KNQF LEVEL 3 · TVET CDACC CYCLE 3

Computer Operations

Level 3 · A Practical Study Guide for Kenyan Trainees

Computing concepts · Windows, Word and Excel · Internet, email and safety



Realistic pictures **Step-by-step tasks** **Mock assessments**

For trainees, RPL candidates, trainers and cyber café operators

Alphonce Kimutai Kirui

Aligned to the TVET CDACC Competency-Based Modular Curriculum, Computer Operations KNQF Level 3

Computer Operations Level 3

A Practical Study Guide for Kenyan Trainees

Basic Computing Concepts · Basic Computer Skills · Computer-Based Communication
Kenya National Qualifications Framework (KNQF) Level 3

Alphonce Kimutai Kirui

Computer Operations Level 3: A Practical Study Guide for Kenyan Trainees
First edition, October 2026

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About the curriculum

This book is an independent study guide. It follows the topics and units of the TVET CDACC Competency-Based Modular Curriculum and Occupational Standard for Computer Operations (Computer Operator), KNQF Level 3 (Cycle 3, programme code 0611 254 A, unit codes IT/CU/CO/CR/01–03/3/MA). Unit titles and codes are used for reference only. The book is not published, endorsed or approved by TVET CDACC, TVETA or the Ministry of Education. Always follow the current official curriculum and your trainer's guidance.

Safety and accuracy notice

Computers run on mains electricity, and long hours at a screen can strain the eyes, neck, back and wrists. The methods in this book are for training under the supervision of a qualified trainer. Always follow the manufacturer's instructions, your trainer, workplace rules and the Occupational Safety and Health Act 2007. Software changes often: menus and buttons on your computer may look slightly different from the pictures, especially in older versions of Windows and Microsoft Office. Prices are approximate (2026) and vary by town.

Names of people, businesses, email addresses, websites and phone numbers used in examples are made up for teaching.

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Illustrations and photographs

The illustrations and screen pictures in this book were drawn for it. Screen pictures are realistic drawings based on Windows 11 and Microsoft 365; they are not screenshots and contain no company logos. Photographs come from Wikimedia Commons under free licences (public domain, CC0, CC BY or CC BY-SA). Each photograph is credited under the picture, and the full list of credits is at the back of the book.

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How to use this book

This book follows the Computer Operations Level 3 course from start to finish. It covers the three core units and the industrial training, in the same order as your training. You can read it cover to cover, or study one unit at a time if you are taking a part qualification.

The course at a glance

Part	What it covers	Training time
1. Getting started	The job and the course, assessment, working safely and comfortably with computers	Used throughout
2. Basic computing concepts	Unit 1: Apply Basic Computing Concepts (IT/CU/CO/CR/01/3/MA)	60 hours
3. Basic computer skills	Unit 2: Apply Basic Computer Skills (IT/CU/CO/CR/02/3/MA)	100 hours
4. Computer-based communication	Unit 3: Apply Computer-Based Communication (IT/CU/CO/CR/03/3/MA)	70 hours
5. Industrial training and assessment	Industry training, your portfolio and getting ready to be assessed	240 hours

What is in each chapter

- **What you will learn:** the chapter's goals, with the unit, learning outcome and training hours it belongs to.
- **Key words:** the computer words you need, explained simply. More are in the Glossary at the back.
- **Explanations and drawings:** each topic explained step by step, with realistic labelled illustrations, screen pictures and photographs.
- **Worked examples:** storage sizes, printing costs, typing speed, spreadsheet totals and business costs worked through with real numbers.
- **Practical tasks:** real computer jobs with the equipment, materials, steps and safety points. Do them with your trainer.
- **Check your competence:** a checklist of what an assessor will expect you to show. Tick each item when you can do it without help.
- **Practice questions:** answers are at the back of the book.

Look out for these boxes

SAFETY FIRST

Hazards and how to stay safe. Never skip these.

GREEN TIP

Ways to save electricity and paper, reuse equipment, and handle e-waste correctly.

TRAINER'S TIP

Advice from experienced trainers and computer operators to help you work faster and better.

COMMON MISTAKES

Errors trainees often make, and how to avoid them.

IN THE KENYAN WORKPLACE

How the topic looks in real Kenyan cyber cafés, offices, schools and government services.

INCLUDING EVERYONE

How to make computers and communication work for people with disabilities.

About the pictures

This book uses realistic illustrations of real equipment, drawn screen pictures of Windows 11 and Microsoft 365, and photographs. Numbered orange rings show where to click, in order. Labels and thin leader lines point to the parts that matter. Blue arrows show movement or the order of steps. Red marks a danger or a mistake; green marks the correct way. Keys to press are shown like this: Ctrl + S.

PART 1

Getting Started

What a Level 3 computer operator does, how you will be trained and assessed, and how to work safely and comfortably with computers.

Chapter 1: Becoming a Computer Operator in Kenya
Chapter 2: Working Safely: The Computer Lab, Ergonomics and Care of Equipment

CHAPTER 1

Becoming a Computer Operator in Kenya

WHAT YOU WILL LEARN

- Describe the daily work of a Level 3 computer operator and the places where operators find jobs.
- Explain how competency-based training works: units, elements, performance criteria and certificates.
- Read the course map: the three units, their hours and credits, and industrial training.
- Explain how you will be assessed and turn a mark into a competence rating.
- Behave like a professional in the computer lab from your first day.

Course introduction · Computer Operations KNQF Level 3 (Cycle 3) · All three units and industrial training

Almost every office, shop, school and hospital in Kenya now runs on computers. Someone has to type the letters, enter the records, print the forms and help customers with online services. That person is a computer operator. This chapter shows you what the job looks like, how your course is organised and how you will prove that you are competent.

Key words

Computer operator
A worker who uses a computer and its devices to produce documents, records and online services for an employer or customers.

CBET
Competency-Based Education and Training. You are trained and judged on what you can actually do at work, not only on what you can write in an exam.

Unit of competency
One complete area of skill, such as Basic Computer Skills. Your course has three units.

Element
One part of a unit, such as "operate a computer". In the curriculum each element is a learning outcome.

Performance criteria
Statements that describe exactly what an assessor must see you do for each element.

Credit
A measure of learning time. In this course one credit equals 10 hours.

KNQF
Kenya National Qualifications Framework. It places every Kenyan qualification on a level, so employers can compare them.

Formative assessment
Assessment done during training, as you learn each element.

Summative assessment
The final assessment at the end of a unit.

RPL
Recognition of Prior Learning. Skills you already gained at work can be assessed and certified.

Portfolio of evidence
A file (paper and digital) of your work, checklists and reports that proves your competence.

Industrial training
Time spent working in a real ICT workplace under a supervisor, also called attachment.

1.1 What a computer operator does

Think about your smartphone. You already type messages, take photos, send money by M-Pesa and search for information. A computer operator does the same kinds of things, but on a desktop or laptop computer, faster, neater and for other people. The work is mostly practical. You will spend most of your time with your hands on the keyboard and mouse.

1.1.1 A day at the cyber

Faith Chebet works at a busy cyber near the bus stage in a small town. At 8 a.m. she switches on the computers and the photocopier, checks the paper and toner, and opens the shop. Her first customer needs a CV typed and printed. The next one wants to apply for a KUCCPS course online. Before lunch she has scanned twelve land documents, laminated three identity cards, typed a church programme and helped an old man check his KRA iTax account. In the evening she records the day's sales in an Excel sheet and shuts down every machine correctly. Every one of these tasks is a skill you will learn in this course.



Figure 1.1 A real cyber café in Mombasa. The signboard lists the kind of work a computer operator does every day: typing, printing, photocopying, scanning and lamination, KRA PIN registration, CV writing and M-Pesa services.

Photo: Chaostar, CC BY-SA 3.0, via Wikimedia Commons

Look at the signboard in Figure 1.1. Count how many services on it need a computer. Now look at Figure 1.2, which shows the inside of a small cyber counter and the main jobs done there.

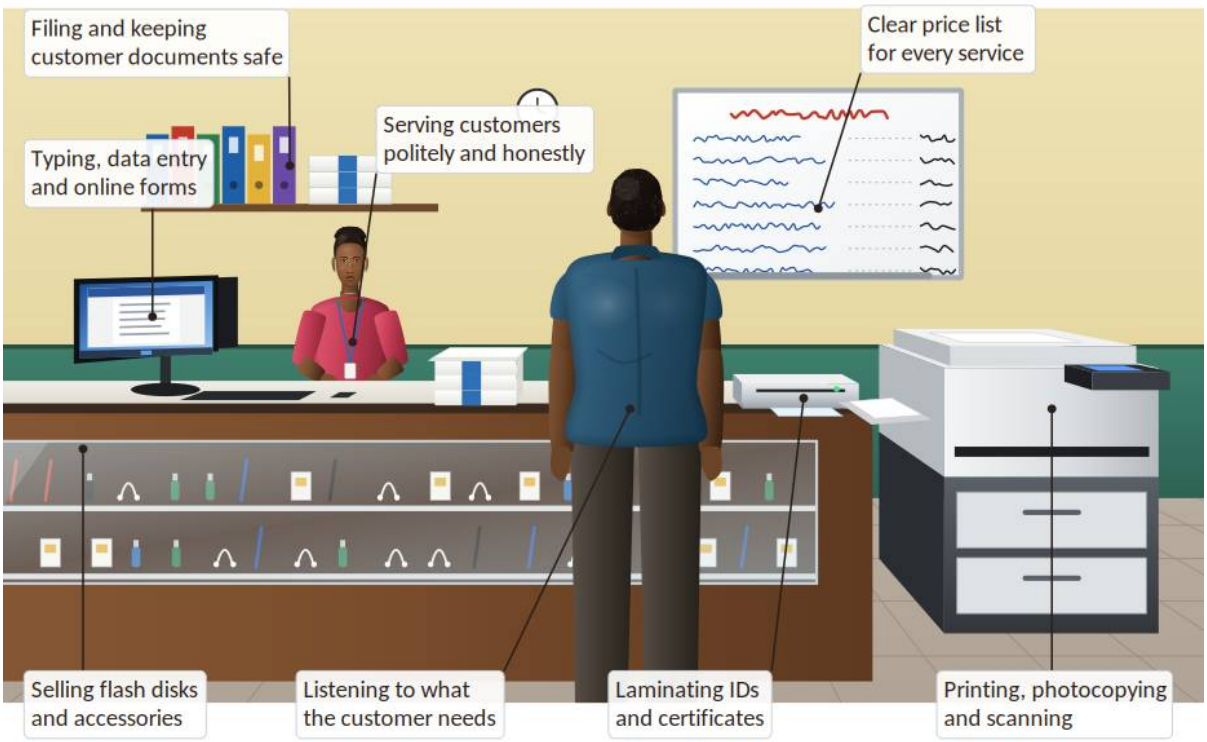


Figure 1.2 Inside a small cyber café. The labels show the main jobs a computer operator does at and around the counter.

Table 1.1 Typical tasks of a Level 3 computer operator and where this book teaches them

Task at work	Example	Chapter
Setting up and switching on equipment	Connecting a printer and testing it before customers arrive	5, 8
Typing and formatting documents	Letters, CVs, minutes, notices, exam papers	11
Data entry and simple spreadsheets	Daily sales, class marks lists, stock records	12
Managing files and storage	Saving customers' work in named folders; using flash disks safely	10
Printing, scanning and photocopying	Printing 40 copies of a notice; scanning title deeds	4, 11
Online services and email	eCitizen, KRA iTax, KUCCPS and HELB applications; sending a CV by email	15
Customer care and communication	Explaining prices, handling complaints, answering the phone	7, 14
Keeping records and running a business	Receipts, cash book, budget for a small cyber	13

1.1.2 Where computer operators work

Computer operators are needed wherever information is handled. Common workplaces in Kenya include:

- **Cyber cafés and printing shops** in towns and trading centres: typing, printing, online applications.
- **Offices** of companies, SACCOs, churches and NGOs: front-office work, records, letters and email.
- **Schools and colleges**: typing exams, entering marks, keeping learner records.

- **Hospitals and clinics**: registering patients, keeping records and processing SHA (health insurance) claims at the records office.
- **Supermarkets and shops**: operating the point-of-sale (POS) till and the stock system.
- **County and national government offices**, including Huduma Centres, where staff help citizens with eCitizen services.
- **Self-employment**: many graduates open their own cyber or typing bureau (see Chapter 13).

> **IN THE KENYAN WORKPLACE**
>
> Many government services are now online only. Applications for a good conduct certificate, a business name or a driving licence start on eCitizen, and tax returns are filed on KRA iTax. Many citizens, especially older people, still need help to use these systems. A skilled, honest operator who charges fair prices (about KSh 100–200 service fee plus any government fee) will always have customers. Never ask a customer for their PIN or password: let them type it themselves.

1.2 Your career path

The Kenya National Qualifications Framework (KNQF) puts qualifications on levels. Your course is at **Level 3**, which is the entry level for working with computers. You need only KCPE or an equivalent qualification to join. Once you are competent at Level 3, you can climb further, as Figure 1.3 shows.

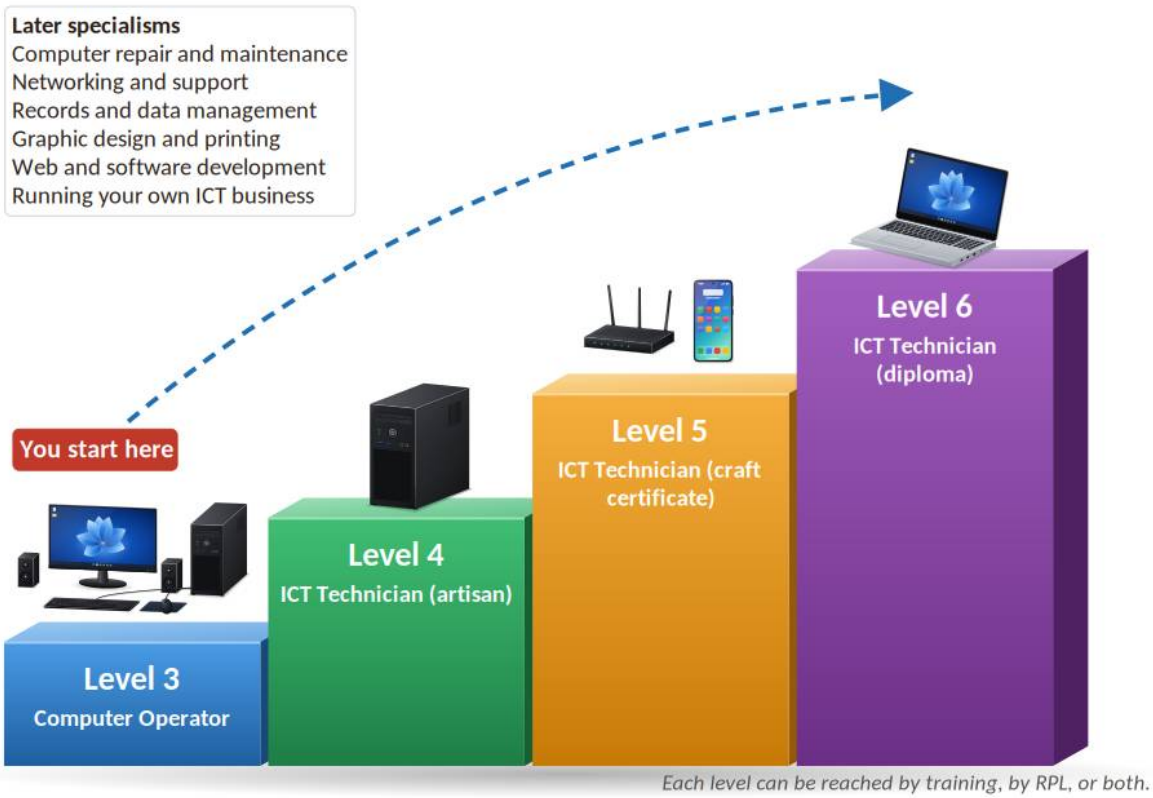


Figure 1.3 The career ladder. Level 3 is your first step. With more training, experience or RPL you can climb to Levels 4, 5 and 6 and choose a specialism.

Course names differ a little between institutions, so check with your trainer. In general:

- **Level 3 – Computer Operator.** You use computers, office software, the Internet and email to do everyday work.
- **Level 4 – ICT technician (artisan level).** You begin to install, connect and maintain computers and simple networks.
- **Level 5 – ICT technician (craft certificate level).** You repair hardware, install software and support users.
- **Level 6 – ICT technician (diploma level).** You manage networks and systems, and may supervise others. From here, some people continue to degree studies.

As you grow, you may choose a specialism, such as computer repair, networking, records management, graphic design or web development. Your Level 3 skills (typing, Word, Excel, email and good customer care) remain useful in every one of them.

> **TRAINER'S TIP**
>
> Start a simple "career file" today. Keep your KCPE or other certificates, your admission letter and later every certificate you earn in a clear plastic folder. Scan each one and save a copy in a folder named *My Certificates* on your email or cloud storage. Employers and the next college will ask for them.

1.3 How competency-based training works

Your course follows CBET. In the old system, many trainees memorised notes, wrote an exam and forgot everything. In CBET the question is simple: **can you do the job to the standard that industry needs?** The curriculum was written from an occupational standard, a document prepared with employers, which describes what a computer operator must be able to do.

1.3.1 Units, elements and performance criteria

The work of a computer operator is divided into **units of competency**. Each unit is divided into **elements**, and each element has **performance criteria**. Think of a house: the unit is the whole house, the elements are the rooms, and the performance criteria are the checks an inspector makes in each room.

For example, in the unit Basic Computer Skills, one element is "operate a computer". To pass it, an assessor will watch you switch a computer on and off correctly, use the mouse in different ways, explain the keyboard layout and type simple text. If you can do all of these, that element is achieved. The "Check your competence" list at the end of each chapter in this book is written from these performance criteria, in simple words.

1.3.2 Certificates you can earn

All certificates for this course are issued by TVET CDACC (the Curriculum Development, Assessment and Certification Council):

- **Certificate of Competency** – for each core unit in which you are found competent. You can get a job with one unit already certified.
- **Statement of Attainment** – for a certifiable element inside a unit, when you have not yet completed the whole unit.
- **Kenya National TVET Certificate in Computer Operations Level 3** – the full qualification, when you are competent in all the units.

Because each unit is certified on its own, you can study part of the course, go to work, and return later to complete the rest. These smaller awards are called **part qualifications**.

1.3.3 Recognition of Prior Learning (RPL)

Some people have worked in a cyber for years without any certificate. Through **RPL**, such a person can be assessed on what they already know. If they show competence, they can be awarded part or all of the qualification, without repeating training they do not need.

> **INCLUDING EVERYONE**
>
> Computer operation is an excellent career for many persons with disabilities (PWDs). A blind operator can work fast with a screen reader such as NVDA (free) or JAWS, which reads the screen aloud. A trainee with low vision can use Windows Magnifier, high-contrast themes and large-print keyboards. A trainee with limited hand movement can use Sticky Keys, so shortcuts like Ctrl + C can be pressed one key at a time. If you have a disability, tell your trainer early: the lab, the learning materials and the assessment arrangements can be adjusted so that you can show your real skill.

1.4 The course map

Your course has three core units taught at the VTC, followed by industrial training in a real workplace. Figure 1.4 shows the whole course drawn to scale, and Table 1.2 gives the official details.

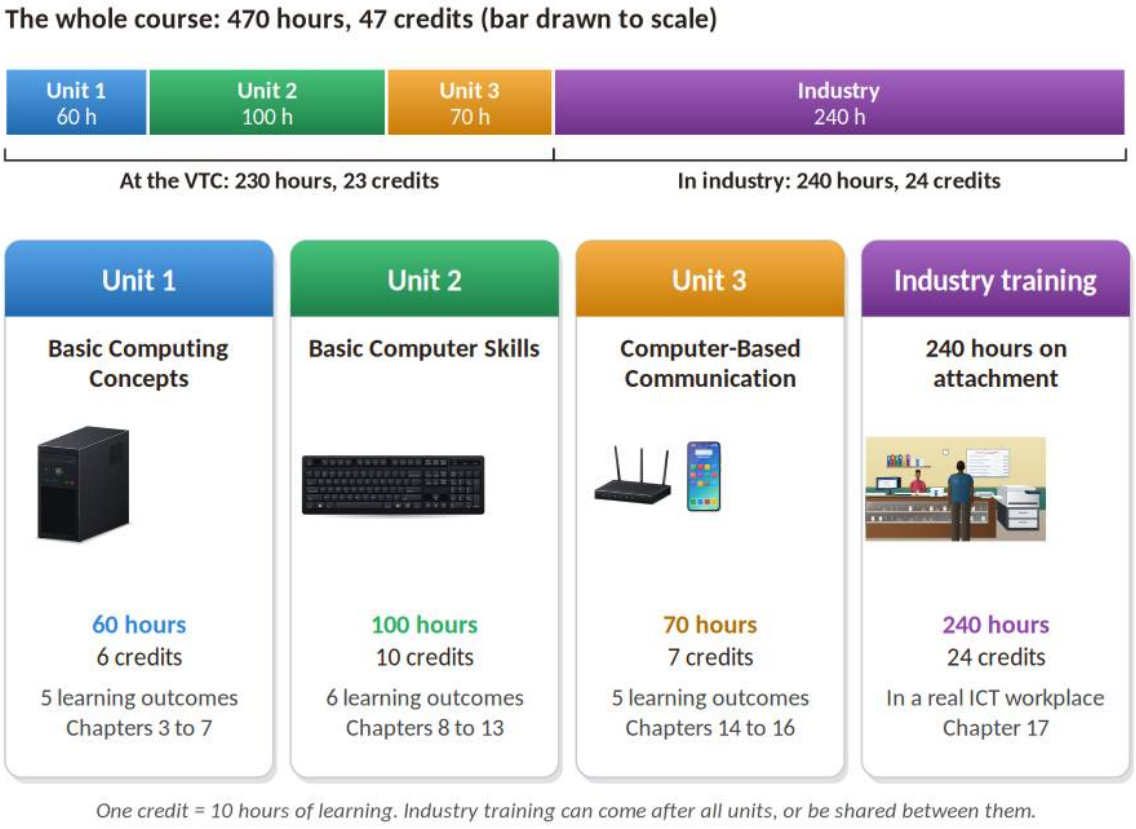


Figure 1.4 The course map. Three units at the VTC (230 hours) and industrial training (240 hours) make 470 hours and 47 credits.

Table 1.2 The units of Computer Operations Level 3

Unit	Code	Hours	Credits	Chapters
Basic Computing Concepts	IT/CU/CO/CR/01/3/MA	60	6	3–7
Basic Computer Skills	IT/CU/CO/CR/02/3/MA	100	10	8–13
Computer-Based Communication	IT/CU/CO/CR/03/3/MA	70	7	14–16
Units sub-total		**230**	**23**	
Industrial training (ICT sector)	–	240	24	17
Grand total		**470**	**47**	

Worked example: hours and credits. One credit is 10 hours of learning, so credits = hours ÷ 10.

- Units: 60 + 100 + 70 = 230 hours, and 230 ÷ 10 = 23 credits.
- Industrial training: 240 ÷ 10 = 24 credits.
- Whole course: 230 + 240 = 470 hours, and 23 + 24 = 47 credits.

If you do your 240 hours of attachment at 8 hours a day, you need 240 ÷ 8 = 30 working days, which is six weeks of five days. Trainees who take the full course usually go for attachment after all the units. Those taking part qualifications may share the attachment hours between the units. Your trainer is qualified to at least Level 5 in computer science or a related area and is licensed by TVETA.

1.5 How you will be assessed

1.5.1 Practical first

In each unit, **90% of the marks are for practical work and only 10% for theory** (a ratio of 10:90). There is no separate theory paper to cram for. Instead, the assessor asks you **oral questions** while you work. For example, while you print a document, the assessor may ask, "Why did you check Print Preview first?" Learn to explain what you are doing, in simple words, as you do it.

1.5.2 Formative and summative assessment

You will be assessed many times. **Formative** assessments happen during training, at least one for each element of a unit. The **summative** assessment comes at the end of the unit. Your final score for a unit combines the two: formative counts **60%** and summative counts **40%**. This means steady work every week matters more than the final day. Your competence in basic and common areas, such as communication and teamwork, is assessed inside the three units, not separately.

1.5.3 Where the marks are

The performance criteria do not all carry the same marks. Figure 1.5 shows how the marks in each unit are shared between the elements.

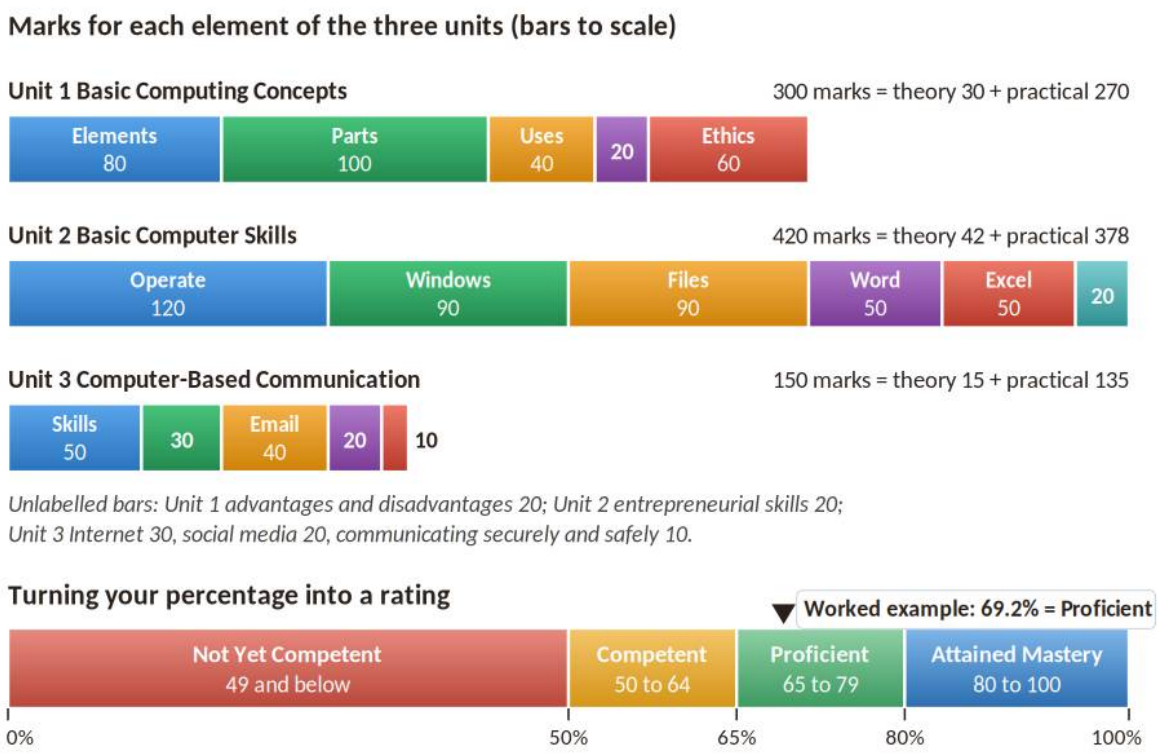


Figure 1.5 Where the marks are. The marks of each unit are shared between its elements (10% theory, 90% practical). Your final percentage then gives your competence rating.

Some performance criteria carry very heavy marks. In Unit 1, explaining real hardware devices while holding them carries the most, followed by connecting devices so that they work as one unit. In Unit 2, switching a computer on and off, using the mouse and typing text carry the most marks, followed by personalising the desktop and creating Word documents and Excel worksheets. In Unit 3, composing, attaching, sending and retrieving email carries the most. Practise these skills until you can do them without thinking.

1.5.4 From marks to a rating

After assessment, your score is turned into a percentage and then a rating:

Table 1.3 Competence ratings

Score	Rating
80–100	Attained Mastery
65–79	Proficient
50–64	Competent
49 and below	Not Yet Competent
Y	Assessment malpractice or irregularity (for example cheating)

Worked example: combining formative and summative scores. Otieno scored 216 out of 300 in his formative assessments for Unit 1, and 65% in the summative assessment.

1. Formative percentage: 216 ÷ 300 × 100 = 72%.
2. Formative share: 72 × 0.6 = 43.2.

3. Summative share: 65 × 0.4 = 26.0.
4. Unit score: 43.2 + 26.0 = 69.2%.
5. Rating: 69.2 lies between 65 and 79, so Otieno is **Proficient** in Unit 1.

COMMON MISTAKES

- Thinking "it is only practical, so I don't need to know why". Oral questions are part of every assessment.
- Missing formative assessments. They count 60% of your final score.
- Copying another trainee's file or using someone else's printout. This is malpractice and is graded "Y".
- Leaving the portfolio of evidence until the last week. Collect evidence from the first day.

1.6 Professional behaviour in the computer lab

Employers often say they can teach software, but they cannot easily teach attitude. Start behaving like a professional computer operator now, in the lab. Your industrial training supervisor will rate your worker behaviour, such as communication and teamwork, as well as your skills.

- **Be on time** and sign the attendance register. A cyber that opens late loses customers.
- **Use your own login** and never share your password. Lock the screen with Windows + L when you step away.
- **Save your work in your own folder** with clear file names, and back it up on your flash disk or cloud storage.
- **Respect other people's files and privacy.** Never open, copy or delete another person's work. In a job, customers' documents are confidential.
- **Do not install, download or change software** without permission. Never use cracked (pirated) software: it is illegal and often carries viruses.
- **Keep your phone silent** and away during practical sessions.
- **Ask before printing**, check Print Preview, and print only what you need.
- **Follow the safety rules** in Chapter 2: no food or drink near computers, no running, no playing with cables.
- **Shut down correctly** and leave your workstation clean and tidy, with the chair pushed in.
- **Help others politely**, including classmates with disabilities, and ask the trainer when you are not sure.

GREEN TIP

Make good habits now that save money and the environment later. Switch off the monitor when you leave for a break, shut down the computer at the end of the day, read documents on screen instead of printing them, and reuse paper printed on one side for rough drafts. A cyber that prints only what is needed saves reams of paper (about KSh 650 each) and toner.

SAFETY FIRST

On your first day in the lab, find the emergency exit, the CO2 fire extinguisher, the first-aid box and the main power switch. Never touch sockets or cables with wet hands. Chapter 2 explains lab safety in full; read it before you start the practical work in Chapter 5.

Practical task 1.1: Lab orientation and starting your portfolio

Tools and equipment

- The VTC computer lab
- A computer with your login
- Your flash disk (optional)

Materials

- A box file or spring file
- A notebook and pen
- Five paper dividers or coloured sheets

Steps

1. Walk around the lab with your trainer. In your notebook, draw a simple plan of the room and mark the emergency exit, the fire extinguisher, the first-aid box and the main power switch.
2. Read the lab rules on the notice board. Copy the three rules you think are most important and write one sentence on why each matters.
3. Label your box file "Computer Operations Level 3 – Portfolio of Evidence" with your name and admission number.
4. Use the dividers to make five sections: Unit 1, Unit 2, Unit 3, Industrial training, and Certificates.
5. Log in to your computer under supervision. Check that your name appears on the screen, then lock the screen with Windows + L and unlock it again.
6. In your notebook, write the three units with their hours and credits from Table 1.2 and put this page in the front of your portfolio.
7. Ask your trainer to sign and date the page as your first piece of evidence.

Safety

- Do not touch sockets, cables or the main switch during the tour; only look.
- Keep bags out of the walkways and away from cables.
- No food or drink in the lab.

Chapter summary

- A Level 3 computer operator types and formats documents, enters data, manages files, prints and scans, helps customers with online services and email, and keeps simple records.
- Operators work in cyber cafés, offices, schools, hospitals, supermarkets, government offices such as Huduma Centres, NGOs and their own businesses.
- Level 3 is the first step; you can progress to Levels 4, 5 and 6 and choose a specialism.
- CBET judges what you can do. Units contain elements, and elements contain performance criteria.
- You can earn a Certificate of Competency for each unit, a Statement of Attainment for an element, and the Kenya National TVET Certificate in Computer Operations Level 3 for all units. RPL can certify skills you already have.
- The course is 230 hours of units plus 240 hours of industrial training: 470 hours, 47 credits.
- Assessment is 90% practical and 10% oral theory; formative counts 60% and summative 40%; ratings run from Not Yet Competent to Attained Mastery.
- Professional behaviour, safety and good habits start on your first day in the lab.

Check your competence

- [ ] I can describe at least six tasks a computer operator does at work.
- [ ] I can name five kinds of workplaces that employ computer operators in Kenya.
- [ ] I can explain the difference between a unit, an element and a performance criterion.
- [ ] I can name the three units of my course with their hours and credits.
- [ ] I can name the certificates I can earn and explain what RPL is.
- [ ] I can explain the 10:90 and 60/40 rules of assessment.
- [ ] I can turn a mark into a percentage and a competence rating.
- [ ] I can follow the basic rules of professional behaviour in the computer lab.

Practice questions

1. List five tasks that a computer operator in a cyber café does in a normal day.
2. Name four workplaces, other than a cyber café, where a computer operator can be employed, and give one task for each.
3. Explain, using an example, what is meant by an element and a performance criterion.
4. (Oral) Your friend says, "There is no theory in this course, so I will not read." What would you tell her?
5. What is the difference between a Certificate of Competency and the Kenya National TVET Certificate in Computer Operations Level 3?
6. Kiprono has run a typing bureau for five years but has no certificate. Explain how RPL could help him.
7. Unit 2 has 100 hours. How many credits is it worth? How many credits are there in the whole course?
8. Wanjiru scored 255 out of 300 in Unit 1. Work out her percentage and give her rating.
9. A trainee scored 58% in formative assessment and 70% in summative assessment for a unit. Work out the unit score and the rating.
10. (Practical) Prepare your portfolio file with the five sections shown in Practical task 1.1, and show your trainer the lab plan with the exit, extinguisher and first-aid box marked.

CHAPTER 4

Inside the Computer: Input, Output, Storage and Processing Devices

WHAT YOU WILL LEARN

- Group hardware into input, output, storage, processing and communication devices.
- Name, show and explain the functions of common input and output devices, including printers and projectors.
- Explain primary and secondary storage, compare storage devices and work with bits, bytes, KB, MB, GB and TB.
- Identify the main parts inside a system unit on a training rig, safely and under supervision.
- Work out printing costs, storage space and printing time with real figures.

Unit: Basic Computing Concepts · IT/CU/CO/CR/01/3/MA · Learning outcome 2 · About 20 hours

A customer walks into a cyber with a flash disk and asks for ten colour copies of a poster. To serve her you will use a storage device, the computer's processor, a monitor and a printer, all within a few minutes. This chapter takes you round every kind of computer hardware. In the Unit 1 assessment, physically explaining hardware carries more marks than any other single criterion, so learn each device with the device in your hands.

Key words

Peripheral
A device connected to the system unit from outside, such as a printer or mouse.

Input device
Hardware used to put data and commands into a computer.

Output device
Hardware that gives out the results of processing, on screen, on paper or as sound.

Soft copy / hard copy
A soft copy is shown on a screen or kept as a file; a hard copy is printed on paper.

CPU
Central processing unit: the chip that carries out the instructions of programs. The "brain" of the computer.

Motherboard
The main circuit board inside the system unit, which connects all the other parts.

RAM
Random access memory: fast, temporary working memory, emptied when the power goes off.

ROM
Read-only memory: a small chip that keeps start-up instructions even with the power off.

Secondary storage
Devices that keep files permanently, such as hard disks, flash disks and DVDs.

Capacity
How much data a storage device can hold, measured in MB, GB or TB.

Resolution
The number of dots (pixels) a screen shows, or the dots per inch (dpi) a scanner or printer uses.

ppm
Pages per minute: how fast a printer prints.

4.1 Categories of Hardware

Every piece of hardware has a job in the input, process, output and storage cycle you met in Chapter 3. We group hardware by that job (Figure 4.1 and Table 4.1).

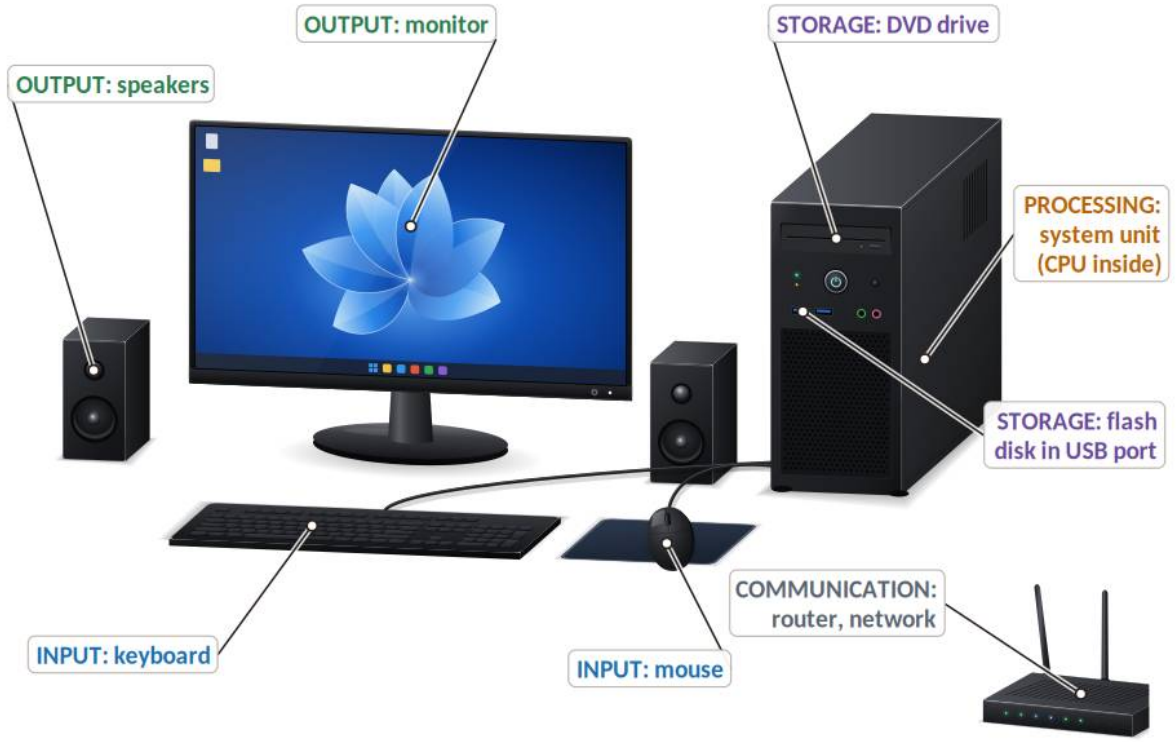


Figure 4.1 A desktop computer system with its devices grouped by category: input (blue), output (green), processing (orange), storage (purple) and communication (grey).

Table 4.1 Categories of hardware

Category	Job	Examples
Input	Put data and commands into the computer	Keyboard, mouse, scanner, webcam, microphone, touchscreen, barcode reader
Output	Give out results as pictures, print or sound	Monitor, printer, projector, speakers, headphones
Storage	Keep data and programs	RAM (temporary); hard disk, SSD, flash disk, CD, DVD, memory card (permanent)
Processing	Work on the data	CPU, with the motherboard and RAM that support it
Communication	Send and receive data between computers	Network card and cable, Wi-Fi adapter, router, modem

Some devices do two jobs: a touchscreen is input and output, and a multifunction printer prints (output) and scans (input).

> **TRAINER'S TIP**
>
> Use the same five-point routine every time you **physically explain** a device to an assessor or a customer: **(1) Name** it. **(2) Category**: input, output, storage, processing or communication. **(3) Function**: what it does, with a work example. **(4) Connection**: the port or wireless link it uses. **(5) Care**: one safety or care point. Example: "This is an optical mouse. It is an input device. It moves the pointer and lets me click, drag and scroll. It connects to a USB port. Keep it on a clean mouse pad so that the sensor works."

4.2 Input Devices

An **input device** lets you put data and commands into the computer. Figure 4.2 shows the input devices you must recognise.



Figure 4.2 Common input devices: keyboard, mouse, flatbed scanner, webcam, microphone, barcode reader, fingerprint reader, and a stylus with a graphics tablet.

4.2.1 Keyboard

The **keyboard** is the main device for typing text and numbers. Most keyboards use the **QWERTY** layout, named after the first six letter keys. A full keyboard has about 104 keys, including function keys (F1 to F12) and a numeric keypad for fast number entry. Keyboards connect by USB cable or wirelessly (a small USB receiver or Bluetooth). Chapter 8 teaches every key group and correct typing.

4.2.2 Mouse and touchpad

The **mouse** controls the pointer on the screen. Its left button selects and opens, the right button shows a shortcut menu, and the scroll wheel moves up and down a page. Most mice today are **optical**: a red or invisible light under the mouse tracks its movement. A laptop has a **touchpad** that does the same work with your finger.

4.2.3 Scanner

A **scanner** copies a paper document or photo into the computer as a picture or a PDF file. On a **flatbed scanner** you lay the page face down on the glass, line it up with the corner mark and close the lid. Multifunction printers and photocopiers in cybers also have an **automatic document feeder (ADF)** on top that pulls in many pages one after another. Scan quality is measured in dots per inch (**dpi**): 200 to 300 dpi is enough for documents uploaded to eCitizen or KUCCPS; photos need more. A cyber charges about KSh 20 per page for scanning.

4.2.4 Webcam and microphone

A **webcam** is a small video camera, built into the top of a laptop screen or clipped onto a monitor. It is used for online meetings and interviews. A **microphone** records sound for calls, recordings and voice typing. Many headsets combine headphones and a microphone. A small light beside the webcam shows when it is on; cover the lens when you are not using it.

4.2.5 Touchscreen and stylus

A **touchscreen** is a screen that senses your finger. It is found on phones, tablets, POS tills, bank ATMs and some laptops. A **stylus** is a pen used to write or draw on a touchscreen or a graphics tablet, useful for signatures and design work.

4.2.6 Barcode readers, card readers and biometric devices

- **Barcode reader**: shines a red light across the black-and-white stripes on a product and sends its code to the POS computer, which looks up the name and price. Used at supermarket tills, pharmacies and libraries.
- **Card reader**: reads bank cards, smart ID cards or memory cards, for example the PIN pad at a till.
- **Biometric reader**: reads a fingerprint or face to confirm who a person is, for registration of persons, SIM registration, banking and staff clock-in.

4.3 Output Devices

An **output device** gives you the results of processing. Output on a screen or played as sound is a **soft copy**; output printed on paper is a **hard copy** (Figure 4.3).



Figure 4.3 Common output devices: monitor, laser printer, inkjet printer, projector, speakers and a headset.

4.3.1 Monitor

The **monitor** (screen) shows text, pictures and video. Modern monitors are flat **LCD** screens lit by **LEDs**, sold as "LED monitors". Three facts describe a monitor:

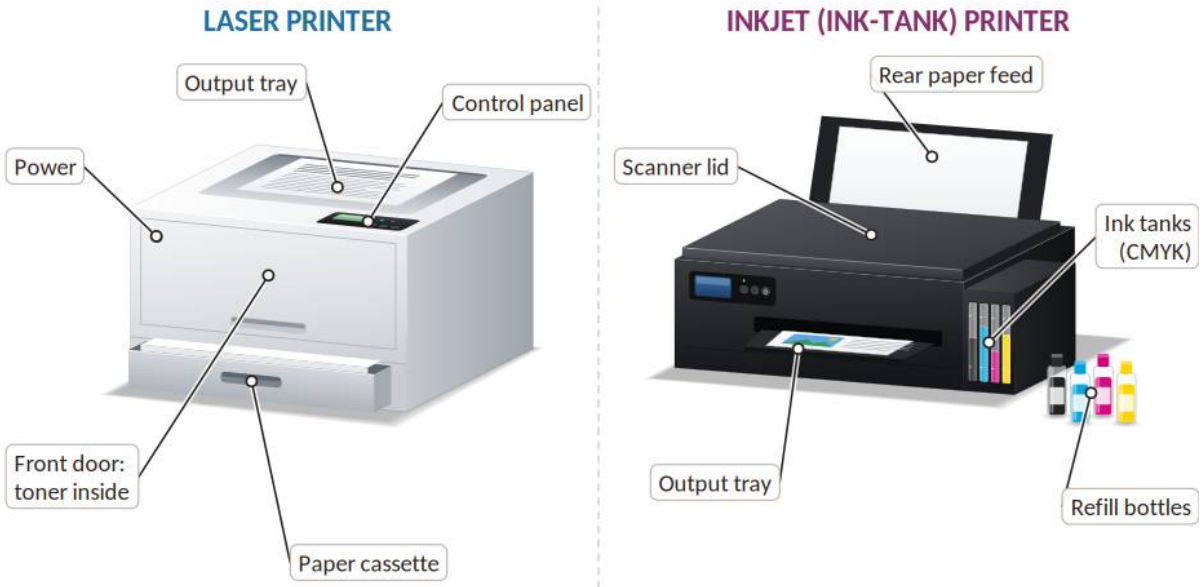
- **Size**: measured diagonally across the screen, in inches. Office monitors are usually 19 to 24 inches. One inch is 2.54 cm, so a 24-inch screen is 24 × 2.54 = about 61 cm from corner to corner.
- **Resolution**: the number of tiny dots (**pixels**) across and down. Full HD is 1920 × 1080 pixels, which is 2,073,600 pixels in total. More pixels give sharper text.
- **Connection**: HDMI, DisplayPort or the older blue VGA plug (see Chapter 5), plus a power cable.

4.3.2 Printers

A **printer** produces hard copies. The two main kinds in offices and cybers are laser and inkjet printers (Figure 4.4).

- **Laser printer**: uses a fine powder called **toner**, which is stuck to the paper by a hot roller (the fuser). It is fast (about 20 to 40 pages per minute), sharp and cheap for black-and-white text. Most cybers use a laser printer or a laser multifunction copier for documents.
- **Inkjet printer**: sprays tiny drops of liquid ink. It prints good colour and photos. **Ink-tank** inkjets, with refillable tanks on the side, are now common in Kenya because the ink bottles are cheap. They are slower (about 8 to 15 pages per minute), and the ink can dry in the nozzles if the printer stands unused for weeks.
- **Dot-matrix printer**: older and noisy; its pins strike an ink ribbon, so it can print multi-part carbon forms.

- **Thermal printer**: prints receipts on heat-sensitive paper at tills and M-Pesa agents. The print fades with time.



How it prints	Toner powder fixed by heat	Tiny drops of liquid ink
Typical speed	About 20–40 pages a minute	About 8–15 pages a minute
Best for	Many black-and-white pages	Colour pages and photos
Supplies	Toner KSh 3,500 (≈ 2,000 pages)	Ink bottle KSh 900 each
Watch out	Hot inside; toner dust	Ink dries if not used

Figure 4.4 A laser printer and an ink-tank inkjet printer, with their main parts labelled and compared.

Printer speed is given in **pages per minute (ppm)**. A 20 ppm printer needs 100 ÷ 20 = 5 minutes for a 100-page job. The other important figure is the **cost per page**, which tells a business owner how much each printed page really costs.

WORKED EXAMPLE 4.1: COST PER PAGE, LASER AND INK-TANK

Prices: laser toner cartridge KSh 3,500 (about 2,000 pages); toner refill KSh 1,200 (about 2,000 pages); a ream of 500 A4 sheets KSh 650; ink-tank black ink bottle KSh 900. **Assumption:** one black bottle prints about 4,000 pages of ordinary text. Makers usually quote between 4,000 and 7,500 pages, depending on the model, so check the figure on the box and redo the sum with it.

1. Paper per sheet: KSh 650 ÷ 500 = KSh 1.30.
2. Laser toner per page (new cartridge): KSh 3,500 ÷ 2,000 = KSh 1.75. Cost per page: 1.75 + 1.30 = **KSh 3.05**.
3. Laser with a refilled cartridge: KSh 1,200 ÷ 2,000 = KSh 0.60. Cost per page: 0.60 + 1.30 = **KSh 1.90**.
4. Ink-tank black ink per page: KSh 900 ÷ 4,000 = KSh 0.225, about KSh 0.23. Cost per page: 0.23 + 1.30 = **about KSh 1.53**.
5. A cyber charges KSh 10 per black-and-white page. With a new toner cartridge the gross profit is 10 − 3.05 = KSh 6.95 per page.

Lesson: the ink-tank is cheapest in supplies, but the laser is two to three times faster, sharper and does not dry out, so busy cybers use lasers for documents and an ink-tank for colour. Notice that paper costs more than toner or ink.

4.3.3 Projector

A **projector** shows the computer screen as a large picture on a wall or white screen, for trainings and meetings. Its brightness is measured in **lumens**; around 3,000 lumens works in a normal classroom. It connects to a laptop by an HDMI or VGA cable, or wirelessly. Chapter 5 shows how to use Windows + P to send the picture to the projector.

4.3.4 Speakers and headphones

Speakers play sound for a whole room. **Headphones** and **headsets** give private sound, which is better in a busy cyber or open office. They plug into the green 3.5 mm audio port or a USB port, or connect by Bluetooth. Keep the volume moderate to protect your hearing.

SAFETY FIRST

The fuser inside a laser printer becomes very hot. When clearing a paper jam, switch the printer off, wait about 10 minutes, then pull the paper out gently in the direction it travels. Do not touch the roller inside. Do not shake or open a toner cartridge: the fine dust irritates the lungs and stains. If toner spills, wipe it with a damp cloth; never blow it or use an ordinary vacuum cleaner. Place printers where air can move freely, away from your face while printing many pages.

4.4 Storage Devices

A computer needs two kinds of storage: fast working memory for what is open now (**primary storage**), and permanent storage that keeps files when the power is off (**secondary storage**). Figure 4.5 shows both kinds with typical capacities.



Figure 4.5 Storage devices with typical capacities (2026). RAM is primary storage; the others are secondary storage that keeps files when the power is off.

4.4.1 Primary storage: RAM and ROM

RAM (random access memory) is the computer's working memory. When you open Word and a letter, both are copied from the disk into RAM so that the CPU can work on them quickly. RAM is fast but **volatile**: everything in it is lost when the power goes off. That is why a power cut can destroy an unsaved letter, and why you should press Ctrl + S often. RAM comes on small boards called modules (sticks) that plug into slots on the motherboard. An office computer usually has 4 to 16 GB of RAM; more RAM lets you keep more programs open without the computer slowing down.

ROM (read-only memory) is a small chip on the motherboard. It keeps the start-up program (the firmware, often called the BIOS or UEFI) that checks the hardware and starts loading Windows. ROM is **non-volatile**: it keeps its contents without power, and you do not normally change it.

4.4.2 Hard disk drive (HDD) and solid-state drive (SSD)

The **hard disk drive (HDD)** is the main permanent store in many desktops. Inside a sealed metal case, shiny platters spin very fast while a tiny head on an arm reads and writes data (Figure 4.6). Hard disks hold a lot for little money, often 500 GB to 2 TB, but the moving parts can be damaged by knocks, especially while the computer is running.



Figure 4.6 A real hard disk opened to show the inside: the mirror-like platter that stores the data, the spindle in the centre and the read/write arm. Hard disks are sealed in a factory; never open a working one.

Photo: Evan-Amos, CC BY-SA 3.0, via Wikimedia Commons

A **solid-state drive (SSD)** does the same job with memory chips and no moving parts. It is much faster: Windows starts in seconds, not minutes. It is also quieter, lighter and survives knocks better, which is why most new laptops use an SSD. A 2.5-inch SSD looks like a small flat box; an **M.2** SSD is a small card that plugs straight into the motherboard. An SSD costs more per GB than an HDD.

4.4.3 Removable and portable storage

- **Flash disk** (USB flash drive or "flash"): a small stick with memory chips and a USB plug. It is the everyday way customers bring documents to a cyber. Common sizes are 8 GB to 256 GB; a 32 GB flash costs about KSh 700 and a 64 GB flash about KSh 1,000.
- **Memory cards**: SD cards for cameras and microSD cards for phones, usually 8 GB to 256 GB. A card reader or adapter lets the computer read them.
- **CD** (compact disc): an optical disc that holds about 700 MB. A laser in the DVD drive reads it.
- **DVD**: looks like a CD but holds about 4.7 GB, enough for a film or many photos. Blank DVDs cost about KSh 50, and a cyber charges about KSh 100 to burn one. Many new computers have no DVD drive, so CDs and DVDs are now used less.
- **External hard disk**: a hard disk in a small case with a USB cable, usually 1 to 2 TB, about KSh 6,500 for 1 TB. Used for backups of a whole computer.
- **Cloud storage**: space on internet servers, such as OneDrive or Google Drive. Files can be opened from any computer after you sign in, and survive if your computer is stolen. It needs an internet connection.

SAFETY FIRST

Before removing a flash disk, close the files on it, then select the **Safely Remove Hardware and Eject Media** icon in the notification area (it may be hidden under the ^ arrow) and choose the flash disk (or right-click the drive in File Explorer and choose **Eject**). Wait for the message that it is safe to remove. Pulling it out while files are being written can corrupt them. Scan every customer's flash disk with antivirus before opening any file, and never open unknown files ending in .exe.

4.5 Measuring Storage: Bits to Terabytes

Computers store everything, letters, photos, songs, as numbers made of only two digits, 0 and 1. One 0 or 1 is a **bit** (binary digit). Eight bits make one **byte**, which is enough to store one letter such as "A". Bigger units go up in steps of 1,024 (Figure 4.7), because computers count in twos: 2 × 2 × 2 × 2 × 2 × 2 × 2 × 2 × 2 × 2 = 1,024.

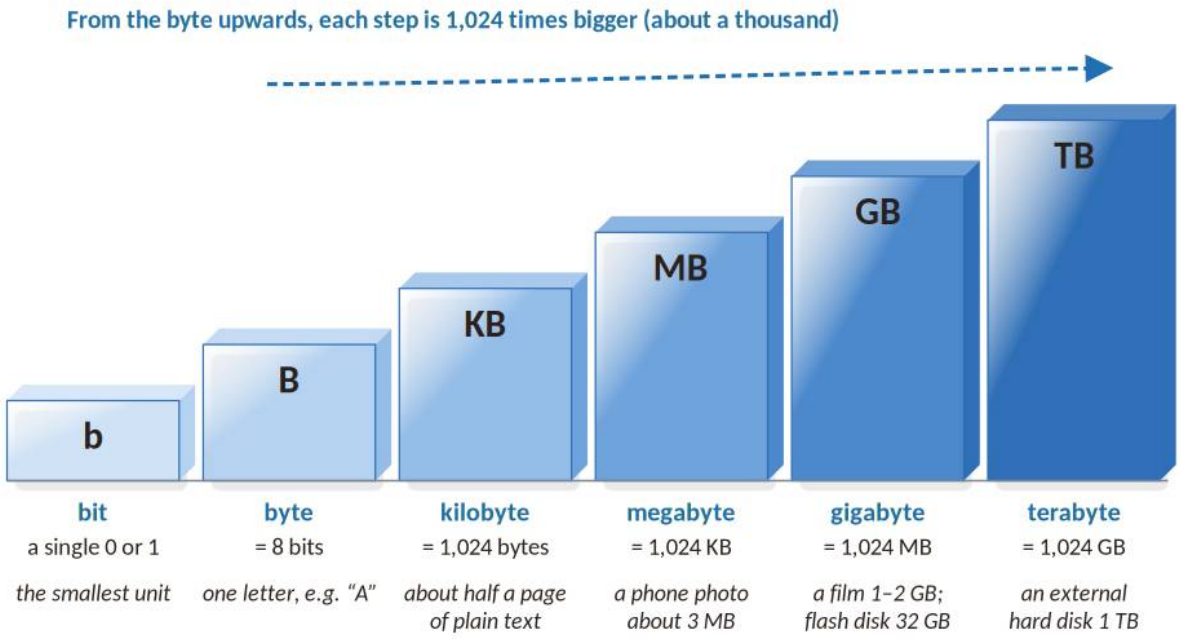


Figure 4.7 Storage units from the bit to the terabyte, with everyday examples. From the byte upwards, each unit is 1,024 times the one before.

Table 4.2 Storage units

Unit	Short form	Equal to	Example
Bit	b	0 or 1	One on/off signal
Byte	B	8 bits	One character, e.g. "K"
Kilobyte	KB	1,024 bytes	A short typed letter in Notepad: 2–3 KB
Megabyte	MB	1,024 KB	A phone photo: about 3 MB; a song: about 4 MB
Gigabyte	GB	1,024 MB	A film: 1–2 GB; RAM: 8 GB; flash disk: 32 GB
Terabyte	TB	1,024 GB	An external hard disk: 1 TB

To change a bigger unit into a smaller one, **multiply** by 1,024. To change a smaller unit into a bigger one, **divide** by 1,024. For example, 2 MB = 2 × 1,024 = 2,048 KB, and 1.5 GB = 1.5 × 1,024 = 1,536 MB.

> **WORKED EXAMPLE 4.2: PHOTOS ON A 32 GB FLASH DISK**
>
> A customer wants to copy phone photos of about 3 MB each onto a new 32 GB flash disk. How many photos fit?
>
> 1. Change GB to MB: 32 GB × 1,024 = 32,768 MB.
> 2. Divide by the size of one photo: 32,768 MB ÷ 3 MB = 10,922.67.
> 3. You cannot store part of a photo, so round down: about **10,922 photos**.
>
> **In practice, fewer.** Makers count 1 GB as 1,000,000,000 bytes, so Windows shows a "32 GB" flash disk as only about 29.8 GB. That gives 29.8 × 1,024 ÷ 3 = about 10,170 photos, so say "about 10,000" to the customer.

Internet speeds are given in **bits** per second (10 Mbps = 10 megabits per second), but file sizes are in **bytes**: 8 Mb is only 1 MB.

4.6 Processing: Inside the System Unit

The **system unit** (case or tower) holds the parts that process and store data. At Level 3 you do not repair these parts, but you must be able to **identify** them on a training rig, under your trainer's supervision, with the power cable removed (Figures 4.8 and 4.9).

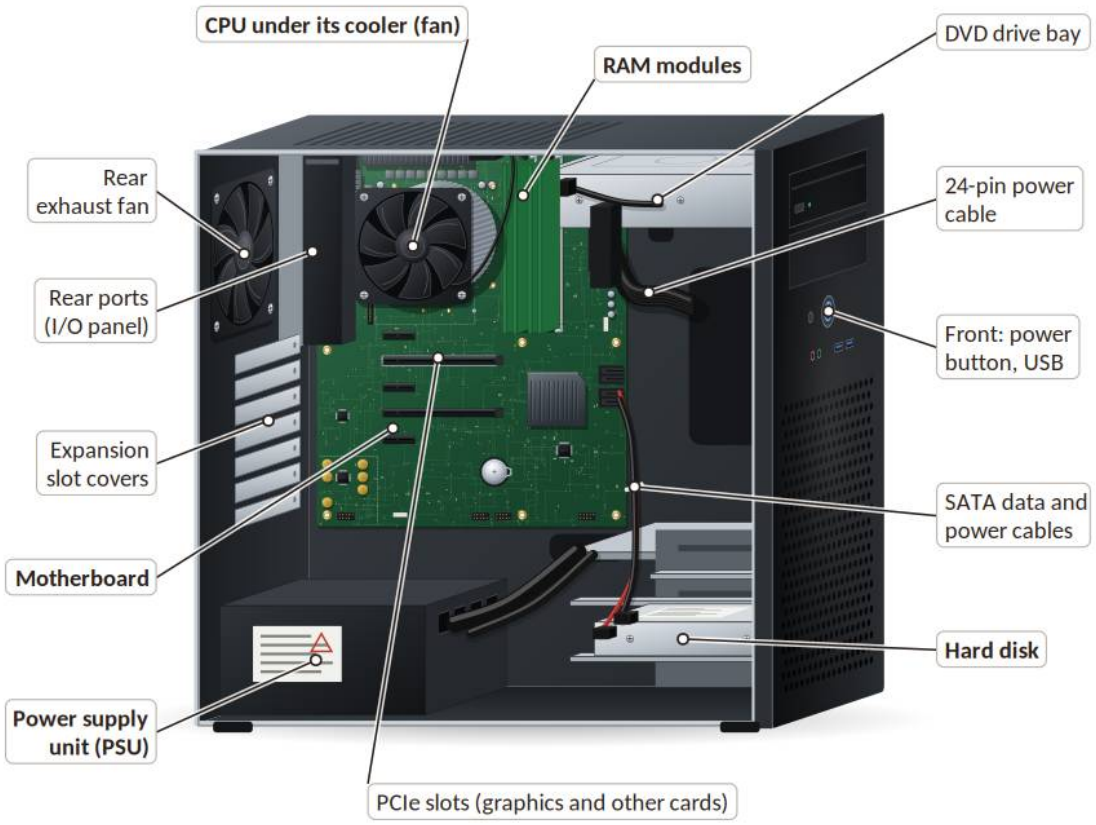


Figure 4.8 Inside a desktop system unit with the side panel removed. The front of the case is on the right; the rear ports and power supply are on the left.

- **Motherboard**: the large main circuit board. Every other part plugs into it or connects to it by cable. It carries the CPU socket, RAM slots, expansion slots, the ROM chip, a small round CMOS battery that keeps the clock running, and the ports at the back.
- **CPU (central processing unit)** or **processor**: the chip that carries out program instructions and does all calculations. Its speed is measured in gigahertz (GHz), and modern CPUs have several **cores** that work at the same time. The CPU gets hot, so it sits under a metal **heat sink** and a **fan** (the cooler). In Settings > System > About you can read the name of the processor.
- **RAM modules**: the long thin boards standing in slots beside the CPU.
- **Power supply unit (PSU)**: the metal box at the bottom or top rear. It changes the 240 V mains electricity into the low voltages the parts need. It contains dangerous voltages even after it is unplugged: never open a PSU.
- **Hard disk or SSD**: in a drive bay at the front, connected by a thin **SATA** data cable and a power cable (or an M.2 SSD directly on the motherboard).
- **Optical (DVD) drive**: in the wide bay at the top front, if fitted.
- **Expansion slots**: long slots on the motherboard (PCIe) for extra cards such as a graphics card for design work or a Wi-Fi card. Unused slots are closed at the back by metal covers.
- **Fans, vents and front panel**: fans move cool air through the case; the front panel has the power button, USB ports and audio jacks.



Figure 4.9 Inside a real desktop computer. Find the power supply (top left), the CPU cooler with its round fan, two RAM modules to its right, a graphics card below, coloured SATA cables and a hard disk in the drive cage (right).

Photo: Tobias "ToMar" Maier, CC BY-SA 3.0, via Wikimedia Commons

The system unit also has **communication** hardware. A **network interface card** (usually built into the motherboard) connects to an Ethernet cable; a **Wi-Fi adapter** connects without wires. A **router** outside the computer links all the office computers to each other and to the internet.

SAFETY FIRST

Opening a system unit is a trainer-supervised activity on a training rig only. Before the side panel comes off: shut down Windows, switch off at the wall and **remove the power cable**. Wear an **anti-static (ESD) wrist strap** clipped to bare metal on the case, because a small spark of static electricity from your body, too small to feel, can destroy RAM or a CPU. Hold parts by their edges, never touch the gold contacts or chips, and work on a dry, clean bench. Never open the power supply unit.

GREEN TIP

Use print preview and print on both sides (duplex) to halve the paper used; print drafts in draft mode on re-used paper. Refill toner cartridges at a reputable dealer and return empties for recycling. A slow computer can often be saved by adding RAM or replacing the HDD with an SSD, instead of buying a new one. Old printers, monitors and system units go to a NEMA-licensed e-waste collector.

IN THE KENYAN WORKPLACE

At a Huduma Centre an officer uses a fingerprint reader, a webcam, a scanner and a laser printer. A supermarket till combines a touchscreen, barcode reader, card reader, thermal printer and cash drawer. A busy cyber relies on a multifunction laser copier for printing, copying and scanning. The operator who can explain every device to a customer in simple words is trusted and valued.

INCLUDING EVERYONE

Some hardware is made for persons with disabilities. Input: large-key and high-contrast keyboards, trackballs and head or mouth pointers for users with limited hand movement, and speech recognition (Windows voice typing with Windows + H). Output: screen readers such as NVDA, JAWS or Narrator speak the screen through speakers or headphones; a **refreshable braille display** shows text as raised dots; a **braille embosser** prints braille on paper; a large monitor with Magnifier helps users with low vision. Captions on videos help Deaf users. When you set up a workstation, ask the user what works for them.

COMMON MISTAKES

- Calling RAM "storage space". RAM is working memory; files are kept on the hard disk or SSD.
- Pulling out a flash disk without ejecting it, and corrupting the customer's files.
- Mixing up bits and bytes: a 10 Mbps connection does not download 10 MB every second.
- Opening the system unit with the power cable still connected, or without an anti-static strap.
- Pricing printing only by the cost of toner and forgetting the paper.

Practical task 4.1: Physically explain input, output and storage devices

Tools and equipment

- A desktop workstation with keyboard, mouse, monitor and speakers or headset
- Printer (laser or inkjet), scanner or multifunction printer
- Flash disk, DVD, memory card, external hard disk (if available)

Materials

- Device record sheet with columns: Name, Category, Function, Connection, Care point
- Pen

Steps

1. Lay out the devices on a clean, dry table. Do not connect anything yet.
2. Pick up each device in turn. Fill in one row of the record sheet using the five-point routine: name, category, function, connection, care.
3. Find the label on each device and copy one specification (for example "Capacity 32 GB" on the flash disk, "Input 220–240 V" on the printer).
4. With your trainer as the "customer", explain any five devices aloud, holding each one up as you speak.

5. Insert the flash disk into a USB port. Open **File Explorer > This PC** and read its total size and free space. Scan it for viruses: right-click the drive and select **Scan with Microsoft Defender** (if you do not see it, select **Show more options** first).
6. Eject the flash disk safely and wait for the "safe to remove" message before pulling it out.
7. Return all devices neatly and coil any cables loosely.

Safety

- Hold the flash disk and DVD by the edges; do not touch the shiny side of the disc.
- Keep hands dry and liquids away from all devices.
- Do not drop the external hard disk: it has moving parts.

Practical task 4.2: Identify the parts inside a system unit (training rig)

Tools and equipment

- Training rig system unit with the side panel already opened by the trainer
- Anti-static (ESD) wrist strap
- Torch
- Sample parts: RAM module, old hard disk, CPU (in a protective box)

Materials

- Printed copy of Figure 4.8 with the labels covered
- Sticky labels and pen

Steps

1. Confirm with the trainer that the rig is switched off at the wall and the power cable is **removed** from the back.
2. Put on the ESD wrist strap and clip it to a bare metal part of the case, as the trainer shows you.
3. Without touching anything, use the torch to find and point to: the power supply unit, motherboard, CPU cooler, RAM modules, hard disk or SSD, DVD drive (if fitted), expansion slots, SATA cables and case fans.
4. Write the name of each part on your covered copy of Figure 4.8.
5. Pick up the sample RAM module by its short edges. Show the trainer the notch in the gold contacts and explain what RAM does.
6. Pick up the sample hard disk and explain the difference between an HDD and an SSD.
7. Remove the wrist strap only after you have finished handling parts. The trainer closes the case.

Safety

- Never open a system unit by yourself or while it is connected to power.
- Never open the power supply unit, even when unplugged.
- Avoid touching chips and gold contacts; hold parts by the edges.

Chapter summary

- Hardware is grouped by job: input, output, storage, processing and communication. Some devices do two jobs.
- Input devices include the keyboard, mouse, scanner, webcam, microphone, touchscreen, stylus, barcode, card and fingerprint readers.
- Output devices include the monitor (size in inches, resolution in pixels), printers (laser, inkjet, dot-matrix, thermal), projectors, speakers and headphones.
- Laser printers are fast and sharp for text; ink-tank inkjets are good for colour and cheap in ink but slower. Work out cost per page including paper.
- RAM is fast, temporary working memory; ROM keeps start-up instructions; secondary storage (HDD, SSD, flash, memory cards, CD, DVD, external disks, cloud) keeps files permanently.
- Storage is measured in bits and bytes; from the byte upwards each unit (KB, MB, GB, TB) is 1,024 times the one before.
- Inside the system unit are the motherboard, CPU and cooler, RAM, power supply, drives, expansion slots and fans. Identify them only on a training rig, unplugged and with an ESD strap.

Check your competence

- [ ] I can sort a set of devices into input, output, storage, processing and communication.
- [ ] I can hold up a device and explain its name, category, function, connection and one care point.
- [ ] I can explain the functions of the keyboard, mouse and scanner and of other input devices used at work.
- [ ] I can explain the functions of the monitor, printer and projector and compare laser and inkjet printers.
- [ ] I can explain the functions of the hard disk, CD, DVD and flash disk, and the difference between RAM and storage.
- [ ] I can convert between KB, MB, GB and TB and work out how many files fit on a device.
- [ ] I can identify the main parts inside a system unit on a training rig while following safety rules.
- [ ] I can eject a flash disk safely and scan it for viruses.

Practice questions

1. Name the five categories of hardware and give two examples of each.
2. Explain the function of each of these input devices: scanner, barcode reader, fingerprint reader, webcam.
3. Distinguish between a soft copy and a hard copy, and name the device that produces each.
4. Give three differences between a laser printer and an ink-tank inkjet printer.
5. Explain the difference between RAM and a hard disk. Why can a power cut destroy an unsaved document?
6. Calculation: Convert (a) 3 GB to MB, (b) 5,120 KB to MB, (c) 2 TB to GB.
7. Calculation: How many songs of 4 MB each can be stored on a 64 GB flash disk? (Use 1 GB = 1,024 MB.)

8. Calculation: A cyber prints a 60-page report for a customer on a laser printer. Using a cost per page of KSh 3.05 and a charge of KSh 10 per page, find (a) the cost to the cyber, (b) the amount charged and (c) the profit. If the printer prints 20 pages per minute, how long does the job take?
9. Oral: Your trainer shows you the inside of a training rig. Point to and explain the job of the CPU, RAM, power supply unit and hard disk, and state two safety rules for this activity.
10. Practical: Using File Explorer, find the total size and free space of drive C: and of a flash disk, then eject the flash disk safely. Record each step.

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This free sample has the front matter, Chapter 1 and the full Chapter 4. The complete guide has **17 chapters** and **317 pages**. It covers all three units (Basic Computing Concepts, Basic Computer Skills and Computer-Based Communication), with full chapters on Windows, files and folders, Microsoft Word, Microsoft Excel, the Internet, email and online safety.

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