



CompTIA A+ Core 1 Exam Guide to Computing Infrastructure



Tenth Edition




Jean Andrews
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Jill West



CompTIA A+ Core 1 (220-1001) Exam

	Objective	Chapters
Domain 1.0	Mobile Devices	
1.1	Given a scenario, install and configure laptop hardware and components.	1, 2, 3, 4, 5, 6
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2.4	Compare and contrast wireless networking protocols.	7, 9
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2.6	Explain common network configuration concepts.	7, 8
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3.5	Given a scenario, install and configure motherboards, CPUs, and add-on cards.	1, 2, 3, 4, 5, 6
3.6	Explain the purposes and uses of various peripheral types.	5, 6, 10
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5.5	Given a scenario, troubleshoot common mobile device issues while adhering to the appropriate procedures.	1, 4, 6, 9
5.6	Given a scenario, troubleshoot printers.	10
5.7	Given a scenario, troubleshoot common wired and wireless network problems.	8



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Infrastructure**
TENTH EDITION
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COMPTIA A+ CORE 1 (220-1001) EXAM OBJECTIVES MAPPED TO CHAPTERS

CompTIA A+ Core 1 Exam Guide to Computing Infrastructure, Tenth Edition fully meets all of the CompTIA's A+ Core 1 (220-1001) Exam Objectives.

1.0 MOBILE DEVICES

1.1 Given a scenario, install and configure laptop hardware and components.

Objectives	Chapter	Primary Section
<ul style="list-style-type: none"> • Hardware/device replacement <ul style="list-style-type: none"> - Keyboard - Hard drive <ul style="list-style-type: none"> ○ SSD vs. hybrid vs. magnetic disk ○ 1.8 in. vs. 2.5 in. - Memory - Smart card reader - Optical drive - Wireless card/Bluetooth module - Cellular card - Video card - Mini PCIe - Screen - DC jack - Battery - Touchpad - Plastics/frames - Speaker - System board - CPU 	<ul style="list-style-type: none"> 1 5 5 5 3 5 5 6 6 6 6 6 4 1 6 1 6 2 3 	<ul style="list-style-type: none"> First Look at Laptop Components Hard Drive Technologies and Interface Standards Hard Drive Technologies and Interface Standards Hard Drive Technologies and Interface Standards How to Upgrade Memory Supporting Other Types of Storage Devices Supporting Other Types of Storage Devices Identifying and Installing I/O Peripheral Devices Installing and Configuring Adapter Cards Supporting the Video Subsystem Installing and Configuring Adapter Cards Supporting the Video Subsystem Troubleshooting the Electrical System First Look at Laptop Components Identifying and Installing I/O Peripheral Devices First Look at Laptop Components Identifying and Installing I/O Peripheral Devices Motherboard Types and Features Selecting and Installing a Processor

1.2 Given a scenario, install components within the display of a laptop.

Objectives	Chapter	Primary Section
<ul style="list-style-type: none"> • Types <ul style="list-style-type: none"> - LCD - OLED • Wi-Fi antenna connector/placement • Webcam • Microphone • Inverter • Digitizer/touch screen 	<ul style="list-style-type: none"> 6 6 6 6 6 6 6 	<ul style="list-style-type: none"> Supporting the Video Subsystem Supporting the Video Subsystem Supporting the Video Subsystem Installing and Configuring Adapter Cards Identifying and Installing I/O Peripheral Devices Identifying and Installing I/O Peripheral Devices Supporting the Video Subsystem Identifying and Installing I/O Peripheral Devices

1.3 Given a scenario, use appropriate laptop features.

Objectives	Chapter	Primary Section
<ul style="list-style-type: none"> • Special function keys <ul style="list-style-type: none"> - Dual displays - Wireless (on/off) 	<ul style="list-style-type: none"> 1 1 1 	<ul style="list-style-type: none"> First Look at Laptop Components First Look at Laptop Components First Look at Laptop Components

Objectives	Chapter	Primary Section
- Cellular (on/off)	1	First Look at Laptop Components
- Volume settings	1	First Look at Laptop Components
- Screen brightness	1	First Look at Laptop Components
- Bluetooth (on/off)	1	First Look at Laptop Components
- Keyboard backlight	1	First Look at Laptop Components
- Touchpad (on/off)	1	First Look at Laptop Components
- Screen orientation	1	First Look at Laptop Components
- Media options (fast forward/rewind)	1	First Look at Laptop Components
- GPS (on/off)	1	First Look at Laptop Components
- Airplane mode	1	First Look at Laptop Components
• Docking station	1	First Look at Laptop Components
• Port replicator	1	First Look at Laptop Components
• Physical laptop lock and cable lock	1	First Look at Laptop Components
• Rotating/removable screens	1	First Look at Laptop Components

1.4 Compare and contrast characteristics of various types of other mobile devices.

Objectives	Chapter	Primary Section
• Tablets	9	Types of Mobile Devices
• Smartphones	9	Types of Mobile Devices
• Wearable technology devices	9	Types of Mobile Devices
- Smart watches	9	Types of Mobile Devices
- Fitness monitors	9	Types of Mobile Devices
- VR/AR headsets	9	Types of Mobile Devices
• E-readers	9	Types of Mobile Devices
• GPS	9	Types of Mobile Devices

1.5 Given a scenario, connect and configure accessories and ports of other mobile devices.

Objectives	Chapter	Primary Section
• Connection types	9	Configuring and Syncing a Mobile Device
- Wired	9	Configuring and Syncing a Mobile Device
○ Micro-USB/Mini-USB/USB-C	9	Configuring and Syncing a Mobile Device
○ Lightning	9	Configuring and Syncing a Mobile Device
○ Tethering	9	Configuring and Syncing a Mobile Device
○ Proprietary vendor-specific ports (communication/power)	9	Configuring and Syncing a Mobile Device
- Wireless	9	Configuring and Syncing a Mobile Device
○ NFC	9	Configuring and Syncing a Mobile Device
○ Bluetooth	9	Configuring and Syncing a Mobile Device
○ IR	9	Configuring and Syncing a Mobile Device
○ Hotspot	9	Configuring and Syncing a Mobile Device
• Accessories	9	Configuring and Syncing a Mobile Device
- Headsets	9	Configuring and Syncing a Mobile Device
- Speakers	9	Configuring and Syncing a Mobile Device
- Game pads	9	Configuring and Syncing a Mobile Device
- Extra battery packs/battery chargers	9	Configuring and Syncing a Mobile Device
- Protective covers/waterproofing	9	Configuring and Syncing a Mobile Device
- Credit card readers	9	Configuring and Syncing a Mobile Device
- Memory/MicroSD	9	Configuring and Syncing a Mobile Device

1.6 Given a scenario, configure basic mobile device network connectivity and application support.

Objectives	Chapter	Primary Section
• Wireless/cellular data network (enable/disable)	9	Configuring and Syncing a Mobile Device
- Hotspot	9	Configuring and Syncing a Mobile Device
- Tethering	9	Configuring and Syncing a Mobile Device
- Airplane mode	9	Configuring and Syncing a Mobile Device
• Bluetooth	9	Configuring and Syncing a Mobile Device
- Enable Bluetooth	9	Configuring and Syncing a Mobile Device
- Enable pairing	9	Configuring and Syncing a Mobile Device
- Find a device for pairing	9	Configuring and Syncing a Mobile Device
- Enter the appropriate PIN code	9	Configuring and Syncing a Mobile Device
- Test connectivity	9	Configuring and Syncing a Mobile Device
• Corporate and ISP email configuration	9	Configuring and Syncing a Mobile Device
- POP3	9	Configuring and Syncing a Mobile Device
- IMAP	9	Configuring and Syncing a Mobile Device
- Port and SSL settings	9	Configuring and Syncing a Mobile Device
- S/MIME	9	Configuring and Syncing a Mobile Device
• Integrated commercial provider email configuration	9	Configuring and Syncing a Mobile Device
- iCloud	9	Configuring and Syncing a Mobile Device
- Google/Inbox	9	Configuring and Syncing a Mobile Device
- Exchange Online	9	Configuring and Syncing a Mobile Device
- Yahoo	9	Configuring and Syncing a Mobile Device
• PRI updates/PRL updates/baseband updates	9	Configuring and Syncing a Mobile Device
• Radio firmware	9	Configuring and Syncing a Mobile Device
• IMEI vs. IMSI	9	Configuring and Syncing a Mobile Device
• VPN	9	Configuring and Syncing a Mobile Device

1.7 Given a scenario, use methods to perform mobile device synchronization.

Objectives	Chapter	Primary Section
• Synchronization methods	9	Configuring and Syncing a Mobile Device
- Synchronize to the cloud	9	Configuring and Syncing a Mobile Device
- Synchronize to the desktop	9	Configuring and Syncing a Mobile Device
- Synchronize to the automobile	9	Configuring and Syncing a Mobile Device
• Types of data to synchronize	9	Configuring and Syncing a Mobile Device
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- Applications	9	Configuring and Syncing a Mobile Device
- Email	9	Configuring and Syncing a Mobile Device
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- Social media data	9	Configuring and Syncing a Mobile Device
- E-books	9	Configuring and Syncing a Mobile Device
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• Mutual authentication for multiple services (SSO)	9	Configuring and Syncing a Mobile Device
• Software requirements to install the application on the PC	9	Configuring and Syncing a Mobile Device
• Connection types to enable synchronization	9	Configuring and Syncing a Mobile Device

2.0 NETWORKING

2.1 Compare and contrast TCP and UDP ports, protocols, and their purposes.

Objectives	Chapter	Primary Section
• Ports and protocols	8	Understanding TCP/IP and Windows Networking
- 21 – FTP	8	Understanding TCP/IP and Windows Networking
- 22 – SSH	8	Understanding TCP/IP and Windows Networking
- 23 – Telnet	8	Understanding TCP/IP and Windows Networking
- 25 – SMTP	8	Understanding TCP/IP and Windows Networking
- 53 – DNS	8	Understanding TCP/IP and Windows Networking
- 80 – HTTP	8	Understanding TCP/IP and Windows Networking
- 110 – POP3	8	Understanding TCP/IP and Windows Networking
- 143 – IMAP	8	Understanding TCP/IP and Windows Networking
- 443 – HTTPS	8	Understanding TCP/IP and Windows Networking
- 3389 – RDP	8	Understanding TCP/IP and Windows Networking
- 137-139 – NetBIOS/NetBT	8	Understanding TCP/IP and Windows Networking
- 445 – SMB/CIFS	8	Understanding TCP/IP and Windows Networking
- 427 – SLP	8	Understanding TCP/IP and Windows Networking
- 548 – AFP	8	Understanding TCP/IP and Windows Networking
- 67/68 – DHCP	8	Understanding TCP/IP and Windows Networking
- 389 – LDAP	8	Understanding TCP/IP and Windows Networking
- 161/162 – SNMP	8	Understanding TCP/IP and Windows Networking
• TCP vs. UDP	8	Understanding TCP/IP and Windows Networking

2.2 Compare and contrast common networking hardware devices.

Objectives	Chapter	Primary Section
• Routers	7	Setting Up a Multifunction Router for a SOHO Network
• Switches	8	Local Network Infrastructure
- Managed	8	Local Network Infrastructure
- Unmanaged	8	Local Network Infrastructure
• Access points	8	Local Network Infrastructure
• Cloud-based network controller	10	Cloud Computing
• Firewall	8	Local Network Infrastructure
• Network interface card	7	Connecting a Computer to a Local Network
• Repeater	8	Local Network Infrastructure
• Hub	8	Local Network Infrastructure
• Cable/DSL modem	7	Types of Networks and Network Connections
• Bridge	8	Local Network Infrastructure
• Patch panel	8	Setting Up and Troubleshooting Network Wiring
• Power over Ethernet (PoE)	8	Local Network Infrastructure
- Injectors	8	Local Network Infrastructure
- Switch	8	Local Network Infrastructure
• Ethernet over Power	8	Local Network Infrastructure

2.3 Given a scenario, install and configure a basic wired/wireless SOHO network.

Objectives	Chapter	Primary Section
• Router/switch functionality	7	Setting Up a Multifunction Router for a SOHO Network
• Access point settings	7	Setting Up a Multifunction Router for a SOHO Network
• IP addressing	7	Setting Up a Multifunction Router for a SOHO Network
• NIC configuration	7	Connecting a Computer to a Local Network
- Wired	7	Connecting a Computer to a Local Network
- Wireless	7	Connecting a Computer to a Local Network

Objectives	Chapter	Primary Section
• End-user device configuration	7	Connecting a Computer to a Local Network
• IoT device configuration	9	The Internet of Things (IoT)
- Thermostat	9	The Internet of Things (IoT)
- Light switches	9	The Internet of Things (IoT)
- Security cameras	9	The Internet of Things (IoT)
- Door locks	9	The Internet of Things (IoT)
- Voice-enabled, smart speaker/digital assistant	9	The Internet of Things (IoT)
• Cable/DSL modem configuration	7	Types of Networks and Network Connections
• Firewall settings	7	Setting Up a Multifunction Router for a SOHO Network
- DMZ	7	Setting Up a Multifunction Router for a SOHO Network
- Port forwarding	7	Setting Up a Multifunction Router for a SOHO Network
- NAT	7	Setting Up a Multifunction Router for a SOHO Network
- UPnP	7	Setting Up a Multifunction Router for a SOHO Network
- Whitelist/blacklist	7	Setting Up a Multifunction Router for a SOHO Network
- MAC filtering	7	Setting Up a Multifunction Router for a SOHO Network
• QoS	7	Setting Up a Multifunction Router for a SOHO Network
• Wireless settings	7	Setting Up a Multifunction Router for a SOHO Network
- Encryption	7	Setting Up a Multifunction Router for a SOHO Network
- Channels	7	Setting Up a Multifunction Router for a SOHO Network
- QoS	7	Setting Up a Multifunction Router for a SOHO Network

2.4 Compare and contrast wireless networking protocols.

Objectives	Chapter	Primary Section
• 802.11a	7	Setting Up a Multifunction Router for a SOHO Network
• 802.11b	7	Setting Up a Multifunction Router for a SOHO Network
• 802.11g	7	Setting Up a Multifunction Router for a SOHO Network
• 802.11n	7	Setting Up a Multifunction Router for a SOHO Network
• 802.11ac	7	Setting Up a Multifunction Router for a SOHO Network
• Frequencies	7	Setting Up a Multifunction Router for a SOHO Network
- 2.4Ghz	7	Setting Up a Multifunction Router for a SOHO Network
- 5Ghz	7	Setting Up a Multifunction Router for a SOHO Network
• Channels	7	Setting Up a Multifunction Router for a SOHO Network
- 1–11	7	Setting Up a Multifunction Router for a SOHO Network
• Bluetooth	9	Configuring and Syncing a Mobile Device
• NFC	9	Configuring and Syncing a Mobile Device
• RFID	9	The Internet of Things (IoT)
• Zigbee	9	The Internet of Things (IoT)
• Z-Wave	9	The Internet of Things (IoT)
• 3G	7	Types of Networks and Network Connections
• 4G	7	Types of Networks and Network Connections
• 5G	7	Types of Networks and Network Connections
• LTE	7	Types of Networks and Network Connections

2.5 Summarize the properties and purposes of services provided by networked hosts.

Objectives	Chapter	Primary Section
• Server roles	8	Local Network Infrastructure
- Web server	8	Local Network Infrastructure
- File server	8	Local Network Infrastructure
- Print server	8	Local Network Infrastructure

Objectives	Chapter	Primary Section
- DHCP server	8	Local Network Infrastructure
- DNS server	8	Local Network Infrastructure
- Proxy server	8	Local Network Infrastructure
- Mail server	8	Local Network Infrastructure
- Authentication server	8	Local Network Infrastructure
- syslog	8	Local Network Infrastructure
• Internet appliance	8	Local Network Infrastructure
- UTM	8	Local Network Infrastructure
- IDS	8	Local Network Infrastructure
- IPS	8	Local Network Infrastructure
- End-point management server	8	Local Network Infrastructure
• Legacy/embedded systems	8	Local Network Infrastructure

2.6 Explain common network configuration concepts.

Objectives	Chapter	Primary Section
• IP addressing	8	Understanding TCP/IP and Windows Networking
- Static	8	Understanding TCP/IP and Windows Networking
- Dynamic	8	Understanding TCP/IP and Windows Networking
- APIPA	8	Troubleshooting Network Connections
- Link local	8	Understanding TCP/IP and Windows Networking
• DNS	8	Understanding TCP/IP and Windows Networking
• DHCP	8	Understanding TCP/IP and Windows Networking
- Reservations	7	Setting Up a Multifunction Router for a SOHO Network
• IPv4 vs. IPv6	8	Understanding TCP/IP and Windows Networking
• Subnet mask	8	Understanding TCP/IP and Windows Networking
• Gateway	8	Understanding TCP/IP and Windows Networking
• VPN	7	Connecting a Computer to a Local Network
• VLAN	8	Local Network Infrastructure
• NAT	8	Understanding TCP/IP and Windows Networking

2.7 Compare and contrast Internet connection types, network types, and their features.

Objectives	Chapter	Primary Section
• Internet connection types	7	Types of Networks and Network Connections
- Cable	7	Types of Networks and Network Connections
- DSL	7	Types of Networks and Network Connections
- Dial-up	7	Types of Networks and Network Connections
- Fiber	7	Types of Networks and Network Connections
- Satellite	7	Types of Networks and Network Connections
- ISDN	7	Types of Networks and Network Connections
- Cellular	7	Types of Networks and Network Connections
○ Tethering	7	Types of Networks and Network Connections
○ Mobile hotspot	7	Types of Networks and Network Connections
- Line-of-sight wireless Internet service	7	Types of Networks and Network Connections
• Network types	7	Types of Networks and Network Connections
- LAN	7	Types of Networks and Network Connections
- WAN	7	Types of Networks and Network Connections
- PAN	7	Types of Networks and Network Connections
- MAN	7	Types of Networks and Network Connections
- WMN	7	Types of Networks and Network Connections

2.8 Given a scenario, use appropriate networking tools.

Objectives	Chapter	Primary Section
• Crimper	8	Setting Up and Troubleshooting Network Wiring
• Cable stripper	8	Setting Up and Troubleshooting Network Wiring
• Multimeter	8	Setting Up and Troubleshooting Network Wiring
• Tone generator and probe	8	Setting Up and Troubleshooting Network Wiring
• Cable tester	8	Setting Up and Troubleshooting Network Wiring
• Loopback plug	8	Setting Up and Troubleshooting Network Wiring
• Punchdown tool	8	Setting Up and Troubleshooting Network Wiring
• Wi-Fi analyzer	8	Setting Up and Troubleshooting Network Wiring

3.0 HARDWARE

3.1 Explain basic cable types, features, and their purposes.

Objectives	Chapter	Primary Section
• Network cables	8	Local Network Infrastructure
- Ethernet	8	Local Network Infrastructure
○ Cat 5	8	Local Network Infrastructure
○ Cat 5e	8	Local Network Infrastructure
○ Cat 6	8	Local Network Infrastructure
○ Plenum	8	Local Network Infrastructure
○ Shielded twisted pair	8	Local Network Infrastructure
○ Unshielded twisted pair	8	Local Network Infrastructure
○ 568A/B	8	Local Network Infrastructure
- Fiber	8	Local Network Infrastructure
- Coaxial	8	Local Network Infrastructure
- Speed and transmission limitations	8	Local Network Infrastructure
• Video cables	6	Supporting the Video Subsystem
- VGA	6	Supporting the Video Subsystem
- HDMI	6	Supporting the Video Subsystem
- Mini-HDMI	6	Supporting the Video Subsystem
- DisplayPort	6	Supporting the Video Subsystem
- DVI	6	Supporting the Video Subsystem
- DVI-DDVI-I	6	Supporting the Video Subsystem
• Multipurpose cables		
- Lightning	9	Configuring and Syncing a Mobile Device
- Thunderbolt	6	Supporting the Video Subsystem
- USB	6	Identifying and Installing I/O Peripheral Devices
- USB-C	6	Identifying and Installing I/O Peripheral Devices
- USB 2.0	6	Identifying and Installing I/O Peripheral Devices
- USB 3.0	6	Identifying and Installing I/O Peripheral Devices
• Peripheral cables		
- Serial	6	Identifying and Installing I/O Peripheral Devices
• Hard drive cables	5	Hard Drive Technologies and Interface Standards
- SATA	5	Hard Drive Technologies and Interface Standards
- IDE	5	Hard Drive Technologies and Interface Standards
- SCSI	5	Hard Drive Technologies and Interface Standards
• Adapters		
- DVI to HDMI	6	Troubleshooting I/O Devices
- USB to Ethernet	6	Troubleshooting I/O Devices
- DVI to VGA	6	Supporting the Video Subsystem

3.2 Identify common connector types.

Objectives	Chapter	Primary Section
• RJ-11	7	Types of Networks and Network Connections
• RJ-45	7	Types of Networks and Network Connections
• RS-232	6	Basic Principles for Supporting Devices
• BNC	6	Basic Principles for Supporting Devices
• RG-59	6	Basic Principles for Supporting Devices
• RG-6	6	Basic Principles for Supporting Devices
• USB	6	Basic Principles for Supporting Devices
• Micro-USB	6	Basic Principles for Supporting Devices
• Mini-USB	6	Basic Principles for Supporting Devices
• USB-C	6	Identifying and Installing I/O Peripheral Devices
• DB-9	6	Basic Principles for Supporting Devices
• Lightning	6	Identifying and Installing I/O Peripheral Devices
• SCSI	5	Hard Drive Technologies and Interface Standards
• eSATA	5	Hard Drive Technologies and Interface Standards
• Molex	2	Motherboard Types and Features

3.3 Given a scenario, install RAM types.

Objectives	Chapter	Primary Section
• RAM types	3	Memory Technologies
- SODIMM	3	Memory Technologies
- DDR2	3	Memory Technologies
- DDR3	3	Memory Technologies
- DDR4	3	Memory Technologies
• Single channel	3	Memory Technologies
• Dual channel	3	Memory Technologies
• Triple channel	3	Memory Technologies
• Error correcting	3	Memory Technologies
• Parity vs. non-parity	3	Memory Technologies

3.4 Given a scenario, select, install, and configure storage devices.

Objectives	Chapter	Primary Section
• Optical drives	5	Supporting Other Types of Storage Devices
- CD-ROM/CD-RW	5	Supporting Other Types of Storage Devices
- DVD-ROM/DVD-RW/DVD-RW DL	5	Supporting Other Types of Storage Devices
- Blu-ray	5	Supporting Other Types of Storage Devices
- BD-R	5	Supporting Other Types of Storage Devices
- BD-RE	5	Supporting Other Types of Storage Devices
• Solid-state drives	5	How to Select and Install Hard Drives
- M2 drives	5	How to Select and Install Hard Drives
- NVME	5	How to Select and Install Hard Drives
- SATA 2.5	5	How to Select and Install Hard Drives
• Magnetic hard drives	5	How to Select and Install Hard Drives
- 5,400rpm	5	Hard Drive Technologies and Interface Standards
- 7,200rpm	5	Hard Drive Technologies and Interface Standards
- 10,000rpm	5	Hard Drive Technologies and Interface Standards
- 15,000rpm	5	Hard Drive Technologies and Interface Standards
- Sizes:	5	Hard Drive Technologies and Interface Standards
○ -2.5	5	Hard Drive Technologies and Interface Standards
○ -3.5	5	Hard Drive Technologies and Interface Standards

Objectives	Chapter	Primary Section
• Hybrid drives	5	Hard Drive Technologies and Interface Standards
• Flash	5	Supporting Other Types of Storage Devices
- SD card	5	Supporting Other Types of Storage Devices
- CompactFlash	5	Supporting Other Types of Storage Devices
- Micro-SD card	5	Supporting Other Types of Storage Devices
- Mini-SD card	5	Supporting Other Types of Storage Devices
- xD	5	Supporting Other Types of Storage Devices
• Configurations	5	
- RAID 0, 1, 5, 10	5	How to Select and Install Hard Drives
- Hot swappable	5	Hard Drive Technologies and Interface Standards

3.5 Given a scenario, install and configure motherboards, CPUs, and add-on cards.

Objectives	Chapter	Primary Section
• Motherboard form factor	2	Motherboard Types and Features
- ATX	2	Motherboard Types and Features
- mATX	2	Motherboard Types and Features
- ITX	2	Motherboard Types and Features
- mITX	2	Motherboard Types and Features
• Motherboard connectors types		
- PCI	2	Motherboard Types and Features
- PCIe	2	Motherboard Types and Features
- Riser card	2	Motherboard Types and Features
- Socket types	2	Motherboard Types and Features
- SATA	2	Motherboard Types and Features
- IDE	2	Motherboard Types and Features
- Front panel connector	1	First Look at Laptop Components
- Internal USB connector	2	Installing or Replacing a Motherboard
• BIOS/UEFI settings		
- Boot options	2	Using BIOS/UEFI Setup to Configure a Motherboard
- Firmware updates	2	Updating Motherboard Drivers and BIOS/UEFI
- Security settings	2	Using BIOS/UEFI Setup to Configure a Motherboard
- Interface configurations	2	Using BIOS/UEFI Setup to Configure a Motherboard
- Security	2	Using BIOS/UEFI Setup to Configure a Motherboard
o Passwords	2	Using BIOS/UEFI Setup to Configure a Motherboard
o Drive encryption	2	Using BIOS/UEFI Setup to Configure a Motherboard
o TPM	2	Using BIOS/UEFI Setup to Configure a Motherboard
o LoJack	2	Using BIOS/UEFI Setup to Configure a Motherboard
o Secure boot	2	Using BIOS/UEFI Setup to Configure a Motherboard
• CMOS battery	2	Updating Motherboard Drivers and BIOS/UEFI
• CPU features	3	Types and Characteristics of Processors
- Single-core	3	Types and Characteristics of Processors
- Multicore	3	Types and Characteristics of Processors
- Virtual technology	3	Types and Characteristics of Processors
- Hyperthreading	3	Types and Characteristics of Processors
- Speeds	3	Types and Characteristics of Processors
- Overclocking	3	Types and Characteristics of Processors
- Integrated GPU	3	Types and Characteristics of Processors
• Compatibility	3	Selecting and Installing a Processor
- AMD	3	Selecting and Installing a Processor
- Intel	3	Selecting and Installing a Processor

Objectives	Chapter	Primary Section
• Cooling mechanism	4	Cooling Methods and Devices
- Fans	4	Troubleshooting the Electrical System
- Heat sink	4	Cooling Methods and Devices
- Liquid	4	Cooling Methods and Devices
- Thermal paste	4	Cooling Methods and Devices
• Expansion cards	6	Installing and Configuring Adapter Cards
- Video cards	6	Installing and Configuring Adapter Cards
○ Onboard	6	Basic Principles for Supporting Devices
○ Add-on card	6	Installing and Configuring Adapter Cards
- Sound cards	6	Installing and Configuring Adapter Cards
- Network interface card	6	Installing and Configuring Adapter Cards
- USB expansion card	6	Installing and Configuring Adapter Cards
- eSATA card	5	Hard Drive Technologies and Interface Standards

3.6 Explain the purposes and uses of various peripheral types.

Objectives	Chapter	Primary Section
• Printer	10	Printer Types and Features
• ADF/flatbed scanner	10	Printer Types and Features
• Barcode scanner/QR scanner	6	Basic Principles for Supporting Devices
• Monitors	6	Supporting the Video Subsystem
• VR headset	6	Identifying and Installing I/O Peripheral Devices
• Optical	5	Supporting Other Types of Storage Devices
• DVD drive	5	Supporting Other Types of Storage Devices
• Mouse	6	Identifying and Installing I/O Peripheral Devices
• Keyboard	6	Identifying and Installing I/O Peripheral Devices
• Touchpad	6	Identifying and Installing I/O Peripheral Devices
• Signature pad	6	Identifying and Installing I/O Peripheral Devices
• Game controllers	6	Identifying and Installing I/O Peripheral Devices
• Camera/webcam	6	Identifying and Installing I/O Peripheral Devices
• Microphone	6	Identifying and Installing I/O Peripheral Devices
• Speakers	6	Identifying and Installing I/O Peripheral Devices
• Headset	6	Identifying and Installing I/O Peripheral Devices
• Projector	6	Supporting the Video Subsystem
- Lumens/brightness	6	Supporting the Video Subsystem
• External storage drives	5	How to Select and Install Hard Drives
• KVM	6	Identifying and Installing I/O Peripheral Devices
• Magnetic reader/chip reader	6	Identifying and Installing I/O Peripheral Devices
• NFC/tap pay device	6	Identifying and Installing I/O Peripheral Devices
• Smart card reader	5	Supporting Other Types of Storage Devices

3.7 Summarize power supply types and features.

Objectives	Chapter	Primary Section
• Input 115V vs. 220V	4	Selecting a Power Supply
• Output 5.5V vs. 12V	4	Selecting a Power Supply
• 24-pin motherboard adapter	4	Selecting a Power Supply
• Wattage rating	4	Selecting a Power Supply
• Number of devices/types of devices to be powered	4	Troubleshooting the Electrical System

3.8 Given a scenario, select and configure appropriate components for a custom PC configuration to meet customer specifications or needs.

Objectives	Chapter	Primary Section
• Graphic/CAD/CAM design workstation	6	Customizing Computer Systems
- Multicore processor	6	Customizing Computer Systems
- High-end video	6	Customizing Computer Systems
- Maximum RAM	6	Customizing Computer Systems
• Audio/video editing workstation	6	Customizing Computer Systems
- Specialized audio and video card	6	Customizing Computer Systems
- Large, fast hard drive	6	Customizing Computer Systems
- Dual monitors	6	Customizing Computer Systems
• Virtualization workstation	10	Client-Side Virtualization
- Maximum RAM and CPU cores	10	Client-Side Virtualization
• Gaming PC	6	Customizing Computer Systems
- Multicore processor	6	Customizing Computer Systems
- High-end video/specialized GPU	6	Customizing Computer Systems
- High-definition sound card	6	Customizing Computer Systems
- High-end cooling	6	Customizing Computer Systems
• Standard thick client	10	Client-Side Virtualization
- Desktop applications	10	Client-Side Virtualization
- Meets recommended requirements for selected OS	10	Client-Side Virtualization
• Thin client	10	Client-Side Virtualization
- Basic applications	10	Client-Side Virtualization
- Meets minimum requirements for selected OS	10	Client-Side Virtualization
- Network connectivity	10	Client-Side Virtualization
• Network attached storage device	5	How to Select and Install Hard Drives
- Media streaming	6	Customizing Computer Systems
- File sharing	6	Customizing Computer Systems
- Gigabit NIC	6	Customizing Computer Systems
- RAID array	5	How to Select and Install Hard Drives

3.9 Given a scenario, install and configure common devices.

Objectives	Chapter	Primary Section
• Desktop	10	Client-Side Virtualization
- Thin client	10	Client-Side Virtualization
- Thick client	10	Client-Side Virtualization
- Account setup/settings	7	Connecting a Computer to a Local Network
• Laptop/common mobile devices		
- Touchpad configuration	6	Identifying and Installing I/O Peripheral Devices
- Touch screen configuration	6	Identifying and Installing I/O Peripheral Devices
- Application installations/configurations	9	Configuring and Syncing a Mobile Device
- Synchronization settings	9	Configuring and Syncing a Mobile Device
- Account setup/settings	9	Configuring and Syncing a Mobile Device
- Wireless settings	9	Configuring and Syncing a Mobile Device

3.10 Given a scenario, configure SOHO multifunction devices/printers and settings.

Objectives	Chapter	Primary Section
• Use appropriate drivers for a given operating system	10	Using Windows to Install, Share, and Manage Printers
- Configuration settings	10	Using Windows to Install, Share, and Manage Printers
○ Duplex	10	Printer Types and Features
○ Collate	10	Printer Types and Features
○ Orientation	10	Using Windows to Install, Share, and Manage Printers
○ Quality	10	Using Windows to Install, Share, and Manage Printers
• Device sharing	10	Using Windows to Install, Share, and Manage Printers
- Wired	10	Using Windows to Install, Share, and Manage Printers
○ USB	10	Using Windows to Install, Share, and Manage Printers
○ Serial	10	Using Windows to Install, Share, and Manage Printers
○ Ethernet	10	Using Windows to Install, Share, and Manage Printers
- Wireless	10	Using Windows to Install, Share, and Manage Printers
○ Bluetooth	10	Using Windows to Install, Share, and Manage Printers
○ 802.11(a, b, g, n, ac)	10	Using Windows to Install, Share, and Manage Printers
○ Infrastructure vs. ad hoc	10	Using Windows to Install, Share, and Manage Printers
- Integrated print server (hardware)	10	Using Windows to Install, Share, and Manage Printers
- Cloud printing/remote printing	10	Using Windows to Install, Share, and Manage Printers
• Public/shared devices	10	Using Windows to Install, Share, and Manage Printers
- Sharing local/networked device via operating system settings	10	Using Windows to Install, Share, and Manage Printers
○ TCP/Bonjour/AirPrint	10	Using Windows to Install, Share, and Manage Printers
- Data privacy	10	Using Windows to Install, Share, and Manage Printers
○ User authentication on the device	10	Using Windows to Install, Share, and Manage Printers
○ Hard drive caching	10	Using Windows to Install, Share, and Manage Printers

3.11 Given a scenario, install and maintain various print technologies.

Objectives	Chapter	Primary Section
• Laser	10	Printer Maintenance
- Imaging drum, fuser assembly, transfer belt, transfer roller, pickup rollers, separate pads, duplexing assembly	10	Printer Maintenance
- Imaging process: processing, charging, exposing, developing, transferring, fusing, and cleaning	10	Printer Maintenance
- Maintenance: Replace toner, apply maintenance kit, calibrate, clean	10	Printer Maintenance
• Inkjet	10	Printer Maintenance
- Ink cartridge, print head, roller, feeder, duplexing assembly, carriage, and belt	10	Printer Maintenance
- Calibrate	10	Printer Maintenance
- Maintenance: Clean heads, replace cartridges, calibrate, clear jams	10	Printer Maintenance
• Thermal	10	Printer Maintenance
- Feed assembly, heating element	10	Printer Maintenance
- Special thermal paper	10	Printer Maintenance
- Maintenance: Replace paper, clean heating element, remove debris	10	Printer Maintenance
• Impact	10	Printer Maintenance
- Print head, ribbon, tractor feed	10	Printer Maintenance
- Impact paper	10	Printer Maintenance
- Maintenance: Replace ribbon, replace print head, replace paper	10	Printer Maintenance

Objectives	Chapter	Primary Section
• Virtual	10	Printer Maintenance
- Print to file	10	Printer Maintenance
- Print to PDF	10	Printer Maintenance
- Print to XPS	10	Printer Maintenance
- Print to image	10	Printer Maintenance
• 3D printers	10	Printer Maintenance
- Plastic filament	10	Printer Maintenance

4.0 VIRTUALIZATION AND CLOUD COMPUTING

4.1 Compare and contrast cloud computing concepts.

Objectives	Chapter	Primary Section
• Common cloud models	10	Cloud Computing
- IaaS	10	Cloud Computing
- SaaS	10	Cloud Computing
- PaaS	10	Cloud Computing
- Public vs. private vs. hybrid vs. community	10	Cloud Computing
• Shared resources	10	Cloud Computing
- Internal vs. external	10	Cloud Computing
• Rapid elasticity	10	Cloud Computing
• On-demand	10	Cloud Computing
• Resource pooling	10	Cloud Computing
• Measured service	10	Cloud Computing
• Metered	10	Cloud Computing
• Off-site email applications	10	Cloud Computing
• Cloud file storage services	10	Cloud Computing
- Synchronization apps	9	Configuring and Syncing a Mobile Device
• Virtual application streaming/cloud-based applications	10	Cloud Computing
- Applications for cell phones/tablets	10	Cloud Computing
- Applications for laptops/desktops	10	Cloud Computing
• Virtual desktop	10	Cloud Computing
- Virtual NIC	10	Client-Side Virtualization

4.2 Given a scenario, set up and configure client-side virtualization.

Objectives	Chapter	Primary Section
• Purpose of virtual machines	10	Client-Side Virtualization
• Resource requirements	10	Client-Side Virtualization
• Emulator requirements	10	Client-Side Virtualization
• Security requirements	10	Client-Side Virtualization
• Network requirements	10	Client-Side Virtualization
• Hypervisor	10	Client-Side Virtualization

5.0 HARDWARE AND NETWORK TROUBLESHOOTING

5.1 Given a scenario, use the best practice methodology to resolve problems.

Objectives	Chapter	Primary Section
<ul style="list-style-type: none"> Always consider corporate policies, procedures, and impacts before implementing changes 	4	Strategies to Troubleshoot Any Computer Problem
1. Identify the problem	4	Strategies to Troubleshoot Any Computer Problem
<ul style="list-style-type: none"> Question the user and identify user changes to computer and perform backups before making changes 	4	Strategies to Troubleshoot Any Computer Problem
<ul style="list-style-type: none"> Inquire regarding environmental or infrastructure changes 	4	Strategies to Troubleshoot Any Computer Problem
<ul style="list-style-type: none"> Review system and application logs 	4	Strategies to Troubleshoot Any Computer Problem
2. Establish a theory of probable cause (question the obvious)	4	Strategies to Troubleshoot Any Computer Problem
<ul style="list-style-type: none"> If necessary, conduct external or internal research based on symptoms 	4	Strategies to Troubleshoot Any Computer Problem
3. Test the theory to determine cause	4	Strategies to Troubleshoot Any Computer Problem
<ul style="list-style-type: none"> Once the theory is confirmed, determine the next steps to resolve problem 	4	Strategies to Troubleshoot Any Computer Problem
<ul style="list-style-type: none"> If theory is not confirmed, re-establish new theory or escalate 	4	Strategies to Troubleshoot Any Computer Problem
4. Establish a plan of action to resolve the problem and implement the solution	4	Strategies to Troubleshoot Any Computer Problem
5. Verify full system functionality and, if applicable, implement preventive measures	4	Strategies to Troubleshoot Any Computer Problem
6. Document findings, actions, and outcomes	4	Strategies to Troubleshoot Any Computer Problem

5.2 Given a scenario, troubleshoot problems related to motherboards, RAM, CPUs, and power.

Objectives	Chapter	Primary Section
<ul style="list-style-type: none"> Common symptoms 	4	Troubleshooting the Motherboard, Processor, and RAM
<ul style="list-style-type: none"> Unexpected shutdowns 	4	Troubleshooting the Electrical System
<ul style="list-style-type: none"> System lockups 	4	Troubleshooting the Motherboard, Processor, and RAM
<ul style="list-style-type: none"> POST code beeps 	4	Troubleshooting the Motherboard, Processor, and RAM
<ul style="list-style-type: none"> Blank screen on bootup 	4	Troubleshooting the Motherboard, Processor, and RAM
<ul style="list-style-type: none"> BIOS time and setting resets 	4	Troubleshooting the Motherboard, Processor, and RAM
<ul style="list-style-type: none"> Attempts to boot to incorrect device 	4	Troubleshooting the Motherboard, Processor, and RAM
<ul style="list-style-type: none"> Continuous reboots 	4	Troubleshooting the Motherboard, Processor, and RAM
<ul style="list-style-type: none"> No power 	4	Troubleshooting the Electrical System
<ul style="list-style-type: none"> Overheating 	4	Troubleshooting the Motherboard, Processor, and RAM
<ul style="list-style-type: none"> Loud noise 	4	Troubleshooting the Motherboard, Processor, and RAM
<ul style="list-style-type: none"> Intermittent device failure 	4	Troubleshooting the Motherboard, Processor, and RAM
<ul style="list-style-type: none"> Fans spin – no power to other devices 	4	Strategies to Troubleshoot Any Computer Problem
<ul style="list-style-type: none"> Indicator lights 	4	Troubleshooting the Electrical System
<ul style="list-style-type: none"> Smoke 	4	Strategies to Troubleshoot Any Computer Problem
<ul style="list-style-type: none"> Burning smell 	4	Strategies to Troubleshoot Any Computer Problem
<ul style="list-style-type: none"> Proprietary crash screens (BSOD/pin wheel) 	4	Troubleshooting the Motherboard, Processor, and RAM
<ul style="list-style-type: none"> Distended capacitors 	4	Troubleshooting the Motherboard, Processor, and RAM
<ul style="list-style-type: none"> Log entries and error messages 	4	Troubleshooting the Motherboard, Processor, and RAM

5.3 Given a scenario, troubleshoot hard drives and RAID arrays.

Objectives	Chapter	Primary Section
<ul style="list-style-type: none"> • Common symptoms <ul style="list-style-type: none"> - 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/pin wheel) - S.M.A.R.T. errors 	5	Troubleshooting Hard Drives
	5	Troubleshooting Hard Drives
	5	Troubleshooting Hard Drives
	5	Troubleshooting Hard Drives
	5	Troubleshooting Hard Drives
	5	Troubleshooting Hard Drives
	5	Troubleshooting Hard Drives
	5	Troubleshooting Hard Drives
	5	Troubleshooting Hard Drives
	5	Troubleshooting Hard Drives

5.4 Given a scenario, troubleshoot video, projector, and display issues.

Objectives	Chapter	Primary Section
<ul style="list-style-type: none"> • Common symptoms <ul style="list-style-type: none"> - VGA mode - No image on screen - Overheat shutdown - Dead pixels - Artifacts - Incorrect color patterns - Dim image - Flickering image - Distorted image - Distorted geometry - Burn-in - Oversized images and icons - Multiple failed jobs in logs 	6	Troubleshooting I/O Devices
	6	Troubleshooting I/O Devices
	6	Troubleshooting I/O Devices
	6	Troubleshooting I/O Devices
	6	Troubleshooting I/O Devices
	6	Troubleshooting I/O Devices
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	6	Troubleshooting I/O Devices
	6	Troubleshooting I/O Devices
	6	Troubleshooting I/O Devices
	6	Troubleshooting I/O Devices

5.5 Given a scenario, troubleshoot common mobile device issues while adhering to the appropriate procedures.

Objectives	Chapter	Primary Section
<ul style="list-style-type: none"> • Common symptoms <ul style="list-style-type: none"> - 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 - Touch screen non-responsive - Apps not loading - Slow performance - Unable to decrypt email 	6	Troubleshooting I/O Devices
	6	Troubleshooting I/O Devices
	6	Troubleshooting I/O Devices
	1	First Look at Laptop Components
	9	Troubleshooting Mobile Devices
	4	Troubleshooting the Electrical System
	6	Troubleshooting I/O Devices
	4	Troubleshooting the Electrical System
	6	Troubleshooting I/O Devices
	9	Troubleshooting Mobile Devices
	9	Troubleshooting Mobile Devices
	6	Troubleshooting I/O Devices
	9	Troubleshooting Mobile Devices
	9	Troubleshooting Mobile Devices
	9	Troubleshooting Mobile Devices
	9	Troubleshooting Mobile Devices

Objectives	Chapter	Primary Section
- Extremely short battery life	9	Troubleshooting Mobile Devices
- Overheating	9	Troubleshooting Mobile Devices
- Frozen system	9	Troubleshooting Mobile Devices
- No sound from speakers	9	Troubleshooting Mobile Devices
- GPS not functioning	9	Troubleshooting Mobile Devices
- Swollen battery	9	Troubleshooting Mobile Devices
• Disassembling processes for proper reassembly	1	First Look at Laptop Components
- Document and label cable and screw locations	1	First Look at Laptop Components
- Organize parts	1	First Look at Laptop Components
- Refer to manufacturer resources	1	First Look at Laptop Components
- Use appropriate hand tools	1	First Look at Laptop Components

5.6 Given a scenario, troubleshoot printers.

Objectives	Chapter	Primary Section
• Common symptoms	10	Troubleshooting Printers
- Streaks	10	Troubleshooting Printers
- Faded prints	10	Troubleshooting Printers
- Ghost images	10	Troubleshooting Printers
- Toner not fused to the paper	10	Troubleshooting Printers
- Creased paper	10	Troubleshooting Printers
- Paper not feeding	10	Troubleshooting Printers
- Paper jam	10	Troubleshooting Printers
- No connectivity	10	Troubleshooting Printers
- Garbled characters on paper	10	Troubleshooting Printers
- Vertical lines on page	10	Troubleshooting Printers
- Backed-up print queue	10	Troubleshooting Printers
- Low memory errors	10	Troubleshooting Printers
- Access denied	10	Troubleshooting Printers
- Printer will not print	10	Troubleshooting Printers
- Color prints in wrong print color	10	Troubleshooting Printers
- Unable to install printer	10	Troubleshooting Printers
- Error codes	10	Troubleshooting Printers
- Printing blank pages	10	Troubleshooting Printers
- No image on printer display	10	Troubleshooting Printers

5.7 Given a scenario, troubleshoot common wired and wireless network problems.

Objectives	Chapter	Primary Section
• Common symptoms	8	Troubleshooting Network Connections
- Limited connectivity	8	Troubleshooting Network Connections
- Unavailable resources	8	Troubleshooting Network Connections
○ Internet	8	Troubleshooting Network Connections
○ Local resources:	8	Troubleshooting Network Connections
○ Shares	8	Troubleshooting Network Connections
○ Printers	8	Troubleshooting Network Connections
○ Email	8	Troubleshooting Network Connections
- No connectivity	8	Troubleshooting Network Connections
- APIPA/link local address	8	Troubleshooting Network Connections
- Intermittent connectivity	8	Troubleshooting Network Connections
- IP conflict	8	Troubleshooting Network Connections
- Slow transfer speeds	8	Troubleshooting Network Connections
- Low RF signal	8	Troubleshooting Network Connections
- SSID not found	8	Troubleshooting Network Connections

Introduction: CompTIA A+ Core 1 Exam Guide to Computing Infrastructure

CompTIA A+ Core 1 Exam Guide to Computing Infrastructure, Tenth Edition was written to be the very best tool on the market today to prepare you to support users and their resources on networks, desktops, laptops, mobile devices, virtual machines, and in the cloud. The text has been updated to include the most current hardware and software technologies; this book takes you from the just-a-user level to the I-can-fix-this level for hardware, software, networks, and virtual computing infrastructures. It achieves its goals with an unusually effective combination of tools that powerfully reinforce both concepts and hands-on, real-world experiences. It also provides thorough preparation for the content on the new CompTIA A+ Core 1 Certification exam. Competency in using a computer is a prerequisite to using this book. No background knowledge of electronics or networking is assumed. An appropriate prerequisite course for this book would be a general course in computer applications.

This book includes:

- ▲ *Several in-depth, hands-on projects* at the end of each chapter that invite you to immediately apply and reinforce critical thinking and troubleshooting skills and are designed to make certain that you not only understand the material, but also execute procedures and make decisions on your own.
- ▲ *Comprehensive review and practice end-of-chapter material*, including a chapter summary, key terms list, critical thinking questions that focus on the type of scenarios you might expect on A+ exam questions, and real-world problems to solve.
- ▲ *Step-by-step instructions* on installation, maintenance, optimization of system performance, and troubleshooting.
- ▲ *A wide array of photos, drawings, and screenshots* support the text, displaying in detail the exact software and hardware features you will need to understand to set up, maintain, and troubleshoot physical and virtual computers and small networks.

In addition, the carefully structured, clearly written text is accompanied by graphics that provide the visual input essential to learning and to help students master difficult subject matter. For instructors using the book in a classroom, instructor resources are available online.

Coverage is balanced—while focusing on new technologies and software, including virtualization, cloud computing, and the Internet of Things, the text also covers the real world of an IT support technician, where some older technologies remain in widespread use and still need support. For example, the text covers M.2 motherboard slots and NVMe, the latest drive interface standard for SSDs, but also addresses how to install SSDs and magnetic hard drives using the older SATA interfaces. The text covers Android, iOS, Windows Mobile, and Chrome OS for mobile devices and Windows 10/8/7 for laptops and desktops. Other covered content that is new with the A+ Core 1 exam includes managed switches and VLANs.

This book provides thorough preparation for CompTIA's A+ Core 1 Certification examination. This certification credential's popularity among employers is growing exponentially, and obtaining certification increases your ability to gain employment and improve your salary. To get more information on CompTIA's A+ certification and its sponsoring organization, the Computing Technology Industry Association, see their website at www.comptia.org.

FEATURES

To ensure a successful learning experience, this book includes the following pedagogical features:

- ▲ **Learning Objectives.** Every chapter opens with a list of learning objectives that sets the stage for you to absorb the lessons of the text.
- ▲ **Comprehensive Step-by-Step Troubleshooting Guidance.** Troubleshooting guidelines are included in almost every chapter. In addition, Chapter 4 gives insights into general approaches to troubleshooting that help apply the specifics detailed in each chapter for different hardware and software problems. Chapters 8 and 9 also focus on troubleshooting networks and mobile devices.
- ▲ **Step-by-Step Procedures.** The book is chock-full of step-by-step procedures covering subjects from hardware installations and maintenance to troubleshooting a failed network connection and setting up a virtual machine.
- ▲ **Visual Learning.** Numerous visually detailed photographs, three-dimensional art, and screenshots support the text, displaying hardware, software, and virtualization features exactly as you will see them in your work.
- ▲ **CompTIA A+ Table of Contents.** This table of contents gives the chapter and section that provides the primary content for each certification objective on the A+ Core 1 exam. This is a valuable tool for quick reference.
- ▲ **Applying Concepts.** These sections offer real-life, practical applications for the material being discussed. Whether outlining a task, developing a scenario, or providing pointers, the Applying Concepts sections give you a chance to apply what you've learned to a typical computer or network problem, so you can understand how you will use the material in your professional life.

A+
CORE 1
220-1001

A+
CORE 2
220-1002

 Notes

 A+ Exam Tip

 Caution

 OS Differences

A+ Icons. All of the content that relates to CompTIA's A+ Core 1 Certification exam is highlighted with a green A+ icon. The icon notes the exam name and the objective number. This unique feature highlights the relevant content at a glance, so that you can pay extra attention to the material. Content that also applies to the A+ Core 2 (220-1002) exam is highlighted with a blue A+ icon.

Notes. Note icons highlight additional helpful information related to the subject being discussed.

A+ Exam Tip Boxes. These boxes highlight additional insights and tips to remember if you are planning to take the CompTIA A+ exams.

Caution Icons. These icons highlight critical safety information. Follow these instructions carefully to protect the computer and its data and to ensure your own safety.

OS Differences. These boxes point you to the differences among Windows 10, Windows 8, and Windows 7.

- ▲ **End-of-Chapter Material.** Each chapter closes with the following features, which reinforce the material covered in the chapter and provide real-world, hands-on testing:
 - ▲ **Chapter Summary:** This bulleted list of concise statements summarizes all major points of the chapter.
 - ▲ **Key Terms:** The content of each chapter is further reinforced by an end-of-chapter key term list. The definitions of all terms are included with this text in a full-length glossary.
 - ▲ **Thinking Critically Questions:** You can test your understanding of each chapter with a comprehensive set of “Thinking Critically” questions to help you synthesize and apply what you've learned in scenarios that test your skills at the same depth as the A+ exam.
 - ▲ **Hands-On Projects:** These sections give you practice using the skills you have just studied so that you can learn by doing and know you have mastered a skill.
 - ▲ **Real Problems, Real Solutions:** Each comprehensive problem allows you to find out if you can apply what you've learned in the chapter to a real-life situation.
- ▲ **Student Companion Site.** Additional content included on the companion website includes Electricity and Multimeters, and FAT Details. Other helpful online references include Frequently Asked Questions and a Computer Inventory and Maintenance form.

WHAT'S NEW IN THE TENTH EDITION

Here's a summary of what's new in the *Tenth Edition*:

- ▲ Content maps to all of CompTIA's A+ Core 1 exam.
- ▲ There is now more focus on A+, with non-A+ content moved online to the companion website or eliminated.
- ▲ The chapters focus on Windows 10 with some content about Windows 8/7.
- ▲ New content is added (all new content was also new to the A+ Core 1 exam).
 - ▲ Windows 10 is added. Operating systems covered now include Windows 10, Windows 8, and Windows 7. New content on mobile operating systems (Android, iOS, Windows Phone, and Chrome OS) is added.
 - ▲ Enhanced content on supporting mobile devices (including the Android OS, iOS, Windows Phone, and Chrome OS) is covered in Chapter 9.
 - ▲ New content on virtualization and cloud computing is covered in Chapter 10.
 - ▲ Hands-On Projects use virtual machines so that you get plenty of practice using this essential cloud technology.
 - ▲ New content on VLANs and managed switches is covered in Chapter 8.
 - ▲ The Internet of Things (IoT) and how to set up a smart home are covered in Chapter 9.
 - ▲ Content on supporting and troubleshooting laptops is integrated throughout the text.

FEATURES OF THE NEW EDITION

Chapter **objectives** appear at the beginning of each chapter, so you know exactly what topics and skills are covered.

A+ Exam Tips include key points pertinent to the A+ exams. The icons identify the sections that cover information you will need to know for the A+ certification exams.

CHAPTER 7

Setting Up a Local Network

After completing this chapter, you will be able to:

- Describe network types and the Internet connections they use
- Connect a computer to a wired or wireless network
- Configure and secure a multifunction router on a local network
- Troubleshoot network

In this chapter, you learn about the types of networks and the technologies used to build networks. You also learn to connect a computer to a network and how to set up and secure a small wired or wireless network.

This chapter prepares you to assume total responsibility for supporting both wired and wireless networks in a small office/home office (SOHO) environment. Later, you'll learn more about the hardware used in networking, including network devices, connectors, cabling, networking tools, and the types of networks used for Internet connections. Let's get started by looking at the types of networks you might encounter as an IT support technician and the types of connections they might use to connect to the Internet.

A+ Exam Tip Much of the content in this chapter applies to both the A+ Core 1 220-1001 exam and the A+ Core 2 220-1002 exam.

Caution When researching a problem, suppose you discover that Microsoft or a manufacturer's website offers a fix or patch you can download and apply. To get the right patch, recall you need to make sure you get a 32-bit patch for a 32-bit installation of Windows, a device driver, or an application. For a 64-bit installation of Windows, make sure you get a 64-bit device driver. An application installed in a 64-bit OS might be a 32-bit application or a 64-bit application.

>> HANDS-ON PROJECTS

Hands-On Project 2-1 Examining a Motherboard in Detail

1. Look at the back of a desktop computer. Without opening the case, list the ports that you believe come directly from the motherboard.
2. Remove the cover of the case, as you learned to do in Chapter 1. List the different expansion cards in the expansion slots. Was your guess correct about which ports come from the motherboard?
3. To expose the motherboard so you can identify its parts, remove all the expansion cards.
4. Draw a diagram of the motherboard and label these parts:
 - ▲ Processor socket
 - ▲ Chipset
 - ▲ RAM (each DIMM slot)
 - ▲ CMOS battery
 - ▲ Expansion slots (Identify the slots as PCI, PCIe ×1, PCIe ×4, or PCIe ×16.)
 - ▲ Each port coming directly from the motherboard
 - ▲ Power supply connections
 - ▲ SATA drive connectors
5. What is the brand and model of the motherboard?
6. Locate the manufacturer's website. If you can find the motherboard manual on the site, download it. Find the diagram of the motherboard in the manual and compare it with your diagram. Did you label components correctly?
7. Reassemble the computer, as you learned to do in Chapter 1.

Cautions identify critical safety information.

Hands-On Projects provide practical exercises at the end of each chapter so that you can practice the skills as they are learned.

Notes indicate additional content that might be of student interest or information about how best to study.

APPLYING CONCEPTS DISCOLORED CAPACITORS

Jessica complained to Wally, her IT support technician, that Windows was occasionally giving errors, data would get corrupted, or an application would not work as it should. At first, Wally suspected Jessica might need a little more training on how to open and close an application or save a file, but he discovered user error was not the problem. He tried reinstalling the application software Jessica most often used, and even reinstalled Windows, but the problems persisted.

Notes Catastrophic errors (errors that cause the system not to boot or a device not to work) are much easier to resolve than intermittent errors (errors that come and go).

Wally began to suspect a hardware problem. Carefully examining the motherboard revealed the source of the problem: failing capacitors. Look carefully at Figure 4-37 and you can see five bad **discolored capacitors** with bulging heads. (Know that sometimes a leaking capacitor can also show crusty corrosion at its base.) When Wally replaced the motherboard, the problems went away.

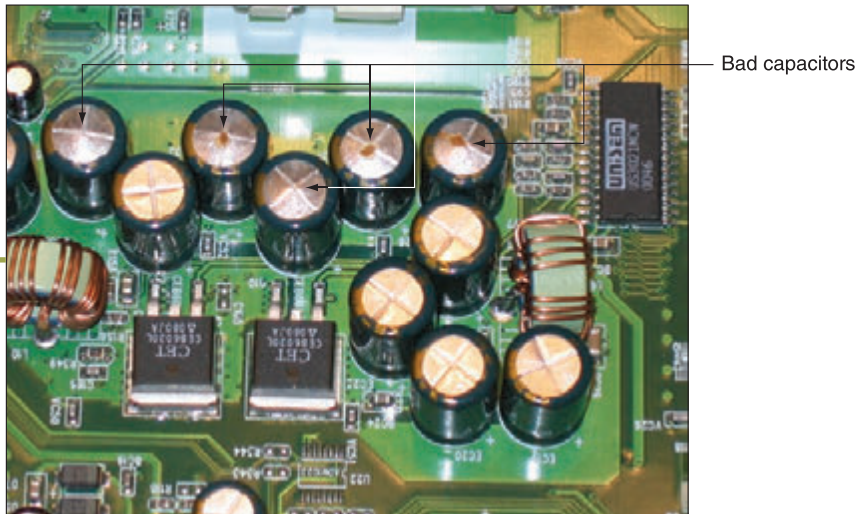


Figure 4-37 These five bad capacitors have bulging and discolored heads

Visual full-color graphics, photos, and screenshots accurately depict computer hardware and software components.

Applying Concepts sections provide practical advice or pointers by illustrating basic principles, identifying common problems, providing steps to practice skills, and encouraging solutions.

Chapter Summary bulleted lists of concise statements summarize all major points of the chapter, organized by primary headings.

>> CHAPTER SUMMARY

Exploring a Desktop Computer

- ▲ When hardware support technicians disassemble or reassemble a computer, it is important for them to stay organized, keep careful notes, and follow all the safety procedures to protect the computer equipment and themselves.
- ▲ Before opening a computer case, shut down the system, unplug it, disconnect all cables, and press the power button to drain residual power.
- ▲ Common tools for a computer hardware technician include an ESD strap, screwdrivers, tweezers, flashlight, compressed air, and cleaning solutions and pads.
- ▲ Special tools a hardware technician might need include a POST diagnostic card, power supply tester, multimeter, and loopback plugs.

>> KEY TERMS

For explanations of key terms, see the Glossary for this text.

4-pin 12-V connector	docking port	main board	screen orientation
8-pin 12-V connector	docking station	microATX (mATX)	serial ATA (SATA)
20-pin P1 connector	dual-voltage selector switch	microprocessor	serial port
24-pin P1 connector	DVI (Digital Video Interface) port	modem port	SO-DIMM (small outline DIMM)
airplane mode	electrostatic discharge (ESD)	Molex connector	spacers
all-in-one computer	Ethernet port	motherboard	SPDIF (Sony-Philips Digital Interface) sound port
analog	expansion card	multimeter	spudgers
ATX (Advanced Technology Extended)	external SATA (eSATA) port	netbook	standoffs
ATX12V power supply	firmware	network port	system board
audio ports		notebook	Thunderbolt 3 port
base station		optical connector	
		PCI Express (PCIe)	

>> THINKING CRITICALLY

These questions are designed to prepare you for the critical thinking required for the A+ exams and may use content from other chapters and the web.

1. You purchase a new desktop computer that does not have wireless capability, and then you decide that you want to use a wireless connection to the Internet. What are the two least expensive ways (*choose two*) to upgrade your system to wireless?
 - a. Trade in the computer for another computer that has wireless installed.
 - b. Purchase a second computer that has wireless capability.
 - c. Purchase a wireless expansion card and install it in your system.
 - d. Purchase a USB wireless adapter and connect it to the computer by way of a USB port.

Key Terms are defined as they are introduced and listed at the end of each chapter. Definitions can be found in the Glossary.

Thinking Critically sections require you to analyze and apply what you've learned.

>> REAL PROBLEMS, REAL SOLUTIONS**REAL PROBLEM 8-1** Setting Up a Wireless Access Point

As a computer and networking consultant to small businesses, you are frequently asked to find solutions to increasing demands for network and Internet access at a business. One business rents offices in a historical building that has strict rules for wiring. They have come to you asking for a solution for providing Wi-Fi access to their guests in the lobby of the building. Research options for a solution and answer the following questions:

1. Print or save webpages showing two options for a Wi-Fi wireless access point that can mount on the wall or ceiling. For one option, select a device that can receive its power by PoE from the network cable run to the device. For the other option, select a device that requires an electrical cable to the device as well as a network cable.
2. Print or save two webpages for a splitter that can be mounted near the second wireless access point and that splits the power from data on the network cable. Make sure the power connectors for the splitter and the access point can work together.
3. To provide PoE from the electrical closet on the network cable to the wireless access point, print or save the webpage for an injector that injects power into a network cable. Make sure the voltage and wattage output for the injector are compatible with the needs of both wireless access points.
4. You estimate that the distance for network cabling from the switch to the wireless access point is about 200 feet (61 meters). What is the cost of 200 feet of PVC CAT-6a cabling? For 200 feet of plenum CAT-6a cabling?
5. Of the options you researched, which do you recommend? Using this option, what is the total cost of the Wi-Fi hotspot?

REAL PROBLEM 8-2 Exploring Packet Tracer

In Chapter 7 you installed Packet Tracer and created a very basic network. In this project, you work through three chapters of the Packet Tracer Introduction course to take a brief tour of the simulator interface and create a more complex network in Packet Tracer. Notice in the Packet Tracer course that the activities refer to the OSI model instead of the TCP/IP model. Review the section entitled “Compare the TCP/IP Model and OSI Model” in this chapter for a brief refresher. Then complete the following steps to access your course:

1. Return to the Networking Academy website (netacad.com), sign in, and click **Launch Course**. You’ve already downloaded Packet Tracer, so you can skip Chapter 1.
2. Complete Chapters 2, 3, and 4, including the videos and labs, and complete the Packet Tracer Basics Quiz at the end of Chapter 4. The other chapters provide excellent information on Packet Tracer but are not required for this project. Answer the following questions along the way:
 - a. What is a simple PDU in Packet Tracer?
 - b. What is a .pka file?
 - c. Which window shows instructions for a lab activity?
 - d. Which Packet Tracer feature do you think will be most helpful for you in learning how to manage a network?

Real Problems, Real Solutions allow you to apply what you’ve learned in the chapter to a real-life situation.

WHAT'S NEW WITH COMPTIA® A+ CERTIFICATION

The CompTIA A+ certification includes two exams, and you must pass both to become CompTIA A+ certified. The two exams are Core 1 (220-1001) and Core 2 (220-1002).

Here is a breakdown of the domain content covered on the two A+ exams. This text covers content on the Core 1 (220-1001) exam. Content on the Core 2 (220-1002) exam is covered in the companion text, *CompTIA A+ Exam Guide to Operating Systems and Security*.

CompTIA A+ 220-1001 Exam	
Domain	Percentage of Examination
1.0 Mobile Devices	14%
2.0 Networking	20%
3.0 Hardware	27%
4.0 Virtualization and Cloud Computing	12%
5.0 Hardware and Network Troubleshooting	27%
Total	100%

CompTIA A+ 220-1002 Exam	
Domain	Percentage of Examination
1.0 Operating Systems	27%
2.0 Security	24%
3.0 Software Troubleshooting	26%
4.0 Operational Procedures	23%
Total	100%

INSTRUCTOR'S MATERIALS

Please visit *cengage.com* and log in to access instructor-specific resources on the Instructor Companion Site, which includes the Instructor's Manual, Solutions Manual, Test creation tools, PowerPoint Presentation, Syllabus, and figure files.

Instructor's Manual: The Instructor's Manual that accompanies this textbook includes additional instructional material to assist in class preparation, including suggestions for classroom activities, discussion topics, and additional projects.

Solutions: Answers to the end-of-chapter material are provided. These include the answers to the Thinking Critically questions and to the Hands-On Projects (when applicable), as well as Lab Manual Solutions.

Cengage Learning Testing Powered by Cognero: This flexible, online system allows you to do the following:

- ▲ Author, edit, and manage test bank content from multiple Cengage Learning solutions.
- ▲ Create multiple test versions in an instant.
- ▲ Deliver tests from your LMS, your classroom, or wherever you want.

PowerPoint Presentations: This book comes with Microsoft PowerPoint slides for each chapter. These are included as a teaching aid for classroom presentation, to make available to students on the network for chapter review, or to be printed for classroom distribution. Instructors, please feel at liberty to add your own slides for additional topics you introduce to the class.

Figure Files: All of the figures in the book are reproduced on the Instructor Companion Site. Similar to the PowerPoint presentations, these are included as a teaching aid for classroom presentation, to make available to students for review, or to be printed for classroom distribution.

TOTAL SOLUTIONS FOR COMPTIA A+

MINDTAP FOR A+ CORE 1 EXAM GUIDE TO COMPUTING INFRASTRUCTURE, TENTH EDITION

MindTap is an online learning solution designed to help students master the skills they need in today's workforce. Research shows employers need critical thinkers, troubleshooters, and creative problem-solvers to stay relevant in our fast-paced, technology-driven world. MindTap helps you achieve this with assignments and activities that provide hands-on practice, real-life relevance, and certification test prep. Students are guided through assignments that help them master basic knowledge and understanding before moving on to more challenging problems.

MindTap activities and assignments are tied to CompTIA A+ certification exam objectives. Live, virtual machine labs allow learners to practice, explore, and try different solutions in a safe, sandbox environment using real Cisco hardware and virtualized Windows, Linux, and UNIX operating systems. The Adaptive Test Prep (ATP) app is designed to help learners quickly review and assess their understanding of key IT concepts. Learners have the ability to test themselves multiple times to track their progress and improvement. The app allows them to filter results by correct answers, by all questions answered, or only by incorrect answers to show where additional study help is needed.

You can test students' knowledge and understanding with graded pre- and post-assessments that emulate the A+ certification exams. Module tests and review quizzes also help you gauge students' mastery of the course topics.

Readings and videos support the lecture, while "In The News" assignments encourage students to stay current with what's happening in the IT field. Reflection activities require students to problem-solve for a real-life issue they would encounter on the job and participate in a class discussion to learn how their peers dealt with the same challenge.

MindTap is designed around learning objectives and provides the analytics and reporting so you can easily see where the class stands in terms of progress, engagement, and completion rates. Use the content and learning path as is or pick and choose how our materials will wrap around yours. You control what the students see and when they see it. Learn more at <http://www.cengage.com/mindtap/>.

- ▲ Instant Access Code: (ISBN: 9780357108314)
- ▲ Printed Access Code: (ISBN: 9780357108321)

LAB MANUAL FOR A+ CORE 1 EXAM GUIDE TO COMPUTING INFRASTRUCTURE, TENTH EDITION

The Lab Manual, now part of your MindTap course, contains over 60 labs to provide students with additional hands-on experience and to help prepare for the A+ exam. The Lab Manual includes lab activities, objectives, materials lists, step-by-step procedures, illustrations, and review questions.

ACKNOWLEDGMENTS

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Thank you to all the people who took the time to voluntarily send encouragement and suggestions for improvements to the previous editions. Your input and help is very much appreciated. The reviewers of this edition provided invaluable insights and showed a genuine interest in the book's success. Thank you to:

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Kimberly Perez – Tidewater Community College

To the instructors and learners who use this book, we invite and encourage you to send suggestions or corrections for future editions. Please write to the author team at jean.andrews@cengage.com. We never ignore a good idea! And to instructors, if you have ideas for how to make a class in A+ Preparation a success, please share your ideas with other instructors! You can find us on Facebook at <http://www.facebook.com/JeanKnows>, where you can interact with the authors and other instructors.

This book is dedicated to the covenant of God with man on earth.

Jean Andrews, Ph.D.
Joy Dark
Jill West

ABOUT THE AUTHORS

Jean Andrews has more than 30 years of experience in the computer industry, including more than 13 years in the college classroom. She has worked in a variety of businesses and corporations designing, writing, and supporting application software; managing a help desk for computer support technicians; and troubleshooting wide area networks. She has written numerous books on software, hardware, and the Internet, including the best-selling *CompTIA A+ Core 1 Exam Guide to Computing Infrastructure, Tenth Edition*, and *CompTIA A+ Core 2 Exam Guide to Operating Systems and Security, Tenth Edition*. She lives in northern Georgia.

Joy Dark has worked in the IT field as a help-desk technician providing first-level support for a company with presence in 29 states, a second-tier technician in healthcare IT, and an operations specialist designing support protocols and structures. As a teacher, Joy has taught online courses in IT and has taught English as a Second Language in the United States and South America. She has helped write several technical textbooks with Jean Andrews. She also creates many photographs used in educational content. Joy lives in northwest Georgia with her two daughters and Doberman dog.

Jill West has taught K thru college using a flipped classroom approach, distance learning, hybrid teaching, and educational counseling. She currently teaches computer technology courses at Georgia Northwestern Technical College, both online and in the classroom. She regularly presents on CompTIA certification courses at state and national conferences and international webinars. Jill and her husband Mike live in northwest Georgia, where they homeschool their four children.

READ THIS BEFORE YOU BEGIN

The following hardware, software, and other equipment are needed to do the Hands-On Projects in each chapter:

- ▲ You need a working desktop computer and laptop that can be taken apart and reassembled. You also need a working computer on which you can install an operating system. These computers can be the same or different computers.
- ▲ Troubleshooting skills can better be practiced with an assortment of nonworking expansion cards that can be used to simulate problems.
- ▲ Windows 10 Pro is needed for most chapters.
- ▲ Internet access is needed for most chapters.
- ▲ Equipment required to work on hardware includes an ESD strap and flathead and Phillips-head screwdrivers. In addition, a power supply tester, cable tester, and can of compressed air are useful. Network wiring tools needed for Chapter 8 include a wire cutter, wire stripper, and crimper.
- ▲ An iOS or Android smartphone or tablet is needed for Chapter 9.
- ▲ A SOHO router that includes a wireless access point is needed for Chapter 7.

**Caution**

Before undertaking any of the lab exercises, starting with Chapter 1, please review the safety guidelines in Appendix A.

Taking a Computer Apart and Putting It Back Together

After completing this chapter, you will be able to:

- Disassemble and reassemble a desktop computer safely while being able to identify various external ports and major components inside a desktop and describe how they connect together and are compatible. You'll be able to identify various tools you will need as a computer hardware technician.
- Disassemble and reassemble a laptop computer safely while being able to identify various external ports and slots and major internal components of a laptop. You will know what special concerns need to be considered when supporting and maintaining laptops.

Like many other computer users, you have probably used your personal computer to play games, update your Facebook profile, write papers, or build Excel worksheets. This text takes you from being an end user of your computer to becoming an information technology (IT) support technician able to support all types of personal computers. The only assumption made here is that you are a computer user—that is, you can turn on your machine, load a software package, and use that software to accomplish a task. No experience in electronics is assumed.

As an IT support technician, you'll want to become A+ certified, which is the industry standard certification for IT support technicians. This text prepares you to pass the A+ 220-1001 Core 1 exam by CompTIA (comptia.org). Its accompanying text, "CompTIA A+ Core 2 Exam Guide to Operating Systems and Security," prepares you to pass the A+ 220-1002 Core 2 exam. Both exams are required by CompTIA for A+ certification.

In this chapter, you take apart and reassemble a desktop computer and laptop while discovering the various hardware components inside the cases. You'll also learn about the tools you'll need to work inside the case.

★ A+ Exam Tip As you work your way through a chapter, notice the green and blue A+ mapping icons underneath headings. These page elements help you know to which objectives on which exam the content applies. After studying each chapter, take a look at the grid at the beginning of this text and make sure you understand each objective listed in the grid for the chapter just completed.

Taking apart and servicing a computer are tasks that every A+ certified technician needs to know how to do. As part of your preparation to become A+ certified, try to find old desktop and laptop computers you can take apart. If you can locate the service manual for a laptop, you should be able to take it apart, repair it (assuming the parts are still available and don't cost more than the computer is worth), and get it up and running again. Have fun with this chapter and enjoy tinkering with these computers!

EXPLORING A DESKTOP COMPUTER

A+
CORE 1
2.8, 3.2,
3.3, 3.4,
3.5, 3.7,
5.5

In this part of the chapter, you learn how to take apart a desktop computer and put it back together. This skill is needed in this chapter and others as you learn to add or replace computer parts inside the case and perhaps even build a system from scratch. As you read the following steps, you might want to refer to the Hands-On Projects at the end of the chapter, which allow you to follow along by taking a computer apart. As you do so, be sure to follow all the safety precautions found in Appendix A. In the steps that follow, each major computer component is identified and described. You learn much more about each component later in the text. Take your time—*don't rush*—as you take apart a computer for the first time. It can be a great learning experience or an expensive disaster! As you work, pay attention to the details and work with care.

STEP 1: PLANNING AND ORGANIZING YOUR WORK AND GATHERING YOUR TOOLS

A+
CORE 1
5.5

When you first begin to learn how to work inside a computer case, make it a point to practice good organization skills. If you keep your notes, tools, screws, and computer parts well organized, your work goes more smoothly and is more fun. Here are some tips to keep in mind:

- ▲ As you work, make notes using pencil and paper and perhaps take photos with your cell phone so that you can backtrack later if necessary. (When you're first learning to take a computer apart, it's easy to forget where everything fits when it's time to put the computer back together. Also, in troubleshooting, you want to avoid repeating or overlooking things to try.)
- ▲ Remove loose jewelry that might get caught in cables and components as you work.
- ▲ To stay organized and not lose small parts, keep screws and spacers orderly and in one place, such as a cup or tray.
- ▲ Don't stack boards on top of each other: You could accidentally dislodge a chip this way. When you remove a circuit board or drive from a computer, carefully lay it on an antistatic mat or in an antistatic bag in a place where it won't get bumped.
- ▲ When handling motherboards, cards, or drives, don't touch the chips on the device. Hold expansion cards by the edges. Don't touch any soldered components on a card, and don't touch the edge connectors unless it's absolutely necessary. All this helps prevent damage from static electricity. Also, your fingerprints on the edge connectors can cause later corrosion.
- ▲ To protect a microchip, don't touch it with a magnetized screwdriver.
- ▲ Never, ever touch the inside of a computer that is turned on. The one exception to this rule is when you're using a multimeter to measure voltage output.
- ▲ Consider the monitor and the power supply to be "black boxes." Never remove the cover or put your hands inside this equipment unless you know about the hazards of charged capacitors and have been trained to deal with them. The power supply and monitor contain enough power to kill you, even when they are unplugged.
- ▲ As you work, remember to watch out for sharp edges on computer cases that can cut you.
- ▲ In a classroom environment, after you have reassembled everything, have your instructor check your work before you put the cover back on and power up.

TOOLS USED BY A COMPUTER HARDWARE TECHNICIAN

Every IT support technician who plans to repair desktop or laptop computers or mobile devices needs a handy toolbox with a few essential tools. Several hardware and software tools can help you maintain a computer and diagnose and repair computer problems. The tools you choose depend on the amount of money you can spend and the level of hardware support you expect to provide.



Figure 1-1 Tools used by IT support technicians when maintaining, repairing, or upgrading computers

Essential tools for computer hardware troubleshooting are listed here, and several of them are shown in Figure 1-1. You can purchase some of these tools in a computer toolkit, although most toolkits contain items you really can do without.

One of the more important tools is an ESD strap (also called a ground bracelet), which protects against ESD when working inside the computer case. **Electrostatic discharge (ESD)** is another name for static electricity, which can damage chips and destroy motherboards, even though it might not be felt or seen with the naked eye. Use the strap to connect or ground your hand to the case, as shown in Figure 1-2, and any static electricity between you and the case is dissipated.



Figure 1-2 An ESD strap, which protects computer components from ESD, can clip to the side of the computer case and eliminate ESD between you and the case

Here is a list of essential tools:

- ▲ An ESD strap (also called a ground bracelet)
- ▲ Flathead screwdriver
- ▲ Phillips-head or crosshead screwdriver

- ▲ Torx screwdriver set, particularly size T15
- ▲ Tweezers, preferably insulated ones, for picking pieces of paper out of printers or dropped screws out of tight places
- ▲ Software, including recovery CD or DVD for any operating system (OS) you might work on (you might need several, depending on the OSs you support), antivirus software on bootable CDs or USB flash drives, and diagnostic software

The following tools might not be essential, but they are very convenient:

- ▲ Cans of compressed air (see Figure 1-3), small portable compressor, or antistatic vacuum cleaner to clean dust from inside a computer case
- ▲ Cleaning solutions and pads such as contact cleaner, monitor wipes, and cleaning solutions for CDs and DVDs



Figure 1-3 A can of compressed air is handy to blow dust from a computer case

- ▲ Multimeter to check cables and the power supply output
- ▲ Power supply tester
- ▲ Needle-nose pliers for removing jumpers and for holding objects in place while you screw them in (especially handy for those pesky nuts on cable connectors)
- ▲ Cable ties to tie cables up and out of the way inside a computer case
- ▲ Flashlight to see inside the computer case
- ▲ AC outlet ground tester
- ▲ Network cable tester
- ▲ Loopback plugs to test ports
- ▲ Small cups or bags to help keep screws organized as you work
- ▲ Antistatic bags (a type of Faraday cage) to store unused parts
- ▲ Pen and paper for taking notes
- ▲ POST diagnostic cards

Notes It's important to know how to stay safe when working inside computers. Before opening a computer case and using the tools described in this section, be sure to read Appendix A. As you work inside a computer, follow all the safety guidelines discussed in this appendix.

Keep your tools in a toolbox designated for hardware troubleshooting. If you put discs and hardware tools in the same box, be sure to keep the discs inside a hard plastic case to protect them from scratches and dents. In addition, make sure the diagnostic and utility software you use is recommended for the hardware and software you are troubleshooting.

As you turn your attention to the disassembly of a desktop computer, you'll also learn about several IT support technician tools, including loopback plugs, diagnostic cards, power supply testers, and multimeters. Now that you've prepared your work area and tools, put on your ESD strap and let's get started with opening the computer case.

STEP 2: OPENING THE CASE

A+
CORE 1
2.8, 3.2,
3.3, 3.4,
3.5, 3.7,
5.5

Before we discuss the parts inside a desktop case, let's take a quick look at the outside of the case and the ports and switches on it.

WHAT'S ON THE OUTSIDE OF A DESKTOP CASE

A computer case for any type of computer is sometimes called the **chassis**, and it houses the power supply, motherboard, processor, memory modules, expansion cards, hard drive, optical drive, and other drives. A computer case can be a tower case, a desktop case that lies flat on a desk, an all-in-one case used with an all-in-one computer, or a mobile case used with laptops and tablets. A **tower case** (see Figure 1-4) sits upright; it can be as high as two feet and has room for several drives. Often used for servers, this type of case is also good for desktop computer users who anticipate upgrading because tower cases provide maximum space for working inside a computer and moving components around. A **desktop case** lies flat and sometimes serves double-duty as a monitor stand. Later in this chapter, you learn how to work inside a tower case, desktop case, laptop case, and all-in-one case.



© Courtesy of IN WIN Development, Inc.

Figure 1-4 This slimline tower case supports a microATX motherboard



Notes

Don't lay a tower case on its side when the computer is in use because the CD or DVD drive might not work properly. For the same reason, if a desktop case is designed to lie flat, don't set it on its end when the computer is in use.

Table 1-1 lists ports you might find on a desktop or mobile computer. Consider this table your introduction to these ports so that you can recognize them when you see them. Later in the text, you learn more about the details of each port.



A+ Exam Tip

The A+ Core 1 exam expects you to know how to identify the ports shown in Table 1-1.

Port	Description
	<p>A VGA (Video Graphics Array) port, also called a DB-15 port, DB15 port, HD15 port, or DE15 port, is a 15-pin, D-shaped, female port that transmits analog video. (Analog means a continuous signal with infinite variations as compared with digital, which is a series of binary values—1s and 0s.) All older monitors use VGA ports. (By the way, the HD15 [high-definition 15-pin] name for the port is an older name that distinguishes it from the early 9-pin VGA ports.)</p>
	<p>A DVI (Digital Video Interface) port transmits digital or analog video. Three types of DVI ports exist, which you learn about in Chapter 6.</p>
	<p>An HDMI (High-Definition Multimedia Interface) port transmits digital video and audio (not analog transmissions) and is often used to connect to home theater equipment.</p>
	<p>A DisplayPort transmits digital video and audio (not analog transmissions) and is slowly replacing VGA and DVI ports on personal computers.</p>
 <p data-bbox="215 1245 443 1323">Source: https://en.wikipedia.org/wiki/Thunderbolt_(interface)#/media/File:Thunderbolt_3_interface_USB-C_ports.jpg</p>	<p>A Thunderbolt 3 port transmits video, data, and power on the same port and cable and is popular with Apple computers. The port is shaped the same as the USB-C port and is compatible with USB-C devices. Up to six peripherals (for example, monitors and external hard drives daisy-chained together) can use the same Thunderbolt port.</p>
	<p>A system usually has three or more round audio ports, also called sound ports, for a microphone, audio in, audio out, and stereo audio out. These types of audio ports can transmit analog or digital data. If you have one audio cable to connect to a speaker or earbuds, plug it into the lime-green sound port in the middle of the three ports. The microphone uses the pink port.</p>
	<p>An SPDIF (Sony-Philips Digital Interface) sound port connects to an external home theater audio system, providing digital audio output and the best signal quality. SPDIF ports always carry digital audio and can work with electrical or optical cable. When connected to a fiber-optic cable, the port is called an optical connector.</p>
	<p>A USB (Universal Serial Bus) port is a multipurpose I/O port that comes in several sizes and is used by many different devices, including printers, mice, keyboards, scanners, external hard drives, and flash drives. Some USB ports are faster than others. Hi-Speed USB 2.0 is faster than regular USB, and Super-Speed USB 3.0 is faster than USB 2.0.</p>

Table 1-1 Ports used with desktop and laptop computers (continues)

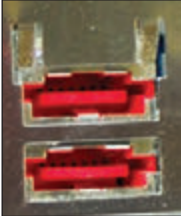

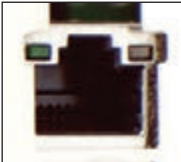
Port	Description
	An external SATA (eSATA) port is used by an external hard drive or other device using the eSATA interface.
	A PS/2 port , also called a mini-DIN port, is a round 6-pin port used by a keyboard or mouse. The ports look alike but are not interchangeable. On a desktop, the purple port is for the keyboard and the green port is for the mouse. Many newer computers use USB ports for the keyboard and mouse rather than the older PS/2 ports.
	An older serial port , sometimes called a DB9 port , is a 9-pin male port used on older computers. It has been mostly replaced by USB ports. Occasionally, you see a serial port on a router, where the port is used to connect the router to a device a technician can use to monitor and manage the router.
	A modem port , also called an RJ-11 port , is used to connect dial-up phone lines to computers. A modem port looks like a network port, but is not as wide. In the photo, the right port is a modem port and the left port is a network port shown for comparison.
	A network port , also called an Ethernet port or an RJ-45 port , is used by a network cable to connect to the wired network. Fast Ethernet ports run at 100 Mbps (megabits per second), and Gigabit Ethernet runs at 1000 Mbps or 1 Gbps (gigabits per second). A megabit is one million bits and a gigabit is one billion bits. A bit is a binary value of 1 or 0.

Table 1-1 Ports used with desktop and laptop computers (continued)

LOOPBACK PLUGS

A **loopback plug** is used to test a network port in a computer or other device to make sure the port is working. It might also test the throughput or speed of the port. Figure 1-5 shows a loopback plug testing a network port on a laptop. You know both the port and the network cable are good because the lights on either side of the port are lit. You can also buy a USB loopback plug to test USB ports.



Figure 1-5 A loopback plug testing a network port and network cable

WHAT'S INSIDE A DESKTOP CASE

Now that you're familiar with the outside of the case, let's open the case to see what is inside. Here are the steps to open a computer case:

1. **Back up important data.** If you are starting with a working computer, make sure important data is backed up first. Copy the data to an external storage device such as a flash drive or external hard drive. If something goes wrong while you're working inside the computer, at least your data will be safe.
2. **Power down the system and unplug it.** Remove discs from the optical drive. Then, power down the system and unplug the power, monitor, mouse, and keyboard cables, and any other peripherals or cables attached. Then, move these cables out of your way.

Caution When you power down a computer and even turn off the power switch on the rear of the computer case, know that residual power is still on. Some motherboards even have a small light inside the case to remind you of this fact and to warn you that power is still getting to the system. Therefore, be sure to always unplug the power cord before opening a case.

3. **Press and hold down the power button for a moment.** After you unplug the computer, press the power button for about three seconds to completely drain the power supply (see Figure 1-6). Sometimes when you do so, you'll hear the fans quickly start and go off as residual power is drained. Only then is it safe to work inside the case.



Figure 1-6 Press the power button after the computer is unplugged

4. **Have a plastic bag or cup handy to hold screws.** When you reassemble the computer, you will need to insert the same screws in the same holes. This is especially important with the hard drive because screws that are too long can puncture the hard drive housing, so be careful to label those screws clearly.

5. *Open the case cover.* Sometimes I think figuring out how to open a computer case is the most difficult part of disassembling. If you need help figuring it out, check the user manual or website of the case manufacturer. To remove the computer case cover, do the following:

- ▲ Some cases require you to start by laying the case on its side and removing the faceplate on the front of the case first. Other cases require you to remove a side panel first, and much older cases require you to first remove all the sides and top as a single unit. Study your case for the correct approach.
- ▲ Most cases have panels on each side that can be removed. It is usually necessary to remove only one panel to expose the top of the motherboard. To know which panel to remove, look at the port locations on the rear of the case. For example, in Figure 1-7, the ports on the motherboard are on the left side of the case, indicating the bottom of the motherboard is on the left. Therefore, you will want to remove the right panel to expose the top of the motherboard. Lay the case down to its left so that the ports and the motherboard are on the bottom. Later, depending on how drives are installed, it might become necessary to remove the other side panel in order to remove the screws that hold the drives in place.



Figure 1-7 Decide which side panel to remove

- ▲ Locate the screws or clips that hold the side panel in place. Be careful not to unscrew any screws besides these. The other screws probably are holding the power supply, fan, and other components in place (see Figure 1-8). Place the screws in the cup or bag used for that purpose. Some cases use clips on a side panel in addition to or instead of screws (see Figure 1-9).