

1.3 Hardware and software

Candidates should be able to:

1.3.1 Logic gates

- use logic gates to create electronic circuits
- understand and define the functions of NOT, AND, OR, NAND, NOR and XOR (EOR) gates, including the binary output produced from all the possible binary inputs (all gates, except the NOT gate, will have 2 inputs only)
- draw truth tables and recognise a logic gate from its truth table
- recognise and use the following standard symbols used to represent logic gates:
NOT AND OR NAND NOR XOR
- produce truth tables for given logic circuits, for example:

| a | b | c | out |
|---|---|---|-----|
|---|---|---|-----|

| | | | |
|---|---|---|--|
| 0 | 0 | 0 | |
|---|---|---|--|

| | | | |
|---|---|---|--|
| 0 | 0 | 1 | |
|---|---|---|--|

| | | | |
|---|---|---|--|
| 0 | 1 | 0 | |
|---|---|---|--|

| | | | |
|---|---|---|--|
| 0 | 1 | 1 | |
|---|---|---|--|

| | | | |
|---|---|---|--|
| 1 | 0 | 0 | |
|---|---|---|--|

| | | | |
|---|---|---|--|
| 1 | 0 | 1 | |
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| | | | |
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| 1 | 1 | 0 | |
|---|---|---|--|

| | | | |
|---|---|---|--|
| 1 | 1 | 1 | |
|---|---|---|--|

- produce a logic circuit to solve a given problem or to implement a given written logic statement, such as IF (switch A is NOT on) OR (switch B is on AND switch C is NOT on) then alarm, X, sounds

1.3.2 Computer architecture and the fetch-execute cycle

- show understanding of the basic Von Neumann model for a computer system and the stored program concept (program instructions and data are stored in main memory and instructions are fetched and executed one after another)
- describe the stages of the fetch-execute cycle

1.3.3 Input devices

- describe the principles of operation (how each device works) of a range of input devices including 2D and 3D scanners, barcode readers, digital cameras, keyboards, mice, touch screens, microphones
- describe how these principles are applied to real-life scenarios, for example: scanning of passports at airports, barcode readers at supermarket checkouts, and touch screens on mobile devices
- describe how a range of sensors can be used to input data into a computer system, including light, temperature, magnetic field, gas, pressure, moisture, humidity, pH/acidity/alkalinity and motion/infra-red
- describe how these sensors are used in real-life scenarios, for example: street lights, security devices, pollution control, games, and household and industrial applicationslanguage.

1.3.4 Output devices

- describe the principles of operation of a range of output devices, including: inkjet, laser and 3D printers; 2D and 3D cutters; speakers and headphones; actuators; flat-panel display screens, including Liquid Crystal Display (LCD) and Light-Emitting Diodes (LED); and LCD projectors and Digital Light Projectors (DLP)
- describe how these principles are applied to real-life scenarios for example: printing single items on demand or in large volumes; banks of digital displays; use of small screens on mobile devices; smart boards

1.3.5 Memory, storage devices and media

- show understanding of the difference between: primary, secondary and off-line storage and provide examples of each, such as, primary: Read Only Memory (ROM), Random Access Memory (RAM) and DVD-RAM; secondary: hard disk drive (HDD) and Solid State Drives (SSDs); off-line: Digital Versatile Disks (DVDs), Compact Disks (CDs), Blu-ray, USB flash memory and removable disks
- describe the principles of operation of a range of types of storage devices and media including magnetic, optical and solid state
- describe how these principles are applied to currently available storage solutions, such as SSDs, hard disk drives, USB flash memory, DVDs, CDs and Blu-ray
- calculate the storage requirement of a file

1.3.6 Operating systems

- describe the purpose of an operating system
- show understanding of the need for interrupts

1.3.7 High- and low-level languages and their translators

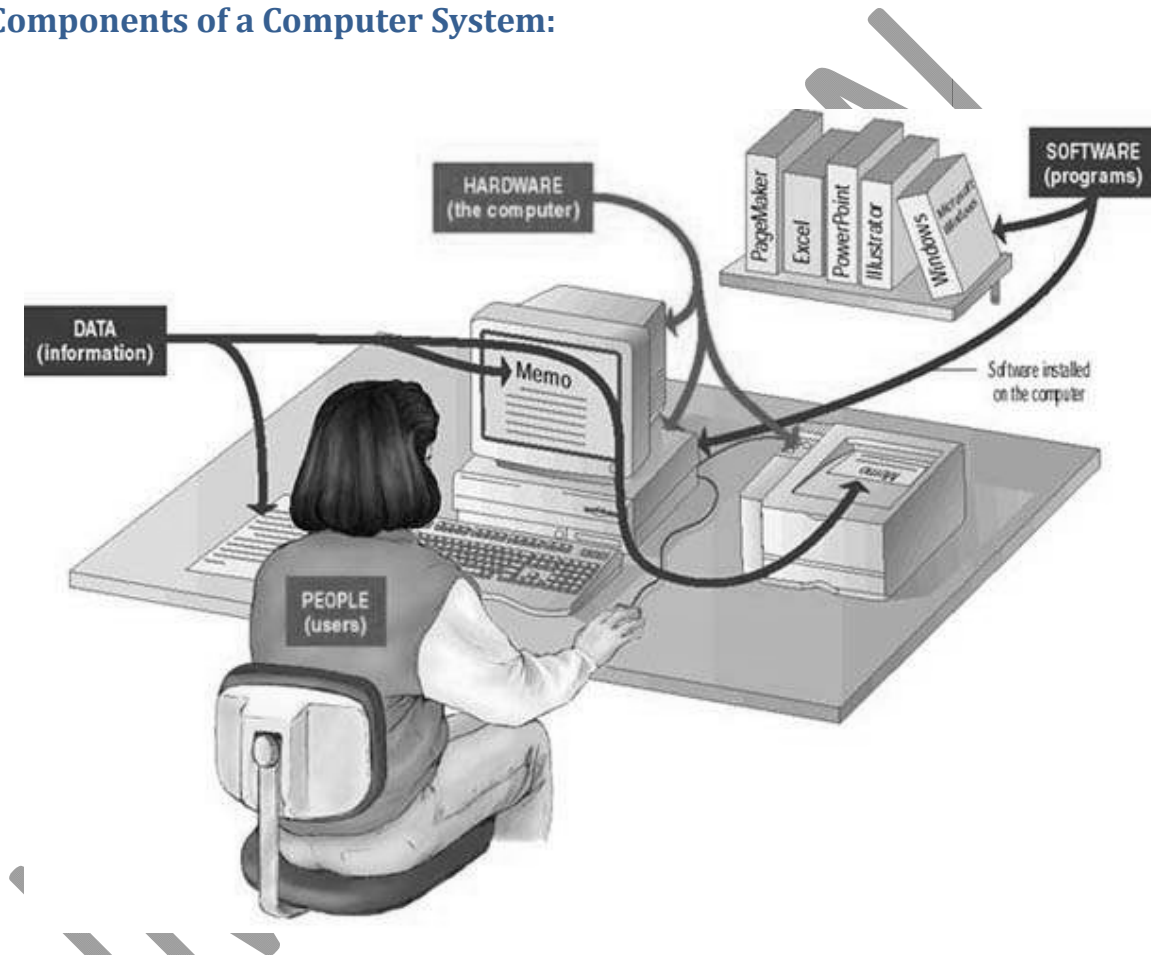
- show understanding of the need for both high-level and low-level languages
- show understanding of the need for compilers when translating programs written in a high-level language
- show understanding of the use of interpreters with high-level language programs
- show understanding of the need for assemblers when translating programs written in assembly language

Computer:

An electronic device which is capable of receiving information (data) in a particular form and of performing a sequence of operations in accordance with a predetermined but variable set of procedural instructions (program) to produce a result in the form of information or signals.

A computer is a device that accepts information (in the form of digitalized data) and manipulates it for some result based on a program or sequence of instructions on how the data is to be processed.

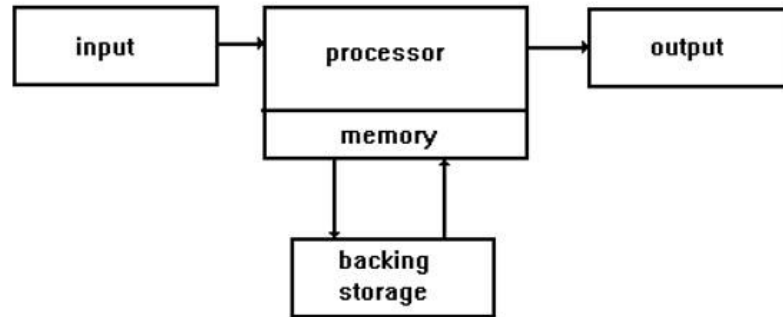
Components of a Computer System:



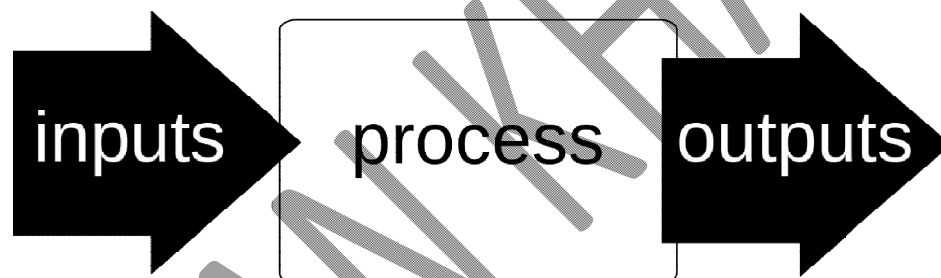
1. **Hardware**
Physical components that make up a computer system.
2. **Software**
Computer programs and related data that provide the instructions for telling computer hardware what to do and how to do it.

Hardware:

Physical components that make up a computer system.



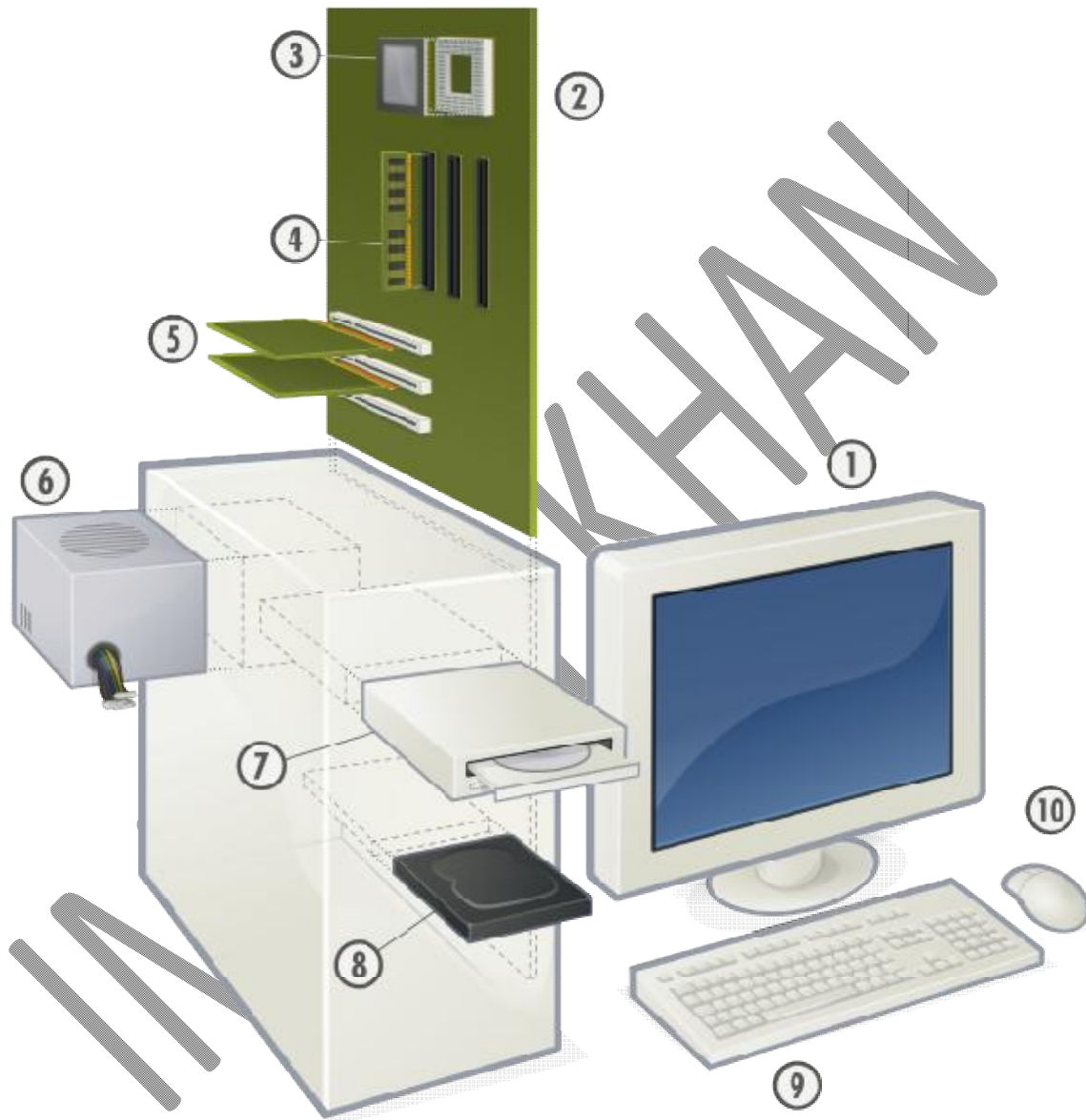
1. Input Devices
2. Output Devices
3. Processor
4. Memory
5. Backing Storage



Computers work along the lines shown above, they receive inputs (instructions etc.), they process the input working out what to do with it, and then they output some form of result.

Activity:

Write down the name of above labelled devices.



Input Devices:

In computing, an input device is a peripheral (piece of computer hardware equipment) used to provide data and control signals to an information processing system such as a computer or other information appliance. Examples of input devices include keyboards, mouse, scanners, digital cameras and joysticks.

Mainly there are two types of input devices

1. Manual input devices
2. Automatic input devices

Manual input devices

Manual input devices are those devices which are used by the people to capture data.

The most common **manual** input devices are:

- Mouse
- Keyboard
- Concept Keyboard
- Trackball
- Joystick
- Digital Camera
- Micro Phone
- Touch Screen
- Video Digitiser
- Scanner
- Graphic Tablet

Mouse:

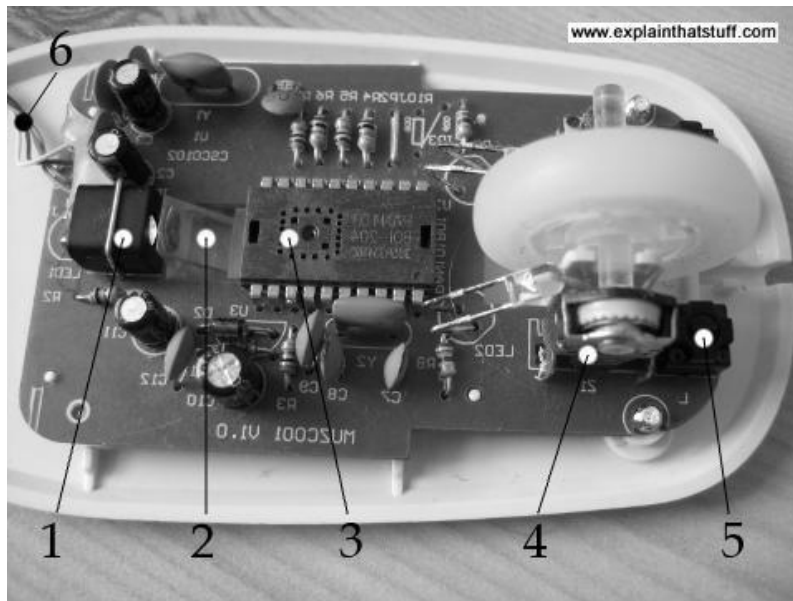
Enables the user to execute commands or issue instructions to the computer by controlling a pointer on the screen.



Working of Mouse:

An optical mouse is much more hi-tech than a ball mouse. Where a ball mouse has quite a few moving parts, an optical mouse is almost entirely electronic (it has almost no moving parts).

Here's the inside of a typical optical mouse and a few of the main components. The most interesting bits are in the center (where the LED light shines down onto your desk) and at the front (where button presses are detected by switches):



1. An LED at the back generates red light and shines it horizontally, from the back of the mouse toward the front (from the left to the right of this photo).
2. A plastic prism bends (refracts) the light from the LED at an angle, down onto the desk.
3. A light-detector chip measures light reflected back up from the desk, converting the analogue movements of your hand into digital signals that can be sent to your computer.
4. The scroll wheel at the front of the mouse is mounted on a switch mechanism that detects both how much it's rotated and whether you've pressed it (it functions like the central button of a conventional mouse). Rotations of the scroll wheel can be detected in a variety of different ways. Some mice use potentiometers (broadly, variable resistors), similar to the volume control on a radio but able to turn around multiple times. Others use various kinds of rotary switches or optical (rotary) encoders to convert analogue wheel movements to digital signals.
5. A micro switch detects when you press the right mouse button. There's an identical switch on the other side to detect the left mouse button.
6. The USB cable connection carries digital information from the mouse to your computer.

Advantages of Mouse:

1. Ideal for use with desktop computers

2. Usually supplied as part of a new computer system
3. Most computer users are familiar with them and require little training
4. Works well in conjunction with a keyboard for data entry

Disadvantages of Mouse:

1. They need a flat space close to the computer
2. The rollers in mice that use balls can become clogged with grease and grime and lose their accuracy until cleaned.
3. Overuse can lead to RSI

Touchpad:

A touchpad is a pointing device featuring a tactile sensor, a specialized surface that can translate the motion and position of a user's fingers to a relative position on the operating system that is outputted to the screen. Touchpad are a common feature of laptop computers, and are also used as a substitute for a mouse where desk space is scarce.



Advantages:

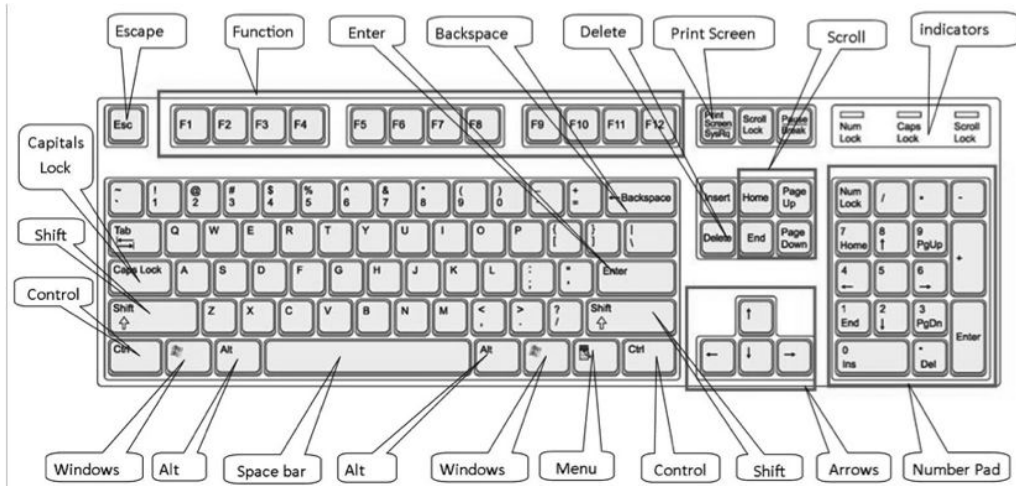
1. Useful for laptops when using a mouse is not practical
2. The pad's position is fixed compared to the keyboard, unlike with a traditional mouse
3. Very short finger movements are required to move the cursor

Disadvantages:

1. Takes practice and skill to control the position of the cursor using the touchpad
2. Gloves cannot be worn i.e. in a cleanroom environment
3. Moist, sweaty or calloused fingers can disrupt the signals picked up by the sensors.

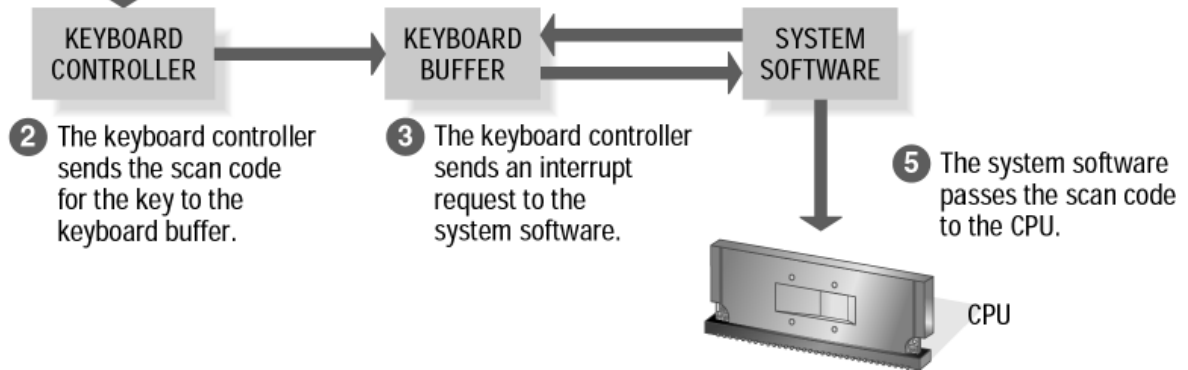
Keyboard:

The keyboard is one of the most popular ways of inputting information into a computer. The basic mechanical keyboard relies on springed keys being pressed down to complete an electrical circuit. This circuit then transmits a binary signal (commonly using ASCII) to the computer to represent the key pressed.



Working of Keyboard:

- 1 Key is pressed on the keyboard.



Concept keyboard



Each button on a concept keyboard relates to a particular item or function. Buttons can be labelled with text or a picture. Fast food restaurants often use concept keyboards because very little training is needed to operate them and they're efficient – a single button can order an entire meal.

Advantages:

1. Much faster for making non-text selections such as menu choices on the till of a fast-food outlet.
2. The keyboard is waterproof which can be useful where there is dirt or the risk of splashes

Disadvantages:

1. Poor for text or numeric input - although some keyboards do include a numeric keypad so the operator can enter the amount sold.
2. Limited to the options shown on the keyboard.

Trackball



Used as an alternative to a mouse. To operate it the user rotates the ball which moves the pointer on screen. They are particularly easy to use for those with limited movement in their hands and are often used in Computer Aided Design (CAD) for their increased precision over a mouse.

The basic principle of a trackball is the same as a ball mouse: with a ball mouse, moving the mouse causes the ball on the bottom to move, and sensors pick up the movement. With a track ball, the thumb moves the ball directly instead rolling the ball across a flat surface.

Advantages:

- **Movement:** Trackballs are useful because the hand can remain stationary while using them, so they are easy to use without a flat surface or mouse pad.
- **Accuracy:** Trackballs tend not to skip and flow more smoothly than mice or touch pads, but mice are often easier to manipulate quickly and accurately.

Joystick



Joysticks used to be popular with gamers but have slowly been replaced by other types of game controller. In construction, joysticks are used to control machinery such as cranes.

Working of Joystick:

Joysticks pull off a really neat trick. They take something entirely physical -- the movement of your hand -- and translate it into something entirely mathematical -- a string of ones and zeros (the language of computers).

Advantages:

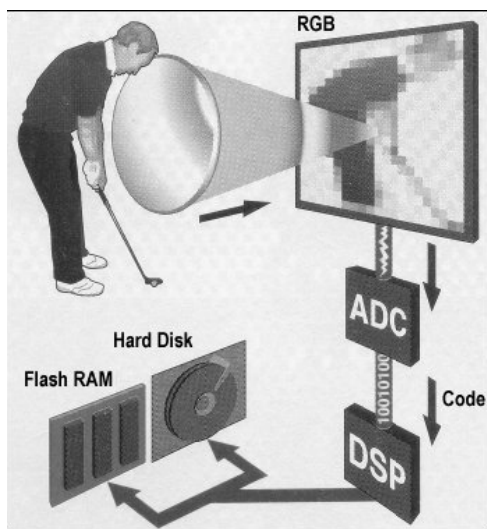
1. They give a better gaming experience for racing or flying styles of computer games

Disadvantages:

1. Some people find joysticks more difficult to control than a traditional mouse.

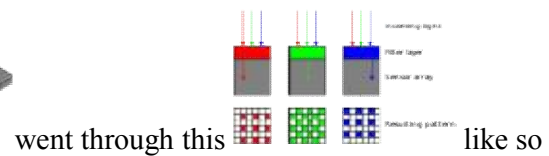
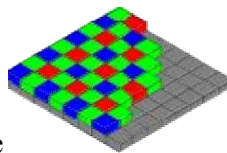
2. Joysticks are not particularly robust and can break easily if too much force is used on them.

Digital camera



A digital camera takes pictures and can usually record video too. The pictures it takes and the videos it records are stored in files. These files can be copied to a computer and later edited.

1. Light is focused through the lens onto the image sensor at the back of the camera
2. The image sensor is made up of an array of Red, Green and Blue photo sensors, called a Bayer filter. Each sensor will only record values for that particular colour.
- 3.



And became these:



3. The different color arrays are combined to form an image and make this:



Advantages:

1. You can preview images taken without having to get them developed
2. You can apply filters and images to add special effects.

Disadvantages:

1. Some people argue that the quality of photos taken using the traditional film medium is better.

IMRAN KHAN

Microphone



Microphones are used to input sound. In computing they can be used with voice recognition software and a word processing application to enter text. Webcams commonly have microphones built-in too.

Video digitiser



A video digitiser takes an image from a video camera or television and digitises it so it can be read by, and stored on, a computer. Video sequences captured using a video digitiser are often used in multimedia presentations.

Graphics tablet



A graphics tablet consists of a flat pad (the tablet) on which the user draws with a special pen. As the user draws on the pad the image is created on the screen. Using a graphics tablet a designer can produce very accurate on-screen drawings as if they were drawing on paper.

Advantages:

1. It is much more natural to draw diagrams with a pencil type implement (the stylus) rather than with a mouse
2. A great level of accuracy can be achieved

Disadvantages:

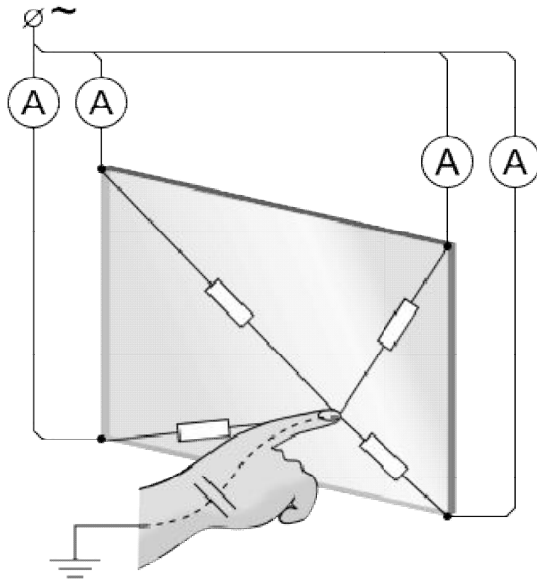
1. Not really suitable for general selection work such as pointing and clicking on menu items
2. Graphics tablets are much more expensive than a mouse

Touch screen



A touch sensitive visual display unit (VDU) or screen has a grid of light beams or fine wires criss-crossing the screen that is used to detect touch. Many mobile phones use touch screens and do away with the keypad entirely. They're often used on cash machines and in shopping centres too. Touch screens are robust, easy to operate and easy to reprogram.

1. Each of the four corners of a screen emits a uniform electric field which covers the screen
2. When you place your finger on or near the screen it disrupts this field and draws current
3. Measuring the amount of current pulled from each corner you can triangulate the position of the finger



Advantages

- Natural, intuitive interface with devices
- The ability to remap screen functions to suit the task (for example bringing up a keyboard when necessary)
- Easy to use - intuitive, don't need much training
- No extra peripherals such as a mouse are needed
- Software can alter the screen while it is being used, making it more flexible than a concept keyboard which has a permanent overlay.

Disadvantages

- Cold weather can affect the functioning of touch screens
- Won't work through standard gloves, as this stops your fingers conducting electricity
- Not suitable for inputting large amounts of data
- Not very accurate - selecting detailed objects can be difficult with fingers
- Tiring to use for long periods
- More expensive than alternatives such as a mouse
- Not robust - can soon become faulty if misused.

Scanner:



A scanner can be used to digitise images. They're similar to a photocopier but they make a digital copy instead of a physical copy. They can also be used with optical character recognition (OCR) software to scan in text that is then editable.

There are several types of scanners we have,

- Flatbed Scanner / 2D Scanners
- Fingerprint Scanner
- Retina Scanner
- Iris Scanner
- 3D Scanners

Advantages:

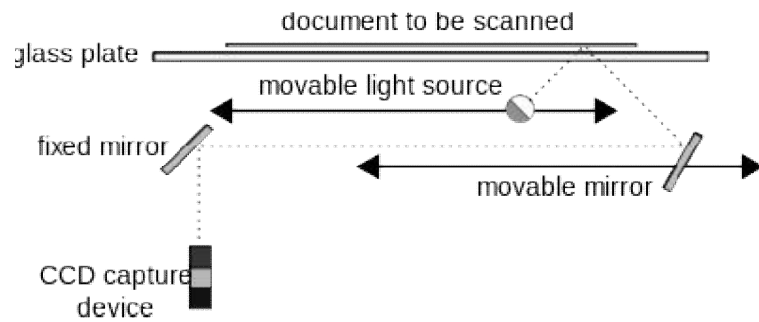
1. Flatbed scanners are very accurate and can produce reasonably high quality images
2. Any image which is digitised by the scanner can then be included on electronic documents
3. Images once digitised can be enhanced with a graphics application

Disadvantages:

1. Images can take up a lot of memory space
2. Images lose some quality in the scanning and digitising process
3. The quality of the final image is dependent on the quality of the original image

Flatbed Scanners:

Flat bed scanners are used to convert images and text into a digital format.



The main components of a flatbed scanner

1. Place the object you want to scan on the glass pane, face down
2. the light moves to the start of the document and illuminates a slice
3. The slice is reflected into the CCD where it's image is stored
4. the light and mirror move down to the next slice and so on
5. once all the slices are completed they are put together into a digital image



Flatbed Scanner

Fingerprint Scanners:

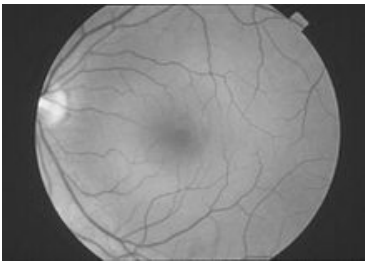


A finger print

The ridges and troughs on a person's finger and toes are unique to that person. Using a scanner a finger print pattern can be recorded and compared to others on a database, allowing a computer to match finger prints from crimes to a suspect, or to allow people into restricted areas.



Retina scanners:



The blood vessels in a normal human retina form a unique pattern for each person

Retina scanners are used to record the pattern of blood vessels at the back of someone's eye. As everyone has different pattern of vessels, retina scanners can be used to uniquely identify people.

Iris Scanners:



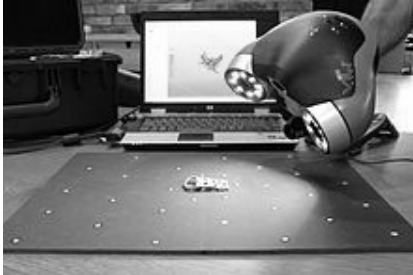
Iris patterns can be different colours and form a unique identifier for each person

By taking a picture of the blood vessels and coloring of someone's eye, we can get a unique pattern that can be used to identify individuals. People might try and circumvent this by using contact lenses.

3D Scanners:

A 3D scanner is a device that analyses a real-world object or environment to collect data on its shape and possibly its appearance (e.g. color). The collected data can then be used to construct digital three-dimensional models.

Many different technologies can be used to build these 3D-scanning devices; each technology comes with its own limitations, advantages and costs. Many limitations in the kind of objects that can be digitized are still present, for example, optical technologies encounter many difficulties with shiny, mirroring or transparent objects. For example, industrial computed tomography scanning can be used to construct digital 3D models, applying non-destructive testing.



Voice Recognition:

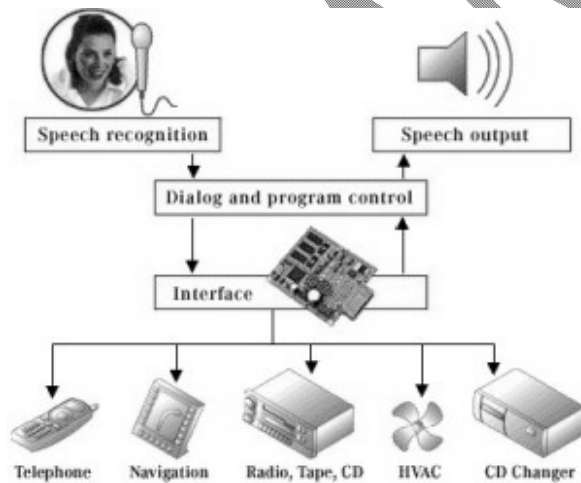
Microphone connected to software that converts human speech into commands or text.

Advantages:

Natural interface with a computer allowing for new users to execute commands without having to learn complex command set.

Disadvantages:

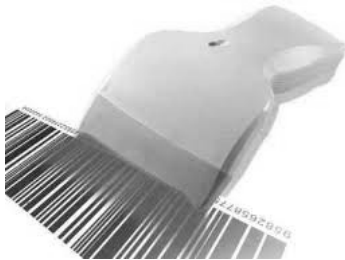
Speech recognition might not recognise the difference between similar words i.e. "their" and "they're" or be able to understand regional accents.



Automatic input devices

Automatic input devices are those devices which enable data to be entered without human involvement.

Barcode reader



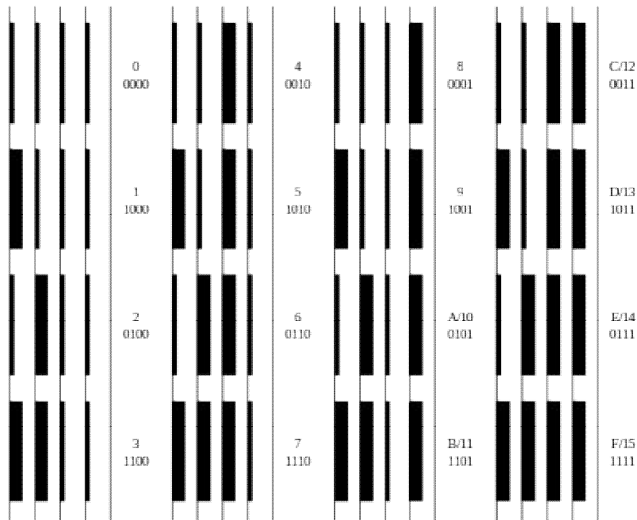
Barcodes are represented by black vertical bars and are read by a barcode reader. Barcodes are printed on nearly every product you buy, each product has a unique code. When read, information stored in the shop's database is recalled, such as the product name and price. This information later appears on your receipt. The scanning process also assists in stock management, reducing the stock by one each time a product is scanned/sold.

Used in supermarkets, keeping track of produce etc. They allow for quick reading of product details so that prices and information can be retrieved and/or stock levels updated. However the amount of data stored in a barcode is very limited.



Barcodes are very common

1. A laser is directed towards the barcode, scanning across it and the reflected light is captured by the reader
2. The intensity of light reflected back is read by a sensor in the bar code reader
3. High intensity = white bar
4. Low intensity = black bar
5. The pattern received is translated into a code which gives the identity of the barcode being scanned
6. This code is checked against a product database and the product details displayed



Plessey code is one way to encode barcodes

To make sure that the number you have received is correct barcodes employ check digits.

Advantages:

- Cheap to produce as all you need to do is print a black and white image
- Quick to read, and with multi-direction scanners, can be read from different angles

Disadvantages:

- Only a limited amount of data can be stored

Magnetic strip (or stripe) reader



Magnetic stripes are built into many plastic cards such as debit or credit cards and personal identity cards. The magnetic strip on the back of the card can hold the personal details of the card owner and, with the necessary PIN, will allow access to secure information, e.g. bank account details. Data stored on the strip is scanned and input into a computer system by a magnetic stripe reader.

Magnetic Ink Character Reader (MICR)



Magnetic ink characters appear at the bottom of cheques. Banks use MICR to read the numbers from the bottom of cheques to obtain data such as account numbers and bank sort codes. A particular font is used that makes it easy for the machine to discriminate between characters. The ink is magnetised, this makes it immune to creases and dirty marks.

Optical Mark Reader (OMR)



An OMR reads marks made by pencil on a printed form into the computer. OMR systems are suited to reading pre-printed forms and check boxes such as National Lottery number selection sheets and multiple choice exam papers.

Application:

The use of OMR is not only limited to schools or data collection agencies; many businesses and health care agencies use optical mark readers to streamline their data input processes and reduce input error. There are many applications for Optical Mark Recognition including: institutional research, community surveys, consumer surveys, tests & assessments, evaluations/feedback, data compilation, product evaluation, time sheets, inventory counts, membership subscription forms, and lotteries & voting

Advantages:

1. A fast method of inputting large amounts of data - up to 10,000 forms can be read per hour depending on the quality of the machine used.
2. Only one computer needed to collect and process the data
3. OMR is much more accurate than data being keyed in by a person

Disadvantages:

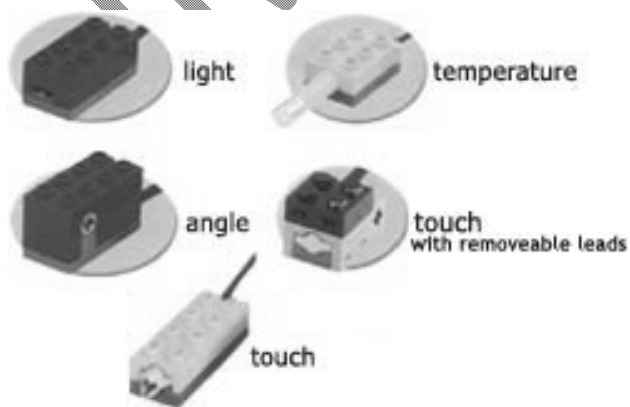
1. If the marks don't fill the space completely, or aren't in a dark enough pencil, they may not be read correctly
2. Only suitable for recording one out of a selection of answers, not suitable for text input
3. The OMR reader needs the answers to be on the prepared forms which will all be identical to one another. You can't just pick up a blank sheet of paper and mark your answers on it.

Optical Character Recognition:

Optical character recognition (OCR) is the mechanical or electronic conversion of images of typewritten or printed text into machine-encoded text. It is widely used as a form of data entry from printed paper data records, whether passport documents, invoices, bank statements, computerized receipts, business cards, mail, printouts of static-data, or any suitable documentation.



Sensors:



Sensors are often used as part of a feedback cycle. They collect data continuously and are typically linked to a **control program** that specifies acceptable levels, eg the minimum and maximum temperature in a green house. The control program decides what to do next based on the data it's fed by the sensors.

A normal PC has no way of knowing what is happening in the real world around it. It doesn't know if it is light or dark, hot or cold, quiet or noisy. How do we know what is happening around us? We use our eyes, our ears, our mouth, our nose and our skin – our **senses**.

A normal PC has no senses, but we can give it some: We can connect **sensors** to it...

A **sensor** is a device that **converts a real-world property** (e.g. temperature) into **data** that a computer can **process**.

Examples of sensors and the properties they detect are...

| Sensor | What it Detects |
|------------------|--|
| Temperature | Temperature |
| Light | Light / dark |
| Pressure | Pressure (e.g. someone standing on it) |
| Moisture | Dampness / dryness |
| Water-level | How full / empty a container is |
| Movement | Movement nearby |
| Proximity | How close / far something is |
| Switch or button | If something is touching / pressing it |

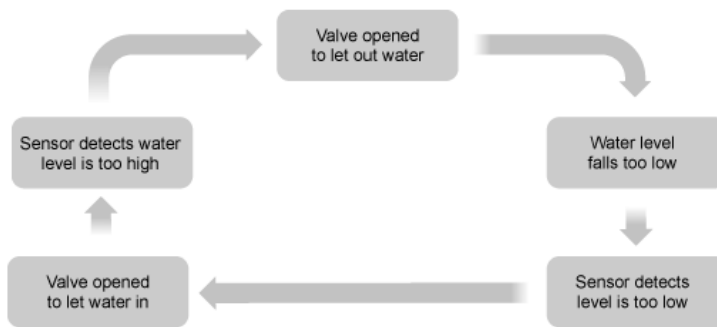
How Sensors Works:

A sensor measures a specific property data and sends a signal to the computer. Usually this is an **analogue** signal so it needs to be converted into **digital** data for the computer to process. This is done using by an Analogue-to-Digital Converter (ADC).

Sensors are used extensively in monitoring / measuring / data logging systems, and also in computer control systems.



The diagram below shows a control program for maintaining the water level in a fish tank.



Feedback cycle for a fish tank

The **control program** stores the highest and lowest acceptable water levels and what action to take if they're exceeded.

The process is continuous and is called a **feedback cycle**.

Stages of the feedback cycle / Sensors with actuators

1. water level falls too low
2. sensor detects water level is too low
3. valve opened to let water in
4. sensor detects water level is too high
5. valve opened to let water out

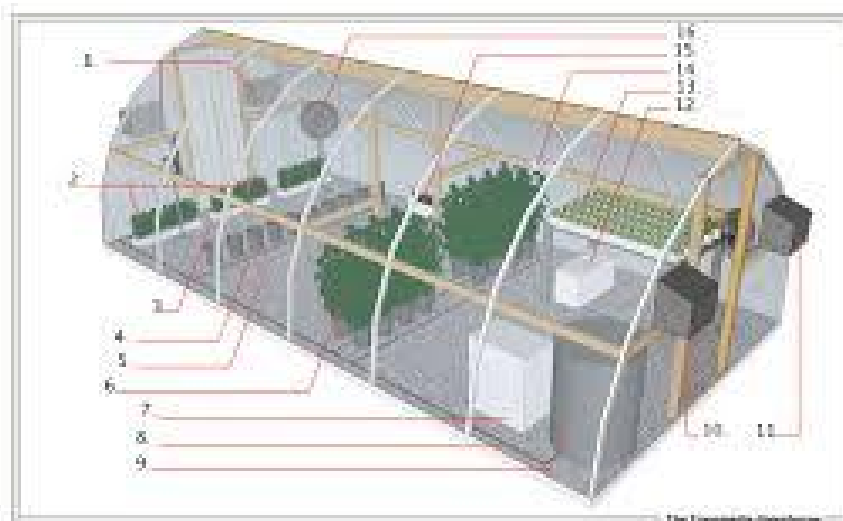
A computer-controlled greenhouse

To get the best plant growing conditions temperature and humidity (moisture in the air) have to be controlled.

The greenhouse therefore has temperature and humidity sensors linked to a computer, and the computer has a control program storing details of the correct temperature and humidity settings. The greenhouse is fitted with a heater, sprinkler and window motor, also linked to the computer.

If the humidity falls below the values stored in the program, the computer activates the sprinklers and closes the windows. If the temperature falls outside the values stored in the program, the heater is activated by the computer.

The system monitors the conditions night and day with immediate response to any changes. To alter the growing conditions the values in the computer program can of course be changed.



Output devices

Common output formats are printed paper, sound, video and on-screen documents. They let the computer communicate with the user. Examples of devices that take advantages of these formats are:

Monitor

The most common output device is the monitor or VDU.

Modern monitors, where the case isn't more than a few centimetres deep, are usually Liquid Crystal Displays (LCD) or Thin Film Transistors (TFT) monitors.

Older monitors, where the case is likely to be around 30 cm deep, are Cathode Ray Tube (CRT) monitors.



CRT Monitor

Cathode-Ray Tube

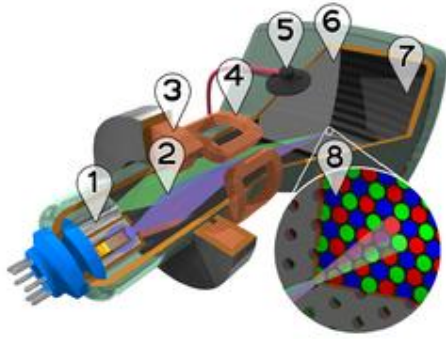
A cathode ray tube is a Visual Display Unit. You might know them as the old 'fat' televisions and monitors that have mostly been superseded by LCD screens.

Advantages

the image on a CRT can be viewed from a wide range of angles

Disadvantages

Heavy, large and power hungry compared to LCD screens



Cutaway rendering of a color CRT:

1. Three Electron guns (for red, green, and blue phosphor dots)
2. Electron beams
3. Focusing coils
4. Deflection coils
5. Anode connection
6. Mask for separating beams for red, green, and blue part of displayed image
7. Phosphor layer with red, green, and blue zones
8. Close-up of the phosphor-coated inner side of the screen

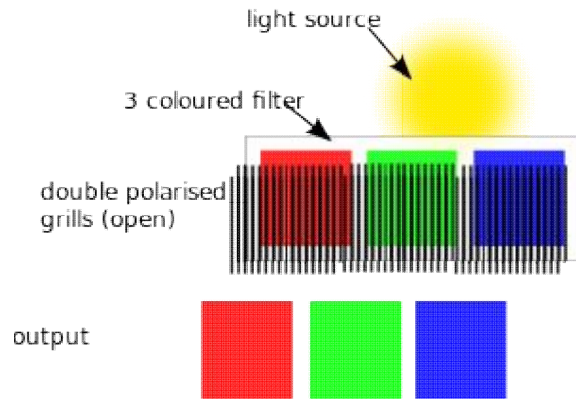
Flat Screen LCD:



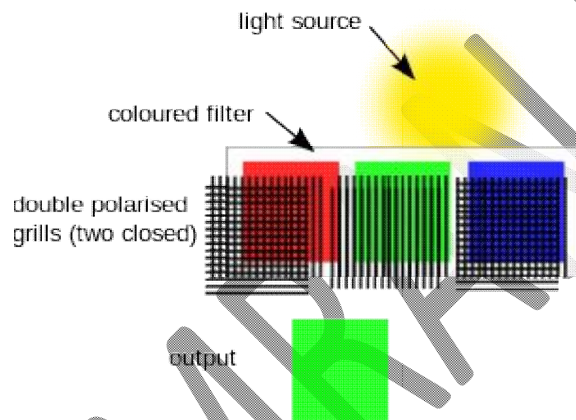
A 19-inch [LG](#) flat-panel [LCD monitor](#).

LCDs are Visual Display Units. Most modern Televisions and Monitors are liquid crystal displays (LCD). An LCD screen is made up by an array of pixels or picture elements, each pixel contains Red Green and Blue and there is a back light that shines through the pixel, creating an image

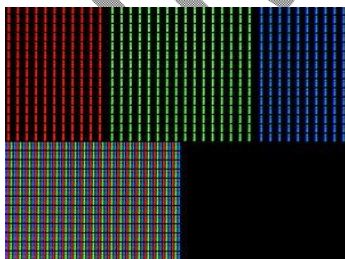
To change the image displayed on the screen will require different combinations of Red, Green and Blue pixels. To do this the pixels are sandwiched between two polarized grills.



These grills are controlled by an electric current and when current is applied, the grids go perpendicular to each other, blocking out all light from a particular colour.



Applying different current patterns to different pixels means that you can choose whether each pixel displays Red, Green or Blue, thus building an image:



Advantages

LCD screens have several benefits over traditional CRT screens:

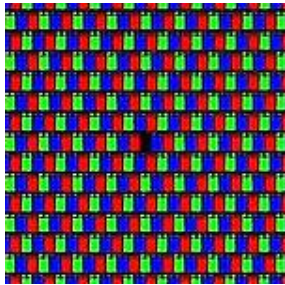
Smaller and lighter than equivalent sized CRT

More energy efficient than CRT

Disadvantages

Viewing angles of LCD screens can be smaller than an equivalent CRT. This means the viewers can't see images from the side of the screen

Dead pixels can plague LCD Monitors, where the grills governing the colour of an individual pixel get stuck and fix that pixel to always displaying a certain colour or no colour at all



an example of a dead pixel

Plasma Screen

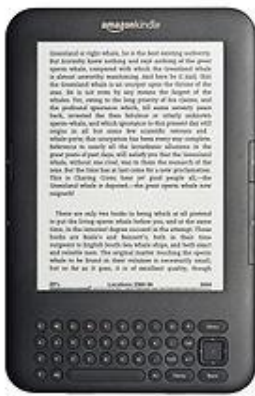
Plasma screens are Visual Display Units. They are generally more expensive than LCDs and CRTs, and offer similar performance to an LCD. They are power hungry and used mainly for large television sets.

Sound output

Speech output might include speech synthesis, headphones or speakers

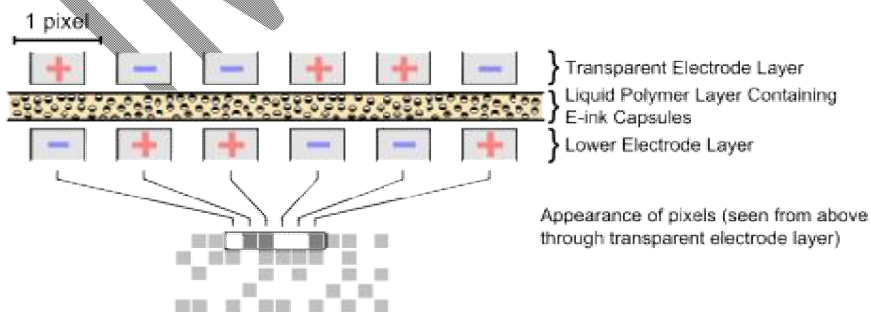


Electronic paper



Amazon Kindle using an e-paper display

Electronic paper is made up of tiny plastic balls that have different colours on each side (black and white). Applying an electrical current to the 'paper' flips the balls to make the pattern of a picture and an image is displayed. The image stays there until you apply another current. This is used in modern e-book readers such as the Amazon Kindle and in other devices such as phones



Advantages

- + Images are easy to read in sunlight, unlike most electronic screens
- + You only need to use electricity to change the image, not maintain it, meaning batteries last longer than LCD screens. In some cases batteries may last weeks, whilst an LCD equivalent would only last a day or two

Cons

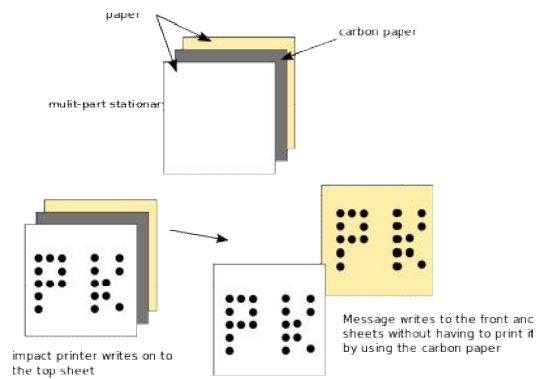
- The refresh rate of screens is too slow to show moving images
- Ghosting might occur, where the shadow of old images remains on the screen after you have refreshed



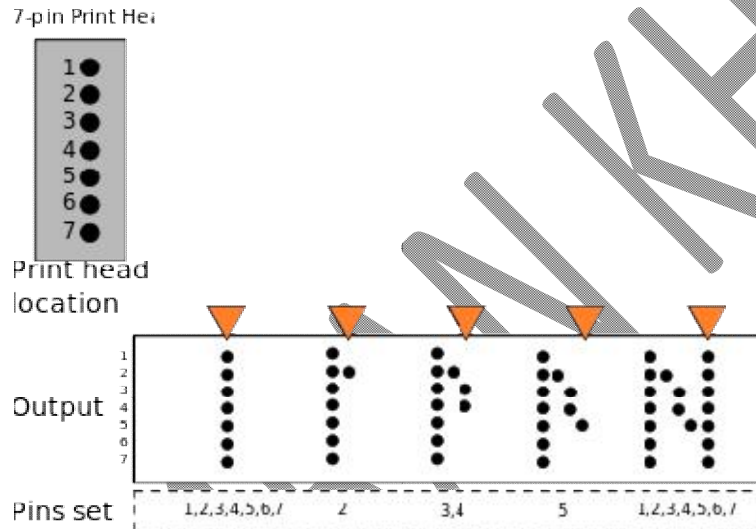
Printer

- **Laser printers** are quite expensive to buy and run but produce a high quality output and are quiet and fast.
- **Ink-jet printers** offer black and white or colour printing with reduced levels of quality and speed. Colour ink jet printers are cheaper to buy than colour laser printers.
- **Dot matrix printers** are not so common today. They are comparatively noisy and low quality but are cheap to run and are used when carbon copies or duplicates need to be made, such as for wage slips. Also, they are useful in dirty environments such as a garage because they are much sturdier than the other two types of printer.

Dot Matrix Printer:



Dot matrix printers use a print head containing a line of pins. The number of pins can vary from 7 into the dozens. As the print head passes over the paper the pins impact on the ink ribbon forming characters on the paper line by line.



Advantages

- + Can print multi-part stationary
- + very cheap to run

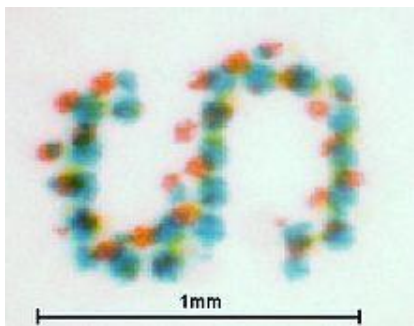
Disadvantages

- unable to produce high definition images, you are limited to the number of pins available
- slow when compared to laser

Ink jet Printer:

Inkjets are examples of non-impact printer. They operate by propelling variably-sized droplets of liquid or molten material (ink) onto almost any sized page. They are the most common type of computer printer used by consumers.

1. The paper is fed into the printer
2. The print head contains one or more cartridges of ink of different colours (some only have black ink)
3. The print head moves from one side to another, each cartridge spraying tiny particles of ink onto the paper to form the correct pattern
4. After one line is finished the paper is fed through a little more, and the next line printed



Advantages

- + Inkjet printers are cheaper than lasers
- + They can produce high quality images for photos etc

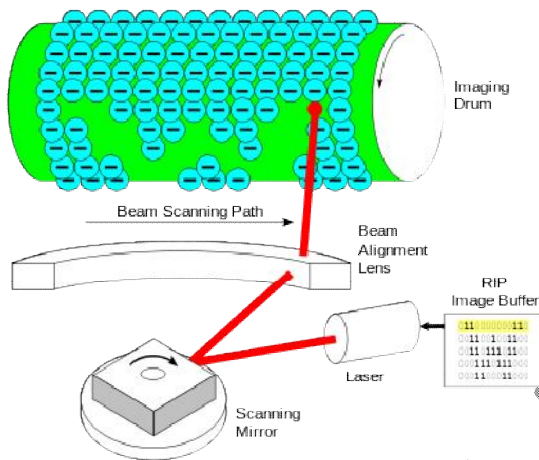
Disadvantages

- They are slower than lasers
- Per page they are relatively expensive

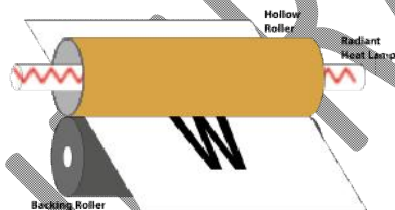
Laser Printer:

Lasers are examples of non-impact printers. A laser printer rapidly produces high quality text and graphics. They work in the following way:

1. The drum is given a negative charge
2. This charge is erased in the correct places by the laser to create the image using the photoelectric effect



1. The drum is coated in toner, a negatively charged fine dust, which is repelled by the charge on the drum. Only in the uncharged areas does the toner apply
2. The drum rolls over the paper and transfers the toner onto it (if your printing gets jammed the paper might have this dust on it which comes off on your hands)
3. The paper is then put through heated rollers which melts the toner and seals it to the paper, thus finishing the image.



Advantages

- + Fast
- + Cheap to Produce large volumes of printing

Disadvantages

- Expensive hardware

Plotters

A plotter can be used to produce high quality, accurate, A3 size or bigger drawings. They are usually used for Computer Aided Design (CAD) and Computer Aided Manufacture (CAM) applications, such as printing out plans for houses or car parts.

1. Paper is placed in the plotter.
2. The plotter arm selects a pen of the correct colour
3. the arm then moves the pen to the area where printing needs to start.
4. the pen is lowered onto the paper and the arm moves it drawing a continuous image.
5. The pen raises and lowers depending on what needs to be drawn, the plotter can also select from a group of colour pens

(some plotters involve keeping the pens stationary and moving the paper instead)

Advantages

- + cheap to run
- + can produce very precise technical drawings

Disadvantages

- there may be issues around the colour pens available, it is hard to combine colours as you would in an inkjet
- slow



2D and 3D Cutters

3d Cutters

A 3d laser cutter can recognize all sides of a substrate to make more complex shapes. A 3d laser cutter can also work with a cube instead of a flat piece of a material.

2D and 3D Cutters

A 2d and 3d cutter is a high powered laser that cuts material such as thin metals or woods, used mostly for industrial purposes. They make precise and clean cuts, it is also very fast which makes it efficient. It is first designed through a computer and then sent through a laser cutter to give you the design.

2D Laser Cutters

A high powered laser that can only recognize the face of the material.

How its used in real life scenarios

Laser cutters are used mostly for parts of cars, aircrafts, or buildings. They can also engrave materials so it can be used for license plates.



Quiz

1. What is a 3D laser cutter?

Q.1 Answer

A 3D laser cutter is a high powered laser and can recognize all sides of a object or substrate to make more complex shapes.

2D and 3D Cutters

Question.2

What type of materials can a laser cutter cut through?

Question 2 Answer

A variety of Thin metals, plastics, or woods.

Question 3

What are laser cutters used for?

Question 3 Answer

Laser cutters are used for aircraft parts, buildings, and car parts.
Pause if needed.....

Actuator

An **actuator** is a type of motor that is responsible for moving or controlling a mechanism or system.

It is operated by a source of energy, typically electric current, hydraulic fluid pressure, or pneumatic pressure, and converts that energy into motion. An actuator is the mechanism by which a control system acts upon an environment. The control system can be simple (a fixed mechanical or electronic system), software-based (e.g. a printer driver, robot control system), a human, or any other input.



Examples of actuators

- Comb drive
- Digital micromirror device
- Electric motor
- Electroactive polymer
- Hydraulic piston
- Piezoelectric actuator
- Pneumatic actuator
- Relay
- Servomechanism
- Thermal bimorph

Smart Board

The **Smart Board** (stylized as "SMART Board") is a line of interactive whiteboards produced by the Calgary, Alberta-based company Smart Technologies.



Digital Light Processing

Digital Light Processing (DLP) is a display device based on of micro-electro-mechanical technology that uses a digital micro mirror device.



Storage capacity and file size

Storage capacities and file sizes are measured from lowest to highest in:

- bits
- bytes
- kilobytes
- megabytes
- gigabytes
- terabytes

An operating system abbreviates these measurements, eg 1 megabyte becomes 1MB (**megabyte**).

Relationship between measurements

The table below outlines the relationship between bits (smallest) and terabytes (largest). Read each row of the table from left to right:

Relationship between measurement

| Size | Equal to |
|----------------|------------|
| 8 bits | 1 byte |
| 1024 bytes | 1 kilobyte |
| 1024 kilobytes | 1 megabyte |
| 1024 megabytes | 1 gigabyte |
| 1024 gigabytes | 1 terabyte |

The size of a file and a storage device's capacity will always be written in its simplest form. For example, an operating system would report a 1 terabyte hard disk's size as 1TB **not** as 1024GB, although both are correct.

Example file sizes

The table below lists files commonly found on a computer and their typical file size (compressed):

File File size

Photo3MB

File File size

Song 5MB

Film 700MB

A file's size can be influenced by a number of factors but ultimately the more information a file stores, the larger it will be.

A computer uses two types of storage. A main store consisting of ROM and RAM, and backing stores which can be internal, eg hard disk, or external, eg a CD or USB flash drive.

ROM and RAM

Main store (or computer memory) is divided into Read Only Memory (ROM) and Random Access Memory (RAM).

ROM

ROM is memory that cannot be changed by a program or user. ROM retains its memory even after the computer is turned off. For example, ROM stores the instructions for the computer to start up when it is turned on again.

RAM

RAM is a fast **temporary** type of memory in which programs, applications and data are stored. Here are some examples of what's stored in RAM:

- the operating system
- applications
- the graphical user interface (GUI)

If a computer loses power, all data stored in its RAM is lost.



The hard disk

The main internal backing store is a computer's hard disk.

Hard disk

A hard disk stores:

- the operating system
- software applications or programs
- the majority of your data files

Hard disks spin at very high speeds (around 7,200 RPM - revolutions per minute) within a sealed unit inside the computer. Hard disks store large amounts of data - 200GB to 1TB is common in desktop computers. The data stored on a hard disk is retained until deleted, but it needs to be loaded into main store RAM before it can be used.

Floppy and zip disks



Floppy discs became popular in the 1970s. The most common format was 1.44 MB, capable of holding only very small amounts of data. Computers need a floppy drive to read floppy disks, and many modern computers are no longer supplied with a floppy disc drive because we now work with much larger files.

Now we are capable of storing 16 GB of data on a memory card which is, physically, six times smaller than a floppy disk. It would take roughly 11,111 floppy disks to store 16 GB of data.

In the past, floppy disks were used to:

- transfer small files of data from one machine to another
- backup important small files stored on a hard disk
- store restricted files that you didn't want other users of your computer seeing

In the past, floppy disks were used to:

- transfer small files of data from one machine to another
- backup important small files stored on a hard disk
- store restricted files that you didn't want other users of your computer seeing

Zip disk



Zip disks are like large floppy disks but can store 250MB or more of data. To read them a computer needs a zip drive. Their use is similar to that of floppy disks.

Newer storage mediums such as DVD-RWs and memory sticks have replaced floppy/zip disks.

External backing stores: optical discs

There are several different types of optical disc, although they all look pretty much the same.

CD (Compact Disc)

Optical discs that use the same technology as music CDs. They store up to 700MB of data. CDs can be used for multimedia applications such as encyclopaedias and can store pictures, sounds and video clips or anything else that will fit.

There are several formats on the market, such as:

- CD-ROM - read only, the data is written to them before they are sold.
- CD-R - meaning CD-Recordable, the user can write data to the CD once or fill it over time using multi-session (writing to the same disc on separate occasions).
- CD-RW - meaning CD-ReWritable, the CD can be written and re-written to. Unlike multi-session discs, existing data can be overwritten.

DVD (Digital Versatile Disc)

DVDs are the same physical size as CDs but hold much more data - a single sided disc can hold up to 4.7GB. DVDs are commonly used for storing video so you will often see them measured in minutes, eg 4.7GB = 120 minutes.

There are several formats on the market, such as:

- DVD-ROMs - read only, the data is written to them before they are sold.
- DVD-R - meaning DVD-Recordable, the user can write data to the DVD once or fill it over time using multi-session.
- DVD-RW - meaning DVD-ReWritable, the DVD can be written and re-written to. Unlike multi-session discs, existing data can be overwritten.

CD/DVD drives



To read from and write data to CDs and DVDs you will need a suitable drive. Today you can buy CD/DVD drives that are able to:

- read all CD and DVD formats
- write to CD-R, CD-RW, DVD-R and DVD-RW

Data is written to and read from the discs using a laser.

External backing stores: Magnetic tape



Principally used for backup of important files from the hard disk and for the long term storage and archiving of data.

Advantage

- They are small, robust, portable and provide low cost storage per GB.

Disadvantages

- They are very slow to write to and read from.
- Serial access means all the data on the tape must be read before you can access the data you need.

External hard disks

An external hard disk can store very large amounts of data, eg 1TB, and can be plugged into your computer via a USB or FireWire port to provide extra storage. They're essentially the same as the hard disk in your computer but due to the casing are usable externally.



Advantage

- High capacity, eg 1TB or more so they can be used to backup data or move large amounts of data between machines.

Disadvantages

- They're often quite large and therefore inconvenient to carry around.
- They have moving parts so are more likely to break, especially if dropped.

Memory sticks

A memory stick is 'pen top' sized USB device and can be used in a similar way to a floppy disk but it is inserted into the USB port - it is then seen by the computer as a removable drive. They typically come in sizes from 512MB to 32GB upwards depending on the price paid.



Advantages

- Memory sticks can hold large quantities of data.
- They are extremely portable, so the user can take them wherever they go.
- They're durable, because they have no moving parts.

Disadvantage

- Portable storage devices in general are more likely to be lost, stolen or damaged.

Memory Cards

A memory card is a stamp-sized USB device and can be used in a similar way to a floppy disk but it is inserted into either a memory card reader or a USB converter - it is then seen by the computer as a removable drive. They typically come in sizes from 1 GB to 32 GB upwards, depending on the price paid. There are many available memory card formats, but since 2010 the SD card became the more favoured format.

Advantages

- Memory cards can hold large quantities of data.
- They are extremely portable so the user can take them wherever they go.
- Digital accessories such as compact cameras and mobile phones are able to read and write to memory cards allowing the user to transport large collections of photographs, songs or information with them.
- They're durable because they have no moving parts.

Disadvantage

- Memory cards, specifically the micro SD card, are the smallest storage devices available. This means they are more likely to be lost, stolen or damaged.
- All computers do not come with memory card readers built in. Users will often be required to purchase a card reader or USB converter to view the data on a card.

Backing up and archiving data

Data needs to be backed up for many reasons:

- a user may delete an important file
- hard disks can fail
- a virus can wipe out data
- a fire may destroy the building where the data was being stored (businesses will often store their backups off-site)

If the data wasn't backed up then the consequences could be disastrous depending on what data was lost. If a business lost details of all the payments it had yet to receive the business could go bankrupt as they wouldn't know what was owed to them or by who.

Businesses typically use magnetic tape to backup important data. Your average home user is unlikely to backup their data but those who do will most likely use an external hard disk.

Frequency of backups

Some data is more valuable than other data and some data is changed more frequently than other data. These are the kind of issues that must be taken into account when deciding how often to backup data.

The value of the data should determine how frequently it is backed up.

If the data doesn't change often then it doesn't need to be backed up as often, maybe just after each change. If the data changes frequently then it should be backed up frequently (maybe every evening).

Archiving

Some data may not be being used very often but it may still be useful or needed in the future. In this case data can be archived. Archived data is copied to a suitable storage medium (perhaps DVDs or magnetic tape) then it is stored safely and securely. The original data is then deleted from the computer system. This is done to free up storage space for new data.

Exam Style Question

What are the main differences between ROM and RAM? (4 marks)

Answer

- RAM is computer memory which **loses its data** when the computer is switched off.
- ROM is computer memory which **retains its data**, even when the computer is switched off.
- RAM is a temporary storage area used whilst the computer is switched on and is constantly being written to and read from.
- ROM is 'read only' memory and cannot be changed by the program or user. The contents remain the same.

High Capacity Optical Discs

Blu-Ray

Blu-Ray disks are a recent replacement for DVDs. A Blu-Ray disc can hold **25 – 50GB** of data (a dual-layer Blu-Ray disc can hold twice that). Blu-Ray discs are **random-access** devices.

Blu-Ray discs are used in the same way as DVD-ROMs (see above) but, since they can hold more data, they are also used to store very high-quality, **high-definition (HD) video**.

*The 'Blu' part of Blu-Ray refers to the fact that the laser used to read the disc uses **blue** light instead of red light. Blue light has a **shorter wave-length** than red light (used with CDs and DVDs).*

Using a blue laser allows more data to be placed closer together on a Blu-Ray disc, than on a DVD or CD, so Blu-Ray has a much **higher storage capacity** than these older discs.

HD DVD

High-density DVD (HD-DVD) discs can hold around **15GB** of data (a dual-layer HD-DVD can hold twice that). HD-DVDs are **random-access** devices.

HD-DVD discs are used in the same way as DVD-ROMs (see above) but, since they can hold more data, they are also used to store very high-quality, **high-definition (HD) video**.

The HD-DVD format was launched at the same time as Blu-Ray. For about a year they competed to be the 'next DVD'. For various reasons, Blu-Ray won the fight, and the HD-DVD format has been abandoned.

Recordable Optical Discs

Recordable optical discs can have **data written** onto them (**'burnt'**) by a computer user using a special disc drive (a disc **'burner'**).

CD-R and DVD-R

CD-Recordable (CD-R) and DVD-recordable (DVD-R) discs can have **data burnt** onto them, but **not erased**. You can keep adding data **until the disc is full**, but you cannot remove any data or re-use a full disc.

CD-RW and DVD-RW

CD-ReWritable (CD-RW) and DVD-ReWritable (DVD-RW) discs, unlike CD-Rs and DVD-Rs, can have **data burnt** onto them and **also erased** so that the discs can be **re-used**.

*When CD-Rs and DVD-Rs are burnt, the laser makes **permanent** marks on the silver-coloured metal layer. This is why these discs cannot be erased.*

When CD-RWs and DVD-RWs are burnt the laser makes marks on the metal layer, but in a way that can be undone. So these discs can be erased.

DVD-RAM

DVD-Random Access Memory (DVD-RAM) discs are a type of **re-writable** DVD. They often come in a floppy-disc style **case** (to protect the disc).

DVD-RAM discs have a similar capacity to a normal DVD, holding **4.7GB** of data. DVD-RAM discs are **random-access** devices.

DVD-RAM discs are used in many **camcorders** (video recording cameras).

The discs are much higher quality than normal DVD-RWs and can reliably store data for up to 30 years. This means that they are often used for video and data **back-up** and **archiving**.

'Solid-State'?

The term 'solid-state' essentially means 'no moving parts'.

Solid-state storage devices are based on **electronic circuits** with **no moving parts** (no reels of tape, no spinning discs, no laser beams, etc.)

Solid-state storage devices store data using a special type of **memory** called **flash memory**...

Flash Memory

Flash memory is a type of Electronically-Erasable Programmable Read-Only Memory (**EEPROM**). Flash memory is **non-volatile** (like ROM) but the data stored in it can also be **erased** or **changed** (like RAM).

Flash memory can be found in many data storage devices...

You might wonder why, since flash memory is non-volatile, normal computers don't use it instead of RAM. If they did we would have computers that you could turn off, turn back on again and no data would be lost – it would be great!

The reason is **speed** – saving data to flash memory is very slow compared to saving it to RAM. If a computer were to use flash memory as a replacement for RAM it would run very **slowly**.

However some portable computers are starting to use flash memory (in the form of **solid-state 'discs'** as a replacement for **hard-drives**. No moving parts mean less to go wrong and longer battery life.

USB Memory Sticks

Memory sticks (or 'thumb-drives') have made many other forms of portable storage almost obsolete (why burn a CD or DVD when you can more easily copy your files onto a memory stick?).

Memory sticks are **non-volatile**, **random-access** storage devices.

Each of these small devices has some **flash memory** connected to a **USB interface**. Plug it into your computer and it appears as a drive. You can then add files, erase files, etc. You can use it to **move any type of file** between computers.

Flash memory used to be very expensive, but in recent years it has become much **cheaper** and you can now buy a 16GB memory stick for just a few dollars.

Memory Cards

Many of our digital devices (**cameras**, **mobile phones**, **MP3 players**, etc.) require **compact, non-volatile** data storage. Flash memory cards provide this and come in a variety of shapes and sizes.

One of the most common formats used by digital cameras is the SD Card. The cards store the digital images taken by the camera.

Mobile phones contain a Subscriber Identity Module (**SIM**) card that contains the phone's number, the phonebook numbers, text messages, etc.

Many phones also have extra memory cards to store music, video, photos, etc. (e.g Tiny Micro-SD cards).

Smart Cards

Many credit cards (e.g. ‘**chip-and-pin**’ cards), door entry cards, satellite TV cards, etc. have replaced the very limited storage of the magnetic strip (the dark strip on the back of older cards) with **flash memory**. This is more **reliable** and has a much **larger storage capacity**.

Cards with flash memory are called **smart cards**.

What is a Backup?

A backup simply means making **one or more copies** of your data.

For example, if you have a folder of photos stored on the hard-drive of your laptop, you might back them up by copying them to a CD-R.

*Note: If you move the photos from the hard-drive to a CD-R, you do **not** have a back-up – you still only have **one copy** of the photos, but now they are on a CD instead of the hard-drive.*

CPU

Central Processing Unit

The CPU (Central Processing Unit) is the part of a computer system that is commonly referred to as the “brains” of a computer. The CPU is also known as the processor or microprocessor.



The CPU is responsible for executing a sequence of stored instructions called a program. This program will take inputs from an input device, process the input in some way and output the results to an output device.

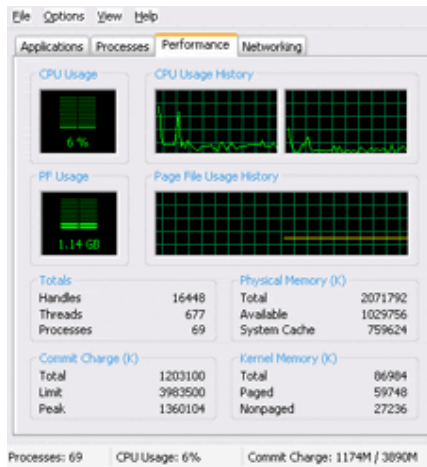
CPUs aren't only found in desktop or laptop computers, many electronic devices now rely on them for their operation. Mobile phones, DVD players and washing machines are examples of equipment that have a CPU.

Operating System

An operating system is a system program that controls and organises the general operation of the computer.

Operating system functions

In any computer, the operating system:



Windows Task Manager provides information about programs running on your computer

- controls the backing store and peripherals such as scanners and printers
- deals with the transfer of programs in and out of memory
- organises the use of memory between programs
- organises processing time between programs and users
- maintains security and access rights of users
- deals with errors and user instructions
- allows the user to save files to a backing store
- provides the interface between the user and the computer – for example, Windows Vista and Apple OSX. For more information, see the User Interfaces Revision Bite.
- issues simple error messages
- Polling (Polling is the process where the computer waits for an external device to check for its readiness.)
- Interrupt (an **interrupt** is a signal to the processor emitted by hardware or software indicating an event that needs immediate attention.)

Types of Operating Systems

Within the broad family of operating systems, there are generally four types, categorized based on the types of computers they control and the sort of applications they support. The categories are:

- **Real-time operating system (RTOS)** - Real-time operating systems are used to control machinery, scientific instruments and industrial systems. An RTOS typically has very little user-interface capability, and no end-user utilities, since the system will be a "sealed box" when delivered for use. A very important part of an RTOS is managing the resources of the computer so that a particular operation executes in precisely the same amount of time, every time it occurs. In a complex machine, having a part move more quickly just because system resources are available may be just as catastrophic as having it not move at all because the system is busy.
- **Single-user, single task** - As the name implies, this operating system is designed to manage the computer so that one user can effectively do one thing at a time. The Palm OS for Palm handheld computers is a good example of a modern single-user, single-task operating system.
- **Single-user, multi-tasking** - This is the type of operating system most people use on their desktop and laptop computers today. Microsoft's Windows and Apple's MacOS platforms are both examples of operating systems that will let a single user have several programs in operation at the same time. For example, it's entirely possible for a Windows user to be writing a note in a word processor while downloading a file from the Internet while printing the text of an e-mail message.
- **Multi-user** - A multi-user operating system allows many different users to take advantage of the computer's resources simultaneously. The operating system must make sure that the requirements of the various users are balanced, and that each of the programs they are using has sufficient and separate resources so that a problem with one user doesn't affect the entire community of users. Unix, VMS and mainframe operating systems, such as *MVS*, are examples of multi-user operating systems.

Interrupt

In systems programming, an **interrupt** is a signal to the processor emitted by hardware or software indicating an event that needs immediate attention.

Buffer

In computer science, a **data buffer** (or just **buffer**) is a region of a physical memory storage used to temporarily store data while it is being moved from one place to another.

Spooling

In computing, **SPOOL** is an acronym for *simultaneous peripheral operations on-line*. It is a type of buffering. The most common spooling application is print spooling, which places a task (or 'print job') into a queue for extended or later processing.

The operating system's tasks, in the most general sense, fall into six categories:

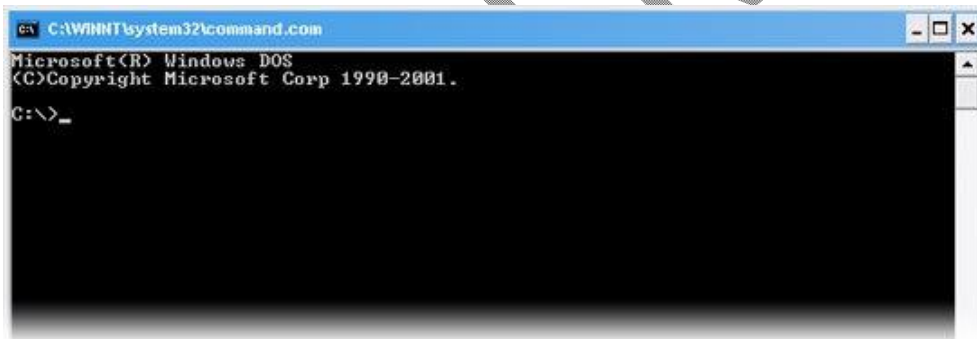
- Processor management
- Memory management
- Device management
- Storage management
- Application interface
- User interface

User Interfaces

A user interface is the method by which the user and the computer exchange information and instructions. There are three main types: command-line, menu driven and graphical user interface (GUI).

Command-line interfaces

A command-line interface allows the user to interact with the computer by typing in commands. The computer displays a prompt, the user keys in the command and presses enter or returns.



The command line screen

In the early days of personal computers, all PCs used command-line interfaces.

Features of a command-line interface

- Commands must be typed correctly and in the right order or the command will not work.
- Experienced users who know the commands can work very quickly without having to find their way around menus.
- An advantage of command driven programs is that they do not need the memory and processing power of the latest computer and will often run on lower spec machines.
- Command driven programs do not need to run in Windows.
- A command-line interface can run many programs, for example a batch file could launch half a dozen programs to do its task.

- An inexperienced user can sometimes find a command driven program difficult to use because of the number of commands that have to be learnt.

An example of a common command driven interface is **MS-DOS**. The MS-DOS command to display all files on c:\ would be: **dir c:**

Command Line Interface

| Advantages and Disadvantages | |
|--|--|
| Advantages | Disadvantages |
| If the user knows the correct commands then this type of interface can be much faster than any other type of interface | For someone who has never used a CLI, it can be very confusing |
| This type of interface needs much less memory (RAM) in order to use it than other user interfaces | Commands have to be typed precisely. If there is a spelling error the command will fail |
| This type of interface does not use as much CPU processing time as others | If you mis-type an instruction, it is often necessary to start from scratch again |
| A low resolution, cheaper monitor can be used with this type of interface | There are a large number of commands which need to be learned - in the case of Unix it can be hundreds |
| A CLI does not require Windows to run | You can't just guess what the instruction might be and you can't just 'have a go'. |

Menu driven interfaces

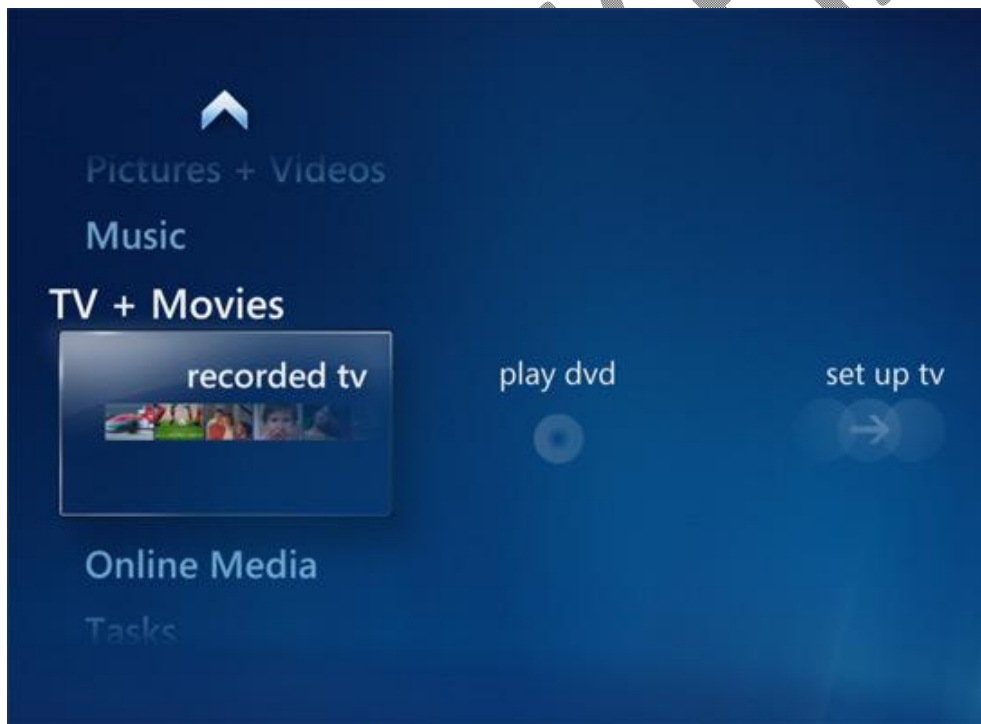
Simple menu

```
Select an option:  
  
1. Start in MS DOS mode  
2. Start Windows  
3. Run system check  
4. Shut down and log off
```

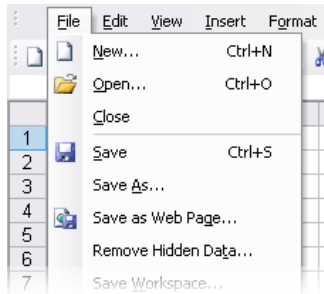
The user is offered a simple menu from which to choose an option. One menu often leads to a further menu. Part of the screen may have an instruction followed by a numbered list of options to choose from.

Full screen menu

A full screen menu takes up the **entire screen**.



Menu bar



The drop-down menu when file is clicked

A menu bar is the set of options at the top of the screen. When an option is chosen a drop-down menu may be offered.

Features of menu driven interfaces include:

- They are easy to use as the user does not have to remember sets of commands.
- They are user friendly – you can often guess your way around the options.
- They can be irritating if there are too many levels of menus to move around – with a command-line interface you can go to the option required immediately.

| Advantages and Disadvantages | |
|---|---|
| Advantages | Disadvantages |
| Extremely easy to use. Someone who has never seen the interface before can work out what to do | A poorly designed menu interface may be slow to use |
| There are no commands to learn or remember | It can be irritating if there are too many menu screens to work through - users get annoyed or bored if it takes too long |
| Step-by-step options are given so that the user doesn't have to remember anything | You often can't go to the exact place you want right at the start. You have to work your way through the menu screens even if you know where you want to get to. |
| Even if you don't know what to do, you can usually guess your way round the options | The menu can take up a large part of the screen so you have to keep flicking back and forwards between applications |
| Menu interfaces don't have to be visual, they can be spoken - good for telephones or for visually impaired people | If the menu is poorly designed it might be hard to read e.g. writing is too small for people with poor sight, colours might clash and be difficult to read, font style might be hard to read. |
| They don't need huge amounts of processing power or memory | |

Graphical user interfaces

Graphical user interface is sometimes shortened to **GUI**. The user chooses an option usually by pointing a mouse at an icon representing that option.

Features of GUIs include:

- They are much easier to use for beginners.
- They enable you to easily exchange information between software using cut and paste or 'drag and drop'.
- They use a lot of memory and processing power. It can be slower to use than a command-line interface if you are an expert user.
- They can be irritating to experienced users when simple tasks require a number of operations.

When discussing user interfaces, it is important to note that Windows XP, Windows Vista, Apple OSX and Ubuntu all have **graphical user interfaces**.

Windows Vista desktop environment



| Advantages and Disadvantages | |
|---|--|
| Advantages | Disadvantages |
| this type of user interface is easy to use, especially for a beginner | GUIs take up a much larger amount of hard disk space than other interfaces |
| it is easy to explore and find your way around the system using a WIMP/ GUI interface | They need significantly more memory (RAM) to run than other interface types |
| you do not have to learn complicated commands | They use more processing power than other types of interface |
| there are usually a reasonable 'help' system included with WIMP interfaces | They can be slow for experienced programmers to use. These people often find CLI interfaces much faster to use |
| you get the benefits of WYSIWYG | |
| they let you exchange data between different software applications | |

Good user interfaces

A good user interface should:

- be attractive and pleasing to the eye
- allow the user to try out different options easily
- be easy to use
- use suitable colours for key areas
- use words that are easy to understand aimed at the type of user
- have help documentation

It should also consider the needs of the users. For example, young children are likely to prefer pictures to words and people with disabilities may benefit from particular input or output devices.

Machine language:

Sometimes referred to as **machine code** or **object code**, **machine language** is a collection of binary digits or bits that the computer reads and interprets. Machine language is the only language a computer is capable of understanding.

Low Level Language:

Low level languages are languages that are easy for the computer to understand like binary languages and hexadecimal language. These languages are also called **object codes**.

High Level Language:

High level languages are the languages that are easy for us to understand like C language, Java. These languages are also called **source codes**.

Translators:

Translators are the computer software that translate high level language into low level language and low level language into high level language. There are three types of translators

1. Compilers (translate in one go that is mean whole program will be translated in a single step)
2. Interpreters (translate program in one by one instruction)
3. Assemblers (translate assembly language into machine code)

Types of software

All computers are made up of hardware, software and data. In your exam, you will need to be able to explain how and why particular hardware or software is suitable for a particular task; and list and discuss criteria which can be used to evaluate or judge the suitability of hardware and software.

Main types of software

Generic

General-purpose software, such as word processors and spreadsheets.

Specialised packages

Sold for specific uses, eg managing the accounts of a large organisation.

Bespoke software

Written specially for the end user by a team of people within the company or by external consultants; for example the software which manages London's congestion-charging system.

For more detailed information about software types, go to the section on Applications and programming languages.

Types of applications software

Applications come in several different types:

- **Utility programs** – examples include virus scanners, disk defragmenters and backup utilities.
- **Generic** – general purpose software that is not written for any particular type of business. Examples of this include word processors and spreadsheets.
- **Integrated** – a collection of software that has a common set of commands/icons. Usually they include word processors, spreadsheets and graphics software, but they can contain databases as well. They tend to be cheaper than purchasing each application separately.
- **Specific** – software written for a defined purpose. Accountancy software is a good example of this that can be bought by anyone.
- **Bespoke** – bespoke software is written when a company requires a piece of software to perform a very specific task or function and there's no existing software that does what they need. It can be very expensive.

Computer Architecture

(Von Neumann Model, Fetch Execute Cycle)

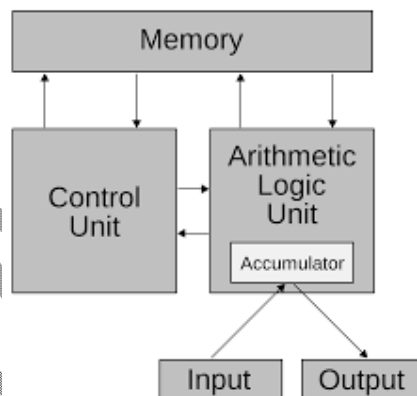
(Input/Output, Memory, Control Unit, ALU and Registers)

Von Neumann model of a Computer:

There are four functional components that all computers must have:

- Input/output (I/O)
- Memory
- A Control Unit
- An Arithmetic Logic Unit (ALU)

This idea about how computers should be built, called the von Neumann Architecture after mathematician John von Neumann who proposed it in 1945, is still the basis for computers today. Using these four components, a von Neumann computer will execute a series of instructions, called a program, which are stored in the computer's memory. This is called the stored program concept.



Input/output (I/O):

The Input/output (I/O) components of a computer are hardware devices that are responsible for getting data from the computer to the user or from the user to the computer. Data going from the user to the computer is called "input." The two main input devices are the mouse and the keyboard. With both of these devices the user can transmit information (in letters or clicks) to the computer. These are not the only types of input devices that are possible — there are also graphics tablets, touch screens, and voice recognition devices, among others.

Output devices are used to transmit data from the computer's memory to the user. The two output devices almost every computer system has are the monitor and the printer.

Another common output device is a speaker system for sound. The specific input devices change over time, but every computer must have input and output devices.

The remaining three components of the von Neumann model of a computer are found inside the system unit.

Memory:

Although a computer has several types of memory, the memory referred to in the Von Neumann model is the main memory, also called RAM or Random Access Memory. Main memory is used by the computer for storing a program and its data while the program is running. What distinguishes a computer from a calculator is the ability to run a stored program; main memory allows the computer to do that.

RAM can be thought of as a sequence of boxes, called cells, each of which can hold a certain amount of data. RAM is constructed from circuitry that can hold data in the form of an electronic charge that is either high or low. Conceptually, a high charge represents the number 1 and a low charge the number 0.

RAM must be coded in binary – in terms of 0's and 1's. (later modules explain exactly how numbers, letters, graphics, and sounds can be represented in binary – using only 0's and 1's.)

One of the high or low charges stored in memory (one 0 or one 1) is called a bit and 8 bits is called a byte. For every computer, each memory cell can hold a certain fixed number of bits, usually 8.

Control Unit:

Inside the computer, the remaining two components of the von Neumann Architecture are found on the CPU (Central Processing Unit) chip. The control unit controls the sequencing and timing of all operations. It contains a “clock,” that is actually a quartz crystal that oscillates at a regular frequency when electrical power is applied. The clock emits an electronic signal for each oscillation. Each separate operation is synchronized to the clock signal.

Arithmetic and Logic Unit:

Also on the CPU chip is circuitry for performing arithmetic and logical calculations. This is called the Arithmetic/Logic Unit or ALU for short. It can be thought of as being similar to a calculator, except that, in addition to normal math, it can also do logical (true/false) operations, such as comparing two numbers to see which one is larger. Logical operations are important in computer programming.

Register:

In computer architecture, a **processor register** is a small amount of storage available as part of a digital processor, such as a CPU. Such registers are (typically) addressed by mechanisms other than main memory and can be accessed faster.

Types of Register:

MBR:

A **Memory Buffer Register (MBR)** is the register in a computer's processor, or central processing unit, CPU, that stores the data being transferred to and from the immediate access store.

MDR:

The **Memory Data Register (MDR)** is the register of a computer's control unit that contains the data to be stored in the computer storage (e.g. RAM), or the data after a fetch from the computer storage.

MAR:

In a computer, the **Memory Address Register (MAR)** is a CPU register that either stores the memory address from which data will be fetched to the CPU or the address to which data will be sent and stored.

Fetch Execute Cycle:



1. Fetch the instruction (transfer the instruction from main memory to the decoder)
2. Decode the instruction (from machine language)
3. Execute the instruction (e.g., add, divide, load, store...)
4. Store the result (for instructions like ADD, place the 'answer' in the specified register.)

Chapter 9 Logic gates

Learning Summary

In this chapter you will learn about:

- **Logic gates**
- **Truth tables**
- **Logic circuits/networks**

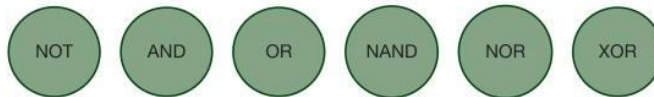
In this chapter we will look at how logic gates are used and how truth tables are used to check if combinations of logic gates (known as logic circuits or logic networks) carry out the required functions.

9.1 Logic gates

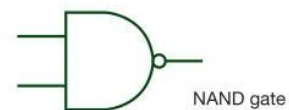
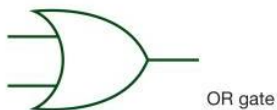
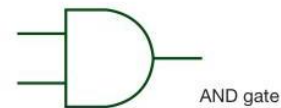
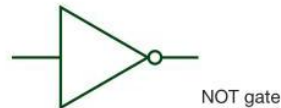
Signals can be represented as ON or OFF, 1 or 0 as well.

A large number of electronic circuits (in computers, control units, and so on) are made up of logic gates. These process signals which represent true or false.

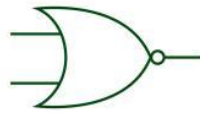
The most common symbols used to represent logic gates are shown below. In this book, we will use the **MIL symbols**. But the reader may also see the simpler, more general, logic gate representations.



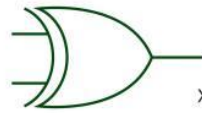
MIL symbols



There are many different logic gates but we will concentrate on these.



NOR gate



XOR gate

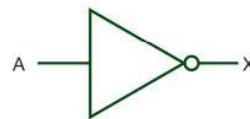
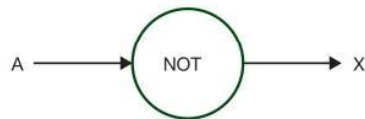
9.2 Truth tables

Truth tables are used to show logic gate functions. The NOT gate has only one input, but all the others have two inputs.

When constructing a truth table, the binary values 1 and 0 are used. Every possible combination, depending on number of inputs, is produced. Basically, the number of possible combinations of 1s and 0s is 2^n where n = number of inputs. For example, 2 inputs have 2^2 combinations (i.e. 4), 3 inputs have 2^3 combinations (i.e. 8) and so on. The next section shows how these truth tables are used.

Description of the six logic gates

NOT gate



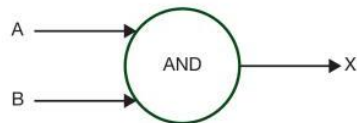
The output (X) is **true** (i.e. 1 or ON) if:

INPUT A is NOT TRUE (i.e. 0 or OFF)

Truth table for: $X = \text{NOT } A$

| INPUT A | OUTPUT X |
|---------|----------|
| 0 | 1 |
| 1 | 0 |

AND gate



The output (X) is **true** (i.e. 1 or ON) if:

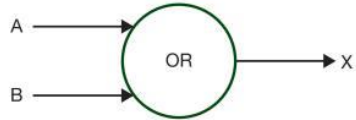
INPUT A AND INPUT B are BOTH TRUE (i.e. 1 or ON)

Truth table for: $X = A \text{ AND } B$

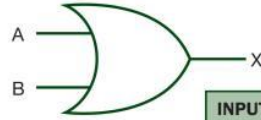
| INPUT A | INPUT B | OUTPUT X |
|---------|---------|----------|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

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OR gate

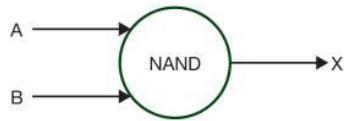


The output (X) is true (i.e. 1 or ON) if:
INPUT A OR INPUT B is TRUE (i.e. 1 or ON)
 Truth table for: $X = A \text{ OR } B$



| INPUT A | INPUT B | OUTPUT X |
|---------|---------|----------|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

NAND gate



The output (X) is true (i.e. 1 or ON) if:
INPUT A AND INPUT B are NOT BOTH TRUE (i.e. 1 or ON)
 Truth table for: $X = \text{NOT } A \text{ AND } B$

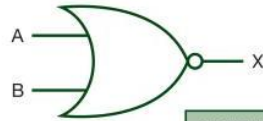


| INPUT A | INPUT B | OUTPUT X |
|---------|---------|----------|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

NOR gate

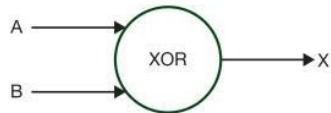


The output (X) is true (i.e. 1 or ON) if:
INPUT A OR INPUT B are NOT BOTH TRUE (i.e. 1 or ON)
 Truth table for: $X = \text{NOT } A \text{ OR } B$



| INPUT A | INPUT B | OUTPUT X |
|---------|---------|----------|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 0 |

XOR gate



Logic gates 9

The output (X) is true (i.e. 1 or ON) if:

INPUT A OR (NOT INPUT B) OR (NOT INPUT A) OR INPUT B

is **TRUE** (i.e. 1 or ON)

Truth table for: $X = A \text{ OR } (\text{NOT } B) \text{ OR } (\text{NOT } A) \text{ OR } B$

| INPUT A | INPUT B | OUTPUT X |
|---------|---------|----------|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

9.3 Logic circuits/networks

Logic gates can be combined together to produce more complex logic circuits (networks).

Key Point

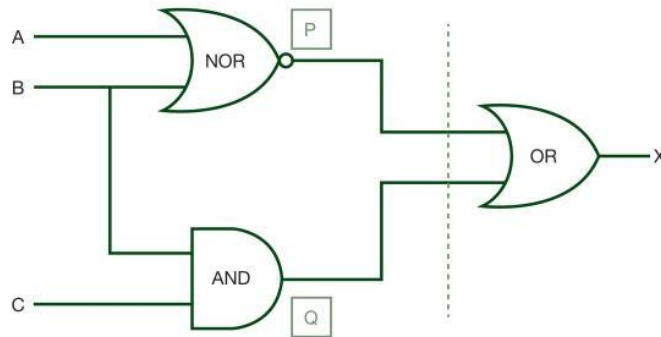
The output from a logic circuit (network) is checked by producing a truth table.

Two different types of problem are considered here:

- drawing the truth table from a given logic circuit (network)
- designing a logic circuit (network) from a given problem and testing it by also drawing a truth table.

Example 1

Produce a truth table from the following logic circuit (network).



To show how this works, we will split the logic circuit into two parts (shown by the dotted line).

First part

There are 3 inputs; thus we must have 2^3 (i.e. 8) possible combinations of 1s and 0s.

To find the values (outputs) at points P and Q, it is necessary to consider the truth tables for the NOR gate (output P) and the AND gate (output Q) i.e.

$$P = A \text{ NOR } B$$

$$Q = B \text{ AND } C$$

Logic gates 9

The output (X) is true (i.e. 1 or ON) if:

INPUT A OR (NOT INPUT B) OR (NOT INPUT A) OR INPUT B

is **TRUE** (i.e. 1 or ON)

Truth table for: $X = A \text{ OR } (\text{NOT } B) \text{ OR } (\text{NOT } A) \text{ OR } B$

| INPUT A | INPUT B | OUTPUT X |
|---------|---------|----------|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

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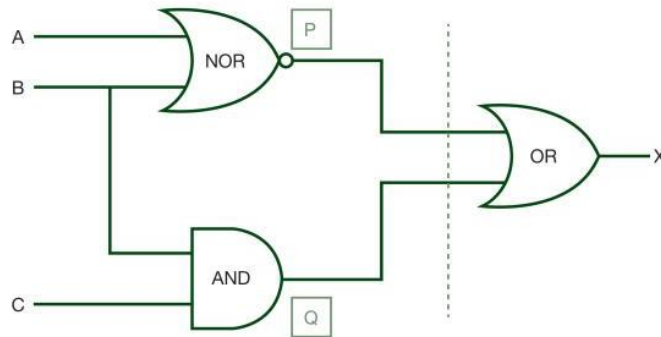
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$$P = A \text{ NOR } B$$

$$Q = B \text{ AND } C$$

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We thus get:

| INPUT A | INPUT B | INPUT C | OUTPUT P | OUTPUT Q |
|---------|---------|---------|----------|----------|
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 0 | 1 |

Second part

There are 8 values from P and Q which form the inputs to the last OR gate.

Hence we get $X = P \text{ OR } Q$ which gives the following truth table:

| INPUT P | INPUT Q | OUTPUT X |
|---------|---------|----------|
| 1 | 0 | 1 |
| 1 | 0 | 1 |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0 | 1 | 1 |

Which now gives us the final truth table for the logic circuit given at the start of the example:

| INPUT A | INPUT B | INPUT C | OUTPUT X |
|---------|---------|---------|----------|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |



Example 2

Consider the following problem.

A system used 3 switches A, B and C; a combination of switches determines whether an alarm, X, sounds:

If switch A or switch B are in the ON position and if switch C is in the OFF position then a signal to sound an alarm, X is produced.

It is possible to convert this problem into a logic statement.

So we get:

If (A = 1 OR B = 1)

The first part is two inputs (A and B) joined by an OR gate

AND

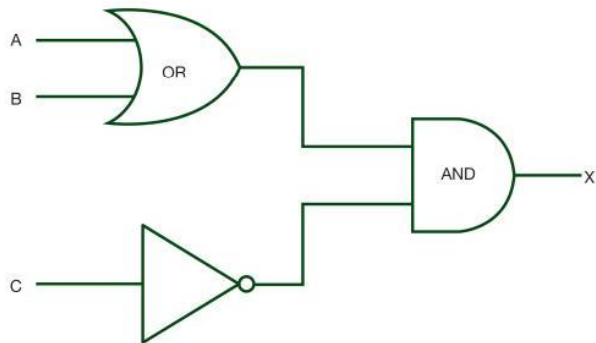
The output from the first part and the third part are joined by an AND gate

(C = NOT 1) then X = 1

The third part is one input (C) which is put through a NOT gate

Remembering that ON = 1 and OFF = 0; also remember that we write 0 as NOT 1.

So we get the following logic circuit (network):



This gives the following truth table:

| INPUT A | INPUT B | INPUT C | OUTPUT X |
|---------|---------|---------|----------|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |

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Example 3

A manufacturing process is controlled by a built in logic circuit which is made up of AND, OR and NOT gates only. The process receives a STOP signal (i.e. $X = 1$) depending on certain conditions, shown in the following table:

| INPUTS | BINARY VALUES | CONDITION IN PROCESS |
|--------|---------------|----------------------------------|
| V | 1 | Volume > 1000 litres |
| | 0 | Volume <= 1000 litres |
| T | 1 | Temperature > 750°C |
| | 0 | Temperature <= 750°C |
| S | 1 | Speed > 15 metres/second (m/s) |
| | 0 | Speed <= 15 metres/ second (m/s) |

A stop signal ($X = 1$) occurs when:

either Volume, $V > 1000$ litres and Speed, $S <= 15$ m/s

or Temperature, $T <= 750^\circ\text{C}$ and Speed, $S > 15$ m/s

Draw the logic circuit and truth table to show all the possible situations when the stop signal could be received.

First of all, it is necessary to turn the problem into a series of logic statements:

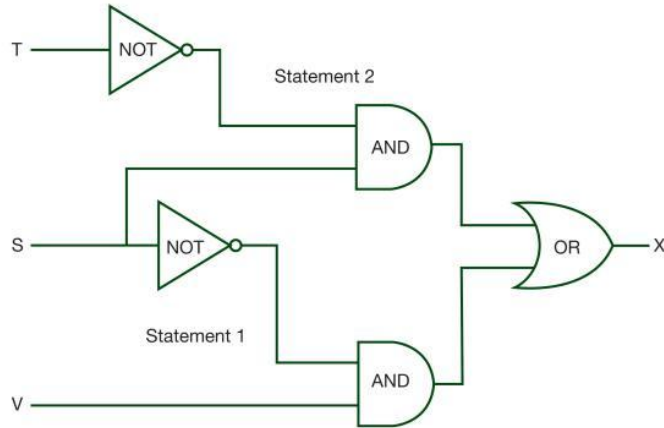
- statement 1 can now be re-written as:
 $V = 1$ AND $S = \text{NOT } 1$ since $V > 1000$ (binary value = 1) and $S <= 15$ (binary value = 0)
- statement 2 can now be re-written as:
 $T = \text{NOT } 1$ AND $S = 1$ since $T <= 750^\circ\text{C}$ (binary value = 0) and $S > 15$ (binary value = 1)
- both statements are joined together by an **OR gate**

So, our logic statement becomes:

$X = 1$ if ($V = 1$ AND $S = \text{NOT } 1$) OR ($T = \text{NOT } 1$ AND $S = 1$)

We can now draw the logic circuit (network) by constructing it for statement 1 and for statement 2 and joining them with an **OR gate**.

In the following logic circuit note that V has been placed at the bottom of logic diagram – this is done to avoid crossing over of lines which makes it look neater and less complex. It is not essential to do this and is only done for the reasons given.



We can now construct the truth table:

| INPUT V | INPUT T | INPUT S | OUTPUT X |
|---------|---------|---------|----------|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |

9.4 End of chapter questions

In questions 1 to 6 produce truth tables from the given logic circuits (networks). Remember, if there are two inputs then there will be 4 possible outputs; if there are three inputs then there will be 8 possible outputs. The truth tables will look like this:

| Input A | Input B | Output X |
|---------|---------|----------|
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

1.

HARDWARE AND SOFTWARE WORKSHEETS

MAY/JUNE SESSION 2002

Q1) Describe two ways that a scanner could be used to transfer paper-based documents to files stored on a computer.

1

.....

.....

2

.....

..... [2]

Q2) (a) State two advantages of using a high-level language rather than a low-level language for writing programs.

1

.....

.....

2

.....

..... [2]

(b) Explain the difference between a compiler and an interpreter.

.....

.....

..... [2]

May/June 2003

Q3) (a) State two sensors that would be used in a microprocessor-controlled camera.

1

.....

.....

2

.....

..... [2]

(b) Describe how the data collected by the sensors would be used by the camera's control program.

.....

.....

.....

.....

..... [2]

Q4) (a) State the purpose of a compiler.

.....

.....

.....

..... [2]

(b) State one difference between a compiler and an assembler.

.....

.....

..... [1]

May/June 2004

Q5) Interfaces enable computer users to interact with the operating system.

State three advantages for using a graphical user interface (GUI) for loading programs and files.

1

.....

.....

2

.....

.....

3

.....

.....[3]

Q6) (a) Name one item used in the home, other than a computer, that contains a microprocessor.

.....[1]

(b) For your item named in (a) describe two different tasks that the microprocessor performs.

1

.....

.....

2

.....

.....[2]

May/June 2005

Q7) Computers systems can have special hardware and special software installed so that disabled students can use a computer to help them study.

(a) State one type of special hardware and the way it helps a disabled student.

Special hardware

Way

.....

.....

.....[2]

(b) State one type of special software and the way it helps a disabled student.

Special software.....

Way

.....

.....

.....[2]

Q8 (a) A digital camera contains a microprocessor. State the input and the processing done by the microprocessor when a person takes a photograph.

Input

Processing

.....[3]

(b) State two reasons why the photograph costs less using the digital camera than it would cost if a non-digital camera was used.

1

.....

2

.....[2]

May/June 2006

Q9) (a) Give two benefits of using a high-level language for writing programs.

1

.....

2

..... [2]

(b) State one type of program that would be written in a low-level language rather than a high-level language and give a reason why.

Type

.....

.....

Reason

.....

..... [2]

May/June 2007

Q10) Digital cameras do not use film. Therefore, there is no need to pay to develop the film and produce prints.

(a) Give two other advantages of using digital cameras rather than traditional cameras.

1

.....

2

..... [2]

(b) On what does the quality of the pictures taken by the digital camera mainly depend?

.....

..... [1]

May/June 2008

Q11) Name two types of automatic data capture and give one application for each type named.

Type 1

Application 1

.....
Type 2

Application 2

..... [4]

May/June 2009

Q12) (a) Give three features of a typical operating system.

1

.....

2

.....

3

..... [3]

(b) Some microprocessor-controlled devices do not need an operating system.

(i) Give one example of such a device.
..... [1]

(ii) Give one reason why it does not need an operating system.
..... [1]

Q13) (a) what is an interrupt?
..... [1]

(b) How can an interrupt be generated?
.....
.....

(c) An exchange of signals between two devices to allow communication to take place.
What is this computer function?
..... [1]

May/June 2010

Q14) (a) Give three different types of device that allow human beings to interface with computer systems.

- 1
- 2
- 3 [3]

(b) Give three automatic data capture devices and give a suitable application for each device.

- Device 1
- Application 1
- Device 2
- Application 2
- Device 3
- Application 3 [6]

May/June 2011

Q15) Many computer-controlled systems use sensors to gather physical data. For example, temperature sensors are used in the control of central heating systems.

(a) Name three other sensors and give a different application for each named sensor.

- Sensor 1
- Application
- Sensor 2
- Application
- Sensor 3
- Application [6]

(b) Describe how temperature sensors are used in computer-controlled central heating systems.

-
-
- [3]

May/June 2012

Q16) A list of four printers and four different applications which use printers is shown below.

(a) Using arrows, link each printer to the most appropriate application.

Printing documents in a factory environment which is dusty and damp

High quality printing of 30 000 colour booklets per day

Producing prototypes in resin of a new design

Producing a colour poster

3D printer

Dot matrix printer

Colour inkjet printer

Colour laser printer

[4]

(b) Give one feature of each printer which makes it appropriate for the application.

3D printer

.....

.....

Dot matrix printer

.....

.....

Colour inkjet printer

.....

.....

Colour laser printer

.....

..... [4]

May/June 2013

Q17) Name a suitable hardware device to enable automatic data capture in each of the following applications. Each device must be different.

| Application | Hardware device |
|---|-----------------|
| automatic stock control system in a supermarket | |
| keeping track of the livestock on a large farm | |
| input data into a computer using speech recognition | |

[3]

Q18) Four types of data storage media and four descriptions are shown in the table below.

Tick () the appropriate boxes in the table to match each data storage medium to its most suitable description.

| | CD-ROM | DVD-RAM | fixed hard disk | memory stick |
|---|--------|---------|-----------------|--------------|
| storage medium where data can only be read and not altered | | | | |
| portable medium which allows transfer of data between computers | | | | |
| memory where operating systems and applications software are usually stored | | | | |
| medium which allows recording and playback to occur at the same time | | | | |

[4]

October/November 2003

Q19) A computer system is described as having the following features:

512 Mbyte RAM

internal modem

A4 colour scanner

(a) State the purpose of each of these.

RAM.....

 modem.....

 scanner.....
[3]

October/November 2004

Q20) Speed cameras are used on many roads to take photographs of cars which have exceeded the speed limit. Some of these cameras use microprocessor controlled chips to store information rather than photographic film.

(a) State two advantages of storing car details on chips rather than on film.

1

2 [2]

(b) State two tasks which would be carried out by the microprocessor as a speeding car approaches a camera.

1.....

2..... [2]

(c) State two tasks which would be carried out by the microprocessor as the photograph is being taken.

1.....

2..... [2]

Q21) (a) Give two reasons why a buffer is used in a printer.

1..... [2]

(b) Give one advantage of increasing the size of a buffer in a printer.

..... [1]

October/November 2005

Q22) A school uses computers to teach disabled students. Describe one special input device and one special output device which could be used to help these students to learn. Give a reason for your choice of each device.

Input device

Reason for choice.....

.....
Output device
Reason for choice.....
.....
.....[4]

October/November 2006

Q23) An airport has multimedia kiosks linked to a central computer.

(a) State two input devices, other than a keyboard, which might be used at the multimedia kiosks.

1
.....
2
..... [2]

(b) Give two items of information that might be accessed from multimedia kiosks.

1
.....
2
..... [2]

(c) State one advantage and one disadvantage for the airport of providing multimedia kiosks.

Advantage
.....
Disadvantage
..... [2]

October/November 2008

Q24) A large city has decided to computerise totally its traffic management system. Traffic lights and electronic road signs are now under automatic computer control.

(a) Sensors are placed around the city to gather information about traffic. Describe what information would need to be gathered.

.....
.....
.....
..... [2]

(b) Describe two ways the information from the sensors could be sent to the central computer which is located several miles away.

1.....
.....
2.....
..... [2]

(c) Give two advantages of having the traffic in the city controlled in this way.

1.....
.....
2.....
..... [2]

October/November 2009

Q25) (a) How could a computer simulation be used by a supermarket to reduce queuing at checkouts?

.....
.....
.....
.....

(b) The supermarket has decided to fit sensors at the shop entrance to count people coming in and leaving.

(i) What type of sensor would be suitable to detect people?

..... [1]

(ii) How could the supermarket use the information obtained from these sensors?

..... [2]

(c) The supermarket has decided to fit information screens at various locations for customer use. These information screens do not use keyboards.

(i) Give one example of a suitable input device.

..... [1]

(ii) What information could be made available to supermarket customers?

..... [1]

(iii) Give one advantage of using this system rather than displaying signs and notices around the supermarket.

..... [1]

October/November 2010

Q26) A typical computer system contains the following four components:

- RAM
- ROM
- hard disk
- modem

Describe the function of each of these components.

RAM..... [1]

ROM..... [1]

Hard disk..... [1]

Modem.....
..... [1]

October/November 2011

Q27) Computer memories are measured in terms of the number of bytes.

(a) (i) What is meant by the term byte?

..... [1]

(ii) What is meant by a Gigabyte?

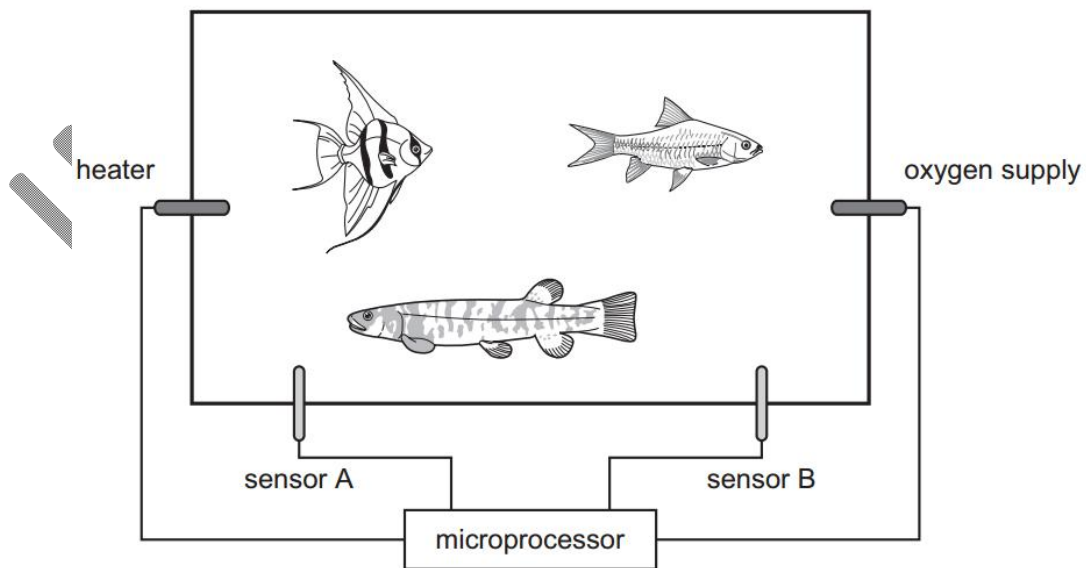
..... [1]

(b) Flash memories and CD-RWs are used as backing media for computers.
Give two differences between these two media.

1..... [1]

2..... [1]

Q28) The conditions in a fish tank are being controlled using sensors and a microprocessor. To keep the fish healthy, the temperature must be at 25°C and the oxygen content needs to be 20 ppm (parts per million). The tank contains a heater and an oxygen inlet controlled by a valve.



(a) Name the two sensors used in this application.

Sensor A1..... [1]

Sensor B 1..... [1]

(b) Describe how the sensors and the microprocessor are used to maintain the correct conditions in the fish tank.

.....
.....
.....
..... [4]

(c) What safeguards would be needed to stop the fish tank temperature rising too high?

..... [1]

October/November 2012

Q29) For each of the following five groups of hardware items, write down a computer application that would need those items.

| List of hardware items | Application |
|-------------------------------------|-------------|
| webcam, microphone, speakers | |
| barcode reader, POS terminal | |
| pressure sensor, ADC, lights, siren | |
| data gloves, data goggles | |
| light pen, plotter, 3D printer | |

Q30) State three tasks done by the operating system.

1.....
..... [1]

2.....
..... [1]

3.....
..... [1]

Specimen 2015

Q31) Kamil is setting up a new computer system to record television programmes. He wants to be able to record, view and then erase programmes that he does not want to keep. He has chosen to use DVD-RAM as an optical storage medium.

Explain to Kamil why it is better to use DVD-RAM rather than DVD+RW or DVD-RW.

3.....
..... [2]

LOGIC GATES WORKSHEETS

May/June 2011

Q1) (a) Two logic gates are the AND gate and the OR gate. Complete the truth tables or these two gates:

AND gate

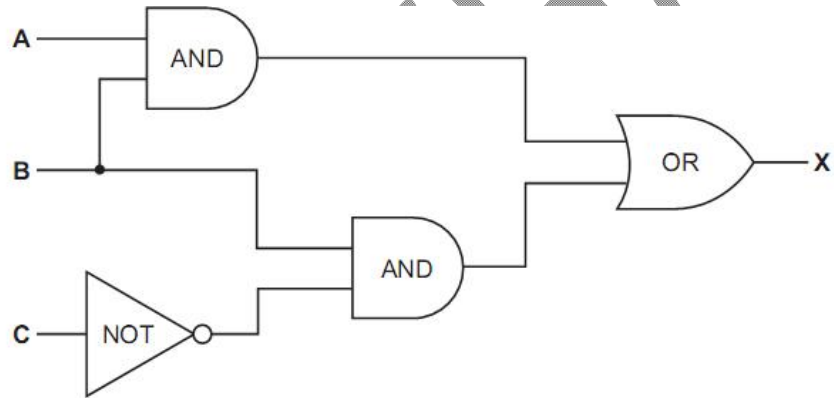
| A | B | X |
|---|---|---|
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

OR gate

| A | B | X |
|---|---|---|
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

[2]

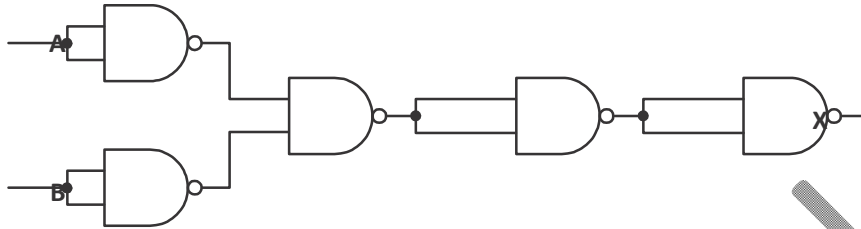
(b) Complete the truth table for the following logic circuit:



| A | B | C | X |
|---|---|---|---|
| 0 | 0 | 0 | |
| 0 | 0 | 1 | |
| 0 | 1 | 0 | |
| 0 | 1 | 1 | |
| 1 | 0 | 0 | |
| 1 | 0 | 1 | |
| 1 | 1 | 0 | |
| 1 | 1 | 1 | |

May/June 2012

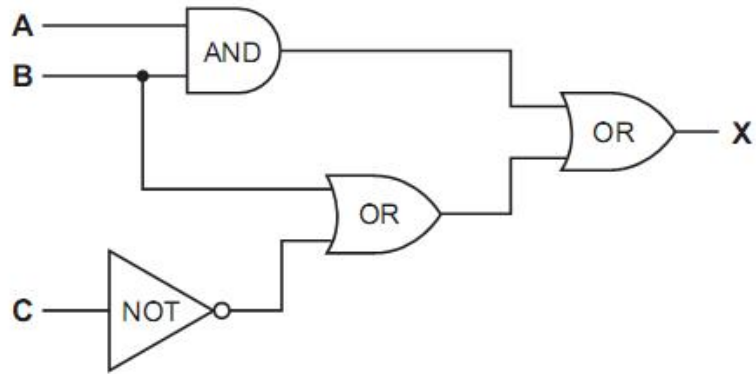
12 (a) (i) Complete the truth table for the following logic circuit, which is made up of NAND gates:



| A | B | X |
|---|---|---|
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

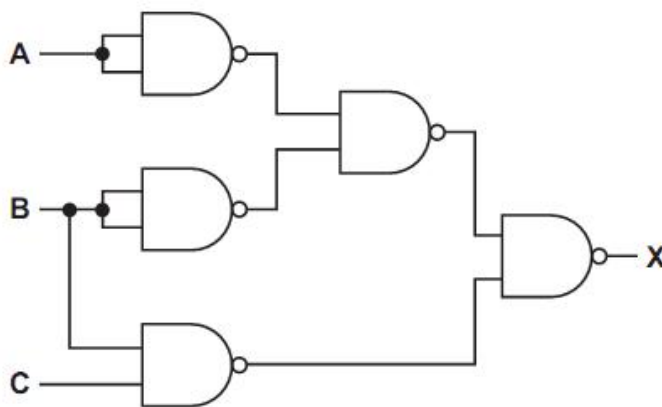
(ii) What single logic gate has the same function as the above logic circuit? 2]

(b) Complete the truth table for the following logic circuit:



| A | B | C | X |
|---|---|---|---|
| 0 | 0 | 0 | |
| 0 | 0 | 1 | |
| 0 | 1 | 0 | |
| 0 | 1 | 1 | |
| 1 | 0 | 0 | |
| 1 | 0 | 1 | |
| 1 | 1 | 0 | |
| 1 | 1 | 1 | |

Q3) (a) Complete the truth table for the following logic circuit, which is made up of NAND gates:



| A | B | C | X |
|---|---|---|---|
| 0 | 0 | 0 | |
| 0 | 0 | 1 | |
| 0 | 1 | 0 | |
| 0 | 1 | 1 | |
| 1 | 0 | 0 | |
| 1 | 0 | 1 | |
| 1 | 1 | 0 | |
| 1 | 1 | 1 | |

(b) Name **two** other types of logic gate and complete their associated truth tables:

Gate 1:

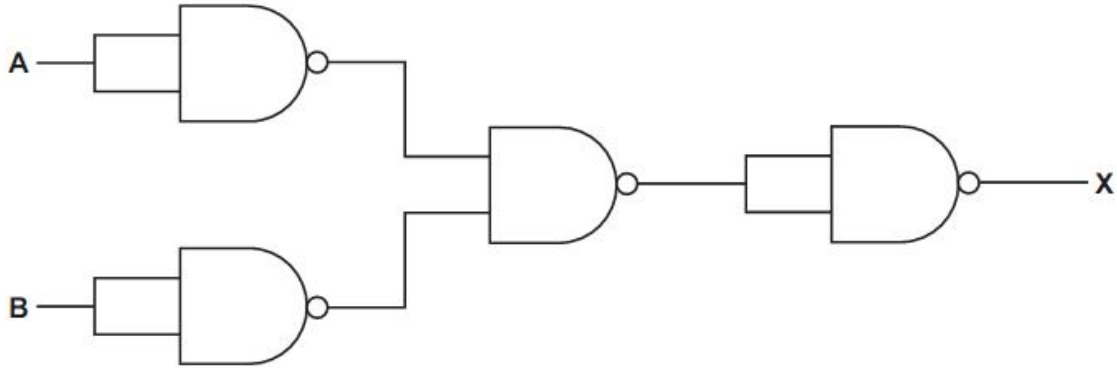
| A | B | X |
|---|---|---|
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

Gate 2:

| A | B | X |
|---|---|---|
| 0 | 0 | |
| 0 | 1 | |
| 1 | 0 | |
| 1 | 1 | |

May/June 2012
 Q4)

(a) (i) Complete the truth table for the logic circuit which is made up of **NAND** gates only.

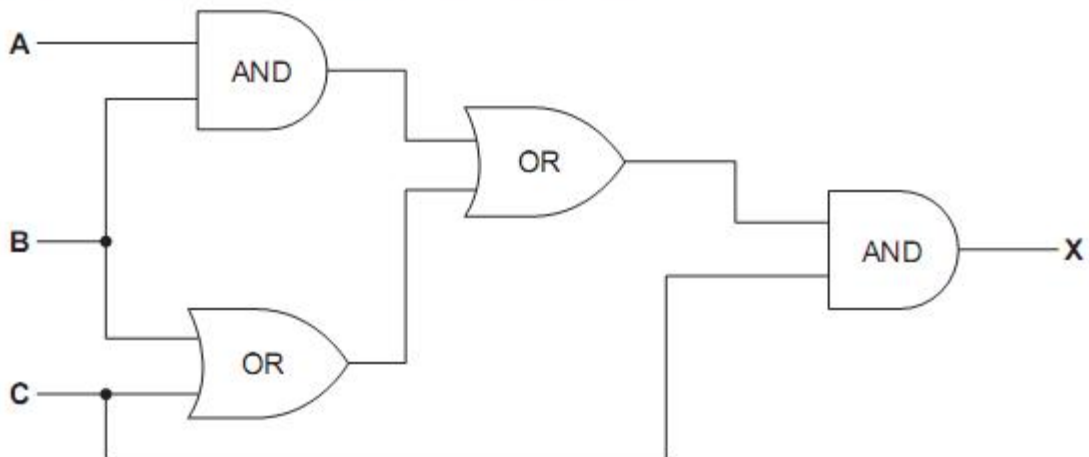


| | | Working space | |
|---|---|---------------|---|
| A | B | | X |
| 0 | 0 | | |
| 0 | 1 | | |
| 1 | 0 | | |
| 1 | 1 | | |

(ii) What single logic gate has the same function as the above logic circuit?

.....

(b) (i) Complete the truth table for the logic circuit.



| | | | Working space | |
|---|---|---|---------------|---|
| A | B | C | | X |
| 0 | 0 | 0 | | |
| 0 | 0 | 1 | | |
| 0 | 1 | 0 | | |
| 0 | 1 | 1 | | |
| 1 | 0 | 0 | | |
| 1 | 0 | 1 | | |
| 1 | 1 | 0 | | |
| 1 | 1 | 1 | | |

[4]

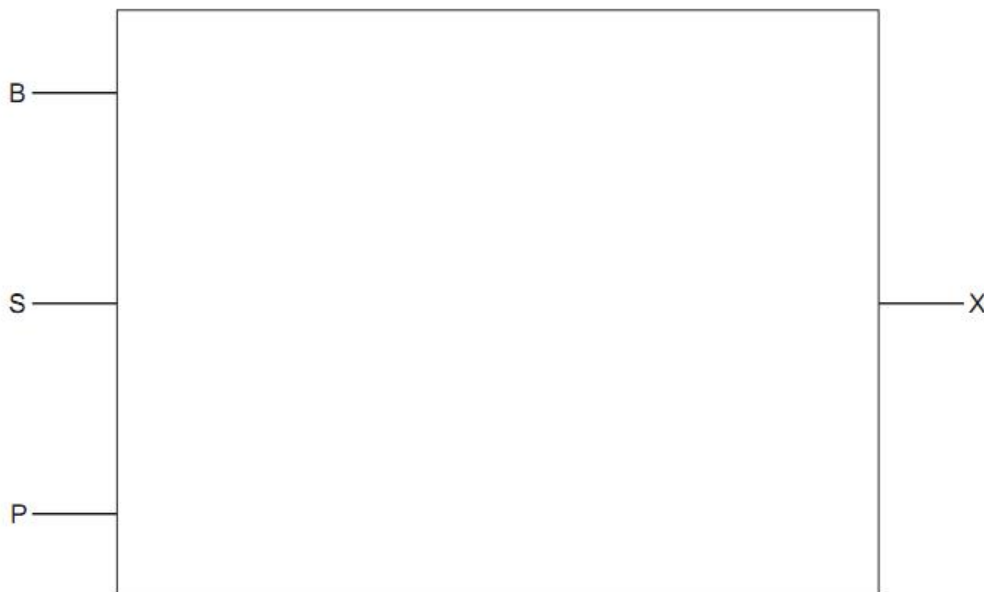
(ii) What could replace the whole logic circuit?

.....

Q5)

(a) Draw the logic circuit represented by the logic statement:

$X = 1$ if (B is NOT 1 AND S is NOT 1) OR (P is NOT 1 AND S is 1)



(b) Complete the truth table for the above logic statement.

| B | S | P | Working space | X |
|---|---|---|---------------|---|
| 0 | 0 | 0 | | |
| 0 | 0 | 1 | | |
| 0 | 1 | 0 | | |
| 0 | 1 | 1 | | |
| 1 | 0 | 0 | | |
| 1 | 0 | 1 | | |
| 1 | 1 | 0 | | |
| 1 | 1 | 1 | | |

October/November 2011

Q6)

An alarm, X, gives a signal (i.e. $X = 1$) when a car fuel injection system gives certain fault conditions. The inputs are:

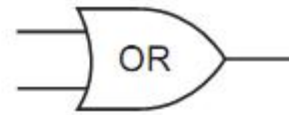
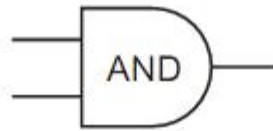
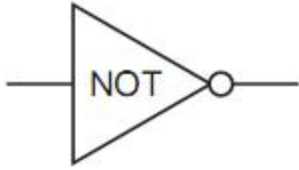
| input | binary value | condition |
|-------|--------------|-----------------------|
| P | 0 | pressure < 5 bar |
| | 1 | pressure \geq 5 bar |
| R | 0 | revs > 8000 rpm |
| | 1 | revs \leq 8000 rpm |
| T | 0 | temp > 120 °C |
| | 1 | temp \leq 120 °C |

The alarm returns a value of 1 if:

either (i) pressure < 5 bar AND revs > 8000 rpm

or (ii) revs \leq 8000 rpm AND temp > 120 °C

(a) Draw the logic circuit for the above system using these logic gates.



IMRAN KHAN

(b) Complete the truth table for this alarm system.

| P | R | T | X |
|---|---|---|---|
| 0 | 0 | 0 | |
| 0 | 0 | 1 | |
| 0 | 1 | 0 | |
| 0 | 1 | 1 | |
| 1 | 0 | 0 | |
| 1 | 0 | 1 | |
| 1 | 1 | 0 | |
| 1 | 1 | 1 | |

Q7)

An alarm, Y, sends a signal ($Y = 1$) when certain fault conditions in a chemical process are detected. The inputs are:

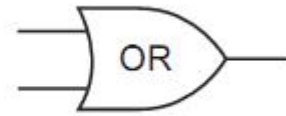
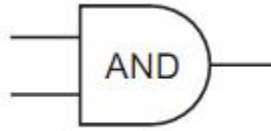
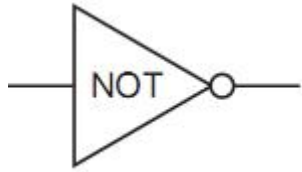
| Input | Binary value | Condition |
|-------|--------------|--------------------------|
| A | 1 | acidity > 5 |
| | 0 | acidity \leq 5 |
| T | 1 | temperature \geq 120°C |
| | 0 | temperature < 120°C |
| S | 1 | stirrer bar ON |
| | 0 | stirrer bar OFF |

The alarm, Y, returns a value of 1 if:

either (i) temperature \geq 120°C AND stirrer bar is OFF

or (ii) acidity > 5 AND temperature < 120°C

(a) Draw the logic circuit for the above system using these logic gates.



IMRAN KHAN

(b) Complete the truth table for this alarm system.

| A | T | S | Y |
|---|---|---|---|
| 0 | 0 | 0 | |
| 0 | 0 | 1 | |
| 0 | 1 | 0 | |
| 0 | 1 | 1 | |
| 1 | 0 | 0 | |
| 1 | 0 | 1 | |
| 1 | 1 | 0 | |
| 1 | 1 | 1 | |

October/November 2012

Q8)

An alarm sounds when certain conditions occur in a nuclear reactor.

The output, X, of a logic circuit that drives the alarm must have a value of 1 if:

either carbon dioxide pressure too low and temperature $\leq 300^{\circ}\text{C}$

or water pressure > 10 bar and temperature $> 300^{\circ}\text{C}$

The inputs to the system are:

| Input | Binary | Condition |
|-------|--------|--|
| P | 0 | carbon dioxide pressure too low |
| | 1 | carbon dioxide pressure acceptable |
| T | 0 | temperature $> 300^{\circ}\text{C}$ |
| | 1 | temperature $\leq 300^{\circ}\text{C}$ |
| W | 0 | water pressure > 10 bar |
| | 1 | water pressure ≤ 10 bar |

(a) Draw the required logic circuit using AND, OR and NOT gates only.

(b) Make and complete the truth table for the above system.

Q9) A small airport handles 400 flights per day from three airlines:

FASTAIR (code
FA)

ANSWER KEYS

HARDWARE AND SOFTWARE

Q1)

Any **two** from eg
Digital images from scanner and printed
Imported into DTP software
Scanning by OCR and converted into text

[2]

Q2)

(a) **Two** advantages from e.g.
H L instructions similar to English
H L are easy to understand
easy to correct errors/test
problem orientated
portable

[2]

(b) **Compiler** converts whole program to object code in one go/with all
errors reported [1]
Interpreter converts each instruction then carries it out/until first error

[1]

Q3) (a) Two sensors from:

- light/infra red/PIR
- motion/movement
- pressure
- proximity
- level
- position (end of film)
- distance [2]

(b) Two points from:

- comparing with stored values
- calculation
- qualified named adjustment

- according to data received from sensor
- Award marks for 2 sensors discussed or 1 sensor with two points discussed.
- Battery, end of film, pushing buttons is ok if explained.
- AC/DC = 0 [2]

Q4) a) Any two points from e.g.:

- translate/convert/change
- high level language to machine code/binary/low level language/object
- code
- so program can be run/computer can understand program [2]

(b) Any one point from assembler and one point from compiler e.g.:

- assembler one one
- written for the particular machine code/machine
- translates assembly language = 0
- compiler one many
- written for a particular H L Language
- For a comparative type statement which states the feature of one and the other is implied, e.g. closer to machine code, award the mark [1]

Q5) Any three points from e.g.

- novice can use the system right away
- user-friendly/easy to select
- click on icons/picture to select
- easier to input/words are replaced with icons
- no need to know command language to use the system/remember
- command language
- selecting item using mouse is faster than entering commands
- avoids typing errors
- no need to type
- no need to remember commands
- no need know the different commands for the different software
- multitasking (several programs open at the same time therefore easier
- /faster to switch
- easier/faster switching between files, folders etc. [3]

Q6) (a) One item from e.g.

Q6) (a)

- camera microwave
- washing machine video recorder
- fridge sewing machine
- air conditioning games console
- electronic game electronic toys
- rice cooker dish washer
- TV alarm clock
- radio [1]

(b) Award one mark for each task controlled e.g.

- camera film speed, position (end of film), distance, light
- washing machine amount of water, speed of wash/temperature/time
- fridge temperature, display panel
- air conditioning temperature, timing, display panel [2]

Q7) Award 1 mark for the hardware and 1 mark for the way it helps:

- Hardware – large tracker ball
- touch pad/screen
- concept keyboard
- Braille keyboard
- mouth pen
- microphone
- head switches
- speaker
- Way – appropriate for deaf/dumb/blind/limited – movement/ speech/hearing [2]

(b) Award 1 mark for the software and 1 mark for the way it helps:

- Software – voice recognition/synthesis
- special word processing program/predictive testing
- Way – appropriate for deaf/dumb/blind/limited movement identified,
- e.g. voice recognition– converts speech to text/commands
- voice synthesis – gives on–screen feedback on loudness, pitch and timing
- word processing – completes words when first few letters typed
- braille output [2]

Q8) (a) Award 1 mark each from:

- input – light/infra red signal
- PIR sensors/motion/movement
- pressure/button pressed e.g. zoom/flash
- battery level
- distance
- processing – e.g. calculate light level
- adjust shutter speed/decide resolution
- adjust aperture
- operate flash
- calculate focus point
- name/save file
- adjust white balance
- add date/time [3]

(b) Award 1 mark for each reason:

- no processing/no darkroom/no posting/no expensive paper/no need to print
- direct transfer to a computer/flash path/no scanning
- extra copies anytime
- can delete unwanted photographs immediately
- no cost of film/no need to buy a film [2]

Q9) (a) Two benefits from

- similar to English
- easy to understand
- easy to correct errors/test
- problem orientated
- portable [2]

(b) Award one mark for example and one mark for reason

- example e.g. operating system
- defragmenter
- device driver
- booting
- game
- reason fast response/execution
- no need to compile/compiler is slower

- 1 → 1 with machine code [2]

Q10) (a) Any two from:

- transfer images directly to computer (no need to scan in)
- can easily wipe photos from memory video possible = 0
- view pictures immediately
- adjust pictures immediately
- store more pictures in less space [2]

(b) Any one point from:

- number of pixels/memory size
- the sensor (determines number of pixels) [1]

Q11) One mark for each type + 1 mark for each matching application

- bar code readers - used in stock taking/control
 - used at POS terminals to access prices
- sensors - any description of control/monitoring
- OMR/OCR - reading documents automatically
 - reading multi-choice questionnaires
- MICR - automatic reading/clearing of cheques
- voice recognition - text input
- other suitable type/device - application [4]

Q12) (a) Any three features from:

- file management/delete/copy/save/load files
- memory management
- I/O control
- error messages/handling
- interrupt handling
- user interface
- security issues
- logging on/off
- accounting/user account management
- time slicing
- multi access
- multi-tasking
- JCL/job control
- network management [3]

(b) (i) any typical device such as a microwave oven [1]

(ii) any one reason from:

- has only one set of tasks to perform
- simple input expected (e.g. keypad on front of device)
- simple, never-changing hardware
- would increase development and manufacturing costs [1]

Q13)

(a) Signal that temporarily stops execution of a program [1]

(b) Any one from e.g.:

- by a key stroke (e.g. BREAK key)
- by a printer (e.g. out of paper error)
- fault in program when running (e.g. try to divide by zero)
- end of an operation (e.g. end of time slice) [1]

(c) Handshaking [1]

Q14) (a) Any three from:

- keyboard (type in the responses)
- touch screen (select options from on screen menus)
- mouse/tracker ball/touchpad (click on options from a menu)
- microphone (speak options)
- data gloves/goggles
- camera [3]

(b) Any three different devices + associated application areas, e.g.:

- bar code reader – stock control
- library systems
- OMR/mark sensing – multi-choice papers
- questionnaires
- touch screens – information desks/kiosks
- choosing goods on line
- sensors – monitoring chemical plant
- central heating systems
- cameras – traffic control
- security

- MICR – reading bank cheques
- reading travellers cheques
- microphones – telephone systems
- games
- magnetic stripe reader – reading credit cards
- reading security cards
- data loggers – weather monitoring
- collecting experimental data
- OCR – reading in documents
- Scanner – scanning in photos etc. [6]

Q15)

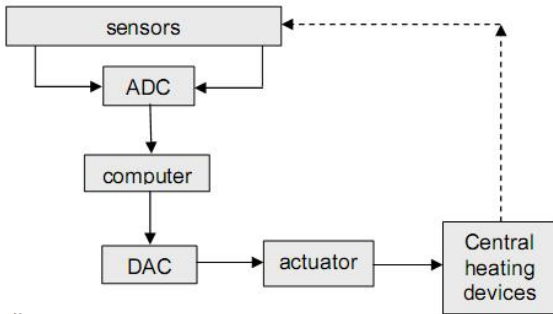
| Named sensor | Application of named sensor |
|---------------------------------|--|
| Humidity Moisture (water) | greenhouse environmental control spin drier in automatic washing machine libraries/archives where moisture levels need controlling |
| oxygen | fish tank/aquarium environmental monitoring car engine management system/fuel injection system |
| light | burglar alarm automatic doors greenhouse environmental control |
| infra red | automatic doors car in correct place to allow paint spraying in car factory burglar alarm |
| pressure | traffic control automatic doors burglar alarm |
| gas | Environmental monitoring Safety system |

[6]

(b) Any three points from:

- sensor relays reading back to computer
- if reading is analogue, need an analogue to digital converter (ADC)
- computer compares reading with stored value
- sends signal to actuators
- signal converted using digital to analogue converter (DAC)
- actuator alters factors such as heating, coolers, etc.

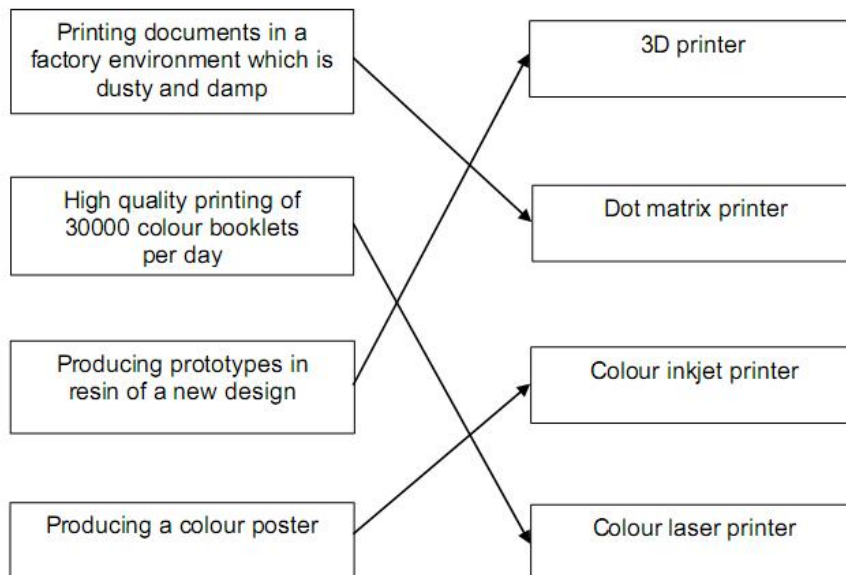
- cycle continues / output affects input
- accept a diagram such as:



- How to mark a diagram:
- 1 mark for link between sensor(s) and computer
- 1 mark for showing an ADC
- 1 mark for showing a DAC
- 1 mark for link from computer to actuator
- 1 mark for arrow implying cycling of system

Q16)

(a)



[4]

(b)

- ❖ 3D printer
 - capable of producing solid objects
 - cheaper than making a working model (by conventional methods)
 - works with CAD
- ❖ dot matrix printer
 - can work in harsh environments
 - (since in a factory,) noise levels are not important
 - quality of printout not important
 - robust printer
- ❖ colour inkjet printer
 - suited to low volume
 - good/photographic quality printing
- ❖ colour laser printer
 - fast for volume printing [4]

Q17)

1 mark for each correct device

| application | hardware device |
|--|--|
| <i>automatic stock control system in a supermarket</i> | barcode <u>reader/scanner</u>/EFTPOS terminal |
| <i>keeping track of the live stock on a large farm</i> | barcode/RFID/microchip <u>reader</u> |
| <i>input data into a computer using speech recognition</i> | microphone |

[3]

Q18)

1 mark for each correctly identified use of data storage medium (**column**):

| | CD-ROM | DVD-RAM | fixed hard disk | memory stick |
|---|--------|---------|-----------------|--------------|
| storage medium where data can only be read and not altered | ✓ | | | |
| portable medium which allows transfer of data between computers | | | | ✓ |
| memory where operating systems and applications software are usually stored | | | ✓ | |
| medium which allows recording and playback to occur at the same time | | ✓ | | |

Q19) (a) RAM (max: 1 mark)

- any one from:
- storage of (user's) data/holds program
- memory that can be used to read from/write to/change
- directly addressable
- temporary store
- volatile memory
- reference to dynamic/static RAM
- reference to operating system

modem (max: 1 mark)

any one from:

- modulator-demodulator
- device which interconverts digital bits and analogue signals

- to allow computer signals to be sent over phone lines
- to connect to the Internet

scanner (max: 1 mark)

any one from:

- device for transferring or copying printed documents/graphics
- converting to pixels/storing a computer file/digitise to scan = 0 [3]

(b) electronic conferencing

any two devices from:

- microphone telephone = 0
- speakers cabling = 0
- web camera/video camera network card = 0
- sound card keyboard = 0
- video card printer = 0
- monitor/screen
- satellite dish tv = 0
- (NOT modem, memory – already in question) [2]

Q20) (a) any two from:

- data/images can be transferred/imported automatically/faster
- image can be manipulated/viewed straight away/no need to develop
- can store considerably more data/photos
- can store other info (apart from photo image) e.g. road conditions
- chips can be re-used
- more reliable, more robust, safer = 0 [2]

(b) any two from:

- calculate/sense/collect (or record) speed of vehicle
- compare speed of vehicle with stored value(s)/decide whether photograph should be taken
- check on value of light intensity/adjust focal length/focus image/adjust shutter
- speed/set exposure - (**) [2]

(c) any two from:

- log time/date/speed/road conditions
- operate “flash”
- operate shutter

- store image
- check on value of light intensity/adjust focal length/focus image/adjust
- shutter speed/set exposure – (**) [2]

(** - only award this mark once either in part (b) OR part (c))

Q21) (a) any two from

- stores data/information being sent to printer temporarily
- compensates for difference in speed of CPU and printer
- allows CPU to carry out other tasks whilst printer is printing [2]

(b) any one from

- reduces the number of data transfers to the printer
- more efficient use of the CPU
- larger files can be sent to the printer [1]

Q22) 1 mark per input device + 1 mark for correct reason

- I. input device reason
 - a. tracker ball - to control on-screen pointer
 - b. if limited mobility in hands
- II. - voice input/microphone } - to control data input to the computer speech recognition } - if user unable to use the keyboard
 - a. touch screen - using a head wand/fingers
 - b. to select options from a screen menu
 - c. foot activated input devices - when operator has no arm movement
 - d. used instead of mouse or keyboard
- III. - braille keyboard - raised dots on keyboards to id keys - to help blind people input data

1 mark per output device + 1 mark for correct reason

- I. output device reason
 - a. audio output/speaker - to help blind/partially sighted people
 - b. who cannot see output on a screen/so
- II. they can hear the output
 - a. braille printer - to help blind/partially sighted people

- to read output from the computer [4]

Q23) (a) Any two input devices from:

- touch screens/light pens
- roller/tracker ball/mouse/joystick
- microphone
- touch pads (containing options shown on keys) [2]

(b) Any two examples from:

- maps/directions
- prices of goods/shop products
- flight details
- bank statements/bills
- travel offers
- news updates
- emails/messages [2]

Q24) (a) Any two points from:

- speed of the traffic
- information from number plates
- traffic violation information (e.g. jumped red light)
- number of vehicles on road/at junctions
- whether vehicles are stationary/moving/timing of vehicles [2]

(b) Any two from:

- (fibre optic)cables connected to computer
- radio waves/use of transmitters
- use of satellite/microwave technology [2]

(c) Any two from:

- can keep traffic moving freely.....
- since system can control light sequences (i.e. timing) and traffic signs
- helps to prevent traffic build up/jams
- can reduce pollution levels (less stationary traffic)
- can re-route traffic using electronic signs if accident has occurred
- no need to employ/train human traffic controllers [2]

Q25) (a) Any two from:

count people at the check-outs
allows optimum number of check-outs to be open
run computer model with differing scenarios [2]

(b) (i) infra-red sensor [1]

(ii) any two from:

safety reasons (in case of fire, for example)
how many check-outs to open
check on how many customers use s/market at different times
feed information into simulation/model [2]

(c) (i) any one from:

touch screen/pad
trackerball [1]

(ii) any one from:

special offers/goods on sale
map of supermarket/where things are
prices of goods
services available (e.g. insurance) [1]

(iii) any one from:

quick to update
more information can be made available
could allow interaction with customers [1]

Q26)

RAM – allows random access

- stores work user is currently working on
- stores files/data temporarily when s/ware running

ROM – stores BIOS

- stores files/data that should not be changed

Internal hard drive – main memory of the computer

- stores applications software

Internal modem – allows computer to link to a network/internet

- allows modulation/demodulation to enable info to be sent/received
by analogue cables

- controls the flow of data

- error correction

- compresses data transmitted

- converts digital to analogue and vice versa [4]

Q27) (a) (i) Any one from:

- unit of data/memory
- 8 bits
- used to represent a character [1]

(ii) Any one from:

- 2^{30} bytes
- 1 073 741 824 bytes
- 1 048 576 kilobytes
- 1024 megabytes [1]

(b) Any two from:

Flash memory

- magnetic media/solid state memory
- no formatting issues
- plugs directly into the USB port
- direct transfer of data

CD-RW

- optical media
- slower access speed/flash memory has faster access speed
- requires a separate drive
- data needs to be burnt/finalised/finished (before being used on another device) [2]

Q28) (a) Only answers:

- temperature (sensor)
- oxygen (sensor) [2]

(b) Any four from:

- information from the sensors sent to microprocessor
- the ADC converts the analogue data into digital form
- if temperature $< 25^{\circ}\text{C}$ OR temperature checked against stored value
- ...microprocessor sends signal to heater/actuator/valve...
- ...to switch on heater
- if oxygen level < 20 ppm OR oxygen level checked against stored value
- ...to open valve/oxygen supply
- use of DAC between microprocessor and devices
- sounds an alarm if system unable to respond
- continuously monitors sensor inputs
- any reference to feedback [4]

(c) Any one from:

- unsafe limit stored in memory
- warning sound/signal if too high a value reached
- fail safe switch off in case of a malfunction [1]

Q29)

| List of hardware items | Application |
|-------------------------------------|---|
| webcam, microphone, speakers | – video conferencing/chat |
| barcode reader, POS terminal | e.g. – supermarket checkout – shop sales point – stock control system – library systems |
| pressure sensor, ADC, lights, siren | – <u>burglar/intruder</u> alarm |
| data gloves, data goggles | – virtual reality (applications) (NOT VR) – simulation – e.g. motor racing simulator |
| light pen, plotter, 3D printer | – CAD (applications) – e.g. <u>designing</u> buildings/cars |

Q30)

Any three points from:
file management resource management = 0
input/output control/peripheral management
spooling
memory management
multitasking/JCL/batch processing
multiprogramming
handling interrupts
error reporting/handling
security
interfaces with users/WIMP type interfaces
loads/runs programs
processor management
manages user accounts
copy/save/format/DOS utilities [3]

Q31)

- direct access because of concentric tracks
- can read and write at the same time because it has a read/write head [2]

LOGIC GATES WORKSHEETS

Q1)

(a)

AND gate

| A | B | X |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

OR gate

| A | B | X |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

(1 mark for correct X column in each gate)

[2]

(b)

| A | B | C | X |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |

} 1
} 1
} 1
} 1

[4]

(a) (i)

| A | B | X |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

} 1 mark

} 1 mark

Q2)

(ii) OR gate

(b)

| A | B | C | X |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |

} 1 mark

} 1 mark

} 1 mark

} 1 mark

Q3)

(a)

| A | B | C | X |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |

(1 mark)

(1 mark)

(1 mark)

(1 mark)

(b) 1 mark for correct logic gate + 1 mark for correct associated truth table.

Any two from:

- NOR, AND, OR, XOR (EOR)

| A | B | NOR | AND | OR | XOR |
|---|---|-----|-----|----|-----|
| 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 0 |

Q4)

(a) (i)

| A | B | X |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 0 |



1 mark

1 mark

(ii) NOR gate (allow follow through from part (i))

(b) (i)

| A | B | C | X |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |



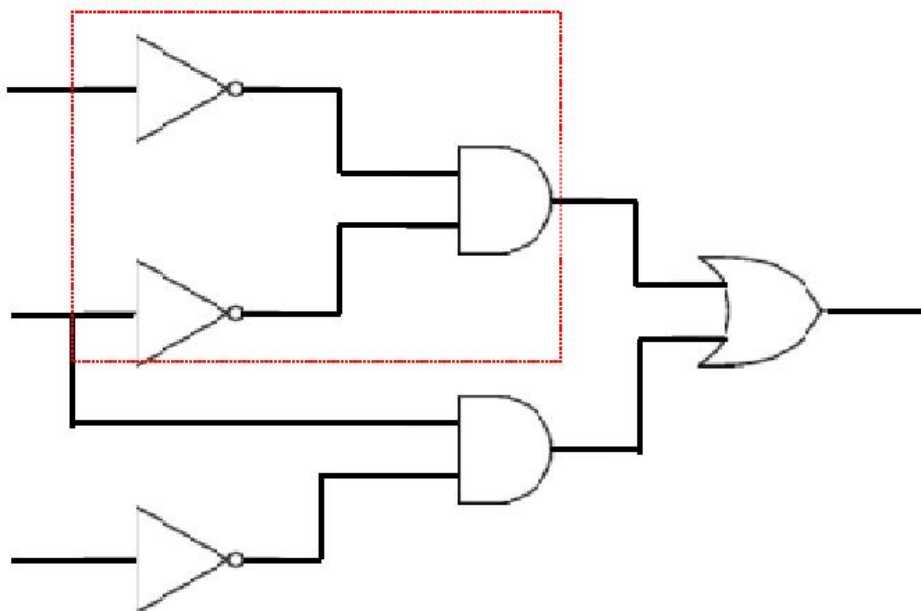
1 mark

1 mark

1 mark

1 mark

Q5)



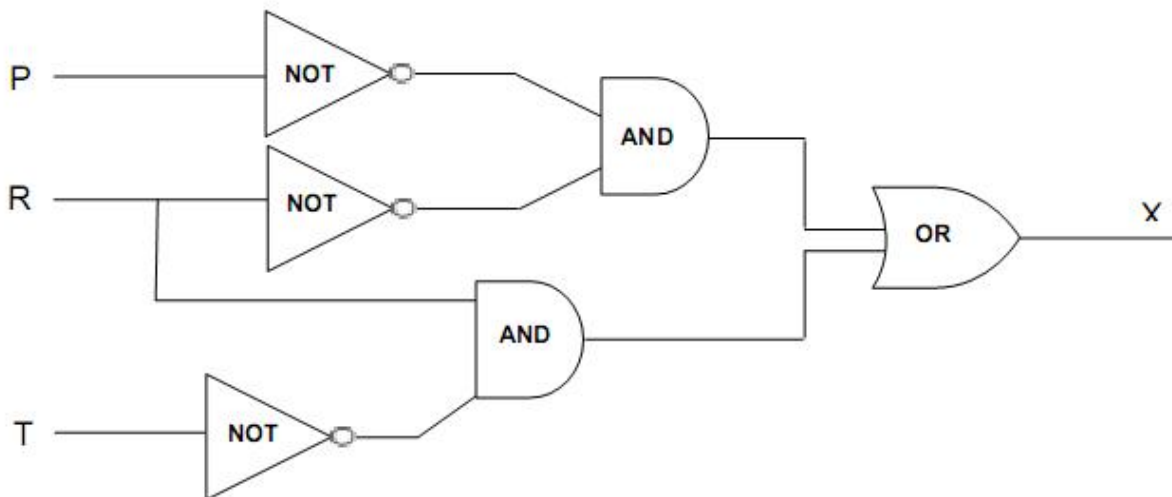
(b)

| B | S | P | X |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |



Q6)

(a) 1 mark for each correct logic gate:



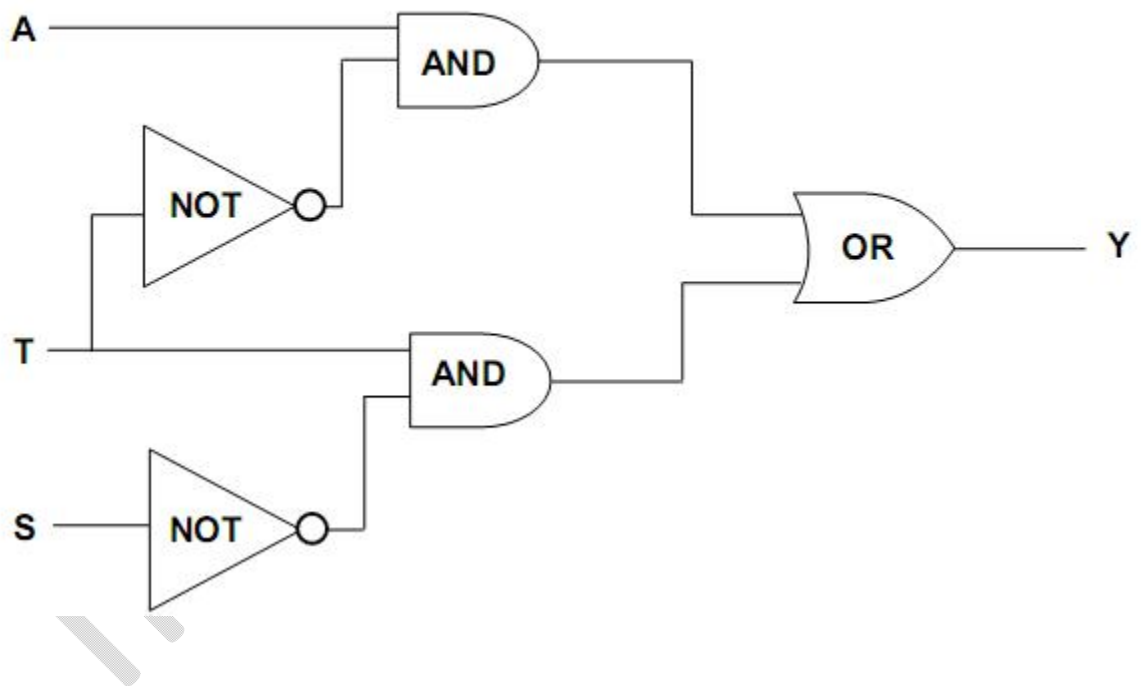
(b)

| P | R | T | X |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |

1 mk
1 mk
1 mk
1 mk

Q7)

(a) 1 mark for each logic gate:



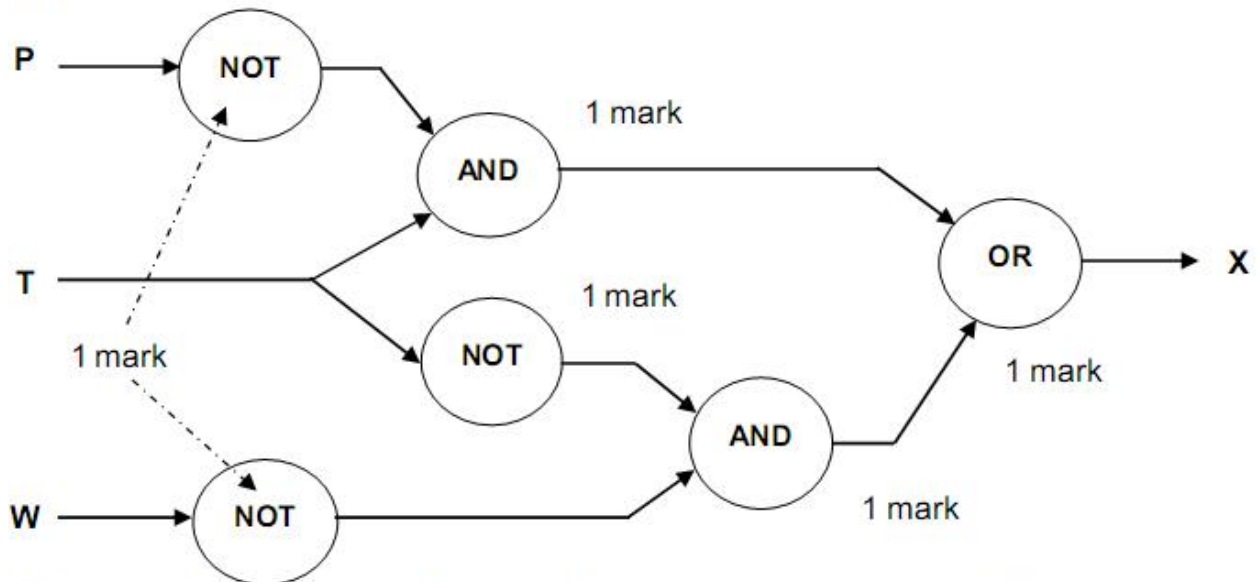
(b)

| A | T | S | Y |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |

] 1 mk
] 1 mk
] 1 mk
] 1 mk

Q8)

(a)



Note: accept answers using MIL symbols e.g.



(b)

| P | T | W | X |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 |

1 mark

1 mark

1 mark

1 mark

(NOTE: 1 mark per pair of rows)

IMRAN KHAN