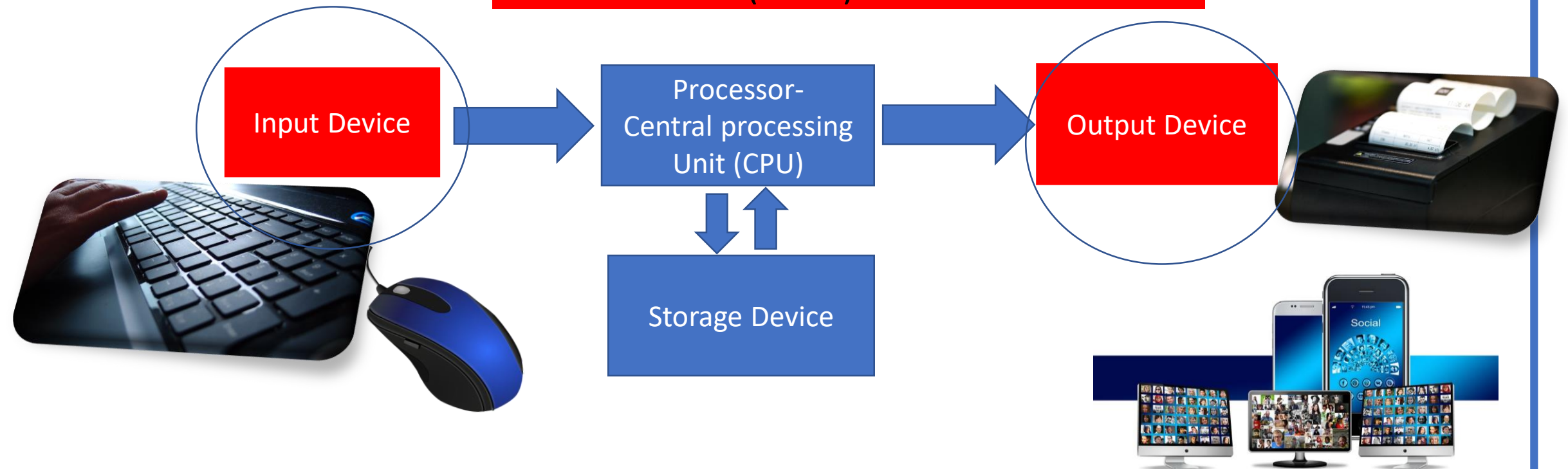


INPUT AND OUTPUT DEVICES

CAIE IGCSE ICT (0417) CHAPTER 2-THEORY



Chapter 2: Input and output devices

Learning objectives

2.1 Understand the characteristics of input devices (like mouse, keyboards, microphones, etc.), their uses, advantages and disadvantages.

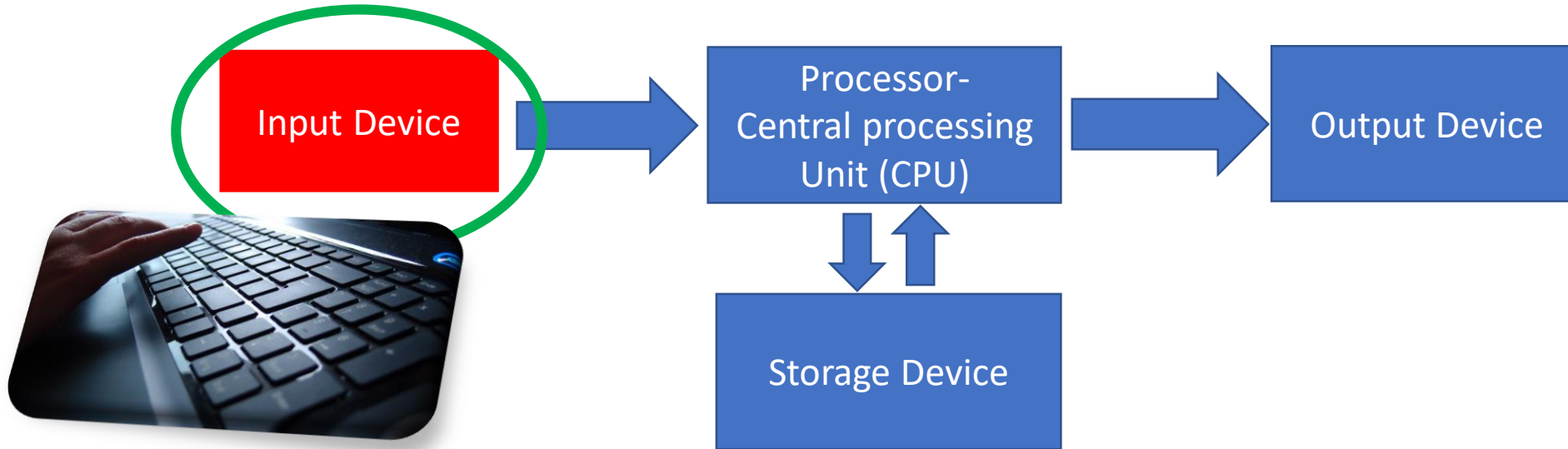
2.2 Understand the characteristics of Direct Data Entry (DDE) devices (card readers, RFID reader, OCR etc.), their uses, advantages and disadvantages.

2.3 Understand different characteristics of Output Devices (like monitors, projectors, printers etc.), their uses, advantages, and disadvantages.

2.1 Understand the characteristics of input devices (like mouse, keyboards, microphones, etc.), their uses, advantages and disadvantages.



2.1: Input Devices and their uses

- Hardware devices that **enable or allow us enter data** into a computer.





- Manual Input devices:** **Involves much human effort** to enter data (e.g mouse, keyboard, remotes etc.)
- Direct Data entry devices:** **little human effort is needed**, data is directly entered by a machine or device. Examples: barcode readers, etc.


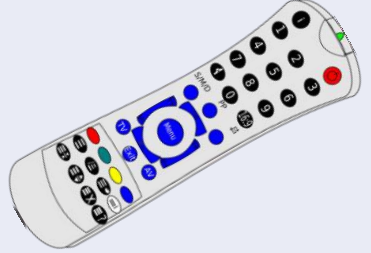
2.1 Manual Input devices and their uses

Input device	Characteristics/uses	Advantages (Pros)	Disadvantages(Cons)
Keyboards 	<ul style="list-style-type: none"> Most common and easy way to enter data into a computer Can be wired or wireless Virtual in tablets, mobile phones & some laptops 	<ul style="list-style-type: none"> Easy to use for most people Fast text entry into documents Easy to verify data during entry. 	<ul style="list-style-type: none"> Slow data entry compared to direct data entry. Device takes up desk space Can be difficult to use
Numeric keypads 	<ul style="list-style-type: none"> Mainly use for numeric data entry, some allow short text and symbols Use for fast spreadsheet data entry Use on mobile phones, ATMs, POS, chip and pin devices. 	<ul style="list-style-type: none"> Faster than keyboards for numeric data entry Very portable compared to standard keyboards 	<ul style="list-style-type: none"> Might be difficult to use in case of small keys Difficulty in entering text especially on telephones



2.1 Manual Input devices and their uses

Input device	Characteristics/uses	Advantages (Pros)	Disadvantages(Cons)
Mouse 	<ul style="list-style-type: none">▪ Moved around on a smooth surface to control a cursor on screen▪ Can be wired or wireless▪ Use for opening, closing, minimizing software, editing etc.	<ul style="list-style-type: none">▪ Fast method for selecting, opening and closing apps, documents etc.▪ Take little desk space compared to keyboards	<ul style="list-style-type: none">▪ Difficult to use if surface is not flat.▪ Easy to get damage, ball mouse easily get dirty.
Touchpad 	<ul style="list-style-type: none">▪ Main pointing device on laptops▪ Moving fingers on the surface and gently tapping provides uses as in mouse above.	<ul style="list-style-type: none">▪ Faster than keyboards▪ No need for separate mouse and extra desk space, as it is part of the computer.	<ul style="list-style-type: none">▪ Difficult to use by people with hand/wrist problems (RSI)▪ Difficult to use compared to normal mouse



2.1 Manual Input devices and their uses

Input device	Characteristics/uses	Advantages (Pros)	Disadvantages(Cons)
Tracker ball mouse 	<ul style="list-style-type: none">• Same as normal mouse, but ball is on the top or side.• Suitable for users with RSI or to prevent it.• Use in industrial control to navigate process screens.	<ul style="list-style-type: none">• Easier to use than a normal mouse• More robust than a mouse• More accurate position of pointer on screen	<ul style="list-style-type: none">• More costly than mouse• May require training before use.
Remote control 	<ul style="list-style-type: none">• Employs infrared technology to control other devices.• Use to control:<ul style="list-style-type: none">○ Televisions, DVD/CD players○ Machinery in industry and robots.	<ul style="list-style-type: none">• Easy to use• Can be operated from a considerable distance.	<ul style="list-style-type: none">• Signals can easily be block• Might be difficult to use by some persons especially for advance controls



2.1 Manual Input devices and their uses

Input device	Characteristics/uses	Advantages (Pros)	Disadvantages(Cons)
Joystick 	<ul style="list-style-type: none">• Pointing device with similar uses to mouse and tracker ball• Use for gaming• Use for flight control simulations	<ul style="list-style-type: none">• Easy screen navigation than keyboards	<ul style="list-style-type: none">• More difficult to use compared to standard mouse.
Touchscreen 	<ul style="list-style-type: none">• Screen is used to select/input options• Use on: ATMs, POS, mobile phones, tablets, interactive white boards etc.	<ul style="list-style-type: none">• Faster entry options than using keyboard or mouse.• Very easy method for choosing options.• Often very user-friendly method	<ul style="list-style-type: none">• User is limited to available input options.• Screen can get very dirty (public use)

2.1 Manual Input devices and their uses

Input device	Characteristics/uses	Advantages (Pros)	Disadvantages(Cons)
Light pens 	<ul style="list-style-type: none">▪ Used with computers as input device.▪ Use for selecting objects on CRT screens▪ Use for drawing on screen	<ul style="list-style-type: none">▪ Greater accuracy than touch screens▪ Very handy in cases where space is an issue▪ Easy to use technology.	<ul style="list-style-type: none">▪ Lagging problems when drawing on screen▪ Currently, they only work with CRT monitors▪ Rather dated technology.
Scanners 	<ul style="list-style-type: none">▪ Used to enter information from hard copy documents like text, photographs, barcodes etc.	<ul style="list-style-type: none">▪ Scans information which can be stored in different formats,▪ Faster information entry	<ul style="list-style-type: none">▪ Limited quality depending on resolution of scanner used▪ Fairly slow in high resolution scans

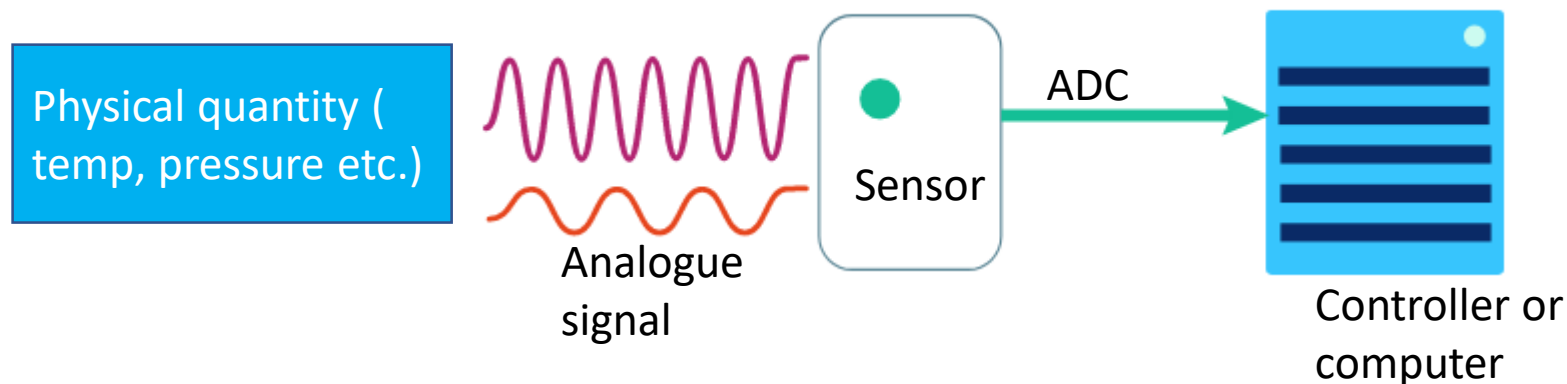
2.1 Manual Input devices and their uses

Input device	Characteristics/uses	Advantages (Pros)	Disadvantages(Cons)
Digital Camera 	<ul style="list-style-type: none">▪ Use for taking of photographs, video recording.▪ Use in cars for data capture or visual aid when reversing.	<ul style="list-style-type: none">▪ Produces better quality images than traditional cameras.▪ Easier and faster to upload/transfer photographs/videos to computers	<ul style="list-style-type: none">▪ User often requires proper training before use of device.▪ Lost of jobs by artist as most software are doing.
Microphones 	<ul style="list-style-type: none">▪ Built-in or USB connected device use to input: speech, sounds, voice recoding.▪ Use in mobile phones and computers for calls	<ul style="list-style-type: none">▪ Faster text entry than typing with keyboard▪ Aids in safety when used in voice activation or security systems.	<ul style="list-style-type: none">▪ Sound files can used up a lot of space▪ Voice-recognition is not as accurate as manual typing.


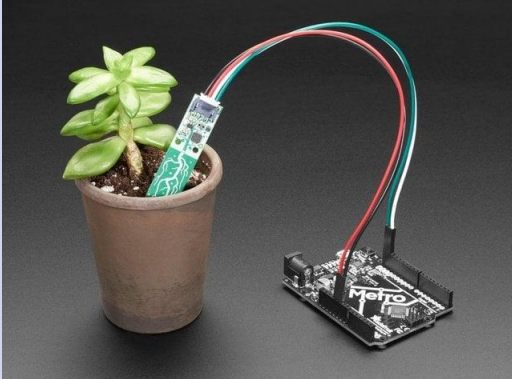





2.1 Input devices and their uses

Sensors

- A sensor is a device that **reads and inputs** a measurement(s) of a **continuously changing physical quantity** into a computer.
- Most sensors are **analogue**, they collect continuously changing measurements (e.g temperature, moisture, etc).
- These analogue measurements must be converted from **analogue to digital data (using ADC)** for easy understanding by the computer.



Sensors: Types of Sensors

Type of sensor	Areas of applications	Advantages/disadvantages
Temperature 	<ul style="list-style-type: none"> Used for temperature monitoring in automatic washing machines, central heating systems, automated glasshouses, ovens etc. 	<p>Advantages</p> <ul style="list-style-type: none"> More accurate readings compared to human readings More reliable especially as readings need to be taken continuously Most suitable for hazardous systems, they require little human intervention. <p>Disadvantages</p> <ul style="list-style-type: none"> Faulty sensors can give poor readings Most sensors are analogue and often used an ADC which is additional cost. 
Pressure 	<ul style="list-style-type: none"> Used to detect pressure changes in intruder alarm systems, robotics, environmental monitoring 	
Light 	<ul style="list-style-type: none"> Used to detect light in automatic glasshouses, automatic doors, intruder alarm systems, street lighting control 	
Sound 	<ul style="list-style-type: none"> Used in intruder alarm systems, monitoring liquid and powder flow in pipes etc. 	
Humidity/moisture 	<ul style="list-style-type: none"> Used in automatic glasshouses, environmental monitoring, in factories where moisture levels are crucial (for example, manufacture of microchips, paint spraying) 	
Ph 	<ul style="list-style-type: none"> Used to measure Ph levels in chemical processes, environmental monitoring, automatic glass houses. 	



Past Exam question

Q>> A river authority is concerned about levels of pollution in a major river. The quality of the water in the river needs to be monitored using sensors.

(a) Name three sensors that could be used to measure the pollution in the river.

IGCSE ICT Q10a, P11, M/J 2022

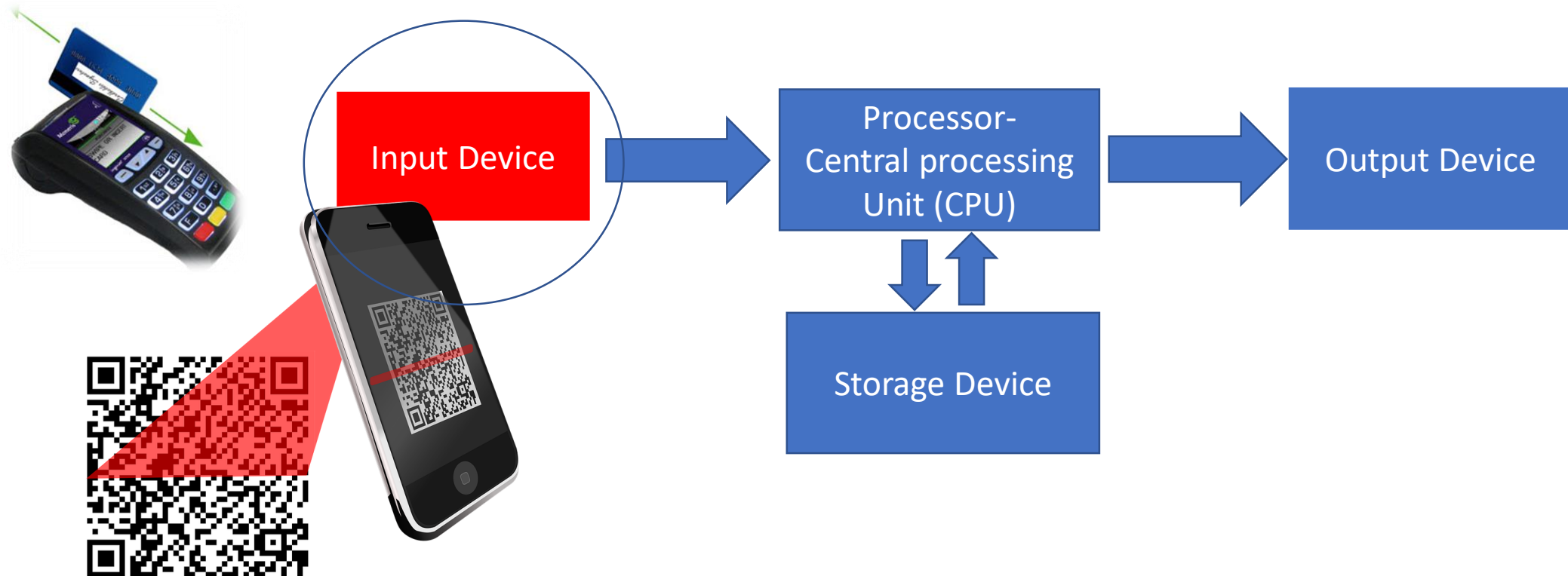
Answer: any three

- ✓ Oxygen
- ✓ Light
- ✓ pH
- ✓ Turbidity (measures clarity of the water)

2.2 Understand the characteristics of Direct Data Entry (DDE) devices (card readers, RFID reader, OCR etc.), their uses, advantages and disadvantages.

Direct data entry devices-DDE

➤ little human effort needed to enter data.



Magnetic Stripe Reader




DDE device	Description/Use	Advantages	Disadvantages
Magnetic stripe readers	<ul style="list-style-type: none">Reads data from magnetic stripe found on the back of debit cards or credit cards.The magnetic strip carries information like: account details, login details to security system.Use in electronic fund transfer at point of sale (EFTPOS) terminals.Security device in buildings, hotel rooms etc.	<ul style="list-style-type: none">Fast data entry compared to using keyboards or keypads.Error free; no typing involveSecure form of data entryRobust device; no moving parts, Resistant to most common liquids and moisture.	<ul style="list-style-type: none">Damage on magnetic strip can lead to data lossNeeds close contact to workStrong magnetic fields can lead to data corruption and loss.

2.2: Direct data entry (DDE) devices cont..

DDE

Contactless debit card readers

DDE device	Description/Use	Advantages	Disadvantages
<p>Contactless debit card readers</p> 	<ul style="list-style-type: none">▪ Reads data off a chip that emits radio waves. This chip is found on debit cards and enable payments for varied amounts.▪ Allows for payments of items at EFTPOS terminals.	<ul style="list-style-type: none">▪ Fast transactions; within seconds▪ Data is protect with 128-bit encryption system▪ Error free; no typing involved	<ul style="list-style-type: none">▪ More expensive than standard credit/debit cards.▪ Limited transaction amount▪ Might be easy to hack without users notice.



Past Exam Question

Q>> Contactless debit cards are replacing standard debit cards. Some countries are introducing contactless debit card transactions at ATM machines. Give three disadvantages to the customer of using these cards at an ATM. [3]


IGCSE ICT (0417) Paper 12 Q12, October/November 2017

Answer:

- ✓ The card may be read accidentally
- ✓ Only small amounts can be withdrawn
- ✓ More chance of fraud if card is stolen/lost
- ✓ Devices can read the cards wirelessly to steal money

2.2: Direct data entry (DDE) devices cont..

Chip and PIN reader


DDE device	Description/Use	Advantages	Disadvantages
 Chip and PIN reader	<ul style="list-style-type: none">▪ Has a slot, screen and keypad. The card is inserted into the slot, the user then enters a PIN using a keypad, instructions are displayed on small screen.▪ Used in restaurants, supermarkets, travel agencies etc.▪ Mostly used at EFTPOS terminals.	<ul style="list-style-type: none">▪ More secure than contactless card systems.▪ More robust system than magnetic strip readers	<ul style="list-style-type: none">▪ PIN can easily be stolen when typing it.▪ PIN can easily be forgotten

2.2: Direct data entry (DDE) devices cont.. **RFID**

Radio Frequency Identification(RFID) Readers



- Uses radio waves to read and capture data stored on a tag.
- Contains a microchip for storage and processing of information, and an antenna used to receive and transmit data.
- Use for livestock tracking by farmers.
- Use in retail shops, libraries etc.

DDE	Advantages	Disadvantages
RFID Readers 	<ul style="list-style-type: none">• Can read data from tags several meters away.• Fast data reception and processing• Reliable and robust• Allows bidirectional data transfer.	<ul style="list-style-type: none">• More expensive than barcodes.• Prone to collision/interference of signals between tags.• Radio wave signals are relatively easy to Jam or block• Relatively easy to hack into device; radio waves



Past Exam question on RFID

Q>> A library is considering the way it issues books. The librarians are planning to use RFID rather than bar codes. Describe the advantages of using RFID rather than bar codes. [4]

IGCSE ICT Q5, P12, M/J 2022

Answer: Any four

- ✓ RFID are faster to read than bar codes
- ✓ RFID scanning is more accurate than bar codes
- ✓ RFID does not need line of sight to read but bar code does
- ✓ RFID will read the data if the reader is further away
- ✓ RFID can scan multiple items at the same time
- ✓ RFID have better encryption allowing for greater security
- ✓ RFID can store more data than a bar code
- ✓ RFID tags are more robust as bar codes will not scan if damaged

2.2: Direct data entry (DDE) devices cont..

Optical mark recognition/reader (OMR)

OMR

- Device which **reads marks written in pen or pencil** on special places or positions on paper/forms.
- Mostly used to read **questionnaires, MCQ-marking, voting papers** etc.



Advantages of OMR	Disadvantages of OMR
<ul style="list-style-type: none">▪ Very fast way of inputting results into a computer▪ More accurate than manually keying in data▪ More accurate than OCR	<ul style="list-style-type: none">▪ Forms must be carefully designed and positions accurately place for marks to be made for easy recognition.▪ Marks can be difficult to read if not done with good ink or pencil

2.2: Direct data entry (DDE) devices cont..

Optical Character recognition(OCR)

OCR

- An OCR device **converts text on hard copy documents into electronic form.**
- Special OCR software further converts this electronic data to a form compatible for other applications.
- Used in airports for processing of passports
- Used to convert documents to electronic form.



Advantages of OCR	Disadvantages of OCR
<ul style="list-style-type: none">▪ Faster data entry system than manual methods▪ Less error; no manual typing or data entry	<ul style="list-style-type: none">▪ Difficulty in reading some handwritings or data▪ Still not very accurate as needed

2.2: Direct data entry (DDE) devices cont...

Comparison between OMR and OCR

Optical Mark Reader (OMR)	Optical Character Recognition (OCR)
<ul style="list-style-type: none">• More accurate data reading method than OCR	<ul style="list-style-type: none">• More accurate than manual typing, but issues of recognizing all hand writings still exist
<ul style="list-style-type: none">• Easier and faster to complete forms	<ul style="list-style-type: none">• Less easier to complete forms compared to OMR forms
<ul style="list-style-type: none">• Simply detects marks on page and compares position with stored template.	<ul style="list-style-type: none">• Detects written characters; reading can be difficult if writing is not very clear.
<ul style="list-style-type: none">• Good for use in marking multiple-choice examination papers.	<ul style="list-style-type: none">• Good for converting documents to an editable electronic form

2.2: Direct data entry (DDE) devices cont...

Barcode readers/scanners

- The scanner is used to **scan and read information from barcodes on various categories of products** (food, books, electronics etc.)
- Used in supermarkets for product identification, tracking and billing.
- Use to keep track of books in libraries.



shutterstock.com · 1922009195

Advantages of barcode systems	Disadvantages of barcode systems
<ul style="list-style-type: none">▪ Faster than manually keying in data▪ Reliable technology▪ Allow automatic stock control	<ul style="list-style-type: none">▪ Relatively expensive system▪ System can be tricked if barcodes are swapped on products.▪ Barcodes can be easily damaged compared to RFID tags or magnetic strips

2.2: Direct data entry (DDE) devices cont...

Quick response (QR) code scanners (readers)



- Made up of a **matrix of filled-in dark squares** on a light background.
- These matrix filled-in (light and dark) squares carry information that can be used to get access to an app, website, product etc.
- Can hold up to **4296 characters** compared to 30 digits in barcodes.
- Used for **product advertisements, access to systems, website access** etc.

Advantages of QR codes

- Faster and easier to read compared to barcodes
- QR codes can be encrypted giving them better protection than barcodes.
- Hold much more information compared to normal barcode.

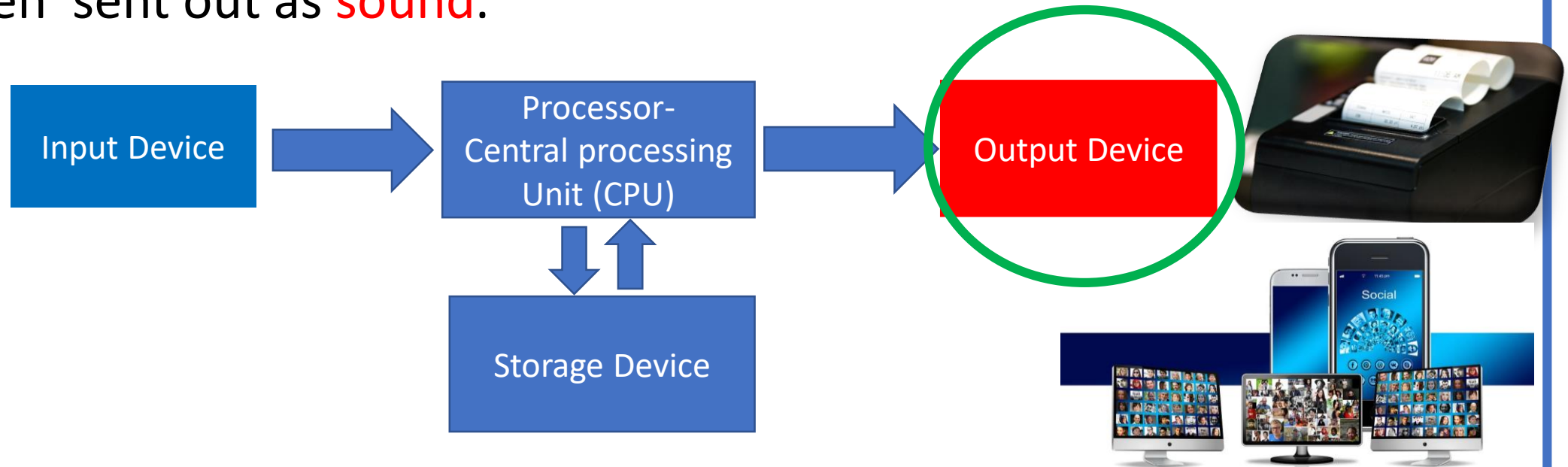
Disadvantages of QR codes

- Multiple QR formats exist
- The ease of access to different apps to generate QR codes means QR Can easily be used to transmit malicious codes; attaging.

2.3 Understand different characteristics of Output Devices (like monitors, projectors, printers etc.), their uses, advantages, and disadvantages.

Output devices and their uses

- Output devices help us see processed information from a computer
- This information can be displayed on monitors, printed on paper, or even sent out as sound.



2.3 Output Devices and their uses

Monitors (Screens)

Cathode Ray Tube (CRT) monitor

- They are the least expensive type of monitors.
- mostly used as large screens in specialized areas for Computer-aided design (CAD).



Advantages of CRT monitors	Disadvantages of CRT monitors
<ul style="list-style-type: none">▪ Screen has a wider range of viewing angles than most LCD monitors▪ Allow use of light pens for CAD/CAM applications	<ul style="list-style-type: none">▪ Bulky and heavy compared to most LCD screens▪ They can flicker leading to headaches and eyestrain▪ Consumes more power than LCD monitors

2.3 Output Devices and their uses

Monitors (Screens)

LED screens

- Made up of tiny light emitting diodes (LEDs) in red, green or blue use to produce a vast range of onscreen colours by varying the electric current sent to each LED.
- Used for large outdoor displays due to their **good quality of colours** produced.



2.3 Output Devices and their uses

Monitors (Screens)

LCD screens

- LCD screens use **LED technology for backlighting** by employing a matrix of tiny blue-white LEDs behind the LCD screen.
- LEDs are more widely used now instead of Cold Cathode Fluorescent (CCFL) technology due to the following **superior advantages of LEDs**;
 - ✓ LEDs produce brighter light which gives better colour definition
 - ✓ LED screens are much thinner compared to screens using CCFL
 - ✓ LEDs can reach their maximum brightness within a few seconds
 - ✓ LEDs screens consume less energy compared to CCFL screens.



LCD
cold cathode fluorescent



LED Backlight

2.3 Output Devices and their uses

Monitors (Screens)

LCD screens cont....

- LCD screens are used for display on computers, smartphones, laptop and tablets.

Advantages of LCD monitors	Disadvantages of LCD monitors
<ul style="list-style-type: none">▪ They are very efficient and consume less energy▪ Lightweight compared to CRTs▪ Do not suffer from flickering screens as in CRTs▪ Produce very good image resolutions in many colours	<ul style="list-style-type: none">▪ Limited viewing angles with colour inconsistencies▪ It is harder to produce deep, rich black colour, leading to lower contrast than in CRT monitors.▪ Motion blur is very common in LCD screens

2.3 Output Devices and their uses

Monitors (Screens)

Touchscreens

- Touch screens **serve as both an input and output** device.
- **Used in:** smartphones and tablets,
- ATMs at banks for selecting and entering options
- Ticket collection machines in cinemas, railway stations...



Advantages of touch screens

- Faster and error free method for entering options
- User friendly method in most cases.

Disadvantages of touch screens

- Limited options to select from
- Not good for large amounts of data entry
- Screen can get very dirty especially public ATMs

2.3 Output Devices and their uses

Multimedia projectors

- Receives analogue or digital signal inputs from a computer or DVD player and a **magnified image is projected onto a large screen.**
- Use for presentations during training, classroom, advertisement, cinemas etc.



Advantages of projectors

- Provides better screen(presentation) size for a larger audience compared to a small computer screen.
- Larger viewing angle

Disadvantages of projectors

- Expensive to buy
- Images can sometimes be fuzzy.

2.3 Output Devices and their uses

Printers

Laser printers

- Makes use of **laser light** to create character/images which are printed onto paper.
- Used where low noise is required; **offices, libraries, schools etc.**
- Ideal printer for **high-quality, high-volume printouts.**



Advantages of laser printers

- Faster printouts; quick print rates
- Can handle very large printout jobs; printing press.
- Produces consistently high quality outputs



Disadvantages of laser printers

- Only fast when large printout copies are made
- Colour laser printers are more expensive to run
- Can lead to health hazards; produces ozone and other organic compounds during printing.

2.3 Output Devices and their uses



Printers

• Inkjet and Dot Matrix Printers

Printer	Description/Use	Advantages	Disadvantages
Inkjet printers 	<ul style="list-style-type: none">▪ Droplets of ink are sprayed on paper to make characters▪ Ideal printer for high quality low-volume printouts (just a few pages),	<ul style="list-style-type: none">▪ High quality output▪ Cheaper to buy than laser printers.▪ Do not produce ozone and other harmful gases	<ul style="list-style-type: none">▪ Output is slow for large volume printouts▪ Expensive to run▪ ink runs out quickly.
Dot matrix printer 	<ul style="list-style-type: none">▪ A type of impact printer▪ Still used for continuous rolls on paper printouts and till receipt.▪ Useful for printing in noisy and dirty environments	<ul style="list-style-type: none">▪ Can be used in dusty or moist environments.▪ Very cheap to run and maintain▪ Easy to use especially for long print jobs.	<ul style="list-style-type: none">▪ They are very noisy and slow▪ They might cost more than inkjet to buy.

2.3 Output Devices and their uses

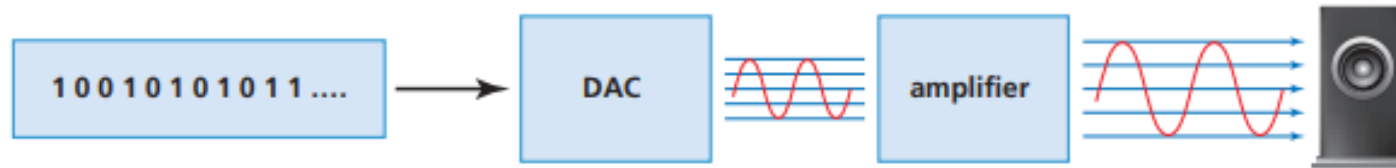
Plotters and 3D printers

Output device	Description/Use	Advantages	Disadvantages
Plotter 	<ul style="list-style-type: none"> Used with CAD and CAM systems Used for producing architectural drawings, engineering drawings and animation characters. 	<ul style="list-style-type: none"> Very High quality output Produces large accurate colour drawings Can print on a variety of materials. 	<ul style="list-style-type: none"> Very slow printing method Expensive equipment and accessories.
3D printers 	<ul style="list-style-type: none"> Primarily used in CAD applications. Used to produce solid 3D object that actually work. Used in manufacturing industries etc. 	<ul style="list-style-type: none"> Much easier manufacturing of items. Rapid prototyping is possible with 3D printers. Can be used in medical facilities for prosthetics and reconstruction surgery. 	<ul style="list-style-type: none"> Potential job losses especially in manufacturing and construction. In the wrong hands, the technology can be used for counterfeiting, dangerous or illegal activities.

2.3 Output Devices and their uses

Speakers

- Output devices that produce sound from a digitized sound or from speech through a microphone. Used in phones, laptops, tablets, TVs etc.



Advantages of Speakers

- Enables output from a computer to be heard by crowd of people
- They are very helpful for visually impaired persons.

Disadvantages of speakers

- Output from speakers can be disturbing in certain environments such as offices.
- Speakers can be very expensive; for high quality sound.

2.3 Output Devices and their uses

Actuators

- A **mechanical or an electromechanical** device such as *relays, motors*, etc. used to activate or deactivate (**start/stop**) a system controlled by a computer.
- They allow computers to control devices that require analogue inputs.
- E.g: **computer control of conveyor belts in factories use actuators.**

Advantages of actuators	Disadvantages of actuators
<ul style="list-style-type: none">• They allow remote control of many devices.• Relatively cheap to operate	<ul style="list-style-type: none">• Device becomes faulty the system is halted• Computers signals must be converted to analogue using DAC to carry out control of devices.

2.3 Output Devices and their uses

Actuators

- **Motors**: movements of robotic parts or system components
- **Buzzers** : produces noise as an alert
- **Light** : alert lights on devices for battery low, fuel low etc.
- **Heater**: Heat control; mainly increases heat.
- **Relay**: Turn on or off a device or circuit





Past Exam Question

Q>> Identify two devices which are used in control systems.

IGCSE ICT Q3, P11, M/J 2022

Answer: Any two

- ✓ Actuator
- ✓ Computer Analogue to digital convertor (ADC)
- ✓ Digital to Analogue convertor (DAC)

Reference book

- Cambridge IGCSE Information and Communication Technology

Graham Brown and David Watson

- IGCSE ICT past papers and Mark schemes.