

Computer Systems

Introduction

A computer system refers to a collection of entities working together to process and manage information using computers. Systems exist either as computerised or manual.

A computer system consists of three main components;

- **Hardware** - All the physical components that make up a computer. They include input devices, central processing unit, output devices and storage devices.
- **Software** - Computer programs that guide a computer in each and every activity that happens during data processing operations. They include system and application softwares.
- **Liveware** - The computer experts and users.

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Computer hardware

Input devices - These are the devices that convert data from human readable form into electronic or machine readable form. They help a user to enter data and instructions into the computer. Input devices can be classified according to how they are used to enter data as follows:

a) Keying devices -These devices enter data into a computer by typing. Examples include keyboard and keypad

b) Pointing devices -These are the input devices that enter data or instructions by controlling a pointer on the screen. Examples include mouse, trackball, joystick and light pen. Other pointing input devices include digitisers, stylus, touch screens among others.

c) Scanning devices - They directly capture data from source document into the computer using optical beam technology. They include optical, magnetic and speech recognition scanners.

- Optical scanners use light to capture data. Examples include: Optical Mark Recognition (OMR), Optical Bar Recognition (OBR), Optical Character Recognition (OCR) or image scanners and QR scanners.

- Magnetic scanners capture data by using magnetic technology. Examples of magnetic scanners include: Magnetic-ink Character Recognition (MICR), Magnetic stripe recognition.

- Speech recognition or voice input- They are used to enter verbalised and non-verbalised sounds into the computer. They have some disadvantages like complexity in developing and do not take care of speech related problems such as accents, inflections and tone.

- Other digital devices include digitisers, sensors, biometric scanners, digital cameras and interactive boards.

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The Central Processing Unit (CPU)

It is also known as the processor. In microcomputers, it is mounted on the motherboard. It is the main component in a computer that transforms data into information. It has three main functional units:

a) Arithmetic and Logic Unit (ALU)- It is where all mathematical and logical operations are carried out. It has special purpose memory location called registers that holds data and instructions to be executed by the ALU.

b) Control Unit (CU)- It issues timing signals that coordinate all the processing activities in the CPU as well as input, storage and output activities. It uses a system clock that sends command signals similar to the way traffic lights coordinates road users in a busy point.

c) Main memory (primary storage or working storage)- It provides storage location for data and instructions accessed by the control unit. It is classified as follows:

i) Read Only Memory (ROM)- It is used to permanently or semi-permanently store programmed instructions and data. There are four types of read only memories namely;

- **Mask Read Only Memory** -It is not reprogrammable.
- **Programmable Read Only Memory (PROM)** - It can be modified once by the user.
- **Erasable Programmable Read Only Memory (EPROM)** - Its content can be erased by exposing it to Ultra Violet (UV) light, and then reprogrammed for another use.
- **Electrically Erasable Programmable Read Only Memory (EEPROM)** - Can be erased using a pulsed voltage and reprogrammed for another use.

Characteristics of (ROM) are;

- User cannot write on it unless it is a special type of ROM.
- Non-volatile - its content is not lost when the computer is powered off.
- Stores permanent or semi-permanent instructions or data from the manufacturer called firmware

ii) Random Access Memory (RAM)- It is a temporary storage where the user carries all the workings on a computer. Also known as working storage. There are two types of RAM as described below.

Static RAM (SRAM)	Dynamic RAM (DRAM)
Faster	Slower
Stable	Leaks in charge – needs constant refreshment
More expensive	Cheaper
Uses flip flops	Uses capacitors

Characteristics of RAM are:

- Its content is user defined.
- Data can be both read from and written onto it.
- It is volatile - Its content is lost when the computer is powered off.

Special purpose memories

Apart from RAM and ROM, a computer has other memories with specialised use which include the following:

1. Buffers - This is a temporary holding place that may be part of the CPU or built in an input or output device. They harmonise the speed between processor and I/O devices.

2. Registers - Hold one piece of data at a time during processing and are found inside the processor. Examples include accumulator, Instruction register, program counter, index register, memory buffer register and flag register.

3. Cache Memory- It is a small high-speed type of SRAM. It allows the processor to improve efficiency in data and instructions access.

Memory capacities

Memory and storage capacity is measured in special units called byte. A byte is equivalent to a single character. Memory quantities are expressed as shown in Table below.

Table: Computer memory size

Unit size	Description
1 bit	Binary digit (0 or 1)
1 byte	8 bits
1 kilobyte (KB)	1024 bytes
1 Mega byte (MB)	1024 kilobytes
1 Gigabyte (GB)	1024 Megabytes
1 Terabyte (TB)	1024 Gigabytes
1 Petabyte (PB)	1024 Terabytes
1 Exabyte (EB)	1024 Petabyte

Computer bus is an electrical pathway for data, instructions, addresses and control signals during processing. There are three types of buses namely:

- Control bus – Unidirectional pathway that transfers timing signals from CU.
- Address bus – Unidirectional pathway for address information.
- Data bus – Bidirectional pathway for data and instructions.

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Types of processors and their clock speeds

Processors may be classified into two categories depending on instruction set and the processing speed.

Processor types - categorised into two depending on the instruction set supported:

i) Complex Instruction Set Computer (CISC) processors – Popularised by Intel Corporation and is made up of large number of instruction set.

ii) Reduced Instruction Set Computer (RISC) processors - Manufactured by Motorola and Sun Microsystems. They use fewer instruction set compared to CISC processors.

Processor clock speed- The speed at which a processor executes instructions is determined by its clock speed. System clock speed is measured in hertz. Examples;

- Kilohertz (kHz): Approx. one thousand hertz
- Megahertz (MHz): Approx. one million hertz
- Gigahertz (GHz): Approx. one billion hertz
- Terahertz (THz): Approx. one trillion hertz

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Output devices

Are peripheral devices that convert processed data into a user friendly form. There are two types of output:

- **Softcopy** – An output in a non-tangible medium for instance in audio or visual form.
- **Hardcopy** – An output in a tangible medium for instance paper or film.

Softcopy output devices

1. Monitor

A monitor or a Visual Display Unit (VDU) is the most common output device. Types of monitors include Cathode Ray Tube (CRT), Liquid Crystal Display (LCD), Light Emitting Diode (LED) and Gas Plasma Display (GDP). There are two ways of classifying monitors namely:

- i) Based on colours supported
- Monochrome – Supports one colour to display output.
 - Colour Monitors – Supports multiple colours to display output.
- ii) Based on technology used:

CRT monitors	Flat panel monitors
Use vacuum tubes	Use two glass plates with a substance in between
Consume more power	Consume less power
Emit a lot of electromagnetic radiations	Emit negligible electromagnetic radiations
Occupy larger space	Occupy less space
Cheaper	More expensive
Bulkier	Lighter in weight

Flat panel display screens can be classified as follows:

- Liquid Crystal Display (LCD) - Have tiny liquid crystals that reflect light falling on them from the environment. They are widely used in watches, calculators, cell phones and digital cameras.
- Electro Luminescent (EL): They are an improvement on LCDs. Electro luminescent emits light when electrically charged. This makes them clear, sharper and easier to read.
- Gas-plasma - Use a gas that emits light in the presence of electric current.
- Thin Film Transistor (TFT) – Each pixel is controlled by (from one to four) transistors to provide high quality output than all the previous flat panel screens.
- Light Emitting Diodes (LED) screens – They use an array of LEDs as pixels for video display

2. Graphic adapters

A special circuit board that determines the number of colours supported, graphics support ability and speed with which images appear on screen. There are several graphic adapters including:

- Monochrome Display Adapter (MDA)
- Hercules Graphics Card (HGC)
- Colour Graphics Adapter (CGA)
- Enhanced Graphics Adapter (EGA)
- Video Graphics Array (VGA)
- Super Video Graphics Array (SVGA)

3. Sound output - Speakers are used to output sound from a computer. Sound may be in form of music, warning, video, beeps, and interactive communication with a computer among others.

4. Light-Emitting Diodes (LED) - These are light emitting components that display light when an electric current is passed through them.

5. Data projectors - They display output from the computer to a white board or surface.

6. Hardcopy output devices

The most common hard copy output devices are printers and plotters. Printers produce a hard copy of information on papers. There are two main ways of classifying printers:

- Based on printing mechanism – Impact and nonimpact.
- Based on printing speed – Character, line and page printers.

Table below summarises where various printer belong:

Table: Types of printers

Printer name	Printing mechanism		Printing speed		
	Impact	Non-impact	Character	Line	Page
Laser printer		✓			✓
Thermal printer		✓	✓		
Dot matrix printer	✓		✓		
Inkjet printer		✓		✓	
Daisy wheel	✓		✓		
Golfball printer	✓		✓		
Bubblejet printer		✓		✓	
Drum printer	✓			✓	
Chain printer	✓			✓	

Plotters resemble a printer but specialise in producing high quality big charts, maps, pictures and drawings.

There are three types of plotters: pen plotters, thermal plotters and electrostatic plotters. Computer Output on Microform (COM). Transcribers produce their output on films called microforms. There are two types of microforms:

- Microfilm – Holds more data.
- Microfiche – Holds less data than microfilm.

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Secondary (auxiliary/ backing) storage devices and media

The technology used is either magnetic or optical. They have the following characteristics:

- Mass storage devices.
- Permanently hold data and instructions.
- Can be both read and written onto.

There are mainly two categories of secondary storage devices: removable and fixed (See Table below)

Table: Storage devices

Storage device	Classification				Estimated storage capacity	Comments
	Removable	Fixed				
		Magnetic	Optical	Solid state		
Internal Hard Disk		√			10GB to 4TB	Permanently reside within a computer system unit casing
External Hard Disk	√	√			100GB to 4TB	Portable devices
Floppy disk	√	√			UPTO 1.44MB	Obsolete
Zip disk	√	√			250MB	Obsolete
Jaz disk	√	√			2GB	Obsolete
Magnetic tapes	√	√			35TB	Used for backups or archives
CD-ROM	√		√		700MB	Compact Disk Read Only Memory
CD-R	√		√		700MB	Compact Disk Recordable
CD-RW	√		√		700MB	Compact disk rewritable
DVD-ROM	√		√		4.7GB	Digital Versatile Disk ROM
DVR-R	√		√		4.7GB	Digital Versatile Disk Recordable
DVD-RW	√		√		4.7GB	Digital Versatile Disk Rewritable
Optical tapes	√		√		185TB	
Ls-120 super disk	√		√		120MB	Laser servo 120 super disk
Blu-ray disk	√		√		25GB	Has higher capacity than DVD
Flash disk	√			√	1TB	
Memory cards	√			√	2TB	

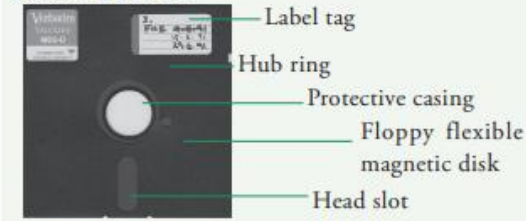
Care for magnetic storage media

- Keep them away from strong magnetic fields.
- Do not drop the disk on the ground.
- Avoid applying pressure on them.
- Keep them dust free and smoke free.

Care for optical disks

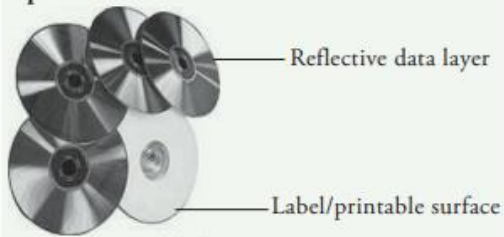
- Handle them from edges or from the central hole.
- While labelling them, use non-solvent permanent markers.
- Keep them dust free
- Keep them upright in their cases.

Parts of a diskette



parts of a diskette

Optical disks

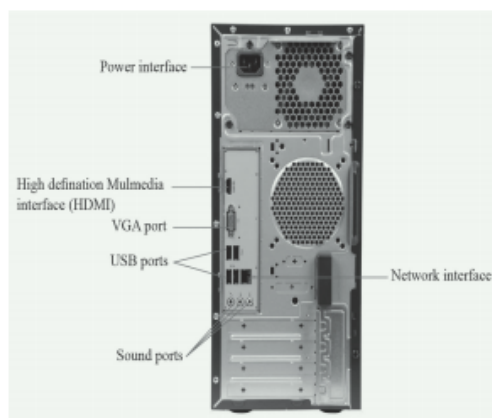


Optical disks

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Power and interface cables

Power cables connect the system unit and peripheral devices to the source of power. Interface cables connect peripheral devices to the system unit via input or output ports. There are different types of cables and ports. Figure below shows the different types of ports from a system unit.



Types of ports

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Basic computer setup and cabling

The following precautions should be observed:

- Discharge electrostatic charges from the hands by touching an earthed metallic object or wearing an anti-static wrist member.
- Disconnect all devices from power source.
- Follow teacher's instructions as you connect components.
- Work with a colleague to assist you.

Tools and other requirements used

- Manufacturer's manuals for all components.
- Relevant device drivers.
- Anti-static wrist member.
- Screw drivers
- Pliers with narrow nose.
- A dismantled system unit.
- Peripheral devices.
- Interface and power cables.

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Computer software

Computer software is a program or a set of instructions, which a computer follows to perform tasks. They can be classified according to:

- Purpose
- Acquisition
- End user license

1. Classification by purpose- In this category, software is classified as follows:

a) System software - They perform a variety of primary operations that avails computer resources to the user.

System software are classified as:

- **The operating system** - It is a suite of programmes that manage all computer resources and oversee all the computer operations. Examples include Microsoft Windows 7, UNIX, Linux and Macintosh (Mac OS).
- **Firmware** also called stored logics - a combination of software and hardware recorded permanently on electronic chips.
- **Utility software** - a special program that performs commonly used services that make definite aspects of computing to go on more smoothly. Services provided include sorting, copying, file handling, disk management among others.
- **Networking software** - These are programs used to institute communication between two or more computers by linking them using a communication channel like cables to create a computer network. Examples include Novel Netware, Ms Windows NT and UNIX.

b) Application software - They are also called application packages and are designed to help the user accomplish specific tasks. Examples of application packages are shown in Table below.

Software	Uses	Examples
Word processor	Typing documents like letters	Ms Word, Lotus WordPro, WordStar
Spreadsheet	Handling of numeric data for example calculating budgets	Ms Excel, Lotus 1 2 3 LibreOffice
Desktop Publishing	Designing publications such as school magazines and books	Adobe PageMaker, Ms publisher
Databases	Keeping records and files	Ms Access, Dbase IV, FoxBASE
Computer Aided Design	Technical drawing	AutoCAD, ArchiCAD.
Graphics software	Making and manipulating pictures or images	Picasa, Adobe Photoshop, Digital Image Suite

2. Classification according to acquisition -In this category, software is divided as follows:

a) In-house developed programs - They are distinctively designed and tailored to meet a user's or an organisation's particular needs.

b) Standard software (Vendor off-the-shelf software) -They are developed by software companies, packaged and made available for purchase by the general public. Examples of standard software are Lotus Suite, Open office suite, Microsoft Office 2007 suite, Sage among others.

Advantages of standard software

- Easily setup for use.
- Can be personalised to some extent to meet specific users need.
- Easily purchased from the vendors.
- They have minimal or no errors.
- They are less expensive compared to tailor-made.

3. Classification by end user license - In this category, software is classified as follows:

- Proprietary – Do not provide source code to the user. Cannot be modified. Needs license to use.
- Open source – Provide source codes which can be modified by the user.
- Freeware – Available at no cost but do not provide source codes.
- Shareware- Allows users to freely make and distribute copies of the software.

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Criteria for selecting a computer system

1. Hardware considerations

- Processor speed - high processor speed.
- Memory capacity - sufficient memory.
- Warranty - should cover the following points: time span, response time and liability agreement and type of cover on maintenance.
- User needs - unique needs of the user.
- Cost - Might be determined by the other attributes associated with the computer.
- Portability- The size for possible mobility.
- Upgradeability - easily upgraded to accommodate emergent technologies.
- Compatibility - Should be able to fit in the other available computer resources
- Monitor -User's choice may depend on size, resolution and the technology used to make it.
- Multimedia capability - Consider computer's ability to handle video, audio, text and images.

2. Software considerations

- Authenticity - Refers to genuineness, validity and or legitimacy of the software.
- Documentation - Guides prepared by the developer having details on how to install, use and maintain the software.
- User needs - Consider the purpose for which the software is needed.
- Reliability and security - Should offer good security to confidential and private information.
- User friendliness - Should be easy to learn and use.
- Cost - Dependent on the other specifications of the computer.
- Compatibility and system configuration - User should be able to run the software depending on the system setup.
- Portability - Ability to install and use in more than one type of computer.
- Data security- Good software should be able to protect data from illegal access.

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Sample KCSE Questions

- 1.Distinguish between the following: a) OCR and OMR. (2 marks) **KCSE 2008 Paper 1 Qn. 2**
- 2.State two functions of the control unit of a computer. (2 marks) **KCSE 2012 Paper 1 Qn.1.**
- 3.When purchasing a computer, the clock speed, RAM size, Hard disk size and monitor size are often quoted. State the unit for measuring: (2 marks) **KCSE 2012 Paper 1 Qn.5.**
 - a) Clock speed
 - b) RAM size
 - c) Hard disk size
- 4.A school has bought a Computer System. The hardware items supplied include: a 800MHZ processor, 640 MB of RAM, a sound card, speakers, a monitor, a keyboard, a 12GB hard disk, a floppy disk drive, a CD - Read/Write drive, a mouse, a modem, an inkjet printer and a joystick. The software supplied include: an operating system, a BASIC interpreter and the following packages: spreadsheet, graphics, word processor, art, database and games.**KCSE 2004 Paper 1 Qn.19**
 - a) List three input devices from the given specifications. (3 marks)
 - b) Explain the meaning of the following:
 - i) 800MHZ (2 marks)
 - ii) 640 MB (2 marks)
 - iii) 12GB (2 marks)
- 5.Computer systems are built from three types of physical components: processors, memories and I/O devices. **KCSE 2003 Paper 1 Qn.1**
 - a) State two tasks of a processor. (2 marks)
 - b) State the functions of I/O devices. (1 mark)
- 6.Distinguish between the following: (2 marks) **KCSE 2008 Paper 1 Qn.2.**
 - i) CRT and LCD
- 7.List three differences between a laser printer and a dot matrix printer. (3 marks) **KCSE 2004 Paper 1 Qn.6**
- 8.Indicate whether the following devices are used for input or output. (2 marks) **KCSE 2005 Paper 1 Qn.1**
 - i) Plotter
 - ii) Light pen
 - iii) Mouse
 - iv) Visual display unit
- 9.A student saved a document in a diskette. Later on, the student found that the diskette could not open and therefore the work got lost. Give three precautions the student should have taken to ensure the work was not lost. **KCSE 2007 Paper 1 Qn.7**
- 10.A student saved a document in a diskette. Later on, the student found that the diskette could not open and therefore the work got lost. Give three precautions the student should have taken to ensure the work was not lost. **KCSE 2007 Paper 1 Qn.5**
- 11.Name three types of optical disks. (3 marks) **KCSE 2006 Paper 1 Qn.14**
- 12.Explain two features of a DVD that enables it to store more information than a CD-R. (4 marks) **KCSE 2006 Paper 1 Qn.10**
- 13.State three reasons why an organisation may opt to develop its own software in-house rather than buy off-the-shelf software. (3 marks) **KCSE 2013 Paper 1 Qn.7.**
- 14.Describe compatibility as a factor to consider when purchasing a computer. (2 marks) **KCSE 2013 Paper 1 Qn.14**

