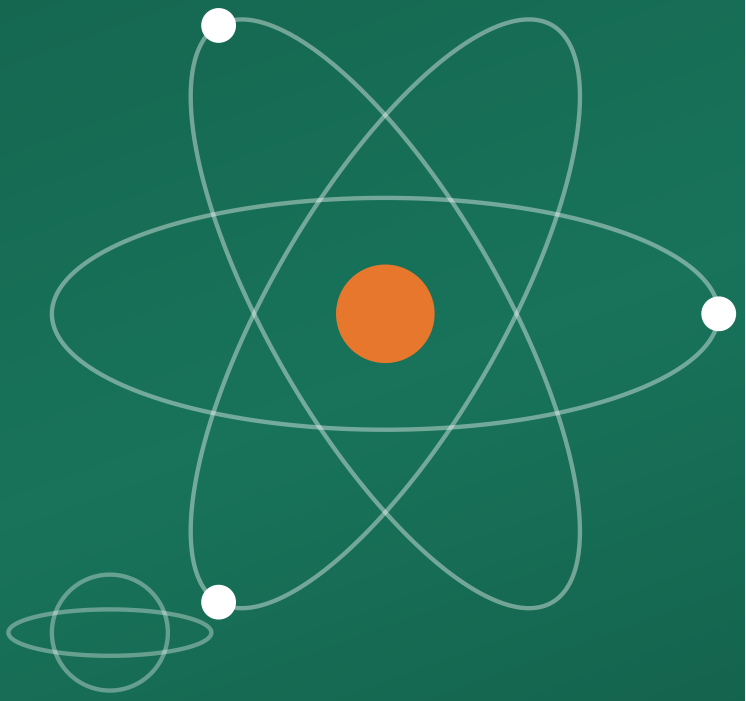
EXAM READY GENERAL SCIENCE

Exam Ready General Science

GRADE 8

Study Guide, Worked Examples and Practice Tests for the Grade 8 Examination



- ✓ **7 units** with clear key ideas, diagrams and “Watch out!” boxes
- ✓ **76 worked examples** and **170+ practice questions** at three levels
- ✓ **140 unit-quiz questions** and **3 full mock exams** (60 MCQ each)
- ✓ Diagnostic test · Key Facts Sheet · Top 20 Mistakes · teacher notes

Follows the units and order of the Addis Ababa Grade 8 General Science textbook

ERMIAS WEDAJE TEGBARU

Exam Ready General Science

Grade 8

Study Guide, Worked Examples and Practice Tests

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This is an independent study guide. It follows the Grade 8 General Science curriculum used in Addis Ababa, but it is not an official publication of the Addis Ababa City Administration Education Bureau or the Ministry of Education. All explanations, examples and questions are original.

Every answer in this book was checked by computer. If you find a mistake, please tell the author on Telegram (@Ermias_Wedaje) so it can be corrected in the next edition.

First edition, 2026.

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How to Use This Book

Each unit follows the same pattern, so you always know where to look. Each unit opens with a **How this unit is examined** box, and examples marked **Exam Booster** cover question types that appear often in recent model examinations.

Key ideas
The rules and facts of the section, short and clear.

Worked examples
Step-by-step solutions. Cover the solution and try first.

Watch out!
The mistakes students make most often, and the right way.

Practice
Level 1 Basic · Level 2 Standard · Level 3 Challenge.

Exam-style quiz
20 multiple-choice questions in the style of the Grade 8 examination.

For the Teacher
Timing, starters, misconceptions, activities and assessment.

For students

- Begin with the **Diagnostic Test** on page 1. It shows which units need the most work.
- Read the key ideas, then study each example with the solution covered.
- Do Level 1 and Level 2 practice for every section; try Level 3 when you are ready.
- Take the quiz in 30 minutes, mark it with the answers at the end of the unit, and redo every question you got wrong.
- In the final weeks, learn the Key Facts Sheet and the Top 20 Mistakes page, and sit the three mock exams (60 questions, one hour) each. The mock answer keys show which unit each question comes from, so you know what to revise.

For teachers

- Each unit follows the textbook sections, so the book can be used alongside your lessons.
- The “For the Teacher” page gives a suggested number of periods, five-minute starters, common misconceptions with fixes, and ideas for activities and differentiation.
- The quizzes and mock exams can be used as class tests; the answer tables include a short reason for each answer.

For parents

- Ask your child to explain one worked example to you each day. Teaching is the best way to learn.
- Check the quiz score after each unit and celebrate progress, not only high marks.

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Diagnostic Test · Where Should I Start?

14 questions · 15 minutes. Take this test **before** you start the book. There are two questions on each unit. Your score only shows you where to spend your time.

1. The SI unit of mass is the
   A. gram **B.** newton **C.** pound **D.** kilogram

2. A stone of mass 30 g has a volume of 10 cm^3. Its density is
   A. 0.3 g/cm^3 **B.** 40 g/cm^3 **C.** 300 g/cm^3 **D.** 3 g/cm^3

3. The atomic number of an element is the number of
   A. shells **B.** protons **C.** electrons and neutrons **D.** neutrons

4. How many neutrons are in $^{16}_{8}O$?
   A. 24 **B.** 0 **C.** 16 **D.** 8

5. The general formula of the alkenes is
   A. C_nH_{2n-2} **B.** C_nH_{2n} **C.** C_nH_n **D.** C_nH_{2n+2}

6. Acids turn blue litmus paper
   A. red **B.** blue **C.** green **D.** yellow

7. Which part of the blood fights germs?
   A. white blood cells **B.** platelets **C.** plasma **D.** red blood cells

8. The longest bone in the body is the
   A. femur **B.** tibia **C.** radius **D.** humerus

9. Decomposers are
   A. producers **B.** heterotrophs **C.** plants **D.** autotrophs

10. Building flat steps on a hillside to prevent erosion is
    A. terracing **B.** overgrazing **C.** irrigation **D.** deforestation

11. The planet known as the red planet is
    A. Jupiter **B.** Venus **C.** Mars **D.** Mercury

12. The Earth revolves once around the Sun in about
    A. 30 days **B.** 24 hours **C.** 365¼ days **D.** 7 days

13. Sound cannot travel through
    A. air **B.** steel **C.** a vacuum **D.** water

14. Heat from the Sun reaches the Earth by
    A. reflection **B.** radiation **C.** conduction **D.** convection

Answers and Study Plan

Q	Unit	Ans	Why
1	1	D	kg
2	1	D	density = mass ÷ volume = 30 g ÷ 10 cm^3 = 3 g/cm^3
3	2	B	Z = protons
4	2	D	neutrons = A − Z = 16 − 8 = 8
5	3	B	Double bond
6	3	A	Blue → red
7	4	A	White blood cells
8	4	A	Femur
9	5	B	Feed on dead matter
10	5	A	Terracing
11	6	C	Iron oxide dust
12	6	C	One year
13	7	C	Needs a medium
14	7	B	No medium needed

How to use your result

- **Both questions right in a unit:** read the Watch out! boxes, then go straight to the Level 2 and 3 practice and the quiz.
- **One right:** work through the unit normally, from the key ideas.
- **None right:** start with that unit, slowly, and try every worked example yourself before reading the solution.
- Take the test again when you finish the book and compare your scores.

Unit 1 · Basics of Scientific Investigation

By the end of this unit you will be able to:

- name the seven SI base units and give examples of derived units
- convert between units using prefixes such as kilo, centi, milli and micro
- choose the right instrument and read it correctly
- calculate volume, density and average values from measurements
- describe the steps of a scientific investigation
- identify independent, dependent and controlled variables and plan a fair test
- record and present data in tables and graphs, and work safely with others

Before you start — check yourself. (a) 1 m = ☐ cm (b) 1 kg = ☐ g (c) 2.5 × 1000 (d) Is "the sky is blue" an observation or a guess?
Answers: (a) 100 (b) 1000 (c) 2500 (d) an observation

Key words: physical quantity · SI unit · base unit · derived unit · prefix · mass · volume · density · meniscus · parallax · hypothesis · variable · fair test · data · conclusion

How this unit is examined

Question types that appear again and again in Addis Ababa model examinations:

- Traditional units (feresula, weqet, tassa, kubaya, cubit) and why they are not standard
- Matching quantities with SI units; base or derived quantities
- Prefixes and conversions: mg ↔ g, km ↔ m, hours ↔ seconds, quintals and tonnes
- Accuracy and precision; instruments; the steps of the scientific method

1.1 Scientific Measurements

Key ideas

- A **physical quantity** is anything that can be measured. Every measurement has a **number** and a **unit**: 5 kg, 12 s, 3.2 m.
- Scientists everywhere use the **SI system** (International System of Units).

- There are **seven SI base units**:

Quantity	SI unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Temperature	kelvin	K
Electric current	ampere	A
Amount of substance	mole	mol
Luminous intensity	candela	cd

- **Derived units** are made by combining base units: area (m^2), volume (m^3), speed (m/s), density (kg/m^3), force (newton, N).
- **Prefixes** make units bigger or smaller:

Prefix	Symbol	Meaning
mega	M	$\times 1\,000\,000$
kilo	k	$\times 1000$
centi	c	$\div 100$ ($\times 0.01$)
milli	m	$\div 1000$ ($\times 0.001$)
micro	μ	$\div 1\,000\,000$

Example 1.1 — Base or derived?

Classify each unit as base or derived: (a) kilogram (b) m/s (c) kelvin (d) m^3 (e) newton

Solution. Base: (a) kilogram, (c) kelvin. Derived: (b) m/s (length ÷ time), (d) m^3 (length × length × length), (e) newton (from kg, m and s).

Example 1.2 — Converting units

Convert (a) 3.5 km to m (b) 250 g to kg (c) 45 mm to cm (d) 2 hours to seconds

Solution.
(a) $3.5 \times 1000 = 3500$ m
(b) $250 \div 1000 = 0.25$ kg
(c) 10 mm $= 1$ cm, so $45 \div 10 = 4.5$ cm
(d) $2 \times 60 \times 60 = 7200$ s

Example 1.3 — Temperature in kelvin

Water boils at 100 °C. A room is at 25 °C. Change both to kelvin.

Solution. $T(\mathrm{K}) = T(^\circ\mathrm{C}) + 273$.
Boiling water: $100 + 273 = 373$ K. Room: $25 + 273 = 298$ K.

Measuring instruments and how to read them

Quantity	Instrument	Reading tip
Length	metre rule, tape measure, vernier caliper	Look straight at the scale
Mass	beam balance, electronic balance	Check it reads zero first
Volume of a liquid	measuring cylinder	Read the **bottom of the meniscus** at eye level
Temperature	thermometer	Wait until the reading stops changing
Time	stopwatch	Start and stop at the exact moment

- **Parallax error:** reading a scale from an angle gives a wrong value. Always keep your eye **level** with the mark.
- **Zero error:** an instrument that does not start at zero gives every reading too high or too low.
- **Repeat** a measurement and take the **average** to make the result more reliable.

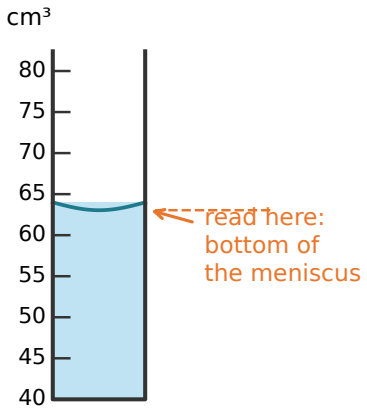


Figure 1.1 — reading a measuring cylinder (reading: 64 cm³)

Example 1.4 — Volume of an irregular solid

A measuring cylinder holds 50 cm³ of water. When a stone is lowered in, the level rises to 68 cm³. Find the volume of the stone.

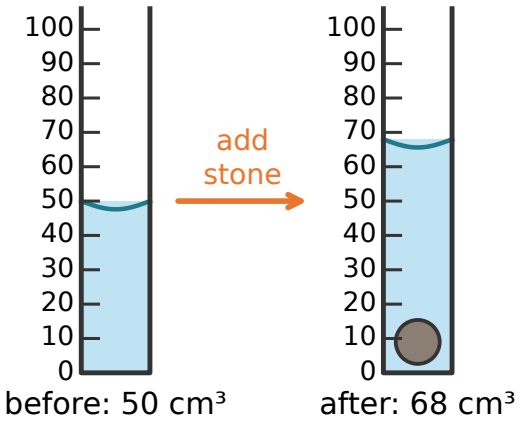


Figure 1.2 — the displacement method

Solution. The stone pushes aside (displaces) its own volume of water:

$$V = 68 - 50 = 18 \text{ cm}^3$$

Density

- **Density** is mass per unit volume:

$$\rho = \frac{m}{V} \qquad \left(\text{density} = \frac{\text{mass}}{\text{volume}}\right)$$

- Units: g/cm³ or kg/m³. 1 g/cm³ = 1000 kg/m³. Water has density 1 g/cm³.
- An object **sinks** in water if its density is more than 1 g/cm³ and **floats** if it is less.
- Useful: 1 cm³ = 1 mL and 1000 cm³ = 1 L.

Example 1.5 — Density of the stone

The stone in Example 1.4 has a mass of 45 g. Find its density. Will it float or sink in water?

Solution.

$$\rho = \frac{45}{18} = 2.5 \text{ g/cm}^3$$

$2.5 > 1$, so the stone **sinks**.

Example 1.6 — Finding mass from density

Cooking oil has a density of 0.9 g/cm³. Find the mass of 500 cm³ of oil. Does oil float on water?

Solution. $m = \rho \times V = 0.9 \times 500 = 450$ g. Its density is less than 1 g/cm³, so oil **floats** on water.

Example 1.7 — Averaging repeated readings

Three students time the same pendulum swing: 1.42 s, 1.38 s and 1.40 s. Find the average.

Solution.

$$\frac{1.42 + 1.38 + 1.40}{3} = \frac{4.20}{3} = 1.40 \text{ s}$$

Exam Booster 1A — Traditional units, accuracy and precision

- **Traditional (indigenous) Ethiopian units** are still used in markets and homes, but they are **not standard**: their size changes from person to person or place to place.

Quantity	Traditional unit	What it is
Length	*kend* (cubit), *sinzir* (span), *ermija* (pace)	elbow to fingertip · spread hand · one step
Mass	*feresula*, *weqet*	a load of about 17 kg (grain, coffee) · a small unit for gold
Volume	*tassa*, *kubaya*, *gan*	a tin cup · a drinking cup · a large clay jar
Time	sundial, shadow length, cock crow	

- Common market units: 1 **quintal** = 100 kg · 1 **tonne** = 1000 kg = 10 quintals.
- **Accuracy** = how close a measurement is to the **true value**. **Precision** = how close repeated measurements are to **each other**.
- Large and small numbers can be written with prefixes: 0.000001 = one **millionth** (micro); 5 000 000 m = 5 **M**m.

Exam Booster 1B — Accurate, precise, both or neither?

A bag of flour has a true mass of 10 kg. Four students weigh it three times each. Describe each set of results.
(a) 10.1, 9.9, 10.0 kg (b) 8.0, 8.1, 8.0 kg (c) 8, 5, 11 kg (d) 9, 11, 10.5 kg

Solution.
(a) close to 10 **and** close together: **accurate and precise**
(b) close together but far from 10: **precise but not accurate**
(c) far from 10 and spread out: **neither accurate nor precise**
(d) average 10.2 kg is close to 10, but the readings are spread out: **accurate (on average) but not precise**

Exam Booster 1C — Market and laboratory conversions

Convert (a) 3.5 quintals to kg (b) 2 tonnes to quintals (c) 525 mg to g (d) 230 km to m

Solution.
(a) $3.5 \times 100 = 350$ kg (b) $2 \times 10 = 20$ quintals (c) $525 \div 1000 = 0.525$ g (d) $230 \times 1000 = 230\,000$ m

Watch out!

✗ Wrong	✓ Right
The SI unit of mass is the gram	It is the **kilogram** (kg)
The SI unit of temperature is °C	It is the **kelvin** (K); °C is in everyday use
Read the top edge of the water in a cylinder	Read the **bottom of the meniscus**, eye level
250 g $= 2.5$ kg	$250 \div 1000 = 0.25$ kg
Density $= V \div m$	Density = **mass ÷ volume**
Precise means correct	Precise = readings agree with **each other**; accurate = close to the **true value**
A *feresula* is an SI unit	Traditional units are **not standard**

Practice 1.1

Level 1 — Basic

1. Write the SI unit and its symbol for: (a) length (b) time (c) electric current (d) temperature
2. Which are derived units? m, m^2, kg, m/s, s, kg/m^3
3. Convert: (a) 2.4 km to m (b) 750 g to kg (c) 3 minutes to seconds (d) 85 cm to m
4. Name the instrument used to measure: (a) the mass of a book (b) the volume of milk (c) body temperature

Level 2 — Standard

5. Change to kelvin: (a) 0 °C (b) 37 °C. Change to °C: (c) 300 K
6. A cylinder holds 40 cm^3 of water. A key is dropped in and the reading becomes 47 cm^3. Find the volume of the key.
7. A block of wood has mass 120 g and volume 200 cm^3. Find its density. Will it float?
8. Explain why you should look at a measuring cylinder with your eye level with the liquid.

Level 3 — Challenge

9. A metal cube has edges of 2 cm and a mass of 72 g. Find its volume and density.
10. A balance shows 0.3 g when nothing is on it. A student then weighs a beaker and reads 55.8 g. What is the true mass? What is this error called?
11. Four readings of a length are 12.4 cm, 12.6 cm, 12.5 cm and 14.9 cm. Which reading is probably a mistake? Find the average of the other three.
12. *Exam Booster.* Name a traditional unit for (a) the volume of milk (b) the mass of grain (c) length. Why are they not used in science?
13. *Exam Booster.* Convert: (a) 4 quintals to kg (b) 1.5 tonnes to quintals (c) 750 mg to g (d) 2.5 hours to seconds
14. *Exam Booster.* A pencil is 15.0 cm long. Readings: 14.2, 14.3, 14.2 cm. Are they accurate, precise, both or neither?

1.2 Doing Scientific Investigation

Key ideas

- A **scientific investigation** is a careful way of answering a question by testing. The usual steps are:

1. **Observe** something and ask a **question**.
2. Do **background research** (what is already known).
3. Make a **hypothesis**: a possible, testable explanation ("If ... then ...").
4. **Plan and do an experiment** (a fair test).
5. **Record** the results in a table.
6. **Analyse** the data (graphs, patterns).
7. Draw a **conclusion**: does the evidence support the hypothesis?
8. **Communicate** the results to others.

- **Variables** are the things that can change in an experiment:
- **Independent variable:** the one **you change** on purpose.
- **Dependent variable:** the one **you measure** (it depends on the change).
- **Controlled variables:** everything you **keep the same**.
- A **fair test** changes **only one** variable at a time.
- An **observation** uses the senses or instruments (what you see, hear, measure). An **inference** is an explanation of an observation.
- **Qualitative** data are descriptions ("the solution turned blue"); **quantitative** data are numbers ("the temperature rose by 8 °C").
- **Graphs:** put the independent variable on the x-axis. Use a **line graph** when both variables are numbers, and a **bar chart** for categories.

Example 1.8 — Identifying the variables

Selam wants to know whether the amount of water affects how tall bean plants grow. She gives four plants 0, 50, 100 and 150 mL of water a day for two weeks and measures their height. Name the independent, dependent and two controlled variables.

Solution.
Independent: the **amount of water** (she changes it).
Dependent: the **height of the plants** (she measures it).
Controlled (any two): type of bean, size of pot, type of soil, amount of light, temperature, number of days.

Example 1.9 — Writing a hypothesis

Write a testable hypothesis for Selam's investigation.

Solution. "**If** a bean plant gets more water (up to 100 mL a day), **then** it will grow taller, because plants need water to make food and grow."

Example 1.10 — Is it a fair test?

Dawit tests which paper towel soaks up the most water. He uses a large piece of brand A and a small piece of brand B. Is this fair? How can he improve it?

Solution. No. He changed **two** things: the brand **and** the size. To make it fair he should use pieces of the **same size**, the same amount of water and the same time, and change only the brand.

Example 1.11 — Reading a graph

Hana heats water and records the temperature every two minutes. Describe the pattern and estimate the temperature at 5 minutes.

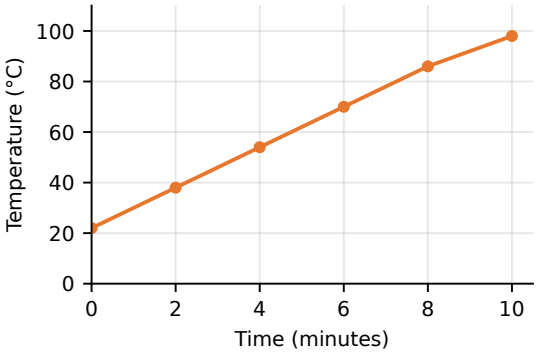


Figure 1.3 — temperature of water while heating

Solution. The temperature rises steadily, by about 8 °C every minute, and the rise slows near 100 °C as the water starts to boil. At 5 minutes it is about halfway between 54 °C and 70 °C: about 62 °C.

Example 1.12 — Observation or inference?

Sort: (a) The leaves are yellow. (b) The plant did not get enough sunlight. (c) The mass of the beaker is 120 g. (d) The milk smells sour, so it has gone bad.

Solution. Observations: (a) and (c). Inferences: (b) and (d), because they explain **why**.

Working safely and together

- Wear **eye protection** when heating or using chemicals; tie back long hair.
- **Never taste** chemicals or eat in the laboratory. Smell gases by **wafting** with your hand.
- Point a heated test tube **away** from yourself and others.
- Report spills, breakages and injuries to the teacher **at once**.
- Know the warning signs: **flammable** (catches fire easily), **corrosive** (burns skin), **toxic** (poisonous).
- In group work, share the jobs (measurer, recorder, timer, reporter), listen to everyone's ideas and record results **honestly**, even when they do not match the prediction.

Watch out!

✗ Wrong	✓ Right
A hypothesis is just a guess	It is a **testable** explanation, often "If … then …"
The independent variable is what you measure	You **change** the independent variable; you **measure** the dependent one
Changing several things at once to save time	A fair test changes **one** variable only
Changing results that "look wrong"	Record honestly; repeat the test if you doubt a result
Smelling a chemical directly	**Waft** the smell towards your nose

Practice 1.2

Level 1 — Basic

1. Put the steps in order: conclusion, hypothesis, experiment, question, analyse data, communicate results.
2. In an experiment, which variable do you (a) change (b) measure (c) keep the same?
3. Give two safety rules for heating a liquid in a test tube.

Level 2 — Standard

4. Abel tests how the height from which a ball is dropped affects how high it bounces. Name the independent, dependent and two controlled variables.
5. Write a hypothesis for Abel's investigation.
6. Is each one qualitative or quantitative? (a) The gas smelled like rotten eggs. (b) The car travelled 60 km in one hour. (c) The solution turned pink.

Level 3 — Challenge

7. Liya says, "Salt water freezes more slowly than tap water." Plan a fair test: state the variables, the equipment and what you will measure.
8. A student's results did not support her hypothesis. Is the experiment a failure? Explain.
9. Should you draw a line graph or a bar chart for (a) the mass of a puppy each week (b) the favourite fruit of students in a class? Explain.

Unit 1 Summary

Topic	Remember
SI base units	m, kg, s, K, A, mol, cd
Derived units	m^2, m^3, m/s, kg/m^3, N
Prefixes	M $= 10^6$ · k $= 1000$ · c $= \frac{1}{100}$ · m $= \frac{1}{1000}$ · μ $= \frac{1}{10^6}$
Temperature	K $=$ °C $+273$
Reading scales	eye level · bottom of meniscus · check zero · repeat and average
Irregular volume	final reading − first reading (displacement)
Density	$\rho = \frac{m}{V}$ · water 1 g/cm^3 · more sinks, less floats
Investigation	question → research → hypothesis → experiment → record → analyse → conclude → communicate
Variables	independent (change) · dependent (measure) · controlled (keep same)
Fair test	change one variable only
Graphs	independent variable on the x-axis · line graph for numbers · bar chart for categories

Unit 1 Exam-Style Quiz

Choose the correct answer. Suggested time: 30 minutes.

1. Which is an SI **base** unit?
   A. litre **B.** newton **C.** gram **D.** kelvin

2. The SI unit of mass is the
   A. pound **B.** kilogram **C.** newton **D.** gram

3. Which unit is a **derived** unit?
   A. metre per second **B.** ampere **C.** second **D.** metre

4. 3.2 km is equal to
   A. 32 m **B.** 0.0032 m **C.** 3200 m **D.** 320 m

5. The prefix "milli" means
   A. $\times 1000$ **B.** $\div 100$ **C.** $\div 1000$ **D.** $\times 1\,000\,000$

6. 27 °C is equal to
   A. 300 K **B.** 273 K **C.** 327 K **D.** 246 K

7. The best instrument for measuring the volume of a liquid is a
   A. metre rule **B.** beam balance **C.** thermometer **D.** measuring cylinder

8. When reading a measuring cylinder, you should read

A. the side of the cylinder **B.** the top of the meniscus from above **C.** any part of the curve **D.** the bottom of the meniscus at eye level

9. A cylinder reads 30 cm^3. After a stone is added it reads 42 cm^3. The volume of the stone is

A. 12 cm^3 **B.** 72 cm^3 **C.** 30 cm^3 **D.** 42 cm^3

10. An object has mass 60 g and volume 20 cm^3. Its density is

A. 1200 g/cm^3 **B.** 40 g/cm^3 **C.** 0.33 g/cm^3 **D.** 3 g/cm^3

11. Which object will **float** in water?

A. density 7.9 g/cm^3 **B.** density 2.7 g/cm^3 **C.** density 0.8 g/cm^3 **D.** density 1.5 g/cm^3

12. Reading a scale from an angle causes

A. zero error **B.** parallax error **C.** a fair test **D.** a hypothesis

13. Three readings are 4.2 s, 4.4 s and 4.3 s. Their average is

A. 4.2 s **B.** 4.4 s **C.** 12.9 s **D.** 4.3 s

14. A testable statement such as "If plants get more light, then they grow faster" is a

A. hypothesis **B.** conclusion **C.** observation **D.** law

15. In an investigation, the variable that you **change** on purpose is the

A. controlled variable **B.** independent variable **C.** result **D.** dependent variable

16. A student tests how temperature affects how fast sugar dissolves. The dependent variable is

A. the temperature of the water **B.** the time for the sugar to dissolve **C.** the type of sugar **D.** the size of the cup

17. A fair test means

A. changing only one variable at a time **B.** doing the test once **C.** changing every variable **D.** guessing the result

18. Which is an **inference**?

A. The water is 40 °C. **B.** The road is wet, so it probably rained. **C.** The stone has a mass of 45 g. **D.** The leaf is green.

19. Which data should be shown as a **bar chart**?

A. height of a plant each day **B.** distance travelled each second **C.** number of students who like each sport **D.** temperature every minute

20. Which is a correct laboratory safety rule?

A. Hide a broken beaker from the teacher **B.** Taste chemicals to identify them **C.** Waft gases towards your nose **D.** Point a heated test tube towards your partner

For the Teacher — Unit 1

Suggested timing (about 10 periods). 1.1: 5 periods (units, instruments, density) · 1.2: 4 periods (investigation, variables, graphs, safety) · Quiz and review: 1 period.

5-minute starters.
- *Guess and measure:* students estimate the length of the desk, the mass of an exercise book and the volume of a water bottle, then measure. Who was closest?
- *Unit race:* call out quantities (time of a football match, mass of a sack of teff, length of a pen); students reply with the best unit.

Common misconceptions and how to fix them.
- **"The SI unit of mass is the gram."** Write the seven base units on a classroom poster and point to "kilogram" whenever mass comes up.
- **Mass and weight are the same.** Mass (kg) is the amount of matter; weight is a force (N). Keep the word "mass" in all measurements.
- **Mixing up independent and dependent variables.** Teach the sentence: "I change the *independent*; the *dependent* depends on it."
- **Thinking a failed prediction means a failed experiment.** Praise honest results that disprove a hypothesis — that is how science moves forward.

Activity ideas.
- *Density of everyday objects:* using a measuring cylinder and a balance, groups find the density of a stone, a piece of wood, a candle and an eraser, then predict and test floating or sinking.
- *Paper helicopter investigation:* groups change one variable (wing length) and measure falling time, record a table, draw a line graph and present their conclusion.

Differentiation. Supported learners: Examples 1.1–1.5, 1.8 and Level 1. Extension: Practice 1.1 Q9–11 and Practice 1.2 Q7, and writing a full investigation report.

Assessment. Quiz questions 1–6 check units and conversions; 7–13 instruments, density and readings; 14–19 investigation skills; 20 safety.

Answers and Worked Solutions — Unit 1

Practice 1.1

1. (a) metre, m (b) second, s (c) ampere, A (d) kelvin, K
2. m^2, m/s and kg/m^3
3. (a) 2400 m (b) 0.75 kg (c) 180 s (d) 0.85 m
4. (a) beam or electronic balance (b) measuring cylinder (c) clinical thermometer
5. (a) 273 K (b) 310 K (c) 27 °C
6. $47 - 40 = 7\ cm^3$
7. $\frac{120}{200} = 0.6\ g/cm^3$; less than 1, so it floats
8. To avoid **parallax error**: reading from above or below gives a wrong value.
9. $V = 2^3 = 8\ cm^3$; $\rho = \frac{72}{8} = 9\ g/cm^3$
10. $55.8 - 0.3 = 55.5$ g; a **zero error**
11. 14.9 cm is far from the others. Average $= \frac{12.4+12.6+12.5}{3} = 12.5$ cm
12. (a) *tassa* or *kubaya* (b) *feresula* (c) *kend* (cubit), *sinzir* (span) or pace. Their size is not the same for everyone, so results cannot be compared.
13. (a) 400 kg (b) 15 quintals (c) 0.75 g (d) 9000 s
14. Close together but about 0.8 cm short: **precise but not accurate** (perhaps a zero error)

Practice 1.2

1. question → hypothesis → experiment → analyse data → conclusion → communicate results (the **last** step)
2. (a) independent (b) dependent (c) controlled
3. Any two: wear eye protection; point the tube away from people; hold it with a test-tube holder; heat gently and move it in the flame.

4. Independent: drop height. Dependent: bounce height. Controlled (any two): the same ball, the same floor, how the ball is released, how the height is measured.
5. "If the ball is dropped from a greater height, then it will bounce higher."
6. (a) qualitative (b) quantitative (c) qualitative
7. Independent: salt in the water (none or a fixed amount). Dependent: time to freeze (or temperature after a fixed time). Controlled: same volume of water, same cups, same freezer, same starting temperature. Equipment: two identical cups, measuring cylinder, salt, balance, thermometer, clock.
8. No. Evidence that does not support the hypothesis is still useful; the hypothesis may need to change, and the test can be repeated to check.
9. (a) line graph — both are numbers that change continuously (b) bar chart — the fruits are categories

Unit 1 Quiz

Q	Ans	Why
1	D	Kelvin is one of the seven base units
2	B	Kilogram
3	A	Length ÷ time
4	C	$\times 1000$
5	C	One thousandth
6	A	$27 + 273$
7	D	Measuring cylinder
8	D	Bottom of meniscus, eye level
9	A	$42 - 30$
10	D	$\frac{60}{20}$
11	C	Less than 1 g/cm³
12	B	Parallax
13	D	$\frac{12.9}{3}$
14	A	Testable "if … then"
15	B	Independent
16	B	What is measured
17	A	One variable at a time
18	B	An explanation of an observation
19	C	Categories
20	C	Wafting is safe

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