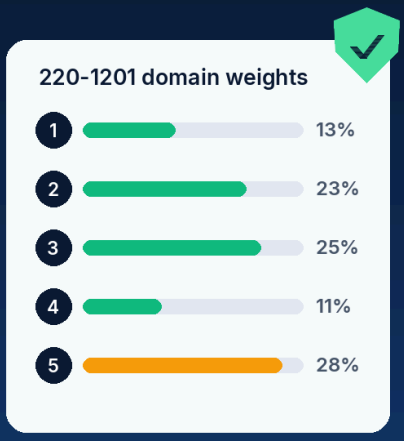
CERTIFICATION STUDY GUIDE

CompTIA A+ Core 1 Study Guide (220-1201): Every Objective Explained



Enterprise Techie

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CompTIA A+ Core 1 (220-1201) Study Guide

All five domains and 27 objectives, explained in plain English.

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This is a free study guide for the CompTIA A+ Core 1 exam, code 220-1201. It follows the official exam objectives in CompTIA's own order, domain by domain and objective by objective, and explains each topic in plain English, with reference tables for ports, Wi-Fi, cables, memory, RAID and cloud models.

A+ takes two exams. Core 1 covers hardware and networking, and Core 2 (220-1202) covers operating systems and security, according to CompTIA's A+ page, which also says they can be taken in any order. Core 2 has its own A+ Core 2 study guide.

The test details and domain weights come from CompTIA's A+ Core 1 V15 exam page and the Core 1 exam objectives (document version 4.0). Every technical fact after that links to the standards body or vendor that publishes it, and all sources are listed at the end.

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A+ Core 1 (220-1201) at a glance

Exam code	220-1201 (A+ Core 1, version V15)
Launch date	March 25, 2025
Number of questions	Maximum of 90
Question types	Multiple-choice (single and multiple response), drag-and-drop and performance-based
Time	90 minutes
Passing score	675 on a scale of 100 to 900
Recommended experience	12 months of hands-on experience as an IT support specialist
Languages	English, German and Japanese
Retirement	Usually three years after launch; CompTIA estimates 2028
To earn A+	Pass Core 1 and Core 2 (220-1202), both from the same version

CompTIA does not allow mixing versions, so both exams must be V15. Core 2 has the same 90-question maximum and 90-minute limit, with a passing score of 700. A+ is valid for three years from the certification date, and CompTIA's renewal policy lets holders renew through continuing education instead of retaking the exams.

How to use this guide

Core 1 has five domains, each with a share of the exam, and this guide spends its words in roughly the same proportion. The two right-hand columns are counted from the objectives document.

Domain	Share of exam	Objectives	"Given a scenario" objectives
1.0 Mobile Devices	13%	3	2
2.0 Networking	23%	8	1
3.0 Hardware	25%	8	4
4.0 Virtualization and Cloud Computing	11%	2	0
5.0 Hardware and Network Troubleshooting	28%	6	6
Total	**100%**	**27**	**13**

Troubleshooting is the largest domain at 28 percent, and all six of its objectives are scenario-based. Together with Hardware, the two hands-on domains make up 53 percent of the exam.

Each numbered heading below is one objective, reworded, and most end with an **Exam tip** where two ideas are easy to confuse. For the objective list on its own, covering both cores, see CompTIA A+ exam objectives explained. For practice questions, see the A+ practice test app.

The objectives document also prints CompTIA's troubleshooting method: identify the problem, form a theory of probable cause, test it, plan and carry out the fix, confirm the whole system works, and document the outcome. CompTIA states that the method itself is not tested, but it is the habit the Domain 5 scenarios reward.

Domain 1: Mobile Devices (13%)

Laptops, phones and tablets: the parts inside them, what plugs into them, and how they get online and stay managed. Three objectives, two of them scenario-based.

1.1 Laptop and mobile hardware: watching for wear and replacing parts

This objective is about knowing which parts of a portable device can be replaced and what to watch as they wear: the battery, keyboard, memory, storage, wireless cards, Wi-Fi antenna, cameras, microphones and the biometric and near-field sensors.

Batteries wear out by design. Apple calls all rechargeable batteries consumable components that become less effective as they chemically age, and its iPhone battery page explains that Maximum Capacity measures the battery against its capacity when new. Apple designs iPhone 14 and earlier batteries to keep 80 percent of original capacity at 500 complete charge cycles, and iPhone 15 and later at 1,000 cycles, under ideal conditions. A battery well below that, or one that is visibly swelling, is a replacement job.

Laptops take the smaller SODIMM memory module, while desktops take full-size DIMMs (see 3.3). Laptop storage is either a 2.5-inch drive or an M.2 card (see 3.4), so check which one the bay or slot accepts before ordering.

Wireless cards connect to antenna leads that run elsewhere in the chassis, so reconnecting those leads is part of any card or display swap, and a weak signal right after a repair is a reason to check them first. Camera and microphone complaints are usually checked in software before the hardware: privacy permissions, a physical shutter or switch, and drivers. Fingerprint readers, face sensors and the near-field scanner used for contactless payment are the physical privacy and security components in the list.

Exam tip: SODIMM and DIMM modules are not interchangeable, even within one DDR generation. Their sizes and pin counts differ, so laptop memory fits only laptop slots.

1.2 Mobile accessories and the ways they connect

Method	What to know
USB-C	A reversible connector: USB-IF's guidelines say it does not matter which side of the plug goes in. USB-IF also states that USB Type-C is not USB 3.2 or USB4: the shape says nothing about speed.
microUSB and miniUSB	Smaller USB connectors found on older phones, cameras and peripherals.
Lightning	Apple's connector on earlier iPhones and many accessories. Apple says iPhone 15 and later models have a USB-C connector instead.
NFC	Short-range radio at 13.56 MHz with a typical range of up to 2 cm, according to the NFC Forum. Used for contactless payment and tap-to-pair with Bluetooth accessories.
Bluetooth	Radio in the unlicensed 2.4 GHz ISM band. Bluetooth Classic is mainly used for wireless audio, and Bluetooth Low Energy is designed for very low power operation (Bluetooth SIG).
Tethering and hotspot	Sharing a phone's cellular data with other devices. Apple's Personal Hotspot shares it over Wi-Fi, Bluetooth or USB.

The accessories in the objective are the stylus, headsets, speakers and webcams, plus pointing devices: trackpads, drawing pads and the track point, the small pointing stick set between the keys

on some laptop keyboards. Docking stations and port replicators both turn a single laptop connection into desk-side ports for displays, wired networking and USB devices; a docking station is generally the fuller-featured of the two.

Exam tip: treat USB-C as a shape. The same connector can run at USB 2.0's 480 Mbps or at USB4 rates, so a slow transfer over USB-C usually comes down to the port or cable rating.

1.3 Getting mobile devices online and supporting their apps

Cellular data comes in generations. 5G is the system 3GPP defines from Release 15 onward, and it supports almost all of the features of 4G LTE. Cellular data can be switched off on the device, which matters on plans with data caps, because background sync of mail, photos and cloud storage can use up an allowance unnoticed.

The SIM identifies the subscriber to the carrier. Apple describes an eSIM as an industry-standard digital SIM built into the iPhone, which removes the need for a physical card, and says one iPhone can manage up to eight or more eSIMs.

Bluetooth pairing follows the same pattern everywhere. In Apple's steps: turn on Bluetooth, make the accessory discoverable using its own instructions, tap its name when it appears, and enter a PIN or passcode if asked. Then test it by playing audio, typing or making a call.

Location services combine several sources. Apple's Location Services uses cellular, Wi-Fi, GPS and Bluetooth information, which is why the objective lists both GPS and cellular location services.

Mobile device management (MDM) is how an organization enrolls and controls devices. In Microsoft Intune, MDM manages the whole device, including settings, security and apps, and can wipe it if it is lost. Mobile application management (MAM) manages only the work apps and their data, which Microsoft says is typical for personal devices in bring-your-own-device (BYOD) setups. Either way, policies push required settings and corporate applications to the device. Synchronization then keeps mail, calendars, contacts and files the same across devices through the work or personal cloud account.

Exam tip: MDM controls the whole device; MAM controls only the work apps on it. A BYOD scenario that must leave personal data untouched points to app-level management.

Domain 2: Networking (23%)

Ports, Wi-Fi, network services, and the hardware and settings of a small office or home network. Eight objectives, one scenario-based.

2.1 TCP and UDP: port numbers, protocols and what each one does

TCP, defined in RFC 9293, provides a reliable, in-order byte stream between two hosts. UDP, defined in RFC 768, sends messages with a minimum of protocol mechanism and makes no promise of

delivery or duplicate protection; the RFC itself says applications that need ordered, reliable delivery should use TCP.

Port	Protocol	Transport	Used for
20, 21	FTP	TCP	File transfer: 21 carries commands, 20 is the server's default data port (RFC 959)
22	SSH	TCP	Encrypted remote login (RFC 4253)
23	Telnet	TCP	Remote terminal sessions (RFC 854)
25	SMTP	TCP	Sending and relaying mail (RFC 5321)
53	DNS	UDP and TCP	Name resolution (RFC 1035)
67, 68	DHCP	UDP	Clients send to server port 67; servers reply to client port 68 (RFC 2131)
80	HTTP	TCP	Web traffic (RFC 9110)
110	POP3	TCP	Retrieving mail from a server mailbox (RFC 1939)
137 to 139	NetBIOS/NetBT	137 names, 138 datagrams (UDP), 139 sessions (TCP)	Legacy Windows naming and file sharing (RFC 1002)
143	IMAP	TCP	Managing mail kept on the server (RFC 9051)
389	LDAP	TCP	Directory queries (RFC 4511)
443	HTTPS	TCP	HTTP over TLS (RFC 9110, RFC 2818)
445	SMB/CIFS	TCP	Windows file and printer sharing (Microsoft)
3389	RDP	TCP and UDP	Remote Desktop (Microsoft)

The IANA port registry lists most of these numbers for both TCP and UDP, but each protocol's specification decides which is used; IANA even marks UDP 143 as reserved. Microsoft notes that shares using SMB2 or later do not use NetBIOS ports 137 to 139, so TCP 445 is the port modern SMB needs.

Exam tip: DNS uses both transports. RFC 1035 sends ordinary queries over UDP 53 and zone transfers over TCP 53, and RFC 7766 requires DNS software to support TCP. DHCP runs only over UDP.

2.2 Wireless networking: bands, channels and standards

Wi-Fi uses three bands. Cisco's RF reference guide explains that 2.4 GHz travels farther than 5 GHz but is crowded with non-Wi-Fi interference (see 5.5). In 2.4 GHz, channels are 20 MHz wide and only

1, 6 and 11 avoid overlapping; in the U.S. they are the only three for non-interfering use. 5 GHz has twenty-three 20 MHz channels; 6 GHz, from 5925 to 7125 MHz, adds fifty-nine.

Bonding joins channels into 40, 80 and 160 MHz, and 320 MHz for Wi-Fi 7 in 6 GHz, per the Wi-Fi Alliance. Cisco does not recommend bonding in 2.4 GHz for enterprise networks. Regulations decide which channels can be used: in the U.S., part of the 5 GHz band (UNII-2) is shared with radar, so access points there must use Dynamic Frequency Selection (DFS).

IEEE standard	Wi-Fi Alliance name	Bands
802.11a	None	5 GHz
802.11b	None	2.4 GHz
802.11g	None	2.4 GHz
802.11n	Wi-Fi 4	2.4 and 5 GHz
802.11ac	Wi-Fi 5	5 GHz (most Wi-Fi 5 products are dual-band, adding 2.4 GHz)
802.11ax	Wi-Fi 6, and Wi-Fi 6E in the 6 GHz band	2.4, 5 and 6 GHz
802.11be	Wi-Fi 7	2.4, 5 and 6 GHz

The Wi-Fi Alliance introduced the generation names for 802.11n, 802.11ac and 802.11ax, and bases Wi-Fi 7 on 802.11be; the older bands come from Cisco. Bluetooth shares 2.4 GHz with Wi-Fi (2.402 to 2.480 GHz, per the Bluetooth SIG). RFID uses radio to identify tagged items, and the NFC Forum notes that NFC devices can work with ISO/IEC 14443 contactless cards.

Exam tip: Wi-Fi 6E is not a separate IEEE standard. It is 802.11ax extended into the 6 GHz band; the next standard is 802.11be, sold as Wi-Fi 7.

2.3 Services that networked hosts provide

Role	What it does
DNS server	Answers name lookups with records such as an A record's host address (RFC 1035)
DHCP server	Leases IP addresses, subnet mask and default gateway (Microsoft Learn)
File share and print server	Hold shared files (SMB on Windows), print queues and drivers
Mail server	Sends mail with SMTP and serves mailboxes over IMAP or POP3
Syslog	Collects event notification messages from devices (RFC 5424)
Web and database servers	Serve sites over HTTP(S); store data applications query
AAA	Authentication identifies the user, authorization decides what that user may access, and accounting measures the resources used (Cisco)
NTP	Synchronizes computer clocks across a network (RFC 5905)

Among internet appliances, a spam gateway filters mail before the mail server, a unified threat management (UTM) appliance combines several security functions, and a load balancer spreads requests across servers. A proxy server, in the definition NIST's glossary carries, services client requests by forwarding them to other servers. NIST describes SCADA as a computerized system that gathers and processes data and applies operational controls over long distances, as in power transmission and pipelines, and IoT devices as user or industrial devices connected to the internet.

Exam tip: authentication proves who someone is, authorization decides what that person may do, and accounting records what was used.

2.4 Common network settings: DNS records, DHCP, VLANs and VPNs

DNS record	What it holds
A	A host's IPv4 address (RFC 1035)
AAAA	A single IPv6 address (RFC 3596)
CNAME	An alias, pointing to the canonical name (RFC 1034)
MX	The mail exchange for a domain, with a preference value where lower is preferred (RFC 1035)
TXT	Text strings, used to publish SPF, DKIM and DMARC records

Those three TXT-based records fight spoofed mail. SPF (RFC 7208) lets a domain authorize the hosts allowed to use its name in mail. DKIM (RFC 6376) signs each message, and the receiver checks the signature with a public key fetched from the signer's domain. DMARC, now RFC 9989, which made

RFC 7489 obsolete, lets the domain owner say how failing mail should be handled and ask for reports.

In DHCP, per Microsoft Learn, the scope is the pool of addresses handed out, exclusions are addresses never offered, a reservation ties one address to one client, and the lease is how long a client may use an address before renewing. A VLAN splits one switched network into separate logical networks under IEEE 802.1Q. A VPN, in NIST SP 800-113's words, is a virtual network built on top of existing networks that provides a secure communications mechanism.

Exam tip: a CNAME points to a name, while A and AAAA records point to addresses. An MX record also names a host, not an IP address.

2.5 Networking hardware and how the devices differ

Cisco's short version: switches let devices on a network communicate, and routers let different networks communicate. An unmanaged switch needs no configuration; a managed switch adds security and features. An access point joins wireless clients to the wired network, and a patch panel terminates building cable runs. A firewall, per NIST SP 800-12, is a gateway that limits access between networks in line with local security policy.

PoE name	IEEE standard	Type	Maximum power
PoE	802.3af	Type 1	15.4 W
PoE+	802.3at	Type 2	30 W
PoE++	802.3bt	Type 3	60 W
4PPoE	802.3bt	Type 4	90 W

PoE figures are from Cisco's PoE guide; power comes from a PoE switch or an injector, an inline unit that powers one cable. At the edge, a cable modem serves cable broadband, which CableLabs describes as running over hybrid fiber coax networks; a DSL modem serves digital subscriber line service; and an optical network terminal (ONT) is where fiber service ends at the premises. Every network interface card has a MAC address, which the IEEE Registration Authority calls an EUI-48 when it is a 48-bit universally unique address, typically built from a 24-bit OUI assigned to the manufacturer.

Exam tip: 802.3af is 15.4 W, 802.3at is 30 W, and 802.3bt covers both 60 W (Type 3) and 90 W (Type 4).

2.6 Setting up a small office or home network

Term	Meaning
Private IPv4	10.0.0.0/8, 172.16.0.0/12 and 192.168.0.0/16, set aside for private networks by RFC 1918
Public IPv4	Globally unique, internet-reachable addresses; a SOHO router shares one through NAT
IPv6	128-bit addresses written as eight hexadecimal groups, where "::" can replace one run of zero groups, once per address (RFC 4291)
APIPA	169.254.0.0/16: a host gives itself an address here for local-link use when no other configuration method is available (RFC 3927)
Static or dynamic	Entered by hand, or leased from a DHCP server
Subnet mask	Marks the network part of an IPv4 address
Gateway	The router address used to reach other networks; DHCP delivers it as the Router option (Microsoft Learn)

Servers and printers generally get static addresses or reservations; laptops and phones take dynamic ones.

Exam tip: a 169.254.x.x address means the host never heard back from a DHCP server. The fix is upstream: the cable, the Wi-Fi association or the DHCP server itself.

2.7 Internet connection types and network types

The objective lists six internet connection types: fiber to an ONT, cable over hybrid fiber coax, DSL over telephone lines, cellular 4G or 5G through a hotspot or cellular router, satellite where wired service does not reach, and a wireless internet service provider (WISP) over fixed radio links.

Network type	Scope
PAN	The devices around one person, such as Bluetooth accessories
LAN and WLAN	One building or site, wired or wireless; WLAN is the subject of the IEEE 802.11 working group
MAN	Across a city or campus
WAN	Links between sites over long distances
SAN	A network whose primary purpose is moving data between computer systems and storage devices (SNIA)

Exam tip: SAN describes what the network carries, storage traffic, while LAN, MAN and WAN describe how far it reaches.

2.8 Networking tools and what each is for

Tool	Used to
Crimper	Attach RJ45 or RJ11 plugs to a cable
Cable stripper	Remove the outer jacket without nicking the wires
Punchdown tool	Seat wires into a punchdown block, patch panel or keystone jack
Cable tester	Check a finished cable for continuity and wiring faults
Toner probe	Trace a cable with a tone generator and probe; Fluke's Pro3000 works on non-active networks
Wi-Fi analyzer	Show nearby networks, their channels and signal strength
Loopback plug	Send a port's output back into its input to test the port
Network tap	Copy the traffic crossing a link to a monitoring tool

Exam tip: a cable tester answers whether a cable is wired correctly; a toner probe answers which cable is which.

Domain 3: Hardware (25%)

Displays, cables, memory, storage, motherboards, power and printers. Eight objectives, four of them scenario-based.

3.1 Display types and the attributes that describe them

Type	Known for (HP)
IPS (LCD)	Consistent color and brightness from almost any angle
TN (LCD)	Fast pixel response and low cost, with the weakest color and viewing angles
VA (LCD)	High contrast, commonly 3,000:1 or higher
OLED	Pixels make their own light, no backlight, true blacks
Mini-LED	An LCD with a backlight of thousands of very small LEDs, using full-array local dimming

The table summarizes HP's panel guide. A touch screen pairs the display with a digitizer, the layer that turns touches into positions, and the two can fail separately. Resolution is the pixel count, pixel density is pixels per inch, refresh rate is how many times per second the image is redrawn, and color gamut is the range of colors shown. Apple's Studio Display XDR specifications list all four: 5120-by-2880 resolution at 218 pixels per inch, 120Hz, P3 and Adobe RGB color gamuts, with a Mini-LED backlight of 2304 dimming zones.

Exam tip: OLED has no backlight; Mini-LED is still an LCD, with a finer, locally dimmed backlight.

3.2 Cable types, their connectors and what they are for

Copper category	What it supports
Cat 5 and Cat 5e	Gigabit Ethernet (1000BASE-T) up to 100 meters
Cat 6	Gigabit up to 100 meters; 10GBASE-T up to 55 meters on unshielded cable
Cat 6A	10GBASE-T up to 100 meters

The distances come from Cisco's switch module data sheet. T568A and T568B are the two color orders for wiring an RJ45 plug; the same order on both ends makes a straight-through cable. A crossover cable connects pin 1 at one end to pin 3 at the other and pin 2 to pin 6, per Cisco's hardware guide, but ports with auto-MDIX detect the cable type and adjust. Shielded twisted pair (STP) adds foil or braid against interference; unshielded (UTP) is the everyday cable. Direct burial cable goes in the ground, and plenum-rated cable is made for air-handling spaces.

Multimode fiber has a 62.5 or 50 micron core and suits shorter runs: in Cisco's data sheet, 10GBASE-SR reaches 300 meters over OM3 multimode and 10GBASE-LR 10 kilometers over single-mode. Per Fluke Networks, ST uses a bayonet design, SC is square with a push-pull action, and LC is the small one, with a 1.25 mm ferrule and a latch.

Peripheral or video cable	Key facts
USB 2.0	Up to 480 Mbps (USB-IF)
USB 3.0	SuperSpeed USB (Intel), 5Gbps, now named USB 3.2 Gen 1 by USB-IF
USB-C	Reversible connector for USB 2.0 through USB4, video, and USB Power Delivery up to 240W (USB-IF)
Thunderbolt	USB-C connector; Thunderbolt 4 at 40 Gbps, Thunderbolt 5 up to 80 Gbps both ways or 120 Gbps with Bandwidth Boost (Intel)
Serial	DB9, a 9-pin D-shell connector (CompTIA's acronym list)
HDMI	Digital video and audio; Ultra High Speed cables carry up to 48Gbps, HDMI 2.2 up to 96Gbps (HDMI.org)
DisplayPort	Digital video and audio; DisplayPort 2.1 UHBR20 cables carry four 20 Gbps lanes, 80 Gbps total (VESA)
DVI and VGA	Video only, no audio; DVI is digital and VGA analog (Dell)

SATA connects internal drives and eSATA external ones; SATA-IO names its generations SATA 1.5Gb/s, 3Gb/s and 6Gb/s and asks vendors not to say "SATA III". RJ45 is Ethernet and RJ11 the

smaller modem jack, as Dell's port guide labels it. Molex is the older peripheral power connector, now optional in Intel's ATX design guide. The list also names F-type, punchdown blocks and adapters.

Exam tip: HDMI and DisplayPort carry audio; DVI and VGA do not. A monitor on DVI with no sound is working as designed.

3.3 Memory: module sizes, DDR generations, ECC and channels

Generation	Desktop DIMM	Laptop SODIMM
DDR3	240 pins	204 pins
DDR4	288 pins	260 pins
DDR5	288 pins	262 pins

DDR3 and DDR4 figures come from the module specifications in JEDEC Standard 21C, which gives DDR4 modules a 1.2 V supply. DDR5 figures come from Kingston's DDR5 overview: DDR5 runs at 1.1 V, splits each module into two independent 32-bit subchannels, and moves the key notch so a module cannot go into an incompatible socket. ECC (error-correcting code) modules add extra bits so ECC-capable server and workstation processors can correct errors on the fly. DDR5's on-die ECC is different: Kingston explains it corrects errors inside each DRAM chip but not on the bus to the memory controller.

For channels, Intel's datasheet explains that dual-channel modes need a module in both channels; with equal capacity in each, the controller runs in symmetric (interleaved) mode for the best performance. In every mode, memory runs at the frequency of the slowest module installed.

Exam tip: pin count does not separate DDR4 from DDR5 desktop memory, since both have 288 pins. Check the notch and the label.

3.4 Storage devices, interfaces and RAID

Hard drives come in 2.5-inch and 3.5-inch sizes, with spindle speed in revolutions per minute: WD's Blue 2.5-inch laptop drives are a 5400 RPM class, and Seagate's 3.5-inch Exos 7E2 spins at 7200 RPM.

SSD interface or form factor	What it means
SATA	The hard drive interface, now at SATA 6Gb/s
NVMe	The register interface and command set for storage attached over PCI Express (NVM Express)
PCIe	The bus NVMe drives use; modern M.2 SSDs use four lanes (Intel)
SAS	Serial Attached SCSI, a drive interface used in servers
M.2	A card form factor: 2280 means 22 mm wide and 80 mm long. SATA drives tend to use B-key cards, four-lane PCIe drives M-key cards (Dell)
mSATA	Mini-SATA, a small card form factor for SATA SSDs

RAID level	How it works	Minimum drives	Drive failures survived
RAID 0	Striping for performance; no redundancy	2	None
RAID 1	Mirroring in real time	2	One
RAID 5	Striping with parity	3	One
RAID 6	Striping with two parity blocks	4	Any two
RAID 10	RAID 1 mirrors, striped together as RAID 0	4	At least one

The levels and minimums come from Intel's RAID volume guide, Intel on RAID 6 and Dell's RAID table. Intel's capacity examples: four 120 GB drives in RAID 0 appear as one 480 GB drive, and RAID 5 makes up to 75 percent of capacity usable. Removable storage covers flash drives, memory cards (Apple's Mac SD slot reads SD, SDHC, SDXC, MMC and UHS-II cards) and optical drives.

Exam tip: RAID keeps data available when a drive fails, but mirroring copies a deletion to both drives at once, so backups are still needed.

3.5 Installing and configuring motherboards, CPUs and expansion cards

Form factor	Size	Typical memory slots
ATX	12 by 9.6 inches	Four
microATX	9.6 by 9.6 inches	Four
Mini-ITX	6.7 by 6.7 inches	Two

Sizes are from Intel's motherboard guide; smaller boards fit ATX case mounting holes. Slots are the older PCI and current PCIe, which Intel explains comes in x1, x2, x4, x8 and x16 widths, graphics cards usually taking the top x16; rates double each generation, from 8 GT/s (PCIe 3.0) to 16 GT/s (4.0) and 32 GT/s (5.0), all backward compatible. Boards also carry power connectors, SATA and eSATA

ports, M.2 slots and headers. A CPU fits only a board with the matching AMD or Intel socket, and multisocket server boards hold two or more CPUs.

BIOS and UEFI settings cover boot options, USB permissions, fans, temperatures and passwords: a boot password guards startup, a BIOS password the settings. Secure Boot, in Microsoft's description, is an industry standard that makes a device boot only software the manufacturer trusts, with firmware checking each boot component's signature. Windows 11 requires Secure Boot capable UEFI and TPM version 2.0, and the same page notes that a Hyper-V host needs VT-x and VT-d virtualization enabled in the BIOS.

A TPM is a tamper-resistant crypto-processor chip that generates, stores and limits the use of keys and records boot measurements; a hardware security module, per NIST, is a physical device that safeguards and manages keys and performs cryptographic processing. Windows PCs traditionally use x86 and x64 processors; ARM is a RISC design (Arm), and on Arm devices x86 and x64 apps run under emulation. Intel's Hyper-Threading lets one physical core work like two logical cores.

Expansion cards add sound, graphics, capture or networking. Cooling uses fans, a heat sink or liquid, with thermal paste or pads between chip and cooler; Intel's thermal guide says that thermal interface material provides conductivity between the processor's heat spreader and the heat sink.

Exam tip: Secure Boot checks signatures; the TPM stores keys and boot measurements. Blocking an unsigned bootloader is a Secure Boot job.

3.6 Choosing and installing the right power supply

A power supply turns wall AC into DC for the components. Intel's ATX design guide specifies two input ranges, 90 to 135 VAC around 115 V and 180 to 265 VAC around 230 V, at 47 to 63 Hz, covering the objective's 110 to 120 VAC and 220 to 240 VAC inputs. Its 24-pin main connector carries +3.3 V, +5 V and +12 V, plus -12 V and +5 V standby. A 20+4 pin connector is that 24-pin plug with four detachable pins for older 20-pin boards.

A redundant supply keeps running if one module fails, and a modular supply lets unused cables be detached. Choose a wattage rating above the system's total draw. 80 PLUS certifies energy efficiency, requiring at least 80 percent at 10, 20, 50 and 100 percent of rated load, with higher tiers that include Bronze, Silver, Gold, Platinum and Titanium.

Exam tip: wattage is a ceiling. A larger supply only adds headroom; the parts still draw what they need.

3.7 Deploying and configuring printers and multifunction devices

Pick a spot with power, ventilation, a network connection and a stable surface, then remove all packing tape and shipping locks. Install the driver for the operating system and the printer language: PCL and PostScript are both page description languages, HP's universal print driver comes in PCL 6 and PostScript versions, and Adobe describes PostScript as the first device-independent page

description language. Update the firmware, connect by USB, Ethernet or wireless, and share it directly or through a print server.

Settings include duplex (both sides), orientation (portrait or wide), tray assignments and quality. Security covers user authentication and badge readers at the device, audit logs, and secured prints that wait until the owner signs in. Scan services send to email, an SMB share or a cloud service, and the automatic document feeder (ADF) pulls a stack through while the flatbed takes single sheets and books.

Exam tip: scan to an SMB share needs the share path and an account with write permission; scan to email needs the device's SMTP settings.

3.8 Printer maintenance by printer type

Type	How it prints	Maintenance
Laser	Toner bonded to the page by a fuser	Replace toner; fit a maintenance kit (HP's centers on a new fuser and refreshes the pick rollers); calibrate; clean
Inkjet	Ink from cartridges through a printhead	Clean the printhead when a nozzle check shows gaps or faint lines (Epson), replace cartridges, calibrate, clear jams
Thermal	A heated printhead discolors heat-sensitive paper, with no ribbon (Zebra)	Replace paper, clean the heating element, remove debris from the feed assembly
Impact	Print pins strike through a ribbon, so multipart forms print in one pass; Epson's 9-pin FX-890II handles forms up to 7 pages thick	Replace the ribbon, printhead and paper

Exam tip: direct thermal printers use no ribbon or ink, so faint output points to the paper or the printhead.

Domain 4: Virtualization and Cloud Computing (11%)

The smallest domain: two objectives, neither scenario-based, on what virtual machines are for and how cloud services are described.

4.1 Virtualization: why it is used and how it runs

A virtual machine runs a complete operating system on virtual hardware. The objective lists the reasons: a sandbox for running something risky in isolation, test and development environments, application virtualization, keeping legacy software or an old operating system alive, and cross-platform work such as running Linux on a Windows PC. Windows Sandbox is a ready example:

Microsoft describes a lightweight, isolated desktop that deletes everything when closed, included in Windows Pro, Enterprise and Education but not Home.

Virtual machines have requirements. The host needs enough CPU, memory and storage for itself and every guest. Each guest needs a virtual network connection, shared with the host, bridged to the physical network or isolated, and the same security care as a physical machine. Operating systems add their own rules: Microsoft's Windows 11 requirements call for a generation 2 virtual machine that is Secure Boot capable, with a virtual TPM, at least 4 GB of memory and at least 64 GB of storage.

Hypervisor	Runs on	Most often used for	Example
Type 1 (bare metal)	Directly on the hardware, with no host operating system	Servers	Microsoft Hyper-V, which Microsoft calls a type-1 hypervisor
Type 2 (hosted)	On top of a host operating system such as Windows, Linux or macOS	Desktops	Oracle VirtualBox, which Oracle calls a type 2 hypervisor

The bare metal and hosted descriptions and the server and desktop pattern come from NIST SP 800-125; the examples from Microsoft, which includes Hyper-V in Windows 11 Pro, Enterprise and Education, and Oracle.

Desktop virtualization moves the desktop itself onto a server. With virtual desktop infrastructure (VDI), users connect to a desktop that runs in a data center or cloud; Azure Virtual Desktop is one such service, reached through an app or a web browser. Containers are lighter. NIST SP 800-190 describes them as operating system virtualization that packages and runs an application in isolation, and notes that because containers share the same kernel, they do not offer as clear a security boundary as a virtual machine.

Exam tip: Type 1 runs on the hardware and Type 2 runs on an operating system. A hypervisor installed as an app on a laptop is Type 2.

4.2 Cloud computing models and characteristics

The standard vocabulary comes from NIST SP 800-145, which defines cloud computing through five essential characteristics, three service models and four deployment models.

Deployment model	Who it serves (NIST)
Public cloud	Open use by the general public; it exists on the provider's premises
Private cloud	Exclusive use by a single organization; on or off premises
Community cloud	Exclusive use by a community of organizations with shared concerns, such as security or compliance requirements
Hybrid cloud	Two or more distinct clouds bound together so data and applications can move between them

Service model	The customer controls (NIST)
IaaS	Operating systems, storage and deployed applications, and possibly some networking components such as host firewalls
PaaS	The applications it deploys and possibly the hosting environment's settings, but not the operating system
SaaS	At most a few user-specific application settings

The objective's cloud characteristics line up with NIST's list. Shared resources are NIST's resource pooling, where the provider serves many consumers from a multi-tenant model; that is multitenancy, and dedicated resources are the opposite. Metered utilization is NIST's measured service, in which usage is monitored and reported. Data moving in (ingress) and out (egress) is often priced separately: AWS's EC2 pricing, for example, is based on data transferred in to and out of EC2. Elasticity is NIST's rapid elasticity, scaling out and back in with demand. Availability is the service staying reachable when needed. File synchronization keeps copies current between devices and the cloud, as OneDrive does between a computer and the cloud.

NIST's other two characteristics complete the picture: on-demand self-service, where a consumer provisions computing capabilities without human interaction with the provider, and broad network access, where capabilities are reached over the network from phones, tablets, laptops and workstations.

Exam tip: who manages the operating system decides the service model. The customer manages it in IaaS; the provider manages it in PaaS and SaaS.

Domain 5: Hardware and Network Troubleshooting (28%)

The largest domain: six objectives, all scenario-based, and each one a list of symptoms. The skill being tested is matching a symptom to its likely cause and to the first thing worth checking. The tables give the common pairings, and the paragraphs add the vendor guidance behind them.

5.1 Troubleshooting motherboards, memory, processors and power

Symptom	Likely causes and first checks
POST beeps	A fault found by the power-on self-test before video works; look up the code for that make and model
Proprietary crash screens	A Windows stop error (blue screen) or a macOS kernel panic; note the code, then check recent driver, software and hardware changes
Blank screen	Monitor, cable and input first; then listen for beeps and reseat memory and the graphics card
No power	Outlet, power cord, the supply's switch, the front-panel connector, then the supply itself
Sluggish performance	Heat, too little memory or a failing drive; check temperatures and resource use
Overheating	Dust, a failed fan or dried-out thermal paste; clean, check fans, reapply paste
Burning smell	A failing component or supply; power off at once and inspect
Random shutdown	Overheating or a failing power supply
Application crashes	Faulty memory or software; run a memory test
Unusual noise	Fan bearings or a hard drive; find the source
Capacitor swelling	Bulging capacitors on the board or in the supply; replace the part
Inaccurate system date and time	The CMOS battery that keeps the real-time clock running

Beep codes depend on the manufacturer. Dell's beep code guide explains that a computer whose display cannot show errors may beep during startup instead. On Inspiron desktops, two beeps mean no memory detected, and five beeps mean a CMOS battery failure, listed under real-time clock power failure. That link between the battery and the clock is why a PC that keeps losing its date and time points to the CMOS battery.

Crash screens differ by platform. Microsoft says an unexpected restart or stop error might be caused by a hardware device, its driver, or software. Apple says the most likely cause of a Mac kernel panic is faulty software, and that damaged or incompatible hardware, including external devices, can also cause one. Apple's method works as a general one: disconnect everything except the keyboard and mouse, reconnect one device at a time, and run the built-in diagnostics.

Heat shows up in several rows of the table. Overheating, random shutdowns and sluggish performance can all trace back to a clogged heat sink, a stopped fan or thermal paste that has dried out. Cleaning and reapplying thermal interface material restores the conductive path between the processor and its cooler that Intel's thermal guide describes (see 3.5). Memory is the other common

thread: crashes that move around between applications suggest a memory test before reinstalling software.

Exam tip: a computer that loses its date and time whenever it is unplugged points to the CMOS battery before any clock setting.

5.2 Troubleshooting drives and RAID arrays

Symptom	What it suggests
LED status indicators	Activity or fault lights on the drive, bay or RAID controller show which disk has failed
Grinding noises or clicking sounds	Mechanical failure in a hard drive; back up immediately
Bootable device not found	Wrong boot order, a failed drive or a damaged boot record
Data loss or corruption	Failing media, a bad cable or file system damage
RAID failure or array missing	More drives failed than the level tolerates, or the controller lost its configuration
S.M.A.R.T. failure	The drive's own prediction that it is about to fail
Extended read/write times or low IOPS	A failing drive, an array rebuilding after a failure, or a drive running in the wrong mode
Missing drives in the OS	Not yet initialized or partitioned, a cable or port problem, or a missing controller driver
Audible alarms	A RAID controller reporting a failed or degraded drive

Seagate's guidance on S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) is plain: a FAIL status is a near-term prediction of drive failure, the drive usually still works normally, and backing up important data right away is the priority. The same reasoning applies to a degraded RAID 5 array. It keeps working on parity after one failure, but a second failure loses the array, so replace the failed drive and let the rebuild finish before anything else.

Exam tip: when a drive clicks, grinds or reports a S.M.A.R.T. failure, back up first and diagnose second.

5.3 Troubleshooting video, projectors and displays

Symptom	First thing to check
Incorrect input source	The display's input selection
Physical cabling issues	Both ends seated, the right cable for the port, a known-good spare
Burnt-out bulb	The projector lamp
Fuzzy image	Resolution set to the panel's native resolution; focus on a projector
Display burn-in	A faint image that stays on screen, a risk with static, high-contrast content on OLED
Dead pixels	Pixels that never light: a panel defect
Flashing screen	A loose cable, the refresh rate setting or the graphics driver
Incorrect color display	Cable, color profile or display settings
Audio issues	Whether the cable carries audio at all, then the audio output setting
Dim image	Brightness and power-saving settings, then an aging backlight or lamp
Intermittent projector shutdown	Overheating: blocked vents or a clogged air filter
Sizing issues or distorted image	Resolution, scaling and aspect settings; keystone correction on a projector

Apple explains the difference between image persistence and burn-in on OLED screens: persistence is a faint remnant of an earlier image that disappears after a few minutes of normal use, while burn-in can occur in more extreme cases, such as the same high-contrast image shown at high brightness for long periods. Auto-brightness reduces both. For audio, remember from 3.2 that HDMI and DisplayPort carry sound and DVI and VGA do not.

For projectors that shut off, Epson's guidance is to let the unit cool for a few minutes, make sure nothing blocks the ventilation vents, and check whether the air filter is clogged. Epson projectors can also turn the lamp off on purpose through sleep mode and A/V mute timers, so check those settings before blaming the hardware.

Exam tip: a projector that runs for a while and then shuts itself off is most likely overheating. Clean or replace the filter and clear the vents before replacing the lamp.

5.4 Troubleshooting phones, tablets and laptops

Symptom	Likely cause and first step
Poor battery health	An aged battery; check the device's battery health reading
Swollen battery	A failed battery; stop using and charging the device and replace the battery
Broken screen	Replace the screen assembly, then test touch
Improper charging	Cable, adapter, debris or liquid in the port
Poor or no connectivity	Airplane mode, a radio switched off, signal, or the SIM or eSIM
Liquid damage	Power off and dry the device properly before charging
Overheating	Heavy apps, charging in heat, or a failing battery
Digitizer issues	Touches ignored or registered in the wrong place; recalibrate or replace the digitizer
Physically damaged ports	Inspect and replace the port
Malware	Unknown apps, pop-up ads or unexplained data use; remove the app and update the OS
Cursor drift or touch calibration	Recalibrate, update, or check the trackpad on a laptop
Unable to install new applications	Storage full, an OS version too old for the app, or an MDM restriction
Stylus does not work	Pairing, charge, or a stylus the device does not support
Degraded performance	Low free storage, an aged battery or too many background apps

Liquid deserves a closer look. When an iPhone detects liquid in its port, Apple explains that charging and accessory connections stay unavailable until the connector, cable ends and accessory are dry, and that charging while wet can corrode the pins. Apple's advice is to wait at least 30 minutes before trying again, and not to use an external heat source, compressed air, cotton swabs or a bag of rice.

Battery health ties back to 1.1: Apple's Maximum Capacity reading compares the battery with its capacity when new, so a low figure explains short battery life without any software fault.

Exam tip: treat a swollen battery as a safety problem: stop charging the device and replace the battery.

5.5 Troubleshooting network problems

Symptom	Likely causes
Intermittent wireless connectivity	Interference, weak signal at the edge of coverage, or overlapping channels
Slow network speeds	Congestion, a poor channel choice, a duplex mismatch, or an older Wi-Fi standard on the client
Limited connectivity	Usually no DHCP: a 169.254.x.x APIPA address means the host could not get a lease
Jitter	Variation in packet delay, usually from congestion and queuing
Poor VoIP quality	Jitter, latency and packet loss
Port flapping	A link that keeps going up and down; bad cables, duplex mismatch or a bad transceiver
High latency	Distance (satellite links in particular), congestion or an overloaded device
External interference	Microwave ovens, cordless phones, baby monitors and Bluetooth in the 2.4 GHz band
Authentication failures	A wrong Wi-Fi passphrase, expired credentials, or an unreachable authentication server
Intermittent internet connectivity	The provider, the modem or ONT, or DNS

Jitter is easy to confuse with latency. Cisco defines jitter as a variation in the delay of received packets. Voice equipment buffers packets to smooth that out, and packets that arrive outside the buffer's range are discarded, which callers hear as dropouts. For delay itself, Cisco summarizes ITU guidance: one-way delay from 0 to 150 ms is acceptable for most applications, and delay above 400 ms is unacceptable for general network planning.

Port flapping has a precise meaning. Cisco's errdisable guide calls it an interface that continually moves up and down, and names a Layer 1 problem, such as a bad cable, a duplex mismatch or a bad transceiver module, as the common cause. For wireless trouble, a Wi-Fi analyzer (2.8) shows whether neighbors crowd the same 2.4 GHz channel; moving to 1, 6 or 11, or to the 5 or 6 GHz band, is a sensible first fix.

Exam tip: latency is how long a packet takes, and jitter is how much that time varies from packet to packet.

5.6 Troubleshooting printers

Symptom	Likely cause and fix
Lines down the printed pages	Laser: a dirty corona wire, the toner cartridge or the drum unit. Inkjet: clogged nozzles
Garbled print	The wrong or a damaged driver; install the correct one for the printer
Paper jams	Wrong or damp paper, worn rollers or debris in the paper path
Faded prints	Low toner, toner save mode turned on or a drum that needs cleaning; inkjet nozzles
Paper not feeding or multipage misfeed	Worn pickup or separation rollers, an overfilled tray or humid paper
Multiple prints pending or frozen print queue	A stuck spooler; restart the Print Spooler service
Speckling on printed pages	Loose toner, or a dirty drum or fuser area
Double or echo images	The drum or fuser not clearing the previous image (ghosting)
Grinding noise	Worn gears or rollers, or a foreign object
Finishing issues (staple jams, hole punch)	Clear the finisher, refill staples, empty the punch waste
Incorrect page orientation	The driver or application setting
Tray not recognized	Tray seating, or the tray configuration in the driver
Connectivity issues	Cable, Wi-Fi, a changed IP address (a DHCP reservation prevents this) or the driver's port

The laser causes come from Brother's guide to vertical lines, which names a dirty corona wire, a toner cartridge or the drum unit, and its guide to faded pages, which starts with toner save mode and remaining toner life. For inkjets, the nozzle check and cleaning in 3.8 is the first step for both lines and fading. For a frozen queue, Microsoft's steps are to cancel the jobs, restart the Print Spooler in services.msc, and if the queue still will not clear, stop the spooler, delete the files in C:\Windows\System32\spool\PRINTERS and start it again.

Exam tip: a stuck queue is a software problem on the computer or print server, so restarting the Print Spooler comes before touching the printer.

A study plan

Here is one example of a six-week plan built from the domain weights. Treat it as a starting point and shift time toward whatever is least familiar.

Week	Focus	Share of exam
1	Domain 1, Mobile Devices, and Domain 4, Virtualization and Cloud Computing	24%
2	Domain 2, Networking: ports first, then wireless and SOHO setup	23%
3	Domain 3, Hardware: cables, memory, storage, motherboards, power and printers	25%
4	Domain 5, Hardware and Network Troubleshooting	28%
5	The weakest objectives from weeks 1 to 4, with practice questions by domain	All
6	Timed practice exams and a last pass through the exam tips	All

Weeks 3 and 4 carry the most weight, because Hardware and Troubleshooting together make up 53 percent of the exam. Hands-on time pays off there: opening a desktop, reseating memory, building a RAID 1 mirror on a spare PC, or reading a router's DHCP lease table turns the tables above into practical memory.

Practice questions

A+ Practice Test: ET for iPhone and iPad has 2,000 original practice questions, 1,000 for Core 1 (220-1201) and 1,000 for Core 2 (220-1202). The Core 1 bank follows the domain weights, with 130, 230, 250, 110 and 280 questions for Domains 1 to 5. It is free to start with 30 sample questions in each core and needs no account.

Every question is written to the 220-1201 and 220-1202 exam objectives and checked in a separate review against primary sources such as Microsoft, Apple and hardware vendor documentation.

Frequently asked questions

How many questions are on the CompTIA A+ Core 1 exam?

A maximum of 90, with 90 minutes to answer them, according to CompTIA. The questions mix multiple-choice (single and multiple response), drag-and-drop and performance-based items.

What is the passing score for A+ 220-1201?

675 on a scale of 100 to 900. Core 2 (220-1202) uses the same scale with a passing score of 700.

Do you need to pass both Core 1 and Core 2?

Yes. The A+ certification requires both exams. CompTIA says they can be taken in any order, but both must come from the same version, which for these exams is V15.

What are the five A+ Core 1 domains?

Mobile Devices (13%), Networking (23%), Hardware (25%), Virtualization and Cloud Computing (11%), and Hardware and Network Troubleshooting (28%), according to CompTIA's 220-1201 exam objectives.

Is the troubleshooting methodology on the A+ Core 1 exam?

Not as a tested objective. The objectives document prints CompTIA's troubleshooting method but states that the method itself is not tested. Troubleshooting is still the largest domain, at 28 percent of the exam.

How long is the CompTIA A+ certification valid?

Three years from the certification date, according to CompTIA's renewal policy. Holders can renew through CompTIA's continuing education program instead of retaking the exams.

When will the 220-1201 exam retire?

CompTIA launched A+ V15 on March 25, 2025, and its exam page says retirement usually comes three years after launch, estimated for 2028. CompTIA had not published an exact retirement date when this guide was last checked.

Sources

- CompTIA: A+ Core 1 V15 and its exam objectives (version 4.0), A+ Core 2 V15, A+, renewal policy
- RFC Editor: 768, 854, 959, 1002, 1034, 1035, 1918, 1939, 2131, 2818, 3596, 3927, 4253, 4291, 4511, 5321, 5424, 5905, 6376, 7208, 7766, 9051, 9110, 9293, 9989; IANA port registry
- NIST: SP 800-145, SP 800-125, SP 800-190; glossary: firewall, VPN, proxy server, SCADA, IoT, HSM
- Standards and industry bodies: IEEE 802.1Q, IEEE RA, IEEE 802, Wi-Fi Alliance (naming, MAC/PHY, Wi-Fi 7), Bluetooth SIG, NFC Forum, 3GPP, USB-IF (Type-C, USB 3.2, performance names), HDMI.org, VESA, SATA-IO, NVM Express, JEDEC 21C, SNIA, CableLabs, 80 PLUS
- Microsoft: RDP port, SMB traffic, DHCP, Intune, Secure Boot, TPM, Windows 11 requirements, Windows on Arm, Hyper-V, Windows Sandbox, Azure Virtual Desktop, OneDrive, stop errors, print queue
- Apple: battery, USB-C, eSIM, Bluetooth, Location Services, Personal Hotspot, Mac ports, Studio Display XDR, OLED displays, liquid detection, kernel panics
- Cisco: RF reference guide, PoE, switches, AAA, copper distances, cable pinouts, auto-MDIX, fiber modules, jitter, delay, link flap
- Intel: motherboards, PCIe, Hyper-Threading, Thunderbolt, USB 3.0, RAID volumes, RAID levels, memory channels, thermal design, ATX power (AC input, main connector, DC connectors)

- Other vendors: Arm, Oracle, AWS, HP (panels, print driver, maintenance kit), Adobe, Kingston, WD, Seagate (Exos 7E2, S.M.A.R.T.), Dell (video cables, ports, M.2, RAID, beep codes), Fluke Networks (fiber connectors, Pro3000), Zebra, Epson (FX-890II, nozzle check, overheating, shut-off), Brother (lines, faded pages)

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