Syllabus outcomes

5.1.2 Selects, maintains and appropriately uses hardware for a range of tasks.

5.3.1 Justifies responsible practices and ethical use of information and software technology.

Overview

This chapter outlines the hardware used in a computer system. Hardware is classified according to its function and specific hardware devices are examined. Hardware systems are also classified according to their capabilities. You will learn troubleshooting procedures when dealing with hardware problems and the basic procedures for the care and maintenance of a computer.
4.1 Functions of hardware

The hardware is the physical units that make up the computer, such as the system unit, keyboard and monitor. It is the computer equipment that you can see and hold. There are five functions of hardware:

- **Input** involves accepting data into the computer for processing into information. The data is the raw facts used by the computer, such as text and images. Information is data that has been ordered and given some meaning. Input devices include keyboards and pointing devices.

- **Process** changes data to produce information by following a series of instructions. Processing is performed by the central processing unit (CPU). The CPU is the ‘brain’ of the computer. It takes the data entered from an input device, changes it to produce information and sends it to an output device to be presented to the user.

- **Storage** involves receiving and retaining data over a period of time. Storage is classified as primary storage (memory) or secondary storage. Primary storage stores data and programs that need to be instantly accessible to the CPU. Secondary storage stores data more permanently and uses media such as hard disks and CDs.

- **Control** coordinates the operations of the input, processing, output and storage. The control unit is part of the CPU. The control unit is the organiser that directs the flow of data in the computer in the same way as traffic lights control the flow of cars at an intersection.

- **Output** involves sending information from the computer. It includes the transfer of data from primary storage to an output device such as a screen, printer or speakers. The information presented is the result of the user’s work on the computer.

The five functions of hardware are: Input, Process, Storage, Control and Output—remember IPSCO.

Figure 4.1 The five functions of hardware
All the functions of hardware work together. Data is entered using an input device and processed in some way before being presented using an output device. If necessary, the data can be retained on a storage device for later use (see Figure 4.1). Input, output and storage devices are often referred to as peripheral devices (pronounced ‘peh-RIHF-er-uhl’).

**Hardware components**

The system unit is the box that contains the computer’s main hardware components such as the motherboard. Most personal computers have a system unit based on the following designs:

- **tower system**—vertical box that is often kept under the desk; towers usually have more expansion slots and bays compared to the other designs
- **desktop system**—horizontal box designed to sit under the monitor like a platform
- **all-in-one system**—combine the monitor and system unit into a single casing such as the iMac.

There are many hardware components in the system unit. The motherboard is the main circuit board that contains the computer’s vital components (see Figure 4.2). It contains the CPU, memory, expansion slots, buses and other electronic components. The motherboard is also called the main board or system board. Motherboards are continually being improved to increase the performance of the computer. With major developments in the CPU it often requires the motherboard to be upgraded.

An integrated circuit (IC) is a single chip of silicon that has replaced millions of transistors and other electrical components. Integrated circuits are referred to as silicon chips or just chips. There are many integrated circuits on the motherboard. The CPU is the largest integrated circuit. There are also numerous memory chips for RAM and ROM, and often co-processor chips. A co-processor is a dedicated chip that works with the main CPU to increase the speed of the

**Figure 4.2** A motherboard
A graphics co-processor allows images to be displayed much faster. It performs the graphics processing allowing the CPU to perform other tasks.

The power supply transforms mains voltage to a lower level that can be used by the computer. It supplies power to all internal components such as the CPU and primary storage. The electromagnetic field generated by the power supply can damage data stored on magnetic tapes and disks. For this reason, disks and tapes should be stored away from the power supply. The power supply also generates the most heat and this can lead to component failure.

Peripheral devices are linked to the CPU using expansion slots and ports. An expansion slot is an opening where a circuit board can be inserted into the motherboard to extend the capabilities of the computer. The circuit board is called an expansion card or expansion board. There are many different types of expansion cards for different purposes such as to connect a monitor, hard disk or any peripheral device. Expansion cards are also used to extend memory. In a portable computer a PC card (originally called a PCMCIA card) is used instead of an expansion card. A PC card is the size of a thick credit card that provides an additional function such as extra memory or a modem.

A bus is a pathway of wires on the motherboard that connects various components. Data travels through a bus. The size of the bus is called its width. The larger the width the more data that can be transmitted at the one time. For example, a 64-bit bus has 64 lanes and can transmit data 64 bits at a time compared to a 32-bit bus that moves 32 bits at a time. The speed of the bus is an important factor in the performance of the computer. A bus with more width will make the applications run faster.

A port is a socket used to connect peripheral devices. It is located at the back of the system unit. Ports have different connectors that are used
to attach cables to the peripheral devices. Most connectors are available in two types called male or female. Male connectors have one or more exposed pins like the end of a power cord. Female connectors have matching holes like a power point. Some of the ports, such as the mouse and the keyboard, are connected directly to the motherboard.

USB (universal serial bus) has become a standard method of connecting peripheral devices (see Figure 4.3). It allows fast transfer of data and connects a range of devices such as digital cameras, scanners and storage devices.

**Exercise 4.1**

1. What am I?
   - a The ‘brain’ of the computer.
   - b Main circuit board that contains the computer’s vital components.
   - c A dedicated chip that works with the main CPU to increase the speed of the computer.
   - d A pathway of wires on the motherboard that connects various components.

2. Copy and complete the following by replacing the letter in brackets with a suitable term:
   Data is entered using an (a) device and processed in some way before being (b) using an output device. If necessary the (c) can be retained on a (d) device for later use.

3. Explain the difference between:
   - input and output
   - a tower and a desktop computer
   - expansion slot and expansion card
   - a male and a female connector.

4. a What are the five functions of hardware?
   - b List four components found on a motherboard.
   - c What is an integrated circuit?
   - d What is the purpose of an expansion card?
   - e Describe a PC card.
   - f Why has the USB become the standard method for connecting peripheral devices?
Examine the contents of the system unit. Find the motherboard, power supply unit, CPU, memory chips, buses, ports and expansion slots. Identify each expansion card and secondary storage device.

Identify a peripheral device that is connected to a computer using an expansion card. Investigate a popular example of this expansion card. Briefly explain how this expansion card works.

There are different types of buses on the motherboard, such as the expansion bus. Do research to find more information on different types of buses. Write a summary of your research.

4.2 Processing

Processing changes data to produce information by following a series of instructions. Processing is performed by the CPU and microprocessors.

Central processing unit

The central processing unit (CPU) or processor performs the transformation of data into information. It is the ‘brain’ of the computer (see Figure 4.4). The CPU accepts the data from any input device, changes this data according to the instructions given by the user and then sends the results to an output device. There are several different types of chips including those from Intel (Pentium), AMD (Athlon) and Motorola (PowerPC). Each of these companies is constantly improving its CPUs to make them more powerful. The CPU consists of the control unit, arithmetic logic unit (ALU) and registers.

The control unit directs and coordinates the entire hardware system. It is the organiser that directs the flow of data in the computer in the same way as traffic lights control the flow of cars at an intersection. The control unit selects and retrieves instructions from storage in sequence, interprets them and starts the required operation.

The arithmetic logic unit (ALU) is part of the CPU that performs data calculations and
comparisons. Arithmetical calculations include addition, subtraction, multiplication and division. Comparisons have a true or a false answer and include relational operators (>, <, =, >=, <=, and <> ) and logical operators (AND, OR and NOT). When using logical operators the AND operator results in a true answer only if all comparisons are true, while the OR operator results in a true answer if any of the comparisons are true. Logical operators can also be used to link relational comparisons such as a > 5 AND b < 7.

The ALU contains several types of registers. A register is a temporary storage area for small amounts of data or instructions before and after processing. It provides fast access to data. Some of the different registers are the:

- accumulator register — stores the data to be processed
- buffer register — stores data coming from or being sent to primary storage
- address register — stores the location of data in primary storage
- instruction register — stores the address of the next instruction to be processed.

**Microprocessors**

A microprocessor is a CPU contained on one integrated circuit. Microprocessors are used in personal computers and many consumer devices such as cameras, digital watches, toys, game machines, DVD players, microwaves and motor vehicles. Most of the world’s microprocessors are hidden from view in these electronic devices. These devices are special-purpose, with programs etched in the silicon that cannot be altered.

**Project: Buying a PC**

*Adel Manning is a university student who needs to purchase a new PC within a tight budget. She has decided to develop criteria for buying a PC. Adel wants to ensure she does not purchase unnecessary equipment. The problem was solved using the four stages in project development.*

- **Define and analyse the problem:** Adel asked friends and family about the type of system and software they purchased. She read computer magazines and accessed relevant Internet sites for the latest information on equipment and prices.
- **Design possible solutions:** Adel's research resulted in a huge amount of data. Much of the information was written using technical language. Adel's criteria needed to focus on the tasks the PC will be performing and the applications required to complete those tasks.
She also wanted the criteria to consider her needs in the foreseeable future. She wrote a draft of the criteria and discussed them with some friends.

- **Produce the solution:** Adel’s final criteria compared hardware with the same configuration in terms of price, reliability and performance. Additional memory, peripherals and software were included. She was not tempted to copy software. Software piracy is theft. Compatibility with her current PC was also one of the criteria.

- **Evaluate the solution:** Adel used her criteria to purchase a new PC. She has been very happy with the performance of her new PC. Adel will be able to upgrade the PC when required in the future.

**Tasks**

1. Create criteria for buying a PC that would be appropriate for this project.
2. Describe any social and ethical issues that would be a concern in this project.

**Activities**

**Exercise 4.2**

1. Copy and complete the following sentences:
   a. Processing changes _______ to produce information by following a series of instructions.
   b. The CPU stands for the central _______ unit.
   c. The _______ directs and coordinates the entire hardware system.
   d. The AND operator is an example of a _______ operator.
   e. A _______ is a CPU contained on one integrated circuit.
2. True or false?
   a. Motorola makes the Pentium processor.
   b. ALU is part of the CPU that performs data calculations and comparisons.
   c. Registers provide fast access to data.
   d. The address register stores the data to be processed.
The QWERTY keyboard is a very inefficient layout. It was originally designed to slow typists down. The most commonly typed letters (A, O, E, T, N, and S) are away from the typist's index fingers.

Activities

3 Unjumble these words:
   a) iesgetrr
   b) otrclno niut
   c) icromrsoroepcs

4 a) Describe the role of the CPU.
   b) List the three parts of the CPU.
   c) What is the purpose of the control unit?
   d) What is a register?
   e) What is the purpose of the buffer register?
   f) Where are microprocessors used?

Development

5 Microprocessors are used in personal computers as well as in consumer devices. List the microprocessor devices that you have used in the past two days. Do research into three microprocessor devices. Describe these devices in terms of input, output, storage, process and control.

6 Parallel processing is the simultaneous processing of instructions using multiple processors or CPUs. Investigate parallel processing. Outline some of the advantages of parallel processing.

4.3 Input devices

To make the computer work it has to be given instructions and data has to be entered. Input involves accepting data into the computer for processing into information. A device designed to assist the entry of data is called an input device. There are many types of input devices used for different purposes.

Keyboard

A keyboard is an input device consisting of a series of keys in a standard layout. It allows the entry of text, numbers, instructions and commands. There are many different types of keyboards, each designed to meet a particular need. For example, the keyboard on an automatic teller machine (ATM) contains special keys that allow the withdrawal of money. Each type of keyboard has a different arrangement of letters, numbers and symbols, which is called its layout. The most common keyboard layout for personal computers is the QWERTY keyboard.

The QWERTY keyboard is divided into four major areas:

- **Alphanumeric keys**—letters and numbers on the keyboard.
  A numeric keypad is located on the right-hand side of the keyboard. It is for quick entry of numbers.
• **Cursor control keys**—allows the cursor to be moved and includes the arrow keys, page down, page up, home and end.

• **Special keys**—include enter/return, tab, space, caps lock, backspace, delete and esc (escape). Modifier keys (such as shift, control, alternate, option and command) are used in combination with other keys.

• **Function keys** (F1, F2 to F12)—allow instructions to be given to the computer and depend on the software.

There are variations to the standard keyboard, such as the wireless keyboard, a folding keyboard for palm computers, a miniature keyboard built into pocket-sized devices and a one-handed keyboard.

**Pointing devices**

Pointing devices are input devices that control an onscreen symbol called a pointer. They are good at giving commands to the computer and for creating certain images. However, pointing devices are not effective for entering large amounts of text. There are many different types of pointing devices:

• **A mouse** is a small hand-held input device that is moved over a flat surface to control the movement of a pointer. The bottom of the mouse is usually a ball that senses the movement of the mouse. If a button on the mouse is pressed or clicked, it allows a character or command to be selected from the screen. There are a large variety of mice using different types of technology to improve their tracking, resolution and ease of use. A mouse may have one or more buttons and a scroll wheel.

• **A trackball** is a pointing device that is similar to a mouse except that the ball is on top of the device instead of the bottom. It allows the cursor to be moved by rotating the ball in the desired direction.

• **A pointing stick** or trackpoint is a small device shaped like a pencil eraser. It moves the pointer by sensing the direction and amount of pressure applied to the device. A pointing stick is located in the keyboard on many portable computers.
• A touchpad or trackpad, is a flat rectangular surface that senses the movement of a finger. When you move your finger on the touchpad it makes a corresponding movement of the pointer.

• A graphics tablet is an input device that consists of a special electronic pad and a pen called a stylus (see Figure 4.6). The stylus performs the same point-and-click functions as a mouse. Graphics tablets are used by artists and designers.

• A joystick is a pointing device consisting of a small base unit with a rod that can be tilted in all directions to move the pointer on the screen. Joysticks are frequently used to provide fast and direct input for moving characters and symbols in computer games.

• A light pen is a pointing device consisting of a small rod that looks like a pen. The tip of the pen has a light detector that senses the intensity of light on a screen and emits signals so that the computer can calculate its position. A light pen is used to select information or draw directly on the screen.

• A touch screen enters data by detecting the touch of your finger. The user’s finger interrupts a matrix of infrared light beams shining horizontally and vertically across the screen.

• A pen input device uses special hardware and software to interpret the movement of a pen. Pen input devices are becoming increasingly popular (see Figure 4.7). They are used in most personal digital assistants (PDA) and palm computers.

**Digital input devices**

Data must be digitised before it is used by a computer. There are a range of input devices that capture and digitise data.

Scanners are input devices that make a digital representation of any printed image. The digital data can be printed, edited or merged into another document. They may be single-pass scanners that scan only once or multiple-pass scanners that scan for each colour. There are three common types of scanners:

![Figure 4.7 A PocketPC with pen input](image)
Flatbed scanners look similar to a small photocopier with the document remaining flat and stationary during the scanning (see Figure 4.8).

Pen scanners are wireless devices that look like a highlighter—when the pen scanner is dragged across a line of printed text it creates a text file.

Drum scanners are high quality scanners used in publishing applications.

Digital cameras are input devices that capture and store images in digital form rather than on film. Digital photos are limited by the amount of memory in the camera, the quality of the lens and the output device. The main advantage of digital cameras is that making the photos is both inexpensive and fast because there is no film processing. Most digital cameras compress and save their images in standard JPEG or FlashPix format.

Digital video cameras are input devices that capture video in a digital format (see Figure 4.9). The video files are initially captured onto a tape and then transferred directly to a computer for editing. Video editing software is used to edit the video including titles, sound and special effects. There is an increasing range of video effects that can be achieved using this software on a personal computer.

Microphones are input devices that capture sound. Sound travels through the air in waves and is analog data. Audio is sound that has been digitised. A sound card is an expansion card that allows the PC to accept microphone input, play music and other sounds through speakers or headphones (see Figure 4.10). Sound cards are...
capable of recording and playing digital audio at CD-quality sound.

*Voice recognition* converts voice signals into digital data. Basic voice recognition systems are restricted to narrow vocabularies because of the difficulty of understanding the grammatical meaning of many words and phrases. Natural language voice recognition interprets the data and makes an appropriate response.

*Optical character recognition* (OCR) devices are scanners that read typed text and, in some cases, handwritten text. First a scanner produces a digital image of the text then the character recognition software matches this image to the shapes of individual characters. Characters are read and stored using ASCII codes and can be used in word processing programs. Characters that cannot be read are usually indicated with a tilde (~) as this symbol does not appear in normal English. When text is scanned, it should be immediately spell checked to find any errors in character recognition.

*Barcode* readers are used extensively in retail industries to input product identification at point of sale. Supermarkets use a laser to read barcodes and many firms use handheld barcode readers. Product information (description, price and code) is held on a central computer linked to the point of sale computer. Items passing the barcode reader are entered quickly and accurately. The description and price of the item is displayed on the cash register and printed on the receipt. Libraries and many industries use barcode readers to keep track of stock movement. Portable barcode readers are used in the field and the data can be downloaded on return to the office.

*Magnetic ink character recognition* (MICR, pronounced ‘miker’) is widely used by banks to print serial numbers on cheques. Characters are recognised using magnetic ink that contains magnetised particles. The system was designed to quickly and accurately read pre-recorded data on cheques and deposit slips. MICR readers process the cheques at speeds up to 2000 cheques per minute.
Activities

Exercise 4.3

1 True or false?
   a The QWERTY keyboard is the only keyboard layout for personal computers.
   b A mouse has one button and a scroll wheel.
   c Touch screens enter data by detecting the touch of your finger.
   d Most digital cameras compress and save their images in standard JPEG or FlashPix format.
   e A flatbed scanner is a high quality scanner used in publishing applications.

2 What am I?
   a A pointing device that is similar to a mouse except that the ball is on top of the device instead of the bottom.
   b A common type of scanner that looks like a highlighter.
   c Input device that captures video in a digital format.
   d An expansion card that allows the PC to accept microphone input, play music and other sounds through speakers.
   e Input device used extensively in retail industries to input product identification at point of sale.

3 Copy and complete the following by replacing the letter in brackets with a suitable term:
   Scanners are (a) devices that make a (b) representation of any printed (c). The digital data can be printed, (d) or merged into another document.

4 a List the four major areas of the QWERTY keyboard.
   b What is one advantage and one disadvantage of a pointing device?
   c How does a light pen work?
   d What type of pointing device is popular in most PDAs and palm computers?
   e What is the main advantage of a digital camera?

Development

5 The QWERTY keyboard is the most common keyboard layout. Do research into the QWERTY keyboard. How was it named? Who designed this keyboard? Why does the QWERTY remain the most popular keyboard layout when it is very inefficient?

6 The Dvorak keyboard is a very efficient keyboard. Do research into the Dvorak keyboard. Describe the layout of the Dvorak keyboard.

4.4 Output devices

Output involves sending information from the computer. Information is presented as text, image, audio or video. A device
designed to assist the output of data is called an output device. There are many types of output devices used for different purposes.

**Screens**

A screen is a display surface that provides immediate feedback about what the computer is doing. It can display text, numeric, image and video data. All images on the screen are made up of tiny dots called pixels. A pixel or picture element is the smallest part of the screen that can be controlled by the computer. The total number of pixels on the screen is called its resolution. For example, an image described as 1024 (columns) × 768 (rows) has 786,432 pixels. Resolution is also measured by the number of dots per inch (dpi). For example, an image described as 300 dpi refers to a square inch grid with 300 pixels on each side.

A monitor is a screen that can display text and graphics. It uses cathode-ray tube (CRT) technology similar to a television. Images are produced by firing a beam of electrons onto the inside of the screen containing a coating of phosphor. The electron beam usually starts in the upper left-hand corner and moves left to right and top to bottom in a series of zigzag lines called a raster scan. Colour monitors use three beams to strike red, green and blue phosphor. The raster scan is repeated to maintain the image as the phosphor only glows for a short time. This is called refreshing. Monitors come in all shapes and sizes. The most widely used monitors are 15 to 21 inches diagonally, but the actual viewable area is usually smaller. Monitors are capable of displaying millions of colours. The number of colours depends on the amount of memory installed on the graphics card.

**LCD screens** are flat-panel displays that use liquid crystal display (LCD) technology (see Figure 4.11). They consist of a backplane and any number of segments or dots. A voltage is applied between a segment and the backplane causing a segment to darken. LCD technology provides displays that are very light, take up less room, produce no heat, have no glare,
and create no radiation. Furthermore, LCDs require less power than CRTs, allowing them to run on batteries. At present LCD technology does not produce the same picture quality as CRT and larger displays are more expensive. Data projectors use LCD technology to project images onto a larger screen.

**Printers**

A printer is an output device that produces a paper copy of any required data. The paper containing the data is called a hard copy or printout. Printers are classified as impact and non-impact printers. Impact printers make an image on the paper by using some sort of physical contact, while non-impact printers make an image using some other method. Impact printers include dot matrix printers, and non-impact printers include laser and inkjet printers.

A dot matrix printer transfers ink to the page by the impact between a pin, a printer ribbon and the paper. Dot matrix printers are reliable and cheap, however, they are noisy and do not produce the highest quality output. Dot matrix printers have resolutions from 60 dpi to 180 dpi. They are useful when duplicate copies are needed from one print job such as credit card receipts.

Inkjet printers produce text and images by spraying very fine drops of ink onto the paper (see Figure 4.12). The print head of an inkjet contains a nozzle with anywhere from fifty to several hundred small holes. The ink is propelled through a combination of nozzle holes to form the characters. Inkjet printers produce high-quality output in either colour or black and white. They are quiet, light and relatively cheap, although the ink cartridges are reasonably expensive. The quality of inkjet output is often 600 dpi or greater. Inkjet printers use standard weight paper for most tasks. High-quality images can be printed on coated paper, photographic glossy paper and overhead transparencies.

Laser printers use a rotating disk to reflect laser beams onto the paper to produce text and images.
A laser printer converts data from the computer into movements of a laser beam that are directed to a positively charged revolving drum. When the drum is touched by the laser beam it attracts toner (powdered ink). The toner is transferred onto the paper and fused using heat and pressure to form the image. Laser printers print a complete page at a time.

Laser printers are fast printers that obtain high quality output to rival normal printing processes. Speed is measured in pages per minute. Laser printers used with a personal computer print from four to twenty pages per minute while high-speed laser printers can print over one hundred pages per minute. Most laser printers offer 600 to 1200 dpi, monochrome (print in black and white) and use standard size paper.

**Speakers**

Sounds are produced using *speakers*. A small speaker is usually located in most personal computers inside the system unit. However, high quality stereo speakers are often connected to the computer using a port and a sound card (see Figure 4.13). The speakers are sometimes built into the sides of the monitor. In addition to sounds and music, speakers work with voice. Voice output is achieved in two ways:

- A person talks into a voice input device such as a microphone. The words are converted and stored as digital data. This digital data is changed back to voice so that the user can hear the words.
- *Voice synthesis* is the artificial production of human speech. The words in memory are analysed and sounds generated for letter combinations. Rules are applied for intonation to make the voice realistic.

**Plotters**

A *plotter* is an output device used to produce high-quality drawings such as maps, charts and building plans (see Figure 4.14). The drawings are often larger than the available paper sizes of a standard printer. Plotters operate with commands from the computer and can draw an amazing array of shapes and figures. There are two different types of plotters:
Pen plotters produce images using coloured ink pens over the surface of the paper. Depending on the output, pen plotters are either flatbed or drum. A flatbed plotter looks like a drafting table with pens suspended over it. The pens are instructed by the software onto the paper and then moved in a certain direction. Most flatbed plotters have different coloured pens with different widths. They are used in engineering and drafting applications. A drum plotter works the same way except the paper is rolled around a drum or cylinder. The pens only move to the left or right with drum rotating. The drawings from a drum plotter are restricted to the width of the printer but are unlimited in length.

Electrostatic plotters create images by moving paper under a row of wires. When the wires are given an electrostatic charge they touch the paper and create the drawing. Electrostatic plotters produce high quality output and are faster than pen plotters.

Exercise 4.4

1. Explain the difference between:
   a. a raster scan and refreshing
   b. an impact and a non-impact printer
   c. a flatbed plotter and a drum plotter.

2. Copy and complete the following sentences:
   a. A monitor uses _______ technology similar to a television.
   b. An _______ is a flat-panel display that uses liquid crystal display technology.
   c. Sounds are produced using a _______.
   d. A _______ is an output device used to produce high-quality drawings.
3 True or false?
   a A pixel is the smallest part of the screen that can be controlled by the computer.
   b A 17-inch monitor has a width of 17 inches.
   c Dot matrix printers produce the highest quality output.
   d Inkjet printers are quiet, light and relatively cheap.
   e High-speed laser printers can print over one hundred pages per minute.

4 a What is the resolution of a screen?
   b How does CRT technology produce an image?
   c List some of the advantages of LCD technology.
   d How does an inkjet printer produce text and images?
   e What are the advantages of buying a laser printer?
   f What is voice synthesis?
   g List two different types of plotters.

Development

5 There have been great improvements in the resolution of screens. Investigate the standard resolutions that were widely used in the past. Write a report on your investigation.

6 Do research into laser printers. Compare and contrast three different laser printers. Your answer should focus on speed, quality and cost.

4.5 Classification of hardware systems

A computer is classified according to its power and capabilities. To measure the power of a computer, many different criteria are used, such as its storage capacity and the speed of the CPU. It is common to divide computers into supercomputers, mainframes, personal computers, and portable computers. However, with advances in technology the differences have become blurred and the criteria are constantly changing. In fact, personal computers now have the capabilities that were only available in mainframes a few years ago.

Supercomputers

A supercomputer is the fastest, most powerful and most expensive type of computer (see Figure 4.15). Supercomputers are used for applications that demand maximum power, such as aerodynamics design and simulation, and processing geological, genetic and weather data. A supercomputer generates so much heat that it
requires an air-conditioned room and fluid to be circulated around its circuitry to protect it from heat damage.

A supercomputer can communicate with several users through a technique called timesharing. People access the supercomputer using a terminal. A terminal is an input and output device—usually a keyboard and monitor. In a timesharing environment, the CPU gives its attention to only one terminal at a time, for a short period of time, and then switches to the next terminal. It switches so quickly that it appears to people using a terminal that the CPU is processing only their data. Timesharing also makes it possible for users such as research scientists to share expensive computing equipment.

**Mainframes**

A mainframe computer is an expensive computer about the size of a refrigerator that is used for large computing jobs (see Figure 4.16). It is very powerful and capable of processing vast amounts of data very quickly, but is slower, less powerful, and less expensive than a supercomputer. When you withdraw money from a bank account or buy a product using EFTPOS the transaction involves a mainframe computer. These computers are installed in a special room where environmental factors such as temperature, humidity and dust are closely monitored. Users generally access a mainframe using terminals in a similar way to supercomputers.

**Personal computers**

A personal computer or PC is a relatively low cost computer that is intended for home and light business use. It is a desktop computer with a
CPU contained on one integrated circuit (silicon chip) called a microprocessor. A personal computer, as the name suggests, is dedicated to serving a single user. However, with increases in computing power PCs are being used as servers. A *server* is a computer designed to provide software and other resources to other computers over a network. Many businesses use networks to share data among employees.

PCs are the most common type of computer. They range in price from less than $1000 to several thousand dollars for the powerful systems with all the peripheral equipment and software. Millions of personal computers are in use throughout the world because they are useful, inexpensive, easy to use, and offer something for almost everyone.

**Portable computers**

*Portable* computers are compact self-contained computers that can be carried around and used with a battery pack or mains electricity (see Figure 4.17). Laptops, notebooks and handheld computers are referred to as portable computers. These computers are light (1 or 2 kilograms), compact and easily transported. Many portable computers compare favourably to powerful desktop PCs. Portable computers are usually contained in a single case with a screen, trackball or touch pad, hard disk and optical drive. They easily allow a range of peripherals and networks to be connected. Portable computers generally cost more than PCs with the same capabilities and are also more difficult to upgrade. *Handheld* computers are small enough to store in the pocket of a jacket. They are sometimes referred to as personal digital assistants (PDAs) or palmtop computers. Handheld computers are used by people who value mobility over a full-sized keyboard and screen.

**Figure 4.17** Portable computers are more expensive than PCs
Exercise 4.5

1. Copy and complete the following by replacing the letter in brackets with a suitable term:
   The (a) of the CPU and its (b) are often used to measure the speed of a computer. It is common to divide computers into (c), mainframes, (d) and portable computers.

2. Unjumble these words:
   a. pesomurceutr
   b. lmptoap
   c. estingmarhi
   d. abprotel

3. What am I?
   a. The fastest and most expensive type of computer.
   b. An input and output device, usually a keyboard and a monitor.
   c. A computer small enough to store in the pocket of a jacket.
   d. An acronym for the most common type of computer.
   e. A computer designed to provide software and other resources to other computers over a network.

4. a. What are the applications completed by a supercomputer?
   b. Describe a mainframe computer.
   c. What is timesharing?
   d. Why are millions of personal computers used throughout the world?
   e. List some of the names for a portable computer.
   f. Describe a portable computer.

Development

5. ‘A personal computer has the same capabilities that were only available in mainframes a few years ago.’ Is this statement correct? What is the current speed of the CPU for personal computers? What was the processing speed of mainframes and supercomputers a few years ago?

6. Handheld computers such as palmtops have become very popular. Do research into handheld computers. Describe the latest features for these devices. Outline the advantages and disadvantages of a handheld computer compared to a PC.
4.6 Troubleshooting and maintenance

Computer users need to perform basic troubleshooting procedures when dealing with hardware problems. It is also important that users adopt procedures for the care and maintenance of their computer.

Troubleshooting

Computers and their peripheral devices will not last forever. It is important to be able to locate the fault so that it can be repaired. Peer checking is a common method of determining whether a piece of equipment is faulty. It involves swapping the device with another device that is working. For example, a monitor is checked by replacing it with another monitor and keeping all the same cables. Peer checking is a useful method of troubleshooting for keyboards, mice, screens, hard disks and most peripheral devices.

Common operating faults are overcome by carefully analysing the situation. Some of the basic problems involve:

- **Starting up:** Turn the power off and check the power chord connections. Press the button to turn on the system unit and the screen.
- **Blank screen:** Check that the screen is turned on and that the monitor cable is connected to the computer. Check the settings for brightness and contrast.
- **Not reading data:** Check that the disk drive is connected to the computer. The drive cable needs to be firmly connected. If you cannot read a CD or DVD it is usually the disk that is causing the problem. Clean the disk and check for scratches (see Figure 4.18).
- **Not printing:** Check that the printer is turned on and correctly connected to the system unit. Ensure there is paper in the printer and that the operating system recognises the printer.

Figure 4.18 Cleaning CDs is an important troubleshooting task
• Mouse not working: Check that the mouse is being used on a flat surface that is dust free. Remove the mouse ball and gently clean it to remove any dust. Ensure that the operating system recognises the mouse in use.

Care and preventative maintenance
The following tasks need to be completed on a regular basis to prevent problems with your PC:
• Turn the computer off when working inside the system unit. A PC toolkit provides the necessary tools to connect any peripheral device (see Figure 4.19). Check that you do not have any static electricity that could damage internal components by wearing an anti-static wrist strap or by touching an unpainted metal surface such as the power supply. Use a surge protector to stop voltage increases affecting your system. Unplug the computer during thunderstorms.
• Do not eat or drink near the computer. Ensure that your work area is free of dust and small objects such as staples. If dust builds up inside the system unit, remove it carefully with a small vacuum cleaner. Be careful around circuit boards as a vacuum cleaner can remove components and jumpers. Small pieces of rubbish in your keyboard can be removed by turning the keyboard up-side down and shaking it gently.
• Clean the screen with a soft and slightly damp cloth or paper towel. Commercial cleaners can damage the surface of the screen and may enter the electrical system.
• Ensure that the computer is not exposed to direct sunlight or any other heat source for long periods of time. Check that the cables are in perfect working condition. Replace any cables that have deteriorated or are frayed. It is good practice to securely bundle large numbers of cables.
• Turn off the printer using the power button as this prevents the print head from drying out. Be careful cleaning inside the printer.
Use water or rubbing alcohol as a cleaning solution. Check the printer for small pieces of paper that may cause jamming.

- Delete unnecessary folders and files. Defragmenting your hard disk will reorganise your files and make disk operations faster. Regularly backup data files to another hard disk, CD or tape. If your main storage device is damaged then you are able to access the backup files to retrieve data. Protect your system from viruses by installing an up-to-date anti-virus program.

- Complete and send all warranty documents and register each piece of software. Most warranties become void if an unauthorised person tries to repair the product.

It is good preventative maintenance to complete an annual service and maintain a file that contains all the information about your system. Each time you make a change to your system, such as adding or removing hardware or software, you should update this file and obtain a hard copy. This file should contain the following information:

- date and retailer where you purchased your computer equipment
- serial numbers of all hardware and software purchased
- telephone numbers and addresses of any businesses that will provide support under warranty
- chronological history of problems and their solutions—this information is helpful for discussions with support people.

**Exercise 4.6**

1. Copy and complete the following sentences:
   a. If the mouse is not working remove the _______ and gently clean it to remove any dust.
   b. A PC toolkit provides the necessary tools to connect any _______ device.
   c. Use a vacuum cleaner carefully near _______ as it can remove components and jumpers.
   d. Protect your system from viruses by installing an up-to-date _______ program.
   e. Most warranties become void if an _______ person tries to repair the product.

2. True or false?
   a. If the PC is not reading data it is usually a problem with the CD.
   b. Commercial cleaners should be used to clean the surface of the screen.
   c. Defragmenting your hard disk will make disk operations faster.
Copy and complete the following by replacing the letter in brackets with a suitable term:
Swapping a device with another device that is working is called (a). This is a useful method of troubleshooting for (b), mice, (c), hard disks and most peripheral devices.

4 Describe the steps to overcome these common operating faults:
   a not starting up
   b blank screen
   c not printing.

5 a What is the purpose of a surge protector?
   b How should you clean the screen?
   c Describe the care that should be taken with a printer.
   d List the information that should be maintained about your system.

Development

6 Write a checklist that a person could use to ensure that they are correctly setting up a PC. Your checklist should contain information to prevent any damage to the PC.

7 Create a table to store information on your PC. The information should contain purchase details, serial numbers, warranties and a history of problems. Complete the table with data relevant to your computer.
Chapter review

**Part A: Multiple choice questions**

Select the alternative (a), (b), (c) or (d) that best answers each question.

1 Which of the following is not a function of hardware?
   a ALU
   b Input
   c Output
   d Storage

2 What is the name of the socket used to connect peripheral devices?
   a Port
   b Bus
   c IC
   d Expansion slot

3 What is a microprocessor?
   a A CPU contained on one integrated circuit
   b Part of the CPU that performs data calculations and comparisons
   c Temporary storage area for small amounts of data
   d Another name for a personal computer

4 What is an input device that consists of a special electronic pad and a pen?
   a Light pen
   b Graphics tablet
   c Pointing stick
   d Touch screen

5 Scanners are input devices that perform what function?
   a Capture and store images in digital form rather than on film
   b Use a light source to read characters and barcodes
   c Capture sound
   d Make a digital representation of any printed image

6 Which of the following is not an input device?
   a CPU
   b Keyboard
   c Mouse
   d Digital camera

7 Which type of fast printer produces high quality output?
   a Inkjet
   b Dot matrix
   c Laser
   d Plotter

8 Which of the following technology involves firing a beam of electrons onto the inside of a screen containing a coating of phosphor?
   a DPI
   b CRT
   c LCD
   d RGB

9 Which of the following is an expensive computer about the size of a refrigerator that is used for large computing jobs?
   a Supercomputer
   b Mainframe
   c Personal computer
   d Portable computer

10 Which of the following help to prevent problems with your PC?
    a Do not eat or drink near the computer.
    b Clean the screen with a slightly damp cloth or paper towel.
    c Turn the computer off when working inside the system unit.
    d All of the above.
Part B: Matching the term

For each of the following statements (1 to 10), select from the list of terms (a to j) the one that most closely fits the statement.

Statements

1. A pathway of wires on the motherboard that connects various components.
2. An expansion card that allows the PC to accept microphone input and play music.
3. It directs and coordinates the entire hardware system.
4. A pointing device consisting of a small rod that looks like a pen.
5. A small handheld input device that is moved over a flat surface to control the movement of a pointer.
6. An input device that captures video in a digital format.
7. It uses LCD technology to project images onto a larger screen.
8. A display surface that provides immediate feedback about what the computer is doing.
9. A handheld computer that is small enough to store in the pocket of a jacket.
10. A common method of determining whether a piece of equipment is faulty.

Terms

a. Bus
b. Control unit
c. Data projector
d. Digital video camera
e. Light pen
f. Mouse
g. PDA
h. Peer checking
i. Screen
j. Sound card

Part C: Extended response questions

Write at least one paragraph for each of the following:

1. Identify the hardware components found in the system unit. What is a co-processor?
2. Is the CPU always contained on one integrated circuit? Explain your answer.
3. How do OCR devices read typed text?
4. Describe three common output devices.
5. Briefly describe the four common classifications of hardware systems.
6. Your computer is not working. List some of the possible reasons for this fault.

Project: Personal computers

Buying a personal computer can be a very costly investment, particularly if you buy a computer that does not meet your needs. What reasons do you have for purchasing a computer? Put these reasons for buying a computer in order. Examine the current prices of hardware for a personal computer. Construct a table that compares the hardware that could be purchased for $1000, $3000 and $5000. For each price scenario state the hardware component, its specifications and price. Ensure that the prices quoted are in Australian dollars. Do the computers you have specified meet your needs?