4.3 Magnetic hard drives 3.4.3.1 5,400 rpm 3.4.3.2 7,200 rpm 3.4.3.3 10,000 rpm 3.4.3.4 15,000 rpm 3.4.3.5 Sizes: 3.4.3.5.1 2.5 3.4.3.5.2 3.5 3.4.4 Hybrid drives 3.4.5 Flash 3.4.5.1 SD card 3.4.5.2 CompactFlash 3.4.5.3 MicroSD card 3.4.5.4 MiniSD card 3.4.5.5 xD	

Day	Tasks	What Is Covered	Notes

7	Watch the following:
	   Install and Configure Storage Devices
	      RAID 0, 1, 5, 10
	      Hot Swappable
	   Internal PC Parts
	      Motherboard Types
	Workbook projects:
	   Fill-in-the-Blanks Domain 3 Item 9-10
	   RAID Types
	   An Introduction to Motherboards
		3 Hardware
		  3.4 Given a scenario, select, install and configure storage devices
		    3.4.6 Configurations
		      3.4.6.1 RAID 0, 1, 5, 10
		      3.4.6.2 Hot swappable
		  3.5 Given a scenario, install and configure motherboards, CPUs, and add-on cards
		    3.5.1 Motherboard form factor
		      3.5.1.1 ATX
		      3.5.1.2 mATX
		      3.5.1.3 ITX
		      3.5.1.4 mITX	

8	Watch the following:
	   Internal PC Parts
	      PCI, PCIe
	      Riser Card, Socket Types, SATA, IDE
	      Front Panel Connectors
	      Internal USB Connector
	      BIOS/UEFI Settings
	      Boot Options and Configurations
	      Security Settings and BIOS Passwords
	      TPM, LoJack, Secure Boot
	      CMOS Battery
	Practice Lab:
	   Displaying the BIOS Version
	Workbook project:
	   Motherboard Connectors
		3 Hardware
		  3.5 Given a scenario, install and configure motherboards, CPUs, and add-on cards
		    3.5.2 Motherboard connectors types
		      3.5.2.1 PCI
		      3.5.2.2 PCIe
		      3.5.2.3 Riser card
		      3.5.2.4 Socket types
		      3.5.2.5 SATA
		      3.5.2.6 IDE
		      3.5.2.7 Front panel connector
		      3.5.2.8 Internal USB connector
		    3.5.3 BIOS/UEFI settings
		      3.5.3.1 Boot options
		      3.5.3.2 Firmware updates
		      3.5.3.3 Security settings
		      3.5.3.4 Interface configurations
		      3.5.3.3 Security
		        3.5.3.5.1 Passwords
		        3.5.3.5.2 Drive encryption
		          3.5.3.5.2.1 TPM
		          3.5.3.5.2.2 LoJack
		          3.5.3.5.2.3 Secure boot
		    3.5.4 CMOS battery	

Day	Tasks	What Is Covered	Notes
9	Workbook project: BIOS/UEFI Settings and the CMOS Battery Watch the following: Internal PC Parts CPU Features Integrated GPU Compatibility, AMD, Intel Cooling Mechanism, Fans CPU Cooling Workbook projects: Fill-in-the-Blanks Domain 3 Items 11-12 CPU Characteristics and Cooling	3 Hardware 3.5 Given a scenario, install and configure motherboards, CPUs, and add-on cards 3.5.3 BIOS/UEFI settings 3.5.3.1 Boot options 3.5.3.2 Firmware updates 3.5.3.3 Security settings 3.5.3.4 Interface configurations 3.5.3.3 Security 3.5.3.5.1 Passwords 3.5.3.5.2 Drive encryption 3.5.3.5.2.1 TPM 3.5.3.5.2.2 LoJack 3.5.3.5.2.3 Secure boot 3.5.4 CMOS battery 3.5.5 CPU features 3.5.5.1 Single-core 3.5.5.2 Multicore 3.5.5.3 Virtualization 3.5.5.4 Hyperthreading 3.5.5.5 Speeds 3.5.5.6 Overclocking 3.5.5.7 Integrated GPU 3.5.6 Compatibility 3.5.6.1 AMD 3.5.6.2 Intel 3.5.7 Cooling mechanism 3.5.7.1 Fans 3.5.7.2 Heat sink 3.5.7.3 Liquid 3.5.7.4 Thermal paste	
10	Watch the following: Internal PC Parts Expansion Cards Network Interface Card USB Expansion Card, eSATA Card Workbook project: Installing PC Expansion Cards Review 3.4-3.5	3 Hardware 3.5 Given a scenario, install and configure motherboards, CPUs, and add-on cards 3.5.8 Expansion cards 3.5.8.1 Video cards 3.5.8.1.1 Onboard 3.5.8.1.2 Add-on card 3.5.8.2 Sound cards 3.5.8.3 Network interface card 3.5.8.4 USB expansion card 3.5.8.5 eSATA card	

Day	Tasks	What Is Covered	Notes

11	Watch the following:
	    Peripheral Types
	        Printers and Scanners
	        Monitors, VR, Optical Drive Types
	        Input Devices and Speakers
	        Other Peripherals
	Workbook projects:
	    Fill-in-the-Blanks Domain 3 Item 13
	    Types of Peripherals
		3 Hardware
		  3.6 Explain the purposes and uses of various peripheral types
		    3.6.1 Printer
		    3.6.2 ADF/flatbed scanner
		    3.6.3 Barcode scanner/QR scanner
		    3.6.4 Monitors
		    3.6.5 VR headset
		    3.6.6 Optical drive types
		    3.6.7 Mouse
		    3.6.8 Keyboard
		    3.6.9 Touchpad
		    3.6.10 Signature pad
		    3.6.11 Game controllers
		    3.6.12 Camera/webcam
		    3.6.13 Microphone
		    3.6.14 Speakers
		    3.6.15 Headset
		    3.6.16 Projector
		    3.6.16.1 Lumens/brightness
		    3.6.17 External storage drives
		    3.6.18 KVM
		    3.6.19 Magnetic reader/chip reader
		    3.6.20 NFC/tap pay device
		    3.6.21 Smart card reader	

Day	Tasks	What Is Covered	Notes

12	Watch the following:
	    Power Supply Types and Features
	      Power and Power Supplies
	    PC Configurations
	      Types of Workstations
	      Audio/Video Editing Workstations
	      Virtualization Workstation
	      Gaming PCs
	      NAS Devices
	      Thick Clients
	      Thin Clients
	Workbook projects:
	    Fill-in-the-Blanks Domain 3 Items 14-16
	    Power Supply Types and Features
	    Custom PC Configurations
		3 Hardware
		  3.7 Summarize power supply types and features
		    3.7.1 Input 115V vs. 220V
		    3.7.2 Output 5V vs. 12V
		    3.7.3 24-pin motherboard adapter
		    3.7.4 Wattage rating
		    3.7.5 Number of devices/types of devices to be powered
		  3.8 Given a scenario, select and configure appropriate components for a custom PC configuration to meet customer specifications or needs
		    3.8.1 Graphic/CAD/CAM design workstation
		      3.8.1.1 SSD
		      3.8.1.2 High-end video
		      3.8.1.3 Maximum RAM
		    3.8.2 Audio/video editing workstation
		      3.8.2.1 Specialized audio and video card
		      3.8.2.2 Large, fast hard drive
		      3.8.2.3 Dual monitors
		    3.8.3 Virtualization workstation
		      3.8.3.1 Maximum RAM and CPU cores
		    3.8.4 Gaming PC
		      3.8.4.1 SSD
		      3.8.4.2 High-end video/specialized GPU
		      3.8.4.3 High-definition sound card
		      3.8.4.4 High-end cooling
		    3.8.5 Network attached storage device
		      3.8.5.1 Media streaming
		      3.8.5.2 File sharing
		      3.8.5.3 Gigabit NIC
		      3.8.5.4 RAID array
		      3.8.5.5 Hard drive
		    3.8.6 Standard thick client
		      3.8.6.1 Desktop applications
		      3.8.6.2 Meets recommended requirements for selected OS
		    3.8.7 Thin client
		      3.8.7.1 Basic applications
		      3.8.7.2 Meets minimum requirements for selected OS
		      3.8.7.3 Network connectivity	

13	Review 3.6-3.8		

Day	Tasks	What Is Covered	Notes

14	Watch the following:
	  Install and Configure Common Devices
	    Thin Client, Thick Client
	    Account Setup/Settings
	    Touchpad Configuration
	    Touch screen, App, and Install Settings
	    Synchronization Settings
	    More Account Settings
	    Wireless Settings
	  Configure Printers and Settings
	    Configuration Settings
	    Print Settings
	Practice lab:
	  Touch screen Configuration
	Workbook projects:
	  Fill-in-the-Blanks Domain 3 Items 17-18
	  Install and Configure Common Devices
	  Installing and Configuring Printers
		3 Hardware
		  3.9 Given a scenario, install and configure common devices
		    3.9.1 Desktop
		      3.9.1.1 Thin client
		      3.9.1.2 Thick client
		      3.9.1.3 Account setup/settings
		    3.9.2 Laptop/common mobile devices
		      3.9.2.1 Touchpad configuration
		      3.9.2.2 Touch screen configuration
		      3.9.2.3 Application installations/configurations
		      3.9.2.4 Synchronization settings
		      3.9.2.5 Account setup/settings
		      3.9.2.6 Wireless settings
		  3.10 Given a scenario, configure SOHO multifunction devices/printers and settings
		    3.10.1 Use appropriate drivers for a given operating system
		      3.10.1.1 Configuration settings
		        3.10.1.1.1 Duplex
		        3.10.1.1.2 Collate
		        3.10.1.1.3 Orientation
		        3.10.1.1.4 Quality	

15	Watch the following:
	  Configure Printers and Settings
	    USB, Serial
	    Ethernet
	    Wireless Configurations
	    Integrated Print Server
	    Share Devices
	Practice lab:
	  Sharing Printers
	Workbook projects:
	  Fill-in-the-Blanks Domain 3 Items 19-20
	  Printer and Device Sharing
		3 Hardware
		  3.10 Given a scenario, configure SOHO multifunction devices/printers and settings
		    3.10.2 Device sharing
		      3.10.2.1 Wired
		        3.10.2.1.1 USB
		        3.10.2.1.2 Serial
		        3.10.2.1.3 Ethernet
		      3.10.2.2 Wireless
		        3.10.2.2.1 Bluetooth
		        3.10.2.2.2 802.11(a, b, g, n, ac)
		        3.10.2.2.3 Infrastructure vs. ad hoc
		      3.10.2.3 Integrated print server (hardware)
		      3.10.2.4 Cloud printing/remote printing
		    3.10.3 Public/shared devices
		      3.10.3.1 Sharing local/networked device via operating system settings
		        3.10.3.1.1 TCP/Bonjour/AirPrint
		      3.10.3.2 Data privacy
		        3.10.3.2.1 User authentication on the device
		        3.10.3.2.2 Hard drive caching	

Day	Tasks	What Is Covered	Notes

16	Watch the following:
	  Install and Maintain Printers
	    Laser Printer Parts
	    Laser Printer Process
	    Laser Printer Maintenance
	    Inkjet Printer Processes
	Workbook projects:
	  Fill-in-the-Blanks Domain 3 Item 21
	  Laser Printer Technologies
	  Inkjet Printer Technologies
		3 Hardware
		  3.11 Given a scenario, install and maintain various print technologies
		    3.11.1 Laser
		    3.11.1.1 Imaging drum, fuser assembly, transfer belt, transfer roller, pickup rollers, separate pads, duplexing assembly
		    3.1.11.2 Imaging process: processing, charging, exposing, developing, transferring, fusing, and cleaning
		    3.1.11.3 Maintenance: Replace toner, apply maintenance kit, calibrate, clean
		    3.11.2 Inkjet
		    3.11.2.1 Ink cartridge, print head, roller, feeder, duplexing assembly, carriage, and belt
		    3.11.2.2 Calibrate
		    3.11.2.3 Maintenance: Clean heads, replace cartridges, calibrate, clear jams	

17	Watch the following:
	  Install and Maintain Printers
	    Thermal Printer Processes
	    Thermal Printer Maintenance
	    Impact Printer Processes
	    Impact Printer Maintenance
	    Print to File
	    Print to PDF
	    Print to XPS
	    Print to Image
	    3D Printers
	Workbook projects:
	  Fill-in-the-Blanks Domain 3 Items 22-23
	  Thermal and Impact Printer Technologies
	  Virtual and 3-D Printing
		3 Hardware
		  3.11 Given a scenario, install and maintain various print technologies
		    3.11.3 Thermal
		    3.11.3.1 Feed assembly, heating element
		    3.11.3.2 Special thermal paper
		    3.11.3.3 Maintenance: Replace paper, clean heating element, remove debris
		    3.11.4 Impact
		    3.11.4.1 Print head, ribbon, tractor feed
		    3.11.4.2 Impact paper
		    3.11.4.3 Maintenance: Replace ribbon, replace print head, replace paper	

18	Review		
19	Post-Assessment		
20	Post-Assessment		
21	Post-Assessment		
22	Post-Assessment		
23	Post-Assessment		
24	Post-Assessment		

Domain 4: Virtualization and Cloud Computing
5 lessons for approximately 2.5 hours

Day	Tasks	What Is Covered	Notes

1	Pre-Assessment
	Watch the following:
	  Cloud Computing Concepts
	    Common Cloud Models
	    IaaS
	    SaaS
	    PaaS
	    Types of Cloud Infrastructures
	Workbook projects:
	  Fill-in-the-Blanks Domain 4 Items 1-2
	  Types of Cloud Infrastructures
		4 Virtualization and Cloud Computing
		  4.1 Compare and contrast cloud computing concepts
		    4.1.1 Common cloud models
		      4.1.1.1 IaaS
		      4.1.1.2 SaaS
		      4.1.1.3 PaaS
		      4.1.1.4 Public vs. private vs. hybrid vs. community	

2	Watch the following:
	  Cloud Computing Concepts
	    Internal vs. External, Rapid Elasticity
	    On-Demand, Resource Pooling
	    Measured Service
	    Metered
	    Off-Site Email Apps
	    Synchronization Apps
	    Cloud Storage Apps
	    Virtual NIC
	Workbook projects:
	  Fill-in-the-Blanks Domain 4 Items 3-4
	  Other Basic Cloud Concepts
		4 Virtualization and Cloud Computing
		  4.1 Compare and contrast cloud computing concepts
		    4.1.2 Shared resources
		      4.1.2.1 Internal vs. external
		    4.1.3 Rapid elasticity
		    4.1.4 On-demand
		    4.1.5 Resource pooling
		    4.1.6 Measured service
		    4.1.7 Metered
		    4.1.8 Off-site email applications
		    4.1.9 Cloud file storage services
		      4.1.9.1 Synchronization apps
		    4.1.10 Virtual application streaming/cloud-based applications
		      4.1.10.1 Applications for cell phones/tablets
		      4.1.10.2 Applications for laptops/desktops
		    4.1.11 Virtual desktop
		      4.1.11.1 Virtual NIC	

3	Watch the following:
	  Client-Side Virtualization
	    Purpose of Virtual Machines
	    Resource Requirements
	    Emulator Requirements
	    Security and Network Requirements
	    Hypervisor
	Workbook projects:
	  Fill-in-the-Blanks Domain 4 Items 5-6
	  Application States
		4 Virtualization and Cloud Computing
		  4.2 Given a scenario, set up and configure client-side virtualization
		    4.2.1 Purpose of virtual machines
		    4.2.2 Resource requirements
		    4.2.3 Emulator requirements
		    4.2.4 Security requirements
		    4.2.5 Network requirements
		    4.2.6 Hypervisor	

4	Review		
5	Post-Assessment		

Domain 5: Hardware and Network Troubleshooting
18 lessons for approximately 9 hours

Day	Tasks	What Is Covered	Notes
1	Pre-Assessment		

2	Watch the following:
	
	Troubleshooting Methods
	  Policies, Procedures, Impact, First Step
	  Steps to Identify the Problem
	  Inquiries
	  Review System and Application Logs
	  Establish a Theory of Probable Cause
	  Test the Theory
	  Plan of Action to Resolve and Solve
	  Verify Functionality
	  Document Findings, Actions, and
	  Outcomes
	
	Workbook projects:
	  Fill-in-the-Blanks Domain 5 Items 1-2
	  The Troubleshooting Theory
		5 Hardware and Network Troubleshooting
		  5.1 Given a scenario, use the best practice methodology to resolve problems
		    5.1.1 Always consider corporate policies, procedures, and impacts before implementing changes
		    5.1.2. 1. Identify the problem
		      5.1.2.1 Question the user and identify user changes to computer and perform backups before making changes
		      5.1.2.2 Inquire regarding environmental or infrastructure changes
		      5.1.2.3 Review system and application logs
		    5.1.3 2. Establish a theory of probable cause (question the obvious)
		      5.1.3.1 If necessary, conduct external or internal research based on symptoms
		    5.1.4 3. Test the theory to determine cause
		      5.1.4.1 Once the theory is confirmed, determine the next steps to resolve problem
		      5.1.4.2 If theory is not confirmed re-establish new theory or escalate
		    5.1.5 4. Establish a plan of action to resolve the problem and implement the solution
		    5.1.6 5. Verify full system functionality and, if applicable, implement preventive measure
		    5.1.7 6. Document findings, actions, and outcomes	

3	Watch the following:
	
	Troubleshoot Hardware Problems
	  Shutdowns and Lockups
	  POST Code Beeps
	  Blank Screen on Bootup
	  BIOS Related Issues
	  Continuous Reboots
	  No Power
	  Overheating
	  Noises and Intermittent Failures
	  Spinning Fans but No Power
	  Other Indicators
	  Distended Capacitors
	  Log Entries and Error Messages
	
	Workbook projects:
	  Fill-in-the-Blanks Domain 5 Items 3-5
	  Common Hardware Problems
		5 Hardware and Network Troubleshooting
		  5.2 Given a scenario, troubleshoot problems related to motherboards, RAM, CPUs, and power
		    5.2.1 Common symptoms
		      5.2.1.1 Unexpected shutdowns
		      5.2.1.2 System lockups
		      5.2.1.3 POST code beeps
		      5.2.1.4 Blank screen on bootup
		      5.2.1.5 BIOS time and setting resets
		      5.2.1.6 Attempts to boot to incorrect device
		      5.2.1.7 Continuous reboots
		      5.2.1.8 No power
		      5.2.1.9 Overheating
		      5.2.1.10 Loud noise
		      5.2.1.11 Intermittent device failure
		      5.2.1.12 Fans spin – no power to other devices
		      5.2.1.13 Indicator lights
		      5.2.1.14 Smoke
		      5.2.1.15 Burning smell
		      5.2.1.16 Proprietary crash screens (BSOD/pin wheel)
		      5.2.1.17 Distended capacitors
		      5.2.1.18 Log entries and error messages	

Day	Tasks	What Is Covered	Notes

4	Watch the following:
	  Troubleshoot Hard Drives and RAIDs
	    Read/Write Failure
	    Slow Performance
	    Loud Clicking Noise
	    Boot Failures, Missing Items, Crashes
	    S.M.A.R.T. Errors
	Practice lab:
	  Write Failures
	Workbook projects:
	  Fill-in-the-Blanks Domain 5 Items 6-8
	  Common Hard Drive Problems
		5 Hardware and Network Troubleshooting
		  5.3 Given a scenario, troubleshoot hard drives and RAID arrays
		    5.3.1 Common symptoms
		      5.3.1.1 Read/write failure
		      5.3.1.2 Slow performance
		      5.3.1.3 Loud clicking noise
		      5.3.1.4 Failure to boot
		      5.3.1.5 Drive not recognized
		      5.3.1.6 OS not found
		      5.3.1.7 RAID not found
		      5.3.1.8 RAID stops working
		      5.3.1.9 Proprietary crash screens (BSOD/pin wheel)
		      5.3.1.10 S.M.A.R.T. errors	

5	Watch the following:
	  Troubleshoot Video and Display Issues
	    Common Symptoms
	Practice lab:
	  Large Icons
	Workbook projects:
	  Fill-in-the-Blanks Domain 5 Items 9-10
	  Common Display Problems
		5 Hardware and Network Troubleshooting
		  5.4 Given a scenario, troubleshoot video, projector, and display issues
		    5.4.1 Common symptoms
		      5.4.1.1 VGA mode
		      5.4.1.2 No image on screen
		      5.4.1.3 Overheat shutdown
		      5.4.1.4 Dead pixels
		      5.4.1.5 Artifacts
		      5.4.1.6 Incorrect color patterns
		      5.4.1.7 Dim image
		      5.4.1.8 Flickering image
		      5.4.1.9 Distorted image
		      5.4.1.10 Distorted geometry
		      5.4.1.11 Burn-in
		      5.4.1.12 Oversized images and icons	

6	Watch the following:
	  Troubleshoot Mobile Device Issues
	    No Display or Dim Display
	    Flickering Display or Sticky Keys
	    Intermittent Wireless
	    Battery Not Charging
	    Cursor and Power Problems, Lock Lights
	    No Wireless Connectivity
	    No Bluetooth Connectivity
	    External Monitor Display Issues
	    Other Mobile Device Issues
	Practice lab:
	  No Wireless Connectivity
	Workbook projects:
	  Fill-in-the-Blanks Domain 5 Items 11-12
	  Common Mobile Device Symptoms
		5 Hardware and Network Troubleshooting
		  5.5 Given a scenario, troubleshoot common mobile device issues while adhering to the appropriate procedures
		    5.5.1 Common symptoms
		      5.5.1.1 No display
		      5.5.1.2 Dim display
		      5.5.1.3 Flickering display
		      5.5.1.4 Sticking keys
		      5.5.1.5 Intermittent wireless
		      5.5.1.6 Battery not charging
		      5.5.1.7 Ghost cursor/pointer drift
		      5.5.1.8 No power
		      5.5.1.9 Num lock indicator lights
		      5.5.1.10 No wireless connectivity
		      5.5.1.11 No Bluetooth connectivity
		      5.5.1.12 Cannot display to external monitor
		      5.5.1.13 Touch screen non-responsive
		      5.5.1.14 Apps not loading
		      5.5.1.15 Slow performance
		      5.5.1.16 Unable to decrypt email
		      5.5.1.17 Extremely short battery life
		      5.5.1.18 Overheating
		      5.5.1.19 Frozen system
		      5.5.1.20 No sound from speakers
		      5.5.1.21 GPS not functioning
		      5.5.1.22 Swollen battery	

Day	Tasks	What Is Covered	Notes
7	Watch the following: Troubleshoot Mobile Device Issues Disassembly Procedures Manufacturer Resources Correct Hand Tools Workbook projects: Fill-in-the-Blanks Domain 5 Items 13-14 Mobile Device Disassembling Processes	5 Hardware and Network Troubleshooting 5.5 Given a scenario, troubleshoot common mobile device issues while adhering to the appropriate procedures 5.5.2 Disassembling processes for proper reassembly 5.5.2.1 Document and label cable and screw locations 5.5.2.2 Organize parts 5.5.2.3 Refer to manufacturer resources 5.5.2.4 Use appropriate hand tools	
8	Watch the following: Troubleshoot Printers Paper Jam Common Printer Problems Other Common Printer Problems Practice lab: Print Queue Problems Workbook projects: Fill-in-the-Blanks Domain 5 Items 15-16 Common Printer Problems	5 Hardware and Network Troubleshooting 5.6 Given a scenario, troubleshoot printers 5.6.1 Common symptoms 5.6.1.1 Streaks 5.6.1.2 Faded prints 5.6.1.3 Ghost images 5.6.1.4 Toner not fused to the paper 5.6.1.5 Creased paper 5.6.1.6 Paper not feeding 5.6.1.7 Paper jam 5.6.1.8 No connectivity 5.6.1.9 Garbled characters on paper 5.6.1.10 Vertical lines on page 5.6.1.11 Backed-up print queue 5.6.1.12 Low memory errors 5.6.1.13 Access denied 5.6.1.14 Printer will not print 5.6.1.15 Color prints in wrong print color 5.6.1.16 Unable to install printer 5.6.1.17 Error codes 5.6.1.18 Printing blank pages 5.6.1.19 No image on printer display 5.6.1.20 Multiple failed jobs in logs	
9	Watch the following: Wired and Wireless Network Problems Connectivity and Resource Issues Shares and Printers Email, IP Address, and Signal Issues Conclusion Workbook projects: Wired and Wireless Network Symptoms	5 Hardware and Network Troubleshooting 5.7 Given a scenario, troubleshoot common wired and wireless network problems 5.7.1 Common symptoms 5.7.1.1 Limited connectivity 5.7.1.2 Unavailable resources 5.7.1.2.1 Internet 5.7.1.2.2 Local resources 5.7.1.2.2.1 Shares 5.7.1.2.2.2 Printers 5.7.1.2.2.3 Email 5.7.1.3 No connectivity 5.7.1.4 APIPA/link local address 5.7.1.5 Intermittent connectivity 5.7.1.6 IP conflict 5.7.1.7 Slow transfer speeds 5.7.1.8 Low RF signal 5.7.1.9 SSID not found	
10	Review		
11	Post-Assessmemt		
12	Post-Assessmemt		
13	Post-Assessmemt		
14	Post-Assessmemt		

A+ Part 1 (220-100) Domain 1 Outline

Laptop Hardware and Components

Introduction
Hardware Device Replacment
Keyboard
Hard Drive
Hard Drive Types and Sizes
Memory
Smart Card Reader
Optical Drives and Wireless Cards
Cellular and Video Cards, Mini PCIe
Other Laptop Parts

Install Laptop Display Components

LCD and OLED
Media Parts

Laptop Features

Special Function Keys
More Special Function Keys
Expanders and Locks
Rotating/Removable Screens

Types of Mobile Devices

Tablets, Smartphones, Wearables
Smart Watches and Fitness Monitors
VR/AR Headsets, E-Readers, and GPS

Mobile Device Accessories and Ports

Connector Types
Wireless Connection Types
Headsets and Speakers
Game Pads and Other Accessories

Mobile Device Networks and Apps

Hotspots, Airplane Mode, and Bluetooth
Email Settings
Commercial Email Providers
Baseband and Other Updates
Radio Firmware and IMEI vs. IMSI
VPN

Mobile Device Synchronization

Cloud Synchronization
Other Synchronization Types
Contacts and Applications
Email
Pictures, Music, and Videos
Calendar
Bookmarks
Documents
Location Data
Social Media Data and E-Readers
Passwords
SSO
Software Requirements, Connection Types

A+ Part 1 (220-1001) Domain 2 Outline

Ports, Protocols, and Their Purposes

Ports and Protocols
21 – FTP
22 – SSH and 23 – Telnet
25 – SMTP and 53 – DNS
Web and Email Protocols
3389 – RDP
137-139 – NetBIOS/NetBT
445 – SMB/CIFS
427 – SLP, 548 – AFP, 67-68 – DHCP
389 – LDAP and 161/162 – SNMP
TCP vs. UDP

Networking Hardware Devices

Routers and Switches
Access Points
Cloud-Based Firewalls and NICs
Repeater
Hub and Cable/DSL Modem
Bridge and Patch Panel
Ethernet and Power

SOHO Networks

Router/Switch Functionality
Access Point Settings
Wired
Wireless and End-User Configuration
IoT Device Configuration
Cable/DSL Modem Configuration
DMZ
Port Forwarding
NAT
UPnP
Whitelist/Blacklist
MAC Filtering
QoS
Encryption
Channels
More QoS

Wireless Networking Protocols

Frequencies
2.4 GHz Channels
Bluetooth, NFC, RFID, and IoT
3G, 4G, 5G and LTE

Server Types

Web Server
File Server
Print Server
DHCP Server
DNS Server
Other Servers
Syslog
UTM, IDS, and IPS
Endpoint Management Server
Legacy/Embedded Systems

IP Addressing

Static
Dynamic
APIPA and Link-Local Addresses
DNS
Reservations
IP Addresses and Subnet Masks
Gateway
VPN, VLAN, NAT

Internet Connection Types

Cable, DSL, Dial-Up, and Fiber
Satellite, ISDN
Tethering and Mobile Hotspots
Line-of-Sight Wireless
Network Types

Networking Tools

Crimper, Cable Stripper, Multimeter
Cable and Connector Testers
Punchdown Tool, Wi-Fi Analyzer

A+ Part 1 (220-1001) Domain 3 Outline

Cable Types, Features, and Purposes

Network Cables

CAT 5, CAT 5e, CAT 6, Plenum

Types of Twisted Pair and Connectors

Fiber, Coaxial, and Overall Limitations

Connector Types

More Connector Types

Serial

SATA, IDE, SCSI

DVI to HDMI, USB to Ethernet, DVI to VGA

Common Connector Types

Ethernet and Coaxial Connectors

Types of USB Connectors, DB-9, Lightning

SCSI, eSATA, Molex

RAM Types

SODIMM, DDR2, DDR3, DDR4

Types of Memory Channels

Types of Error Checking

Install and Configure Storage Devices

Install an Optical Drive

Optical Disc Types

M2 Drives, NVMe, SATA 2.5

Magnetic Hard Drives

Hard Drive Speeds

Hard Drive Sizes

Hybrid Drives

Solid-State Drives

RAID 0, 1, 5, 10

Hot Swappable

Internal PC Parts

Motherboard Types

PCI, PCIe

Riser Card, Socket Types, SATA, IDE

Front Panel Connectors

Internal USB Connector

BIOS/UEFI Settings

Boot Options and Configurations

Security Settings and BIOS Passwords

TPM, LoJack, Secure Boot

CMOS Battery

CPU Features

Integrated GPU

Compatibility, AMD, Intel

Cooling Mechanism, Fans

CPU Cooling

Expansion Cards

Network Interface Card

USB Expansion Card, eSATA Card

Peripheral Types

Printers and Scanners

Monitors, VR, Optical Drive Types

Input Devices and Speakers

Other Peripherals

Power Supply Types and Features

Power and Power Supplies

PC Configurations

Types of Workstations

Audio/Video Editing Workstations

Virtualization Workstation

Gaming PCs

NAS Devices

Thick Clients

Thin Clients

Install and Configure Common Devices

Thin Client, Thick Client

Account Setup/Settings

Touchpad Configuration

Touch Screen, App, and Install Settings

Synchronization Settings

More Account Settings

Wireless Settings

Configure Printers and Settings

Configuration Settings

Print Settings

USB, Serial

Ethernet

Wireless Configurations

Integrated Print Server

Share Devices

Install and Maintain Printers

Laser Printer Parts

Laser Printer Process

Laser Printer Maintenance

Inkjet Printer Processes

Thermal Printer Processes

Thermal Printer Maintenance

Impact Printer Processes

Impact Printer Maintenance

Print to File

Print to PDF

Print to XPS

Print to Image

3-D Printers

A+ Part 1 (220-1001) Domain 4 Outline

Cloud Computing Concepts

Common Cloud Models
IaaS
SaaS
PaaS
Types of Cloud Infrastructures
Internal vs. External, Rapid Elasticity
On-Demand, Resource Pooling
Measured Service
Metered
Off-Site Email Apps
Synchronization Apps
Cloud Storage Apps
Virtual NIC

Client-Side Virtualization

Purpose of Virtual Machines
Resource Requirements
Emulator Requirements
Security and Network Requirements
Hypervisor

A+ Part 1 (220-1001) Domain 5 Outline

Troubleshooting Methods

Policies, Procedures, Impact, First Step
Steps to Identify the Problem
Inquiries
Review System and Application Logs
Establish a Theory of Probable Cause
Test the Theory
Plan of Action to Resolve and Solve
Verify Functionality
Document Findings, Actions, and Outcomes

Troubleshoot Hardware Problems

Shutdowns and Lockups
POST Code Beeps
Blank Screen on Bootup
BIOS Related Issues
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Overheating
Noises and Intermittent Failures
Spinning Fans but No Power
Other Indicators
Distended Capacitors
Log Entries and Error Messages

Troubleshoot Hard Drives and RAIDs

Read/Write Failure
Slow Performance
Loud Clicking Noise
Boot Failures, Missing Items, Crashes
S.M.A.R.T. Errors

Troubleshoot Video and Display Issues

Common Symptoms

Troubleshoot Mobile Device Issues

No Display or Dim Display
Flickering Display or Sticky Keys
Intermittent Wireless
Battery Not Charging
Cursor and Power Problems, Lock Lights
No Wireless Connectivity
No Bluetooth Connectivity
External Monitor Display Issues
Other Mobile Device Issues
Disassembly Procedures
Manufacturer Resources
Correct Hand Tools

Troubleshoot Printers

Paper Jam
Common Printer Problems
Other Common Printer Problems

Wired and Wireless Network Problems

Connectivity and Resource Issues
Shares and Printers
Email, IP Address, and Signal Issues
Conclusion

A+ Part 1 (220-1001)
Project Workbook

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