



Curriculum Analysis Report

**CompTIA's A+
CURRICULUM**

September 2023

The WorkKeys Profiling system is designed exclusively for use with the WorkKeys Assessments. ACT makes no representations regarding the efficacy or predictive value of the WorkKeys Profile if used with any other assessment.

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Executive Summary

CompTIA and ACT recognize the benefits to stakeholders of “stacking” CompTIA A+ Core 1 and Core 2 certification credentials upon ACT’s WorkKeys Assessments, specifically the National Career Readiness Certificate (NCRC), as the “foundation” for CompTIA’s A+ credentialing program. The WorkKeys Applied Technology and Workplace Observation skills were also included in the study because of their relevance to the program. The results of the current project and review of its findings can help guide the selection of students into the training programs and encourage skill development for those applicants whose skills currently do not match the recommendations for entry.

The WorkKeys curriculum profiling procedure is designed to identify the skills and the skill levels needed to enter and successfully complete a training program. When combined with the remaining components of the WorkKeys system, (i.e., the assessments, instructional support, and reporting), curriculum profiles provide educators with information regarding an individual’s readiness for training and provide individuals with the information they need to recognize the areas they may need to strengthen as they pursue their education and career goals.

The profile was conducted by ACT’s Industrial/Organizational Psychologist and profiler Cindy Hill, Ph.D. (Dr. Hill). The curriculum profiling procedure includes the following:

- A review of the curriculum materials available in the E-learning portal
- A review of the Core 1 and 2 Exam Objectives and their crosswalk to the curriculum
- A skill analysis to 1) identify the WorkKeys skills required to accomplish each exam objective, and 2) identify how the skills are used during the training program
- A skill level-setting to determine the skill levels recommended for entry into and for successful completion of the CompTIA A+ training and exams

Skill Level Recommendations for Entry into and Exit from CompTIA’s A+ Curriculum and Core I and II Exams

WorkKeys Skill	Skill Level Range	Entry	Exit
Workplace Documents	3-7	4	5
Graphic Literacy	3-7	4	5
Applied Math	3-7	4	5
Applied Technology	3-6	4	5
Workplace Observation	1-5	2	3

Section 1

Curriculum Review

The first step in conducting the profile was to obtain background information on the A+ program from representatives. This included obtaining the exam objectives and access to the curriculum.

The Computing Technology Industry Association (CompTIA) is an American non-profit trade association, issuing professional certifications for the information technology industry. It is considered one of the IT industry's top trade associations. The CompTIA A+ certification is designed to help students land an entry-level position in IT by ensuring they know the basics of working with hardware, networks, and computer systems. The certification is widely recognized as the go-to certification for an entry-level position in IT. A few entry-level jobs that often call for the CompTIA A+ certification include Help desk analyst, IT technician, Help desk specialist, Technical support specialist, Desktop support administrator, System support specialist, and Associate network engineer.

The content for the Core I and II exams is drawn from a combination of industry-wide survey feedback and contributions from CompTIA's team of subject matter experts (SMEs). Approximately 5,000 SME hours are required to develop one exam. SMEs contribute their expertise by participating in focus groups, item writing sessions and item review sessions. The result is a rigorous exam development process representing thousands of hours.

A trained psychologist/psychometrician assists the development, review and maintenance of the exam. This ensures that the test and the test development process are legally defensible. CompTIA's exam development process abides by and exceeds the test development standards of the following:

- Uniform Guidelines on Employee Selection Procedures (Guidelines) published by U.S. Equal Opportunity Commission, and
- The Standards for Educational and Psychological Testing (Standards) published by the American Educational Research Association, the American Psychological Association, and the National Council on Measurement in Education.

Additionally, CompTIA's A+ certification is accredited by the ANSI National Accreditation Board (ANAB) under the ISO 17024 standard.

CompTIA provides high-quality training materials for candidates who are seeking to enhance their on-the-job skills. Similarly, CompTIA produces world-class certification exams that validate the skills required for a candidate to perform efficiently and effectively on the job. Official CompTIA content and training materials are created independently of the certification exams and in collaboration with different subject matter experts. CompTIA learning content and training materials are rigorously evaluated to ensure coverage of the published exam objectives. These materials offer candidates the opportunity to prepare for CompTIA certification exams using best-in-class content and learning techniques.

It is the goal of CompTIA certification exams to validate candidates have the requisite skills and knowledge as outlined in the exam objectives. To create certifications, CompTIA adheres to strict ANSI guidelines to ensure the entire certification process is free of all bias, including internal bias or unfair advantages candidates might otherwise have by using CompTIA training materials. As a result, CompTIA does not provide any guarantees that candidates who use Official CompTIA content or training materials will pass CompTIA certification exams. CompTIA supports the ongoing development of credentialing best practices through their engagement with the Institute for Credentialing Excellence.

Section 2

Skill Analysis

The skill analysis was conducted by ACT's Industrial/Organizational Psychologist and profiler Cindy Hill, Ph.D. (Dr. Hill). Dr. Cindy Hill has been an Industrial/Organizational Psychologist in Research at ACT, a mission-driven, non-profit organization dedicated to helping people achieve education and workplace success, since 1996. Her work has included the refresh of the National Career Readiness Credential, a portable, evidence-based credential that certifies the essential skills for workplace success. Dr. Hill has been a major contributor to the design and presentation of the WorkKeys Profiling Training Program. She managed the development and implementation of the WorkKeys 7-week profiling training program, which includes paper-based and web-delivered distance learning activities and a face-to-face on-site workshop. Dr. Hill has trained hundreds of people to conduct ACT WorkKeys profiles and provides coaching and support for all profilers. She has worked directly with many different types of service and manufacturing industries including medical, food processing, utilities, music distribution, telecommunications, chemical processing, and oil. For example, her projects have included working with the plastics molding division of a Fortune 200 company with revenue exceeding \$3 billion annually, an agribusiness Fortune 100 company, two chemical processing Fortune 100 companies, and with an international corporation that is one of the largest producers of beverage products. Her recent research has explored the alignment and "stacking" of credentials through standardized frameworks and the use of technology. Dr. Hill has also spent many years developing and reviewing licensure and certification programs. This includes job analysis, the development of test content outlines, national surveys, data analysis, item writing and review, standard setting, and validating the test scores of off-the-shelf and company-specific tests. As part of ACT's partnership with the Association for Talent Development, she developed and facilitates their Test Design and Delivery Certificate Program. This program assists learning professionals to develop valid tests for training, certification, and management decision-making.

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- A review of the curriculum materials available in the E-learning portal
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- A skill analysis to 1) identify the WorkKeys skills required to accomplish each exam objective, and 2) identify how the WorkKeys skills are used during the training program
- A skill level-setting to determine the WorkKeys skill levels recommended for entry into and for successful completion of the CompTIA A+ training

APPLIED MATH

WorkKeys Applied Math is the skill people use when they use mathematical reasoning and problem-solving techniques to solve work-related problems. Students may use calculators and conversion tables to help with the problems, but they still need to use math skills to think them through. Dr. Hill identified 4% of the Core I exam objectives and 1% of the Core II exam objectives as requiring the WorkKeys Applied Math skill.

In evaluating the level of Applied Math skill necessary for the student to master the exam objectives and curriculum, Dr. Hill considered the types of mathematical operations (including single-step or multiple-step mathematical operations and conversions either within or between systems of measurement); how the information in the problem is presented (i.e., the information is presented in the order in which it is needed or it must be reordered); and whether all the information students need for solving problems is provided or if they must derive some necessary information that must be considered. Dr. Hill evaluated the curriculum in comparison to WorkKeys Applied Math skill levels 3 through 7 and determined that WorkKeys Applied Math Level 4 is recommended for entry into the A+ training and students may reach Applied Math Level 5 by the completion of the training.

At Applied Math Level 4, exam objectives and curriculum may present information out of order and may include extra unnecessary information. One or two operations may be needed to solve the problem. A chart, diagram, or graph may be included. When students use Level 4 Applied Math skills, they can solve problems that require one or two operations. They may add, subtract, or multiply using positive or negative numbers, and they may divide positive numbers. They can figure out an average or mean of a set of numbers using whole numbers and decimals. They can figure out simple ratios, simple proportions, or rates. At Level 4 students can add commonly known fractions, decimals, or percentages and add or subtract fractions that share a common denominator. They can multiply a mixed number by a whole number or decimal and they can put the information in the right order before they perform calculations.

Students will need Applied Math Level 4 skills when determining resource requirements for system memory. Students will need a basic understanding of ratios because each guest operating system (OS) requires sufficient system memory over and above what is required by the host OS/hypervisor. For example, it is recommended that Windows 10 be installed on a computer with at least 2 GB memory. This means that the virtualization workstation must have at least 4 GB RAM to run the host and a single Windows 10 guest OS. The resource demands can quickly add up if multiple guest OSs need to run concurrently.

Students need to understand negative numbers when determining the comparative strength of the data signal to the background noise also called the signal-to-noise ratio (SNR). Noise is measured in dBm, and values closer to zero represent higher noise levels. For example, if signal is -65 dBm and noise is -90 dBm, the SNR is the difference between the two values, expressed in dB (25 dB). If noise is -80 dBm, the SNR is 15 dB and the connection will be much worse.

At Applied Math Level 5, the information may not be presented in logical order; the item may contain extraneous information; it may contain a chart, graph, or diagram; and the mathematical set-up may be complicated. In solving the problem, the student may need to perform multiple operations. When students use Level 5 Applied Math skills, they must decide what information, calculations, or unit conversions to use to find the answer to a problem. As part of a multiple step problem, the student may have to find one value and use it to find another value that answers the question. They can add and subtract fractions with unlike denominators. Students can convert units within or between systems of measurement where the formula is provided such as converting from ounces to pounds or from centimeters to inches. They can solve problems that require mathematical operations using mixed units. They can identify the best deal by doing one- and two-step calculations and then comparing the results to determine the solution that meets the stated conditions. At Level 5, students can calculate perimeters, circumference, and areas of basic shapes like rectangles and circles. They can calculate a given percentage of a given number and then use that percentage to determine the solution. They can identify where a mistake occurred in a calculation.

WorkKeys Level 5 Applied Math skills are needed to ensure that a power supply unit (PSU) is able to meet the combined power requirements of the PC's components. Power is measured in watts (W), calculated for electrical components as voltage multiplied by current ($V \times I$). The PSU's output capability is measured as its wattage rating. A PSU designed for use in a standard desktop PC is typically rated at around 200–300 W. Enterprise workstation PCs and servers often have units rated over 300 W to meet the demands of multiple CPUs, additional memory modules, disk drives, and tape units. Gaming PCs might require 500 W or better power supplies to cope with the high specification CPU and graphics card(s). It is important to note that there are online calculators that will work out the power requirement for the student.

Students will need Level 5 Applied Math skills to understand how modern system RAM is implemented as a type called Double Data Rate Synchronous Dynamic Random Access Memory (DDR SDRAM). DDR SDRAM makes two data transfers per clock cycle. DDR memory modules are labeled using the maximum theoretical bandwidth, such as PC1600, PC2100, and so on. As an example of how this value is derived, consider DDR-200 PC-1600 memory:

- The internal memory device clock speed and memory bus speed (between the memory devices and memory controller) are both 100 MHz.
- The data rate is double this as there are two operations per clock "tick." This is expressed in units called mega transfers per second (200 MT/s). This gives the DDR-200 designation.
- The peak transfer rate is 1600 MBps (200 MT/s multiplied by 8 bytes (64 bits) per transfer). This gives the "PC-1600" designation. 1600 MBps is equivalent to 1.6 GBps.

Level 5 skills are required because the problem requires quite a bit of set-up, multiple operations, and the students need to find one value to find another value that answers the question.

Students will also need to have a few Applied Math Level 7 skills. At Applied Math Level 7, the task may be presented in an unusual format and the information presented may be incomplete or require the student to make an assumption. Tasks often involve multiple steps of logic and calculation, and multiple operations. When students use Level 7 Applied Math skills on the job, they can solve problems that include ratios, rates, or proportions with at least one of the quantities related to a fraction. They can identify the reason for a mistake. They can convert between units of measurement that involve fractions, mixed numbers, decimals, or percentages. Students can find the area of multiple shapes or find the area of a composite shape. They can calculate volumes of spheres, cylinders, or cones. They can calculate the volume when it may be necessary to rearrange the formula, convert units of measurement in the calculations, or use the result in further calculations. At Level 7 students can set up and manipulate ratios, rates, or proportions where at least one of the quantities is a fraction. They can determine the better economic value of several alternatives by using graphics or by finding a percentage difference or a unit cost. They can apply basic statistical concepts, for example, calculate the weighted mean, interpret measures of central tendency, or interpret measure of spread and tolerance.

Students will need to understand that wireless signal strength is measured in decibel (dB) units. This understanding aligns with the Level 7 characteristic which involves setting up and manipulating ratios. Signal strength is represented as the ratio of a measurement to 1 milliwatt (mw), where 1 mW is equal to 0 dBm. Because 0 dBm is 1 mW, a negative value for dBm represents a fraction of a milliwatt. When measuring signal strength, dBm values closer to zero represent better performance. The dB units express the ratio between two values using a logarithmic scale. A logarithmic scale is nonlinear, so a small change in value represents a large change in the performance measured. For example, +3 dB means doubling, while -3 dB means halving.

GRAPHIC LITERACY

The WorkKeys Graphic Literacy skill is the skill people use when they work with workplace graphics such as tables, graphs, charts, digital dashboards, flow charts, timelines, forms, maps, and blueprints. Students use this skill when they find, summarize, compare, and analyze information to make decisions using workplace graphics to solve work-related problems. Dr. Hill identified 65% of the Core I exam objectives and 67% of the Core 2 exam objectives as requiring the WorkKeys Graphic Literacy skill for entry into and successful completion of the training program.

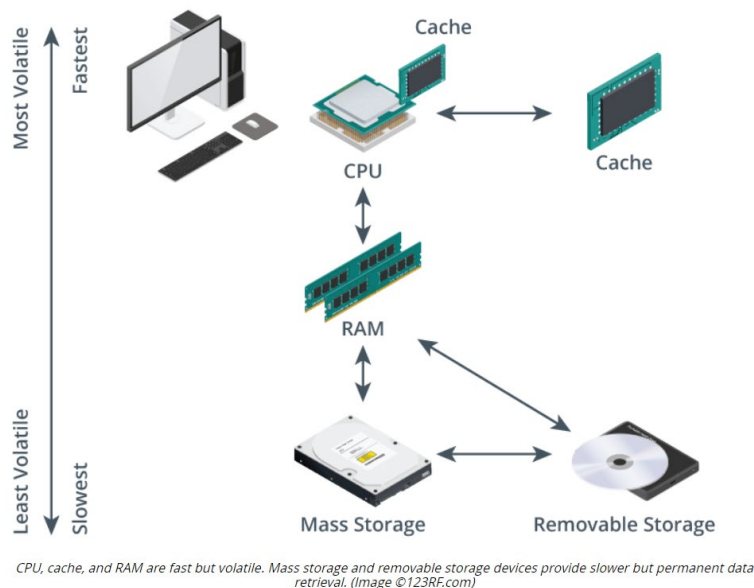
In evaluating the level of Graphic Literacy skill needed to accomplish the exam objectives, the difficulty of the graphics and how hard it is for individuals to find the information they need on the graphic and then to make use of it was considered. Dr. Hill compared the requirements of the training program to WorkKeys Graphic Literacy skill Levels 3 through 7. While students will need Graphic Literacy Level 3 skills for many tasks, Level 4 Graphic Literacy skills are required for entry into and for successful completion of the training. By the completion of the training, students may have Level 5 Graphic Literacy skills and some Level 6 and 7 skills.

At Graphic Literacy Level 3, workplace graphics are common and of simple or low moderate difficulty. Characteristics of simple graphics include a limited amount of data (i.e., less than twenty data points/fields); one level of data; one or two variables; and one or two axes (such as an x and/or

y axis), if there are axes. Characteristics of low moderate graphics include a moderate amount of data; more than one level of data, but no nesting; several variables; one or two axes if there are axes; and if two simple graphics are required to solve the problem, they should be considered a low moderate graphic. At Graphic Literacy Level 3, students use one simple or low moderate graphic at a time to locate and find information and identify the next or missing step in a process.

Students will use Graphic Literacy Level 3 skills throughout the training when they are shown various diagrams and asked to identify and describe various parts. For example, students may be shown a diagram (Figure 1) to help them understand that central processing units (CPUs), cache, and RAM are fast but volatile, but that mass storage and removable storage devices provide slower but permanent data retrieval.

Figure 1.



Level 3 graphics also include a diagram showing a CPU heat sink and fan assembly consisting of four components or a diagram showing a hard disk drive (HDD) with drive circuitry and casing removed. They will also be shown multiple images such as a 2.5-inch form factor solid state drive with SATA interface and a mSATA SSD form factor, and need to identify the similarity and differences. Students will also need Level 3 skills when they are provided with a diagram and asked to identify the distinctive features of a laptop computer, including the built-in screen, integrated keyboard, touchpad pointer control, and I/O ports (on both sides and rear of chassis). A diagram of the operation of delivery and mailbox email protocols consisting of four steps and six components (e.g., local IMAP Server, Local Mail Client, Local SMTP Server, Remote SMTP Server, Remote IMAP Server, and Remote Mail Client) will also require Level 3 Graphic Literacy skills.

Students will also use Graphic Literacy Level 3 skills when they complete performance-based questions (PBQs), and are asked to identify parts on a diagram. In Figure 2, students are provided with a scenario and asked to identify the major connections and PC components.

Figure 2.


Core 1 PBQ: Installing and Configuring PC Components Performance-based Question

Scenario Close

numbered areas on the motherboard.

You are a computer technician at a computer repair shop. Yesterday, a customer brought in various computer hardware components and asked for help assembling them into a final, working computer. The customer mentioned that a friend helped purchase the components and that they should all work together. The customer is not well-versed in assembling all of the components.

You spent some time yesterday assembling all the major components of the PC, including placing the PSU, hard drives, and motherboard in the case. Today, the customer returned, and you pointed out all the major connections and components of the motherboard to help educate the customer.



- 1 Select
- 2 Select
- 3 Select
- 4 Select
- 5 Select
- 6 Select
- 7 Select
- 8 Select

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To return this interactive to its initial state, click Reset.

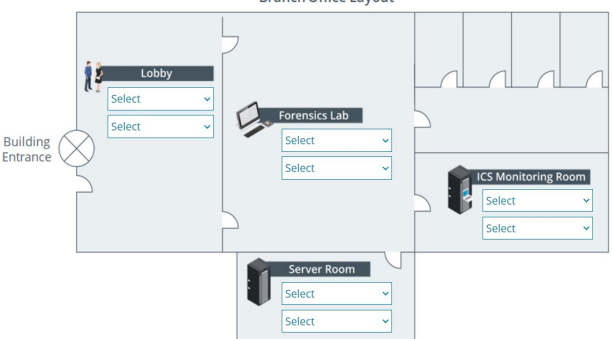
Students will also be provided with a diagram showing the laser print process and then need to identify the similarities and differences to the direct thermal printing imaging process. Some performance-based questions require students to drag and drop responses. Other PBQs present a scenario and the students use dropdown selectors to troubleshoot printers, then use radio selectors to determine if a replacement printer is necessary. In another PBQ, students are provided with a scenario and need to use radio selectors to answer status and security questions about a wireless network. As shown in Figure 3, students will be provided with a scenario and a diagram showing an office layout. Students will use dropdown selectors to make the appropriate physical security recommendations for each area of the building.

Figure 3.

PBQ: Implementing Physical Security Performance-based Question

Instructions
Based on the scenario, use the **dropdown selectors** to make the appropriate physical security recommendations for each area of the building. Physical security measures can be in any order.

Branch Office Layout



Building Entrance

Lobby

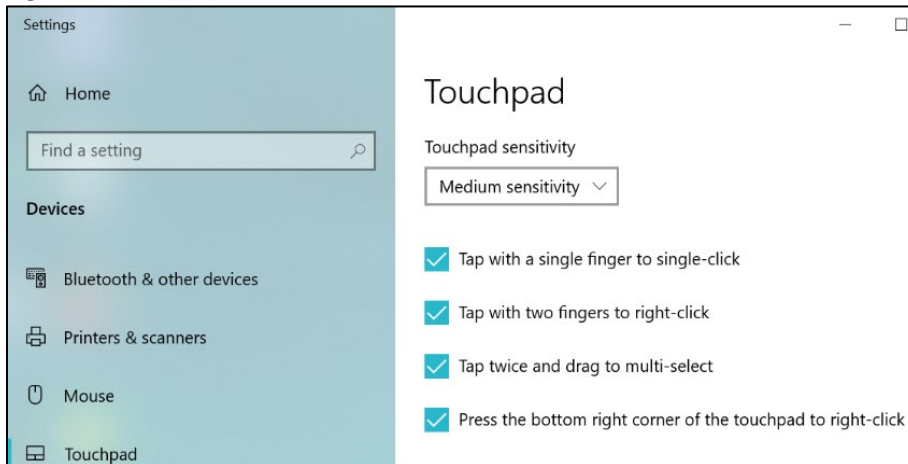
Forensics Lab

Server Room

ICS Monitoring Room

Students need to understand virtualization and the software that facilitates it called a hypervisor. The students are provided with a simple diagram showing how the operating system can be installed under the hypervisor. Settings screens like the ones used to set up a touchpad, trackpad, drawing pads, manage consoles, are simple with checklists and drop-down lists, allowing the student to enable or disable Wi-Fi, a cellular plan, or set printing preferences.

Figure 4.



Students will also use Graphic Literacy Level 3 skills when they locate information in tables that are of simple or of low moderate difficulty. Level 3 graphics include simple two column tables providing fault codes and their meaning. When specifying a PSU for a system with high power requirements, it is also important for students to assess the power distribution for its output voltages (3.3 VDC, 5 VDC, and 12 VDC). Distribution refers to how much power is supplied over each rail. A rail is a wire providing current at a particular voltage. The following table shows an example of how power distribution for a PSU might be configured:

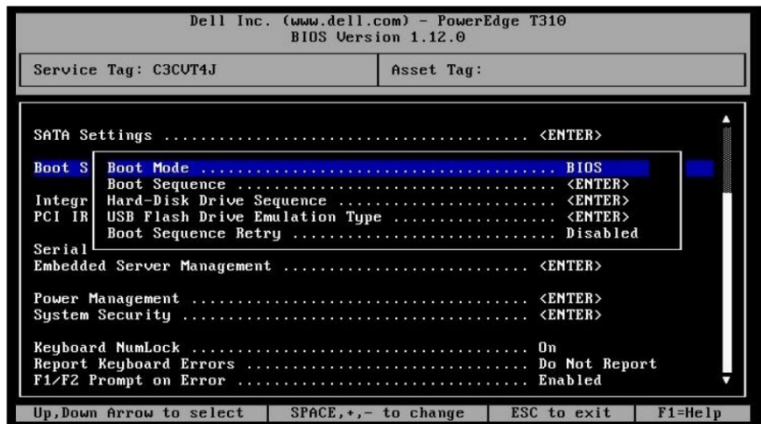
Table 1. Example of how power distribution for a PSU might be configured

Output Rail (VDC)	Maximum Load (A)	Maximum Output (W)
+3.3	20	130
+5	20	130
+12	33	396
-12	0.8	9.6
+5 (standby)	2.5	12.5

In addition, students will need to be able to read a simple Cat specifications table and understand why a higher Cat specification cable is capable of higher data rates and that a network cabled with Cat 5 will probably need to be rewired to support Gigabit Ethernet. The table includes four variables

(i.e., Cat, Max. Transfer Rate, Max. Distance, and Ethernet Standard Support). Students will also need to read a simple table of address classes and default subnet masks that consists of four columns and three rows. Diagnosing power issues may require the student to review the computer bios using the simple graphic shown in Figure 5. Students will use a similar graphic when troubleshooting local network connectivity.

Figure 5.

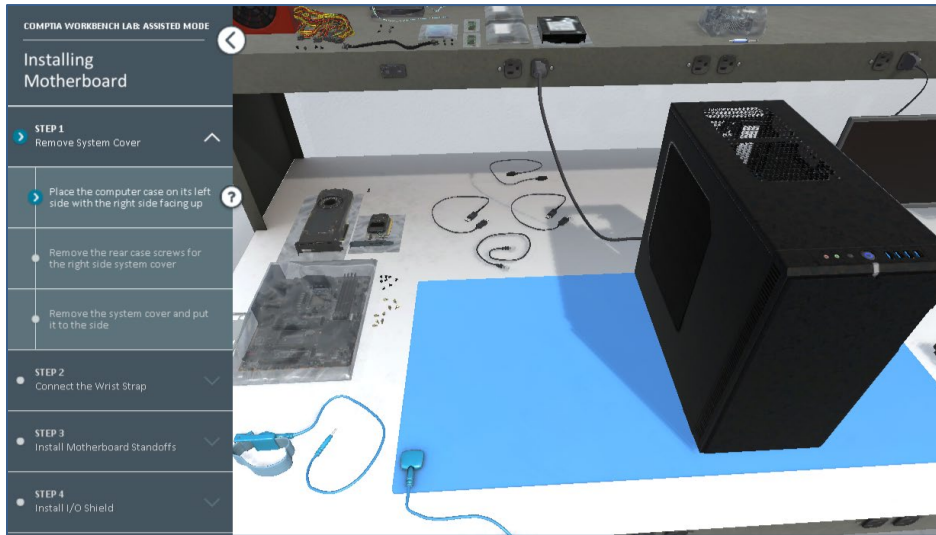


Additional graphics that require Level 3 Graphic Literacy skills include a slide bar to indicate when applications make changes, the Allowed Applications screen where they will check the box for either or both network profile types, the Security tab when giving permissions, the Mission Control and System Preferences screens when setting up and removing desktops, parental control content-filtering screens when configuring them, the Properties dialog box to unlock a user account, the Windows Defender Firewall screen, and Mobile Device Management enterprise software screens to apply security policies, establish a remote desktop connection, and learn to use a help-desk ticketing system.

Most of the graphics students use require Level 4 Graphic Literacy skills. At Graphic Literacy Level 4, workplace graphics are common and of low to high moderate difficulty. Characteristics of low moderate graphics include a moderate amount of data; more than one level of data, but no nesting; several variables; one or two axes, if there are axes; and if two simple graphics are required to solve the problem, they should be considered a low moderate graphic. At Graphic Literacy Level 4, students can use one or two low moderate graphics at a time to locate information in a graphic using information found in another graphic; compare two or more pieces of information; identify a trend/pattern/relationship; make an inference or decision; and identify the graphic that accurately represents the data. High moderate graphics may be less common at Graphic Literacy Level 4 and have characteristics which include a moderate amount of data; more than one level of data and it may be nested; many variables such as types of wood, drill speeds, hole diameter, and type of bit; one or two axes (such as an x and/or y axis), if there are axes; and if a low moderate graphic and a simple graphic are required to solve the problem, they should be considered a high moderate graphic. At Level 4, students can use one high moderate graphic to locate and find information and identify the next or missing step in a process.

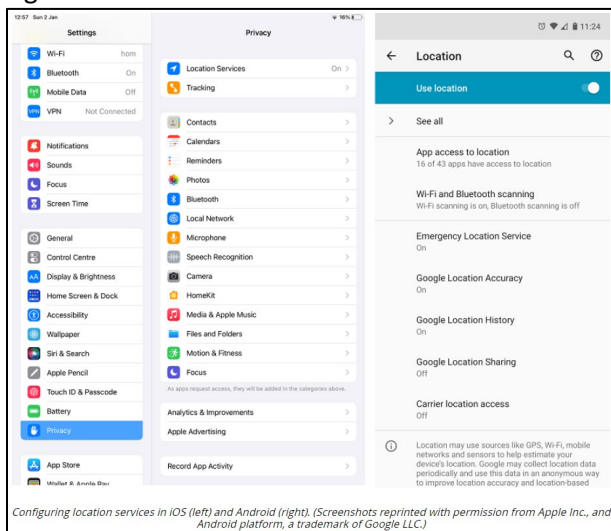
When students complete virtual workbench labs, they can choose to use the assist mode and be walked through the process step-by-step using a list like the one shown in Figure 6. Notice that while four steps are shown, the steps can expand into multiple sub-steps. The students have to locate information on the left and then locate the corresponding part in the workbench diagram. Clues are provided by clicking on the question mark icon. In the lab shown in Figure 6, students are given a scenario, and then need to install and configure a motherboard, central processing units (CPUs), and add-on cards.

Figure 6.



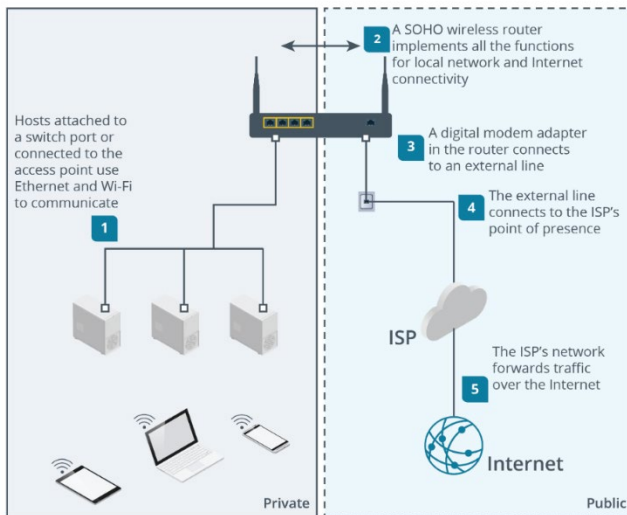
Settings on a mobile device require Level 4 skills because the student is moving from one simple screen to another, but they aren't having to look for trends or compare data from screen to screen (Figure 7).

Figure 7.



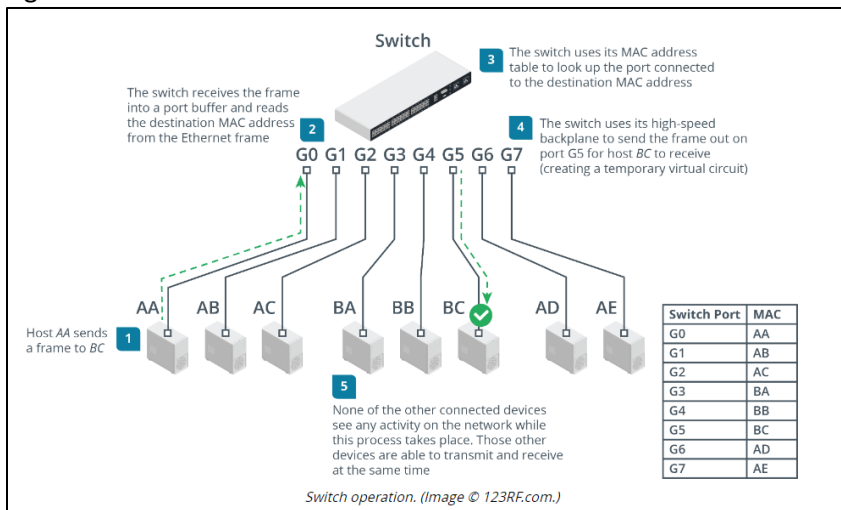
Students will need to understand how a small office/home office (SOHO) wireless router implements all the functions for local network and internet connectivity. The diagram of this layout consists of a wireless router, switch ports, wireless access points, digital modem, an internet service provider (ISP) network, and private and public connections. In contrast, students will need to understand how it differs from a SOHO using a WAN interface using a digital modem as shown in Figure 8.

Figure 8.



Students will be provided with a diagram to help them understand how an ethernet switch can track which MAC source addresses are associated with each port. Figure 9 shows the switch intelligently forwarding an incoming frame to the port that is a match for the destination MAC address using a MAC address table to look up the port connected to the destination MAC address. In other words, the student is presented with a diagram and a simple table and needs to understand how information from one is used in the other.

Figure 9.



A Wi-Fi analyzer screen will require students to use level 4 skills to identify nearby networks and the channel configurations and status of signals. Part of the screen is a table with 9 variables and two screens showing the strength of the 2.4 and 5 GHz using a line graph. Students will also use this

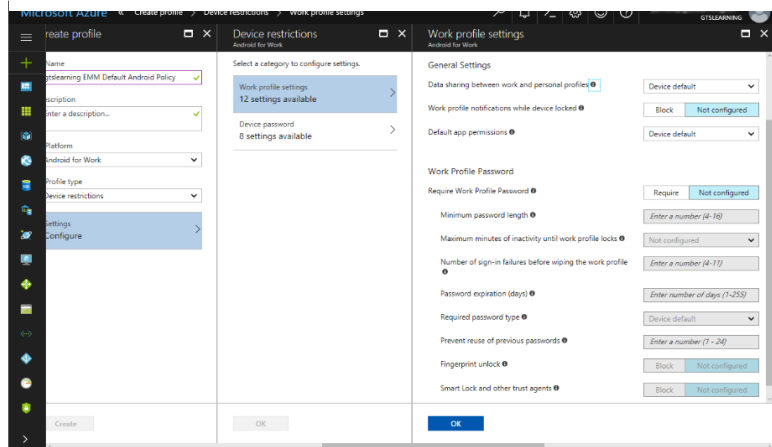
screen when troubleshooting intermittent connectivity that as manifested as port flapping. The switch configuration interface can be used to report how long a port remains in the up state.

Additional graphics that require level 4 skills include disk management console displays with a summary of any fixed and removable disks, the registry editor with root keys and subkeys, system protection tab via advanced system settings to select which disk(s) to enable for system restore and configure how much disk capacity is used, and the driver package rollback screen, asset-management database systems for tracking and managing inventory.

Students will need Graphic Literacy Level 5 skills when completing more advanced lessons. At Graphic Literacy Level 5, workplace graphics may be less common and of low moderate, high moderate, or difficult complexity. Characteristics of low moderate graphics include a moderate amount of data; more than one level of data, but no nesting; several variables; one or two axes, if there are axes; and if two simple graphics are required to solve the problem, they should be considered a low moderate graphic. At Level 5 Graphic Literacy, students can use a low moderate graphic to compare two or more pieces of information; interpret a trend/pattern/relationship; make a reasonable inference or decision based on one graphic after finding information in another graphic; justify a decision or inference based on information; identify the most effective graphic for the task; and justify the most effective graphic for the task. High moderate graphics may be less common at Graphic Literacy Level 5 and have characteristics which include a moderate amount of data; more than one level of data and it may be nested; many variables; one or two axes if there are axes; and if a low moderate graphic and a simple graphic are required to solve the problem, they should be considered a high moderate graphic. At Level 5 Graphic Literacy, students can use one high moderate graphic to locate information in a graphic using information found in another graphic; compare two or more pieces of information; identify a trend/pattern/relationship; make an inference or decision; and identify the graphic that accurately represents the data. Difficult graphics at Graphic Literacy Level 5 are likely to be less common or a composite of graphics. Data presented is dense; more than one level of data and nesting is likely; there are many variables; three or more axes, such as an x, y, and z axis, if there are axes; and if a high moderate graphic and a low moderate graphic are required to solve the problem, they should be considered a difficult graphic. At Level 5, students can use one difficult graphic to locate and find information and identify the next or missing step in a process.

Students will need Graphic Literacy Level 5 skills when working with enterprise mobility management (EMM) screens to create a profile and setting up device restrictions and restricted applications. Notice in Figure 10 that Work profile settings is nested under Device

Figure 10



Configuring authentication and profile policies using Intune EMM. Note that the policy allows the user to have a different type of authentication to the workspace hosting corporate apps and data. (Screenshot courtesy of Microsoft.)

restrictions, which is nested under Create profile. This is an unusual format. A similar screen is used for Configuring authentication and profile policies using Intune EMM. Level 5 skills are required because this is a less common type of graphic with nesting and many variables.

Graphic Literacy Level 5 skills will be needed when students work with the diagrams shown in Figure 11 to compare and contrast a virtual machine with a container virtualization. For example, container virtualization dispenses with the idea of a hypervisor and instead enforces resource separation at the operating system (OS) level. The OS defines isolated containers for each user instance to run in. Each container is allocated CPU and memory resources, but the processes all run through the native OS kernel. These containers may run slightly different OS distributions but cannot run guest OSs of different types (you could not run Windows or Ubuntu in a RedHat Linux container, for instance). Alternatively, the containers might run separate application processes, in which case, the variables and libraries required by the application process are added to the container.

Figure 11.

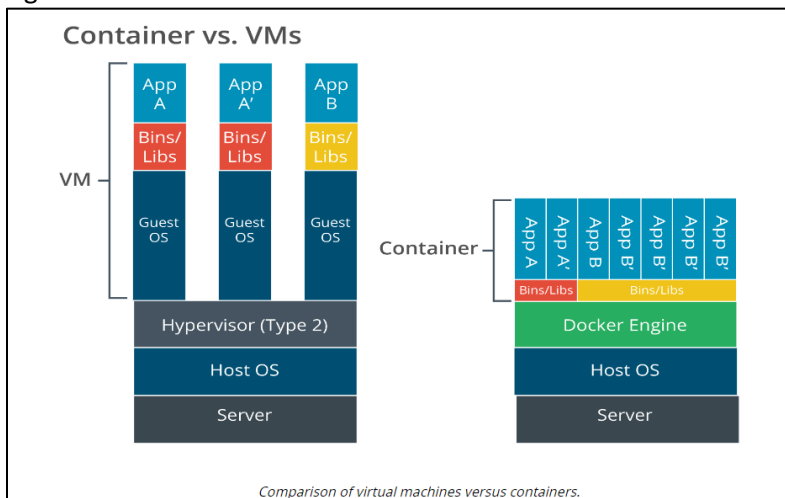
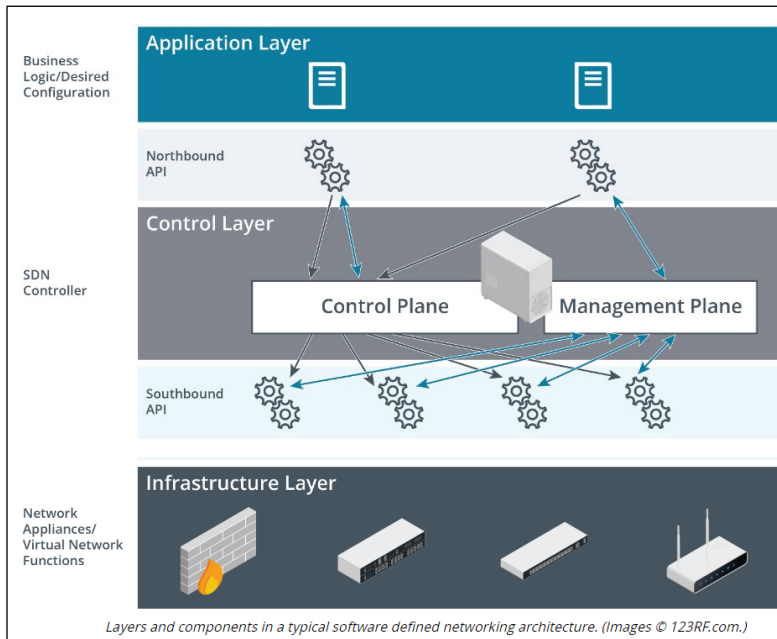


Figure 12.



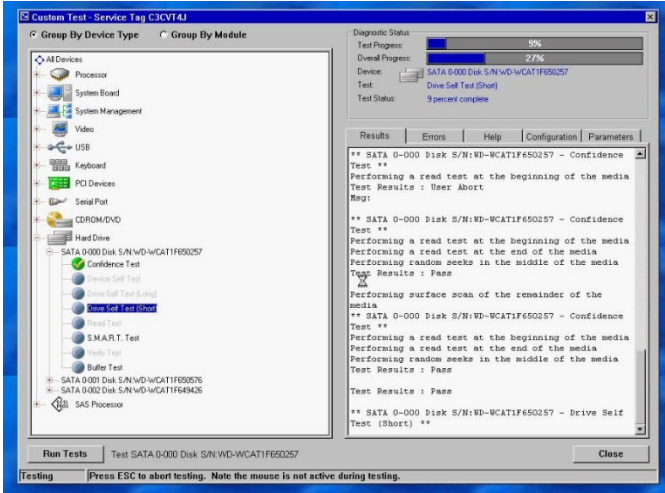
Cloud services require the rapid provisioning and deprovisioning of server instances and networks. This means that these components must be fully accessible to scripting. Students are provided with the unusual graphic of a software-defined networking (SDN) model that shows how these processes can be used to provision and deprovision networks (Figure 12). In the SDN model, network functions are divided into three layers. The top and bottom layers are application and infrastructure, and a control layer is inserted between the application and infrastructure layers. The functions of the control plane are implemented by a virtual device referred to as the "SDN controller." Each layer exposes an application programming interface (API) that can be automated by scripts that call functions in the layer above or below. The interface between SDN applications and the SDN controller is described as the service interface or as the "northbound" API, while that between the SDN controller and infrastructure devices is the "southbound" API.

When students are learning how to troubleshoot drive reliability and performance, they will need to observe system operations. Most fixed disks have a self-diagnostic program, and they will need to be able to review the results. The presentation of the information is not common and will include status bars, and various tabs. They can also use Windows utilities to query SMART (Figure 13) and run manual tests. The Windows utilities screen also contains a lot of information and is presented in an unfamiliar way.

To identify each Ethernet NIC's unique hardware/physical address called the "media access control" (MAC) address, students will need to be able to read a high moderate screen with a large amount of data presented in an unfamiliar way. Each frame of Ethernet data identifies the source MAC address and destination MAC address in fields in a header. Students will use a web developer tool to learn how to inspect the HTTP requests and response headers involved in serving a typical modern web page. HTTP enables clients (typically web browsers) to request resources from an HTTP server. A

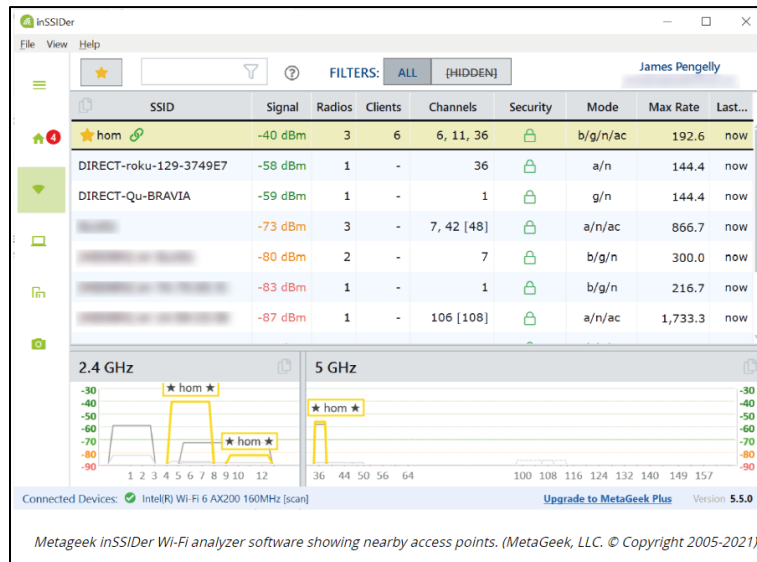
client connects to the HTTP server and submits a request for a resource. The server either returns the requested data if it is available or responds with an error code. The screens are of high moderate difficulty with a large amount of data presented in different ways.

Figure 13.



Students will also use Level 5 skills when troubleshooting port flapping issues. Students will need to use the switch configuration interface to report how long a port remains in the up state. Intermittent connectivity might manifest as port flapping, which means that the NIC or switch interface transitions continually between up and down states. This is often caused by bad cabling or external interference or a faulty NIC at the host end. Level 5 skills are required because the screen consists of a table and two graphs as shown in Figure 14, and the student will need to look for trends and make comparisons.

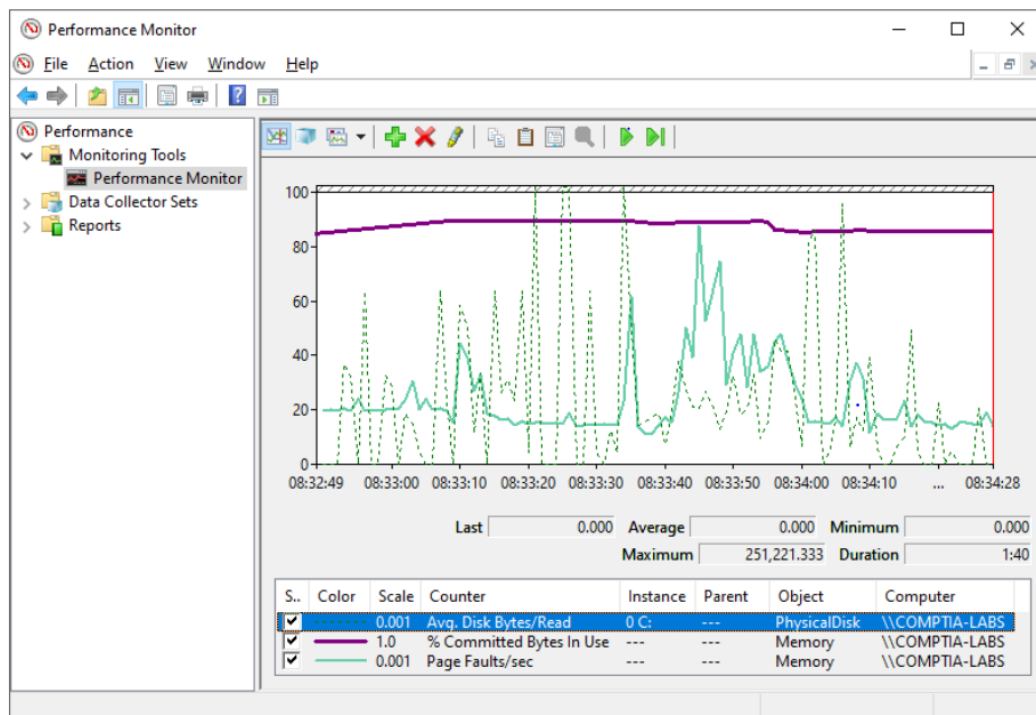
Figure 14.



The IEEE 802.11b standard uses the 2.4 GHz frequency band and was released in parallel with 802.11a. The signal encoding methods used by 802.11b are inferior to 802.11a and support a nominal data rate of just 11 Mbps. The 2.4 GHz band is subdivided into up to 14 channels, spaced at 5 MHz intervals from 2,412 MHz up to 2,484 MHz. Because the spacing is only 5 MHz and Wi-Fi needs 20 MHz channel bandwidth, 802.11b channels overlap quite considerably. This means that interference is a real possibility unless widely spaced channels are chosen (1, 6, and 11, for instance). Also, in the Americas, regulations permit the use of channels 1–11 only, while in Europe, channels 1–13 are permitted, and in Japan, all 14 channels are permitted.

When students learn to investigate and troubleshoot a particular Windows feature, service, or third-party application, they will need Level 6 Graphic Literacy skills in order to use the many logs stored under the Applications and Services Logs node. The Performance tab provides information in graphic form about the CPU, memory, disk, network, and graphic processing unit subsystems, while the App History tab shows usage information for Windows Store apps. The students will be looking for trends and patterns. The Resource Monitor shows an enhanced version of the sort of snapshot monitoring provided by Task Manager. The area graphs on this screen show resource performance along with key statistics provided in a table and on a stacked bar chart. The students are looking for continually rising numbers that would indicate a problem. The Performance Monitor screen shown in Figure 15 requires students to work with a difficult graphic showing average queue length for three different instances, a table, and several additional fields.

Figure 15.



Using Performance Monitor to record three counters from the PhysicalDisk and Memory objects. (Screenshot courtesy of Microsoft.)

At Graphic Literacy Level 6, workplace graphics may be less common and of high moderate or difficult complexity. High moderate graphics may be less common and characteristics include a moderate amount of data; more than one level of data and it may be nested; many variables; one or two axes, if there are axes; and if a low moderate graphic and a simple graphic are required to solve the problem, they should be considered a high moderate graphic. At Graphic Literacy Level 6, employees can use a high moderate graphic to compare two or more pieces of information; interpret a trend/pattern/relationship; make a reasonable inference or decision based on one graphic after finding information in another graphic; justify a decision or inference based on information; identify the most effective graphic for the task; and justify the most effective graphic for the task. Difficult graphics are likely to be less common or a composite of graphics. At Graphic Literacy Level 6, data presented is dense; more than one level of data and nesting is likely; there are many variables; there will be three or more axes, if there are axes; and if a low moderate graphic and a high moderate graphic are required to solve the problem, they should be considered a difficult graphic. At Level 6, employees can use one difficult graphic to locate information in a graphic using information found in another graphic; compare two or more pieces of information; identify a trend/pattern/relationship; make an inference or decision; and identify the graphic that accurately represents the data.

WORKPLACE DOCUMENTS

WorkKeys Workplace Documents is the skill people use when they read and use written text in order to do a job. The written texts include memos, letters, directions, notices, bulletins, policies, and regulations. It is often the case that these workplace communications are not necessarily well written or targeted to the appropriate audience. Workplace Documents material does not include information that is presented graphically, such as in charts, forms, or blueprints.

Workplace Documents skills are required for 100% of the Core I and II exam objectives. To determine the level of Workplace Documents skill needed for the exam objectives and curriculum students complete, the difficulty of the reading materials and how hard it is for students to find the information they need and make use of it was considered. Dr. Hill evaluated the training material as it compares to WorkKeys Workplace Documents skill levels 3 through 7. While the material requires Level 5 Workplace Documents skills, the students have access to many aids such as pop-up definitions, glossaries, instructors, and chat rooms so they could enter the course with Level 4 Workplace Documents skills and with the use of these aids be successful.

At Level 5, Workplace Documents include policies, procedures, announcements, legal, and multiple related documents that have many details. The information that students need is generally stated directly, but it is hard to find because there are so many details, and some may not be needed for the exam objectives and curriculum (extraneous information). The materials include technical terms, jargon, and acronyms, or words that have several meanings. The documents may have complex sentences and/or contain conditional situations. When students use Level 5 skills on the job, in addition to using the skills described at Levels 3 and 4, they can figure out the appropriate meaning of a word based on how the word is used, and identify the appropriate meaning of technical term, jargon, or an acronym that is defined in the document. Students will also need to apply technical terms and jargon to stated situations, apply information/instructions to a new situation that is similar to the one described in the material while considering changing conditions, and apply complex information/instructions that include conditionals to situations described in the materials. They may also need to make some inferences to accomplish their goal.

Students will need Workplace Documents Level 5 skills to figure out the appropriate meaning of a word based on how the word is used as early as Topic 1A. The first sentence says,

A PC is made up of many different components. All these components need to be able to communicate with each other so that the computer can function properly. If you can distinguish connection interfaces and connectors quickly, you will be able to support users by installing, upgrading, and replacing PC peripherals efficiently.

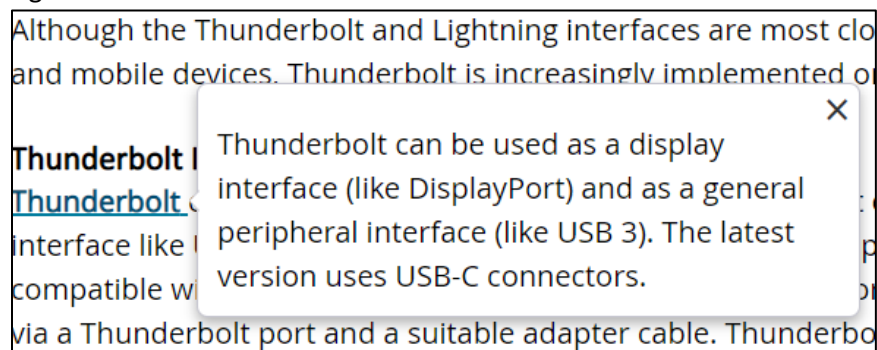
While students may be familiar with words like components, interfaces, and peripherals, they may not be familiar with them in the context of IT and the words are not defined for them. However, they are defined for the student on the next screen. This sentence also appears on that screen, “Most cases use a tower form factor that is designed to be oriented vertically and can be placed on

a desk or on the floor.” Typically, PC cases are referred to just as a tower so the formal name, “tower form factor” could require students to figure out that it is the same thing.

Workplace Documents Level 5 skills will also be needed by students in order to learn a lot of IT terminology throughout the course, and identify the appropriate meaning of technical terms, jargon, and acronyms that are defined in the documents. Students will need to learn over 200 acronyms that are common in the IT industry. However, students are provided with a list and the acronyms will be explained in context throughout the training.

The online modules highlight terminology that students may not be familiar with by showing them in blue. These words are in the glossary. When a student clicks on the word, the full definition will appear in a pop-up box (Figure 16). As you can see in the example below, the word thunderbolt is shown in blue, and a definition appears in a pop-up box when the word is clicked-on.

Figure 16.



Students also need Workplace Documents Level 5 skills to apply technical terms and jargon to stated situations, apply information/instructions to a new situation that is similar to the one described in the material while considering changing conditions, and apply complex information/instructions that include conditionals to situations described in the materials. They may also need to make some inferences to accomplish their goal.

Installing a motherboard is described in seven steps. Four of the steps are shown below.

The general procedure for installing a motherboard is as follows:

1. Use the motherboard documentation to familiarize yourself with the specific installation procedure. Check whether any jumper clips need to be adjusted. A jumper is placed over header pins in a particular orientation. For example, there might be a jumper that enables recovery mode.

The motherboard is vulnerable to electrostatic discharge (ESD). Always take anti-ESD precautions when handling and storing these devices.

2. Orient the board to the oblong I/O cut out at the rear of the case. Prepare the motherboard I/O blanking plate in the correct orientation by removing caps so that USB,

audio, and video ports will be uncovered when the board is fitted. Fit the blanking plate to the case by snapping it into the cut out.

3. Insert standoffs into the case to match the hole locations on the motherboard. Standoffs are usually threaded, though older cases might use push-down pegs. There might be a guide standoff attached to the case or all standoffs might come preinstalled. Make sure that corners, long edges, and the center of the board will be supported. Do not add standoffs where there is no corresponding hole on the motherboard.
4. Optionally, add the CPU and memory modules to the motherboard before installing the board in the case.

Notice that each numbered step consists of multiple steps. There are many conditionals such as if it is an older case, and reminders such as the one about electrostatic discharge, and making sure that corners, long edges, and the center of the board will be supported. Conditionals are often stated in less obvious ways, “there might be” or “optionally”. However, they do require the student to choose what to do when changing conditions call for a different action.

When troubleshooting, students will also need to apply a best practice framework such as CompTIA's A+ troubleshooting model. The steps in this model are as follows:

1. Identify the problem:
 - a. Gather information from the user, identify user changes, and, if applicable, perform backups before making changes.
 - Begin documentation.
 - b. Inquire regarding environmental or infrastructure changes.
2. Establish a theory of probable cause (question the obvious):
 - a. If necessary, conduct external or internal research based on symptoms.
3. Test the theory to determine the cause:
 - a. Once the theory is confirmed, determine the next steps to resolve the problem.
 - b. If the theory is not confirmed, re-establish a new theory or escalate.
4. Establish a plan of action to resolve the problem and implement the solution:
 - a. Refer to the vendor's instructions for guidance.
5. Verify full-system functionality and, if applicable, implement preventive measures.
6. Document the findings, actions, and outcomes.

The students will then need to apply this framework when troubleshooting issues with cable and network adapters, booting, performance, IP configuration, and local network connectivity. A specific example is when students are troubleshooting wired connectivity which is described in five steps, but notice that several of the steps consists of multiple steps.

Troubleshoot cable and network adapter issues:

1. The first step in resolving a no or intermittent connectivity issue is to check that the patch cords are properly terminated and connected to the network ports. If you

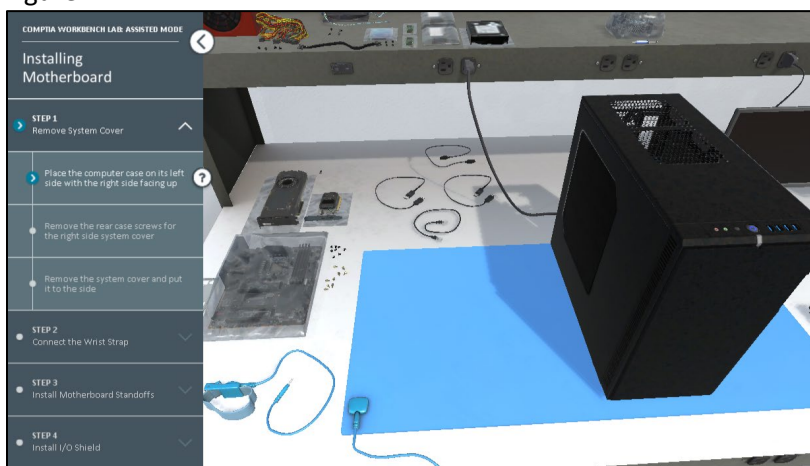
suspect a fault, substitute the patch cord with a known good cable. You can verify patch cords using a cable tester.

2. If you cannot isolate the problem to the patch cords, test the transceivers. You can use a loopback tool to test for a bad port.
3. If you don't have a loopback tool available, another approach is to substitute known working hosts (connect a different computer to the link or swap ports at the switch). This method may have adverse impacts on the rest of the network, however, and issues such as port security may make it unreliable.
4. If you can discount faulty patch cords and bad network ports/NICs, use a cable tester to verify the structured cabling. The solution may involve installing a new permanent link, but there could also be a termination or external interference problem. An advanced type of cable tester called a "certifier" can report detailed information about cable performance and interference.
5. If there is no issue in the structured cabling, verify the Ethernet speed/duplex configuration on the switch interface and NIC. This should usually be set to auto negotiate. You might also try updating the NIC's device driver software.

Four of the steps begin with a conditional statement requiring the student to choose what to do when changing conditions call for a different action. In addition, the instructions usually contain reminders about safety and preparation.

Performance-based questions usually present the student with a written scenario and directions regarding the actions they need to perform to complete the activity. When students complete virtual workbench labs, they can choose to use the assist mode and be walked through the process step-by-step using a list like the one shown in Figure 17. Notice that while four steps are shown, the steps can expand into multiple sub-steps. The students need to locate information on the left and then locate the corresponding part in the workbench diagram. Clues are provided by clicking on the question mark icon. Given a scenario, install and configure motherboards, central processing units (CPUs), and add-on cards.

Figure 17.



APPLIED TECHNOLOGY

The WorkKeys Applied Technology skill is a student's skill in solving problems of a technological nature, involving the basic principles of mechanics, electricity, fluid dynamics, and thermodynamics. The skill level is based on the difficulty of identifying relevant aspects of problems, analyzing and ordering those aspects, and applying existing materials or methods to new situations. Establishing the relationship of the skill to the job.

Applied Technology skills are required for 23% of the Core I exam objectives and 1% of the Core II exam objectives. Dr. Hill evaluated the training material as it compares to WorkKeys Applied Technology skill levels 3 through 7. While students will probably master Level 5 Applied Technology skills by the completion of the course, they can enter the course with Level 4 Applied Technology skills.

A student with Level 4 Applied Technology skills can resolve moderately complex tasks, which may involve two or more simple systems that work together or one moderately complex system. The systems may have up to ten components. The student understands moderately complex tools, diagnostic equipment, machines, and systems, and can apply less obvious basic principles to solve problems within physical systems. In Level 4 tasks, the student must eliminate physical symptoms that do not point to the source of a problem by choosing which information is important and ignoring information that is clearly extra, and identify the best solution after getting rid of other unsuitable options.

A student with Level 5 Applied Technology skills can handle tasks that are moderately complex or of more advanced difficulty. The tasks may involve two more simple tools or systems that affect each other or a complex system that includes several components. These systems perform somewhat complex operations and generally have more than ten components and two or three variables. They may require the use of technical knowledge and often include extra information. Technical terms may be used that are clearly defined or whose meaning may be implied in the context and illustrations. The student understands the operation of moderately complex tools and diagnostic equipment and is able to choose the best tool for the task. They must also understand the operation of complex machines and systems and be able to apply two or more principals of technology as they interact in moderately complex systems. They must be able to solve moderate and advanced problems, and eliminate physical symptoms that do not lead to the source of a problem by choosing which information is important and ignoring extra information. To do this, it is necessary to use clues to find the source of a problem and identify the best solution to a problem after eliminating other unsuitable options.

Electricity

Students need to be able to determine if a power supply unit (PSU) can meet the combined power requirements of the PC's components. The PSU's output capability is measured as its wattage rating. Power is measured in watts (W), calculated for electrical components as voltage multiplied by current ($V \cdot I$). A PSU designed for use in a standard desktop PC is typically rated at around 200–300 W. Students need to recognize that enterprise workstation PCs and servers often have units rated over 300 W to meet the demands of multiple CPUs, additional memory modules, disk drives, and

tape units. They also need to understand that the power output is not the same as the power the PSU draws from grid power. If a PSU works at around 75% efficiency, a 300 W supply would draw 400 W from the outlet. The extra energy is lost mainly as heat. As energy becomes more expensive both in terms of cost and in terms of the climate, power efficiency is an important criterion to use when selecting a PSU. An ENERGY STAR 80 PLUS compliant PSU must be 80% efficient at 20–100% of load. Students will also need to understand the principals of electricity when specifying a PSU for a system with high power requirements.

Students will need to understand that power over ethernet (PoE), is a means of supplying electrical power from a switch port over ordinary data cabling to a powered device (PD), such as a voice over IP (VoIP) handset, camera, or wireless access point. To operate from building power, the laptop needs a power supply to convert the AC supply from the power company to the DC voltages used by the laptop's components. The power supply is provided as an external AC adapter. When replacing a battery, students will need to understand that plugging a fixed-input 220-240 V adapter into a 110-120 V supply won't cause any damage though the laptop won't work, but plugging a fixed-input 110-120 V adapter into a 220-240V supply will cause damage.

Thermodynamics

Students will need to understand the principles of thermodynamics at Level 4 when working with fan cooling systems. Components in a computer system emit heat because of some degree of resistance when electrical current passes through them. Without a cooling solution, this heat will raise the temperature of each component and increase the ambient temperature inside the case. Excessive temperatures can cause the components to malfunction or even damage them. Heat sinks and thermal paste are two ways of cooling components. A heat sink is a block of copper or aluminum with fins and is considered a passive cooling device because it doesn't require extra energy to work. The fins expose a larger surface area to the air around the component to achieve a cooling effect by convection. Students will need to understand how it works and that it is important to keep "cable clutter" to a minimum and cover spare adapter slots with blanking plates. A thermal pad performs a similar function. Students will need to understand how it works and why it doesn't always perform as reliably. Students will need to understand why a fan improves airflow, which helps dissipate heat and the importance of drawing cool air from the low vents in the front of the case over the motherboard and expelling warmed air from the fan positioned at the top of the back of the case.

Fluid Dynamics

PCs used for high-end gaming may generate more heat than basic thermal management can cope with. PCs used where the ambient temperature is very high may also require exceptional cooling measures. Students will need to understand why, in these instances, a liquid-based cooling system is used because water is a more effective coolant than air convection and a good pump can run more quietly than numerous fans. Students will need to understand the difference between a closed-loop and an open-loop system and when each is appropriate.

Mechanics

Students will need to understand how a hard disk drive (HDD) stores data on metal or glass platters that are coated with a magnetic substance. The top and bottom of each platter is accessed by its

own read/write head, moved by an actuator mechanism. The platters are mounted on a spindle and spun at high speed. Each side of each platter is divided into circular tracks, and a track contains several sectors, each with a capacity of 512 bytes. This low-level formatting is also referred to as the drive geometry. Students will need to understand that this technology means that the performance of an HDD is determined by the speed at which the disks spin, measured in revolutions per minute (RPM). RPM is one factor determining access time, measured in milliseconds. Access time is the delay that occurs as the read/write head locates a particular track position, which is known as seek time. Access time is also impacted by the sector location process (rotational latency) on the drive. The internal transfer rate (or data or disk transfer rate) of a drive is a measure of how fast read/write operations are performed on the disk platters. These are concepts students will need to grasp.

Students will also be introduced to concepts such as:

- Distributed parity means that error correction information is spread across all the disks in the array.
- Fault tolerance: The level of fault tolerance and available disk space is inverse. As you add disks to the set, fault tolerance decreases but usable disk space increases. If you configure a RAID 5 set using three disks, a third of each disk is set aside for parity. If four are used, one-quarter is reserved on each disk. Using a three 80 GB disk configuration, you would have a 160 GB usable volume.

Students will need to be able to use hand tools when performing upgrades or replacing parts such as precision screwdrivers.

Apply two or more principals of technology

Students will need to understand all four principles of technology and how they interact when learning about types of cabling and installation. Electrical signals are sent over wires. Students will need to understand that the screening/shielding elements of shielded cable must be bonded to the connector to prevent the metal from acting as a large antenna and generating interference. When installing a cabling system, students will need to learn how to use cable strippers, crimpers, and punch down tools. They will also need to understand the importance of using the correct type of cable. Cable is often installed in the plenum space of a building that is designed to carry heating, ventilation, and air conditioning systems. Unfortunately, this space is an effective conduit for fire, as there is plenty of airflow and no fire breaks. Building regulations require the use of fire-retardant plenum cable in such spaces because it must not emit large amounts of smoke when burned, be self-extinguishing and meet other strict fire safety standards.

Students will also need to understand multiple principles when learning about display components that make a screen assembly for a mobile device such as a liquid crystal display (LCD). Most mobile devices use a flat-panel screen technology based on a type of LCD. A liquid crystal is a compound whose properties change with the application of voltage. Each picture element (pixel) in a color LCD comprises subpixels with filters to generate the primary red, green, and blue (RGB) colors. Each pixel is addressed by a transistor to vary the intensity of each cell, therefore creating the gamut (range of colors shades) that the display can generate. In the types of flat panel used for computer and mobile

device displays, the liquid crystal elements and transistors are placed on a thin film transistor (TFT). Students will need to understand the types of thin film transistors and their advantages and disadvantages. Additional display components that make up the whole screen include a digitizer, an accelerometer and a gyroscope. For example, students will need to understand how a digitizer converts analog touch input to digital software instructions using a grid of sensors sending information through a digitizer cable to a circuit that converts the analog signal to a digital signal. Understanding the difference between laser, inkjet print process, and direct thermal printer imaging process will require students to understand all four principles of technology.

Troubleshooting

Students will need to learn how a complex system works in order to troubleshoot a problem. This will require an understanding of all four principles of technology. When troubleshooting, they will first need to verify that the problem is not a lack of power. They will need to eliminate physical symptoms that do not point to the source of a problem by choosing which information is important and ignoring information that is not relevant. To diagnose no power symptoms, students will need to check if the LEDs on the front panel of the system case are lit up and whether the fans can be heard. A power issue might arise due to a fault in the PSU, incoming electricity supply, power cables/connectors, or fuses. To isolate the cause of no power, students will need to check that other equipment in the area is working, try plugging another piece of known-good basic electrical equipment into the wall socket, and check that the PSU cabling is connected to the PC and the wall socket correctly, and that all switches are in the "on" position. If none of these checks identify or solve the problem, the student will learn to try another power cable to determine if there is a problem with the plug or fuse, and check that all the wires are connected to the correct terminals in the plug. At this point, students will need to check the fuse resistance with a multimeter or swap with a known good fuse. If the problem still isn't identified, the student will need to disconnect extra devices to determine if a PSU with a higher wattage rating is required or one of the devices is faulty. Finally, the student can test the power supply unit using a multimeter or power supply tester if they can ensure a safe working environment.

When troubleshooting drive reliability and performance, students will need to identify any symptoms that can be detected by observing system operation and if available they should run a Self-Monitoring, Analysis, and Reporting Technology (SMART). If no diagnostic utilities are available, the student might be able to identify motherboard, RAM, or CPU hardware issues by observing physical symptoms. Excessive heat can easily damage the sensitive circuitry of a computer. Students will learn to check for physical symptoms of overheating issues such as unusual odors, such as a burning smell or smoke. There are many other techniques for diagnosing and correcting overheating issues the student will need to work through including thermal problems and problems with the motherboard itself. If there is physical damage to the motherboard, students will need to use a diagnostic software.

Students will need to troubleshoot wired connectivity issues when the network adapter does not establish a network link or the connection is unstable or intermittent. If the problem affects a single host only, the student will need to isolate the precise location of the physical issue. Students may need to use a cable tester to verify patch cords, a loopback tool to test for a bad port, an advanced type of cable tester called a "certifier" to report detailed information about cable performance and

interference. An understanding of electrical, mechanical, and fluid dynamics principles will be required.

Mobile devices are more susceptible to mechanical problems than most desktop PCs, so students need to be alert to the symptoms of hardware failure such as overheating symptoms, digitizer issues, cursor drift and touch calibration issues. Devices do have protective circuitry that will initiate shut down quickly if the internal temperature is at the maximum safe limit. Students will need to understand the principles of mechanics, thermal dynamics, and electricity.

Students are provided with instruction in basic electrical safety in the last module of Core 2 that covers the properties of an electrical circuit, fuses, equipment grounding, proper power handling and personal safety, electrical fire safety, how to handle components properly to mitigate electrostatic discharge, and building power issues (e.g., surges, under-voltage events, and power failure) and mitigations such as surge suppressors and battery backups. Information regarding the importance of temperature, humidity and ventilation control is also shared. While these concepts are basic, students must understand the effect of thermodynamics and fluid dynamics on the electrical components so Level 4 skills are required.

While Level 4 skills are needed for entry into the training, it should be noted that some activities are related to Level 3. A student with Level 3 Applied Technology skills can perform straightforward tasks that include one simple system that generally has two to five components where the physical symptoms are clear and usually have only one variable. They will be expected to use basic technical terms. The student can identify how basic tools and machine parts work, can identify physical symptoms that point to the potential source of a problem, and can apply basic principles to solve basic problems and identify the best solution after eliminating clearly unsuitable options.

WORKPLACE OBSERVATION

The WorkKeys Workplace Observation skill is a student's skill in visually observing a workplace event, noticing details, and remembering instructions, procedures, processes, and demonstrations in order to generalize to workplace situations that may be similar or very different from what was observed. Students must pay careful attention to steps that are followed, safety procedures, and quality-control standards. In determining the level of skill necessary for the tasks of the job, the SMEs considered the following five characteristics:

- the complexity of the procedures;
- how likely there are to be extra details presented;
- how likely there are to be distractions;
- how difficult is it to detect differences, discrepancies, or changes; and
- the action the student must take.

Workplace Observation skills are required for 50% of the Core I exam objectives and 6% of the Core II exam objectives. Dr. Hill evaluated the training material as it compares to Workplace Observation skill levels 1 through 5. Students will need Workplace Observation Level 2 skills when they enter the training and may have at least Workplace Observation Level 3 skills by the time they complete the training.

At Workplace Observation Level 2, students interpret a straightforward procedure that involves a condition. With a condition, several possible things may happen, and a specific response is provided for each one. A Level 2 situation includes obvious and easily disregarded distractions, and there are a few extra details and differences. When students use Level 2 Workplace Observation skills, they can recognize cause and effect in a straightforward demonstration, process, pattern, or procedure; can filter out obvious distractions; and can identify the cause of a particular effect. Additionally, students can recognize what to do next in a situation given a single condition. At Level 2, students can also indicate action to be taken when there is an incorrect step identified.

When students use Level 3 Workplace Observation skills on the job, they can identify a course of action to take given more than one condition; distinguish steps that seem similar but are different based on varying factors; and maintain attention to significant details with little prompting. Students are able to recognize when steps can be combined and when they must be kept distinct; and can combine steps to achieve desired result. At Level 3, students identify differences and/or details that are not clear; select, interpret, and integrate the steps, in the correct order, within a complex process; and apply information to a similar situation.

Students will watch many videos demonstrating how to install, maintain, test, troubleshoot, connect, and configure a wide variety of computer components and peripherals. Below is a list of some of the videos:

- How to install a power supply unit
- Installing and configuring mass storage devices

- Installing and upgrading processors
- Troubleshoot RAID issues
- Wire a patch panel
- Installing and configuring a switch
- Installing and configuring a router
- Testing and troubleshooting twisted-wire cabling solutions
- How to connect and configure mobile device accessories – wired and wireless
- Upgrading laptop system components
- Troubleshooting power and cooling issues
- Troubleshooting display issues
- Troubleshooting communication and connectivity issues
- Installing and configuring imaging devices
- Maintaining laser printers
- Maintaining inkjet printers
- Laser printer print defects
- Creating a user account in Windows 10
- Creating custom MMC's in Windows
- Editing Windows Registry
- Checking compatibility for OS installation or upgrade
- Deploying a Windows image
- Managing Windows Local Users & Groups
- Creating home folders
- Backing up data and settings

The students can watch the video as many times as they need and rewind. Transcripts are also provided, and the lessons provide foundational information, practical advice, and often written steps. The students will apply what they observed in the videos and what they read in lessons when they complete the lab activities. A tutorial for the lab is provided to help student become familiar with the basic navigation of the 3D workspace. The tutorial is interactive with a list of steps on one side and instructions appearing as the student progresses. Students can choose to work in assisted lab mode or explore mode. In assisted lab mode, students will need to click on various parts according to the list of steps. Certain sections or parts of the lab will light up with red or yellow to help the student figure out where to click next.

Students use Workplace Observation Level 2 skills in the following ways:

Complexity: Students observe an instructor perform a straightforward process with if-then conditions. For example, when a student is troubleshooting a computer not connecting to the local network, one of many steps they will complete is to verify that the cable that is connected to the back of the computer is valid and works using a LAN media tester. The video will show the student where to plug the drop cable in and where to plug the other side of the media tester. When the media tester is turned on, the student will need to watch the lights to see if they come on in a sequential order. This indicates that all of the pins and conductors are operating properly. The

student will then move on to the next step in troubleshooting. While this is fairly simple, it is just one step in the process. The students will observe the instructor testing multiple ports until they find one that isn't working properly and then watch how to correct the problem. While the complexity of the video does meet the requirements for Workplace Observation Level 3 because the troubleshooting process has several conditions, students can watch the video as many times as they need so Workplace Observation Level 2 skills are required.

Details: There are often several extra details that are a part of the workplace situation being observed by students, but most details are an integral component of the situation. All of the processes shown in the videos involve many details that are integral such as where to plug the drop cable and where to plug the media tester. While it is important for students to maintain attention to many significant details, they do receive prompting and can always rewind the video. As a result, students can enter the program with Level 2 Workplace Observation skills, but will probably have at least Level 3 by the time they complete the training.

Distractors: The videos themselves do not have distractors, but the video may be focused on a small part of the entire computer and the student will need to disregard parts that are not relevant.

Differences: Differences can be hard to discern, but they are generally pointed out, such as during a video when the instructor points out that the lights coming on in a sequential order indicates that the pins and conductors are operating properly and the different ports. There are also different types and brands of various components and students are often shown pictures of both with the differences highlighted. They will need to keep this in mind when completing the labs.

Action: The action taken by the students based on observations is generally straightforward. During the training process, students observe processes demonstrated in a video and then apply them when completing the labs and performance-based questions. Since there are many different brands and technology changes very quickly, the students will be applying what they observed to similar situations, but rarely the exact same situation. Students learn the steps so that they understand which step 'comes next' in the process. The students do need to draw conclusions based on what has been observed when they are troubleshooting, but they will also be able to verify their conclusions when they test the equipment to see if it is fixed.

Section 3

Results and Recommendations

The results of this project and review of its findings can be used to help guide the selection of students into the program and to encourage skill development for those applicants whose skills currently do not match the recommendations for entry. The table shows the results for entry- and exit-level performance for CompTIA's A+ online curriculum. Entry level is defined as the students' first day in the program, before they gain program specific knowledge from training or experience. Exit level is the point at which a student has successfully completed the training requirements. The exit levels are provided for use as training goals.

The results of this curriculum profile support the claim that the ACT NCRC and WorkKeys assessments help ensure that individuals have the academic and employability skills needed to enter the demanding CompTIA A+ program of training. Accelerating the use of these credentials will help individuals find jobs and provide employers with workers who have the academic, employability, and 21st century skills important to success.

CompTIA and ACT should continue to recognize the benefits to stakeholders of "stacking" CompTIA's A+ certification credentials upon ACT's WorkKeys Assessments.

Skill Level Recommendations for Entry into and Exit from CompTIA's A+ Curriculum and Core I and II Exams

WorkKeys Skill	Skill Level Range	Entry	Exit
Workplace Documents	3-7	4	5
Graphic Literacy	3-7	4	5
Applied Math	3-7	4	5
Applied Technology	3-6	4	5
Workplace Observation	1-5	2	3

APPLIED MATH SKILL

WorkKeys® Applied Math is the skill people use when they use mathematical reasoning and problem-solving techniques to solve work-related problems. Employees may use calculators and conversion tables to help with the problems, but they still need to use math skills to think them through.

There are five levels of difficulty. Level 3 is the least complex and Level 7 is the most complex. The levels build on each other, each incorporating the skills assessed at the previous levels. For example, at Level 5, employees need the skills from Levels 3, 4, and 5. Examples are included with each level description.

When deciding what level of the Applied Math skill employees need for the tasks they do at work, consider the following questions:

- How is the information presented? That is:
 - Is it presented in the same order that it is needed?
 - Is it necessary to change the order that the information is in before the math can be performed?

Is all the information needed for solving the problems provided? That is:

- Is all the information presented in the right form?
- Is it necessary to do some calculations to get some of the important information?
- Does the problem require a formula?
- Does the information need to be taken from a graphic?

What kind of mathematical operations do employees perform? That is:

- Can the math problem be completed in one step?
- Does the problem need to be done in several steps?
- Is it necessary to convert measurements from one form to another, either within or between systems of measurement?

Applied Math Level 3

Level 3 problems can easily be translated from a word problem to a math equation requiring a single type of math operation. All the needed information is presented in a logical order and there is no extra information given.

When employees use Level 3 Applied Math skills on the job, they can:

- Solve problems that require a single type of mathematical operation. They add or subtract either positive or negative numbers (such as 10 or -2). They multiply or divide using only positive numbers (such as 10).
- Convert a familiar fraction (such as $\frac{1}{2}$ or $\frac{1}{4}$ to a decimal) and convert from a decimal to a common fraction; OR convert between decimals to percentages (such as 0.75 to 75%).
- Convert between familiar units of money and time (for example, one hour equals 60 minutes or $\frac{1}{2}$ of a dollar equals \$0.50)
- Add the prices of several products to reach a total, and they can make the correct change for a customer.

Applied Math Level 4

At Level 4, tasks may present information out of order and may include extra, unnecessary information. One or two operations may be needed to solve the problem. A chart, diagram, or graph may be included.

When employees use Level 4 Applied Math skills on the job, they can use the skills described at Level 3, and they can:

- Solve problems that require one or two operations. They may add, subtract, or multiply using positive or negative numbers (such as 10, -2), and they may divide positive numbers (such as 10).
- Figure out an average or mean of a set of numbers (such as $\frac{(10+11+12)}{3}$). For this they use whole numbers and decimals.
- Figure out simple ratios (such as $\frac{3}{4}$), simple proportions (such as $\frac{10}{100}$ cases), or rates (such as 10 mph).
- Add commonly known fractions, decimals, or percentages (such as $\frac{1}{2}$, .75, or 25%).
- Add or subtract fractions that share a common denominator (such as $\frac{1}{8} + \frac{3}{8} + \frac{7}{8}$).
- Multiply a mixed number (such as $12\frac{1}{8}$) by a whole number or decimal.
- Put the information in the right order before they perform calculations.

For example, at this level, employees can figure out sales tax or a sales commission on a previously calculated total, and they can find out rates of use or business flow.

Applied Math Level 5

In Level 5 problems, the information may not be presented in logical order; the item may contain extraneous information; it may contain a chart, graph or diagram; and the mathematical set-up may be complicated. In solving, the test taker may need to perform multiple operations. For example, at this level employees may complete an order form by totaling an order and then computing tax.

When employees use Level 5 Applied Math skills on the job, they can use the skills described at Levels 3 and 4, and they can:

- Decide what information, calculations, or unit conversions to use to find the answer to a problem.
- As part of a multiple step problem, the employee may have to find one value and use it to find another value that answers the question.
- Add and subtract fractions with unlike denominators (such as $\frac{1}{2} - \frac{1}{4}$).
- Convert units within or between systems of measurement (e.g., time, measurement, and quantity) where the formula is provided such as converting from ounces to pounds or from centimeters to inches.
- Solve problems that require mathematical operations Calculate using mixed units, such as adding 3.50 hours and 4 hours 30 minutes or subtracting 3 feet and 10 inches from 6 feet and 4 inches.
- Identify the best deal by doing one- and two-step calculations and then comparing the results to determine the solution that meets the stated conditions.
- Calculate perimeters, circumference, and areas of basic shapes like rectangles and circles.
- Calculate a given percentage of a given number and then use that percentage to determine the solution (e.g., find the total cost of a product after calculating discount, markup or tax).
- Identify where a mistake occurred in a calculation (such as identifying the row in a spreadsheet where a problem occurred).

Applied Math Level 6

Level 6 tasks may require considerable translation from verbal form to mathematical expression. They generally require considerable setup and involve multiple-step calculations.

When employees use Level 6 Applied Math skills on the job, they can use the skills described at Levels 3, 4, and 5, and they can:

- Use fractions with unlike denominators and calculate reverse percentages.
- Convert units within or between systems of measurement (e.g., time, measurement, and quantity) where multiple-step conversions are required and the formulas are provided such as converting from kilometers to meters to feet.
- Identify why a mistake occurred in a solution.
- Find the best deal and use the result for another calculation.
- Find the area of basic shapes (rectangles and circles) when it may be necessary to rearrange the formula, convert units of measurement in the calculations, or use the result in further calculations.
- Find the volume of rectangular solids.
- Calculate rates, productions rates, rate by time (such as, production rate is 59 cups produced per hour, how many will be produced in an 8-hour shift).
- Identify the correct equation for solving a problem

Applied Math Level 7

At Level 7, the task may be presented in an unusual format and the information presented may be incomplete or require the employee to make an assumption. Tasks often involve multiple steps of logic and calculation, and multiple operations.

When employees use Level 7 Applied Math skills on the job, they can use the skills described at Levels 3, 4, 5, and 6, and they can:

- Solve problems that include ratios, rates, or proportions with at least one of the quantities related to a fraction
- Identify the reason for a mistake.
- Convert between units of measurement that involve fractions, mixed numbers, decimals, or percentages.
- Find the area of multiple shapes or find the area of a composite shape.
- Calculate volumes of spheres, cylinders, or cones
- Calculate the volume when it may be necessary to rearrange the formula, convert units of measurement in the calculations, or use the result in further calculations
- Set up and manipulate ratios, rates or proportions where at least one of the quantities is a fraction.
- Determine the better economic value of several alternatives by using graphics or by finding a percentage difference or a unit cost.
- Apply basic statistical concepts for example calculate the weighted mean, interpret measures of central tendency, or interpret measure of spread and tolerance.

Applied Technology Skill

WorkKeys Applied Technology is the skill people use when they solve problems with machines and equipment found in the workplace. This skill includes four areas of technology: electricity, mechanics, fluid dynamics, and thermodynamics. Employees need to know the basic principles of each area, as described below.

Electricity involves the flow of electrons. Employees need to know how electrical current moves through a circuit or a system and how electricity affects a circuit or system. For example, they need to know how to control current and resistance.

Mechanics involves the way solid things move and how leverage, force, friction, and momentum affect that motion. Employees need to solve problems with simple machines, complex machines, and mechanical systems.

Fluid dynamics involves the way fluids (liquids and gases such as water and air) move through systems. Employees need to use this knowledge to solve problems with plumbing, hydraulics, or pneumatics (compressed gas).

Thermodynamics involves the movement of heat. Employees need to know which substances warm up quickly when heated and which ones warm up more slowly. For example, air heats faster than water. They also need to know how specific heat works. That is, they need to know how different materials hold heat for different amounts of time. They need to solve problems with refrigeration, heating, air conditioning, and phase changes.

Applied Technology Skill Continued

The Applied Technology skill focuses on reasoning, not math. Therefore, employees do not need to make calculations or use formulas to solve problems.

When employees use the Applied Technology skill, they may:

- Analyze a problem by identifying the problem and its parts.
- Decide which parts of a problem are important.
- Decide on the order to follow when dealing with the parts of the problem.
- Apply existing tools, materials, or methods to new situations.

There are four levels of difficulty. Level 3 is the least complex and Level 6 is the most complex. The levels build on each other, each incorporating the skills assessed at previous levels. For example, Level 5 includes the skills used at Levels 3, 4, and 5. Individual situations may involve only one area of technology, but each skill level requires employees to know the basic principles of all four areas at that skill level.

When considering the level of Applied Technology skill needed for the tasks employees complete on the job, you should think about the complexity of the system and the physical principles involved. You might consider the following questions:

How complex is the system? That is:

- Is the system one simple object or several objects working together?
- Are tools or test equipment involved?
- How much extra information is included?

How complicated is the troubleshooting task? That is:

- How many components of the system are involved?
- Are the underlying principles elementary or complex?
- Is more than one area of technology involved?

Applied Technology Level 3

Level 3 tasks are straightforward because the situations include the following characteristics:

- They involve one simple system (such as a sprinkler) that generally has two to five components.
- They show clear physical symptoms and usually have only one variable.
- They include all the needed information.
- They use only basic technical terms (such as loosen, temperature, and flow).

When employees use Level 3 Applied Technology skills on the job, they can:

- Identify how basic tools (such as hammers and wrenches) work.
- Identify how simple machine parts work (such as how turning a screw clockwise drives it into wood).
- Apply basic principles to solve problems involving a simple system (for example, friction creates heat).
- Solve basic problems (for example, using heat to loosen a metal nut stuck to a bolt or using a rubber washer to stop a leak at a hose connection).
- Identify the clear physical symptom (such as an oil leak, a stopped shaft, or warm coils) that points to the potential source of a problem.
- Identify the best solution after getting rid of clearly unsuitable options.

Applied Technology Level 4

Level 4 tasks are moderately complex because the situations include the following characteristics:

- They can involve two or more simple systems that work together (such as a timer and sprinkler) or one moderately complex system (such as plumbing for a sink). These systems have up to ten components.
- They can involve one or two variables.
- They present all the information that is needed but may contain extra information.
- They include less common technical terms that are defined (such as heat exchanger and circuit breaker).

When employees use Level 4 Applied Technology skills on the job, in addition to the skills at Level 3, they can:

- Understand the operation of moderately complex tools (such as gear pullers) and diagnostic equipment (such as continuity testers).
- Understand the operation of moderately complex machines and systems. These can include appliances, pulley-driven equipment, or piping systems that carry more than one fluid. For example, they can find the drive wheel shown on a diagram of a tape player.
- Apply less obvious basic principles to solve problems within physical systems (moving air cools a warm object).
- Solve moderate problems such as installing a valve to manage oil flow or using a block to improve the leverage of a pry bar.
- Eliminate physical symptoms that do not point to the source of a problem by choosing which information is important and ignoring information that is clearly extra.
- Identify the best solution after getting rid of other unsuitable options.

Applied Technology Level 5

Level 5 tasks can be moderately complex or of advanced difficulty because the situations include the following characteristics:

- They can involve two or more simple tools or systems that affect each other or a complex system (such as the plumbing in a house) that includes several components (such as drains, hot and cold water lines, and valves). These systems perform somewhat complex operations and generally have more than ten components.
- They can involve two or three variables.
- They may require the use of technical knowledge (for example, condensing coils should be warm and evaporating coils should be cool) and often include extra information.
- They use technical terms, which may be clearly defined or whose meaning may be implied in the context and illustrations.

When employees use Level 5 Applied Technology skills on the job, in addition to the skills at Levels 3 and 4, they can:

- Understand the operation of moderately complex tools (such as cutting torches and drill presses) and diagnostic equipment (such as ohmmeters, micrometers, or thermometers) and choose the best tool for the task.
- Understand the operation of complex machines and systems, such as gasoline engines, dishwashers, freezers, and building electrical systems.
- Apply two or more principles of technology (within one area or in two or more areas) as they interact in moderately complex systems (heat from friction causes components to expand).
- Solve moderate and advanced problems, such as how to change the speed of pulley-driven machines, protect electric circuits from overload, place fans in the best position, or find a problem in a hydraulic cylinder.
- Eliminate physical symptoms that do not lead to the source of a problem by choosing which information is important and ignoring extra information. To do this, it is necessary to use clues to find the source of a problem. For example, the smell of hot rubber near a conveyor might indicate a loose drive belt.
- Identify the best solution after getting rid of other suitable options.

Applied Technology Level 6

Level 6 tasks are advanced because the situations include the following characteristics:

- They involve complex tools or systems (such as the water system of a new subdivision) with more than ten components and they include large amounts of information.
- They present a variety of possible sources of problems that are subtle and difficult to diagnose.
- They may involve many variables at the same time.
- They require the use of technical, although not job-specific, knowledge (for example, how an electromagnetic relay operates) and contain considerable extra information.
- They use technical terms, which may be clearly defined or whose meaning may be implied in a complex context and illustrations.

When employees use Level 6 Applied Technology skills on the job, in addition to using the skill at Levels 3, 4, and 5, they can:

- Understand the operation of complex tools (such as an arc welder or compound miter saw) and diagnostic equipment (such as an oscilloscope) and choose the best tool for the task.
- Understand the operation of complex machines and their components (for example, hydraulic lifts, automobiles, and water treatment facilities).
- Apply two or more principles of technology (within one area or in two or more areas) as they interact in complex systems. For example, fluids, like refrigerant, are often subjected to phase changes in order to move greater amounts of heat.
- Solve advanced problems where a variety of mechanical, electrical, thermal, or fluid faults could be the reason for the problem.
- Eliminate physical symptoms that do not lead to the source of a problem by choosing which information is important and ignoring extra information. To do this, it is necessary to use less obvious clues to find the source of a problem. For example, discolored oil may mean a faulty gasket is allowing moisture into an engine.
- Test possible hypotheses to ensure the problem is diagnosed correctly and the best solution is found. This is necessary when systems have difficult problems that could be caused by a variety of mechanical, electrical, thermal, or flow faults.

GRAPHIC LITERACY SKILL

The WorkKeys Graphic Literacy skill is the skill people use when they work with workplace graphics such as tables, graphs, charts, digital dashboards, flow charts, timelines, forms, maps, and blueprints. Employees use this skill when they find, summarize, compare, and analyze information to make decisions using workplace graphics to solve work-related problems.

Graphic Literacy Level 3

At Level 3, workplace graphics are common and of simple or low moderate difficulty.

Characteristics of simple graphics include:

- A limited amount of data (i.e., less than twenty data points/fields)
- One level of data such as number of items in inventory
- One or two variables such as day of the week and number of items in inventory
- If there are axes, there will be one or two, such as an x and/or y axis

Characteristics of low moderate graphics include:

- A moderate amount of data
- More than one level of data, but no nesting
- Several variables
- If there are axes, there will be one or two
- If two simple graphics are required to solve the problem, they should be considered a low moderate graphic.

At Level 3, employees use one simple or low moderate graphic at a time to perform the following tasks:

- Locate and find information
- Identify the next or missing step in a process

Graphic Literacy Level 4

At Level 4, workplace graphics are common and of low to high moderate difficulty.

Characteristics of low moderate graphics include:

- A moderate amount of data
- More than one level of data, but no nesting
- Several variables
- If there are axes, there will be one or two
- If two simple graphics are required to solve the problem, they should be considered a low moderate graphic.

At Level 4, employees have demonstrated all of the skills defined at Level 3 and they can use one or two low moderate graphics at a time to perform the following tasks:

- Locate information in a graphic using information found in another graphic
- Compare two or more pieces of information
- Identify a trend/pattern/relationship
- Make an inference or decision
- Identify the graphic that accurately represents the data

High moderate graphics may be less common and have the following characteristics:

- A moderate amount of data
- More than one level of data and it may be nested
- Many variables such as types of wood, drill speeds, hole diameter, and type of bit
- If there are axes, there will be one or two such as an x and/or y axis.
- If a low moderate graphic and a simple graphic are required to solve the problem, they should be considered a high moderate graphic.

At Level 4, employees have demonstrated all of the skills defined at Level 3 and they can use one high moderate graphic to perform the following tasks:

- Locate and find information
- Identify the next or missing step in a process

Graphic Literacy Level 5

At Level 5, workplace graphics may be less common and of low moderate, high moderate, or difficult complexity.

Characteristics of low moderate graphics include:

- A moderate amount of data
- More than one level of data, but no nesting
- Several variables
- If there are axes, there will be one or two.
- If two simple graphics are required to solve the problem, they should be considered a low moderate graphic.

At level 5, employees have demonstrated all of the skills defined at Levels 3 and 4, and they can use a low moderate graphic to perform the following tasks:

- Compare two or more pieces of information
- Interpret a trend/pattern/relationship
- Make a reasonable inference or decision based on one graphic after finding information in another graphic
- Justify a decision or inference based on information
- Identify the most effective graphic for the task
- Justify the most effective graphic for the task

High moderate graphics may be less common and have the following characteristics:

- A moderate amount of data
- More than one level of data and it may be nested
- Many variables
- If there are axes, there will be one or two.
- If a low moderate graphic and a simple graphic are required to solve the problem, they should be considered a high moderate graphic.

Graphic Literacy Level 5 Continued

At Level 5, employees have demonstrated all of the skills defined at Level 3 and 4, and they can use one high moderate graphic to perform the following tasks:

- Locate information in a graphic using information found in another graphic
- Compare two or more pieces of information
- Identify a trend/pattern/relationship
- Make an inference or decision
- Identify the graphic that accurately represents the data

Difficult graphics are likely to be less common or a composite of graphics and have the following characteristics:

- Data presented is dense.
- More than one level of data and nesting is likely
- Many variables such as types of wood, drill speeds, hole diameter, and type of bit
- If there are axes, there will be three or more such as an x, y, and z axis.
- If a high moderate graphic and a low moderate graphic are required to solve the problem, they should be considered a difficult graphic.

At Level 5, employees have demonstrated all of the skills defined at Level 3 and 4, and they can use one difficult graphic to perform the following tasks:

- Locate and find information
- Identify the next or missing step in a process

Graphic Literacy Level 6

At Level 6, workplace graphics may be less common and of high moderate or difficult complexity.

High moderate graphics may be less common and have the following characteristics:

- A moderate amount of data
- More than one level of data and it may be nested
- Many variables
- If there are axes, there will be one or two
- If a low moderate graphic and a simple graphic are required to solve the problem, they should be considered a high moderate graphic.

At level 6, employees have demonstrated all of the skills defined at Levels 3, 4 and 5, and they can use a high moderate graphic to perform the following tasks:

- Compare two or more pieces of information
- Interpret a trend/pattern/relationship
- Make a reasonable inference or decision based on one graphic after finding information in another graphic
- Justify a decision or inference based on information
- Identify the most effective graphic for the task
- Justify the most effective graphic for the task

Difficult graphics are likely to be less common or a composite of graphics and have the following characteristics:

- Data presented is dense.
- More than one level of data and nesting is likely
- Many variables
- If there are axes, there will be three or more.
- If a low moderate graphic and a high moderate graphic are required to solve the problem, they should be considered a difficult graphic.

Graphic Literacy Level 6 Continued

At Level 6, employees have demonstrated all of the skills defined at Level 3, 4 and 5, and they can use one difficult graphic to perform the following tasks:

- Locate information in a graphic using information found in another graphic
- Compare two or more pieces of information
- Identify a trend/pattern/relationship
- Make an inference or decision
- Identify the graphic that accurately represents the data

Graphic Literacy Level 7

At Level 7, workplace graphics may be less common and of difficult complexity.

Difficult graphics are likely to be less common or a composite of graphics and have the following characteristics:

- Data presented is dense.
- More than one level of data and nesting is likely
- Many variables
- If there are axes, there will be three or more.
- If a low moderate graphic and a high moderate graphic are required to solve the problem, they should be considered a difficult graphic.

At level 7, employees have demonstrated all of the skills defined at Levels 3, 4, 5 and 6, and they can use a difficult graphic to perform the following tasks:

- Compare two or more trends/patterns/relationships
- Interpret a trend/pattern/relationship
- Make a reasonable inference or decision based on one graphic after finding information in another graphic
- Justify an inference or decision based on information
- Identify the most effective graphic for the task
- Justify the most effective graphic for the task

WORKPLACE DOCUMENTS

Employees read and use workplace documents in order to do a job. The documents include, but are not limited to, messages, emails, letters, directions, signs, notices, bulletins, policies, websites, contracts, and regulations and are based on materials that reflect the actual reading demands of the workplace.

It is often the case that these workplace communications are not necessarily clearly written or targeted to the appropriate audience. These documents do not include information that is presented graphically, such as in charts, forms, or blueprints.

There are five levels of difficulty. Level 3 is the least complex and Level 7 is the most complex. The levels build on each other, each incorporating the skills assessed at the preceding levels. For example, at Level 5, employees need the skills from Levels 3, 4, and 5. The reading materials at Level 3 are short and direct. The material becomes longer, denser, and more difficult to use as readers move toward Level 7. The tasks also become more complex as readers move from Level 3 to Level 7. At Level 3, readers begin by finding very obvious details and following short instructions. At the more complex levels, tasks can also involve more application and interpretation.

When you consider what level of skill is needed for the tasks employees complete on the job, you might consider the following questions:

How difficult are the materials? For example:

- Are the sentences short, simple, and clear; or are they complex and possibly even confusing?
- Do the materials use only common words; or do they include difficult words, jargon, and words used in unfamiliar ways?
- How much extra information is included?

How complicated is the task? For example:

- Is it only necessary to use information that is stated clearly?
- Is it necessary to make inferences based on the reading materials before using the information?
- Do the employees need to apply the information to a situation exactly like the one described in the materials or to one that is quite different?

Workplace Documents Level 3

Level 3 reading materials include basic work-related policies, procedures, and announcements with the following characteristics:

- They are short, with no extra information.
- Employees read the materials to find out what they should do.
- All the information within the document is stated clearly and directly.
- Short sentences and common, everyday, and workplace words (such as employee, timecard, office) are used.
- The document contains a small number of clearly stated details.

When employees use Level 3 skills on the job, they can:

- Find the main ideas and clearly stated details.
- Choose when to perform each step in a series of short steps.
- Apply information/instructions to a situation that is the same as the one they are reading about (such as knowing what button to push first after reading instructions on how to run a copy machine).

Workplace Documents Level 4

Level 4 workplace documents include policies, procedures, and notices with the following characteristics:

- They are straightforward with some long sentences and contain a number of details.
- These materials use common words, but do have some harder words, too.
- They describe procedures that include several steps.
- When following the procedures, employees must think about changing conditions that affect what they should do. For example, they can follow directions that include “if-then” statements.

When employees use Level 4 skills on the job, in addition to using Level 3 skills, they can:

- Identify the main idea and details that may not be clearly stated.
- Use the reading material to figure out the meaning of words that are not defined for them (not jargon or technical terms).
- Apply information/instructions to a situation that is the same as the situation in the reading materials.
- Choose what to do when changing conditions call for a different action.

Workplace Documents Level 5

At Level 5, workplace documents include policies, procedures, announcements, legal, and multiple related documents that have many details with the following characteristics:

- The information that employees need is generally stated directly, but it is hard to find because there are so many details and some may not be needed for the task being performed (extraneous information).
- The materials include technical terms, jargon, and acronyms, or words that have several meanings.
- The documents may have complex sentences and/or contain conditional situations.

When employees use Level 5 skills on the job, in addition to using the skills described at Levels 3 and 4, they can:

- Figure out the appropriate meaning of a word based on how the word is used.
- Identify the appropriate meaning of technical term, jargon, or an acronym that is defined in the document.
- Apply technical terms and jargon to stated situations.
- Apply information/instructions to a new situation that is similar to the one described in the material while considering changing conditions.
- Apply complex information/instructions that include conditionals to situations described in the materials.
- They may need to make some inferences to accomplish their goal

Workplace Documents Level 6

At Level 6, workplace documents include policies, informational, instructional (procedures), legal, and multiple related documents with the following characteristics:

- They use mostly complicated sentences.
- Documents may be long and/or complex and/or contain conditional situations.
- There are implied and/or extraneous details with difficult words, jargon, and technical terms.
- Most of the information is not clearly stated.
- Meanings may need to be determined from context.

When employees use Level 6 skills on the job, in addition to using the skills at Levels 3, 4, and 5, they can:

- Infer implied details.
- Infer the meaning of an acronym, jargon, or technical term from context.
- Apply information/instructions to a situation not directly described or to a completely new situation.
- Apply principles inferred in a passage to a situation not directly described or to a completely new situation.
- Identify the rationale behind a procedure, policy, or communication.

Workplace Documents Level 7

At Level 7, workplace documents include policies, informational, instructional (procedures), legal, and multiple related documents with the following characteristics:

- The documents contain a lot of details, and the concepts are complicated.
- May cover uncommon topics (concepts) and/or contain conditional situations.
- There are implied and extraneous details.
- Advanced, unfamiliar, and/or uncommon words, technical terms, and jargon; meanings must be determined from context.
- Not clearly stated, pieces of information may be spread throughout the document and may be extraneous.

When employees use Level 7 skills on the job, in addition to using the skills at Levels 3, 4, 5, and 6, they can:

- Infer the meaning of an acronym, jargon or technical term from context.
- Apply principles inferred from the materials to a situation not directly described or to a completely new situation.
- Identify the rationale behind an entire document or a section of a document.
- Infer implied details.

WORKPLACE OBSERVATION SKILL

WorkKeys® Workplace Observation is the skill that employees use to visually observe a workplace event, notice details, and remember instructions, procedures, processes, and demonstrations in order to generalize to workplace situations that may be similar or very different from what was observed. Employees must pay careful attention to steps that are followed, to safety procedures, and to quality-control standards.

There are five levels. Level 1 is the least complex and Level 5 is the most complex. The levels build on each other, each incorporating the skills assessed at the previous levels. For example, Level 5 includes the skills used at Levels 1, 2, 3, 4, and 5. The skill level is determined by the complexity of the situation being observed and the task(s) that employees are asked to do based on their observations. At Level 1, employees must be able to recall information from a short, straightforward sequence with few details, no distractions, and obvious differences from the standard. For example, they may need to identify the next step in a series of steps. At Level 5, employees must be able to generalize information from a complex situation to new situations in order to make accurate predictions or anticipate changing variables. Distractions and differences are difficult to recognize.

Video examples of situations that belong at each skill level are provided. When you consider what skill level is needed for the tasks that employees complete on the job, think about the following things:

How complex is the procedure being observed and remembered?

- Is it logical or illogical, familiar or new, commonplace or unique, straightforward or complicated?
- How much information is involved, and are the procedure's parts independent or interactive?
- How much distracting information is there?
- Are extra details likely?
- How difficult is it to detect differences, discrepancies, or changes?

How difficult is the task that employees are asked to do?

- How much generalizing is the employee required to do? Are they identifying the next step in a straightforward process or are they determining how a change will affect an outcome?
- How subtle are the details or differences in the procedure to be noticed by employees? Are these differences significant?

- Are employees required to apply instructions, demonstrations, procedures, or processes to other situations?
- Do employees need to take changing conditions into account to choose the best course of action?

Workplace Observation Level 1

At Level 1, employees follow a short, straightforward, and simple procedure with each step clearly shown. The task is performed in a routine and predictable manner. There are no distractions and differences are obvious. There are a few details, but no unnecessary details.

When employees use Level 1 Workplace Observation skills on the job, they can:

- Repeat a short, straightforward demonstration, process, pattern, or procedure
- Recognize an incorrect step (wrong order or not in process)
- Identify the next step in a series of steps
- Put steps in correct order
- Identify a missed or incorrect step
- Match placement or identify misplacement of components (e.g., follow instructions for putting phone cord in proper location when packing a box)

Workplace Observation Level 2

At Level 2, employees interpret a straightforward procedure, but there is a condition (if – then or cause-effect). Several possible things may happen and a specific response is provided for each one. There are obvious and easily disregarded distractions. There are a few extra details and differences.

When employees use Level 2 Workplace Observation skills on the job, they can:

- Recognize cause and effect in a straightforward demonstration, process, pattern, or procedure
- Filter out obvious distractions
- Identify the cause of a particular effect (e.g., alarm sounds when pressurized air is released)
- Recognize what to do next in a situation given a single condition
- Indicate action to be taken when there is an incorrect step identified

Workplace Observation Level 3

At Level 3, employees watch complex procedures that include several tasks that may occur at the same time, interact, and change from one situation to another. More than one condition (if-then or cause-effect) may be present. Several important details are presented, but a few are not clearly prompted. Some distractions may make remembering details difficult. The employee may be asked to apply information observed to other similar situations. Steps may seem similar, but differ based on varying factors. A few differences may be present that are not clear.

When employees use Level 3 Workplace Observation skills on the job, they can:

- Identify course of action to take given more than one condition
- Distinguish steps that seem similar but are different based on varying factors
- Maintain attention to significant details with little prompting
- Recognize when steps can be combined and when they must be kept distinct
- Combine steps to achieve desired result
- Identify differences and/or details that are not clear
- Select, interpret, and integrate the steps, in the correct order, within a complex process
- Apply information to a similar situation

Workplace Observation Level 4

At Level 4, employees must analyze and determine the basic principles before a process can be generalized to a new situation. Several conditions are present that may influence the course of action. Strong distractions compete for attention. Some steps may not be demonstrated (i.e., inferred). Some of the differences are difficult to notice.

When employees use Level 4 skills on the job, they can:

- Make inferences from situational cues in a demonstrated process or procedure
- Derive steps that are missing from a partial or non-explicit pattern, process or procedure
- Apply complicated instructions to new situations
- Decide which conditions apply to a new situation
- Determine the general principle underlying the condition, process, or procedure
- Determine what comes next (e.g., tiling a floor and figuring out the next placement in the pattern)
- Break down a given process and apply results to unfamiliar processes to complete a task or diagnose a problem
- Use situational cues to determine steps to be taken

Workplace Observation Level 5

At Level 5, employees evaluate a new situation with multiple conditions and then choose the best course of action. General principles may be difficult to determine and may need to be applied differently in order to achieve a desired outcome. The situation requires innovation and the level of abstraction may be high. Distractions are present that appear to be relevant but are not. Differences are difficult to recognize and/or evaluate.

When employees use Level 5 skills on the job, they can:

- Determine the best course of action by applying principles to a new situation and/or when the information is not complete.
- Make accurate predictions based on what has been observed (e.g., what is the likely result).
- Consider the implications of a process or procedure and how they will affect outcomes.
- Prioritize appropriately (identify aspects of process that should be given priority under certain circumstances, identify parts of the process that can be omitted in different circumstances)
- Identify ways to improve the process
- Evaluate whether something is or is not a distraction

Appendix B

CompTIA A+ Core 1 Exam Objectives Linked to WorkKeys Skills

The CompTIA A+ Core Exam Objectives are shown in the table below with the corresponding topic and lesson in the curriculum and the links to the WorkKeys skills. The titles of the WorkKeys skills are abbreviated: Applied Math (AM), Graphic Literacy (GL), Workplace Documents (WD), Applied Technology (AT), and Workplace Observation (WO).

CompTIA A+ Core 1 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
1.0 Mobile Devices							
1.1 Given a scenario, install and configure laptop hardware and components.							
• Hardware/device replacement (Battery, Keyboard, Random-access Memory (RAM), Hard disk Drive, Wireless Card)	Lesson 8	Topic C		x	x	x	x
• Physical privacy and security components (Biometrics, Near-field Scanner Features)	Lesson 8	Topic C		x	x		x
1.2 Compare and contrast the display components of mobile devices.							
• Types (Liquid Crystal Display (LCD) In-plane Switching (IPS) Twisted Nematic (TN))	Lesson 8	Topic A		x	x	x	x
• Mobile display components	Lesson 8	Topic A		x	x	x	x
• Wi-Fi antenna connector/ placement	Lesson 8	Topic A		x	x		x
• Camera/webcam	Lesson 8	Topic A		x	x		x
• Microphone	Lesson 8	Topic A		x	x		x
• Touch screen/digitizer	Lesson 8	Topic A		x	x		x
• Inverter	Lesson 8	Topic A		x	x		x
1.3 Given a scenario, set up and configure accessories and ports of mobile devices.							
• Connection methods (Universal Serial Bus (USB), Lightning, Serial Interfaces, Blue Tooth, Hot Spot)	Lesson 8	Topic A		x	x		x
• Accessories (Touch Pens, Headsets, Speakers, Webcam)	Lesson 8	Topic A		x	x		x

CompTIA A+ Core 1 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
• Docking station	Lesson 8	Topic A		x	x		x
• Port replicator	Lesson 8	Topic A		x	x		
• Trackpad/drawing pad	Lesson 8	Topic A		x	x		x
1.4 Given a scenario, configure basic mobile-device network connectivity and application support.							
• Wireless/cellular data network (enable/disable) (2G/3G/4G/5G, Hotspot, Preferred Roaming List (PRL) updates)	Lesson 8	Topic B		x	x		
• Bluetooth (Enable Bluetooth, Enable Pairing, Enter appropriate PIN code, Test Connectivity)	Lesson 8	Topic B		x	x		
• Location services (Global Positioning System (GPS) Services, Cellular Location Services)	Lesson 8	Topic B		x	x		
• Mobile device management (MDM)/mobile application management (MAM) (Two-Factor authentication)	Lesson 8	Topic B		x	x		
• Mobile device synchronization (Microsoft 365, Google, iCloud, Data to Synchronize-Mail, Photos, Contacts)	Lesson 8	Topic B		x	x		
2.0 Networking							
2.1 Compare/contrast Transmission Control Protocol (TCP) & User Datagram Protocol (UDP) ports, protocols, & their purposes.							
• Ports and protocols (20/21-file Transfer Protocol (FTP), 22-Secure Shell (SSH), 110-Post Office Protocol (POP3))	Lesson 5	Topic C		x	x		
• TCP vs. UDP (Connectionless-(DHCP, TFTP), Connection-oriented- HTTPS, SSH))	Lesson 5	Topic C		x	x		
2.2 Compare and contrast common networking hardware.							
• Routers	Lesson 5	Topic A		x	x		x
• Switches (Managed, Unmanaged)	Lesson 4	Topic B		x	x		x
• Access points	Lesson 4	Topic D		x	x		x
• Patch panel	Lesson 4	Topic B		x	x		x
• Firewall	Lesson 5	Topic A		x	x		x

CompTIA A+ Core 1 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
• Power over Ethernet (PoE) (Injectors, Switches, PoE Standards)	Lesson 4	Topic B		x	x	x	x
• Hub	Lesson 4	Topic B		x	x		x
• Cable modem	Lesson 5	Topic A		x	x		x
• Digital subscriber line (DSL)	Lesson 5	Topic A		x	x		x
• Optical network terminal (ONT)	Lesson 5	Topic A		x	x		x
• Network interface card (NIC)	Lesson 4	Topic B		x	x		x
• Software-defined networking (SDN)	Lesson 7	Topic B		x	x		x
2.3 Compare and contrast protocols for wireless networking							
• Frequencies (2.4GHz, 5GHz)	Lesson 4	Topic D	x	x	x	x	x
• Channels (Regulations, 2.4GHz vs. 5GHz)	Lesson 4	Topic D		x	x		x
• Bluetooth	Lesson 4	Topic D		x	x		x
• 802.11 (a, b, g, n, ac (WiFi 5), ax (WiFi6))	Lesson 4	Topic D		x	x		x
• Long-range fixed wireless (Licensed, Unlicensed, Power, Regulatory requirements for power)	Lesson 4	Topic D		x	x		x
• NFC	Lesson 4	Topic D		x	x		x
• Radio-frequency identification (RFID)	Lesson 4	Topic D		x	x		x
2.4 Summarize services provided by networked hosts.							
• Server roles (DNS,DHCP, Fileshare, Print servers, Mail servers, Syslog, Web servers, Authentication, authorization)	Lesson 5 & 6	Topic D & A		x	x		
• Internet appliances (Spam gateways, Unified threat management (UTM), Load balancers, Proxy servers)	Lesson 6	Topic B		x	x		
• Legacy/embedded systems (Supervisory control and data acquisition (SCADA))	Lesson 6	Topic B			x		
• Internet of Things (IoT) devices	Lesson 6	Topic B			x		
2.5 Given a scenario, install and configure basic wired/wireless small office/home office (SOHO) networks.							
• Internet Protocol (IP) addressing (IPv4, IPv6, Automatic Private IP Addressing (APIPA), Static, Dynamic, Gateway)	Lesson 5	Topic B		x	x		

CompTIA A+ Core 1 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
2.6 Compare and contrast common network configuration concepts.							
• DNS (Address, Mail Exchanger (MX), Text (TXT), Spam management)	Lesson 5	Topic D					
• DHCP (Leases, Reservations, Scope)	Lesson 5	Topic D			x		
• Virtual LAN (VLAN)	Lesson 5	Topic D			x		
• Virtual private network (VPN)	Lesson 5	Topic D			x		
2.7 Compare and contrast Internet connection types, network types, and their features.							
• Internet connection types (Satellite, Fiber, Cable, DSL, Cellular, Wireless Internet service provider (WISP))	Lesson 5	Topic A			x		
• Network types (Local area network (LAN), Wide area network (WAN), Person area network (PAN))	Lesson 4	Topic A			x		
2.8 Given a scenario, use networking tools							
• Crimper	Lesson 4	Topic C			x		
• Cable stripper	Lesson 4	Topic C			x		
• WiFi analyzer	Lesson 4	Topic D			x		
• Toner probe	Lesson 4	Topic C			x		
• Punchdown tool	Lesson 4	Topic C			x		
• Cable tester	Lesson 4	Topic C			x		
• Loopback plug	Lesson 4	Topic C			x		
• Network tap	Lesson 4	Topic C			x		
3.0 Hardware							
3.1 Explain basic cable types and their connectors, features, and purposes.							
• Network cables (Copper M Cat 5 M Cat5e M Cat 6 M Cat 6a, Plenum, Optical- M Fiber, T568A/T568B)	Lesson 4	Topic C		x	x	x	
• Peripheral cables (USB 2.0, USB 3.0, Serial, Thunderbolt)	Lesson 1	Topic C		X	x		
• Video cables (High-Definition Multimedia Interface(HDMI), DisplayPort, Digital Visual Interface, Video Graphics Array(VGA))	Lesson 1	Topic C		x	x		

CompTIA A+ Core 1 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
• Hard drive cables (Serial Advanced Technology Attachment (SATA), Small Computer system Interface (SCSI))	Lesson 1	Topic C		x	x		
• Adapters	Lesson 1	Topic A			x		
• Connector types (RJ11, RJ45, F type, Straight tip (ST), Subscriber connector (SC), Punchdown block, microUSB, miniUSB)	Lesson 1	Topic A		x	x		
3.2 Given a scenario, install the appropriate RAM.							
• RAM types (Virtual RAM, small outline dual inline memory module (SODIMM), Double Data Rate 3 (DDR#3))	Lesson 2	Topic C	x	x	x		x
• Single-channel	Lesson 2	Topic C		x	x		x
• Dual-channel	Lesson 2	Topic C		x	x		x
• Triple-channel	Lesson 2	Topic C		x	x		x
• Quad-channel	Lesson 2	Topic C		x	x		x
3.3 Given a scenario, select and install storage devices.							
• Hard drives (Speeds-M 5,400rpm M 7200rpm M 10,000rpm M 15,000rpm, Form factor-M2.5, M 3.5))	Lesson 2	Topic B		x	x		
• SSDs (Communication interfaces-M Non-volatile Memory Express (NVMe), Form factor-M M.2, M mSATA)	Lesson 2	Topic B		x	x		x
• Drive configurations (Redundant Array of Independent (or Inexpensive) Disks (RAID) 0, 1, 5, 10)	Lesson 2	Topic B		x	x		
• Removable storage (Flash drives, Memory cards, Optical drives)	Lesson 2	Topic B		x	x		
3.4 Given a scenario, install and configure motherboards, central processing units (CPUs), and add-on cards.							
• Motherboard form factor (Advanced Technology eXtended (ATX), Information Technology eXtended (ITX))	Lesson 1	Topic B		x	x	x	x
• Motherboard connector types (Peripheral component Interconnect (PCI), PCI Express (PCIe), Power Connectors, SATA, M.2)	Lesson 1	Topic B		x	x	x	x
• Motherboard compatibility (CPU sockets, Server, Multisocket, Desktop, Mobile)	Lesson 2	Topic D		x	x	x	x

CompTIA A+ Core 1 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
• Basic Input/Output System (BIOS)/Unified Extensible Firmware Interface (UEFI) settings (Boot options, USB permissions)	Lesson 3	Topic B		x	x	x	x
• Encryption (TPM, Hardware security module (HSM))	Lesson 3	Topic B		x	x	x	x
• CPU architecture (x64/x86, Advanced RISC Machine (ARM), Single core, Multicore, Multithreading, Virtualization support)	Lesson 2	Topic D			x	x	x
• Expansion cards (Sound card, Video card, Capture card, NIC)	Lesson 1	Topic B		x	x	x	x
• Cooling (Fans, Heat sink, Thermal paste/pads, Liquid)	Lesson 2	Topic A		X	x	X	x
3.5 Given a scenario, install or replace the appropriate power supply.							
• Input 110-120 VAC vs. 220-240 VAC	Lesson 2	Topic A			x	x	x
• Output 3.3V vs. 5V vs. 12V	Lesson 2	Topic A			x	x	x
• 20-pin to 24-pin motherboard adapter	Lesson 2	Topic A			x	x	x
• Redundant power supply	Lesson 2	Topic A			x	x	x
• Modular power supply	Lesson 2	Topic A			x	x	x
• Wattage rating	Lesson 2	Topic A	x		x	x	x
3.6 Given a scenario, deploy and configure multifunction devices/ printers and settings.							
• Properly unboxing a device – setup location considerations	Lesson 9	Topic A			x		
• Use appropriate drivers for a given OS (Printer Control Language (PLC) vs. Postscript	Lesson 9	Topic A			x		
• Device connectivity (USB, Ethernet, Wireless)	Lesson 9	Topic A		x	x		
• Public/shared devices (Printer share, Printer server)	Lesson 9	Topic A		x	x		
• Configuration settings (Duplex, Orientation, Tray settings, Quality)	Lesson 9	Topic A		x	x	x	x
• Security (User authentication, Badging, Audit logs, Secured prints)	Lesson 9	Topic A		x	x		
• Network scan services (Email, SMB, Cloud services)	Lesson 9	Topic A		x	x		
• Automatic document feeder (ADF)/flatbed scanner	Lesson 9	Topic A			x		
3.7 Given a scenario, install and replace printer consumables.							

CompTIA A+ Core 1 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
<ul style="list-style-type: none"> Laser (Imaging drum, fuser assembly, transfer belt, transfer rollers, Imaging process, Maintenance) 	Lesson 9	Topic B		x	x	x	x
<ul style="list-style-type: none"> Inkjet (Ink cartridge, print head, roller, feeder, duplexing assembly, carriage belt, Calibration, Maintenance) 	Lesson 9	Topic B			x		
<ul style="list-style-type: none"> Thermal (Feed assembly, heating element, Special thermal paper, Maintenance, Heat sensitivity of paper) 	Lesson 9	Topic B			x		
<ul style="list-style-type: none"> Impact (Print head, ribbon, tractor feed, Impact paper, Maintenance: replace ribbon, replace print head, replace paper) 	Lesson 9	Topic B			x		
<ul style="list-style-type: none"> 3-D printer (Filament, Resin, Print bed) 	Lesson 9	Topic B			x		
4.0 Virtualization on Computing and Cloud							
4.1 Summarize cloud-computing concepts.							
<ul style="list-style-type: none"> Common cloud models (Private cloud, Public cloud, Hybrid cloud, Community cloud, Infrastructure as a service (IaaS)) 	Lesson 7	Topic B			x		
<ul style="list-style-type: none"> Cloud characteristics (Shared resources, Metered utilization, Rapid elasticity, High Availability, File synchronization) 	Lesson 7	Topic B			x		
<ul style="list-style-type: none"> Desktop virtualization (Virtual desktop infrastructure (VDI) on premises, VDI in the cloud) 	Lesson 7	Topic B			x		
4.2 Summarize aspects of client-side virtualization.							
<ul style="list-style-type: none"> Purpose of virtual machines (Sandbox, Test development, Application virtualization) 	Lesson 7	Topic A		x	x		
<ul style="list-style-type: none"> Resource requirements 	Lesson 7	Topic A	x		x		
<ul style="list-style-type: none"> Security requirements 	Lesson 7	Topic A			x		
5.0 Hardware and Network Troubleshooting							
5.1 Given a scenario, apply the best practice methodology to resolve problems.							
<ul style="list-style-type: none"> Always consider corporate policies, procedures, and impacts before implementing changes (Identify problem, Establish theory of probable cause, Test theory, Establish plan of action, Verify functionality, Document) 	Lesson 3	Topic A			x	x	

CompTIA A+ Core 1 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
5.2 Given a scenario, troubleshoot problems related to motherboards, RAM, CPU, and power.							
• Common symptoms (Power-on self-test (POST) beeps, Proprietary crash screens, Black screen, No power)	Lesson 3	Topic C & D			x		
5.3 Given a scenario, troubleshoot and diagnose problems with storage drives and RAID arrays.							
• Common symptoms (Light-emitting diode (LED) status indicators, Grinding noises, Clicking sounds)	Lesson 3	Topic C			x		
5.4 Given a scenario, troubleshoot video, projector, and display issues.							
• Common symptoms (Incorrect data source, Physical cabling issues, Burned-out bulb, Fuzzy image, Display burn-in)	Lesson 3	Topic D			x	x	
5.5 Given a scenario, troubleshoot common issues with mobile devices.							
• Common symptoms (Poor battery health, Swollen battery, Broken screen, Improper charging, Poor/no connectivity)	Lesson 8	Topic D			x	x	x
5.6 Given a scenario, troubleshoot and resolve printer issues.							
• Common symptoms (Lines down the printed pages, Garbles print, Toner not fusing to paper, Paper jams, Faded print)	Lesson 9	Topic C		x	x	x	x
5.7 Given a scenario, troubleshoot problems with wired and wireless networks.							
• Common symptoms (Intermittent wireless connectivity, slow network speeds, Limited connectivity, Jitter)	Lesson 6	Topic C		x	x		x

Appendix C

CompTIA A+ Core 2 Exam Objectives Linked to WorkKeys Skills

The CompTIA A+ Core Exam Objectives are shown in the table below with the corresponding topic and lesson in the curriculum and the links to the WorkKeys skills. The titles of the WorkKeys skills are abbreviated: Applied Math (AM), Graphic Literacy (GL), Workplace Documents (WD), Applied Technology (AT), and Workplace Observation (WO).

CompTIA A+ Core 2 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
1.0 Operating Systems							
1.1 Identify basic features of Microsoft Windows editions.							
• Windows 10 editions (Home, Pro, Pro for Workstations, Enterprise)	Lesson 12	Topic B		x	x		
• Feature differences (Domain access vs. workgroup, Desktop styles/user interface, Availability of Remote Desktop Protocol)	Lesson 12	Topic B		x	x		
• Upgrade paths (In-place upgrade)	Lesson 12	Topic B		x	x		x
1.2 Given a scenario, use the appropriate Microsoft command-line tool.							
• Navigation (cd, dir, md, rmdir, Drive navigation inputs: M C: or D: or x:)	Lesson 11	Topic C		x	x		
• Command-line tools (ipconfig, ping, hostname, netstat, nslookup, chkdisk, net user, net use, tracert, format, xcopy, copy)	Lesson 11	Topic C		x	x		x
1.3 Given a scenario, use features and tools of the Microsoft Windows 10 operating system (OS).							
• Task Manager (Services, Startup, Performance, Processes, Users)	Lesson 11	Topic B		x	x		
• Microsoft Management Console (MMC) snap-in (Event Viewer (eventvwr.msc), Disk Management (diskmgmt.msc))	Lesson 11	Topic A		x	x		x
• Additional tools (System Information (msinfo32.exe), Resource Monitor (resmon.exe) Disk Cleanup (cleanmgr.exe))	Lesson 11	Topic A & B		x	x		
1.4 Given a scenario, use the appropriate Microsoft Windows 10 Control Panel utility.							

CompTIA A+ Core 2 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
• Internet Options	Lesson 10	Topic B		x	x		
• Devices and Printers	Lesson 10	Topic B		x	x		
• Programs and Features	Lesson 10	Topic B		x	x		
• Network and Sharing Center	Lesson 10	Topic B		x	x		
• System	Lesson 10	Topic B		x	x		
• Windows Defender Firewall	Lesson 10	Topic B		x	x		
• Mail	Lesson 10	Topic B		x	x		
• Sound	Lesson 10	Topic B		x	x		
• User Accounts	Lesson 10	Topic A		x	x		x
• Device Manager	Lesson 10	Topic B		x	x		
• Indexing Options	Lesson 10	Topic A		x	x		
• Administrative Tools	Lesson 10	Topic B		x	x		
• File Explorer Options (Show hidden files, Hide extensions, General options, View options)	Lesson 10	Topic A		x	x		
• Power Options (Hibernate, Power plans, Sleep/suspend, Standby, Choose what closing the lid does, Turn on fast startup)	Lesson 10	Topic B		x	x		
• Ease of Access	Lesson 10	Topic A		x	x		
1.5 Given a scenario, use the appropriate Windows settings.							
• Time and Language	Lesson 10	Topic A		x	x		
• Update and Security	Lesson 10	Topic B		x	x		
• Personalization	Lesson 10	Topic A		x	x		
• Apps	Lesson 10	Topic B		x	x		
• Privacy	Lesson 10	Topic A		x	x		
• System	Lesson 10	Topic B		x	x		
• Devices	Lesson 10	Topic B		x	x		
• Network and Internet	Lesson 10	Topic B		x	x		
• Gaming	Lesson 10	Topic B		x	x		

CompTIA A+ Core 2 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
• Accounts	Lesson 10	Topic A		x	x		
1.6 Given a scenario, configure Microsoft Windows networking features on a client/desktop.							
• Workgroup vs. domain setup (Shared resources, Printers, File servers, Mapped drives)	Lesson 14	Topic D		x	x		
• Local OS firewall settings (Application restrictions and exceptions, Configuration)	Lesson 14	Topic A		x	x		
• Client network configuration (Internet Protocol (IP) addressing scheme, Domain Name System (DNS) settings, Gateway)	Lesson 14	Topic A		x	x		
• Establish network connections (Virtual private network (VPN), Wireless, Wired, Wireless wide area network (WWAN))	Lesson 14	Topic A		x	x		
• Proxy settings	Lesson 14	Topic A		x	x		
• Public network vs. private network	Lesson 14	Topic A		x	x		
• File Explorer navigation – network paths	Lesson 14	Topic A		x	x		
• Metered connections and limitations	Lesson 14	Topic A		x	x		
1.7 Given a scenario, apply application installation and configuration concepts.							
• System requirements for applications (32-bit vs. 64-bit dependent application requirements, RAM requirements)	Lesson 13	Topic B		x	x		
• OS requirements for applications (Application to OS compatibility, 32-bit vs. 64-bit OS)	Lesson 13	Topic B		x	x		
• Distribution methods (Physical media vs. downloadable, ISO mountable)	Lesson 13	Topic B		x	x		
• Other considerations for new applications (Impact to device, Impact to network, Impact to operation, Impact to business)	Lesson 13	Topic B		x	x		
1.8 Explain common OS types and their purposes.							
• Workstation Oss (Windows, Linux, macOS, Chrome OS)	Lesson 12	Topic A		x	x		
• Cell phone/tablet Oss (iPadOS, iOS, Android)	Lesson 12	Topic A		x	x		

CompTIA A+ Core 2 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
<ul style="list-style-type: none"> Various filesystem types (New Technology File System (NTFS), File Allocation Table 32 (FAT32), Apple File System (APFS)) 	Lesson 12	Topic A		x	x		
<ul style="list-style-type: none"> Vendor life-cycle limitations (End-of-life (EOL), Update limitations) 	Lesson 12	Topic A		x	x		
<ul style="list-style-type: none"> Compatibility concerns between OSs 	Lesson 12	Topic A		x	x		
1.9 Given a scenario, perform OS installations and upgrades in a diverse OS environment.							
<ul style="list-style-type: none"> Boot methods (USB, Optical media, Network, Solid-state/flash drives, Internet-based, External/hot-swappable drive) 	Lesson 13	Topic A		x	x		
<ul style="list-style-type: none"> Types of installations (Upgrade, Recovery partition, Clean install, Image deployment, Repair installation) 	Lesson 13	Topic A		x	x		x
<ul style="list-style-type: none"> Partitioning (GUID [globally unique identifier] Partition Table (GPT), Master boot record (MBR)) 	Lesson 13	Topic A		x	x		
<ul style="list-style-type: none"> Drive format 	Lesson 13	Topic A		x	x		
<ul style="list-style-type: none"> Upgrade considerations (Backup files and user preferences, Application and driver support/backward compatibility) 	Lesson 13	Topic A		x	x		
<ul style="list-style-type: none"> Feature updates (Product life cycle) 	Lesson 13	Topic A		x	x		
1.10 Identify common features and tools of the macOS/desktop OS.							
<ul style="list-style-type: none"> Installation and uninstallation of applications (File types: M .dmgM .pkgM .app, App Store, Uninstallation process) 	Lesson 15	Topic B		x	x		
<ul style="list-style-type: none"> Apple ID and corporate restrictions 	Lesson 15	Topic B		x	x		
<ul style="list-style-type: none"> Best practices (Backups, Antivirus, Updates/patches) 	Lesson 15	Topic B		x	x		
<ul style="list-style-type: none"> System Preferences (Displays, Networks, Printers, Scanners, Privacy, Accessibility, Time Machine) 	Lesson 15	Topic B		x	x		
<ul style="list-style-type: none"> Features (Multiple desktops, Mission Control, Keychain, Spotlight, iCloud, Gestures, Finder, Remote Disc, Dock) 	Lesson 15	Topic B		x	x		
<ul style="list-style-type: none"> Disk Utility 	Lesson 15	Topic B		x	x		
<ul style="list-style-type: none"> FileVault 	Lesson 15	Topic B		x	x		

CompTIA A+ Core 2 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
• Terminal	Lesson 15	Topic B		x	x		
• Force Quit	Lesson 15	Topic B		x	x		
1.11 Identify common features and tools of the Linux client/desktop OS.							
• Common commands (ls, pwd, mv, cp ,rm, chmod, chown, su/sudo, apt-get, yum, ip, df, grep, ps, man, top, find, dig, cat)	Lesson 15	Topic A		x	x		
• Best practices (Backups, Antivirus, Updates/patches)	Lesson 15	Topic A		x	x		
• Tools (Shell/terminal, Samba)	Lesson 15	Topic A		x	x		
2.0 Security							
2.1 Summarize various security measures and their purposes.							
• Physical security (Access control vestibule, Badge reader, Video surveillance, Alarm systems, Motion sensors, Door locks)	Lesson 16	Topic D			x		
• Physical security for staff (Key fobs, Smart cards, Keys, Biometrics: M Retina Scanner, Lighting, Magnetometers)	Lesson 16	Topic D			x		
• Logical security (Principle of least privilege, Access control lists (ACLs), Multifactor authentication(MFA), Email, Hard token)	Lesson 14	Topic C		x	x		
• Mobile device management (MDM)	Lesson 14	Topic C		x	x		
• Active Directory (Login script, Domain, Group Policy/updates, Organizational units, Home folder, Folder redirection)	Lesson 14	Topic C		x	x		
2.2 Compare and contrast wireless security protocols and authentication methods.							
• Protocols and encryption (WiFi Protected Access2 (WPA2), WPA3, Temporal Key Integrity Protocol (TKIP)	Lesson 16	Topic B		x	x		
• Authentication (Remote Authentication Dial-In User Service (RADIUS),Kerberos, Multifactor)	Lesson 16	Topic B		x	x		
2.3 Given a scenario, detect, remove, and prevent malware using the appropriate tools and methods.							

CompTIA A+ Core 2 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
• Malware (Trojan, Rootkit, Virus, Spyware, Ransomware, Keylogger, Boot sector virus, Cryptominers)	Lesson 17	Topic C		x	x		
• Tools and methods (Recovery Mode, Antivirus, Anti-malware, Software firewalls, Anti-phishing training)	Lesson 17	Topic C		x	x		
2.4 Explain common social-engineering attacks, threats, and vulnerabilities.							
• Social engineering (Phishing, Vishing, Shoulder surfing, Whaling, Tailgating, Impersonation, Dumpster diving, Evil Twin)	Lesson 16	Topic A		x	x		
• Threats (Distributed denial of service (DDoS), Denial of service (DoS), Zero day attack, Spoofing, On-path attack)	Lesson 16	Topic A		x	x		
• Vulnerabilities (Non-compliant systems, Unpatched systems, Unprotected systems (missing antivirus/missing firewall))	Lesson 16	Topic A		x	x		
2.5 Given a scenario, manage and configure basic security settings in the Microsoft Windows OS.							
• Defender Antivirus (Activate/deactivate, Updated definitions)	Lesson 17	Topic A		x	x		
• Firewall (Activate/deactivate, Port security, Application security)	Lesson 17	Topic A		x	x		
• Users and groups (Local vs. Microsoft account, Standard account, Administrator, Guest user, Power user)	Lesson 14	Topic C		x	x		x
• Login OS options (Username and password, Personal Identification number (PIN), Fingerprint, Facial Recognition)	Lesson 14	Topic C		x	x		
• NTFS vs. share permissions (File and folder attributes, Inheritance)	Lesson 14	Topic D		x	x		x
• Run as administrator vs. standard user (User Account Control (UAC))	Lesson 14	Topic C		x	x		
• BitLocker	Lesson 17	Topic A		x	x		
• BitLocker To Go	Lesson 17	Topic A		x	x		
• Encrypting File System (EFS)	Lesson 17	Topic A		x	x		
2.6 Given a scenario, configure a workstation to meet best practices for security.							
• Data-at-rest encryption	Lesson 17	Topic A		x	x		

CompTIA A+ Core 2 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
• Password best practices (Complexity requirements, Expiration requirements, Basic input/output system (BIOS))	Lesson 17	Topic A		x	x		
• End-user best practices (Use screensaver locks, Log off when not in use, Secure/protect critical hardware (e.g. laptops))	Lesson 17	Topic A		x	x		
• Account management (Restrict user permissions, Restrict login times, Disable guest account, Used failed attempts lockout)	Lesson 17	Topic A		x	x		
• Change default administrator's user account/password	Lesson 17	Topic A		x	x		
• Disable AutoRun	Lesson 17	Topic A		x	x		
• Disable AutoPlay	Lesson 17	Topic A		x	x		
2.7 Explain common methods for securing mobile and embedded devices.							
• Screen locks (Facial recognition, PIN codes, Fingerprint, Pattern, Swipe)	Lesson 18	Topic A		x	x		
• Remote wipes	Lesson 18	Topic A		x	x		
• Locator applications	Lesson 18	Topic A		x	x		
• OS updates	Lesson 18	Topic A		x	x		
• Device encryption	Lesson 18	Topic A		x	x		
• Remote backup applications	Lesson 18	Topic A		x	x		
• Failed login attempts restrictions	Lesson 18	Topic A		x	x		
• Antivirus/anti-malware	Lesson 18	Topic A		x	x		
• Firewalls	Lesson 18	Topic A		x	x		
• Policies and procedures (BYOD vs. corporate owned, Profile security requirements)	Lesson 18	Topic A		x	x		
• Internet of Things (IoT)	Lesson 18	Topic A		x	x		
2.8 Given a scenario, use common data destruction and disposal methods.							
• Physical destruction (Drilling, Shredding, Degaussing, Incinerating)	Lesson 19	Topic C		x	x		
• Recycling or repurposing best practices (Erasing/wiping, Low-level formatting, Standard formatting)	Lesson 19	Topic C		x	x		

CompTIA A+ Core 2 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
<ul style="list-style-type: none"> Outsourcing concepts (Third-party vendor, Certification of destruction / recycling) 	Lesson 19	Topic C		x	x		
2.9 Given a scenario, configure appropriate security settings on small office/home office (SOHO) wireless and wired networks.							
<ul style="list-style-type: none"> Home router settings (Change default passwords, IP filtering, Firmware updates, Content filtering, Screened subnet) 	Lesson 16	Topic C		x	x		
<ul style="list-style-type: none"> Wireless specific (Changing the service set identifier (SSID), Disabling SSID broadcast, Encryption settings) 	Lesson 16	Topic C		x	x		
<ul style="list-style-type: none"> Firewall settings (Disabling unused ports, Port forwarding / mapping) 	Lesson 16	Topic C		x	x		
2.10 Given a scenario, install and configure browsers and relevant security settings.							
<ul style="list-style-type: none"> Browser download/installation (Trusted sources: M Hashing, Untrusted sources) 	Lesson 17	Topic B		x	x		
<ul style="list-style-type: none"> Extensions and plug-ins (Trusted sources, Untrusted sources) 	Lesson 17	Topic B		x	x		
<ul style="list-style-type: none"> Password managers 	Lesson 17	Topic B		x	x		
<ul style="list-style-type: none"> Secure connections/sites – valid certificates 	Lesson 17	Topic B		x	x		
<ul style="list-style-type: none"> Settings (Pop-up blocker, Clearing browsing data, Clearing cache, Private-browsing mode, Ad blockers) 	Lesson 17	Topic B		x	x		
3.0 Software Troubleshooting							
3.1 Given a scenario, troubleshoot common Windows OS problems.							
<ul style="list-style-type: none"> Common symptoms (Blue screen of death (BSOD), Sluggish performance, Boot problems, Frequent shutdowns, Time Drift) 	Lesson 13	Topic C		x	x		
<ul style="list-style-type: none"> Common troubleshooting steps (Reboot, Restart services, Uninstall/reinstall/update applications, Add resources, Restore) 	Lesson 13	Topic C		x	x		
3.2 Given a scenario, troubleshoot common personal computer (PC) security issues.							
<ul style="list-style-type: none"> Common symptoms (Unable to access the network, Desktop alerts, False alerts regarding antivirus protection) 	Lesson 17	Topic C		x	x		

CompTIA A+ Core 2 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
<ul style="list-style-type: none"> Browser-related symptoms (Random/frequent pop-ups, Certificate warnings, Redirection) 	Lesson 17	Topic C		x	x		
3.3 Given a scenario, use best practice procedures for malware removal.							
<ul style="list-style-type: none"> Investigate and verify malware symptoms 	Lesson 17	Topic C		x	x		
<ul style="list-style-type: none"> Quarantine infected systems 	Lesson 17	Topic C		x	x		
<ul style="list-style-type: none"> Disable System Restore in Windows 	Lesson 17	Topic C		x	x		
<ul style="list-style-type: none"> Remediate infected systems (Update anti-malware software, Scanning and removal techniques - e.g., safe mode) 	Lesson 17	Topic C		x	x		
<ul style="list-style-type: none"> Schedule scans and run updates 	Lesson 17	Topic C		x	x		x
<ul style="list-style-type: none"> Enable System Restore and create a restore point in Windows 	Lesson 17	Topic C		x	x		x
<ul style="list-style-type: none"> Educate the end user 	Lesson 17	Topic C		x	x		x
3.4 Given a scenario, troubleshoot common mobile OS and application issues.							
<ul style="list-style-type: none"> Common symptoms (Application fails to launch, Application fails to close/crashes, Application fails to update) 	Lesson 18	Topic B		x	x		
3.5 Given a scenario, troubleshoot common mobile OS and application security issues.							
<ul style="list-style-type: none"> Security concerns (Android package (SPK) concerns, Developer mode, Root access/jailbreak, Bootleg/malicious application) 	Lesson 18	Topic C		x	x		
<ul style="list-style-type: none"> Common symptoms (High network traffic, Sluggish response time, Data-usage limit notification, No internet connectivity) 	Lesson 18	Topic C		x	x		
4.0 Operational Procedures							
4.1 Given a scenario, implement best practices associated with documentation and support systems information management.							
<ul style="list-style-type: none"> Ticketing systems (User information, Device information, Description of problems, Categories, Severity, Escalation levels) 	Lesson 20	Topic A		x	x		
<ul style="list-style-type: none"> Asset management (Inventory lists, Database system, Asset tags and IDs, Procurement lifecycle, Warranty and licensing) 	Lesson 20	Topic A		x	x		

CompTIA A+ Core 2 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
• Types of documents (Acceptable use policy (AUP), Network topology diagram, Regulatory compliance requirements)	Lesson 20	Topic A		x	x		
• Knowledge base/articles	Lesson 20	Topic A		x	x		
4.2 Explain basic change-management best practices.							
• Documented business processes (Rollback plan, Sandbox testing, Responsible staff member)	Lesson 20	Topic A			x		
• Change management (Request forms, Purpose of the change, Scope of the change, Date and time of the change)	Lesson 20	Topic A			x		
4.3 Given a scenario, implement workstation backup and recovery methods.							
• Backup and recovery (Full, Incremental, Differential, Synthetic)	Lesson 19	Topic B		x	x		x
• Backup testing (Frequency)	Lesson 19	Topic B		x	x		x
• Backup rotation schemes (On site vs. off site, Grandfather-father-son (GFS), 3-2-1 backup rule)	Lesson 19	Topic B		x	x		
4.4 Given a scenario, use common safety procedures.							
• Electrostatic discharge (ESD) straps	Lesson 20	Topic C		x	x	x	
• ESD mats	Lesson 20	Topic C			x	x	
• Equipment grounding	Lesson 20	Topic C			x	x	
• Proper power handling	Lesson 20	Topic C			x	x	
• Proper component handling and storage	Lesson 20	Topic C			x	x	
• Antistatic bags	Lesson 20	Topic C			x	x	
• Compliance with government regulations	Lesson 20	Topic C			x	x	
• Personal safety (Disconnect power before repairing PC, Lifting techniques, Electrical fire safety, Safety goggles)	Lesson 20	Topic C			x	x	
4.5 Summarize environmental impacts and local environmental controls.							
• Material safety data sheet (MSDS)/documentation for handling and disposal (Proper battery disposal, Proper toner disposal)	Lesson 20	Topic C		x	x	x	

CompTIA A+ Core 2 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
<ul style="list-style-type: none"> Temperature, humidity-level awareness, and proper ventilation (Location/equipment placement, Dust cleanup) 	Lesson 20	Topic C			x	x	
<ul style="list-style-type: none"> Power surges, under-voltage events, and power failures (Battery backup, Surge suppressor) 	Lesson 20	Topic C	x		x	x	
4.6 Explain the importance of prohibited content/activity and privacy, licensing, and policy concepts.							
<ul style="list-style-type: none"> Incident response Chain of custody, Inform management/law enforcement as necessary, Documentation of incident) 	Lesson 19	Topic C		x	x		
<ul style="list-style-type: none"> Licensing/digital rights management (DRM)/end-user license agreement (EULA) (Valid licenses, Non-expired licenses) 	Lesson 19	Topic C			x		
<ul style="list-style-type: none"> Regulated data (Credit card transactions, Personal government-issued information, PII, Healthcare data) 	Lesson 19	Topic C			x		
4.7 Given a scenario, use proper communication techniques and professionalism.							
<ul style="list-style-type: none"> Professional appearance and attire (Match the required attire of the given environment: Formal, Business casual) 	Lesson 20	Topic B			x		
<ul style="list-style-type: none"> Use proper language and avoid jargon, acronyms, and slang, when applicable 	Lesson 20	Topic B			x		
<ul style="list-style-type: none"> Maintain a positive attitude/ project confidence 	Lesson 20	Topic B			x		
<ul style="list-style-type: none"> Actively listen, take notes, and avoid interrupting the customer 	Lesson 20	Topic B			x		
<ul style="list-style-type: none"> Be culturally sensitive (use appropriate professional titles, when applicable) 	Lesson 20	Topic B			x		
<ul style="list-style-type: none"> Be on time (if late, contact the customer) 	Lesson 20	Topic B			x		
<ul style="list-style-type: none"> Avoid distractions (Personal calls, Texting/social media sites, Personal interruptions) 	Lesson 20	Topic B			x		
<ul style="list-style-type: none"> Dealing with difficult customers or situations (Do not argue with customers or be defensive, Avoid being judgmental) 	Lesson 20	Topic B			x		
<ul style="list-style-type: none"> Set and meet expectations/time line and communicate status with customer (Offer repair/replacement options as needed) 	Lesson 20	Topic B			x		

CompTIA A+ Core 2 Exam Objectives	Curriculum		WorkKeys Skills				
	Lesson	Topic	AM	GL	WD	AT	WO
<ul style="list-style-type: none"> Deal appropriately with customers' confidential and private materials (Located on a computer, desktop, printer, etc.) 	Lesson 20	Topic B			x		
4.8 Identify the basics of scripting.							
<ul style="list-style-type: none"> Script file types (.bat, .ps1, .vbs, .sh, .js, .py) 	Lesson 19	Topic D		x	x		
<ul style="list-style-type: none"> Use cases for scripting (Basic automation, Restarting machines, Remapping network drives, Installation of applications) 	Lesson 19	Topic D			x		
<ul style="list-style-type: none"> Other considerations when using scripts (Unintentionally introducing malware, Inadvertently changing system settings) 	Lesson 19	Topic D			x		
4.9 Given a scenario, use remote access technologies.							
<ul style="list-style-type: none"> Methods/tools (RDP, VPN, Virtual network computer (VNC), Secure Shell (SSH), Microsoft Remote Assistance (MSRA)) 	Lesson 19	Topic A			x		
<ul style="list-style-type: none"> Security considerations of each access method 	Lesson 19	Topic A			x		