Topic A: Power supplies

This topic covers the following CompTIA A+ 220-602 exam objectives.

#	Objective
1.1	**Install, configure, optimise and upgrade personal computer components** Add, remove and configure personal computer components, including selection and installation of appropriate components; for example: • Power supplies
1.2	**Identify tools, diagnostic procedures and troubleshooting techniques for personal computer components** Identify the steps used to troubleshoot components (e.g., check proper seating, installation, appropriate components, settings and current driver); for example: • Power supply Recognise names, purposes, characteristics and appropriate application of tools; for example: • Anti-static pad and wrist strap
1.3	**Perform preventative maintenance of personal computer components** Identify and apply common preventative maintenance techniques for personal computer components; for example: • Power devices (e.g., appropriate source such as power strip, surge protector, ventilation and cooling)
7.1	**Identify potential hazards and proper safety procedures, including power supply, display devices and environment (e.g., trip, liquid, situational, atmospheric hazards and high-voltage and moving equipment)**

PC power supplies

Explanation

As you know, the PC's *power supply*, as shown in Exhibit 1-1, is the internal component that converts wall voltage to the various DC voltages used by the computer's other components. Power supplies have a fan to cool their components and, in some cases, to help cool the other components inside the PC. Typically, a power supply provides some conditioning functions and can maintain DC supplies during very brief drops and outages in supply voltage.

Exhibit 1-1: A PC power supply

Power supply selection

When selecting a replacement power supply, you'll find that they are rated according to the watts of DC power they output. Modern power supplies typically offer 300 watts or more to power the PC and its internal components. Older power supplies typically offered 200 watts or less.

The power supply's rating isn't necessarily an indicator of the amount of power that the unit draws from the outlet. A 350 W power supply might not use more electricity than a 200 W model. Power supplies draw only as much power as needed to power the internal components. If your system needs less than the power supply's full capability, the power supply draws enough electricity to power the PC and no more.

When selecting a power supply for a computer, you must make sure it delivers enough power for all the computer's internal components. The typical power requirements for common PC components are listed in the following table.

Component	Typical power requirement
Motherboard	30 W, not including the power for the CPU chip and memory
Memory	10 W or more per 128 MB
CPU chip	Pentium 4 and Athlon-class processors use 65 W or more; older CPUs use 50 W or less
Hard drive	5–15 W
CD-ROM drive	10–20 W
Floppy drive	5–10 W
Adapter card	5–30 W

Standard outputs

Most power supplies provide three output voltage levels at various amperage ratings to supply power to the internal components.

The table on the next page describes these voltage levels and the typical devices that use them.

Output voltage	Amperage	Typical device that uses this output
+3.3 V	14 A	AGP video cards, motherboard. (This output level isn't produced by older, AT class power supplies.)
-5 V	0.3 A	ISA bus (AT bus) adapter cards.
+5 V	30 A	Motherboard, optical (CD and DVD) drives, hard drives, PCI adapter cards, Pentium III and earlier processors.
+5 V	0.85 A	The 'soft power' switch, which maintains the system in a ready-to-start state.
-12 V	1 A	Some older network adapters and serial ports.
+12 V	12 A	Optical drives, hard drives, Pentium 4 and Athlon processors, motherboards.

More devices draw power at the +12 V level than at any of the other ranges. When replacing a power supply, make sure it has sufficient +12 V connectors to meet your needs. It's better to use an oversized power supply, as they're more efficient when run below their maximum output rating.

Power connectors

Standard connectors are used to connect the power supply's output to the various devices. Separate standards exist for the following connectors:

- Drive power connectors
- Motherboard power connectors

Standards for drive power connectors

Hard drives, optical drives and floppy drives use power connectors that are standardised in their size and shape, as well as in the placement and voltage carried by the wires connected through them. There are three common power connectors: the peripheral, floppy and serial ATA power connectors.

- The peripheral connector is sometimes called a *Molex connector*, after one of the manufacturers of this style of connector. Peripheral connectors are typically used to connect hard drives and optical drives to the power supply.
- The floppy connector is sometimes called a *Berg connector*. These connectors are smaller and are typically used to connect floppy drives.
- New serial ATA (SATA) drives use the third type of power connector.

These connectors are shown in the following three exhibits.

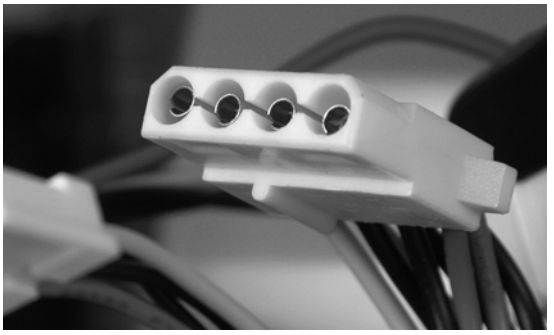

Exhibit 1-2: A peripheral power connector, also called a Molex connector

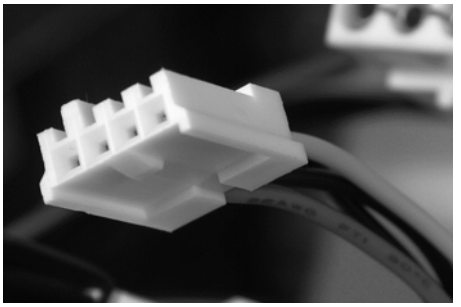

Exhibit 1-3: A floppy power connector, also called a Berg connector

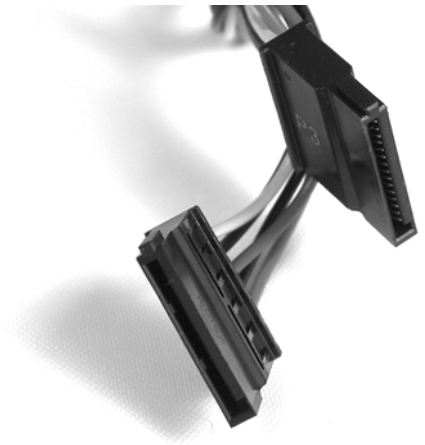

Exhibit 1-4: A serial ATA (SATA) power connector

Due to their shapes, you can insert these connectors into the drive in only one orientation. They are said to be ‘keyed,’ which ensures that you connect the appropriate power input wires to the correct point on the device.

Standards for motherboard power connectors

The motherboard and its components must get power from the power supply. The motherboard is connected to the power supply with either one or two connectors.

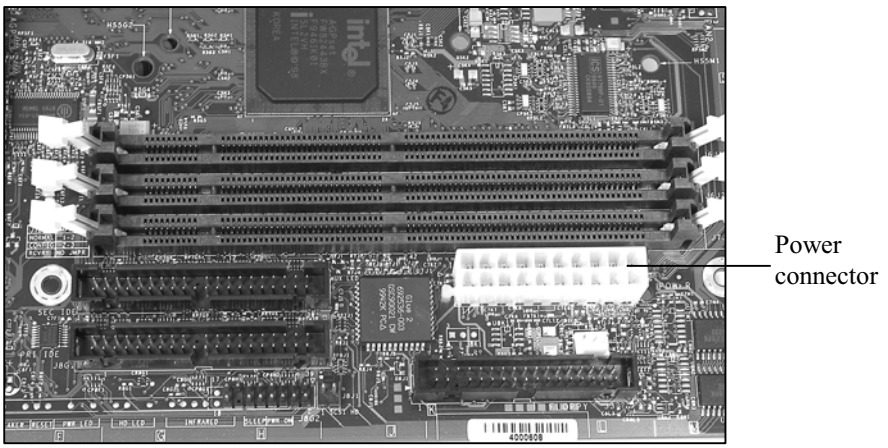

Exhibit 1-5: Single power connector on a motherboard

Newer, single motherboard connectors are keyed. You can't insert these connectors incorrectly (unless you force-fit them backwards).

The older standard for motherboard power connectors is the two-connector system. These older connectors weren't keyed, so they could be inserted in either direction. Not only could you connect one of the pair to the wrong motherboard connector, but you could also connect the plugs backward. Such a misconnection could damage the motherboard.

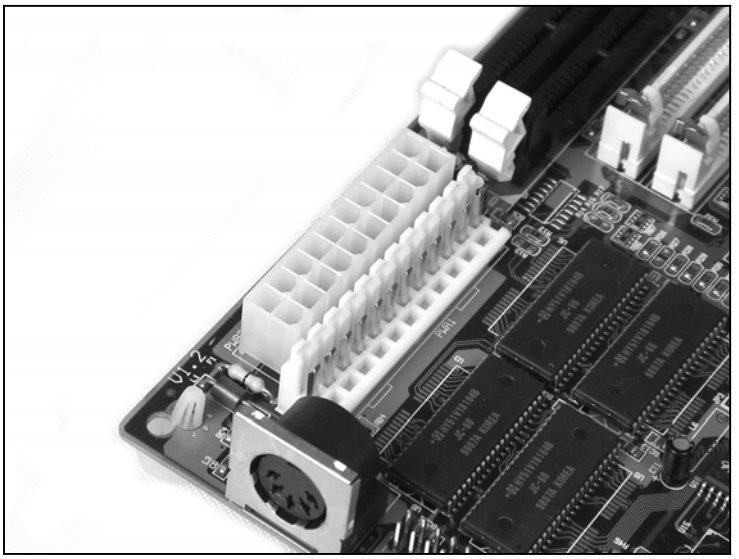

Exhibit 1-6: Dual power connectors on an older motherboard

Form factors

The *form factor* of a power supply describes its size and shape. The form factor you use must not only fit into the case you use; it must also fit in relation to the motherboard and other components. Power-supply form-factor names match those given to system cases because together these components form a matched set.

Form factor	Dimensions (W × D × H in millimetres)	PC model originally made for	Notes
ATX (NLX)	150 × 140 × 86	486-class PCs and Pentium-class PCs	The first to include the +3.3 V output required for AGP video cards. Also, the first to include support for the 'soft power' switches (which replaced the old mechanical switches). Replaced the two motherboard power connectors with a single connector.
SFX	100 × 125 × 63.5	Pentium-class PCs	Doesn't provide the -5 V output required for older ISA expansion cards.
WTX	150 × 230 × 86 (single fan) 224 × 230 × 86 (double fan)	Pentium-class PCs	Doesn't provide the -5 V output required for older ISA expansion cards.

Static electricity

Static electricity is a phenomenon that occurs when the charges on separated objects are unequal. From the perspective of a PC technician, the most interesting (and dangerous) aspect of static electricity happens when statically charged objects are brought near each other. When that happens, a current can flow between them to balance their charges. This current flow is characterised by a high voltage, but low amperage.

Static discharge isn't typically a problem when the computer case is closed. The static current is dissipated through the computer's metal case to ground or is otherwise dampened before reaching sensitive components. (Of course, you should still avoid discharging static through the case.) The biggest problems with static arise when you have the computer's case open and are working with its internal components.

Static dangers

Static discharges aren't dangerous to humans, even though the voltage in the system can measure in the thousands of volts. However, such discharges are potentially harmful to electronics. Electronics can be damaged by a 1000-volt discharge or less—a third or less than the minimum discharge you can feel.

The microscopic wires and components that make up chips and other devices are very sensitive to even small amounts of current. A static spark can melt such components, rendering them useless. Smaller discharges can alter the data stored in chips or otherwise upset their operation without causing physical damage.

Preventing problems with static charges

There are two ways to prevent problems from static electricity:

- Prevent the build-up of static charges.
  - Don’t shuffle your feet as you walk.
  - Increase the humidity in the room or building.
  - Keep yourself grounded as you work and move around. Use the tools found in a typical ESD kit, such as wrist straps (see Exhibit 1-7) and mats.
    An ESD toolkit includes tools you can use to prevent the build-up of charge differentials and to equalise them safely. You should purchase and use a good ESD toolkit. You and the components you’re servicing can remain connected to ground so that charges can’t build up.
  - Wear cotton clothing, which is less likely to generate static charges than are many synthetic materials.
  - Remove carpeting from rooms where you service computers and from computer rooms.
  - Use an air ionisation system to build up an opposite and thus neutralising, charge in the air.
- Prevent discharges or discharge the charge safely.
  - Equalise the charge safely — Unplug the computer and then touch a metal portion of its chassis.
  - If you must move around as you work, keep yourself grounded with an anti-static wrist strap similar to the one shown in Exhibit 1-7, so that charges can’t build up.

Exhibit 1-7: An anti-static wrist strap

To prevent damaging discharge, your goal is to be at a charge potential that's equal with the device you're servicing, not with ground. You shouldn't leave the computer plugged in while servicing it. If there were a fault in the building's wiring system, full wall current could be flowing through the ground wire. You could be injured or killed if you came into contact with the ground.

Safety precautions

You should always follow common-sense safety precautions to avoid electric shock. These precautions include:

- Don't touch exposed electrical contacts with any part of your skin.
- Touch only insulated handles and parts of tools, probes, cords, etc.
- Leave covers on equipment unless you need to access internal components.
- Work one-handed. If you use only one hand, electricity is less likely to flow through your body (specifically, through your heart or head) and cause injury or death.
- Never insert anything other than a power cord into a wall outlet.
- Remove jewellery when working around electricity. Rings, watches and jewellery can cause unintended contact with electrified components. Furthermore, these metallic items can increase the surface area that's in contact with an electrical source and thus lower your body's resistance.
- Keep your hands clean and dry.
- Don't work with electricity in wet surroundings, especially on wet floors.

Do it!

A-1: Identifying your computer's power supply

Here's how	Here's why
1 Follow safety precautions to avoid electrical shock and use the tools from your ESD toolkit	Place your antistatic mat under the area you are working and wear your antistatic wrist strap.
2 Disconnect the power cord from the computer	
3 Disconnect any other cables from the computer	Such as those from the monitor, network, keyboard, mouse and other peripheral devices.
4 Release the restraining mechanisms securing the side that exposes the internal components If you opened the side covering the underside of the main circuit board, open the other side	The restraining mechanisms can be screws, slides or push-buttons.
5 Touch the metal frame of the computer and count slowly to three	To discharge any static charges present on your body or on the computer.
6 Remove the front cover	
7 Identify the power supply in your computer	
8 Identify your power supply's rating and output voltages	This information is normally listed on a label on the power supply.
9 Locate a peripheral's power connector and examine its shape	
10 Locate a floppy-drive power connector and examine its shape	
11 Determine if your computer has a SATA power connector	The power supplies in newer computers provide these connectors. You can purchase adapters for older power supplies.
12 Locate the motherboard's power connector Do you have a single or paired power connector?	

Power supply installation and replacement

Explanation

You might need to replace or install a power supply if:

- The power supply in your system doesn't provide sufficient power for the components that are installed.
- An older power supply has failed.
- You're building a new computer from components.

To install or replace a power supply, follow these general steps:

1 Shut down the computer.
2 Unplug the computer.
3 Remove the cover from the computer. You might need to remove both sides or both the top and bottom of the cover to access all of the retaining screws for the power supply.
4 Disconnect all of the power wires from the various components, including the motherboard.
5 Remove any retaining screws that secure the power supply to the case.
6 Remove the power supply.
7 Install the new power supply and screw it into place.
8 Connect power wires to the various components as needed, including the motherboard. Take care to attach the connectors in the proper orientation.
9 Replace the cover or covers.
10 Plug the computer into the outlet and boot the system to test your work.

Warning: Don't open the cover of the power supply itself. Components within the power supply retain a high-voltage charge even after the unit has been unplugged for a long period. Shock or death could result if you were to touch these components.

Voltage selection

When installing a power supply unit, often you can adjust the power supply to run on either 110 V or 220 V wall voltage. To make this adjustment, with the computer off, you slide a small switch to the appropriate voltage. This switch is normally next to the electrical cord port on the back of the PC, as shown in Exhibit 1-8.

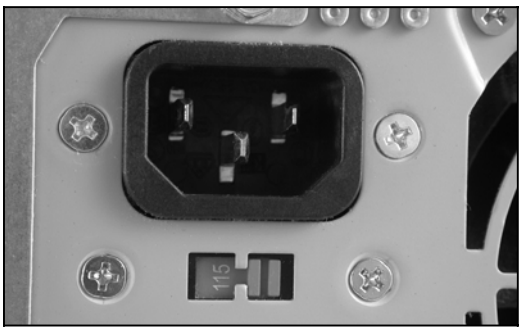

Exhibit 1-8: Voltage selection switch near the electrical cord port

Do it!

A-2: Installing a new power supply

Here's how	Here's why
1 Carefully disconnect all of the power wires from the various components	Your computer is already shut down and unplugged and the case is open. You're using your ESD tools and following safety precautions to avoid electrical shock.
2 Remove any retaining screws that secure the power supply to the case	
3 Remove the power supply and set it aside	
4 Install the new power supply	
5 Connect the power cables to the motherboard and other internal components	Make sure to attach connectors in the appropriate orientation.
6 Replace the cover or covers	
7 Plug the computer into the outlet and reconnect all of the peripherals	
8 Boot the computer	To verify that you have installed the power supply correctly.