Cybersecurity Systems Technology

8628 36 weeks / 140 hours

Table of Contents

Acknowledgments ......................................................................................................................................... 1
Course Description ........................................................................................................................................ 2
Task Essentials List ....................................................................................................................................... 2
Curriculum Framework ................................................................................................................................. 5
Demonstrating Ethical Behavior with Computer Systems Technology ......................................................... 6
Exploring Hardware ........................................................................................................................................ 9
Exploring Networking .................................................................................................................................... 23
Exploring Mobile Devices .......................................................................................................................... 29
Troubleshooting Hardware and Networking ............................................................................................... 33
SOL Correlation by Task ............................................................................................................................ 38
Teacher Resources ...................................................................................................................................... 40
Appendix: Credentials, Course Sequences, and Career Cluster Information ............................................. 41

Acknowledgments

The components of this instructional framework were developed by the following curriculum development team members:

Daviette Anson, Chantilly High School Academy, Fairfax County Public Schools
Jeremiah Doucette, Washington County Career and Technical Education Center, Washington County Public Schools
James Harper, Pittsylvania Vocational-Technical Center, Pittsylvania County Public Schools
Curtis Johnson, Advanced Career Education Center at Highland Springs, Henrico County Public Schools
Bruce Kemp, Christiansburg High School, Montgomery County Public Schools
Brian Matzelle, Senior Manager, CompTIA
Alan Rowland, Director, CompTIA Academy
Lhe Smith, CTE Supervisor, Loudoun County Public Schools
Course Description

Suggested Grade Level: 10 or 11
Prerequisites: 6302

Students enter the world of computer technology and gain practical experience in assembling a computer system. Students will install, configure, and secure various operating systems. Students will troubleshoot computers and peripherals and use system tools and diagnostic software. They develop skills in computer networking and resource sharing. In addition, students explore the relationships between internal and external computer components. Upon successful completion of the course, students may qualify to take the CompTIA A+ certification exam.

Task Essentials List

- Tasks/competencies designated by plus icons (⊕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (○) are optional
- Tasks/competencies designated by minus icons (знак минуса) are omitted
- Tasks marked with an asterisk (*) are sensitive.

<table>
<thead>
<tr>
<th>Task Number</th>
<th>8628</th>
<th>Tasks/Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demonstrating Ethical Behavior with Computer Systems Technology</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>+</td>
<td>Identify security issues related to computer hardware, software, and data.</td>
</tr>
<tr>
<td>40</td>
<td>+</td>
<td>Identify concepts related to copyright, public domain, copy protection, intellectual property, and licensing agreements.</td>
</tr>
<tr>
<td>41</td>
<td>+</td>
<td>Identify concepts of cybersecurity, honesty, courtesy, and confidentiality related to information and email systems and social networking (e.g., spam, viruses, and etiquette).</td>
</tr>
<tr>
<td>42</td>
<td>+</td>
<td>Investigate Internet privacy issues and computer crimes, including identity theft.</td>
</tr>
<tr>
<td>43</td>
<td>+</td>
<td>Comply with copyright and patent laws.</td>
</tr>
<tr>
<td>44</td>
<td>+</td>
<td>Comply with policies regarding acceptable use of technology.</td>
</tr>
<tr>
<td><strong>Exploring Hardware</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>+</td>
<td>Configure settings using Basic Input-Output System/Unified Extensible Firmware Interface (BIOS/UEFI) tools on a personal computer (PC).</td>
</tr>
<tr>
<td>46</td>
<td>+</td>
<td>Describe the purposes and properties of motherboard components.</td>
</tr>
<tr>
<td>47</td>
<td>+</td>
<td>Compare various RAM types and their features.</td>
</tr>
<tr>
<td>48</td>
<td>+</td>
<td>Install PC expansion cards.</td>
</tr>
<tr>
<td>49</td>
<td>+</td>
<td>Install various types of CPUs.</td>
</tr>
<tr>
<td>50</td>
<td>+</td>
<td>Describe the characteristics and purposes of various PC connection interfaces.</td>
</tr>
<tr>
<td>51</td>
<td>+</td>
<td>Install a power supply.</td>
</tr>
<tr>
<td>Task Number</td>
<td>Tasks/Competencies</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>Select appropriate components for a custom PC configuration to meet customer specifications or needs.</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Install storage devices.</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>Compare types of displays.</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>Identify common PC connector types and associated cables.</td>
<td></td>
</tr>
<tr>
<td>56</td>
<td>Install common peripheral devices.</td>
<td></td>
</tr>
<tr>
<td>57</td>
<td>Install Small Office, Home Office (SOHO) multifunction device/printers.</td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>Compare differences between the various print technologies and the associated imaging process.</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>Perform appropriate printer maintenance.</td>
<td></td>
</tr>
</tbody>
</table>

**Exploring Networking**

<table>
<thead>
<tr>
<th>Task Number</th>
<th>Tasks/Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>Identify the various types of network cables and connectors.</td>
</tr>
<tr>
<td>61</td>
<td>Compare the characteristics of connectors and cabling.</td>
</tr>
<tr>
<td>62</td>
<td>Explain the properties and characteristics of Transmission Control Protocol/Internet Protocol (TCP/IP).</td>
</tr>
<tr>
<td>63</td>
<td>Explain common TCP and User Datagram Protocol (UDP) ports, protocols and their purpose.</td>
</tr>
<tr>
<td>64</td>
<td>Compare various Wireless Fidelity (WiFi) networking standards and encryption types.</td>
</tr>
<tr>
<td>65</td>
<td>Install SOHO wireless/wired router.</td>
</tr>
<tr>
<td>66</td>
<td>Compare Internet connection types, network types, and their features.</td>
</tr>
<tr>
<td>67</td>
<td>Compare network architecture devices, their functions and features.</td>
</tr>
<tr>
<td>Task Number</td>
<td>Tasks/Competencies</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>68</td>
<td>Use networking tools.</td>
</tr>
<tr>
<td></td>
<td><strong>Exploring Mobile Devices</strong></td>
</tr>
<tr>
<td>69</td>
<td>Install laptop hardware and components.</td>
</tr>
<tr>
<td>70</td>
<td>Describe the function of components within the display of a laptop.</td>
</tr>
<tr>
<td>71</td>
<td>Demonstrate various laptop features.</td>
</tr>
<tr>
<td>72</td>
<td>Explain the characteristics of various types of mobile devices.</td>
</tr>
<tr>
<td>73</td>
<td>Compare accessories and ports of other mobile devices.</td>
</tr>
<tr>
<td></td>
<td><strong>Troubleshooting Hardware and Networking</strong></td>
</tr>
<tr>
<td>74</td>
<td>Troubleshoot common problems related to motherboards, RAM, CPU, and power.</td>
</tr>
<tr>
<td>75</td>
<td>Troubleshoot hard drives and RAID arrays.</td>
</tr>
<tr>
<td>76</td>
<td>Troubleshoot common video, projector, and display issues.</td>
</tr>
<tr>
<td>77</td>
<td>Troubleshoot wired and wireless networks.</td>
</tr>
<tr>
<td>78</td>
<td>Troubleshoot common mobile devices.</td>
</tr>
<tr>
<td>79</td>
<td>Troubleshoot printers.</td>
</tr>
</tbody>
</table>

Legend: ☑Essential ☐Non-essential ☐Omitted

**Curriculum Framework**
Demonstrating Ethical Behavior with Computer Systems Technology

Task Number 39

Identify security issues related to computer hardware, software, and data.

Definition

Identification should include a list of methods for preventing and consequences of dealing with

- theft of equipment or intellectual property
- loss or corruption of data through viruses
- unauthorized entry into the computer system
- accidental loss or corruption of data by a user or company
- loss or theft of private company or customer information.

Process/Skill Questions

- What is shoulder surfing?
- What is an acceptable use policy (AUP)?
- What is considered a strong password?
- What is ransomware?

Task Number 40

Identify concepts related to copyright, public domain, copy protection, intellectual property, and licensing agreements.

Definition

Identification should include, but not be limited to, software, media (e.g., music, pictures), and logo requirements. Identification should also include

- a list of terms
- examples of each concept
- laws covering the protection of published information
• legal and ethical issues arising from the infringement of copyright laws and licensing agreements.

Process/Skill Questions

• What is pirated software? Is it true that it isn’t considered stealing if the person didn’t know it was pirated software? Explain.
• How can one determine whether a picture on the Internet is free to use? Explain.
• What are some examples of intellectual property?
• What fines might one expect from a violation of copyright law?

Task Number 41

Identify concepts of cybersecurity, honesty, courtesy, and confidentiality related to information and email systems and social networking (e.g., spam, viruses, and etiquette).

Definition

Identification should include a list of items related to

• system security (i.e., ensuring information is transmitted according to approved protocol)
• electronic courtesy (i.e., ensuring the rules of network etiquette are followed)
• confidentiality (i.e., ensuring through technology that information remains private and secure).
• technological integrity (i.e., verifying the source of information and ensuring that information on a user’s screen is the same as what was sent)
• availability (i.e., ensuring that data/information remains available and intact).

Process/Skill Questions

• With regard to cybersecurity, what does CIA stand for?
• What does availability mean with regard to cybersecurity?
• Why is data integrity important?

Task Number 42
Investigate Internet privacy issues and computer crimes, including identity theft.

Definition

Investigation should include research to identify computer crimes and privacy issues related to Internet use, such as

- infection of a computer by a virus
- computer hacking
- cyberstalking
- theft of computer equipment
- software piracy
- identity theft

and methods to prevent or protect against each.

Process/Skill Questions

- What physical security issues can be implemented to protect computer systems?
- What are the dangers and ethical considerations involved in software piracy?
- What is the difference between white hat and black hat hacking?

Task Number 43

Comply with copyright and patent laws.

Definition

Compliance should pertain to scanned images and documents, electronic clip art, recorded sounds, recorded and scanned photography, trademarks, and other elements adapted for use in desktop publishing, multimedia, and web documents.

Compliance should include

- identifying applicable copyright and patent laws
- discussing the consequences of illegal use of any images, documents, audio, video, recordings, trademarks, and any other elements adapted for use in desktop publishing, multimedia, and web documents
- discussing the different methods (direct contact with company, copyright clearinghouses) for obtaining permission to use copyrighted materials
- documenting all copyrighted materials used in class assignments.
Process/Skill Questions

- What are the differences between images that are copyright protected and those which are public domain?
- How can you prove you have permission to use copyrighted materials?
- What images can you use for class PowerPoint presentations?

Task Number 44

Comply with policies regarding acceptable use of technology.

Definition

Compliance should include evaluating the components of various AUPs (e.g., school policies, company policies) and adhering to those policies.

Process/Skill Questions

- When a school acceptable use policy has a guideline not included in state or federal statutes, do you have to comply with the school policy?
- Why do organizations require employees or students to sign an acceptable use policy?
- How should an employer go about informing workers of changes to the acceptable use policy?

Exploring Hardware

Task Number 45

Configure settings using Basic Input-Output System/Unified Extensible Firmware Interface (BIOS/UEFI) tools on a personal computer (PC).

Definition

Configuration should include the following:

- Firmware upgrades/flash BIOS
- BIOS component information
  - Random Access Memory (RAM)
  - Hard drive
- Optical drive
- Central Processing Unit (CPU)
- BIOS configurations
  - Boot sequence
  - Enabling and disabling devices
  - Date/time
  - Clock speeds
  - Virtualization support
  - BIOS security (passwords, drive encryption: Trusted Platform Module [TPM], LoJack, secure boot)
- Built-in diagnostics
- Monitoring
  - Temperature monitoring
  - Fan speeds
  - Intrusion detection/notification
  - Voltage
  - Clock
  - Bus speed

Process/Skill Questions

- What are the advantages to UEFI over BIOS?
- What are the advantages of Global Unique Identifier (GUID) Partition Table (GPT)?
- How can you temporarily change the boot order?

---

**Task Number 46**

**Describe the purposes and properties of motherboard components.**

**Definition**

Description should include the following:

- Sizes
  - Advanced Technology Extended (ATX)
  - Micro-ATX
  - Mini-Information Technology Extended (ITX)
  - ITX
- Expansion slots
  - Peripheral Component Interconnect (PCI)
  - Peripheral Component Interconnect Extended (PCIX)
  - Peripheral Component Interconnect express (PCle)
Process/Skill Questions

- What is an Intel chipset, and what are the three largest chips on a chipset?
- What are the differences between the functions of the Northbridge and Southbridge?
- What is the difference between the front-side bus (FSB) and hypertransport?

Task Number 47

Compare various RAM types and their features.

Definition

Comparison should include the following:

- Types
  - Double Data Rate (DDR)
  - DDR2
  - DDR3
  - Small Outline Dual Inline Memory Module (SODIMM)
  - Dual Inline Memory Module (DIMM)
  - Parity vs. non-parity
  - Error Correcting Code (ECC) vs. non-ECC
  - RAM configurations
  - Single channel vs. dual channel vs. triple channel
  - Single sided vs. double sided
• Buffered vs. unbuffered
  • RAM compatibility

Process/Skill Questions

• Where do you typically find ECC memory?
• What constitutes RAM incompatibility?
• What are two types of laptop RAM chips?
• In which devices can you not upgrade RAM?

Task Number 48

Install PC expansion cards.

Definition

Installation includes configuring the following PC expansion cards:

• Sound cards
• Video cards
• Network cards
• USB cards
• Firewire cards
• Thunderbolt cards
• Storage cards
• Modem cards
• Wireless/cellular cards
• Television (TV) tuner cards
• Video capture cards
• Riser cards

Process/Skill Questions

• What is the difference between Crossfire and scalable link interface (SLI)?
• What are the different types of expansion cards you can plug in?
• What is a device driver, and where do you get drivers?

Task Number 49

Install various types of CPUs.
Definition

Installation should include applying the appropriate cooling methods and should include the following:

- Socket types, such as
  - Intel: 775, 1155, 1156, 1366, 1150, 2011
  - AMD: AM3, AM3+, FM1, FM2, FM2+

- Characteristics
  - Speeds
  - Cores
  - Cache size/type
  - Hyperthreading
  - Virtualization support
  - Architecture (32-bit vs. 64-bit)
  - Integrated graphics processing unit (GPU)
  - Disable execute bit

- Cooling
  - Heat sink
  - Fans
  - Thermal paste
  - Liquid-based
  - Fanless/passive

Process/Skill Questions

- What are the advantages of the current socket types for Intel and AMD?
- What is the difference between pin grid array (PGA) and land grid array (LGA)?
- What is hyperthreading?
- What are the three major cooling methods?

Task Number 50

Describe the characteristics and purposes of various PC connection interfaces.

Definition

Description should include a comparison of various PC connection interfaces and the following:

- Physical connections
  - USB 1.1 vs. 2.0 vs. 3.0
• Connector types: A, B, mini, micro, C-type
  o Firewire 400 vs. Firewire 800
  o Serial Advanced Technology Attachment (SATA)1 vs. SATA2 vs. SATA3, eSATA
  o Small Computer System Interface (SCSI)
  o Serial Attached SCSI (SAS)
  o M.2
  o Fiber optics
  o Other connector types
    ▪ Video Graphics Array (VGA)
    ▪ High-Definition Media Interface (HDMI)
    ▪ Digital Visual Interface (DVI)
    ▪ Audio
      ▪ Analog
      ▪ Digital (Optical connector)
        ▪ Registered Jack Function 45 (RJ-45)
        ▪ Registered Jack Function 11 (RJ-11)
        ▪ Thunderbolt

• Wireless connections
  o Bluetooth
  o Radio Frequency (RF)
  o Infrared (IR)
  o Near Field Communication (NFC)

• Characteristics
  o Analog
  o Digital
  o Distance limitations
  o Data transfer speeds
  o Quality
  o Frequencies

Process/Skill Questions

• What are the speeds of the various USB connectors?
• What are the maximum distances for the various cable lengths?
• How do Bluetooth, RF, IR, and NFC differ?

Task Number 51

Install a power supply.

Definition
Installation should be based on given specifications and should include the following:

- Connector types and their voltages
  - SATA
  - Molex
  - 4/8-pin 12v
  - PCIe 6/8-pin
  - 20-pin
  - 24-pin
- Specifications
  - Wattage
  - Dual rail
  - Size
  - Number of connectors
  - ATX
  - MicroATX
  - Dual voltage options
- Redundancy options
- Ohm’s law

Process/Skill Questions

- Why are redundancy options important?
- What is Ohm’s law?
- What are the purposes of the various power supply connectors?
- What are the three common voltages for power supply?
- What is the purpose of a power supply?

Task Number 52

Select appropriate components for a custom PC configuration to meet customer specifications or needs.

Definition

Selection should include scenarios, such as the following:

- Graphic/Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) design workstation
  - Multicore processor
  - High-end video
  - Maximum RAM
- Audio/video editing workstation
- Specialized audio and video card
- Large, fast hard drive
- Dual monitors
- Virtualization workstation
  - Maximum RAM and CPU cores
- Gaming PC
  - Multicore processor
  - High-end video/specialized GPU
  - High-definition sound card
  - High-end cooling
- Home theater PC (HTPC)
  - Surround sound audio
  - HDMI output
  - HTPC compact form factor
  - TV tuner
- Standard thick client
  - Desktop applications
  - Meets recommended requirements for selected operating system (OS)
- Thin client
  - Basic applications
  - Meets minimum requirements for selected OS
  - Network connectivity
- Home server PC
  - Media streaming
  - File sharing
  - Print sharing
  - Gigabit network interface card (NIC)
  - RAID array

**Process/Skill Questions**

- What are the two main factors to consider when using virtualization?
- What is an important fan consideration for a home theater PC?
- How does a server differ from a gaming computer?

---

**Task Number 53**

**Install storage devices.**

**Definition**

Installation should include configuring and using appropriate media. Installation should also include the following:
• Optical drives
  o Compact Disc-Read-Only Memory/Compact Disc-Rewritable (CD-ROM/CD-RW)
  o Digital Video Disc-Read-Only Memory/Digital Video Disc-Rewritable/Digital Video Disc-Rewritable Dual Layer (DVD-ROM/DVD-RW/DVD-RW DL)
  o Blu-ray
  o Blu-ray disc-recordable (BD-R)
  o Blu-ray disc-recordable erasable (BD-RE)
• Magnetic hard disk drives
  o 5400 revolutions per minute (rpm)
  o 7200 rpm
  o 10,000 rpm
  o 15,000 rpm
• Hot swappable drives
• Solid state/flash drives
  o Compact flash
  o Secure Digital (SD) card
  o MicroSD
  o MiniSD
  o Extreme Digital (xD)
  o Solid State Drive (SSD)
  o Hybrid
  o Embedded Multi-Media Card (eMMC)
  o M.2
  o Non-Volatile Memory express (NVMe)
• Redundant Array of Independent (or Inexpensive) Disc (RAID) types
  o 0
  o 1
  o 5
  o 10
  o Just a Bunch of Discs (JBOD)
• Tape drive
• Media capacity
  o CD
  o CD-RW
  o DVD-RW
  o DVD
  o Blu-ray
  o Tape
  o DVD DL

Process/Skill Questions

• How would you describe a hot swappable device?
• What are the different levels of RAID?
• What is a hybrid drive?
What are the advantages of solid state vs. hard drive?

Task Number 54

Compare types of displays.

Definition

Comparison should include the following:

- Types
  - Liquid Crystal Display (LCD)
  - Twisted nematic (TN) vs. In-Plane Switching (IPS)
  - Fluorescent vs. Light-Emitting Diode (LED) backlighting
  - Plasma
  - Projector
  - Organic Light-Emitting Diode (OLED)
- Refresh/frame rates
- Resolution
  - 720p
  - 1080i
  - 1080p
  - 4K (ultra-high definition [UHD]), (5K, 8K, etc.)
- Native resolution
- Brightness/lumens
- Analog vs. digital
- Privacy/antiglare filters
- Multiple displays
- Aspect ratios
  - 16:9
  - 16:10
  - 4:3

Process/Skill Questions

- What display technology made wearable technology possible?
- What is the major difference between LCD, LED, and plasma?
- How do you install and configure multiple displays?

Task Number 55
Identify common PC connector types and associated cables.

Definition

Identification should include, but not be limited to, the following:

- Display connector types
  - DVI-D
  - DVI-I
  - DVI-A
  - DisplayPort
  - Radio Corporation of America (RCA)
  - HD15 (i.e., DE15 or DB15)
  - Bayonet-Neill-Concelman or British Naval Connector (BNC)
  - miniHDMI
  - miniDin-6
- Display cable types
  - HDMI
  - DVI
  - VGA
  - Component
  - Composite
  - Coaxial
- Device cables and connectors
  - SATA
  - eSATA
  - USB
  - Firewire (IEEE1394)
  - Personal System/2 (PS/2)
  - Audio
- Adapters and convertors
  - DVI to HDMI
  - USB A to USB B
  - USB to Ethernet
  - DVI to VGA
  - Thunderbolt to DVI
  - PS/2 to USB
  - HDMI to VGA

Process/Skill Questions

- What are the different kinds of adapters you can plug in?
- What are the advantages of digital connector vs. analog connector?
- What are the differences between the various DVI types?
Task Number 56

Install common peripheral devices.

Definition

Installation includes configuration of peripheral devices and should include, but not be limited to, the following:

- **Input devices**
  - Mouse
  - Keyboard
  - Scanner
  - Barcode reader
  - Biometric devices
  - Game pads
  - Joysticks
  - Digitizer
  - Motion sensor
  - Touch pads
  - Smart card readers
  - Digital cameras
  - Microphone
  - Webcam
  - Camcorder

- **Output devices**
  - Printers
  - Speakers
  - Display devices

- **Input & output devices**
  - Touch screen
  - Keyboard, Video, and Mouse (KVM)
  - Smart TV
  - Set-top Box
  - Musical Instrument Digital Interface (MIDI)-enabled devices

**Process/Skill Questions**

- What is the difference between an input and an output device?
- What is both an input and an output device?
- What are the dangers of a web camera?

---

Task Number 57
Install Small Office, Home Office (SOHO) multifunction device/printers.

Definition

Installation should include configuration and the following:

- Use appropriate drivers for a given operating system
  - Configuration settings
    - Duplex
    - Collate
    - Orientation
    - Quality
- Device sharing
  - Wired
    - USB
    - Serial
    - Ethernet
  - Wireless
    - Bluetooth
    - 802.11 (a/b/g/n/ac)
    - Infrastructure vs. ad hoc
  - Integrated print server (hardware)
  - Cloud printing/remote printing
- Public/shared devices
  - Sharing local/networked device via operating system settings
    - Transmission Control Protocol (TCP)/Bonjour/AirPrint
  - Data privacy
    - User authentication on the device
    - Hard drive caching
- Scanning

Process/Skill Questions

- What are data privacy concerns related to public or shared devices?
- What is the major advantage of duplex printing?
- What are the two primary printing orientations?

Task Number 58

Compare differences between the various print technologies and the associated imaging process.
**Definition**

Comparison should include the following:

- **Laser**
  - Imaging drum, fuser assembly, transfer belt, transfer roller, pickup rollers, separate pads, duplexing assembly
  - Imaging process: processing, charging, exposing, developing, transferring, fusing and cleaning

- **Inkjet**
  - Ink cartridge, print head, roller, feeder, duplexing assembly, carriage and belt
  - Calibration

- **Thermal**
  - Feed assembly, heating element
  - Special thermal paper

- **Impact**
  - Print head, ribbon, tractor feed
  - Impact paper

- **Virtual**
  - Print to file
  - Print to Portable Document Format (PDF)
  - Print to Open Extensible Markup Language (XML) Paper Specification (XPS)
  - Print to image

**Process/Skill Questions**

- What are the benefits of virtual printing?
- What is the major benefit of the impact printer?
- What are the advantages/disadvantages of laser vs. inkjet printing?
- Which printing technologies use heat?

---

**Task Number 59**

**Perform appropriate printer maintenance.**

**Definition**

Performance should include the following:

- Laser (replacing toner, applying maintenance kit, calibration, cleaning)
- Thermal (replacing paper, cleaning heating element, removing debris)
- Impact (replacing ribbon, replacing print head, replacing paper)
- Inkjet (cleaning heads, replacing cartridges, calibration, clearing jams)
Process/Skill Questions

- How do you clean a printer roller?
- What is included in a printer maintenance kit?
- How do you properly dispose of empty toner and ink cartridges?

Exploring Networking

Task Number 60

Identify the various types of network cables and connectors.

Definition

Identification should include the following:

- Fiber
  - Connectors: SC, ST, LC, and MT-RJ
- Twisted Pair
  - Connectors: RJ-11, RJ-45
  - Wiring standards: T568A, T568B
- Coaxial
  - Connectors: BNC, F-connector

Process/Skill Questions

- What is the major difference between an RJ-45 and an RJ-11 connector?
- What are the color codes for both TIA/EIA 568A and TIA/EIA 568B?
- What is the main use of BNC connectors today?

Task Number 61

Compare the characteristics of connectors and cabling.

Definition

Comparison should include the following:

- Fiber
  - Types (single-mode vs. multi-mode)
  - Speed and transmission limitations
• Twisted pair
  o Types: STP, UTP, CAT3, CAT5, CAT5e, CAT6, CAT6e, CAT7, plenum, Permanent Virtual Circuit (PVC)
  o Speed and transmission limitations
  o Splitters and effects on signal quality
• Coaxial
  o Types: RG-6, RG-59
  o Speed and transmission limitations
  o Splitters and effects on signal quality

Process/Skill Questions

• What would be the major advantage of using single-mode fiber vs multi-mode fiber?
• What was the first category cable to offer 10GBaseT?
• What is a reason that you would want to use plenum cable over PVC cable?

Task Number 62

Explain the properties and characteristics of Transmission Control Protocol/Internet Protocol (TCP/IP).

Definition

Explanation should include the following:

• Internet Protocol Version 4 (IPv4) vs. Internet Protocol Version 6 (IPv6)
• Public vs. private vs. Automatic Private Internet Protocol Addressing (APIPA)/link local
• Static vs. dynamic
• Client-side Domain Name Service (or Server) (DNS) settings
• Client-side Dynamic Host Configuration Protocol (DHCP)
• Subnet mask vs. classless inter-domain routing (CIDR)
• Gateway

Process/Skill Questions

• How many bits is an IPv4 IP address?
• What would be the main reason that you would assign a static IP address to a network device?
• What is the main purpose of a subnet mask?
Task Number 63

Explain common TCP and User Datagram Protocol (UDP) ports, protocols and their purpose.

Definition

Explanation should include the following:

- **Ports**
  - 21 – File Transfer Protocol (FTP)
  - 22 – Secure Shell (SSH)
  - 23 – telecommunications network (TELNET)
  - 25 – Simple Mail Transfer Protocol (SMTP)
  - 53 – DNS
  - 80 – Hypertext Transfer Protocol (HTTP)
  - 110 – Post Office Protocol 3 (POP3)
  - 143 – Internet Mail Access Protocol (IMAP)
  - 443 – Hypertext Transfer Protocol over Secure Sockets Layer (HTTPS)
  - 3389 – Remote Desktop Protocol (RDP)
  - 137-139 – NetBIOS/NetBIOS over TCP/IP (NetBT)
  - 445 – Server Message Block (SMB)/Common Internet File System (CIFS)
  - 427 – Service Location Protocol (SLP)
  - 548 – AppleTalk Filing Protocol (AFP)

- **Protocols**
  - DHCP
  - DNS
  - Lightweight Directory Access Protocol (LDAP)
  - SNMP
  - SMB
  - CIFS
  - SSH
  - AFP

- **TCP vs. UDP**

**Process/Skill Questions**

- What is the major advantage of using port 443 rather than port 80 for web browsing?
- What are the commonly used ports numbers for email and their purposes?
- What are the similarities and differences between TCP and UDP?

---

Task Number 64
Compare various Wireless Fidelity (WiFi) networking standards and encryption types.

Definition

Comparison should include the following:

- Standards
  - 802.11 (a/b/g/n/ac)
  - Speeds, distances and frequencies
- Encryption types
  - Wired Equivalent Privacy (WEP), Wireless Protected Access (WPA), WPA2, Temporal Key Integrity Protocol (TKIP), Advanced Encryption Standard (AES)

Process/Skill Questions

- What are the advantages and disadvantages of using 802.11a vs 802.11b?
- Which of the following is more secure WEP, WPA, or AES?
- Which of the 802.11 standards has the fastest speed?

Task Number 65

Install SOHO wireless/wired router.

Definition

Installation should include configuring and applying appropriate settings, and should include the following:

- Channels
- Port forwarding, port triggering
- DHCP (on/off)
- Demilitarized Zone (DMZ)
- Network Address Translation (NAT)/Dynamic Network Address Translation (DNAT)
- Basic Quality of Service (QoS)
- Firmware
- Universal Plug and Play (UPnP)

Process/Skill Questions

- If you were installing multiple wireless access points, why would you want to use different channels?
• What are the differences between port forwarding and port triggering?
• What is firmware?

---

**Task Number 66**

**Compare Internet connection types, network types, and their features.**

**Definition**

Comparison should include the following:

- Internet connection types
  - Cable
  - Digital Subscriber Line (DSL)
  - Dial-up
  - Fiber
  - Satellite
  - Integrated Services Digital Network (ISDN)
  - Cellular
    - Tethering
    - Mobile hotspot
  - Line-of-sight wireless Internet service
- Network Types
  - Local Area Network (LAN)
  - Wide Area Network (WAN)
  - Personal Area Network (PAN)
  - Metropolitan Area Network (MAN)

**Process/Skill Questions**

- What is the main advantage of using cable over DSL?
- What are some advantages and disadvantages of using satellite for your Internet connection?
- What are the similarities and differences of WANs and MANs?

---

**Task Number 67**
Compare network architecture devices, their functions and features.

Definition

Comparison should include the following:

- Hub
- Switch
- Router
- Access point
- Bridge
- Modem
- Firewall
- Patch panel
- Repeaters/extenders
- Ethernet over Power
- Power over Ethernet injector

Process/Skill Questions

- What style patch panel would you use for data cable?
- What are the two categories of firewalls?
- What is the major advantage of using a switch over a hub?

Task Number 68

Use networking tools.

Definition

Use should include appropriate tools such as the following:

- Crimper
- Cable stripper
- Multimeter
- Tone generator and probe
- Cable tester
- Loopback plug
- Punchdown tool
- WiFi analyzer
Process/Skill Questions

- What is the purpose of a loopback plug?
- What is another name for a tone generator and probe set?
- How does a cable tester work?

Exploring Mobile Devices

Task Number 69

Install laptop hardware and components.

Definition

Installation should include configuration and the following:

- Expansion options
  - Expresscard /34
  - Expresscard /54
  - SODIMM
  - Flash
  - Ports/Adapters
    - Thunderbolt
    - DisplayPort
    - USB to RJ-45 dongle
    - USB to WiFi dongle
    - USB to Bluetooth
    - USB Optical Drive

- Hardware/device replacement
  - Keyboard
  - Hard drive
    - SSD vs. hybrid vs. magnetic disk
    - 1.8 inch vs. 2.5 inch
  - Memory
  - Smart card reader
  - Optical drive
  - Wireless card
  - Mini-PCIe
  - Screen
  - Direct Current (DC) jack
  - Battery
  - Touchpad
  - Plastics/frames
  - Speaker
Process/Skill Questions

- What is the major advantage of using an SSD in a laptop?
- What type of RAM do most laptops use?
- Other than pin count, what is the major difference between Expresscard /34 and Expresscard /54?

Task Number 70

Describe the function of components within the display of a laptop.

Definition

Description should include the following:

- Types
  - LCD
    - TN vs. IPS
    - Fluorescent vs. LED backlighting
  - OLED
- WiFi antenna connector/placement
- Webcam
- Microphone
- Inverter
- Digitizer

Process/Skill Questions

- What are the advantages of LED backlighting vs fluorescent backlighting?
- What is the main function of the display inverter?
- What are the layers of an LCD?

Task Number 71

Demonstrate various laptop features.
Definition

Demonstration should include the following:

- Special function keys
  - Dual displays
  - Wireless (on/off)
  - Cellular (on/off)
  - Volume settings
  - Screen brightness
  - Bluetooth (on/off)
  - Keyboard backlight
  - Touch pad (on/off)
  - Screen orientation
  - Media options (fast forward/rewind)
  - Global Positioning System (GPS) (on/off)
  - Airplane mode
- Docking station
- Physical laptop lock and cable lock
- Rotating/removable screens

Process/Skill Questions

- What are the similarities and differences between a port replicator and a docking station?
- Which of the following is more secure, a physical laptop lock or a cable lock?
- What are the major advantages and disadvantages of rotating/removable screens?

Task Number 72

Explain the characteristics of various types of mobile devices.

Definition

Explanation should include the following:

- Tablets
- Smartphones
- Wearable technology devices
  - Smart watches
  - Fitness monitors
  - Glasses and headsets
• Phablets
• e-Readers
• Smart camera
• GPS

Process/Skill Questions

• What is the main difference between and tablet and a phablet?
• What are the major physical security issues with smartphone use?
• What are some examples of wearable technologies?
• How does your mobile service provider determine the location of your connected device?

Task Number 73

Compare accessories and ports of other mobile devices.

Definition

Comparison should include the following:

• Connection types
  o NFC
  o Proprietary vendor-specific ports (communication/power)
  o MicroUSB/miniUSB
  o Lightning
  o Bluetooth
  o IR
  o Hotspot/tethering
• Accessories
  o Headsets
  o Speakers
  o Game pads
  o Docking stations
  o Extra battery packs/battery chargers
  o Protective covers/water proofing
  o Credit card readers
  o Memory/MicroSD

Process/Skill Questions

• What are some of the ways you can use NFC?
• What manufacturer introduced the lightning connector?
• What are some advantages and disadvantages of using a hotspot vs. tethering?
Troubleshooting Hardware and Networking

Task Number 74

Troubleshoot common problems related to motherboards, RAM, CPU, and power.

Definition

Troubleshooting should be accomplished using appropriate tools and should include the following:

- Common symptoms
  - Unexpected shutdowns
  - System lockups
  - Power-on Self-test (POST) code beeps
  - Blank screen on boot up
  - BIOS time and settings resets
  - Attempts to boot to incorrect device
  - Continuous reboots
  - No power
  - Overheating
  - Loud noise
  - Intermittent device failure
  - Fans spin – no power to other devices
  - Indicator lights
  - Smoke
  - Burning smell
  - Proprietary crash screens (blue screen of death [BSOD]/pinwheel)
  - Distended capacitors
  - Date and time resets

- Tools
  - Multimeter
  - Power supply tester
  - Loopback plugs
  - POST card/USB

Process/Skill Questions

- What problems are identified by common beep codes?
- What is the challenge in troubleshooting intermittent device failures?
- What are the proprietary catastrophic failure screens?
Task Number 75

Troubleshoot hard drives and RAID arrays.

Definition

Troubleshooting should be accomplished using appropriate tools and include the following:

- **Common symptoms**
  - Read/write failure
  - Slow performance
  - Loud clicking noise
  - Failure to boot
  - Drive not recognized
  - OS not found
  - RAID not found
  - RAID stops working
  - Proprietary crash screens (BSOD/pinwheel)
  - Self-Monitoring, Analysis, and Reporting Technology (S.M.A.R.T.) errors

- **Tools**
  - Screwdriver
  - External enclosures
  - Check disk (CHKDSK)
  - FORMAT
  - File recovery software
  - Bootrec
  - Diskpart
  - Defragmentation tool

Process/Skill Questions

- How does disk defragmentation/optimization differ from Disk Cleanup?
- What information can be observed in a CHKDSK report?
- What Windows OS system tools can help address a computer with slow performance?

Task Number 76

Troubleshoot common video, projector, and display issues.

Definition

Troubleshooting should include the following common symptoms:
• VGA mode
• No image on screen
• Overheat shutdown
• Dead pixels
• Artifacts
• Color patterns incorrect
• Dim image
• Flickering image
• Distorted image
• Distorted geometry
• Burn-in
• Oversized images and icons

Process/Skill Questions

• How do you avoid screen burn-in?
• What is likely the problem when the display shows distorted images and icons?
• What are some possible fixes for stuck pixels?

Task Number 77

Troubleshoot wired and wireless networks.

Definition

Troubleshooting should include:

• Common symptoms
  o No connectivity
  o Automatic Private Internet Protocol Addressing (APIPA)/link local address
  o Limited connectivity
  o Local connectivity
  o Intermittent connectivity
  o IP conflict
  o Slow transfer speeds
  o Low RF signal
  o Service Set Identifier (SSID) not found
• Hardware tools
  o Cable tester
  o Loopback plug
  o Punchdown tools
  o Tone generator and probe
  o Wire strippers
- Crimper
- Wireless locator

- Command line tools
  - PING
  - IPCONFIG/IFCONFIG
  - TRACERT
  - NETSTAT
  - NBTSTAT
  - NET
  - NETDOM
  - NSLOOKUP

Process/Skill Questions

- What might cause a device to be issued a 169.254.x.x address?
- What is the difference between a tone generator and a tone probe?
- Which operating systems would use the IPCONFIG vs. the IFCONFIG commands?

Task Number 78

Troubleshoot common mobile devices.

Definition

Troubleshooting should include repair and upgrades to address device issues and the following:

- Common symptoms
  - No display
  - Dim display
  - Flickering display
  - Sticking keys
  - Intermittent wireless
  - Battery not charging
  - Ghost cursor/pointer drift
  - No power
  - Num lock indicator lights
  - No wireless connectivity
  - No Bluetooth connectivity
  - Cannot display to external monitor
  - Touchscreen unresponsive
  - Apps not loading
  - Slow performance
  - Unable to decrypt email
• Extremely short battery life
• Overheating
• Frozen system
• No sound from speakers
• GPS not functioning
• Swollen battery

• Disassembly processes for proper re-assembly
  o Document and label cable and screw locations
  o Organize parts
  o Refer to manufacturer resources
  o Use appropriate hand tools

Process/Skill Questions

• How do you address the issue of swollen batteries in portable devices?
• What is a possible solution for a laptop that cannot display to an external monitor via plug-and-play?
• Why is it important to document and label cable patterns and screw locations?

Task Number 79

Troubleshoot printers.

Definition

Troubleshooting should include the following:

• Common symptoms
  o Streaks
  o Faded prints
  o Ghost images
  o Toner not fused to the paper
  o Creased paper
  o Paper not feeding
  o Paper jam
  o No connectivity
  o Garbled characters on paper
  o Vertical lines on page
  o Backed-up print queue
  o Low memory errors
  o Access denied
  o Printer will not print
  o Color prints in wrong print color
- Unable to install printer
- Error codes
- Printing blank pages
- No image on printer display

- Tools
  - Maintenance kit
  - Toner vacuum
  - Compressed air
  - Printer spooler

Process/Skill Questions

- What component of a laser printer can cause streaks?
- What components in a laser printer need to be avoided during repair, or allowed to cool, due to extreme heat?
- What parts in a maintenance kit may be responsible for paper failing to feed?

SOL Correlation by Task

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>English: 10.5, 11.5</th>
<th>History and Social Science:</th>
</tr>
</thead>
<tbody>
<tr>
<td>39</td>
<td>Identify security issues related to computer hardware, software, and data.</td>
<td></td>
<td>VUS.14, WHII.14</td>
</tr>
<tr>
<td>40</td>
<td>Identify concepts related to copyright, public domain, copy protection, intellectual property, and licensing agreements.</td>
<td></td>
<td>GOVT.16, VUS.1, WG.1, WHI.1, WHII.1</td>
</tr>
<tr>
<td>41</td>
<td>Identify concepts of cybersecurity, honesty, courtesy, and confidentiality related to information and email systems and social networking (e.g., spam, viruses, and etiquette).</td>
<td></td>
<td>GOVT.16, VUS.14, WHII.14</td>
</tr>
<tr>
<td>42</td>
<td>Investigate Internet privacy issues and computer crimes, including identity theft.</td>
<td></td>
<td>GOVT.16, VUS.14, WHII.14</td>
</tr>
<tr>
<td>43</td>
<td>Comply with copyright and patent laws.</td>
<td></td>
<td>GOVT.16, VUS.1, VUS.14, WG.1, WHI.1, WHII.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
</tbody>
</table>
|44| Comply with policies regarding acceptable use of technology. | English: 10.5, 11.5  
History and Social Science: GOVT.16 |
|46| Describe the purposes and properties of motherboard components. | English: 10.5, 11.5 |
|47| Compare various RAM types and their features. |   |
|48| Install PC expansion cards. | Mathematics: COM.16 |
|49| Install various types of CPUs. |   |
|50| Describe the characteristics and purposes of various PC connection interfaces. | English: 10.5, 11.5 |
|51| Install a power supply. | Science: PH.11a |
|52| Select appropriate components for a custom PC configuration to meet customer specifications or needs. | Mathematics: COM.12 |
|53| Install storage devices. | Mathematics: COM.16 |
|54| Compare types of displays. | English: 10.5, 11.5  
Science: PH.9c |
|55| Identify common PC connector types and associated cables. |   |
|56| Install common peripheral devices. | Mathematics: COM.10, COM.11 |
|57| Install Small Office, Home Office (SOHO) multifunction device/printers. |   |
|58| Compare differences between the various print technologies and the associated imaging process. | English: 10.5 |
|59| Perform appropriate printer maintenance. |   |
|60| Identify the various types of network cables and connectors. |   |
|61| Compare the characteristics of connectors and cabling. | English: 10.5 |
|62| Explain the properties and characteristics of Transmission Control Protocol/Internet Protocol (TCP/IP). | English: 10.5, 11.5 |
|63| Explain common TCP and User Datagram Protocol (UDP) ports, protocols and their purpose. | English: 10.5, 11.5  
Mathematics: COM.1, COM.4, COM.7 |
<p>|64| Compare various Wireless Fidelity (WiFi) networking standards and encryption types. | English: 10.5 |</p>
<table>
<thead>
<tr>
<th>Task</th>
<th>Language and Mathematics Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install SOHO wireless/wired router.</td>
<td>English: 10.5</td>
</tr>
<tr>
<td>Compare Internet connection types, network types, and their features.</td>
<td>English: 10.5</td>
</tr>
<tr>
<td>Compare network architecture devices, their functions and features.</td>
<td>English: 10.5</td>
</tr>
<tr>
<td>Use networking tools.</td>
<td></td>
</tr>
<tr>
<td>Install laptop hardware and components.</td>
<td></td>
</tr>
<tr>
<td>Describe the function of components within the display of a laptop.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Demonstrate various laptop features.</td>
<td>Science: PH.9c</td>
</tr>
<tr>
<td>Explain the characteristics of various types of mobile devices.</td>
<td>English: 10.5, 11.5</td>
</tr>
<tr>
<td>Compare accessories and ports of other mobile devices.</td>
<td>English: 10.5</td>
</tr>
<tr>
<td>Troubleshoot common problems related to motherboards, RAM, CPU, and power.</td>
<td>Mathematics: COM.5, COM.18</td>
</tr>
<tr>
<td>Troubleshoot hard drives and RAID arrays.</td>
<td>Science: PH.11c</td>
</tr>
<tr>
<td>Troubleshoot common video, projector, and display issues.</td>
<td>Mathematics: COM.5, COM.18</td>
</tr>
<tr>
<td>Troubleshoot wired and wireless networks.</td>
<td>Mathematics: COM.5, COM.18</td>
</tr>
<tr>
<td>Troubleshoot common mobile devices.</td>
<td>Mathematics: COM.18</td>
</tr>
<tr>
<td>Troubleshoot printers.</td>
<td>Mathematics: COM.18</td>
</tr>
</tbody>
</table>

**Teacher Resources**

**CompTIA**

The Virginia Cyber Range is a Commonwealth of Virginia initiative with a mission to enhance cybersecurity education for students in the Commonwealth’s public high schools, colleges, and universities. The Virginia Cyber Range seeks to increase the number of fully prepared students entering the cybersecurity workforce in operations, development, and research. The Virginia Cyber Range provides an extensive Courseware Repository for educators and a cloud-hosted Exercise Area environment for hands-on cybersecurity labs and exercises for students.

AFA CyberPatriot the National Youth Cyber Education Program created by the Air Force Association to inspire K-12 students toward careers in cybersecurity or other science, technology, engineering, and mathematics (STEM) disciplines critical to our nation's future. At the core of the program is the National Youth Cyber Defense Competition, the nation’s largest cyber defense competition that puts high school and middle school students in charge of securing virtual networks.
Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- A+ Certification Examination
- Apple Certified Support Professional Examination
- Business Information Processing Assessment
- Cisco Certified CyberOps Associate Examination
- Cisco Certified DevNet Associate Examination
- Cisco Certified Networking Associate (CCNA) Examination
- Cisco Certified Networking Professional (CCNP) Automation for Cisco Enterprise Solutions Examination
- Cisco Certified Networking Professional (CCNP) Cisco Enterprise Networks Examination
- Cisco Certified Networking Professional (CCNP) Cisco SD-WAN Solutions Examination
- Cisco Certified Networking Professional (CCNP) Designing Enterprise Wireless Networks Examination
- Cisco Certified Networking Professional (CCNP) Enterprise Advanced Routing and Services Examination
- Cisco Certified Networking Professional (CCNP) Enterprise Network Core Technologies Examination
- Cisco Certified Networking Professional (CCNP) Implementing Enterprise Wireless Networks Examination
- College and Work Readiness Assessment (CWRA+)
- Computer Maintenance Technology Examination
- Computer Networking Fundamentals Assessment
- Computer Repair Technology Assessment
- Computer Service Technician (CST) Examination
- Computer Technology Assessment
- Customer Service Examination
- IC3 Digital Literacy Certification Examination
- IT Fundamentals+ Certification Examination
- Microsoft 365 Fundamentals Examination
- Microsoft Certified Azure Fundamentals Examination
- Microsoft Dynamics 365 Fundamentals Examination
- Microsoft Office Specialist (MOS) Examinations
- Microsoft Technology Associate (MTA) Examinations
- National Career Readiness Certificate Assessment
- Network Administration Certification Tests
- Network+ Certification Examination
- Professional Communications Certification Examination
- Security+ Certification Examination
- Technical Support Certification Tests
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.
- Cybersecurity Fundamentals (6302/36 weeks)
- Cybersecurity Systems Technology, Advanced (8629/36 weeks, 280 hours)

### Career Cluster: Information Technology

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Occupations</th>
</tr>
</thead>
</table>
| Information Support and Services | Computer Support Specialist  
                                 | Computer Systems Engineer, Architect  
                                 | Information Systems Analyst  
                                 | Maintenance Technician  
                                 | Network Systems and Data Communication Analyst  
                                 | Systems Analyst |
| Network Systems                | Computer Operator  
                                 | Computer Security Specialist  
                                 | Computer Support Specialist  
                                 | Computer Systems Engineer, Architect  
                                 | Information Security Analyst  
                                 | Network and Computer Systems Administrator  
                                 | Network Architect  
                                 | Network Systems and Data Communication Analyst  
                                 | Systems Analyst  
                                 | Telecommunications Equipment Installer, Repairer  
                                 | Telecommunications Specialist |
| Programming and Software Development | Computer Software Engineer  
                                 | Network Systems and Data Communication Analyst |
| Web and Digital Communications | Computer Support Specialist  
                                 | Computer Systems Engineer, Architect  
                                 | Systems Analyst |