2 Computer systems

A computer system comprises both hardware and software components and these two basic elements need to work in harmony.

Operating systems software is needed to run the computer. This unit looks at the Microsoft operating systems which currently dominate the market, but you will also look at other operating systems and explore at least one other in some detail. The operating system, together with essential utilities, provides the programs needed to manage a computer system. This unit looks at the options available for essential utilities such as anti-virus software, which is often pre-installed but might be purchased from a third party.

Manufacturers of hardware offer a wide range of models, each with its own specification. This unit reviews the many hardware components of a computer system and how they interact.

Deciding which particular model is appropriate for a given situation depends on a variety of factors. You will explore these factors so that you can make informed choices when selecting the components for a system.

Technicians also need the skills required to set up and carry out routine maintenance of computer systems. Although this unit does not cover fault finding and repair (covered in Units 12 and 13), it includes the basic maintenance skills that would normally be expected of most technicians.

Learning outcomes

After completing this unit you should:

1. understand the components of computer systems
2. be able to recommend computer systems for a business purpose
3. be able to set up and maintain computer systems.

Assessment and grading criteria

This table shows you what you must do in order to achieve a pass, merit or distinction grade, and where you can find activities in this book to help you.

To achieve a **pass** grade the evidence must show that you are able to:	To achieve a **merit** grade the evidence must show that, in addition to the pass criteria, you are able to:	To achieve a **distinction** grade the evidence must show that, in addition to the pass and merit criteria, you are able to:
P1 explain the function of computer hardware components **See Assessment activity 2.1, page 19**		
P2 explain the purpose of operating systems **See Assessment activity 2.1, page 19**	**M1** compare the features and functions of different operating systems **See Assessment activity 2.1, page 19**	
P3 explain the purpose of different software utilities **See Assessment activity 2.1, page 19**		**D1** explain how software utilities can improve the performance of computer systems **See Assessment activity 2.1, page 19**
P4 recommend a computer system for a given business purpose **See Assessment activity 2.2, page 22**	**M2** justify choice of computer system to meet a given business purpose **See Assessment activity 2.2, page 22**	
P5 set up a standalone computer system, installing hardware and software components **See Assessment activity 2.3, page 32**		
P6 configure a computer system to meet user needs **See Assessment activity 2.3, page 32**		
P7 test a configured computer system for functionality **See Assessment activity 2.3, page 32**	**M3** evaluate the performance of a computer system **See Assessment activity 2.3, page 32**	**D2** explain and justify improvements that could be made to a computer system **See Assessment activity 2.3, page 32**
P8 undertake routine maintenance tasks on a standalone computer system **See Assessment activity 2.3, page 32**		

How you will be assessed

This unit will be assessed by a number of internal assignments that will be designed and marked by the staff at your centre. It may be subject to sampling by your centre's External Verifier as part of Edexcel's ongoing quality assurance procedures. The assignments will be designed to allow you to show your understanding of the unit outcomes. These relate to what you should be able to do after completing this unit.

Your teacher will tell you precisely what form your assessment will take, but it could be in the form of:

- diagrams, notes and comparative tables
- a presentation with supporting notes
- witness statements, and observation records of your skills in installing components
- screen shots and test records.

Priya, BTEC National IT student

I've always enjoyed working on computers at school and at home, but whenever we bought a new computer, my elder brother or my Dad would decide what we needed. I was never consulted and I didn't have the confidence to voice an opinion about what we might buy next.

Completing this unit has given me time and the motivation to find out much more about all the components parts of a computer system. I now understand all the technical jargon and can recommend systems to suit different business purposes.

I had also not really had much to do with the maintenance of computers that I used. Now though, I appreciate what needs to be done and when, so that my hardware lasts for longer and my system works more efficiently.

Over to you

- **Do you already know how to set up – and maintain – a computer?**
- **How familiar are you with the technical details associated with hardware and software?**
- **Do you understand all the computer jargon?**
- **How confident would you be if asked by a friend to recommend what computer they should buy?**

1   Understand the components of computer systems

The perfect computer

Just imagine: you've won the lottery or come up on the premium bonds!
If money was no object, what computer would you buy?

- What make and model of computer would you choose?
- What mix of hardware would you order?
- What operating system would you prefer to use?
- What software would you want to install?

Of course, everything depends on your planned use of the computer system, so think about that too.

Compare notes with others in your group. Did you all agree on the same configuration? If not, why not?

1.1   Internal system unit components

Let's look at what's inside the box and what options you might have when purchasing a new computer system: which peripherals you might decide to attach and the specialised cards you might decide to install.

Processors

The processor is a chip housed on the motherboard and is the 'heart' of a computer system – it controls everything. It contains the circuitry which processes the instructions in the computer programs by interpreting them into actual movements of bits of data within the computer memory.

The control circuitry pulls data in via the various ports, directs it along data buses, stores it within the memory, performs calculations on it and sends the results of processing to a VDU screen, to a printer or to a secondary storage device for more processing at a later date.

Computer manufacturers constantly seek to improve the processor by increasing its capabilities (i.e. the types of instructions that it can process) and its speed.

With each new development of processor chip, the voltage that the processor requires has also been reduced; this makes the processor more reliable because it does not get so hot.

Did you know?

The speed of a processor is measured in GHz – the higher the number, the faster the processor works.

Figure 2.1: Processor configuration

The memory capacity has also increased, as has the size of the cache (see page 12).

Motherboard

The motherboard is the most important component within a PC system. It is a **PCB** that houses many of the essential parts of the PC and all connections between the PC and peripheral go through it.

BIOS

The **BIOS** is a collection of software utilities that forms part of the operating system. It is usually on a **ROM** chip that comes with the computer, called the ROM BIOS.

Being on ROM, the BIOS is not affected by power failure and makes it possible for the computer to boot itself. So, what does the BIOS do?

- The BIOS boots up the PC, i.e. it starts up the PC every time it is turned on.
- The BIOS checks the actual hardware configuration against the configuration data. It ensures the integrity of the computer system and can therefore prove to be the most important diagnostic tool available to you.
- The BIOS handles the input and output of the computer, allowing the operating system to use particular features of hardware within the configuration.

Case study: Anne's laptop (1)

The hardware of a computer system – the main components and the **peripherals** – can be found either within the processor box or attached to the computer by some cabling.

There are also peripherals which do not need cabling and which rely on wireless or infrared to transmit data between processor and peripheral, and vice versa. For each type of peripheral, there is a **port** on the processor to which it is connected, either through a cable or via a wireless link.

Anne has a laptop, and this is linked via **USB** cabling to a mouse, a printer, a hard drive and a webcam.

According to the system information on Anne's laptop, she has a Dell Precision M6300 with Intel(R) Core(TM)2 Duo CPU T7770 processor running at 2.4 **GHz** with 3.50 GB of **RAM** (Figure 2.1).

1. Find out what processor is at the heart of your computer. What is its speed? List its other characteristics.

2. Research the Internet to find out more of the history of the chip. What are the most popular chips today? What are their basic characteristics? Present your findings as a table showing the development of the chip from early Pentium days to the present.

Key terms

PCB – stands for printed circuit board.

BIOS – stands for basic input/output system.

ROM – stands for read only memory. See page 11.

Peripheral – any device, such as a printer, attached to a computer so as to expand its functionality.

Port – provides the link between peripherals and the CPU (central processing unit).

USB (universal serial bus) – a higher-speed serial connection standard that supports low-speed devices

(e.g. mice, keyboards, scanners) and higher-speed devices (e.g. digital cameras).

GHz (gigahertz) – hertz are named after Heinrich Rudolf Hertz (1857–1894), a German physicist who studied electromagnetic radiation. Hertz are a measurement of frequency in cycles per second: 1 hertz is one cycle per second.

Giga – one billion; when measuring computer data, giga means 2^{30} (= 1,073,741,824), which is the power of 2 closest to one billion.

RAM – stands for random access memory.

When the computer is turned on, its memory is empty, apart from one set of hardwired instructions that are located at an address called the jump address. These important few instructions, when executed, will load the BIOS into memory. So, the computer 'jumps' to the jump address, starts executing instructions and this results in the BIOS being loaded.

The loading of the BIOS is part of the booting up process during which the configuration of the computer is checked (during the **POST** process) and the operating system loaded, so that everything is ready for the user to start work.

Activity: Motherboards

1 Find out what type of motherboard you have installed on your computer. Locate the BIOS ROM chip on a motherboard. What make of BIOS ROM is it?

2 Identify the main components on a motherboard. Draw a diagram to show the position of the processor chip, the BIOS chip, the battery, the power supply connector, the memory slots, the expansion slots, the ports and other important components. Look at how components are slotted into place.

3 Turn on your computer and watch the POST process. Note what happens if one part of your system is not working or has been disconnected (such as a LAN cable).

Power supply

Within a PC, the **PSU** is a black or silver coloured box, with a fan inside it and cables coming from it.

Did you know?

So that PCs may be used worldwide, there may be a 110/220V selector switch on the PSU.

The main job of the PSU is to supply power to the various components of the PC. There are two types of power: internal and external.

- The external power via the socket provides **AC** of 110–220V.
- The internal power needed by the various components within the PC is either 5V or 12V of **DC**.

Key terms

POST – stands for power-on self test, a hardware diagnostic routine that is run during the start-up boot sequence and checks configuration settings of the computer.

PSU – stands for power supply unit.

AC – stands for alternating current. It is a type of electricity. The direction of the current alternates (very quickly), providing an efficient way of supplying power over long distances.

DC – stands for direct current. A different type of electricity, where the power runs from negative charge to positive charge, always in the same direction. This works fine for battery-powered devices where the power has only a short distance to travel.

Since PC components work on DC and the power from the wall socket supplies AC, the PSU has to convert AC to DC. So, the PSU converts the incoming supply of power to one that is needed: the right type and at the required voltage.

Activity: PSU

1 Locate the PSU within your desktop computer's processor box. Note the leads that run from the PSU to other devices. Draw a diagram to illustrate the connections.

2 Find out what voltages different peripherals (such as a monitor, printer and mouse) require. How are these devices powered?

3 Check the type and power of the battery that is located on the motherboard. What is this battery used to power?

4 Find out how a laptop is powered when there is no connection to the mains supply.

Fan and heat sink or cooling

The airflow and cooling system may seem a minor design point but, like a car engine, if the chips within the PC become overheated, they may fail. Some components, such as 3D video cards, generate a lot of heat and these can affect other chips close to them. So, the placement of essential chips (like the CPU!) has to be carefully decided, all within a limited amount of space on the motherboard.

Early PCs, cooled by airflow within the case created by a fan in the PSU, relied on cool air being sucked into the case by the fan. For later models of PC, a **heat sink** or **processor cooling fan** (or both) were attached to the CPU. To make the system even more efficient, the PSU fan was reversed so that it acted as an extractor, pulling hot air out of the PC case.

Modern chips, such as the Pentium processor, present special problems: they become much hotter than previous designs of chip and so need a careful heat dissipation system. Otherwise, they can overheat and fail.

Key terms

Heat sink – a device attached to the processor chip that has lots of fins so that its surface area is maximised and the heat transfer from the chip is maximised. It draws heat from the processor and therefore keeps its temperature down.

Processor cooling fan – a tiny fan attached to the processor chip or heat sink to prevent it from overheating.

IDE – stands for integrated drive electronics. It refers to a standard electronic interface between a computer motherboard's data paths (or buses) and the computer's disk storage devices, based on the IBM PC ISA (industry standard architecture) 16-bit bus standard.

SATA – stands for serial advanced technology attachment. This is a computer bus interface for connecting host bus adapters to mass storage devices such as hard disk drives and optical drives.

Activity: Cooling

1   Locate the processor on a motherboard. What cooling device is used?

2   Research the Internet for data on heat sinks. What materials might these be made from?

3   Research the Internet to find out what happens (and at what temperature) if the fan stops working on a PC, or the heat sink is removed or not connected properly to the processor chip.

Hard drive configuration and controllers, e.g. SATA, IDE, EIDE, master, slave

The hard drive for a computer, together with a drive for CDs and DVDs, are usually located within the processor box. However, an external hard drive can provide additional secondary storage and may also be used as a backup device.

Hard drives, wherever they are located, are **IDE** devices, controlled by an IDE controller.

Did you know?

An enhanced version of IDE called EIDE (enhanced IDE) was superseded by **SATA** which is now used in most new computers.

There are two types of IDE controller: primary and secondary. The hard drive is normally attached to the primary IDE controller (the IDE1 connector). A CD drive (or DVD drive or another hard drive) can then be attached to the secondary channel (the IDE2 connector) on the motherboard.

Each IDE ribbon, attached to either one of these controllers, can support two drives. To know which data relates to which drive, each drive is identified as either the master drive or the slave drive.

- **Master drive**: handles all the traffic on the IDE cable. Its controller retains its own data and passes on data to the slave drive.

- **Slave drive**: sees only the data that is passed to it by the master drive. (NB There does not have to be a slave drive if there is only one drive attached to the cable.)

Case study: Anne's laptop (2)

Anne's laptop has a three-port SATA storage controller (see Figure 2.2). The Device Manager also reveals Anne's laptop is configured for an HP Officejet 6100 series printer, a Logitech Quickcam Express #5 and a Smartcard Reader.

1   Check the ports available on your computer. List them and the devices that can be attached to them.

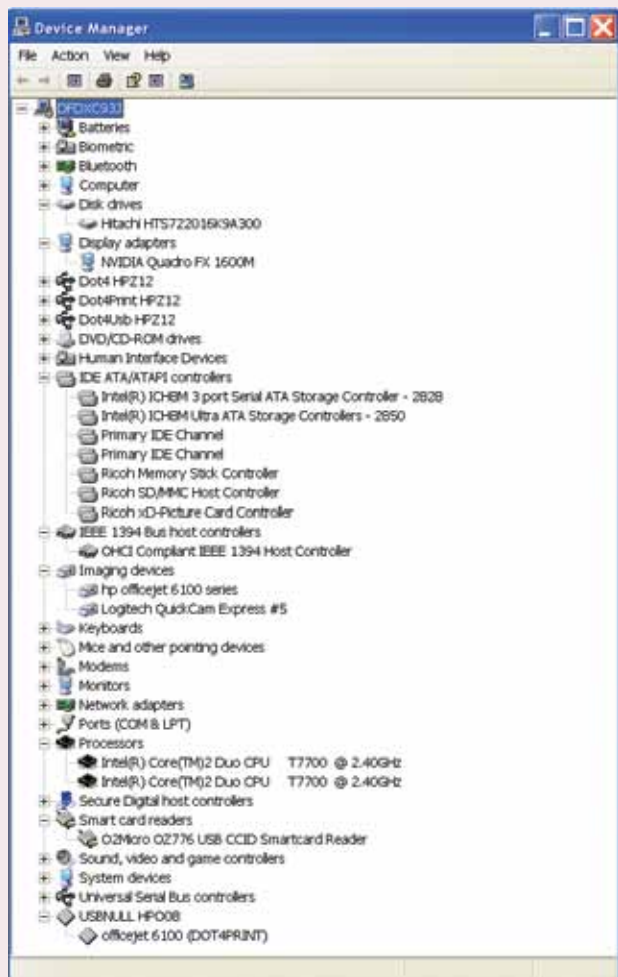2   Research the Internet for information on SATA controllers.

Figure 2.2: The Device Manager

Activity: Hard drives

1   Locate the hard drive within your PC. Check which IDE channel is being used for it. Check the master/slave settings.

2   Identify any other backing storage devices attached to your computer. Which are internal? Which are external? How are they connected to the processor?

Not all peripherals need a cable to link them to the port; some use wireless or infrared technology. However, a variety of ports are available so that a range of peripherals, each with differing needs, may be attached to the processor (see Figure 2.3).
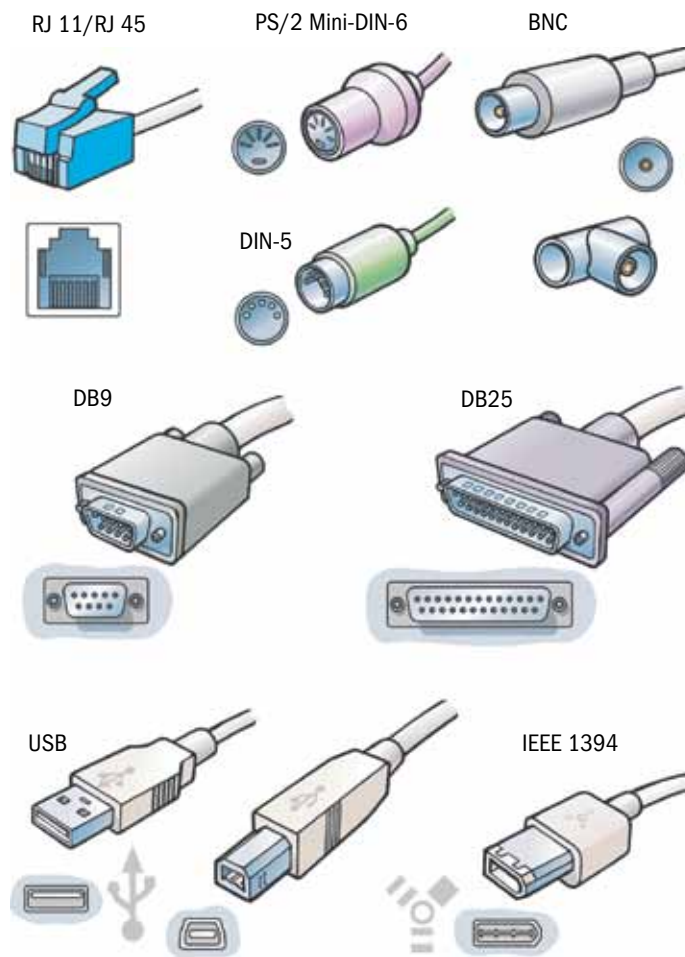

Figure 2.3: Ports and connectors

For example, if cabling is used, the transfer of data to and from the peripheral will be one of two types:

- **serial transmission** – 1 bit at a time and the cable is usually circular in cross-section
- **parallel transmission** – 1 byte (8 bits) at a time. This cabling looks like a ribbon, the wires being laid side by side.

The simplest devices such as mouse and keyboard only need serial connection. Others, such as printers, benefit from the two-way communication of parallel connections. However, nowadays, you're more likely to see a printer connected via a fast serial port using a USB connector, this being a faster option than the old ribbon connection.

The serial and parallel ports on the PC are very different, as are the connectors that fit into them (see Figure 2.4).

- The **serial port** conforms to the **RS-232c** standard. It requires a 25-pin male port, but PCs only use 9 of these pins so it can be, and often is, replaced by a 9-pin male port.

Figure 2.4: Serial and parallel connectors

> ## Key term
>
> **RS-232c** – stands for Reference Standard 232 revision c.
>
> **Hot swapping** – connecting (or disconnecting) a peripheral while the PC is turned on.

- The **parallel port** on the PC, e.g. for a printer, offers a female 25-pin DB (databus) connector. A male 25-pin DB connector on one end of the printer ribbon cable will clip or screw into place. At the other end of the cable, at the printer end, is the 36-pin Centronics connector.

USB was designed to make the installation of slow peripherals, such as the mouse, joystick, keyboard and scanners – and other devices, such as printers, digital cameras and digital telephones – as easy as possible. Nowadays, the USB host controller is included in the chipset and this recognises when you plug a device into a USB port and allows **hot swapping** of devices.

There may be as many as four or more USB ports supported by a motherboard (see Figure 2.5).
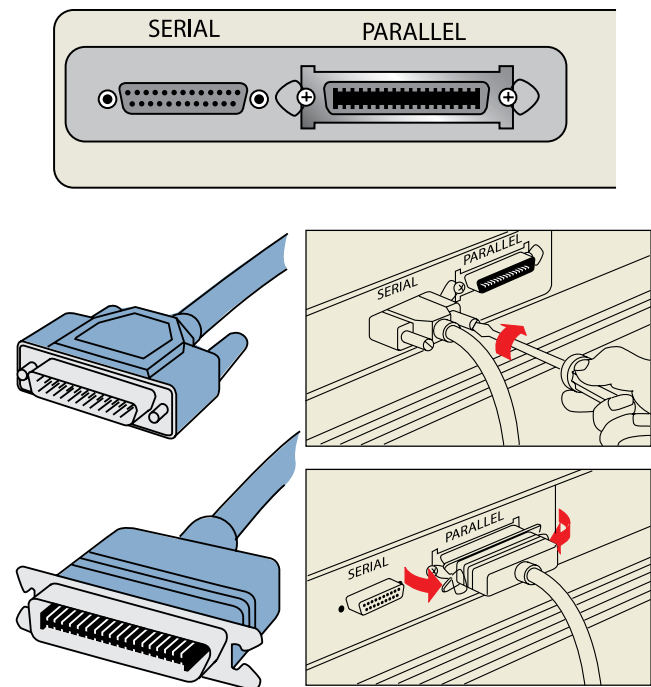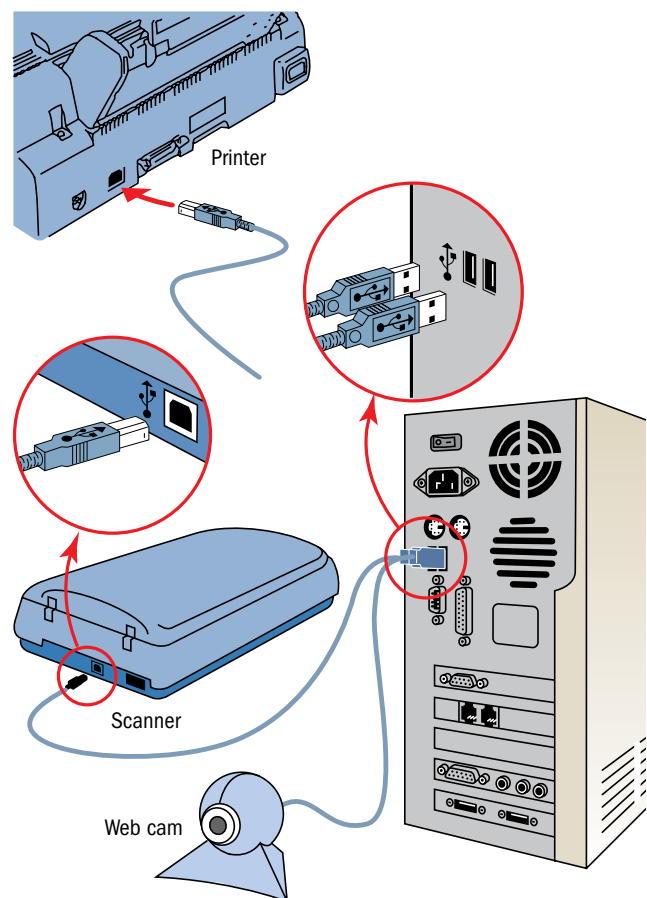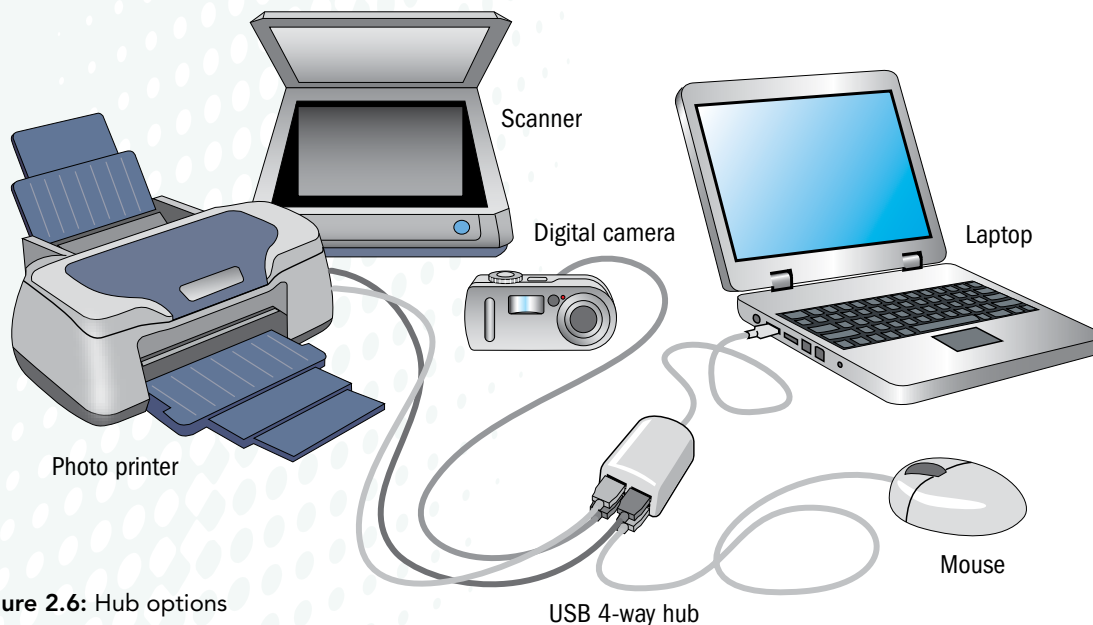

Figure 2.5: USB port and connector

Figure 2.6: Hub options

It is also possible to link the devices in a 'daisy chain' so that the PC may have many more devices attached – each device provides the USB port to the next device in the chain. Another option is to have a USB hub, into which devices can be plugged (see Figure 2.6).

For a wireless mouse, a connector (called a notebook receiver) may be attached to a USB port – the mouse is then battery-operated.

Generally, transmission via a serial port is a slow, inexpensive method of data transfer. USB is faster than standard serial and an optical serial connection may transfer at an even faster rate, faster than a parallel connection. So, parallel transmission is usually, but not always, faster than serial.

Activity: Peripherals

1 Research the Internet to find out when the mouse was first introduced. Prepare a presentation to show the development of technologies for pointing devices from then until the present day.

2 Which peripheral is the most recent invention? Obtain details of its functionality and cost.

Internal memory

Internal memory is used for two main purposes: to store programs that are being run and to store the data that the program works on.

Did you know?

Everything in a computer's memory is data. Although programs may seem different from data, they are treated in exactly the same way: the computer executes a program, instruction by instruction. These instructions are the 'data' of the fundamental program cycle: fetch the next instruction, decode it and execute it. Then the next program cycle starts to process the next instruction. Even the address of the next instruction to be fetched is just data.

There are two main types of memory within the PC: RAM (random access memory), which is volatile, and ROM (read only memory), which is non-volatile. Volatile memory loses its data when the power is turned off. So, for example, when your computer crashes and you have to turn it off and restart it, whatever changes you made to a document since it was last saved (either by you or using an Autosave function) are lost. Like other memory, both RAM and ROM are measured in bytes or, more likely, GB (gigabytes).

Did you know?

Programs that are written and stored in RAM are called software – the instructions can be overwritten. To preserve data and/or program instructions for use later, these have to be stored either on ROM (see page 12) or to a secondary storage device such as a hard disk (see page 15).

RAM memory chips provide a form of memory that offers the same **access time** for allocations within it (hence the term 'random access'). The time it takes to fetch a program instruction affects the speed at which an application can run. For optimum performance, the 'page' of code that is being executed is brought from the backing storage location (e.g. on the hard disk) into RAM. When these instructions have been executed, the next page is swapped into position. Having a greater amount of RAM results in there being space for more instructions that can be held close to the processor at any one time, and this reduces the amount of time spent swapping pages into and out of RAM.

A 'crash' can result when the processor spends its time swapping pages rather than executing the instructions – this can happen if you try to run too many applications at the same time, each of them needing its own page space in RAM.

Did you know?

The RO in ROM stands for 'read only' but, depending on the type of ROM, you may or may not be able to write to it.

Key terms

Access time – length of time that RAM takes to write data (or to read it) once the request has been received from the processor is called the. This is measured in nanoseconds (ns): the fewer ns, the faster the RAM.

Firmware – the name given to the instructions encoded onto ROM chips. Unlike software, once written it cannot be changed.

Cache memory – a fast memory that is used as a data buffer between the CPU and RAM.

Wait state – a time of inactivity for the CPU to allow other devices to catch up with it.

Latency – a time delay that could be better used, e.g. for processing.

ROM is non-volatile memory. It does not lose its data when the power supply is off, so it can be used to store data and/or instructions (called **firmware**) that are needed when you next turn on, e.g. for the BIOS chip.

There is one other type of memory: a fast memory that is used as a data buffer between the CPU and RAM called the **cache memory**.

- Internal cache is located inside the CPU chip – also called primary cache or on-die cache.
- External cache is also on the motherboard but not within the CPU chip19 – also called secondary cache.

Cache memory can also be categorised according to its closeness (proximity) to the CPU.

- Level 1 (L1) cache is closest to the CPU and, like internal cache, is housed within the CPU chip.
- Level 2 (L2) cache is not so close – it may also be on the CPU chip (just behind the L1 cache) or it may be external cache.

Why is cache memory needed? Central to the operation of a PC is the communication between the CPU and RAM. These two components (like many others in a computer) work at differing speeds.

- The CPU works in megahertz (millionths of seconds).
- The RAM works in nanoseconds (billionths of seconds).

Even though the RAM is so much quicker, it takes time to find the data that is needed and bring it via the data bus to the CPU for processing. To aid the process, the CPU interacts with the RAM by having a series of **wait states** – it actually pauses for a while to allow the data that it wants to be transferred from RAM into the registers within the CPU. Data may be coming from far away, e.g. from a hard disk, and so it has to be transferred from the disk to RAM and then from RAM to the CPU. So, extra wait states may be necessary.

Even when the data is within RAM, there is a delay in transferring data within the PC called **latency**. Wherever the data is, the CPU has to wait – and an idle CPU is not acceptable!

The cache memory is there to solve this problem. It acts as a buffer, and holds data that the CPU will need, e.g. things that are used a lot. Like a printer buffer, the cache memory makes up for the mismatch between the speeds of the CPU and RAM.

Caching involves some guesswork by the system which has to decide what the CPU will need next. This

guesswork uses the principle of **locality of reference**, and a good guess results in a more effective use of CPU time.

- A good guess for the disk cache is that it will be whatever comes next on the disk.
- For the internal cache, a good guess would be whatever lies in the next section of RAM.

Activity: Internal memory – cache memory

1 What types of internal memory are being used in your computer? How much is installed?

2 Research the Internet to find out how much cache memory is used in a number of PCs with different specifications.

Specialised cards

Expansion slots allow the life of a computer to be extended, since new technology can be added as it becomes available. They allow you to add specialised cards to your PC, e.g. for a **modem**, a sound card and/or an **NIC**.

Activity: Specialised cards

1 Locate the expansion slots within your PC, and list the expansion cards already in the slots.

2 Repeat this activity on other PCs, noting differences between the form factors (shape and size) of the motherboards and the cards that are present in the slots.

3 For one video card, visit the manufacturer's website and find out as much as you can about the card. Compare notes with others in your group.

4 Research the Internet to find out about video adapter card standards: MDA, CGA, EGA, VGA and AVGA. Discover what resolution they support and how many colours they can display.

Key terms

Locality of reference – guesswork principle used by the caching system. There are three types of locality: temporal, spatial and sequential. Temporal locality assumes that if a resource (e.g. a program instruction or a data item) is referenced now, then it will be referenced again soon. Spatial locality recognises that most program instructions are found in routines and that these routines are usually close together; also that data fields are close together. It assumes that the likelihood of referencing a resource is higher if a resource near it has been referenced. Sequential locality assumes that memory will be accessed sequentially.

Modem – **mod**ulator/**dem**odulator

NIC – stands for network interface card.

I/O devices (input/output devices) – devices which allow input and output.

1.2 Peripherals

Peripherals fall into two groups.

- **Output devices** such as a monitor, printer or plotter present the results of any processing to the user.
- **Input devices** such as a keyboard, camera or scanner provide a way for the user to put data into the processor and to give commands (e.g. a pointing device like a mouse to click on the application you want to open, or to select an option from a menu).

Did you know?

I/O devices – also known as storage devices or the backing store – are not peripherals. They provide a place, other than the RAM or ROM memory within the PC, to store data. They also provide portability, allowing data (and software) to be transferred from one PC to another, e.g. on a CD-ROM.

According to their type (serial or parallel), input and output devices need to be connected to the processor using appropriate cabling (e.g. coaxial, optical, twisted pair) to an appropriate port; or configured as wireless devices.

1.3 Backing storage

Primary storage, located within the computer, is relatively small and the majority of it is lost when the computer is switched off.

- To create a more permanent store for data (including software), a **secondary storage** device or backing store is needed, such as a hard drive.

- To create a portable store for data, offline storage devices are needed: CD-ROMs, DVDs, memory sticks, etc. These are sometimes referred to as **tertiary storage**.

There are a variety of types of backing store now available to the PC user: magnetic discs and optical discs and the newer **pen drives** (see Figure 2.7) and **flash memory cards** (see Figure 2.8).

> **Did you know?**
>
> Flash memory cards evolved from EPROM (erasable programmable read only memory) and the process called flashing, which involves overwriting what was once considered to be a write-once medium.

To access the data on a flash memory card, a card reader is plugged into the USB port and the card is slotted into the reader. Because there are lots of different shapes and sizes of flash memory card and each one needs a reader with the right shape slot before the data can be transferred, there is also a range of readers available. There are also some readers available which accept more than one size of card – these have several slots. Laptops invariably have a memory slot and this will take a Type II memory card.

Figure 2.7: A pen drive

Figure 2.8: A memory card reader

Portable and fixed drives

In the design of early computers, the drives (i.e. the readers) were located within the casing. Hard disks were fixed within the casing but other media formats (such as magnetic tape and floppy disks) provided portable ways of storing data. More recently, external hard drives have been developed and this has brought with it the option to move a hard drive (and the hard disk within it) from one computer to another. Similarly, pen drives and card readers, both of which plug into the USB port, provide a portable solution to data storage. With the increased capacity and compact format of these devices, it is now possible to enjoy portability for large amounts of data.

> **Key terms**
>
> **Primary storage** – the memory of the computer.
>
> **Secondary storage** – a backing store that remains with the computer and provides a greater capacity than the processor can offer.
>
> **Tertiary storage** – a store that is destined for transfer to another computer or archiving and needs to be on a portable medium.
>
> **Pen drives** – small devices that can be used to transfer files between USB-compatible systems and provide a high-capacity alternative to CD-ROMs. They are plugged directly into the USB port and need no batteries for power.
>
> **Flash memory cards** – a portable medium for data. Commonly used in digital cameras, they can hold your photos until you upload them to your computer or output them to a photo printer.

Performance factors

When deciding what storage device to use, a number of factors need to be taken into account.

• How much data will the device hold? What is its maximum capacity?

• How fast can the data be stored on (written to) the device?

• How fast can the data be retrieved (read) from the device?

The performance of a system can be monitored using a **profiler**.

Activity: Portable storage devices

1 Investigate the market for pen drive products. Produce a table to show their promised performance factors and include costings. Compare your findings with others in your group.

2 Research the Internet for data on flash memory cards. Find out which reader(s) is/are compatible with the cards, and compare their performance factors, e.g. transmission speeds.

1.4 Operating system software

At the very heart of any computer system is the operating system software.

Operating system examples

There are several of operating systems on offer:

• **DOS** was originally the name of an operating system developed by IBM for a line of business computers. The first personal computer version of DOS, called PC-DOS but now more commonly referred to as DOS, was developed for IBM by Bill Gates, who then set up Microsoft Corporation. It is a non-graphical line-oriented command or menu-driven operating system, with a relatively simple interface which lacks the 'friendly' user interface of the **WIMP** environment.

• **LINUX**: a Unix-type operating system originally created by Linus Torvalds with the assistance of developers around the world; the source code for Linux is freely available to anyone with Internet access.

Key terms

Profiler – a performance analysis tool that measures the behaviour of a program while it is running.

DOS – stands for disk operating system.

WIMP – stands for window, icon, menu, pointer.

• **Windows**: a WIMP environment system developed by Microsoft Corporation and sold under licence; used on IBM-compatible PCs. The first Windows operating system was simply an application – a user interface – that ran on top of the MS-DOS operating system.

• **MAC OS**: a parallel system of software developed by Apple for those users who choose not to follow the IBM-PC hardware route

Command line and GUI operating systems

Prior to the introduction of the WIMP environment, early computers relied on command line interpreters. The operating system responded to individual commands keyed in by the user. When it had finished doing whatever was asked of it, the user was presented with the command line prompt (usually including a > symbol) and the computer then waited for the next instruction. The user needed to have a high level of knowledge, particularly in how to give the commands in the DOS language.

When Windows-based operating systems were introduced, instead of entering a command, the user now indicated their selection or decision by clicking on an option in a menu, pressing a button or completing boxes on a form. The interface became far more user-friendly and it opened up the use of computers to people who had not learnt how to program a computer.

Operating system functions and services

The operating system includes a number of accessory programs which offer machine and peripheral management, security and file management. To access these functions and services, you might – on a Windows computer – press Start / All Programs / Accessories / Systems Tools and then you might run Disk Cleanup or Disk Defragmenter, both of which provide ways of tidying up your disk space (see pages 29–31).

Device drivers

For each peripheral device, a device driver is needed to interface between the processor and the peripheral. The driver acts as a decoder, so the data is interpreted correctly. Installing device drivers is necessary when new hardware is installed (see page 26).

Features

In choosing which operating system to use, you must take into consideration what features are on offer and which ones are most important for you.

- Does the operating system let you customise what you see on the screen and how you interact with the computer?
- Does it provide support for connectivity of portable media?
- What provisions are there to ensure tight security of the computer system?
- What guarantees do you have of stability and reliability?
- How easy is it to manage the computer system?
- What utilities are included?
- How much does it cost?
- What after sales support is on offer for the user?

1.5　Software utilities

Software utilities offer security in the form of virus protection and firewalls (see Figure 2.9).

Figure 2.9: McAfee's Total Protection Service

Virus protection

PCs can be attacked by **viruses**,**worms** and **trojans** arriving with emails or during access to the Internet.

Anti-virus software checks for intruders. It attempts to trace viruses by spotting the **virus signature**. Meanwhile, virus writers adopt cloaking techniques such as **polymorphing**.

Almost as soon as virus writers invent new viruses, so do anti-virus software vendors produce updated versions of their software.

The anti-virus software vendors maintain a database of information about viruses, their profiles and signatures. Users who subscribe to an online anti-virus protection service may have this database downloaded to their PC automatically each time an update is released. Other users may receive an email telling them that an update is available.

Having the most up-to-date virus information file, scanning regularly and avoiding opening emails that may contain viruses is the best advice. The main defence against viruses is to subscribe to a reliable software vendor's virus protection service. If the software detects a virus, a pop-up screen may offer options: to quarantine the file (i.e. move it so it can do no harm), to repair the file (i.e. delete the virus but retain the file) or to delete the file.

Anti-virus software vendors may offer to create a rescue disk – a bootable disk that also contains anti-virus software. If a virus-infected system won't boot, a rescue disk may solve the problem. Write-protecting the disk may prevent it from becoming infected with a virus.

Key terms

Virus – (so-called because it spreads by replicating itself) program that is designed to erase data and corrupt files.

Worm – type of virus that can forward emails (and the worm) to all your contacts using data from your address book.

Trojan – type of virus that hides by pretending to be a file or program which is usually present (and harmless) on your PC.

Virus signature – a sequence of characters which the anti-virus software gleans by analysing the virus code.

Polymorphing – a virus that is designed to change its appearance, size and signature each time it infects another PC (just as cells in a diseased human mutate), thus making it harder for anti-virus software to recognise it.

Firewalls

Firewalls build a protective barrier around computers that are connected to a network, so that only authorised programs can access data on a particular workstation.

The user can control exactly which software is allowed to pass data in and out of the system. For example, automatic updates might be allowed for some installed software.

For more on firewalls, see *Unit 5: Managing Networks*, page 27

Cleanup tools

Over a period of time, a PC becomes cluttered with data that you do not need.

- **Removal of cookies**: Each time you visit a new website and register so that you can receive newsletter updates or make a purchase, a cookie is most likely left on your PC so that the site can recognise you the next time you visit. These cookies are useful; they save you entering your details again. However, you may have cookies for websites that you never intend to visit again, so you might decide you would prefer to remove them (all) from your system.

- **Internet history**: Each time you request a page on the Internet, a copy of that page is retained in the Temporary Internet Files folder. This is useful because when you use the Back and Forward buttons, the web page does not need to be downloaded afresh. However, the space taken up by these pages can accumulate.

- **Defragmentation**: Each time you save a file, the space on your hard disk begins to fill. When files are deleted, some space becomes available, which appears as 'gaps' on the map of the disk. There may come a time when a file you want to save will not fit into an available gap. The system copes with this by fragmenting the file and storing the fragments wherever it can. Unfortunately, additional space is taken up noting the whereabouts of the fragments. Before long, the organisation of files on the disk is a mess!

Cleanup tools can be used to solve the clutter problem: Disk Cleanup scans a drive and presents a list of files you might like to delete (see Figure 2.10), while Disk Defragmenter (see page 29) rearranges files so that the gaps are used up systematically, leaving available space in contiguous (i.e. connecting) strings.
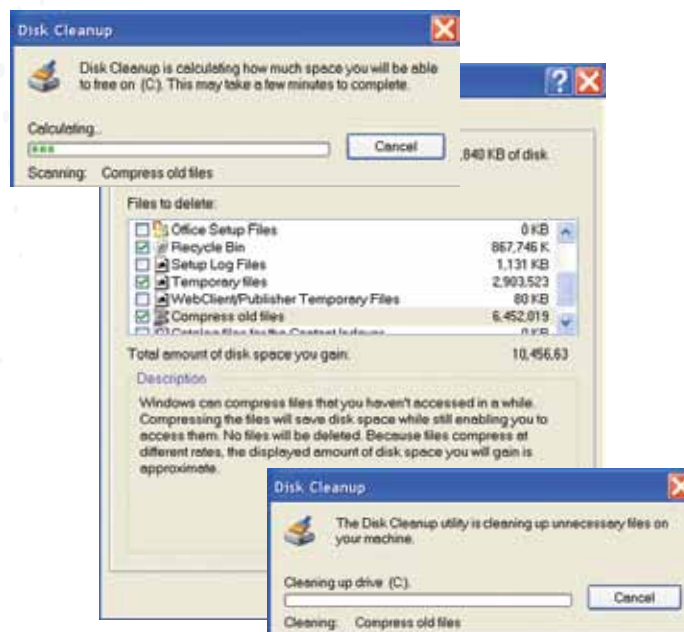

Figure 2.10: Disk Cleanup

Drive formatting

For storage media to be recognised by your computer so that it can be used to store data files, it has to be initialised or 'formatted'.

There are two stages.

- **Physical (low-level) formatting** tests the surface, scanning for imperfections and setting aside those sectors that cannot be used.

- **Logical (high-level) formatting** prepares the disk by setting up a file system which then defines how files and folders will be stored and accessed.

The high-level formatting process writes material to allow the operating system to interact with the disk: the **boot sector**, the **root directory** table and the **FAT** table.

Key terms

Boot sector – set aside to hold data about how data is organised on the disk, such as the number of sectors, the number of sectors per track, the number of bytes per sector, the number of FATs, the size of the root directory and the program needed to load the operating system. (This last item is the program that searches and loads files needed to boot the disk – if these files are missing, the disk is unbootable.)

Root directory table – has an entry for each file on the disk: the name of the file and the file extension, the file attribute, the date and time that the file was created or last updated, the position where the start of this file is to be found on the disk (cluster number) and the length of the file.

FAT – stands for file allocation table.

Did you know?

Since the clusters are too short to store whole files of data, a file will be stored in a number of clusters and these need not be consecutive on the disk. The file is then called fragmented. Keeping track of the many fragments of a file falls to the FAT. It records which clusters are used for which files. Defragmentation (see page 29) is a process which tidies up the disk, reusing the disk space more efficiently after some files have been deleted.

A disk utility program can be used to format or reformat a disk and this will create a seemingly blank, empty disk for storing your files, apparently destroying everything that was previously on that disk. However, the old data is still on the disk; the files don't show on the directory because they are no longer included in the directory structure.

Activity: Software utilities

1 Identify two different providers of anti-virus software. Do they also provide firewall protection?

2 For one provider of firewall protection, find out what is available for the user. Make notes.

3 Use the Disk Cleanup tool to rid your PC of unwanted files.

4 Find out how to format disks on your PC. Make notes.

Did you know?

If you format a disk or just delete files from a disk, you – or someone else – could gain access to the data using a utility such as Norton Disk Doctor.

Assessment activity 2.1

P1 P2 P3 M1 D1 BTEC

1 For your computer system, or one identified by your teacher, list the hardware components and, using one or more diagrams and/or photographs with supporting notes, explain the function of each component. **P1**

2 Jamil is about to buy a new computer system but isn't sure what make to choose: Microsoft Windows or Mac.

(a) Explain the purpose of operating systems. **P2**

(b) Compare the features and functions of different operating systems. **M1**

3 Jamil is also unclear about software utilities.

(a) Using a tabular format or otherwise, explain the purpose of different software utilities. **P3**

(b) Explain how software utilities can improve the performance of computer systems. **D1**

Grading tips

- Make sure to show the communication between components **P1**

  <We await amendment to the spec to include what the examiners require for **P2**

- You will need to refer to at least two different operating systems **M1**

- Include at least one example of each of these four types of utility: security, cleanup tools, defragmentation and drive formatting **P3**

  <We await amendment to the spec to include what the examiners require for **D1**.

PLTS

Text to follow from author

Functional skills

Text to follow from author

2 Be able to recommend computer systems for a business purpose

Activity: The best buy

Refer back to the 'perfect computer' you planned to buy, had you been lucky enough to win the lottery or come up on the premium bonds (see page 5).

- What were your priorities in deciding on the make and model of computer? List the factors of importance to you.
- What helped you to decide which software to include in your specification? Identify the factors that persuaded you one way or another.
- How much did you take into account your own competence on a computer or your own special needs?

Compare notes with others in your group. Are your priorities the same? If not, why not?

2.1 Considerations for selection

When deciding which make and model of computer to purchase and the configuration to construct (how much memory, which peripherals and so on), you should consider a number of factors. The final decision might have to be a compromise – perhaps because you have to keep within a budget – and the priority you give to each factor will, of course, depend on the relative important of each one.

Cost

Cost is usually a deciding factor in any purchase, not just computers: you should aim to buy the best specification within your budget. Computers are constantly being developed (faster memories, larger capacity, new and exciting peripherals), so to buy something that ignores the latest technologies will mean that your system is out of date as soon as you have bought it.

Savings can be made by buying from a company that offers lower prices, but these have to be judged against intangible considerations, such as whether the kit is going to prove reliable and whether there will be any backup support after you have completed the sale.

User requirements

The primary consideration is fitness for purpose. The computer system must meet the needs of the user. Ascertaining the needs of the user is essential before any decisions are made as to what to recommend.

- **Operating software**: Some users have a preference for a particular operating system (such as Microsoft Windows) and may not wish to change to an unfamiliar one (such as Mac) and vice versa. There are options though within these vendors ranges, e.g. Microsoft Windows Vista versus Windows XP, and a user may prefer one to another for ease of use or familiarity reasons. The availability of preferred operating system may limit the range of models available.

- **Applications software**: Applications software will need to be installed so that the user can perform the tasks that he or she wants to do on the computer, e.g. writing letters or reports using word processing, doing design work using painting and drawing packages, processing financial data using spreadsheets or maintaining records using a database. Most applications software will run on both Windows and Mac machines so this should not be a limiting factor.

- **Network sharing**: The system configuration might need to include necessary hardware and software to connect to a network such as the Internet.

- **Need for maintenance**: Hardware vendors may offer a maintenance agreement and software vendors may also offer online support for the user.

Did you know?

Often a computer vendor 'bundles' application software with the hardware, trying to make the complete system attractive to a wider market of potential purchasers. These packaged systems may be targeted towards business users, while others might be described as home entertainment systems. Within the bundle, there will be essential software, but also possibly some software for which the user has no need.

- **Outputs required**: The user may require specialist output such as the highest quality graphics, or sound systems.
- **Integration with other systems**: The necessary hardware and software might need to be integrated with other existing or planned systems, e.g. a home entertainment system.
- **Processing power**: It is essential to include enough processing power to create a usable, fast-moving system. A slow processor may result in a system that does not meet the user's requirements at all.
- **Storage capacity**: It is also essential to ensure sufficient RAM to run the largest of programs and to store data (maybe videos or images).
- **Accessibility for disabled users**: Some users have special needs. Visually impaired people may need to rely on their sense of hearing and the computer system will need to be set up to produce voice output as appropriate. Users with some physical disability may need special peripherals to replace the conventional mouse and/or keyboard.
- **ICT competence of the intended user**: Novice users can be catered for by choosing a user friendly operating system and installing bundled software which will offer a consistent user interface. Once the user has learnt how to use one application, the others will become easier to learn too. For expert users, any system will suffice, but more sophisticated applications might be needed, such as web design applications.
- **Training requirements**: Regardless of the competence of a user, training will help the user to make the best use of the hardware and software. Some vendors provide onscreen help screens; others offer training videos, and sometimes these are free or perhaps free for a limited period.

Assessment activity 2.2   P4 M2   BTEC

Your teacher will give you a detailed business requirement

1   Recommend a computer system that meets the needs of this particular business. You may present your recommendation as a written report or as a presentation. **P4**

2   Justify your choice of computer system to meet the given business purpose. **M2**

Grading tips

- Your specification must include all the necessary hardware and software for the system to work [P4]
- Explain your reasoning clearly, making reference to the user need, and justify any optional extras that you have recommended. This needs to be checked when final spec is released.

PLTS

Text to follow from author

Functional skills

Text to follow from author

3 Be able to set up and maintain computer systems

Activity: Safety first

Do you know how to wire a plug? There are three coloured wires to be connected:

- the green and yellow Earth
- the blue Neutral
- the brown Live.

To help you remember the positioning of these wires:

- BL = Bottom Left = Blue
- BR = Bottom Right = Brown.

The third wire then goes at the top. But what would happen if you wired it incorrectly? Luckily, new plugs come with a handy diagram showing what goes where (Figure 2.11).

Similarly, when connecting and setting up a computer system, it's a good idea to read all the available manuals for each component.

- What risks are there in connecting and setting up a computer system?
- How can you protect yourself from harm?
- What advice can you give others to ensure their safety?

3.1 Connect and set up

In the process of connecting and setting up a computer system, you will be handling many separate items of equipment, such as a monitor, a printer, a modem/router, a keyboard, a mouse, speakers, a microphone, perhaps some RAM and a hard drive.
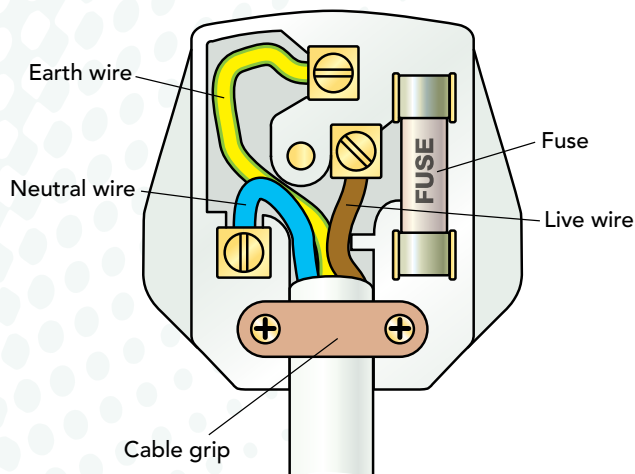

Figure 2.11: Wiring a plug

For each item, you need to identify how it is to be connected to the processor and what cabling may be needed.

Activity: A computer set-up

Your teacher will tell you which computer set-up to study.

1 Draw a sketch showing all the components and the connections between them.
2 On your diagram, label each component (such as monitor, printer, modem/router, keyboard, mouse, speakers, microphone).
3 Label each connection between components and describe the types of connectors (eg USB, serial, parallel)
4 Swap diagram and computers with one of your group. Compare notes and check that you both agree with how you have described each computer set-up.

3.2 Install hardware

Nowadays, the installation of new peripherals is relatively straightforward. The vendors supply all the items that you need: the device, any connectors, a CD with the set-up software and any drivers that you might need. They normally also provide step-by-step instructions that you should follow carefully.

The usual method is to install relevant software first and then to attach the hardware, which will then be recognised. However, modern operating systems are sophisticated enough to spot when you have attached a new device.

Before you are ready to install new hardware, you need to have installed internal component (which we look at next) and to have an operating system installed (see page 24). However, having installed the device, you may need to do some customisation to make it suit the user.

- For a printer, you might want to make it the default printer (see Figure 2.12)
- For a mouse, you might want to set the speed of response or perhaps make it usable for a left-handed operator.
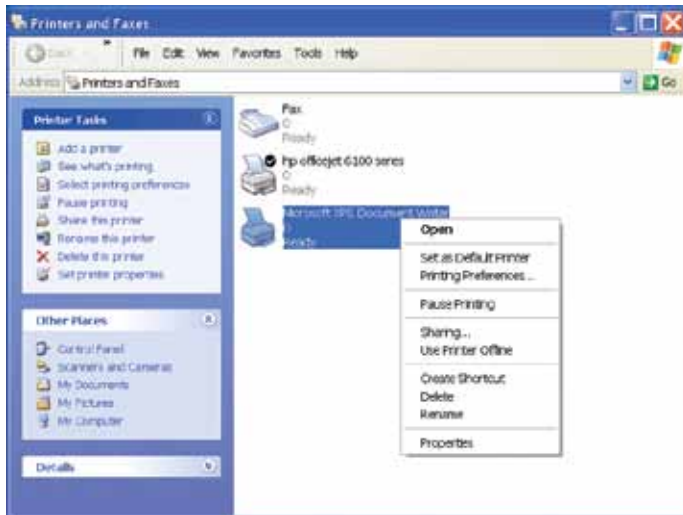
Figure 2.12: Making a printer the default printer

The Control Panel includes an option to Add Hardware (see Figure 2.13). This software will then guide you through the process of configuration.

The installation of internal components, such as a graphics card, sound card or CD/DVD drive, requires a little more expertise than is needed to install a peripheral. You also need to take more care, as accessing the inside of a processor box carries a risk, both to you and to the computer.

Some devices, such as the hard drive, have to be connected to the motherboard and PSU using cabling – this makes installation similar to an external peripheral, the only difference being that they are housed within the box. Other devices, such as the cards available for graphics and networking, have to be fitted into the appropriate slot.

How to… add/remove a video card

1 Check that you know which slot you are going to use, and that you have the correct board for your PC.

2 Be careful to handle the card by its non-connecting edges. Otherwise, you may leave traces of grease and/or dirt from your fingers.

3 Gently place the video card into the slot and press it into place.

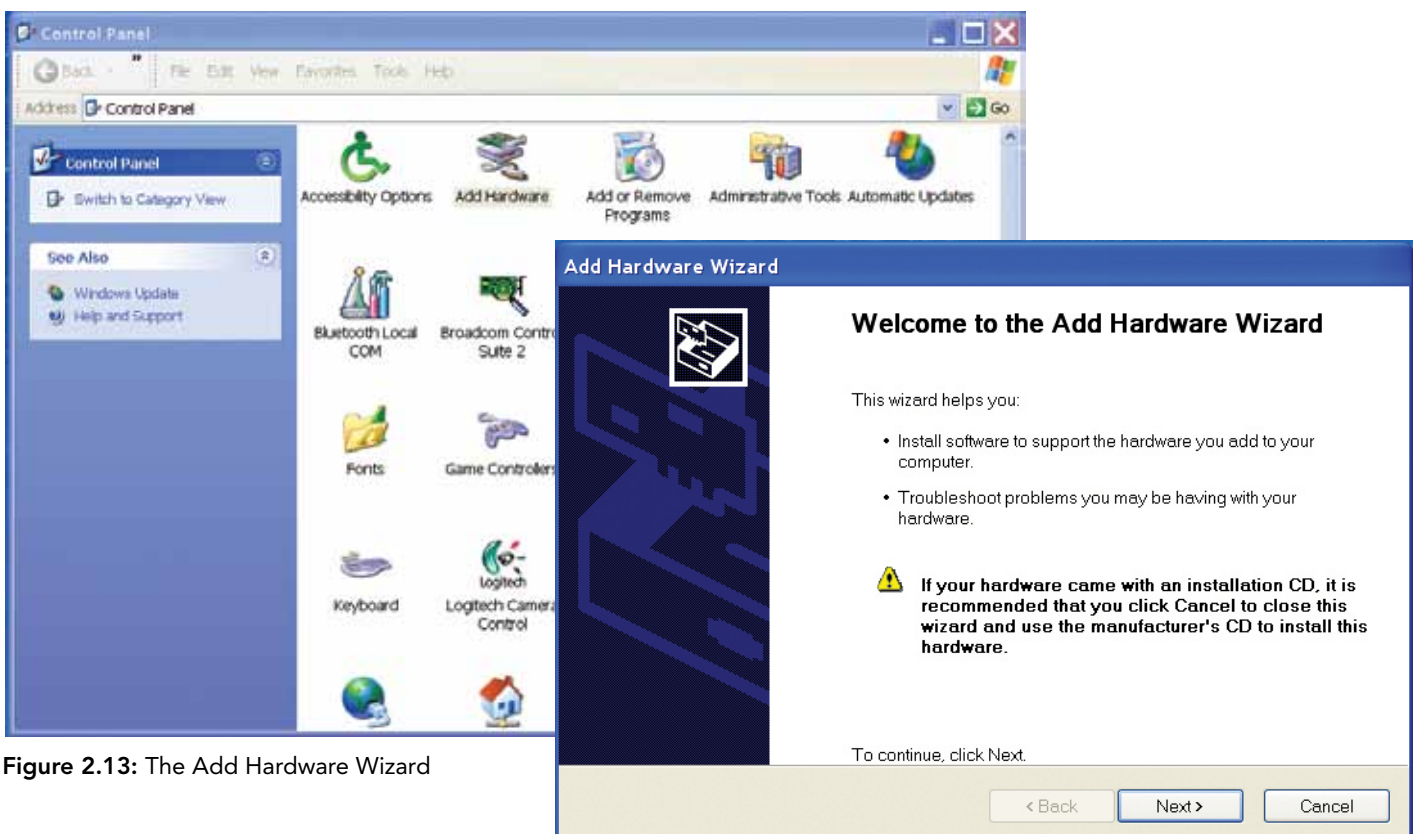4 To remove a card, release the locking mechanism and then slide the card gently out of its slot.

Figure 2.13: The Add Hardware Wizard

3.3 Install software

Once all the necessary hardware is in place and suitably connected, it is time for the software to be installed.

- **Operating system software**: Most computers come with operating system software such as Windows already installed. However, if you don't buy in this way, you will have to install it yourself.
- **Applications software**: Once the operating system is in place, you can install the applications software such as Microsoft Office.
- **Security software**: Then you should consider security software such as virus checkers, firewalls – certainly before connecting to the Internet.
- **Device drivers** (see page 17) will be needed for peripherals such as printers.
- **Directory/folder structures**: Although you can manage for a while without doing so, it's wise to create appropriate directory/folder structures so that finding files at a later date is made easier.

3.4 Configure

Having installed software, the next stage is to configure the system to suit the user.

- **BIOS**: You have the option to determine the BIOS configuration and might set a BIOS password or edit the power management options. To access the BIOS configuration, when you first turn your computer on, notice the message in the top right-hand corner which tells you which function keys can be used to interrupt the boot process and give you access to the BIOS configuration.
- **Anti-virus software**: Editing anti-virus configurations is necessary to determine the frequency and timing of virus scans. Some operating systems include free anti-virus software or you may have installed your own third-party software. Either way, you need to decide what scans you require (Figure 2.14).
- **Desktop**: Editing the desktop – for example changing the icon size, the font size, the text colour, the background, icon choice – personalizes the desktop for the user. These are controlled through the Control Panel / Task Bar and Start Menu (see Figure 2.15).
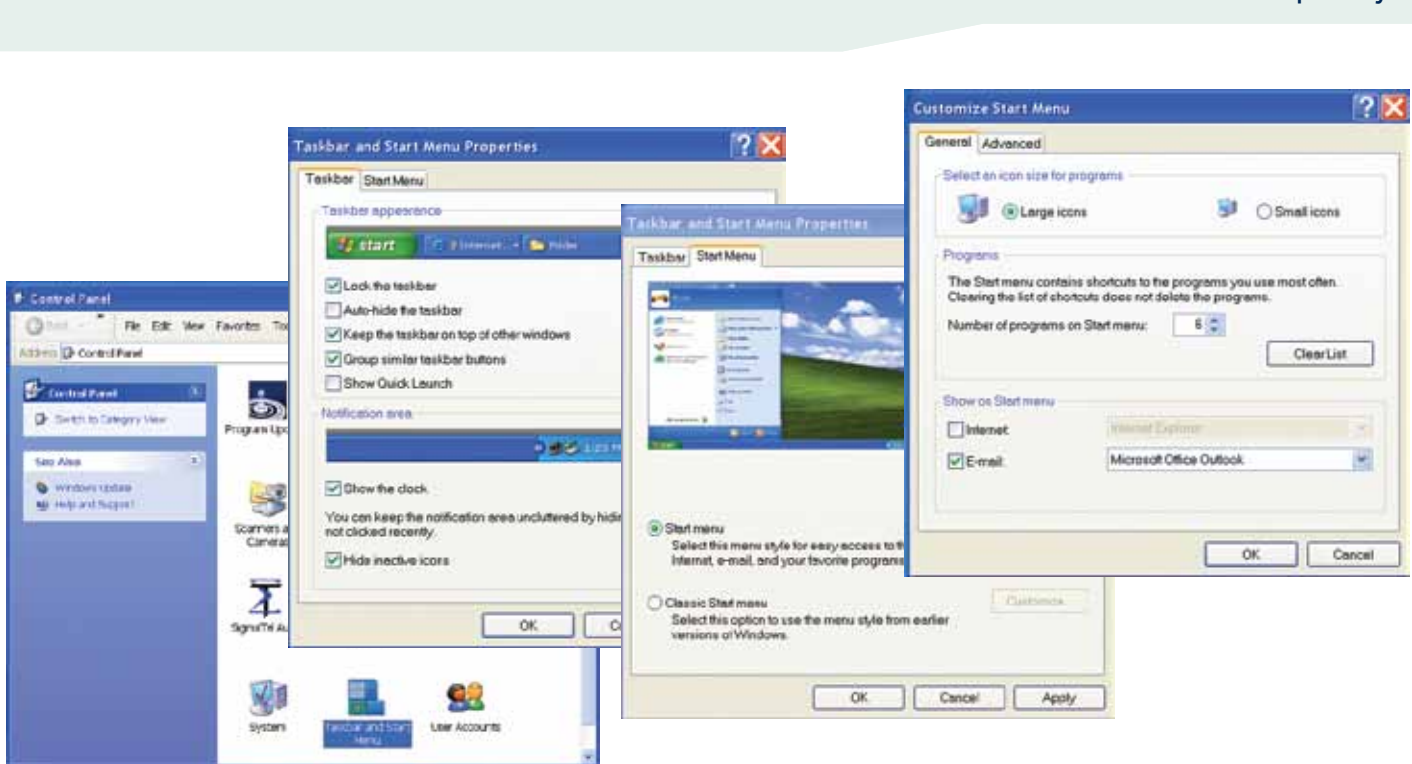

Figure 2.14: Editing anti-virus configurations

Figure 2.15: Editing the desktop

Case study:
Anne's laptop (3)

When Anne turns her computer on, if she presses F2 as soon as the start-up screen appears, this takes her into the BIOS set-up sequence of screens, and she has the option to change the BIOS password and edit the power management options.

1   Watch the process of a computer starting up and note which function keys can be used to enter the BIOS set-up routines.

2   Restart the computer and press the necessary function key to interrupt the boot process.

3   Note what settings you might change.

4   Repeat this process on a different make or model of computer and compare the options made available to you.

Figure 2.16: Creating start-up options

- **Start-up**: Creating start-up options can save time. By identifying which applications are to be opened every time the computer is switched on or restarted, the user is saved the task of opening every application individually. The Startup Folder is accessed through the Start Pane (see Figure 2.16). Moving shortcuts to this folder will result in those applications being opened on start-up. If you change your mind, deleting the short cut will
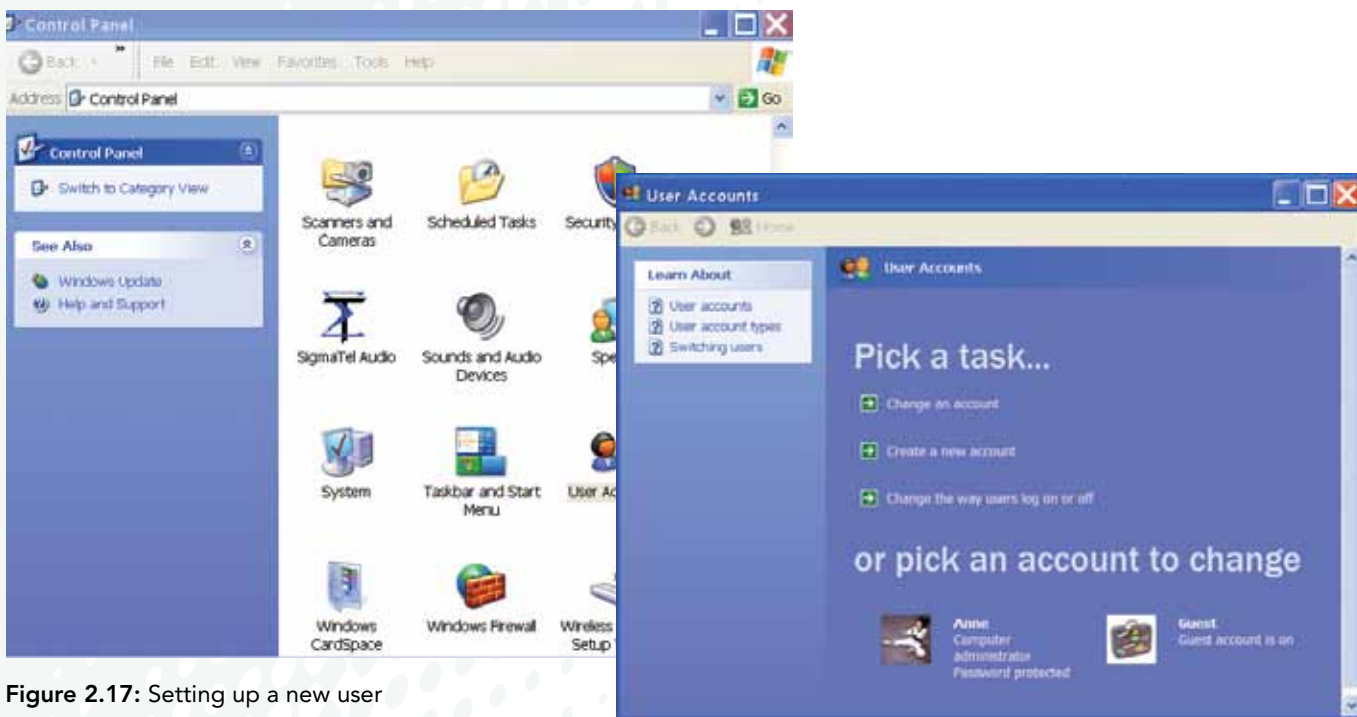
Figure 2.17: Setting up a new user

remove the application from the start-up sequence; it does not remove the application from your computer – to do this you'd have to use Add/Remove Programs.

- **File sharing/permissions**: Setting file sharing/permissions is essential if you plan to have more than one user on the same computer and you want to prevent one user from looking at another user's files. First you'll need to set up each user; see Control Panel / User Accounts (see Figure 2.17). Then each user will have their own workspace and can access files in the Shared workspace. To make a folder available for sharing, drag it to the Shared workspace (Figure 2.18).

- **Application toolbars**: A final touch in the configuration process is to creating and reconfiguring application toolbars so that the user is presented with the most commonly used icons, rather than the set of menus determined by the software vendor. This is done within the applications software (see Figure 2.19).
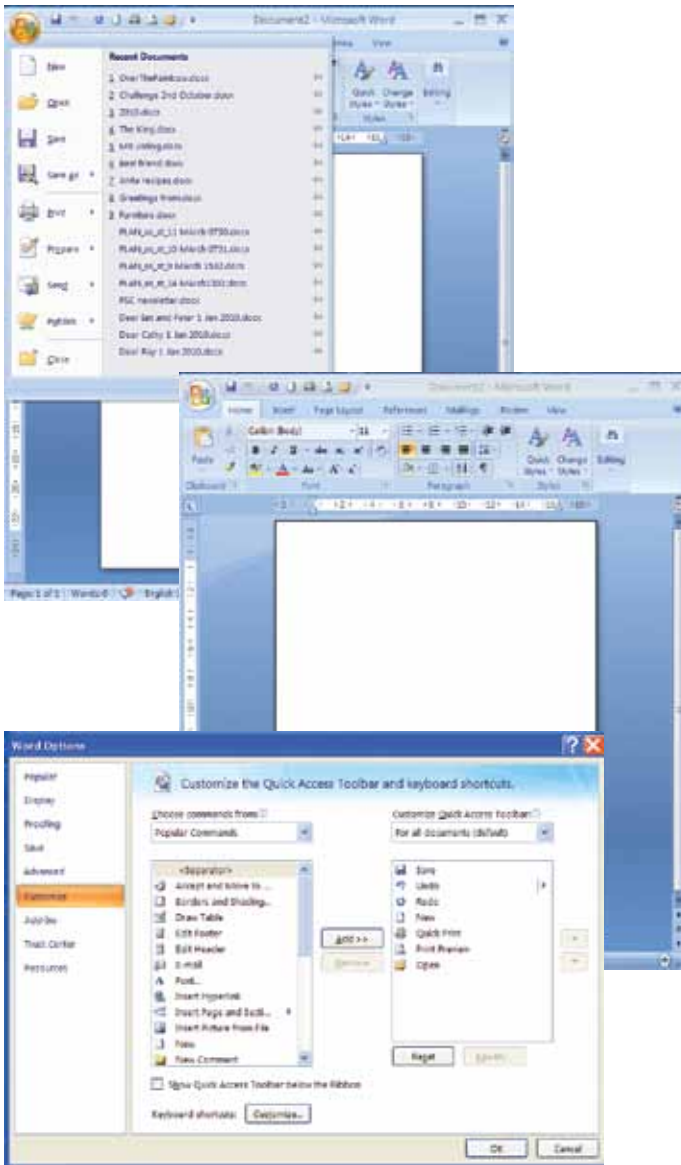

Figure 2.18: Sharing folders

Figure 2.19: Configuring toolbars

3.5 Testing

Once the hardware and software have been installed and any customisation done, you must check that the system works.

- Do the software applications open and work as intended?
- Are the default folder settings correct?
- Do the desktop shortcuts go to the right place?
- Are the correct device drivers installed?
- Are the correct default paper sizes set for printing?
- Do the menu options work as intended?
- Is the correct date and time set? If not, fix it as shown in Figure 2.20.

Activity: Investigating a computer set-up

Your teacher will tell you which computer set-up to study.

1 Find out what anti-virus software is installed and the current settings for frequency of virus scans.

2 Note the current desktop settings – the icon size, font size, colour and background – or take screen grabs to illustrate them. Identify what settings you might change.

3 Find out what software automatically opens on start up.

4 Check what users are permitted to use the computer and what files might be available for shared use.

5 Note the current application toolbars, or take screen grabs to illustrate them. Identify what you might want to change.
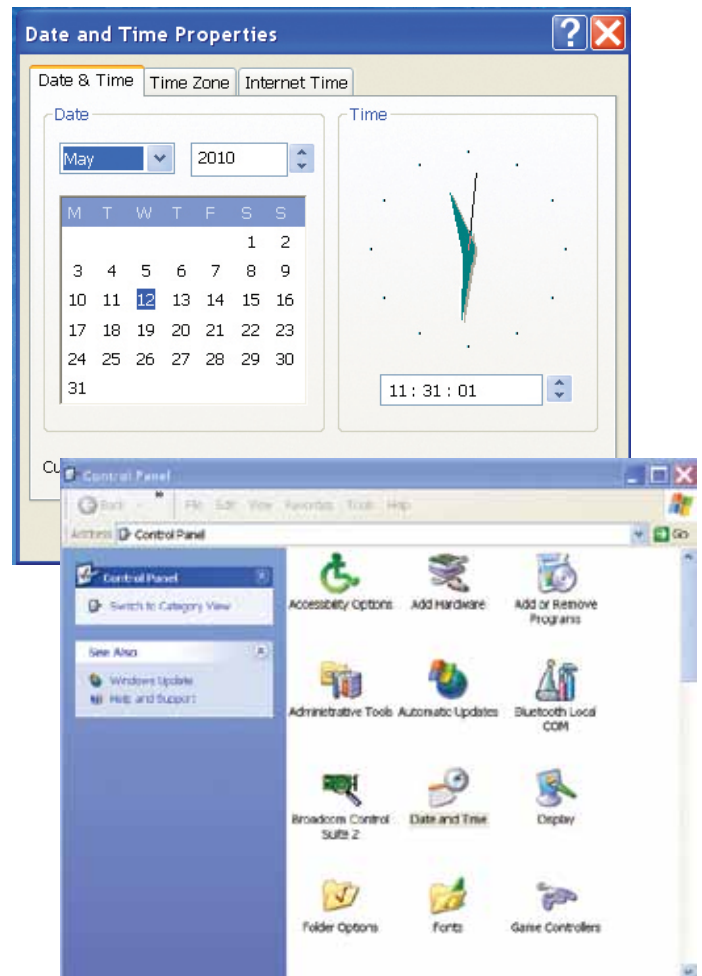

Figure 2.20: Setting the date and time

Activity: Installing hardware

Your teacher will tell you which new item of hardware to install.

1 Read the documentation that is supplied by the manufacturer. Check that you have everything you need: the installation CD, any cabling, any media. Ask your teacher any questions you need answered before starting the installation.

2 Following the instructions supplied with the hardware, and using either the Add Hardware option on the Control Panel, or relying on your operating system to recognise the new hardware, install the new item.

3 Restart your computer and check that it works with the new item of hardware.

4 Configure the new item of hardware in some way, changing an option or setting a default.

Activity: Installing software

Your teacher will tell you which new item of software to install.

1 Read the documentation that is supplied by the vendor. Check that you have everything you need: the software CD or the location on the Internet for the download. Ask your teacher any questions you need answered before starting the installation.

2 Follow the instructions supplied, entering reference numbers where requested to do so.

3 Restart your computer and check that it works with the new item of software.

4 Configure the new software in some way, changing an option or setting a default.

Activity: Testing an installation

Your teacher will tell you which installation – hardware and or software – to test.

1 For each item of hardware or software indicated, list the checks that you intend to do, to make sure it works as you might expect.

2 Work systematically through your list, checking the functionality and noting any problems that you encounter.

3 Report back to your teacher, in writing or verbally, on what you have discovered during the checking process.

4 According to instructions from your teacher, fix any faults or shortcomings that you have discovered.

3.6 Routine maintenance

Maintenance is an essential part of running a computer system. Its aim is to prevent problems arising and to save time when diagnosing and fixing faults. It can also extend the life of your PC.

Just how regularly the maintenance tasks are performed depends on the task – maintenance could be daily, weekly, monthly or annually, or whenever necessary, as suggested in Table 2.1. If the air in which the PC operates is dusty or smoky, even more frequent cleaning will be necessary.

Frequency	Maintenance task
Daily	Virus scan of memory and your hard disk Take backup of changed data files
Weekly	Clean mouse (ball and rollers) and check for wear Clean keyboard, checking for stuck keys Clean monitor screen Clean printer Delete temporary files (Disk Cleanup) Defragment hard disk and recover lost clusters
Monthly	Clean outside of case Take complete backup of data files
Annually	Check motherboard: reseat chips if necessary Clean adapter card contacts with contact cleaner and reseat
As required	Record and backup CMOS set-up configuration Keep written record of hardware and software configuration

Table 2.1: Preventive maintenance schedule

For some routine maintenance tasks, the computer can remain powered up (e.g. cleaning the mouse) or must be powered up (e.g. to do a virus check). For others, it is necessary to power down, i.e. switch off the computer (e.g. when cleaning the monitor). As soon as you have completed the maintenance task, make sure that the PC still works!

Some hardware can – and needs to be – cleaned (casings, mouse rollers, etc.) but some hardware is

Figure 2.22: Automatic backups

sealed so your maintenance is restricted to 'cleaning' using software (e.g. deleting temporary files off the hard disk).

It is possible to use software to remind you when to carry out essential maintenance tasks. Software such as Microsoft Outlook offers a feature where you can set up a task and reminders at times to suit you (see Figure 1.1, Unit 1, page 8). If you prefer, you can schedule the task to happen automatically (see Figure 2.21).

This is especially advisable for essential tasks such as making backups. However, the backup software will usually allow the details of the task (what has to be backed up) to be set once (Figure 2.22), rather than every time you decide to do a backup.

Figure 2.21: Scheduling

Organisation and naming of files

Maintaining the hardware and software so that you have a fully functioning computer system is essential, but your file management is also important; otherwise you might not be able to find your documents.

Microsoft offers some standard folders to encourage users to be systematic when saving files. For example, the My Pictures folder is for your images and photos. Within the My Pictures folder, you would be advised to set up additional folders, perhaps according to the subject of the photos or the date on which they were taken (Figure 2.23). Otherwise, you will soon find you cannot track down a particular shot without trawling through every photo you have ever taken.

You could put all your documents in the My Documents folder. If you save more than 40 files in any one place, there will be too many to view in one dialog box, so to select a file you will have to scroll up and down to find it. For this reason, it makes more sense to create folders within the My Documents

folder. No two users will have the same arrangement, but you should use logic when organising your folder structure: a logic that makes sense to you.

Many people use their computers partly for work and partly for pleasure. If a computer is used for work purposes, a sensible way of organising files could be to have one folder per client. If there are many clients, it might help to group the clients in some way and to create folders within folders. In this way, a hierarchy of folders can be built up and you can browse through the hierarchy to locate the client and then the particular file that you want to work on.

Backup procedures

Having worked on documents and filed them in appropriate folders, if disaster were to hit your system – a power surge which blows components, a house fire or a flood – how would you pick up from where you left off? You should have a system of backing up important documents and data, so that you can recover from such a disaster.
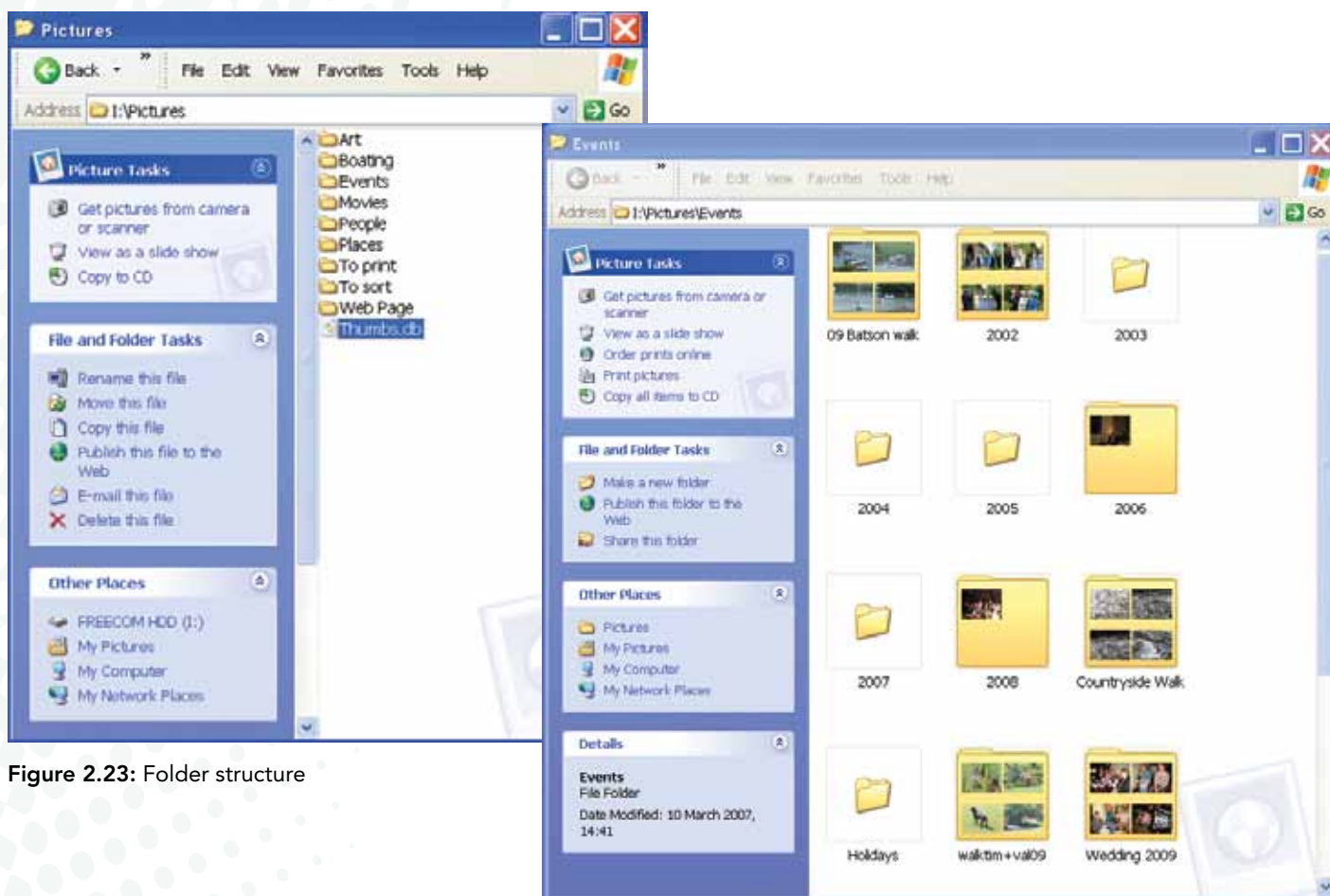

Figure 2.23: Folder structure

Some operating systems incorporate a backup utility; others are available from third party suppliers; Figure 2.22 on page 28 shows a dialog box within Carbonite – an online backup service provider.

The scheduling of backups needs to match the relative importance of the data being backed up. If something rarely changes, it only needs to be backed up infrequently; but if something changes by the minute, it probably needs backing up daily or even more frequently.

Backups are considered in other units: see *Unit 5: Managing Networks*, page 22

Backup media

Backups could be saved to your own hard disk but, if anything happened to the disk, all files might be lost including the backups. So, it makes sense to backup onto an alternative device: another hard disk, or to an online service such as Carbonite.

Automatic scheduling and deletion of unwanted data

There is a limit to how much you can store on one computer. You could resort to storing data on external drives, but you should ask yourself questions such as: 'Do I really need an electronic copy of a letter I wrote to a client eight years ago?'

Did you know?

Emptying the Recycle Bin is one of the things offered in a Disk Cleanup (see page 19).

Until the Recycle Bin is emptied, you have the option to retrieve the file, so you can change your mind!

When files are first deleted, they go to the Recycle Bin – they are not actually deleted from your computer. It is only when the Recycle Bin is emptied that the space they take up is freed for other files.

Archiving

Archiving is the process of setting to one side, usually in a **compressed** form, files that have not been accessed for some time. Old data could be archived for a period, just in case it is needed at a later date but, eventually, some files should be deleted.

Key term

Compression – involves reducing the size of the file by coding it more efficiently into fewer bits of data.

Activity: File management

1   Review the structure of folders on your computer. Does it make sense to you? Is it easy for you to find documents?

2   Review the ages of files stored on your computer. Should you delete some files to free up space?

Defragmentation

Some maintenance, such as disk cleaning and defragmentation, ought to be done by the user, rather than relying on technical support.

Defragmentation is best carried out after a disk cleanup, so that all the unneeded files have been deleted before the tidying up process is done.

Deleting temporary files

Temporary files are created each time you visit a web page (see Internet History on page 18) and each time you open a document or spreadsheet. When you save the document or spreadsheet successfully under the same name or another name, the temporary file is deleted automatically. However, if your computer crashes and open files may be retained as temporary files. During the DiskClean process, you will be offered the option to delete temporary files (Figure 2.9 on page 18) and this is an essential part of a maintenance programme.

How to... defragment a disk

- Select Start/All Programs/Accessories/System Tools/Disk Defragmenter. Alternatively, access this utility through the Control Panel, within the Computer Management folder (see Figure 2.24).
- Click on the Analyze button. The utility will then estimate the disk usage after defragmentation and make a recommendation either to defragment your disk or not to, at this time.

- If you are recommended to defragment your disk, click on the Defragment button. Defragmentation will take several minutes, so you are advised to leave the PC and spend the time doing something useful!
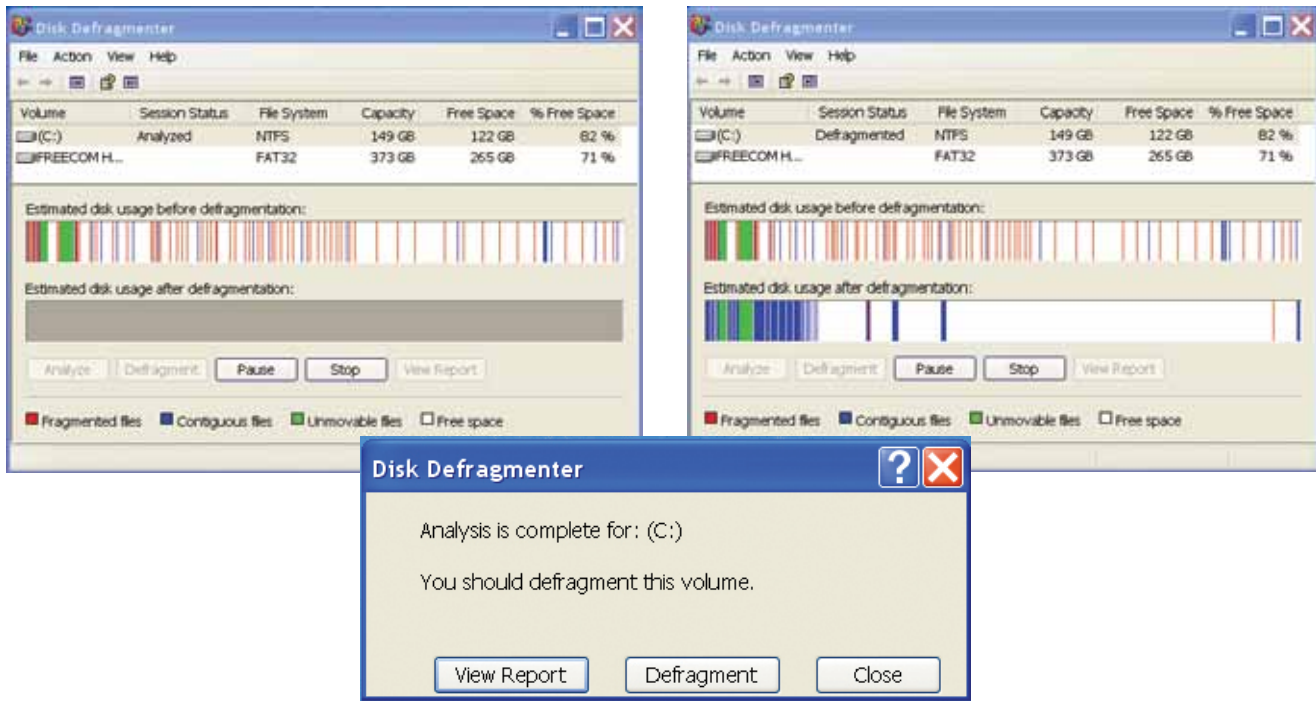

Figure 2.24: Disk Defragmenter

Cleaning hardware

Like any machine, a PC needs some attention on a regular basis, if only to keep the keyboard, mouse, display screen equipment (DSE) and ventilation grills clean. Computers attract a lot of dust: if dust settles on the outside, it soon forms a grimy layer of dirt which is unsightly; if it settles on the inside, it can block airways, preventing the cooling mechanism from working properly. Overheated components may then fail.

When choosing cleaning equipment, you should be wary of potential health risks to you in using these products, as well as selecting the right type of product for the task in hand. For example, many of the chemical solvents are poisonous and may need special handling.

With any chemical product that you buy, you should be given a material safety data sheet (MSDS) – or something similar, e.g. as part of the label. This lists important advice to help you to handle and use the product correctly and safely: its toxicity, any health effects, first aid measures (e.g. if you were to ingest some accidentally), how to store the product, how to dispose of it and what to do if the chemical is spilt. Information about the hazards of chemical cleaners is also available on the Internet.

The cheapest liquid cleaning compound is water. Used carefully, it can be used to clean cases, but you must be sure not to wet the electronic parts of the PC.

Water can be mixed with a general purpose cleaner, and this may be necessary if the casing has not been cleaned for some time and dirt has built up.

The most expensive option, but the safest for your PC, is isopropyl alcohol. This chemical can be used to clean the PC case, the keyboard case and keys and any other similar casing on your PC. It removes dirt and then evaporates so the equipment does not become wet. It can harm you, though, so be sure to read the instructions carefully – and follow them!

A variety of cleaning equipment is needed.

- **Soft lint-free cloth**: This can be used for cleaning glass and plastic surfaces of components.
- **Paper towels**: These may also be useful, especially to mop up any spillages.
- **Cotton buds or swabs**: These might be useful, e.g. for cleaning the contact points inside a mouse, but take care they do not leave deposits.
- **Non-static brush or probe**: This and/or a small flat-bladed screwdriver can be used to dislodge stubborn bits of dirt, e.g. on the mouse rollers.
- **Compressed air**: This comes in an aerosol can and may be used to clean fans and grills or keyboards. To direct the air more precisely, use the long thin plastic tube, taking care to blow the air in a direction that will take the dust away from the PC.
- **Non-static vacuum cleaners**: Vacuuming the inside of a PC can remove a lot of the dust that collects. Some small cleaners include brush heads ideal for the purpose. However, it is important to use non-static vacuum cleaners.

Activity: Hardware maintenance – cleaning

1   Research the Internet to discover what dangers are involved in using isopropyl alcohol.

2   You will give a PC a spring clean and you are to time how long it takes.

(a) Examine the PC to see what you think needs cleaning. Make a list of the tasks you intend to do and assemble the cleaning materials that you plan to use. Obtain approval from your teacher before starting.

(b) Clean each component separately and then check that the PC still works before moving on to clean the next component.

(c) Tick each item on your task list, noting how long it took to do.

(d) Draw up a maintenance list for future cleaning of this PC. Estimate how much time per week will be needed.

Replacing consumables

Consumables are resources that are used up in a process, such as printer paper, ink or toner cartridges. These consumables need replacing; without a supply the computer system cannot output data via the printer.

Replacing damaged components

Wear and tear and accidental damage – a cup of coffee spilt on a keyboard – may result in your having to replace a damaged component. The circumstances of the damage ought to be recorded and the lesson learnt.

Activity: Software maintenance

1   Establish a routine of software maintenance for your own PC. Utilise software such as Outlook to set up reminders for yourself.

2   Set up a scheduled task for some aspect of your software maintenance, e.g. a daily backup.

3   For one item of software, check the Internet for the availability of an upgrade. How much will it cost? And what will the download involve you doing?

4   Check whether a hard disk requires defragmentation and, if it does, choose the option to complete the defragmentation. Take screenshots of the disk usage before and after defragmentation to show the effect.

5   Research the Internet for compression software. Identify one such utility and experiment with compressing files. Which files are reduced in size the most?

Assessment activity 2.3

P5 **P6** **P7** **M3** **D2** **P8**

BTEC

1 Your teacher will instruct you to set up a standalone computer system, installing at least one hardware component and at least one software component. **P5**]

2 Your teacher will instruct you to configure in some way a computer system to meet user needs. **P6**

3 Test a configured computer system for functionality, taking screen shots as appropriate. **P7**

4 Evaluate the performance of a computer system. **M3**

5 Explain and justify improvements that could be made to a computer system. **D2**

6 Undertake routine maintenance tasks on a standalone computer system. **P8**

Grading tips

• Make sure that you observe all necessary safety measures **P5**

• Try to complete the task without undue prompting from your teacher. Prepare by practising beforehand: setting left/right hand buttons on a mouse, setting power saving options, changing the screen resolution, changing the desktop theme, changing the default language setting, and changing default folder locations **P6**

• You should prepare a test plan and present it together with your test results. Include in your presentation an explanation of any test failures, with reasons **P7**

<Await final spec for P8, M3, D2>

PLTS

Text to follow from author

Functional skills

Text to follow from author

Khalid@Whizzworld

Khalid works on the information desk at WhizzWorld and his job is to help customers who have already bought a computer system and are having problems with it. Sometimes someone comes to the information desk because they are thinking about buying a computer and need guidance as to which one to purchase.

It can be bewildering for the prospective customer. WhizzWorld stock all the well-known makes of computer such as Microsoft and Apple MacIntosh and a full range of peripherals such as screens and printers. There is also a wide range of software available and Khalid is expected to know which software products are compatible with which hardware ranges.

The latest products are always exciting to try out and Khalid often attends courses so he knows all there is to know about the WhizzWorld's range of computerware.

Think about it!

1 List five factors you might take into account when recommending a computer system to a particular user.

2 Why might a user insist on a particular brand of operating system?

3 Why is it essential to aim for the maximum processing power and storage capacity that can be afforded?

4 What is a bundle of software? What are the advantages and disadvantages of purchasing a bundle?

5 What is the advantage of choosing a software vendor which offers online training as part of purchase price?

Just checking

1 Explain these terms: peripheral, port, BIOS, PCB and PSU.
2 What purpose is served by the POST?
3 Explain the purpose of an expansion slot and give three examples of cards found in one.
4 Explain how viruses, trojans and worms can infect a PC and how this can be avoided.
5 List five tasks that might be included in a maintenance schedule.
6 What is the purpose of the defragmentation utility?
7 Under what circumstances should you use water while cleaning your computer?
8 What functions does the PSU serve?
9 What is an RJ-11 connector used for?
10 Explain these terms: processor speed, clock rate, access time.

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Assignment tips

- Pool information with others in your group. You can learn from them as much as they can learn from you.
- The Internet will provide you with all the additional information you might need. Just use Google or some other search engine and key in a term, e.g. 'SATA'. Be careful, though, to check the validity of a website.
- When watching a presentation given by your teacher or one of your class mates, be aware of how they present the information on the slides, how they talk along with the slides, referring to notes as necessary, and how they hold your attention throughout the talk. Learn from what works well and, when you are required to make a presentation, avoid making the mistakes that you notice in others'.