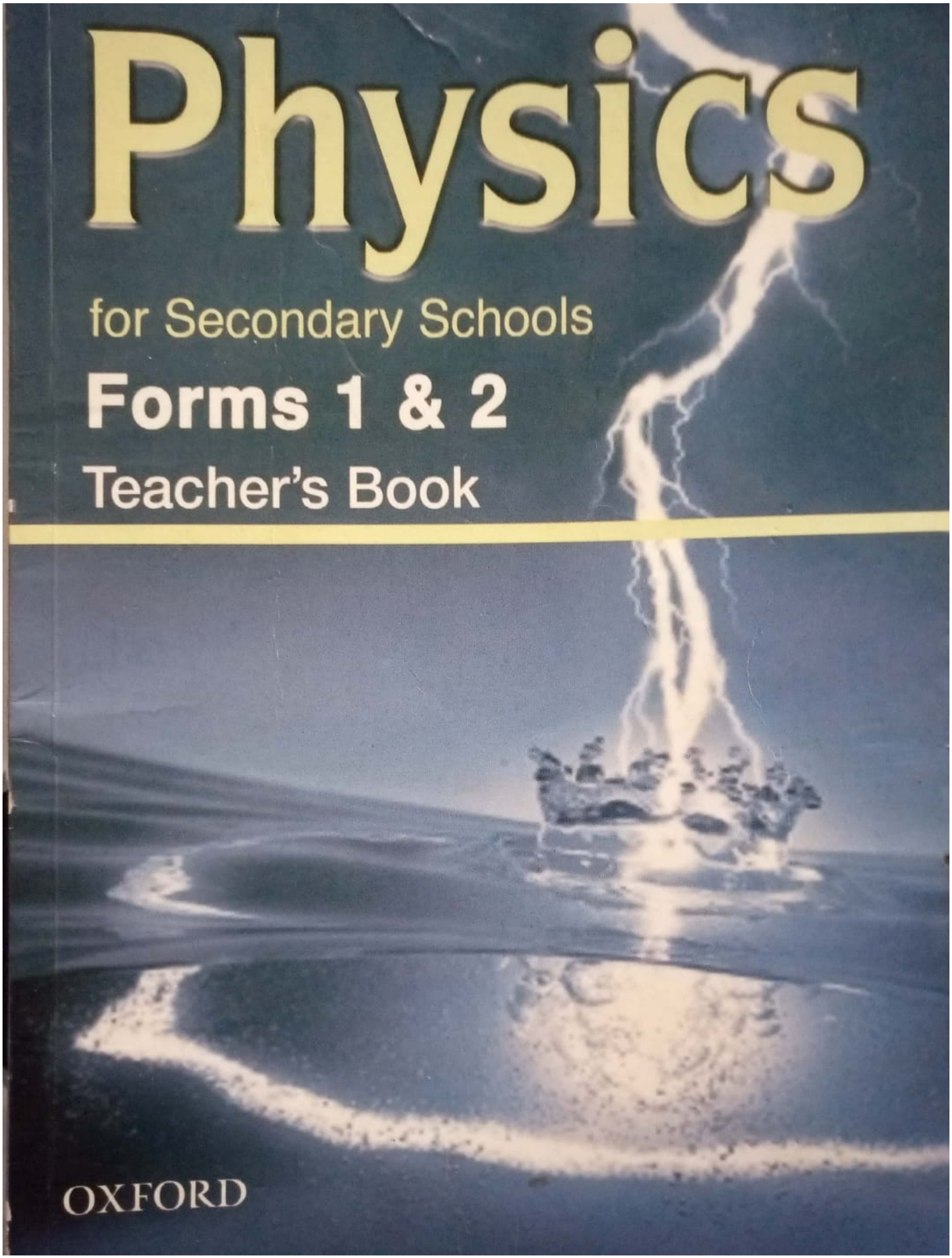
Physics

for Secondary Schools

Forms 1 & 2

Teacher's Book



OXFORD

1 Introduction to Physics

Introduction

This chapter introduces Physics as a subject in secondary schools. It is therefore meant to arouse the interest of the learners in the subject. Revision of topics like *Light, Force* and *Motion* that were covered in primary level will present a very useful background for this subject.

In this chapter, the learners will discover the relationship between Physics and other branches of science and how its study is likely to affect their future careers and lives in general.

Specific objectives

By the end of this chapter, the learner should be able to:

1. explain the concepts of Physics.
2. establish the relationship between Physics and other subjects.
3. explain the applications of Physics in real life.
4. apply Physics in daily life.
5. state the importance of studying Physics.

Key words

Physics, universe, matter, space, time, phenomena, energy, accurate measurement, physicist, observation, record of result, technologist, chemistry, biology, natural science, space, mathematics, astronomy, geography.

Concepts to be covered

(i) Concepts of Physics

- Concepts of Physics
- Relationship between Physics and other subjects

(ii) Application of Physics in real life

- Importance of Physics in real life

Skill

Demonstrating the application of Physics by way of an activity.

Answers to Review exercise

1. (i) C (ii) C (iii) D

2. (a) Matter is any substance which has mass and occupies space.

   (b) A Physicist is a person who studies and/or works in the field of Physics.

3. - Physics enables different people to acquire skills that are required in different professions such as engineering, architecture and teaching.
   - Imparts knowledge that is necessary in the design and manufacture of dry cells, simple and complicated machines like pulleys and mobile phones respectively.

   (Any other relevant answer.)

4. *At home:* Drawing water from a borehole.
   In the medical field: Ultrasound machine.
   In transport: An aeroplane.
   In communication: The telephone.

5. (a) True (b) False (c) True

6. (a) Physics is the study of the relationship between matter and energy.

   (b) Physics concepts are expressed in Mathematical language or Mathematics aids in the teaching and learning of Physics.

7. (a) (i) Aeroplane (ii) Train
   (iii) Ship (iv) Car

   (b) (i) E-mail (ii) Short text messages (sms)
   (iii) Fax (iv) Write a letter

8.

Item A	Item B
(a)	(iv)
(b)	(ii)
(c)	(i)
(d)	(iii)

2 Introduction to laboratory practice

Introduction

The meaning of a laboratory and its use should be made clear to the learners. Since this is the first time they shall encounter a laboratory in their learning situation, they should be made aware of the rules and safety precautions in a Physics laboratory. Let the students feel comfortable while using the laboratory. Emphasise the need for all experiments to be done in the laboratory and ensure that they know the laboratory apparatuses by name.

Note that the Scientific Investigation method forms the foundation block for experimental Physics and other subjects that require research. Ensure that the learners are able to represent data collected in various ways and most importantly on graphs.

Specific Objectives

By the end of this chapter, the learner should be able to:

1. state the rules in a Physics laboratory.
2. explain the safety measures in a Physics laboratory.
3. use the First Aid kit to render First Aid.
4. identify warning signs and how to use them.
5. describe basic laboratory apparatus and their uses.
6. explain the concept of a Scientific Investigation.
7. identify the steps of a Scientific Investigation.
8. use the Scientific Investigation methods in solving problems.

Key words

Laboratory, experiment, apparatus, research, first aid, first aid kit, warning signs, scientific method, evidence.

Answers to Review exercise

1. (a) *A Physics laboratory* is a special room that has been designed and equipped for carrying out experiments for the purposes of study and research.

   (b) Laboratory rules include:

   (i) Do not enter the Physics laboratory without the permission of the teacher or laboratory assistant.

   (ii) Do not do any experiment unless the teacher permits you to do so.

   (iii) Do not start an experiment before you get information about the proper procedure to be followed.

   (iv) Follow instructions carefully to avoid damaging the apparatus or getting wrong results in all experiments.

   (v) Handle all the apparatus with care to avoid damage.

   (vi) Avoid running, screaming or playing in the laboratory.

   (vii) Avoid tasting, eating or drinking anything in the laboratory.

(viii) Do not touch any electrical equipment with wet hands.

(ix) Never attempt to blow out a fire, even a small one.

(x) Wash your hands with water and soap after performing an experiment.

(Any other rules as specified in the Student's Book, page 12.)

(c) *First Aid* is the immediate assistance or care given to a sick or injured person before getting professional medical help.

(d) Five items found in the First Aid kit are:

(i) Painkillers – relieve pain

(ii) Sterile gauze – covers wounds to protect them from dirt and germs

(iii) Scissors and razor blade – cutting dressing materials

(iv) Adhesive bandage – covering minor wounds

(v) Antiseptic solution – cleans fresh cuts and bruises

(e) It is necessary to wear gloves when giving First Aid to a bleeding person because it prevents direct contact with the victim's blood.

2. (a) You should not carry out an experiment if there is no teacher or technician in the laboratory.

(b) Clean the working areas before leaving the laboratory.

(c) Wash your hands using soap and clean water, put on gloves, wash the cut using salt water and a clean cloth and finally cover the cut with an adhesive bandage or plaster.

(d) Burn waste paper away from buildings.

(e) Report all accidents and injuries to the teacher.

(f) Avoid tasting, eating or drinking anything in the laboratory.

(g) Avoid handling apparatus and chemicals in the laboratory until you are asked to do so by the teacher. Also all experiments should be carried out in the laboratory.

(h) Do not touch any electrical equipment with wet hands.

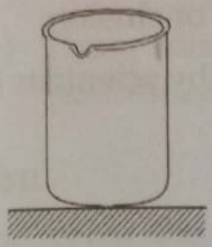
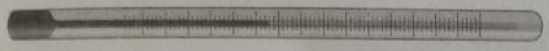
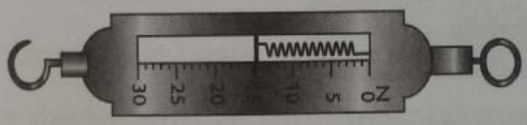
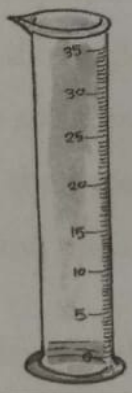
3.

Classes of fire	Fire extinguisher
A	Water
B	Dry powder
C	Dry powder
D	Dry powder
E	Carbon dioxide

4. *Warning signs* are symbols that show that a substance is either toxic, irritant, flammable, oxidising or corrosive.

5. Toxic, Radioactive, Danger of an electric shock.

6.

Apparatus	Function
(a) Beaker 	Used as a container for chemicals and other liquids
(b) Thermometer 	Used for measuring temperatures of substances
(c) Micrometer screw gauge 	Used for measuring the diameter of a wire
(d) Spring balance 	For measuring force
(e) Measuring cylinder 	For measuring volume of liquids

7. To avoid danger of electric shock. This is because electricity and water are incompatible.

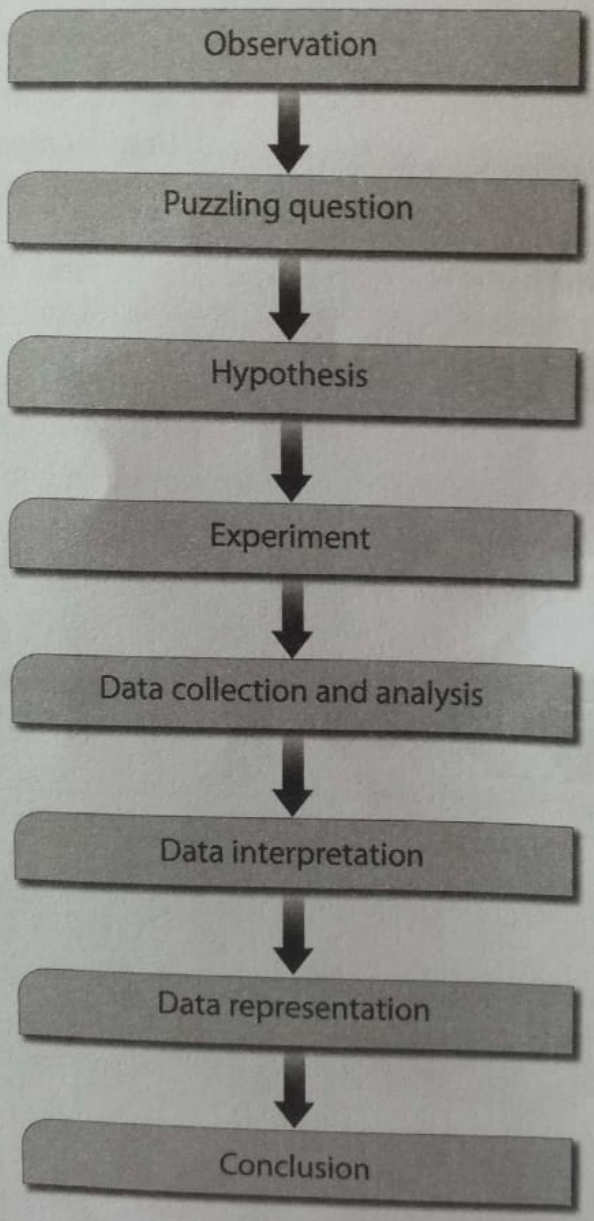
8. (a) False (b) True (c) True (d) True (e) False

9. First aid prevents **victim's condition** from becoming worse, **promotes** recovery by bringing **hope**, helps **to reduce** pain and prevents infection.

10. (a) Problem identification
(b) Asking questions
(c) Formulating a testable hypothesis
(d) Performing an experiment
(e) Data collection and analysis
(f) Data interpretation
(g) Data presentation
(h) Conclusion

11. (a) *A scientific method* is a set of techniques used by scientists to investigate a problem or answer questions.

(b)



(c) (i) Is girls performance better than boys in Physics?
(ii) Girls perform better in Physics than boys.
(iii) Give the Form 2 students a Physics test.

Answers to Exercises

Exercise 3.1

1. Students to draw

   The reading is 0.36 cm.

2. (a) 4.05 cm (b) 5.69 cm (c) 2.17 cm

Exercise 3.2

1. 8.50 mm
2. For a micrometer having 100 divisions, the pitch of the screw is 1.0 mm while that of 50 divisions has its pitch of the screw as 0.5 mm.
3. It cannot be used to measure a length above 25 mm.
4. (a) 3.21 mm (b) 0.32 cm.

Exercise 3.3

1. Measurement of length is the process of assigning numbers to the distance covered while estimation of length does not contain exact values. It is a mere guesswork.

2.

Fundamental quantity	SI Unit
Mass	Kilogram
Length	Metre
Time	Second

3. (a) Length is the distance between any two points. It is measured in metres.
   (b) Mass is the quantity of matter in an object.
   (c) Time is the limited period during which an event occurred or will occur.

4. (a) A stopwatch is smaller than a stop clock i.e. a stop clock, is a large version of a stopwatch. Stopwatches are used in laboratories while stop clocks are designed for viewing at a distance, e.g. in a stadium.

   (b) Mechanical stopwatches are powered by springs. Digital stopwatches are controlled by electric buttons.

5.

Mass	Weight
Is the quantity of matter in a object	Is the force of gravity on an object
It is constant everywhere	Weight varies with position
Measured using a beam balance	Measured using a spring balance
It is fundamental quantity	It is a derived quantity
SI unit is the kilogram	SI unit is newton

Exercise 3.4

1. $8\ cm^3$
2. 2.5 cm
3. $942\ cm^3$
4. $50\ cm^3$
5. $34\ cm^3$
6. $7\ cm^3$

Exercise 3.5

1. Errors can be avoided by:
   (a) not overheating the instruments.
   (b) proper handling of the instruments.
   (c) storing all instruments in a safe place free from dust.
   (d) maintaining the instruments regularly.
   (e) adjusting the pointer to point at zero mark.
   (f) taking perpendicular readings from the instruments.
2. $3.43\ m^3$
3. Item D
4. $15\ g/cm^3$
5. None
6. $3\ g/cm^3$
7. $0.48\ g/cm^3$
8. Relative density is the number of times a substance is denser than a given reference material.

$$\text{Relative density} = \frac{\text{Mass of substance}}{\text{Mass of an equal volume of water}}$$

Answers to Review exercise

1. By aligning the metre rule along the desk with its zero cm mark at the starting point. Record the reading at the finishing point of the measurement. Finally, subtract the initial reading from the final reading. This is the length of the desk.

2. (a) Mass is the quantity of matter in a body while weight is the force of gravity on the body.

   (b) Mass is measured by using a beam balance while weight is measured by using a spring balance.

   (c) Mass is a fundamental quantity while weight is a derived quantity.

3.

Item A	Item B
Volume	cubic metre
Mass	kilogram
Relative density	no unit
Density	kilogram per cubic metre
Length	metre

4. (a) The volume of a substance is the amount of space that an object occupies.

   (b) Measuring cylinder, pipette and burette.

5. (a) False (b) True

6. 2.05 g/cm^3 7. 0.46 g/cm^3 8. 482.5 g.

9. The density of the object decreases.

10. 200 ml. 11. 0.34 g/cm^3 12. 0.35 mm

13. Lead

14. (a) By avoiding overheating of instruments.

    (b) By adjusting the pointer to point at zero mark.

    (c) By taking a perpendicular reading from the instrument.

15. (i) B (ii) C (iii) B

    (iv) D (v) C (vi) D

Answers to Exercise

Exercise 4.1

1. No. Depending on the gravitational field strength of the location in space, the body will have some weight.
2. The answer should be given in terms of newtons (*X* N).
   No. The weight will be different on the moon.
3. The answer should be given in terms of kilogram, *kg*. Yes, the mass on the moon is the same because mass of a body does not change; it remains constant everywhere.

Answers to Review exercise

1. (a) gravitational force
   (b) stretching and gravity
   (c) air resistance, gravity and stretching
   (d) gravity, and frictional and stretching
2. 3 kg. 3. 2 N 4. 20 kg. 5. 0.6 N 6. 24 N
7. Gravitational, nuclear, magnetic, frictional, stretching force
   (Consider any other answers provided by the learner.)
8.

Item 1	Item 2
(a) _____	(ii)
(b) _____	(i)
(c) _____	(iv)
(d) _____	(v)
(e) _____	(iii)

Answers to Exercises

Exercise 5.1

1. 21.6 N 2. 3.33 N 3. 60 cm^3

4. It states that, *'Any object partially or completely immersed in a fluid experiences an upthrust which is equal to the weight of fluid displaced by the object'.*

Exercise 5.2

1. 5.62 x 10^6 m^3 or litres 2. 2 000 cm^3

3. (a) I0 N (b) I0 N (c) 1 000 g (d) 1 000 cm^3
   (e) 1 000 cm^3 and 4 000 g (f) 4 (g) 4 g/cm^3

4. (a) 3 (b) 3 g/cm^3

Exercise 5.3

1. (a) *Floating* is the tendency of an object to be suspended in or to remain on the surface of a fluid due to the forces exerted by the fluid while *sinking* is the tendency of an object to fall or drop to lower levels in a fluid.

   (b) Conditions for floating are:

   (i) The object's submerged volume must be large enough so as to displace a lot of fluid.

   (ii) The density of the body must be less than the density of the surrounding fluid.

   (iii) The upthrust due to the liquid must be equal to the total weight of the object.

2. Though it is made up of steel and iron its density is less than that of the sea water, hence it sails from Unguja to Dar es Salaam. This is made possible by making it hollow from the inside.

3. 222 Kg
4. (a) *A hydrometer* is an instrument used for determining the relative density of liquids.
   (b) The hydrometer is made to float in the milk. Then the relative density of the milk is determined at the point where the surface of the milk touches the stem of the hydrometer. The corresponding mark is the relative density of milk.

Answers to Review exercise

1. (a) *Floating* is the tendency of an object to be suspended in or to remain on the surface of a fluid due to the forces exerted by the fluid.
   (b) *Sinking* is the tendency of an object to fall or drop to lower levels in a fluid.
(c) *Upthrust* is the upward force or thrust which enables the object to float.
2. (i) A (ii) B (iii) A (iv) A (v) C
3. (a) False (b) True (c) False (d) True (e) False
4. (a) *Real weight* is the weight of an object when measured in air.
(b) *Apparent weight* is the weight of an object when measured in liquids.
5. (a) 0.3 N (b) 8.33 g/cm^3
6. 3.16 N
7. 1.25 g/cm^3
8. Object 2. Because it sinks deeper than object 1.
9. 0.89 g/cm^3
10. 1.635 g/cm^3
11. 90 g/cm^3
12. b and d will float in water
13. (a) 50.6% (b) 25.3%
14. (a) Yes, it will be supported
    (b) No, it will not be supported
    (c) 81.3%
15. (a) 0.3 seconds (b) 1.4 m/s^2
16. 89.7%
17. (a) 1.0693 g/cm^3 (b) 0.9622 g/cm^3
18. (a) Liquid A (b) Liquid B

6 Structure and properties of matter

Introduction

When tackling this topic, ask the learners to collect items from their school environment. Guide them to categorise the items as matter.

Use probing questions to revise what the students could have learnt earlier. Charts to illustrate the particle arrangement in the three states of matter will be very helpful.

There are quite a number of activities in this chapter. Apart from enhancing the theory work, certain relevant skills are passed on to the learners through them. Encourage individual participation from students during the time of carrying out these activities so as to uphold their self-confidence.

Specific objectives

By the end of this chapter, the learner should be able to:

1. explain the concept of matter.
2. classify the three states of matter.
3. justify the particulate nature of matter.
4. explain the kinetic theory of matter.
5. explain the concept of elasticity.
6. justify the relationship between tension and extension of a loaded elastic material.
7. identify applications of elasticity in real life.
8. explain the concept of adhesion and cohesion.
9. apply adhesion and cohesion in daily life.
10. explain the concept of surface tension.
11. identify the applications of surface tension in daily life.
12. explain the concept of capillarity.
13. identify the applications of capillarity in daily life.
14. explain the concept of osmosis.
15. identify applications of osmosis in daily life.

Answers to Review exercise

1. (i) C (ii) A (iii) C (iv) B (v) B

2.

Solid	Liquid	Gas
Particles are closely packed together	Particles are close together	Particles are far apart
Has definite shape and volume	Takes the shape of the container but has definite volume	Neither definite shape nor definite volume

Accept any other relevant difference given by the learners.

3. 5 N/cm

4. (a) 0.2 cm (b) 87.5kg.

5. (a) Oil can float on water because of cohesion and adhesion forces.
   (b) Because soap is a surfactant, it breaks the skin cover of the water; that is why oil and water mix after addition of soap.

6. (a) Convex meniscus.
   (b) It will decrease the curve of its meniscus. Soap is a surfactant; it breaks the surface cover of the liquid.
   (c) It will decrease the surface tension of the liquid. This means that the surface tension decreases as the temperature rises.

7. (a) Elastic materials easily regain their original shapes and sizes after being subjected to large deforming forces, while plastic materials will not regain their original shapes even though they do not break.
   (b) *Cohesion:* Is the ability of the molecules of a substance to attract each other.
   Adhesion: Is the ability of molecules of different substances to attract each other.

Answers to Exercises

Exercise 7.1

1. 250 N/m^2, 125 N/m^2 2. 5.475×10^4 N/m^2
3. 10 000 N/m^2 4. 10 500 N/m^2, 70 000 Nm^{-2}

Exercise 7.2

1. 30 000 N/m^{-2} 2. 5×10^8 N
3. 1.5×10^5 Nm^{-2} 4. 1.2 kgm^{-3}

Exercise 7.3

1. (a) 1.0×10^6 Nm^{-2} (b) 2000 N

2 (a) Because pressure is greater at the bottom than at the surface.

(b) So as to withstand the greater pressure exerted. Pressure is greater at the bottom of the dam than at the top.

3. In fluids, pressure acts equally in all directions, increases with depth and the density of the fluid.

4. 4×10^6 Nm^{-2}

Answers for the additional questions:

(a) The large feet provide a large surface over which its weight (force) acts.

(b) Pressure is higher at the downstairs tap.

(c) Pressure is greatest at the bottom of the sea hence the strong suits.

(d) These facilities provide large surface areas over which their enormous weights act.

(e) The weight of the fluid of the whole body is felt at the feet. The blood pressure in the veins of a person's feet exceeds the pressure in the head because blood in the feet supports the weight of the blood above it. This sometimes causes the swelling of the feet especially if one stands for a long time.

Answers to Review exercise

1.

List A	List B
(a)	(ix)
(b)	(ii)
(c)	(iii), (iv)
(d)	(vii)
(e)	(x)

2. (a) Pressure is the force acting normally on unit surface area.
   (b) SI unit of pressure is Nm^{-2} .
   (c) Manometer, aneroid barometer, Fortin barometer and simple barometer.
3. Pascal's principle states that, any external pressure applied to the surface of an enclosed liquid will be transmitted equally throughout the liquid.
4. (a) By using a manometer
   (b) 34 mm
5. It is because of high pressure exerted by the pin.
6. Hole B. Water spurt farthest because pressure increases with increasing depth of the liquid.
7. To withstand the pressure; the greater pressure is at the bottom than at the top.
8. 106.3 kPa $\Rightarrow 1.063 \times 10^5$ Pa
9. (a) 2.52×10^{11} N
   (b) The winds blow from cool regions to warm regions.
10. 3.2 cm; 153.13 N
11. Water has low density as compared to mercury. The liquid column would be too tall since atmospheric pressure pushes water to a height of about 10 m.
12. (i) Aneroid barometer uses aneroid cell made up of metal alloy and is partially evacuated. It does not contain liquid.
    (ii) It is portable.
13. (a) B (b) C (c) C

Answers to Exercises

Exercise 8.1

1. 3 000 J 2. 600 J 3. 300 J
4. When it is moving in a particular direction by the product of force applied and distance moved.

Exercise 8.2

1. Chemical energy, electromagnetic energy, nuclear energy, sound energy, mechanical energy and any other as stated.
2. (a) 3.2 J (b) 4000 J
3. (a) 2 000 J (b) 1 000 J

Exercise 8.3

1. 2 000 Watts
2. (a) 100 000 J (b) 20 000 Watts
3. 6 000 Watts

Answers to Review exercise

1.

List A	(a)	(b)	(c)	(d)	(e)
List B	(ii)	(vi) or (x)	(v)	(ix)	(vii)

2. (a) Work is the product of force and distance moved in the direction of force.
(b) Work is done on the object.
(c) Work is done by the object.

3. (a) Power is the rate of doing work.
(b) Power is measured in watts.
(c) 9.2 hp.

4. (a) Power is the rate of doing work.

(b) $\text{Power (in Watts)} = \dfrac{\text{work done (J)}}{\text{time (seconds)}}$

(c) 1 watt is the rate of working of 1 joule per second.

5. (a) I joule is the work done when a force of I N moves through a distance of 1 metre (in the direction of force).

(b) The principle of conservation of energy states that energy can be transferred from one form to another but cannot be created or destroyed.

6. It is because of transformation of kinetic energy to heat energy.

7. (a) 500 J, the work is done by the object.
(b) No work is done hence 0 joules.
(c) The work is done on the object hence –500 J.

8. 2 000 J

9. Yes, work is done. It is a gravitational force. The work is done on the object.

10. 112 500 J

11. 1 012 500 J. It is 9 times greater.

12. Rock B has more kinetic energy

13. 112 500 J

14. Law of conservation of energy states that *energy can neither be created nor destroyed but can be changed from one form to another.*

15. Chemical energy to heat energy and light energy.

16. A 5 kg object travelling at 10 ms^{-1}.

17. 300 000 J 18. 4 J 19. 1.7 m. 20. 52.125 J

21. 15 250 Watts or 20.3 hp.

9 Light – Part I

Introduction

The topic of reflection of light (covered in the Primary Science syllabus) forms the background knowledge for this topic. Reflection of light using mirrors, and shiny objects like spoons are practical experiences. The learners may be familiar with terms like transparent, opaque and translucent materials. Emphasise the kind of images that are formed in every situation.

Light – Part I shall concentrate more on reflection in plane mirrors. Content on multiple and rotating mirrors is for additional knowledge.

Specific objectives

By the end of this chapter, the learner should be able to:

1. explain the concept of light.
2. identify the sources of light.
3. distinguish luminous from non-luminous bodies.
4. explain the concept of rays and beams of light.
5. verify that light travels in a straight line.
6. identify transparent, translucent and opaque materials.
7. explain the concept of reflection of light.
8. distinguish regular from irregular reflection of light.
9. apply the laws of reflection of light.
10. describe the image formed by plane mirrors.

Key words

Light, ray, luminous, non-luminous, incandescent, beam, propagation, transmission, transparent material, translucent material, umbra, penumbra, reflected ray, incident ray, laws of reflection, regular reflection, diffuse, scattering, normal, virtual.

Answers to Review exercise

1. (a) (i) Natural sources of light are the objects which give out their own light.

(ii) Artificial sources of light are those objects which may reflect light from other objects.

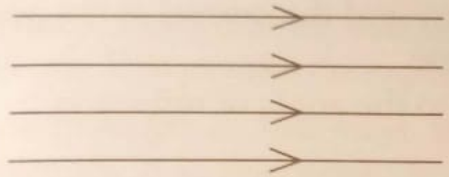
(b) Examples of natural sources are sun and lightning

Examples of artificial sources are candle and kerosene lamp.

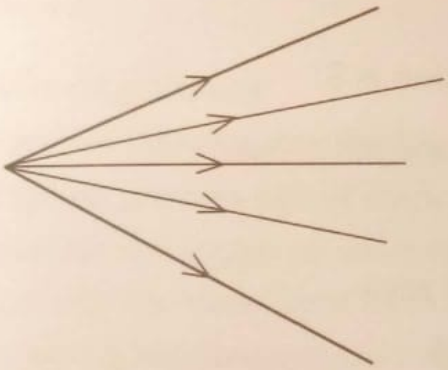
2. (a) Because of the scattering of the sun's light when it enters the earth's atmosphere. The blue light is scattered more than other colours due to the difference in their wavelengths. While on the moon, the sky appears black because the moon has no atmosphere to scatter sunlight.

(b) (i) image is the same size as the object
(ii) image is laterally inverted
(iii) image is virtual
(iv) image is erect
(v) image is the same distance behind the mirror as the object is in front of the mirror.

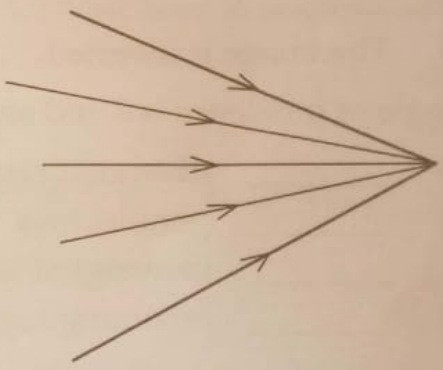
3.



parallel rays



divergent rays



convergent rays

4.

List A	List B
(a)	(xi)
(b)	(vii)
(c)	(i); (xiii)
(d)	(viii)
(e)	(iii)
(f)	(xvii)
(g)	(xix)
(h)	(iv)
(i)	(ix)

5. Light from a fire is incandescent and that from a firefly is luminous.
6. It represents incandenscent materials.
7. A mirror is an opaque material. Because of reflection of light.
8. (a) (i) Reflected ray is a ray that is not transmitted or absorbed but bounces back when it hits an obstacle.
   (ii) Angle of incidence is the angle between the incident ray and the normal.
   (iii) A normal is the perpendicular line drawn from the surface of the mirror.
   (b) In salons and barber shops, in periscopes.
9. (a) Laws of reflection state that:
   (i) The incident ray, the reflected ray and the normal at the point of incidence all lie in the same plane.
   (ii) The angle of incidence is equal to the angle of reflection.
   (b) Ǝ.
   (c) The image is inverted.
10. Angle of incidence is 2 and angle of reflection is 3.
11. (a) _____ divergent rays
   (b) _____ parallel rays
   (c) _____ convergent rays
   (d) _____ Incoming rays or incident rays
12. Teacher to draw ray diagrams. Answer is A.
13. 60°
14. (a) *Diffuse reflection* is the type of reflection which occurs from surfaces that are rough and no image is formed or distorted image is formed.
   (b) *Regular reflection* is the type of reflection which occurs on a smooth surface such that an image of the object emitting the light is clearly seen.
   (c) *Opaque objects* are those objects that do not allow light to pass through them at all.
15 (a) B (b) D
16. 25°
17. (a) Learners to draw.
   (b) As the angle between two mirrors decreases the number of images formed increases.
18. 14 m.

Answers to Exercises

Exercise 10.1

1. (a) Static electricity is the accumulation of excess electric charge in a region which does not conduct electricity.

   (b) Like charges repel, unlike charges attract.

   (c) A negatively charged object attracts a piece of paper because it **repels** electrons away from the surface of the paper.

2. (a) (i) This is due to accumulation of excess charges which creates an electric force between the nylon cloth and the human body.

   (ii) The chain is for earthing.

   (b) The dust particles are attracted by the charged TV screens.

3. Functions of a gold-leaf electroscope are:

   (a) Testing the sign of the charge on a body.

   (b) Identifying the insulating properties of materials.

   (c) Detecting the presence of charge on a body.

4. (i) **Charging by contact:** Charged electrophorus is brought in contact with the brass cap of a gold-leaf electroscope. The electroscope gets charged and the leaf diverges.

   (ii) **Charging by induction:** A charged electrophorus is brought near the brass cap of a gold-leaf electroscope. The latter is momentarily earthed. Hence, the electrophorus is removed; it causes the leaf of the electroscope to diverge or collapse depending on the type of charge initially on the electrophorus. However, charging of the electroscope through induction is mostly done using a positively charged electrophorus.

   (iii) **Charging by friction:** A glass rod rubbed with a piece of cotton cloth is rolled on the brass cap of the electroscope. The leaf diverges showing that the electroscope is being charged.

Exercise 10.2

1. 1.5×10^{-9} Coulombs
2. (a) A capacitor is a device used for storing charges.
   (b) Capacitance is the ratio of charge on a conductor (capacitor) to the potential difference (pd) across the plates of the conductor.
3. 3.6×10^{-5} Coulombs
4. 60 Farads

Exercise 10.3

1. 2.5×10^{-2} Coulombs
2. 2.5×10^{-3} Coulombs
3. 2.7 μF
4. In series, capacitance = 1 μF
   In parallel, capacitance = 11 μF

Answers to Review exercise

1.

	List A	List B
1.	(a)	(ii)
	(b)	(viii)
	(c)	(vi)
	(d)	(i)
	(e)	(v)
2.	(a)	C
	(b)	A
	(c)	D
	(d)	C
	(e)	B
	(f)	A and B

3. (a) (i) Negative charges are the electrons which move around the nucleus of the atom.
   (ii) Positive charges are those particles that constitute the nucleus of an atom. They are also known as protons.
   (b) The fundamental rule of static electricity states that: Like charges repel, unlike charges attract.

(c) When the balloon is rubbed against the hair it acquires negative charges. When brought close to pieces of paper, the papers tend to be attracted by the negatively charged balloon.

4. (a) Gold-leaf electroscope

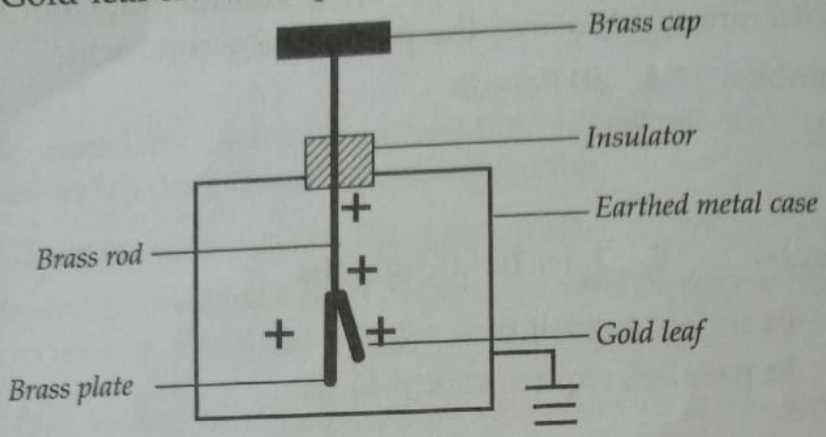


Fig. 10.2

(b) Testing for negative charge, the electroscope must be positively charged. Hence the leaf collapses if the negatively charged material is brought near the cap of the electroscope.

Testing for positive charge, the electroscope must be negatively charged. Hence the leaf collapses if the positively charged material is brought near the cap of the electroscope.

5. (a) There will be an electric force between them. The force will be attractive.

(b) Because of the charge distribution on the rod. The negative charges will move towards one end of the rod while positive charges move to the end near the negatively charged rod. As a result, the force of attraction will be experienced since unlike charges attract and like charges repel.

(c) Same case will happen. Charge distribution within the rod will be observed. Attraction of opposite charges will also occur.

6. (a) The electric force between one of the balloons and the hair will be attractive since they acquire different charges. Unlike charges attract.

(b) The electric force between the two balloons will be repulsive, since they acquire same types of charges and like charges repel.

(c) As explained in (a) and (b) above.

7. (a) It acquires negative charges.

(b) The divergence of the leaf decreases.

(c) No charges inside a hollow object. The proof plane will have no charges.

8. (a) A glass rod rubbed with silk becomes positively charged.
   (b) An ebonite rod rubbed with fur becomes negatively charged.
   (c) When a charged electroscope is touched by a finger it is discharged. This is called earthing.

9. The charge on the electroscope now is the same as the charge that was on rod A. This is because the leaves remain diverged. If the charges are opposite the leaf should collapse indicating attraction.

10. (a) A capacitor is an electronic device used for storing charges.
    Capacitance is the ratio of charge on a capacitor to the potential difference across the plates of the same conductor.
    (b) Types of capacitors and their uses:
        (i) Paper capacitor is used in fluorescent tubes so as to prevent moisture from entering.
        (ii) Mica capacitor.
        (iii) Electrolytic capacitor.
        (iv) Air capacitor used for tuning radio sets.

        Generally, capacitors are used in computers, televisions and other electronic circuits.
    (c) Stereos, radios, computers and televisions.

11. (a) 2.7×10^{-10} coulombs
    (b) 4.05×10^{-9} coulombs

12. The leaf collapsed because the sharp needle has charges opposite to those of the gold-leaf electroscope.

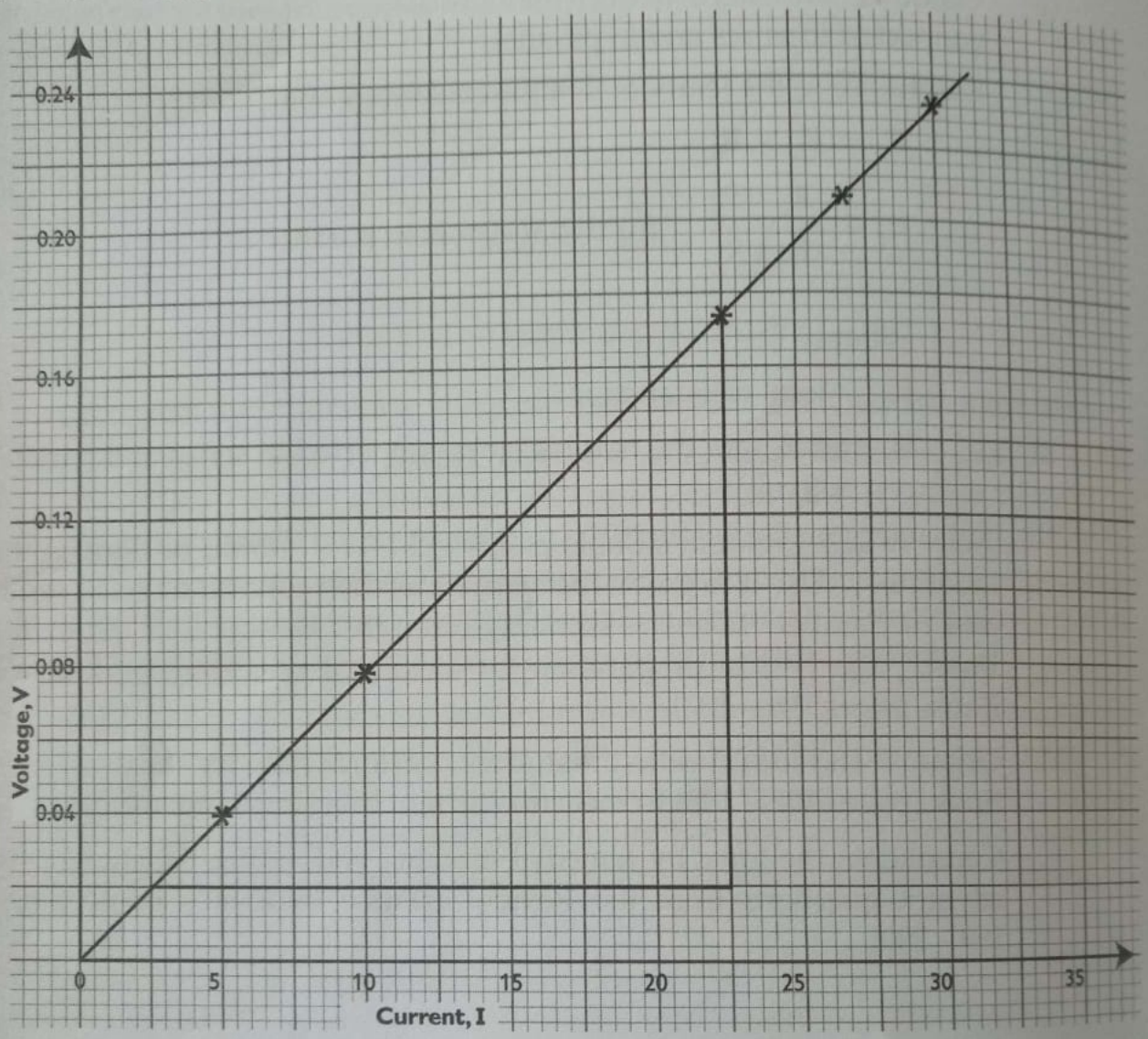
13. (a) 0.9 μF
    (b) 2.7×10^{-6} coulombs

14. While walking on a carpet, you are sort of insulated hence high electron accumulation. On the other hand, the door has excess of the opposite charges. This results in a mild electric shock.

Answers to Exercises

Exercise 11.1

1. R = 7.8 Ω



$$\text{Slope R} = \frac{\text{Vertical increase}}{\text{Horizontal increase}} = 5 \times 10$$

$$R = \frac{0.18 - 0.02}{10^{-3} \times (23.0 - 2.5)}$$

$$= \frac{0.16}{20.5 \times 10^{-3}}$$

$$= 7.8$$

2. 40 Ω

3 (a) (i) Length of the conductor (ii) Temperature

(iii) Cross-sectional area (iv) Type of material

(b) Thin wires have more resistance than thick wires. If Ohm's law is not obeyed, the resistance of a conductor varies depending on the current flowing.

4. (a) Ohmic conductors are those conductors which obey Ohm's law.

(b) Refer to Activity 11.1 on pages 192 to 193.

(c) Long, thin hot nichrome wire.

(d) (i) 0.5 A (ii) 18 V

Exercise 11.2

1. 14.3 V, 5.23 A.
2. In series arrangement the resistors are connected end to end while in parallel arrangement the resistors are connected across two common points.
3. 1 V
4. (a) 18 Ω (b) 3.6 Ω (c) 9.3 Ω

Answers to Review exercise

1. (a) (i) Electric current is the rate of flow of electrons, or it is the sustained movement of electric charge.

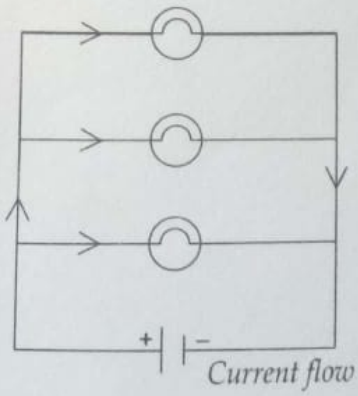
(ii) Resistance is the opposition that a circuit component or substance offers to the flow of electric current.

(iii) Voltage is the potential energy given to each coulomb of charge pushed out.

(b) (i) 0.5 A (ii) 0.25 A

2. A, B and C

3.



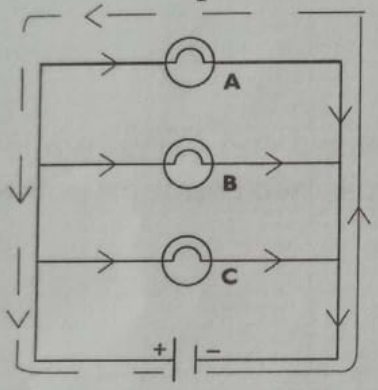
4. 1.2×10^{19} electrons.

5.

List A	List B
(a)	(ii)
(b)	(v)
(c)	(iv)
(d)	(viii)
(e)	(vii)

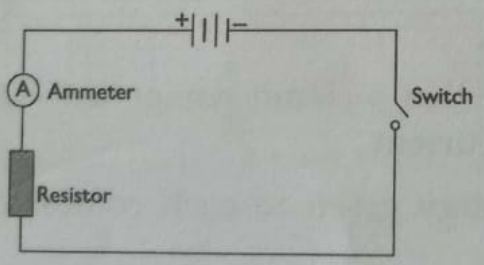
6. (a) C

(b) Yes, lamps B and C will light up. Because the current flow will still form a complete circuit through B and C.

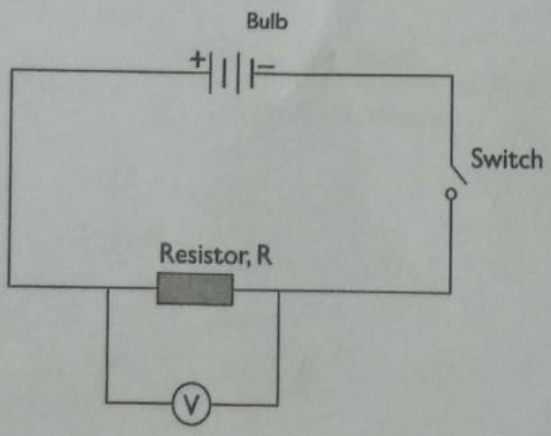


7. (a) Pd is the voltage across the terminal of the cell/battery which causes the flow of electrons while current is the rate of flow of electrons.

(b)



(c)



8. (a) Ohm's law states that, "at a constant temperature, a current passing through a wire (conductor) is directly proportional to the potential difference across its ends"

   (b) ohms

9. (a) The resistance will also increase.

   (b) The resistance will also increase.

   (c) The resistance will increase.

10. 500 V 11. 0.27 A

12. (a) 4 Ω

    (b) (i) Teacher to draw (ii) 2 Ω (iii) 10 V

13. (a) 4.4 Ω

    (b) 2.7 A

14. Teacher to analyse answers from the students

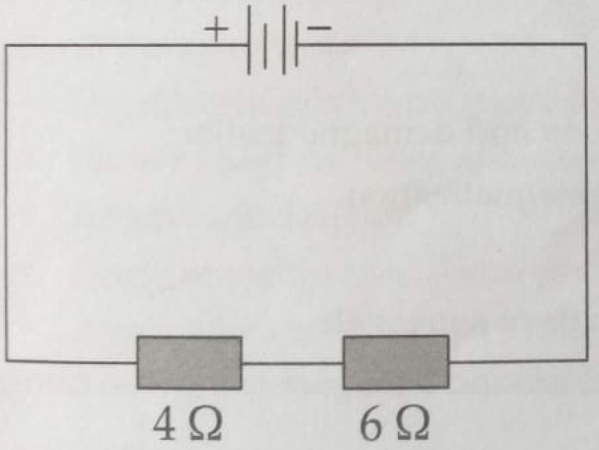
15. (a) 1.33 Ω (b) 6 Ω

16. (i) Teacher to draw (ii) 2.75 Ω

17. b has a lower resistance

18. (a) 20 Ω (b) 3.75 Ω (c) 2.4 Ω (d) 9 Ω

19.



Note: The teacher can also verify any other circuit drawn by learners.

Answers to Exercises

Exercise 12.1

1. (a) Magnetism is the phenomenon of physical attraction for iron that is common in magnets.

   (b) Like poles repel and unlike poles attract.

2. (a) Ferromagnetic materials are magnetic materials that can be magnetised strongly.

   (b) Iron, nickel and cobalt.

3. (a) Magnetization is the process of aligning the atoms in a material so as to produce a net effect of attraction or repulsion.

   Demagnetization is the opposite process of magnetization.

   (b) (i) **Stroking method (single touch method)**

   A magnet is used to stroke a piece of unmagnetized material. The magnet is moved from one end of the material to another repeatedly in the same direction. The pole produced at the end of the stroke is always opposite to the one at the end of the magnet.

   (ii) **Electrical method**

   A long wire is wrapped around an object to be magnetised. Then the wire is connected to a battery. The direct current supply in the wire produces a magnetic field that magnetises the object.

   (iii) **Heating or vibration method**

   The object to be magnetised is placed in an external magnetic field. On heating or vibrating, the object increases the amount of alignment by causing the atoms to move and eventually become aligned. Thus the object is magnetised.

4. (a) (i) Magnetic recording media
   (ii) Common television and computer monitor
   (iii) Credit, Debit and ATM cards
   (iv) Transformers

   (b) On the doors. To keep the doors tightly closed.

5. (a) By ensuring that the magnets do not come in contact with ferrous objects.

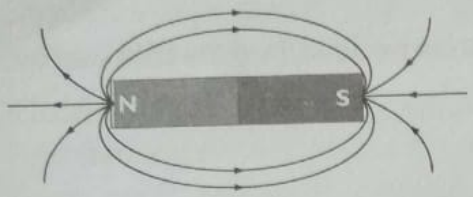
   (b) By using magnetic keepers.

Exercise 12.2

1. (a) A magnetic field is a region around a bar magnet in which magnetic materials are attracted by the magnet.

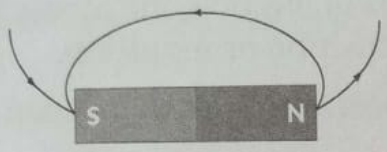
   (b) Magnetic lines of force are the lines that run from the North Pole to the South Pole of a magnet.

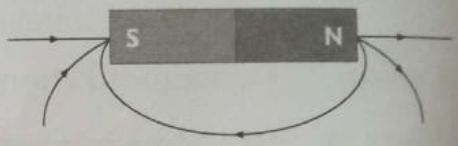
2. (a)



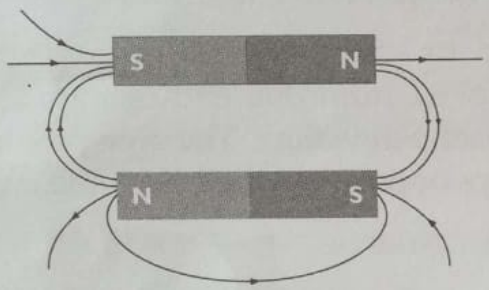
The poles repel each other hence creating neutral points x

(b) (i)





(ii)



Attraction of the poles occurs

3. The earth is a magnet in the sense that the generation of the magnetic field is linked to the rotation of the earth, which leads to the rotation of the fluid metallic iron inside the earth.

4. (a) It is used by map-readers for finding locations of different places.

   (b) It gives useful information in the search for minerals.

   (c) Transmission of information by satellites fitted with magnetometers is about the earth's magnetic field.

Answers to Review exercise

1. (a) Induced

   (b) magnets produced by electric field.

   (c) poles repel, poles attract

2. (a) By bringing the two poles together and identifying attraction or repulsion for the like poles and unlike poles.

   (b) No, the attraction does not test better because it also can be for the magnetic material.

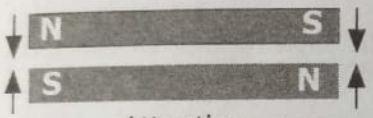
3. Forces due to magnetic force may be attractive or repulsive while force due to gravity is only attractive.

4.

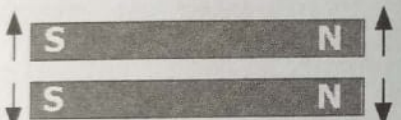
List A	List B
(a)	(v)
(b)	(i)
(c)	(iii)
(d)	(ii)
(e)	(vi)

5. (a) A magnet is a substance which has a tendency of attracting some materials such as iron and steel to itself.

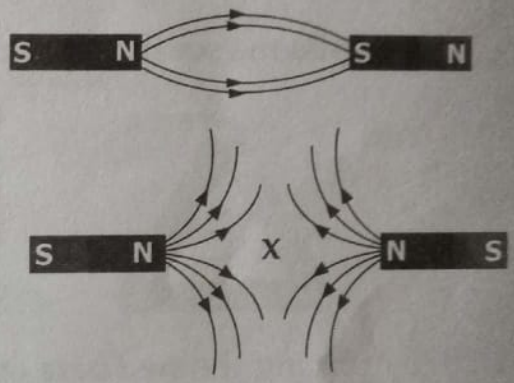
(b) Law of polarity states that like poles repel and unlike poles attract.



Attraction



Repulsion



(c) By bringing together a known North Pole of a bar magnet to the unknown pole of the other bar magnet. If repulsion occurs it will be identified as the North Pole.

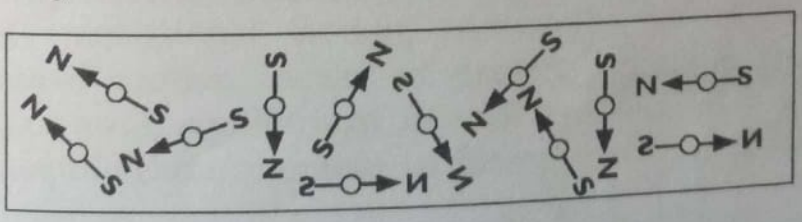
6. (a) (i) Magnetic recording media

(ii) In electric motors and generators

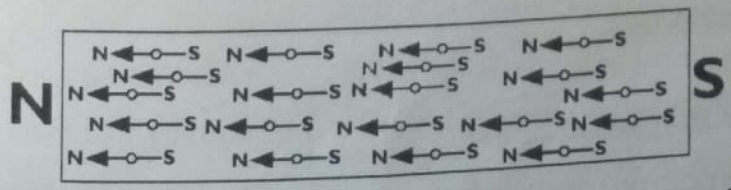
(iii) In speakers and microphones

(iv) in eye clinics

(b) (i)



(ii)



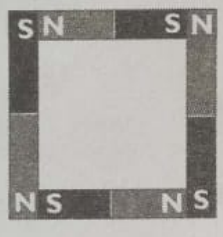
(c) The atoms are arranged according to the poles of the magnet.

7. (a) The magnetisation process is the aligning of the atoms in a material in one direction so as to produce a net effect of attraction or repulsion.
   (b) By overheating or striking with a hammer.
   (c) Repulsion and attraction forces.

8. (a) Magnetic lines of force are lines that run from the north pole to the south pole of a magnet.
   (b) (i) Magnetic lines of force are continuous and always form closed loops.
   (ii) Lines of force start at the North Pole and end at the South Pole.
   (iii) Magnetic lines of force will never cross each other.
   (c) A non-magnetic material is placed in the path of magnetic field lines such that when redirected, the field lines flow through the material thereby magnetising it.

9. Towards the south because repulsion will take place between N – N.

10. Yes

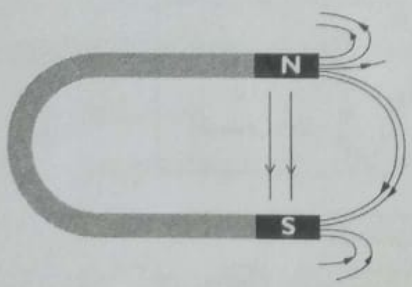


11. By placing the two bars on specific non-magnetic material. The one which will be attracted is then determined to be the magnet.

12. (a) Yes, there is a neutral point between the two magnets 0.5 m in between. Because unlike poles attract each other but the distance of separation is too large for the attraction to occur.
   (b) Yes, there is a neutral point between the two magnets 0.5 m in between the poles. Because like poles repel each other.

13. There is no neutral point thus the attraction between them is great.

14.



15. To redirect the magnetic field.

16. The poles will change, south becomes north and vice versa.

17. (i) C (ii) D

Answers to Exercises

Exercise 13.1

1. Turning effect of force (moment) is the product of force and the perpendicular distance.
2. Moment of force about a point is the product of the force and the perpendicular distance of its line of action from the point.
3. The principle of moments states that, for a system to be in rotational balance, the total clockwise moment must be equal to the total anticlockwise moment.
4. (i) The size of the force
   (ii) The perpendicular distance from the pivot.
5. 150 Nm 6. 160 Nm 7. 0.48 N 8. 20 Nm

Exercise 13.2

1. (a) Centre of gravity is the point where the force of gravity can be considered to act.
   (b) Centre of mass is the point at which the system of particles forming up the object appears to be concentrated.
2. (a) The sum of the forces in one direction must be equal to the sum of the forces in the opposite direction.
   (b) Anticlockwise moments equal to clockwise moments.
3. (a) Stable equilibrium is the steady state of balance of a body.
   (b) Unstable equilibrium is the unsteady state of balance of a body.
   (c) Neutral equilibrium is the state of balance in which a body remains in its position until displaced.
4. (a) In order to reduce the centre of gravity hence to attain stable equilibrium by making the bottom heavy.
   (b) Low centre of gravity and large base area.

Answers to Review exercise

1. A
2. B
3. (i) The position of the centre of gravity
   (ii) Base area

4.

List A	List B
(a)	(ii), (vi)
(b)	(vii)
(c)	(i), (ix)

5. (a) Because it is balanced by having a heavy base.

   (b) Because the tip area is too small and the base area is large. Thus large base area increases stability hence it is more difficult to balance a nail on its tip.

6. When a car is titled to the sides, it does not roll over. This is because its wheels are cambered, i.e. slightly tilted.

7. (a) Magnitude of force determines the turning effect.

   (b) Direction of force determines the direction of fall of an object.

   (c) Point of application of force – whether it is near or at its centre of gravity – determines a body's state of balance.

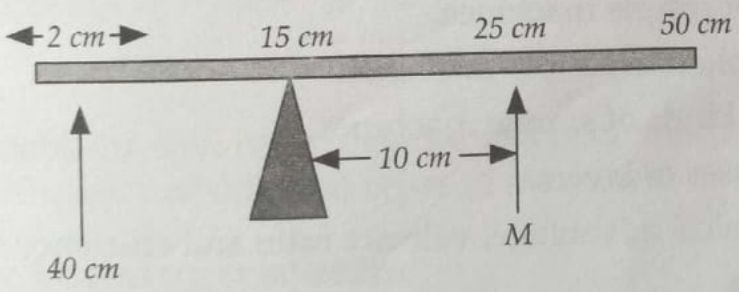
8. (a) F_1 (b) F_2 and F_3 (c) F_3 (d) F_2 (e) F_2

   (f) Translational equilibrium because all the forces are in one direction.

9. 0.75 m

10. Not necessary. Because equilibrium is a state of balance of a body.

11. (a)



   (b) 52 g

12. 600 N

13. a – neutral equilibrium
    b – unstable equilibrium
    c – Stable equilibrium
    d – unstable equilibrium
    e – unstable equilibrium
    f – unstable equilibrium

14. (a) 48 cm

    (b) 0.5 N

Answers to Exercises

Exercise 14.1

1. (a) 100 N (b) 50 N (c) 20 N

   (d) The best pulley to use is single movable pulley. Because it uses a small effort to lift the same load.

2. 50 N

3. (a) 5 (b) 5 (c) 50%

4. (a) 4 000 J (b) 2.5% (c) 80 N

5. 50%

Exercise 14.2

1. (a) $1.5 \approx 2$ (b) 2 (c) 400 J (d) 300 J (e) 75%
2. (a) 555.6 N ≈ 560 N (b) 3.6 (c) 100%
3. (a) 2.5 (b) 2.5 (c) 100%
4. 1 cm

Exercise 14.3

1. 15.9 N ≈ 16 N
2. 12.56 ≈ 13
3. 6.7 cm
4. 502

Exercise 14.4

1. (a) 20 N (b) 170
2. 3
3. (a) 4 (b) 0.75
4. (a) So as to use less effort since the angle of incline will be smaller hence it is easier to go up the hill.
   (b) Four
5. Gearwheels as a simple machine is a distance magnifier.

Exercise 14.5

1. 100
2. 1.59 m
3. (a) 4 (b) 3
4. Mode of action of a hydraulic press

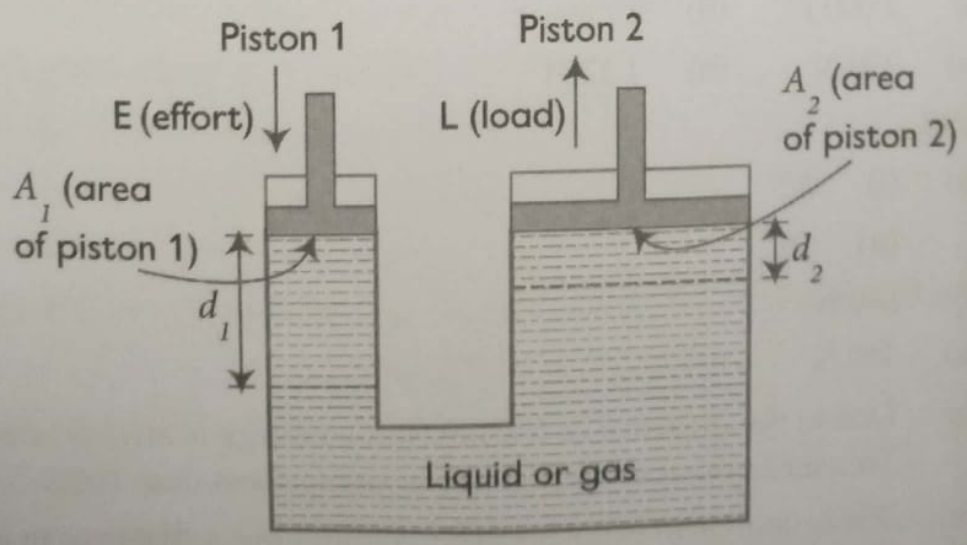


Fig. 14.2 A hydraulic press

On pushing down the smaller piston 1, pressure is created inside the liquid. If Piston 1 is pushed through distance d_1 piston 2 is through d_2. A hydraulic press works on the principle that liquids cannot be compressed; thus the applied force is transmitted to the other end where it produces a larger force. The MA of a hydraulic press is usually less than 1. This is due to the presence of frictional forces.

Answers to Review exercise

1. (a) (ix) (b) (vi) (c) (ii) (d) (i), (iv) (e) (v)
2. (a) False (b) True (c) True (d) False
   (e) False (f) True
3. Second class
4. Because some of the energy is transformed into heat due to friction in the moving parts.
5.

First class	Second class	Third class
Jembe	Bottle opener	Axe
Pliers		Human arm

6. 0.4 m
7. (a) 7 (b) 5 and 140%
8. (a) 2.5 (b) 8 (c) 320%
9. (a) 37.5 N (b) 10 cm
10. (i) 3 000 J (ii) 10 w
11. (a) 250 N (b) 1 125 J
12. 5.5%
13. (a) (i) 3.5
    (ii) 10
    (b) 560 N
14. (a) 350 N (b) 2
15. (a) Due to the presence of friction, some **energy** is always wasted. This means that the **efficiency** is always **less** than 100%.
    (b) The human arm is not a force magnifier but a **distance magnifier**.
16. (a) A (b) C

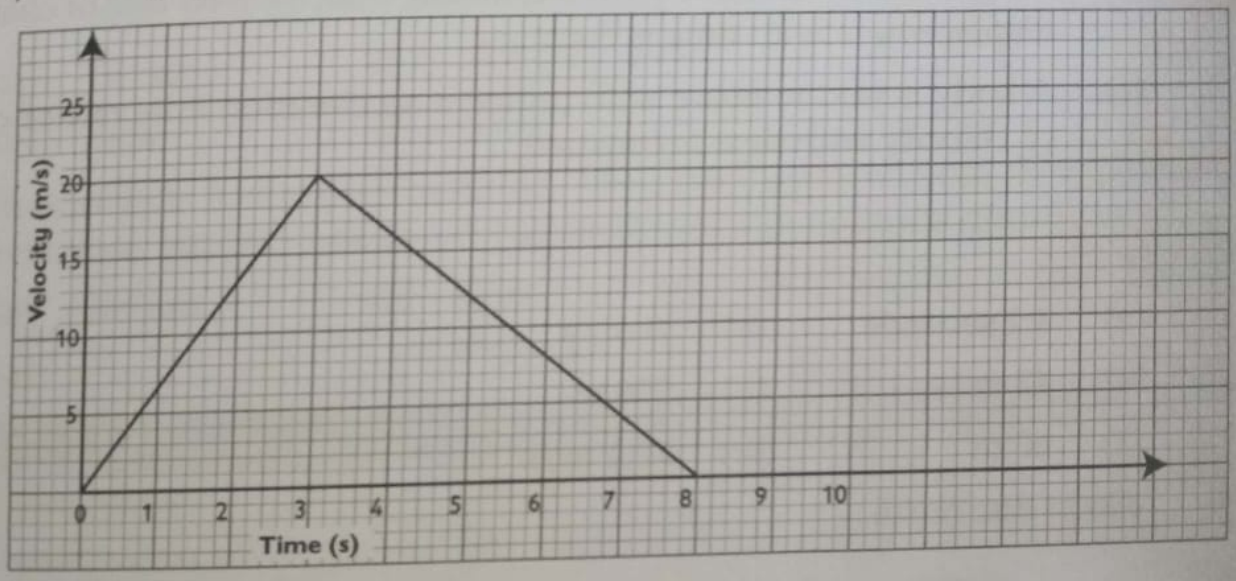
Answers to Exercises

Exercise 15.1

1. (a) 80 m (b) 40 m/s
2. (a) 1 second (b) 1.25 m
3. (a) 13 km (b) 9.1 km
4. 80 km/h

Exercise 15.2

1. (a) The graph of velocity against time



distance travelled = 160 m total displacement = 80 m

(b) 80 m and 0 m

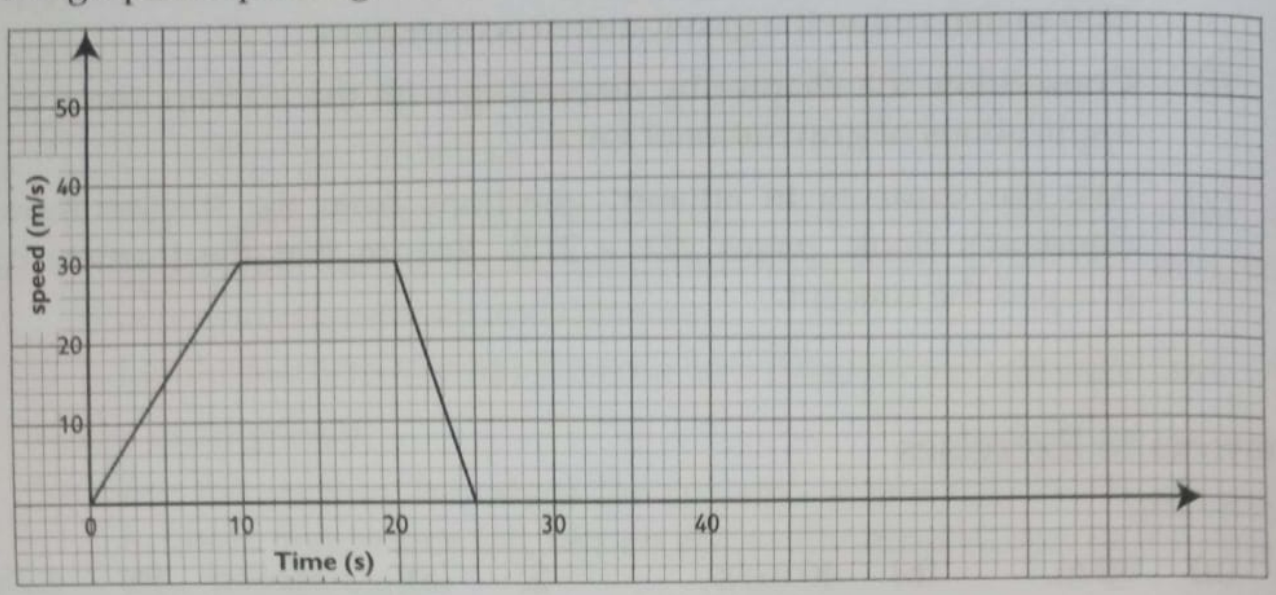
2. (a) The motorcycle is moving in reverse direction with a constant negative velocity.

(b) (i) Movement between C and E

(ii) Movement between B and C

(c) 90 m

3. The graph of speed against time



(a) 525 m (b) 25 seconds (c) 30 m/s (d) 525 m^2

4. (a) A body is said to move with a uniform speed if its rate of change of distance moved with time is constant.

(b) A body is said to move with a uniform velocity if its rate of change of displacement with time is constant.

(c) A body is said to move with uniform acceleration if its rate of change of velocity with time is constant.

Exercise 15.3

1. (a) 4.2 seconds (b) 0 m/s
2. (a) 42 m/s (b) 208 m
3. (a) 60 m (b) 12.1 m/s
4. 200 m due north

Exercise 15.4

1. (a) 20 m/s (b) 20 m
2. (a) 2.94 seconds (b) 5.88 seconds
3. (a) 1 second (b) 10 m
4. 5 m/s

Answers to Review exercises

1.

List A	List B
(a)	(vii)
(b)	(i)
(c)	(ix)
(d)	(iii)
(e)	(viii)
(f)	(ii)
(g)	(v)

2. (a) Distance is defined as the length of a path taken by an object while in motion.

   (b) Displacement is the distance covered in a particular direction.

   (c) Velocity is the rate of change of displacement moved with time.

   (d) Uniform acceleration occurs when the rate of change of velocity of a body moved with time is constant.

3. (a) Distance (b) velocity, m/s

4. (a) False (b) True

5. Both objects had moved with the same displacement from their points of reference, but they had moved equal distance in opposite directions.

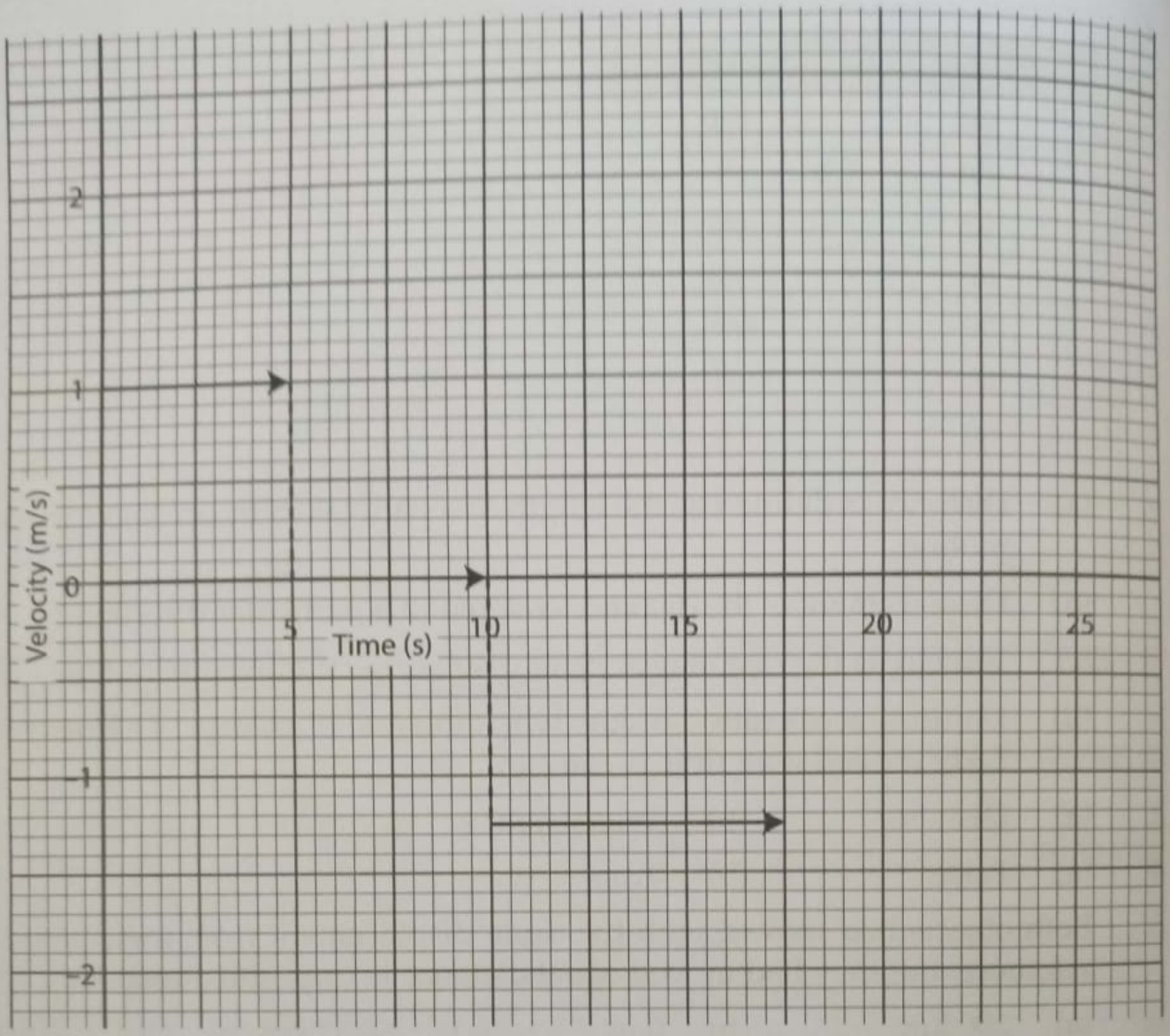
6. (a) 200 km (b) 0 m (c) 66.67 km/h (d) 0 m/s

7. (a)

	1	2	3
Time interval	0 – 5s	5s – 10s	10s – 18s
Initial position, m	2	7	7
Moving toward/ away from the origin or stopped	Away	Stopped	Toward
Final position, m	7	7	5
Velocity increasing, decreasing, constant	Increasing	Constant	Decreasing constant
Average velocity, m/s	1	0	1.5

(b) 14.5 seconds (c) 0.83 m/s

8. *Velocity–Time graph*



9. (a) 2 m/s² to the right (b) 100 m (c) 400 m
10. (a) 80 m (b) 40 m/s
11. b ⟶ Velocity
12. Constant
13. 13 seconds
14. (a) 250 m/s (b) 625 m (c) 225 m (d) 2.5 seconds
    (e) 1185.8 m (f) 12.7 seconds (g) 125 m/s
15. 0.59 seconds
16. t = 10 sec and t = $\sqrt{10}$ seconds. (3.2 seconds)
17. (i) D (ii) D (iii) C
18. 1.5 h

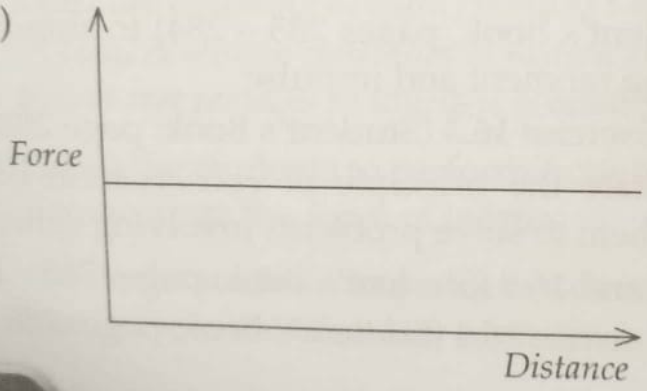
Answers to Exercises

Exercise 16.1

1. (a), (b), (c), (d) Explain with reference to inertia and Newton's first law of motion.

2. (a) There is a zero force (from Newton's first law since there is no change of state).

(b)



(c) A moving car has the same velocity as the passengers when breaks are applied or when the car is involved in an accident. The safety belts prevent them from being thrown out of the car. This prevents further injuries.

(d) Air bags.

Exercise 16.2

1. 48 N
2. 57 276.7 N
3. (a) The rate of change of momentum of a body is directly proportional to the applied force and takes place in the direction of force.
   (b) 0.9 N/kg
4. 10 000 N or 1×10^4 N

Exercise 16.3

1. 5×10^3 m/s
2. 6.8×10^3 N
3. (a) 1.5×10^{-5} m/s (b) 3×10^{-3} m/s
4. 2×10^5 N

Exercise 16.4

1. Momentum is the product of an object's mass and its velocity.
2. (a) 9 kg m/s (b) 4.5 kg m/s
   (c) Because there is a change in velocity. (d) Trolley A KE = 6.75 J
   Trolley B KE = 9 J
3. 4 m/s
4. 5.45×10^7 N

Exercise 16.5

1. (a) Newton's third law of motion states that: *For every action force there is an equal and opposite reaction force.*
   (b) If you wore roller skates and pushed yourself against a wall (that is the action force), the wall would exert a reaction force in the opposite direction and move you backwards.
2. 2.14 m
3. 31 N

Exercise 16.6

1. When the air is released it rushes out (action) but the rubber tries to resist the move.

2. 3. 4. The teacher and the learners to discuss these in terms of action and reaction forces.

Answers to Review exercise

1. (i) C (ii) C (iii) A (iv) C

2. The acceleration due to gravity on Jupiter is 26 m/s^2.

3. No, because there may be some balanced forces acting on the object.

4. (a) 0 N (b) 50 N

5. (a) Inertia of rest (b) Inertia of motion (c) Inertia of direction

6. When you are on a moving vehicle your body tends to fall forward when the vehicle suddenly stops. If you are on a stationary vehicle and it suddenly moves forward, you would fall backwards.

7. Momentum is the **product** of **mass** and **velocity** of an object.

8. 15 N to the left 9. 2.5 m/s^2 upward 10. 6.3 seconds

11. 20 m/s seconds

12. The donkey is pulling forward (action) while the tyres are pulling backwards on the road. The road is also pushing forward on the tyres.

    The whole system of the cart is exerting a force on the ground and the ground is exerting an equal force on the system.

    The earth is exerting a downward force on the cart.

13. (a) Both objects have the same momentum.

    (b) Object A has the most kinetic energy.

14. 3.3 N

15. (a) 5.02 m/s

(b) The total kinetic energy is not conserved during the collision.

Kinetic energy before collision is given as:

$$KE_1 = \tfrac{1}{2} m_1 U_1^2 + \tfrac{1}{2} m_2 U_2^2$$

$$= \tfrac{1}{2} \times 4 \times 2 \times 2 + \tfrac{1}{2} \times 6 \times 2 \times 2$$

$$KE_1 = 20 \text{ J}$$

Kinetic energy after collision is given as:

$$KE_2 = \tfrac{1}{2} m_1 V_1^2 + \tfrac{1}{2} M_2 V_2^2$$

$$= \tfrac{1}{2} \times 4 \times 2.8 \times 2.8 + \tfrac{1}{2} \times 6 \times 1.5 \times 1.5$$

$$KE_2 = 22.43 \text{ J}$$

16. 2 m/s

17. The 4 kg ball velocity = 6 m/s to the left.

The 6 kg ball velocity = 4 m/s to the right.

18. 3 N

19. (a) 390 m/s (b) 76.05 J

20.

List A	List B
(a)	no answer
(b)	(ii)
(c)	(vii)
(d)	(viii)
(e)	(i)

Answers to Exercise

Exercise 17.1

1. *Fixed points* are the standard points that are used in calibrating a thermometer, i.e. the lower fixed point 0° and the upper fixed point 100°.
2. See pages 294 – 295 in the student's book.
3. (a) 27 °C (b) 20 °C
4. (a) 136.4 °F (b) 212 °F

Answers to Review exercise

1. (a) *Temperature* is the degree of coldness or hotness of a body at a particular time.
   (b) *Thermometer* is an instrument used for measuring the temperature of a body.
   (c) *Lower fixed point* is melting/freezing point of water and *upper fixed point* is the boiling point of water.
   (d) *Constriction* is the point close to the bulb of a clinical thermometer which allows accurate measurement of temperature since it does not allow mercury to fall back onto the bulb when temperatures are low.
2. (i) Mercury-in-glass thermometer
   (ii) Maximum and minimum thermometer
   (iii) Thermocouple thermometer
3. – It does not wet glass
   – It boils at 360 °C
   – It is opaque, so it is easily seen.
4.

List A	List B
(a)	(ii)
(b)	(v)
(c)	(iii)
(d)	(i)
(e)	(iv)

5. (a) Their common final temperature, θ will be less than 50 and greater than 10. $(10 < \theta < 50)$. Because object B loses heat and object A gains heat. Rate of flow is from higher to lower temperature.

   (b) If object A had a mass twice that of object B, their common final temperature will be less than that of (5a) above but greater than 10°C.

   Because the mass of A had increased which affects the temperature rise (lowers the temperature).

   (c) If object B had a mass twice that of object A, the final temperature will be greater than that of (5a) above.

   Because the mass of B had increased, which raised the temperature of A rapidly.

6. The function of the constriction of a clinical thermometer is to allow for convenient measurement of temperature by allowing mercury to remain stationary in the tube without returning to the bulb until it is reset.

7. 5 727°C and 10 340.6°F

8. (a) Yes, the thermometers are recording the same temperatures.

   25°C converted to °F:

   $\left(\frac{9}{5} \times 25\right) + 32 = 77°F$

   (b) No. Because of different scales on the thermometers.

9. −40°F

10. 6.69 cm

18 Sustainable energy sources

Introduction

In Form 1, the learners discussed about energy and how work is done due to the availability of energy. Remind the students that energy has many forms. Use the questioning technique in order to know how much the learners can still remember.

In this chapter, the students will be introduced to sustainable sources of energy. A lot of improvization is called for on the part of the teacher if the activities have to be successful. The knowledge acquired in Geography lessons will be very useful.

Specific objectives

By the end of this chapter, the learner should be able to:

1. explain the generation of electricity from water.
2. explain the importance of water energy.
3. construct a model of a hydroelectric power plant.
4. explain the sun as a source of energy.
5. explain the conversion of a solar energy to electric energy.
6. construct a model of solar panel.
7. explain wind as a source of energy.
8. construct a model of a windmill.
9. apply a windmill in daily life.
10. explain sea waves as a source of energy.
11. explain the conversion of sea wave energy to electrical energy.
12. explain the geothermal as a source of energy.
13. explain the conversion of geothermal energy to electric energy.

Key words

Water energy, wind energy, tidal energy, geothermal reservoirs, fumaroles, solar energy, sea wave energy, geothermal energy, geysers.

Answers to Exercise

1. (a) Solar energy (b) Wind energy (c) Sea wave energy
   (d) Geothermal energy (e) Water energy

2. (a) A dam is built across a river to trap water. Water is then allowed to flow through tunnels into the dam where they turn turbines which in turn drive generators. The generators then assist in producing electricity from water.

   (b) The sun heats the atmosphere warming some patches but not others. The warm patches of air rise, cold air blows in to replace them and blows as wind.

   Wind energy is then converted into electricity by building a tall tower with a large propeller on top (wind mill) which rotates causing the attached generators to produce electricity.

   (c) The sun's energy in form of rays falls on solar cells strategically placed on the earth's surface. The interior of the photovoltaic cells is made such that solar energy can be converted to electricity.

3. (a) Coiling the pipes inside the box is for increasing the surface area and length over which the radiant energy can act.

   (b) The water is already hot, hence a longer pipe will allow some cooling to take place. This has to be prevented.

   (c) Just after the glass-covered box.

   (d) The pipe CD requires insulation since it is hot.

4. Kilimanjaro and Oldonyo in Tanzania and Rift Valley in Kenya.

Answers to Review exercise

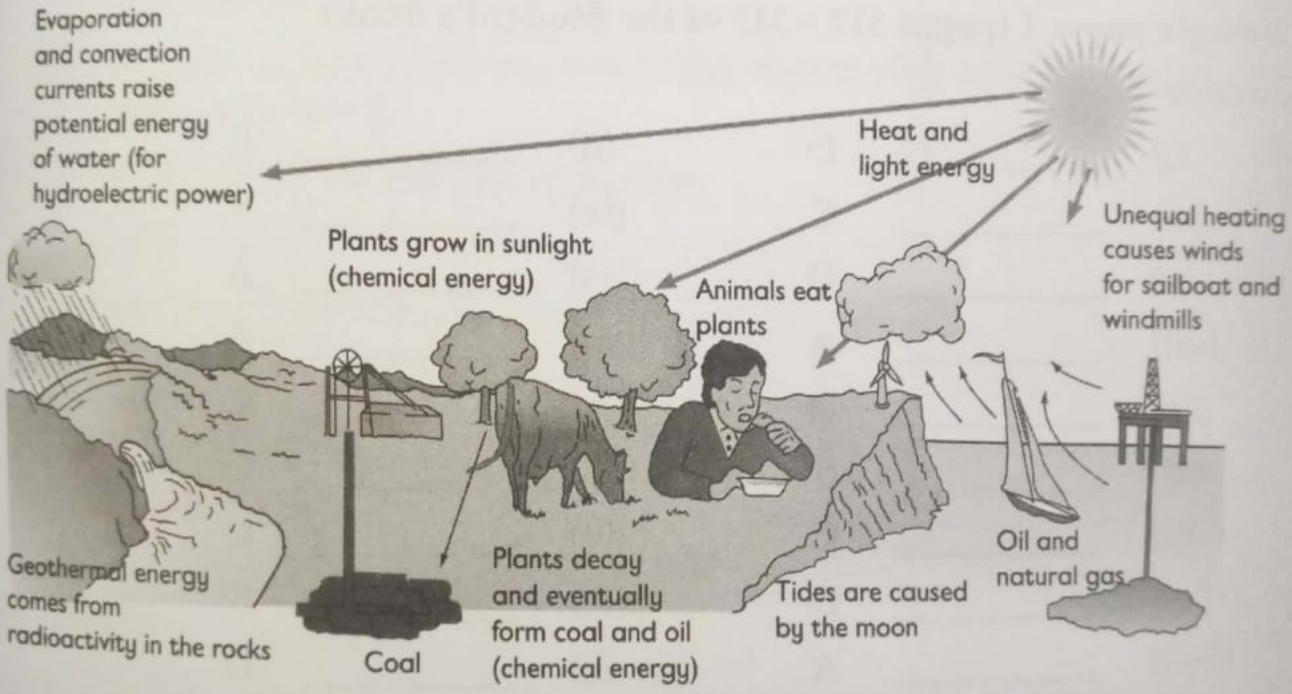
1.

List A	List B
(i)	(f)
(ii)	(a)
(iii)	(i)
(iv)	(k)
(v)	(d)

2. (a) It is virtually available.
   (b) It is environmentally friendly since it produces no waste.
   (c) It is more reliable than other sources of energy.
   (d) It increases power very quickly.
   (e) Electricity can be generated constantly since there is a constant flow of water.

3. (a) In industries it is used to drive machines.
   (b) Lighting homes, schools, hospitals and offices.
   (c) Heating and cooking.

4.



When the sun's heat heats the sea, water evaporates and later falls back as rain. The rain fills the rivers and lakes where hydroelectric energy is generated in nearby power stations.

Due to unequal heating of the earth by the sun, winds are caused. This means that wind is a derivative of the sun.

Green plants require the sunlight for photosynthesis. They store chemical energy in form of starch. This means that heat energy from firewood is from the sun. When plants die, they decay and are compressed to form coal and oil.

Tidal wave energy is as a result of the interaction between the gravity, earth, sun and the moon with the gravitational pull of the moon having a greater influence.

5. (a) Sea wave energy is as a result of series swells of the sea.

(b) *Geothermal energy* is the energy generated by the flow of heat from underneath the earth's surface.

6. (a) Sustainable source of energy

(b) Drives generators

(c) Heats buildings

7. (a) D (b) A

Answers to Model examination papers

Sample paper 1 (pages 312 – 315 of the Student's Book)

Section A

1.

(i)	D	(ii)	B
(iii)	C	(iv)	B
(v)	D	(vi)	A
(vii)	A	(viii)	A
(ix)	D	(x)	C
(xi)	B	(xii)	C
(xiii)	C	(xiv)	C
(xv)	B	(xvi)	B
(xvii)	A	(xviii)	D
(xix)	B	(xx)	B

Section B

2.

(a)	(v)	(b)	(viii)
(c)	(vi)	(d)	(xiv)
(e)	(xvii)	(f)	(xii)
(g)	(xix)	(h)	(vii)
(i)	(xviii)	(j)	(xiii)
(k)	(xvi)		

3. (a) **Length, temperature** and **cross-sectional area.**

(b) When a **magnet** is freely suspended, the **South** pole tends south and the north pole tends **north.**

(c) An **electroscope** is used to detect charge and **the leaf** diverges or collapses.

(d) When a body is immersed in **fluid** the **upthrust** of the body is equal to the weight of **displaced fluid.**

(e) Energy can **neither** be created nor destroyed.

Section C

4. (a) (i) *Elastic collision* is the one where the objects exist in the same state after the collision as before it.

(ii) *Inelastic collision* is the one where the objects after collision are not the same as before it.

(b) From Newton's second law of motion;

Force, $F = P/t$

Where; P = momentum, t = time

$P = Ft$

But SI unit of $F = N$ and $t = s$

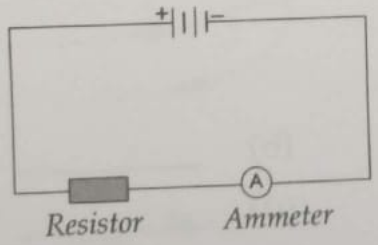
$P = Ns$

The SI unit of momentum is Ns.

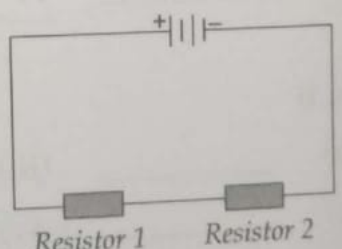
(c) 6 m/s

5. (a) *Ohm's law states* that, at the constant temperature a current passing through a conductor is proportional to the potential difference across its ends.

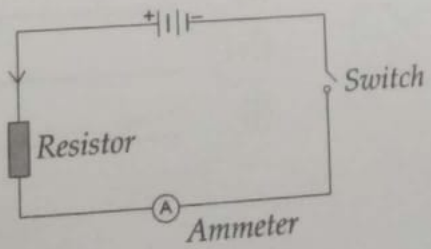
(b) (i)



(ii)



(iii)



6. (a) Power is the rate at which work is done.

(b) The SI unit of power is joule per second (watt).

(c) 9 000 J and 2 250 W.

7. (a) *Efficiency* is the ratio of the work output to the work input.

(b) Velocity ratio, V.R. $= \frac{\text{Effort distance}}{\text{Load distance}}$ (c) 1 000 N.

8. (a) Water

(b) (i) It means that about 45% of the power input (fuel) is changed to electrical energy (power output).

(ii) Power station P. It is a sustainable source of energy.

9. (a) current (b) volume of liquid (c) voltage

Sample paper II (pages 315 – 319 of the Student's Book)

Section A

1. (i) _____ D (ii) _____ A

(iii) _____ B (iv) _____ B

(v) _____ D (vi) _____ B

(vii) _____ D (viii) _____ C

(ix) _____ C (x) _____ D

(xi) _____ D (xii) _____ D

(xiii) _____ B (xiv) _____ B and D

(xv) _____ D (xvi) _____ B

(xvii) _____ A (xviii) _____ D

(xix) _____ A (xx) _____ A

Section B

2. (a) _____ (iii) (b) _____ (xi)

(c) _____ (xiv) (d) _____ (viii)

(e) _____ (v) (f) _____ (ix)

(g) _____ (xvii) (h) _____ (xii)

(i) _____ (xvi) (j) _____ (xiii)

(k) _____ (v)

3. (a) Gases have no definite shape because particles are far apart.

(b) A light bulb changes electric energy to light and heat energy.

(c) The density of a liquid can be measured with a hydrometer. The lower it floats in the liquid the more dense it is.

(d) The sun's rays travel in straight lines, at a speed of 3×10^8 metres per second.

(e) The clockwise moment about a point is equal to the sum of anticlockwise moment about the same point.

4. (a) A *periscope* is an instrument that is used to see over an obstacle from a concealed position.

(b) Refer to pages 156 – 157: *Physics for Secondary Schools, Forms 1 & 2.*

(c) Refer to *Figure 9.41: Physics for Secondary Schools, Forms 1 & 2.*

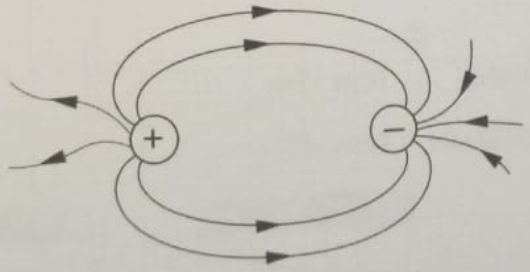
(d) Submarine

5. (a) Coulomb

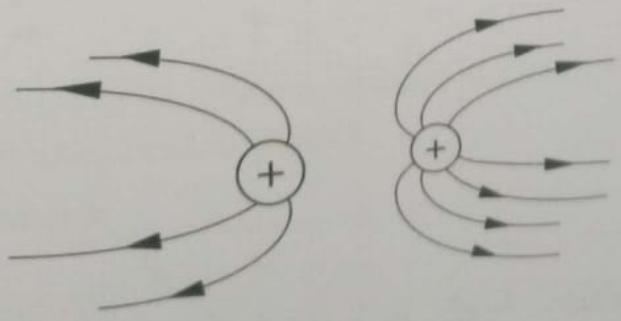
(b) positive and negative charges

(c) Induction, contact and friction

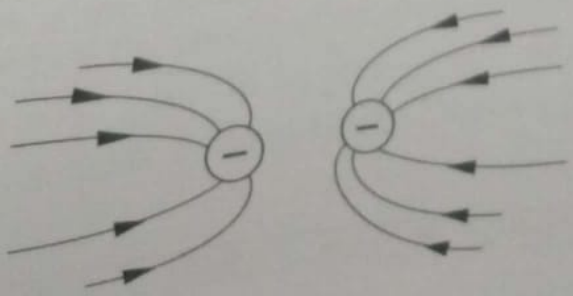
(d) (i)



(ii)



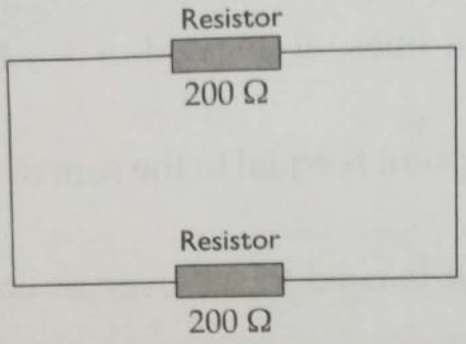
(iii)



6. (a) (i) *A voltmeter* is an instrument that measures the potential difference between two points in a circuit.

(ii) *A rheostat* is a resistor designed to provide variable resistance without breaking the electric circuit of which it is apart.

(b)

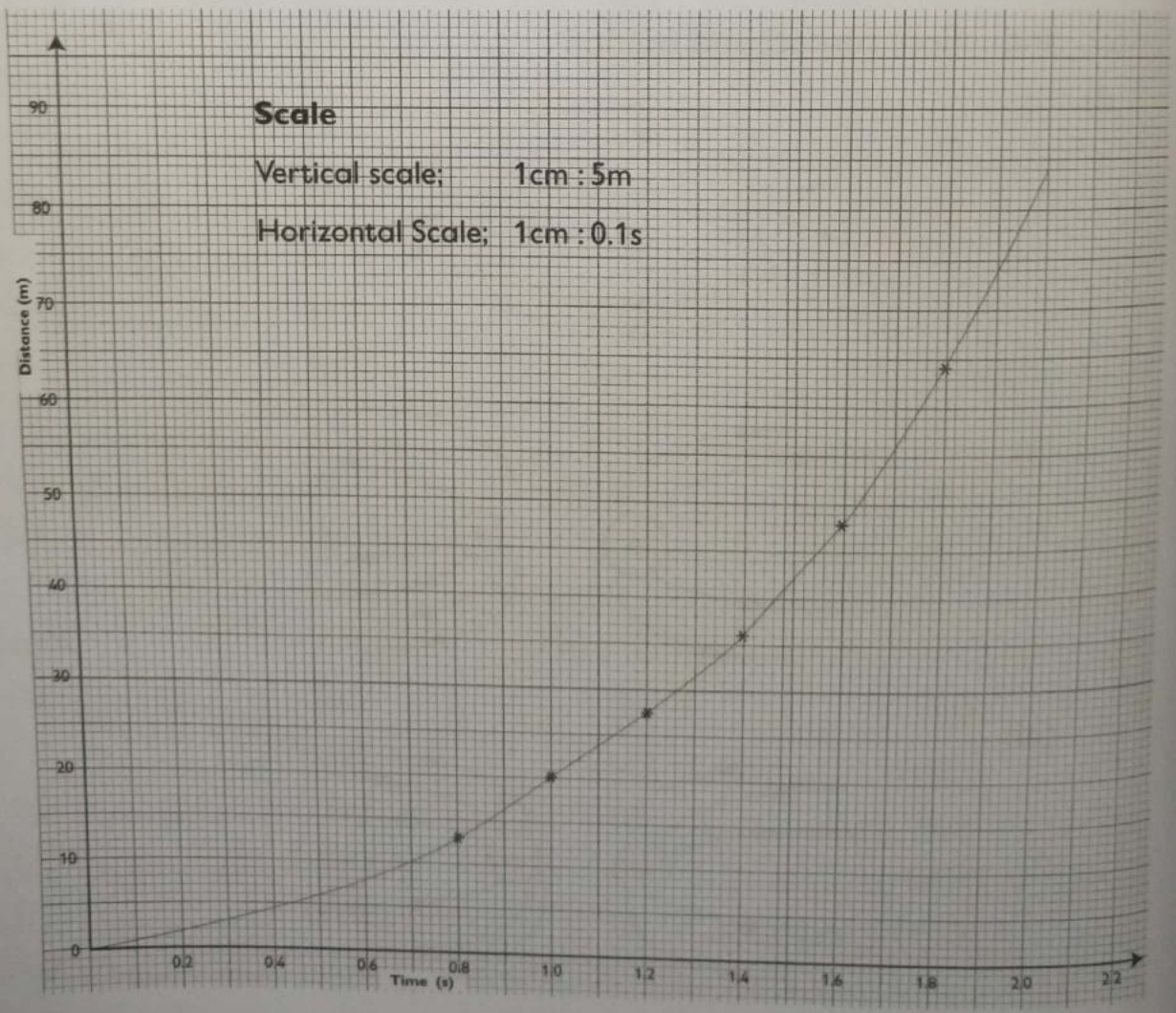


(c) (i) 6 A (ii) 6 V

7. (a) *Acceleration* is the rate of change of velocity with time. It is associated with the increasing of velocity while *retardation* is the rate of change of velocity with time but it is associated with decreasing velocity.

(b) 30.8 m/s²

(c) (i) *The graph of distance against time.*



(ii) The body starts at the origin and moves to the right with an increasing speed.

(iii) 27.5 m/s

8. (a) Refer to *Figure 7.38* on page 122 of *Physics for Secondary Schools, Forms 1 & 2.*

(b) The temperature of the tube rises because some amount of mechanical energy is transformed to heat energy.

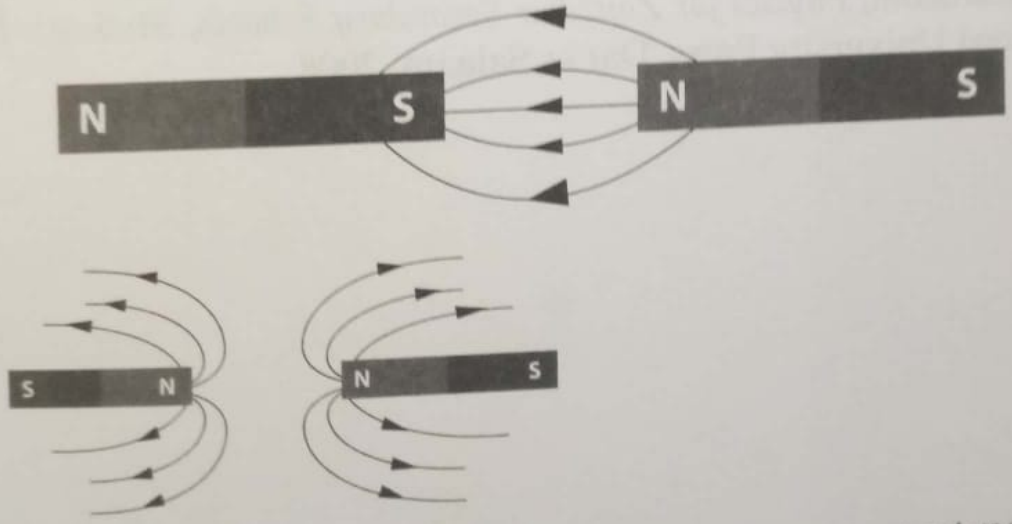
Section C

9. (a) (i) *Magnetism* is the phenomenon of physical attraction for iron that is common in magnets.

(ii) *Electrification* is the process of inducing electric charges in a body so that it is electrically charged.

(iii) Equilibrium – This is a state of balance of a body.

(b)



10. (a) The tendency of an object to remain at rest or in a constant motion along a straight line is called **inertia**.

(b) Galvanometer

11. 5 g.

12. (a) *Momentum* is the product of an object's mass and its velocity while *Kinetic energy* is the energy of an object due to its motion.

(b) (i) 20 kg m/s (ii) 16 kg m/s (iii) 48 J

(iv) It is an inelastic collision, because the kinetic energy is not conserved.