ICSE Living Science

PHYSICS

Book 9

TEACHER'S HANDBOOK

Ratna Sagar P. Ltd.

CONTENTS

Chapter 1
MEASUREMENTS AND EXPERIMENTATION

Check Your Progress (Page 13)

A. 1. c **2.** b **3.** c **4.** b **5.** b

B. 1. Measurement is the comparison of unknown physical quantity with a known fixed unit quantity of the same nature.

2. A quantity used as a standard of measurement is called a unit.

3. Fundamental unit: The units of measurement of length, mass and time are independent of each other, not definable in terms of other quantities and units of all other physical quantities can be obtained from them. These three units are called the fundamental or basic units.

Derived unit: The units of measurement of all other physical quantities which can be expressed in terms of the fundamental units (i.e. mass, length and time) are called derived units.

4. a. CGS system: It is the Gaussian system, which uses centimetre, gram and second as the three basic units of length, mass and time respectively.

b. FPS system: It is the British engineering system of units, which uses **foot** as the unit of length, **pound** as the unit of mass and **second** as the unit of time.

c. MKS system: It uses **metre** as the unit of length, **kilogram** as the unit of mass and **second** as the unit of time. When MKS system is extended to electricity, then with current as fundamental quantity, ampere (A) is taken as its unit. It is then called MKSA system.

d. SI System: In October 1960, the XIth General Conference on Weights and Measures adopted an international system of units called SI units. The name SI is an abbreviation of the "*Systeme International d' Unites*" in French which means **International System of Units**.

5. Plane angle and solid angle. The SI unit of plane angle is radian and solid angle is steradian.

6. The SI unit of length is metre. One metre is the length of the path travelled by light in a vacuum in 1/299,792,458 of a second.

7. a. 1 cm = 10^{-2} m

b. 1 micrometre = 10^{-6} m

c. 1 nanometre = 10^{-9} m

d. 1 angstrom = 10^{-10} m

8. Hectometre and kilometre.

9. a. Astronomical Unit (AU): One astronomical unit is the mean distance between the centres of the earth and the sun, i.e.

1 astronomical unit = 1.496×10^{11} m

or 1 AU = 1.496×10^{11} m

b. Light year (ly): One light year is the distance travelled by light in vacuum in one year, i.e.

1 ly = 9.46×10^{15} m

c. Parsec: One parsec is 3.26 times the light year, i.e.

1 parsec = 3.26 light years

= $3.26 \times (9.46 \times 10^{15}$ m)

1 parsec = 3.08×10^{16} m

10. The SI unit of mass is kilogram. One kilogram is the mass equal to the mass of a standard platinum-iridium alloy cylinder (90% platinum and 10% iridium) kept at 0 °C at the International Bureau of Weights and Measures at Sevres, near Paris in France.

11. The SI unit of time is second. One second is the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium–133 atom.

12. See page 11 of textbook for answer.

13. See page 12 of textbook for answer.

C. Refer to page 13 of the textbook for answers.

Check Your Progress (Page 23)

A. 1. c **2.** b **3.** c **4.** c **5.** a

B. 1. The smallest value of a physical quantity which can be measured (accurately) with an instrument is called the least count (LC) of the measuring instrument.

2. The difference between the size of the smallest division on the main scale and the size of one Vernier division is called Vernier constant. The Vernier constant of an instrument always remains constant. The Vernier constant of the instrument tells us about the smallest length that can be accurately measured with the instrument. So, Vernier constant is the least count of the Vernier callipers.

3. Due to wear and tear of the jaws and due to some manufacturing defect, the zero marks of the main scale and the Vernier scale may not be in the same straight line when the jaws are made to touch each other. This gives rise to an error called zero error.

4. See page 16 of the textbook for answer.
5. See pages 16-17 of the textbook for answer.
6. See pages 18-19 of the textbook for answer.
7. The ratchet avoids undue tightening of the screw. The object whose dimension is to be measured is gripped between stud and spindle by moving the ratchet. Any excessive rotation of the cap would result in unnecessary pressure on the object, and the object might undergo a change in dimensions. This difficulty can be overcome by the ratchet.
8. a. **Pitch:** The linear distance moved by the screw head during one complete rotation of the screw is called the pitch.
   b. **Least count of a screw gauge:** The least count of a screw gauge is the smallest length which can be measured accurately with it.
9. It is a defect in a measuring device (like screw gauge). When jaws of a screw gauge are closed, zero of main scale must coincides with the zero of circular scale in case of screw gauge. If they do not coincide then it is said that a zero error is present in the screw gauge.
10. See page 20 of the textbook for answer.
11. See pages 20-21 of the textbook for answer.

C. 1. **Ans.** Least count = 0.01 cm
2. a. L.C. = 0.01 cm, Reading = 3.45 cm
   b. L.C. = 0.01 cm, Reading = 7.66 cm
   c. L.C. = 0.01 cm, Reading = 4.13 cm
3. **Ans.** 4.62 cm
4. **Ans.** 3.92 cm
5. **Ans.** 0.005 mm
6. **Ans. a.** 0.0837, **b.** 0.555
7. **Ans. a.** Least count = 0.001 cm
   b. Diameter = 0.353 cm

Check Your Progress (Page 30)

A. 1. c 2. c 3. b 4. b

B. 1. An ideal simple pendulum consists of a heavy point mass tied to one end of a perfectly flexible, inextensible and weightless string. Since these ideal conditions are not possible in actual practice, so a metallic bob suspended by means of a fine cotton thread (the closest approximation to the ideal conditions) is used in the laboratory for measuring time interval.
2. See pages 25-26 of textbook for definition.
3. See page 26 of the textbook.
4. Factors affecting the time-period of a simple pendulum:
   a. The time period of a simple pendulum is directly proportional to the square root of its length.
   b. The time period of a simple pendulum is inversely proportional to the square root of the acceleration due to gravity at that place.
   c. The time period of a simple pendulum does not depend on the mass of the suspended body (bob).
   d. The time period of a simple pendulum does not depend on the material of the suspended body (i.e. bob).
   e. The time period of a simple pendulum does not depend upon the amplitude of the vibrations.
5. a. When the length of the pendulum is made 9 times the original length, the time period will increase by 3 times.
   b. When the length of the pendulum is made one-ninth times the original length, the time period will one-third.
   c. When the pendulum is taken to a place where the value of g is 4 times that on the surface of the earth, the time period will be half.
   d. When the pendulum is taken to a place where the value of g is 1/9 times, the time period will be three times that of actual time period.
   e. The time period of a simple pendulum does not depend upon the amplitude of the vibrations.
   f. The time period of a simple pendulum does not depend on the mass of the suspended body.
6. The time period of a simple pendulum does not depend on the following factors: Mass of the bob, material of the bob and amplitude.
7. A pendulum whose time period is two seconds is called a second's pendulum. On the surface of the earth, a simple pendulum having a length of 99.2 cm will have a time period of 2 seconds.

C. 1. Refer to pages 26-27 of the textbook.
2. Given: l = 1.12 m
   g = 9.8 m/s^2
   Time period (T) = ?

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$= 2\pi\sqrt{\frac{1.12}{9.8}}$$

$$= 2\pi \times 0.338$$

$$= 2 \times 3.14 \times 0.338$$

$$= 2.12 \text{ s}$$

3. Given: $T = 1.4$ s

$g = 9.8$ m/s^2

$l = ?$

Using formula

$$l = \frac{g\ T^2}{4\pi^2} = \frac{9.8 \times (1.4)^2}{4 \times \left(\frac{22}{7}\right)^2}$$

$$= 0.49 \text{ m}$$

$$= 49 \text{ cm}$$

4. Given: $T = 2$ s

$$g = \frac{9.8}{6} = 1.63 \text{ m/s}^2$$

$$l = \frac{1.63 \times 2 \times 2}{4 \times \left(\frac{22}{7}\right)^2} = \frac{1.63}{3.14 \times 3.14}$$

$$= 0.165 \text{ m}$$

5.
$$T_1 = 2\pi\sqrt{\frac{l_1}{g}}$$

$$T_2 = 2\pi\sqrt{\frac{l_2}{g}}$$

So, $$\frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}} = \frac{2}{1.44} = \sqrt{\frac{l_1}{l_2}}$$

So, $$\frac{l_1}{l_2} = \frac{(2)^2}{(1.44)^2}$$

$$\frac{l_1}{l_2} = \frac{4}{2.07} = \frac{1.93}{1}$$

$$= 1.93 : 1$$

6.
$$\frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}}$$

$$\frac{l_1}{l_2} = \frac{(T_1)^2}{(T_2)^2} = \frac{(2)^2}{(1)^2} = \frac{4}{1} = 4 : 1$$

7.
$$\frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}} = \sqrt{\frac{110}{27.5}} = \sqrt{\frac{4}{1}} = 2 : 1$$

Exercises (Page 32)

A. 1. Numeric value and unit.

2. The units of measurement of length, mass and time are independent of each other, not definable in terms of other quantities and units of all other physical quantities can be obtained from them. These three units are called the fundamental or basic units.

3.

a. Luminious Intensity	*Ir*	candela	cd
b. Length	*l*	metre	m
c. Quantity of matter		mole	mol
d. Mass	*m*	kilogram	kg
e. Electric Current	*I*	ampere	A
f. Temperature	*T*	kelvin	K
g. Time	*t*	second	s

4. Four characteristics of a standard unit:

(a) It should be of convenient size.

(b) It should be well defined.

(c) It should not change with time and place.

(d) It should be easly available and accessible.

5.

S. NO.	PHYSICAL QUANTITY	SI UNIT	
	NAME	NAME	SYMBOL
1.	Length	metre	m
2.	Mass	kilogram	kg
3.	Time	second	s
4.	Electric current	ampere	A
5.	Temperature	kelvin	K
6.	Luminous intensity	candela	cd
7.	Amount of substance (or quantity of matter)	mole	mol

6.

DERIVED QUANTITY	UNIT	SYMBOL
Volume	cubic metre	m^3
Density	kilogram per cubic metre	kg m^{-3}
Velocity	metre per second	m s^{-1}
Acceleration	metre per second squared	m s^{-2}
Momentum	kilogram metre per second	kg m s^{-1}

7. a. Gram, milligram   b. Quintal, ton

8. Vernier constant (Least count of Vernier callipers)

Suppose the size of one main scale division is

S units and that of one Vernier scale division is **V units**. Also suppose that the length of *m* Vernier divisions is equal to the length of (*m* – 1) main scale divisions, since *m* Vernier divisions coincide with (*m* – 1) main scale divisions. Therefore, the length of (*m* – 1) main scale divisions = length of *m* Vernier scale divisions.

Symbolically,

$$(m-1)S = mV$$

or $$mS - S = mV$$

or $$mS - mV = S \quad \text{or} \quad m(S-V) = S$$

or $$S - V = \frac{S}{m}$$

or $$S - V = \frac{\text{Value of one main scale division}}{\text{Total number of division on the Vernier scale}}$$

The quantity (S – V) represents the **difference between the size of the smallest division on the main scale and the size of one Vernier division**. This quantity (S – V) is called Vernier constant. The Vernier constant of an instrument always remains constant. The Vernier constant of the instrument tells us about the smallest length that can be accurately measured with the instrument. So, Vernier constant is the least count of the Vernier callipers.

Least count of Vernier callipers (Least Count)

$$= \frac{\text{Value of one main scale division}}{\text{Total number of divisions on the Vernier scale}}$$

The least count of Vernier callipers can be calculated by using the principle of Vernier. The length of one small division on the main scale is 1 mm, i.e. S = 1 mm.

$$\therefore \quad \text{Least count} = \frac{S}{m}$$

$$= \frac{1 \text{ mm}}{10 \text{ divisions on the Vernier scale}}$$

$$= 0.1 \text{ mm}$$

Least count = 0.01 cm

9. See page 16 of the textbook for answer

B. 1. Value of one main scale division = 0.05

Total number of division on the vernier scale = 20

Least count = $\frac{0.05}{20}$ = 0.0025 cm.

2. a. pitch

$$= \frac{\text{distance moved by the screw on the main scale}}{\text{number of rotations}}$$

$$= \frac{0.02}{4} = 0.05 \text{ cm}$$

b. Least count

$$= \frac{\text{pitch of the screw guage}}{\text{number of divisions on the circular scale}}$$

$$= \frac{0.05}{50} = 0.001 \text{ cm.}$$

3. Ans. 0.01 cm

4. Ans. 3.22 cm

5. Ans. 0.1 and 0.001 cm

6. Ans. 0.072 cm

7. Ans. 500

8. Ans. 1.40 s

9. Ans. 1.44 s

10. Ans. 0.165 m

11. Ans. 0.995 m

12. Ans. 2 : 1

13. Ans. 4 : 1

14. Ans. 2.34 s

15. Ans. 0.38 m

16. Ans. 1 : 2

17. Ans. 4 : 9

Chapter 2
MOTION IN ONE DIMENSION

Check Your Progress (Page 43)

A. 1. b **2.** c **3.** c **4.** d **5.** a

B. 1. Force, vector.

2. Distance, scalar.

3. m, Basic SI unit

4. A car moving in a market place, Non-uniform acceleration.

C. 1. The book is at rest. When a body is not changing its position with respect to the surroundings is said to be at rest.

2. The bird is in motion, the bird is changing its position with respect to the surroundings, is said to be in motion.

3. Rest and motion are relative terms, see page 34.

4. The motion of an object is said to be one dimensional motion if only one out of the three coordinates (i.e. *x*, *y*, or *z*) specifying the position of the objects changes with respect to time e.g. the motion of a train in a straight line, motion of freely falling object.

5. Scalar quantity: The physical quantities which got only magnitude are known as scalar quantities, e.g. mass, temperature, etc.

Vector quantity: The physical quantities which got magnitude as well as direction are known as vector quantities. e.g. force, acceleration etc.

6. Distance is simply the length between two points, it is a scalar quantity whereas the displacement is the shortest distance between two points, it is a vector quantity.
7. CGS: cm, SI: m.
8. Speed: rate of change of distance; mathematically speed = $\frac{\text{distance}}{\text{time}}$,

   unit – CGS: cm/s, SI: m/s, it is a scalar quantity.

   Velocity: rate of change of displacement, it is a vector quantity.
9. CGS: cm/s, SI : m/s.
10. Uniform speed : If a body covers equal distances in equal intervals of time.

    Non-uniform speed: If a body covers unequal distances in unequal intervals of time.
11. If the speed of a body changes continuously with time, its speed at any instant is known as instantaneous speed.

    If a body travels with non-uniform speed then the speed of the body is obtained by finding the average of the speeds for different instants.
12. Uniform velocity: If a body travels in straight line and covers equal distances in equal intervals of time.

    Non-uniform velocity: When a body covers unequal distances in unequal intervals of time.
13. Average speed: When a body travels with a non-uniform speed, then the average speed of the body is determined by dividing total distance by total time.

    Average velocity: If the velocity of a body in a particular direction changes continuously at a uniform rate, then the arithmetic mean of the initial and final velocities over a given period of time is called the average velocity in that direction.
14. Acceleration: The rate of change of velocity is known as acceleration.
15. CGS: cm/s^2 SI: m/s^2
16. When a body is initially at rest then the change in velocity is known as acceleration, when a body finally comes to rest the change in velocity is known as retardation.
17. When a body travels in a straight line and its velocity changes by equal amounts in equal intervals of time, then it is said to have uniform acceleration. When the velocity of a body changes by unequal amounts in equal intervals of time, then it is said to have non-uniform acceleration.
18. It means that the rate of change of velocity is 9.8 m/s.
19. When a body falls freely the acceleration acting by the pull of the earth is known as the acceleration due to gravity.
20. The value of '*g*' on earth decreases as we go away from the surface of the earth. It is 9.8 m/s^2 on the surface of the earth. As we move down, below the surface of the earth it deceases.
21. Since the acceleration due to gravity is same for both, both will reach at the same time.

D. 1. a. $s = \frac{d}{t} = \frac{1500}{150} = 10$ m/s.

b. $s = \frac{1.5}{1/24} = 36$ km/h.

2. a. Speed = $\frac{450}{120} = 3.75$ m/s.

b. $s = \frac{0.450}{1/30} = 13.5$ km/h.

3. Average speed = $\frac{\text{total distance}}{\text{time}}$

$$= \frac{20+40}{\frac{1}{2}+\frac{1}{3}} = 72 \text{ km/h.}$$

4. Average speed = $\frac{\text{total distance}}{\text{time}}$

$$= \frac{200+200}{\frac{2}{3}+\frac{10}{12}}$$

$$= 266.67 \text{ km/h}$$

5. Average speed = $\frac{\text{total distance}}{\text{time}}$

$$\Rightarrow \quad 40 = \frac{40+120}{\frac{40}{20}+\frac{120}{x}}$$

$$\Rightarrow \quad 2x = 120$$

$$x = \frac{120}{2} = 60 \text{ km/h.}$$

6. Average speed = $\frac{\text{total distance}}{\text{time}}$

$$\Rightarrow \quad 60 \text{ km/h} = \frac{10}{\frac{4}{40}+\frac{6}{x}}$$

therefore, speed (x) = 90 km/h.

7. $a = \frac{v-u}{t} = \frac{20-10}{5} = 2$ m/s^2.

8. Given: $v = 60$ km/h $= \frac{60\times100}{60\times60} = \frac{50}{3}$ m/s

u = 45 km/h = $\frac{45 \times 1000}{60 \times 60} = \frac{25}{2}$ m/s

t = 10 s

Now, $a = \frac{v-u}{t} = \frac{\frac{50}{3}-\frac{25}{2}}{10} = \frac{\frac{100-75}{6}}{10} = \frac{\frac{25}{6}}{10}$

$= \frac{25}{60}$ = 0.42 m/s^2.

Check Your Progress (Page 52)

A. **1.** c **2.** c **3.** d **4.** a

B. **1.** **a.** Speed **b.** Velocity

c. Acceleration **d.** Acceleration

2. **1.** Uniform speed

2. Speed is decreasing

3. Body is moving with constant speed

4. Body is moving with non-uniform speed.

3. 1. Non-uniform velocity initially the body is moving

2. Body starts from rest, velocity is non-uniform,

3. Body is initially not at rest, velocity is increasing uniformly.

4. Velocity is decreasing non-uniformly, body is initially not at rest.

4. **a.** speed (A to B) = slope = $\frac{p}{b} = \frac{6}{3}$ = 2 m/s.

b. speed (B to C) = $\frac{p}{b} = \frac{0}{1}$ = 0

c. speed (C to D) = $\frac{p}{b} = \frac{2}{2}$ = 1 m/s.

5. **a.** 40 km/h

b. a = slope = $\frac{p}{b} = \frac{2}{30}$ = 6.67 km/h^2

c. $a = \frac{p}{b} = \frac{0}{3} = 0$

d. $a = \frac{p}{b} = \frac{40}{2}$ = –20 km/h^2.

6. **a.** $a = \frac{p}{b} = \frac{40}{2}$ = 20 m/s^2

b. $a = -\frac{40}{2}$ = – 20 m/s^2.

c. S = area of graph = $\frac{1}{2}$ × 4 × 40 = 80 m

7. **a.** $a = \frac{25}{6}$ = 4.16 m/s^2

b. $a = \frac{-10}{2}$ = – 5 m/s^2

c. $S = \frac{1}{2} \times 6 \times 25 + \frac{1}{2} \times 40 \times 2 + \frac{1}{2} \times 4 \times 15$

= 75 + 40 + 30 = 145 m

d. $v = \frac{15}{2}$ = 7.5 m/s

8. Graph; average velocity = 10 m/s

9. Graph; distance = 150 m

Check Your Progress (Page 58)

A. **1.** c **2.** c **3.** a

B. **1.** Acceleration = $\frac{\text{final velocity} - \text{initial velocity}}{\text{time taken}}$

$a = \frac{v-u}{t} \Rightarrow at = v - u$ or, $v = u + at$

2. Average velocity

$= \frac{\text{initial velocity + final velocity}}{2}$

$= \frac{u+v}{2}$ since $v = u + at$,

average velocity = $\frac{2u+at}{2}$,

S (distance) = average velocity × time.

$$S = \left(u + \frac{1}{2}at\right)t = ut + \frac{1}{2}at^2$$

3. Average velocity

$= \frac{\text{initial veolcity + final velocity}}{2} = \frac{u+v}{2}$,

$$S = \frac{u+v}{2 \times t} \quad [\text{since } v = u + at]$$

$$t = \frac{v-u}{a}$$

therefore, $S = \frac{(u+v)}{2} \cdot \frac{(v-u)}{a}$

$$S = \frac{v^2 - u^2 + uv - uv}{2a}$$

$$v^2 = u^2 + 2aS.$$

4., **5.**, **6.**, page 56, Equation of motion.

7. **a.** When body is at rest

b. When a body is finally at rest

c. When the change in velocity is constant

C. **1.** $v = u + at$, 0 = 0.5 – 0.05 t, t = 10 s.

2. $a = \frac{v-u}{t} = \frac{20-10}{20}$ = 0.5 m/s^2

$S = ut + \frac{1}{2}at^2$, $S = 10 \times 20 + \frac{1}{2} \times 0.5 \times 400$

= 300 m

3. $S = ut + \frac{1}{2}at^2$, $500 = 0 + \frac{1}{2} \times a \times 100$,

a = 10 m/s^2

$v = u + at$, v = 0 + 10 × 10 = 100 m/s

4. $S = \frac{1}{2}at^2$ (if $u = 0$), $S = \frac{1}{2} \times 10 \times 25 = 125$ m

5. $-a = \frac{u-v}{t} = \frac{16.7-12.5}{10} = 0.42$ m/s^2

6. $v = u + at$, $0 = u + (-5) \times 15 \Rightarrow u = 75$ m/s

7. $v = u + at$, $v = 6 + 1.5 \times 5 = 13.5$ m/s^2

$S = ut + \frac{1}{2}at^2$, $S = 6 \times 5 + \frac{1}{2} \times 1.5 \times 5 \times 5$

$= 48.75$ m

8. $v^2 = u^2 + 2aS$, $0 = 2500 + 2 \times a \times 0.1$,

$a = 12.5$ km/s^2

9. $a = \frac{v-u}{t} = \frac{15-5}{5} = 2$ m/s^2

10. Given: $v = 0$

$t = 20$ s

$a = -2$ m/s^2

$u = ?$

using equation

$v = u + at$

$\Rightarrow 0 = u + (-2) \times 20$ s

$\Rightarrow 0 = u - 40$

$\Rightarrow u = 40$ m/s

11. Given $a = -6$ m/s^2

$t = 2$ s

$v = 0$

$u = ?$

$S = ?$

using equation

$v = u + at$

$\Rightarrow 0 = u + (-6) \times 2$ s

$\Rightarrow 0 = u - 12$

$\therefore u = 12$ s

Now, $S = ut + \frac{1}{2}at^2$

$= 12 \times 2 + \frac{1}{\not{2}} \times -6 \times \not{4}^2$

$= 12$ m

12. Given: $a = 4$ m/s^2, $u = 0$

$t = 10$ s

$S = ut + \frac{1}{2}at^2$

$= 0 \times 10 + \frac{1}{\not{2}} \times \not{4}^2 \times 10 \times 10$

$= 200$ m.

Exercises (Page 59)

1. The moving car is in motion with respect to the surroundings.

   Motion: A body is said to be in motion if it changes its position with respect to a fixed point taken as a reference point in its surroundings.

2. **Speed:** The speed of a body is the distance travelled by it per unit time.

   It is a scalar quantity.

   It is always positive (not zero).

   Velocity: The distance travelled by a body per unit time in a given direction is called its velocity.

   It is a vector quantity.

   It can be zero, negative or positive.

3. **Accelerating car:** It starts from rest and its velocity changes (increases) with respect to time.

   Retarding car: The car is initially in motion and finally the velocity is decreasing, then acceleration is negative, known as retardation.

4. **a.** The value of 'g' is maximum at poles.

   b. The value of 'g' is minimum at the equator. At the centre of the earth the value of 'g' becomes zero.

5. **a.** The value of 'g' decreases as we move away from the surface of the earth.

   b. The value of 'g' is maximum on the surface of earth, i.e. 9.8 m/s^2.

6. **a.** Fig. 4.16 Page 57

   b. Fig. 4.18 Page 58

   c. Fig. 4.19. Page 58

7. **a.** Fig. 4.25 Page 60

   b. Fig. 4.26 Page 60

   c. Fig. 4.27 Page 60

8. **a.** When body is initially at rest.

   b. When body is finally at rest.

   c. When $v = u$.

B. 1. Speed of Cheetah when prey is up to distance less than 500 m

$= 100 \times \frac{5}{18}$ m/s $= \frac{250}{9}$ m/s

Distance of prey $= 100$ m

Time to catch

the prey $= \frac{100}{\frac{250}{9}} = \frac{100}{250} \times 9 = \frac{90}{25} = 3.6$ *s*

2. $u = 5$ m/s $V = 10$ m/s $t = 5$ s

a. $a = \frac{v-u}{t} = \frac{5}{5} = 1 \text{ m/s}^2$

b. $S = ut + \frac{1}{2}at^2$

$= 5 \times 5 + \frac{1}{2} \times 1 \times 5 \times 5$

$= 25 + 12.5 = 37.5$ m

3. $a = -6 \text{ m/s}^2$ $t = 2$ s $v = 0$

$v = u + at$

$0 = u + (-a)t$, $u = 6 \times 2 = 12$ m/s

$S = ut + \frac{1}{2}at^2 = 12 \times 2 - \frac{1}{2} \times 6 \times 4 = 12$ m

4. a. $u = 0$ $v = 6$ m/s $t = 30$ s

$a = \frac{v-u}{t} = \frac{6-0}{30} = \frac{6}{30} = 0.2 \text{ m/s}^2$

b. $u = 6$ m/s $v = 4$ m/s $t = 5$ s

$a = \frac{v-u}{t} = \frac{4-6}{5} = \frac{-2}{5} = -0.4 \text{ m/s}^2$

5. $u = 0$ $v = 72 \text{ km/h} = 72 \times \frac{5}{18} = 20$ m/s

$t = 5 \times 60 = 300$ s

a. $a = \frac{v-u}{t} = \frac{20-0}{300} = \frac{20}{300} = 0.066 \text{ m/s}^2$

b. $S = ut + \frac{1}{2}at^2$

$= 0 + \frac{1}{2} \times 0.066 \times 300 \times 300$

$= \frac{1}{2} \times \frac{2}{30} \times 300 \times 300 = 3000$ m

6. Here, total distance travelled

$S = 30 + 30 = 60$ km

Time taken to travel first 30 km at the uniform speed of 40 km/h

$= \frac{30 \text{ km}}{40 \text{ km/h}} = 0.75$ h

Time taken to travel next 30 km at the uniform speed of 20 km/h

$= \frac{30 \text{ km}}{20 \text{ km/h}} = 1.5$ h

Average speed $= \frac{\text{Total distance}}{\text{Total time}}$

$= \frac{60 \text{ km}}{(1.5 + 0.75)\text{h}} = 26.67$

$= 26.7$ km/h

7. Total distance = 120 km

Total time = ?

Average speed = 60 km/h

Average speed $= \frac{\text{Total distance}}{\text{Total time taken}}$

Hence, $60 \text{ km/h} = \frac{120 \text{ km}}{\text{Time taken}}$

Time taken $= \frac{120 \text{ km}}{60 \text{ km/h}} = 2$ h

Now, distance = 40 km, time = ? speed = 40 km/h

Speed $= \frac{\text{distance}}{\text{time}} = 40 \text{ km/h} = \frac{40 \text{ km}}{\text{Time}}$

time $= \frac{40 \text{ km}}{40 \text{ km/h}} = 1$ h

Now distance = 80 km, time left = (2–1) = 1 h

Now speed for rest part $= \frac{80 \text{ km}}{1 \text{ hr}} = 80$ km/h

8. a. Initial velocity (u) = 0

(As the body starts from rest)

Final velocity (v) = 36 km/h = 10 m/s

Time (t) = 10 s

$a = \frac{v-u}{t} = \frac{(10-0) \text{ m/s}^2}{10 \text{ s}}$

$= 1 \text{ m/s}^2$

b. Initial velocity (u) = 36 km/h = 10 m/s

Final velocity (v) = 0 km/h

(As the body stops)

$t = 20$ s

$a = \frac{v-u}{t} = \frac{(0-10) \text{ ms}^2}{20 \text{ s}} = -0.5 \text{ m/s}^2$

(retardation)

9. Let distance be d.

Total time taken $= \left(\frac{d}{30 \text{ km/h}} + \frac{d}{45 \text{ km/h}}\right)s$

Average speed $= \frac{\text{Total distance}}{\text{Total time}}$

$= \left[\frac{d+d}{\left(\frac{d}{30 \text{ km/h}} + \frac{d}{45 \text{ km/h}}\right)s}\right]$

$= \left[\frac{2}{\left(\frac{1}{30} + \frac{1}{45}\right)}\right]$

$= \frac{2}{\left(\frac{3+2}{90}\right)}$

$= \left(\frac{2}{\frac{5}{90}}\right)\text{km/h}$ $\left(\frac{2 \times 90}{5}\right)$ km/h

$= 36$ km/h

10. Initial speed $(u) = 36$ km/h

$$= \frac{36 \times 1000}{60 \times 60}$$

$= 10$ m/s

Final speed $(v) = 72$ km/h

$$= \frac{72 \times 1000}{60 \times 60} = 20 \text{ m/s}$$

$t = 5$ s

a. acceleration $(a) = \dfrac{v - u}{t}$

$$= \frac{20 - 10}{5} = 2 \text{ m/s}^2$$

b. In this case,

$u = 72$ km/h $= 20$ m/s

$v = 0$ m/s

$t = 20$ s

$$a = \frac{v-u}{t} = \frac{(0-20)\ m/s}{20\ s} = \frac{-20}{20}$$

$= -1$ m/s^2

11. Initial velocity $(u) = 50$ m/s

acceleration $(a) = 5$ m/s^2

distance $(s) = 240$ m

$v^2 = u^2 + 2aS$

$= (50 \text{ m/s})^2 + 2 \times 5 \text{ m/s}^2 \times 240$ m

$= 2500 + 2400 = 4900$ m^{2}s^2

$v = 70$ m/s

Now, $t = \dfrac{v-u}{a} = \dfrac{70 \text{ m/s} - 50 \text{ m/s}}{5 \text{ s}}$

$= 4$ s

12. Given: $a = 4$ m/s^2, $u = 0$

$t = 10$ s

Now, $s = ut + \dfrac{1}{2}at^2$

$= 0 \times 10 \text{ s} + \dfrac{1}{2} \times 4 \text{ m/s}^2 \times 10 \text{ s} \times 10 \text{ s}$

$= 200$ km

13. Given: Initial speed $(u) = 90$ km/h

$$= \frac{90 \times 1000}{60 \times 60} = 25 \text{ m/s}$$

Acceleration $(a) = 0.5$ m/s^2

$v = 0$ (as train stops)

Now,

$v^2 = u^2 + 2aS$

$(0)^2 = (25)^2 + 2 \times (-0.5 \text{ m/s}^2) \times s$

$= 625 - S$

$S = 625$ m

14. Given: Initial velocity $(u) = 90$ km/h

$$= \frac{90 \times 1000}{60 \times 60} = 25 \text{ m/s}$$

Final velocity $(v) = 0$

distance $s = 50$ m

$v^2 = u^2 + 2aS$

$$a = \frac{v^2 - u^2}{2S} = \frac{(0)^2 - (25)^2}{2 \times 50}$$

$$= \frac{-625}{100} = -6.25 \text{ m/s}^2$$

15. Given: acceleration $(a) = -0.25$ m/s^2

$v = 0$, $u = ?$, $t = 20$ s

a. $v = u + at$

$0 = u + (-0.25 \text{ m/s}^2) \times 20$ s

$u = 5$ m/s

b. $S = ut + \dfrac{1}{2}at^2$

$= 5 \times 20 + \dfrac{1}{2} \times (-0.25) \times 20 \times 20$

$= 100 - 50 = 50$ m.

16. Distance = ?, Speed $= 3 \times 10^8$ m/s

$$\text{time} = \frac{0.5 \times 10^{-3}}{2} \text{ s}$$

$= 0.25 \times 10^{-3}$ s

Distance = speed × time

$= 3 \times 10^8 \text{ m/s} \times 0.25 \times 10^{-3}$ s

$= 3 \times 25 \times 10^3$ m

$= 75000$ m

$= 75$ km.

17. Given: $u = 0$, $v = 72$ km/h

$$= \frac{72 \times 1000}{60 \times 60} = 20 \text{ m/s}$$

time $(t) = 5$ min $= 5 \times 60 = 300$ s

a. $a = \dfrac{v-u}{t} = \dfrac{20-0}{300} = \dfrac{20}{300} = \dfrac{1}{15}$ ms^2

b. $v^2 = u^2 + 2aS$

$v^2 = u^2 = 2aS$

$$S = \frac{v^2 - u^2}{2a} = \frac{(20)^2 - (0)^2}{2 \times \frac{1}{15}}$$

$$= \frac{400}{\frac{2}{15}} = \frac{400 \times 15}{2}$$

$= 3000$ m $= 3$ km.

18. Given: $u = 72$ km/h $= 20$ m/s

$a = -2$ m/s^2, $v = 0$, $t = ?$

a. $v = u + at$

$0 = 20 \text{ m/s} + (-2 \text{ m/s}^2) \times t$

$0 = 20 - 2t$

$2t = 20$

$t = \frac{20}{2} = 10 \text{ s}$

b. $S = \frac{v^2 - u^2}{2a}$

$= \frac{(0)^2 - (20)^2}{2 \times -2}$

$= \frac{-400}{-4} = 100 \text{ m.}$

Chapter 3
LAWS OF MOTION

Check Your Progress (Page 66)

A. **1.** b **2.** c **3.** d **4.** c **5.** a

B. **1.** Magnetic force, because all other forces are examples of contact forces.

2. Frictional force, because all other forces are non-contact forces.

3. Catch, because all other are examples of contact forces.

C. **1.** Force is a push or pull acting on a body which changes or tends to change the state of rest or of uniform motion, or the direction of motion, or the shape and size of the body.

2. **a.** Contact forces are forces which act only when objects are in physical contact with each other.

b. The forces which do not involve physical contact between the objects but act through the space between them are called non-contact forces.

3. Push, pull and stretch; (Pushing a wheel-barrow, pulling of a cart by a horse, stretching a spring by suspending a load).

4. **a.** **Frictional force:** When the surface of one body is made to slide or roll over the surface of another body, a force arises which opposes the motion of the first body over the other. This force which opposes the motion is called the frictional force. Example: A moving ball stops after rolling.

b. **Normal reaction force:** The force which acts in normal direction to counter balance the force due to some external source. Example: Weight of an object resting on a surface.

c. **Tension force as applied through strings:** The weight of a bob suspended by a long string acts vertically downwards. An equal and opposite force acts on the string upwards which balances the tension force as applied through string.

d. **Force exerted during collision:** Due to collision, equal and opposite forces act on each body which make them move apart after the collision. Example: When a truck and a car collide with each other, they experience a force, resulting in change in their velocities.

5. Examples of non-contact forces:

1. A body falling freely towards the earth under the force of gravity.

2. A magnet attracting iron clips towards itself.

3. A plastic comb rubbed against dry hair attracting tiny bits of dry paper towards itself.

6. **a.** **Gravitational force:** The force of attraction extracted by the earth on all the objects is called the gravitational force. Example: A ball dropped from a height fall down due to gravitational force.

b. **Magnetic force:** The force between the two magnetic poles of a magnet even when they are at a separation is called the magnetic force. Example: a magnet attracts iron nails kept at a separation.

c. **Electrostatic force:** The force exerted by the electrostatic charge is called the electrostatic force. Example: A rubbed plastic comb attracts small pieces of paper due to electrostatic charge.

7. General properties of non-contact forces.

1. Non-contact forces come into act even though the objects are not in contact with each other.

2. These forces act through the space between the objects (not in physical contact with each other).

3. The magnitude of non-contact forces depends on the distance of separation. It decreases with increase in distance of separation.

8. The magnitude of non-contact forces depends on the distance of separation. It decreases with the increase in distance of separation. Example: A magnet attracts the iron nails which are very near to it. It does not attract the iron nails if they are placed very far from it.

9. **a.** Pulling an engine to move the train, pulling of a grass roller by a gardener.

b. Pushing a door to shut it, pushing the piston of a syringe by a doctor.

c. Squeezing a gum tube to extract the gum, squeezing a piece of lemon to extract lemon juice.

d. Stretching a spring by suspending a load, stretching a rubber band for fastening a roll of papers.

10. 1. Force can cause motion in a stationary object. Example: A horse can make a cart move by pulling it in the forward direction; a railway engine can move a train standing on a railway track.

2. Force can stop a moving object. Example: A moving car comes to rest on applying brakes; a cricketer stops a moving ball by applying a force with his hands.

3. Force can change the direction of motion of an object. Example: When a batsman hits the ball with his bat, the direction of the moving ball changes; a moving car changes its direction, when a force is applied on its steering wheel.

4. Force can change the speed of a moving body. Example: If a person pushes an oscillating swing, it will oscillate faster; the speed of a ball rolling on the ground decreases continuously due to the force of friction.

5. Force can change the shape and size of an object. Example: A thin foil is made by hammering a metal sheet, on pressing a piece of rubber, its shape changes.

11. The SI unit of force is newton.

12. The CGS unit of force is dyne.

$1 \text{ newton} = 1 \text{ kg} \times 1 \text{ m/s}^2$

13. $1 \text{ newton} = 1 \text{ kg} \times 1\text{m/s}^2$

$= 1000 \text{ g} \times 100 \text{ cm/s}^2$

$= 10^5 \text{ g cm/s}^2 = 10^5 \text{ dynes}$

$\therefore \quad 1 \text{ N} = 10^5 \text{ dynes.}$

Check Your Progress (Page 70)

A. 1. a 2. b 3. c 4. a 5. b

B. 1. Every body continues to be in its state of rest or of uniform motion in a straight line unless it is compelled by some external force to change that state.

2. Suppose a book is kept on the table, it will remain on the table unless some external force is applied for removing the book.

3. A ball is thrown on the ground, it will continue to move unless and until some opposing force is applied, it come to rest because of the resistive forces like friction, etc.

4. Newton's first law defines the inertia, it is the inherent property of a body by virtue of which it resists any change in its state of rest or of uniform motion in a straight line on its own.

5. Inertia of a body is directly proportional to mass of the body, a heavier body has more inertia than a lighter body.

6. a. Take an empty and dry glass tumbler. Place a square piece of thick, smooth card over the mouth of the glass. Place a coin at the card, flick the card horizontally striking it hard, the card piece flies away and the coin falls into the glass. The mass of the coin is more than the card board.

b. If a truck and a car met with a head on collision than the car will have greater loss (damage) as the mass of truck is more than the mass of the car.

7. Experiment – Demonstration of the property of inertia, page 72 fig 5.1.

8. A body at rest remains at rest and cannot start moving on its own due to the inertia of rest.

9. a. When a passenger is sitting or standing in a stationary bus, both the bus and the passenger are at rest, when the bus starts suddenly, the lower part of the passenger's body starts moving forward with the bus. But the upper part of the body tends to remain in the state of rest due to inertia of rest.

b. Initially both the carpet and the dust are at rest. When the carpet is shaken or beaten with a stick. The carpet is set into motion while the dust remains in the state of rest due to the inertia of rest, thus dust falls down.

c. Initially the glass is in the state of rest. When a bullet strikes the glass pane which comes in contact with the bullet immediately shares the large velocity of the bullet and flies away making a hole. The remaining part of the glass, due to inertia of rest, remains at rest and is not cracked.

d. When a passenger is sitting or standing in a moving bus, both the bus and passenger are in the state of motion. When bus stops suddenly, the lower part of the passenger's body comes to rest along with the bus, but the upper part of his body tends to remain in state of motion due to its inertia of motion. As a result the passenger leans forward.

e. Initially both the person and the moving bus are in the state of motion. When the passenger jumps out of the speeding bus, the lower part of the body comes to rest on touching the ground, but the upper part remains in motion as a result he may fall forward and get seriously injured.

f. This is because in doing so, he acquires the inertia of motion. The velocity is added to the jump hence, he can jump a longer distance.

Check Your Progress (Pages 74-75)

A. 1. c **2.** d **3.** c **4.** c **5.** a

B. 1. The linear momentum of a body of mass '*m*' is travelling with velocity '*v*' is defined as the product of its mass and velocity. Its SI unit is kg m/s.

2. The momentum of cricket ball will be more as the mass of the cricket ball is more than the tennis ball.

3. P = $m \times v$.

4. It is a vector quantity as the velocity is a vector quantity and mass is a scalar quantity, so the product of scalar and vector is a vector.

5. Newton's second law of motion (derivation of $F = m\,a$, page 75.)

6. Rate of change of momentum, page 76.

7. It states that the rate of change of momentum of a body is directly proportional to the net external force applied on it and the change in momentum takes place in the direction in which the force is applied.

8. newton

9. kgf

10. See page 73 of the textbook

11. See page 72 of the textbook

C. 1. i. Since inertia is directly proportional to the mass. $\frac{I_1}{I_2} = \frac{m_1}{m_2} = \frac{1}{1} = 1 : 1$

ii. $\frac{P_1}{P_2} = \frac{m_1 v_1}{m_2 v_2}\ \frac{P_1}{P_2} = 1 : 3$

iii. $\frac{F_1}{F_2} = \frac{P_1}{P_2} = 1 : 3$

2. $F = ma$, $a = \frac{F}{m} = \frac{10}{2} = 5$ m/s^2

3. $a = \frac{F}{m}$, $a = \frac{5}{10} = 0.5$ m/s^2

4. $a = \frac{30}{10} = 3$ m/s^2, $F = m\,a$, $F = 3 \times 3 = 9$ N

5. i. $-a = \frac{20}{10} = -2$ m/s^2

ii. $F = m\,a$

$F = 2400 \times 2 = 4800$ N.

6. $P = mv$, $P = \frac{0.450 \times 120 \times 5}{18} = 15$ kg m/s.

7. $P_1 = mv$, $P_1 = 5 \times 10 = 50$ kg m/s.

$P_1 = 5 \times 0 = 0$

8. $P = 1500\ (50 - 40) = 15000$ kg m/s

9. i. $P = 1600 \times 0 = 0$

ii. $P = 1600 \times 30 = 48000$ kgm/s

iii. $\frac{4800}{20} = 2400$ N

iv. $a = \frac{F}{m} = \frac{2400}{1600} = 1.5$ m/s^2

v. 2400 N

Check Your Progress (Page 79)

A. 1. c **2.** b **3.** c **4.** b **5.** c

B. 1. To every action, there is an equal and opposite reaction; action and reaction forces justify act on different bodies.

2. The weight of the book acting downward and the reaction of the table acting downward.

3. Experimental demonstration of Newton's third law of motion page 80 supporting fig. 5.9

4. a. When a gun is fired, the bullet goes out due to the force applied on it through the trigger, according to Newton's third of motion, the gun recoils backwards due to the reaction acting in opposite direction.

b. Fig. 5.15; when a man gets out of a boat, he pushes the boat backward, the boat exerts an equal and opposite force in the forward direction which enables him to move forward.

c. In a jet plane the jet engine burns the fuel and produces large volume of hot gases which scape out of a nozzle with a great force, according to Newton's third law of motion, the equal and opposite reaction pushes the jet plane which provides an easy lift to the jet plane.

d. A runner presses the ground with his feet before he starts his race to get a better start as the push from the ground as the reaction of the force applied by him helps him to drag forward.

e. As the water comes out with a great speed from the hose-pipe which applies a great force just to oppose the force the fireman holds the pipe tightly.

f. The swimmer pushes water backward as action and he moves forward as the reaction according to Newton's third law of motion.

g. When we walk on the ground, we push the ground by our feet the ground in turn pushes our feet with an equal and opposite reaction, because of which forward walking is possible.

h. While hammering a nail, the force of the hammer on the nail is the action, according to Newton's third law of motion, the nail exerts an equal and opposite force on the hammer, since the hammer is held firmly so our hand feels the force due to reaction.

i. When we strike a rubber ball against a wall or hard floor the ball exerts a force on the floor. According to Newton's third law of motion the floor exerts an equal and opposite force on the ball.

Exercises (Page 80)

A. 1. Force is a push or a pull which changes or tends to change the state of rest or of uniform motion, the direction of motion or the shape and the size of a body.

2. **a.** A spring is stretched by a force : A force can change the size of an object

b. A small piece of copper sheet is hammered to make a thin foil : A force can change the shape of an object.

c. A football lying on the ground is kicked : A force can cause motion in a stationary object.

d. A fielder catches a cricket ball : A force can stop a moving ball.

e. A player hits an incoming ball with a hockey stick : A force can change the direction of motion of an object.

f. Brakes are applied in a moving car : A force can stop a moving body.

3. **Contact forces:** Wind force, Pushing a cart, Hitting a ball, Pressing a rubber ball.

Non-contact forces: Gravitational force, Magnetic force, Electrostatic force.

4. Refer to Check Your Progress (Page 66) section question C.10

5. See page 67 of the textbook.

6. See page 67 of the textbook

7. Mass

8. See page 68 of the textbook

9. See page 69 of the text book.

10. A ball with more speed, due to more momentum

11. i. 1 : 2 ii. 1 : 1 iii. 1 : 1

12. 20 s

13. i. 5 m/s^2 ii. 90 m

14. 0.3 m/s^2, 3 N

15. See page 76 of the textbook

16. See pages 77-78 of the textbook.

B. 1. i. 2 m/s^2 ii. 14000 N

2. 2550 N

3. i. – 5000 m/s^2 ii. 2.25 m iii. – 50 N

4. 2500 N

5. i. – 5 m/s^2 ii. – 24000 kg m/s iii. – 6000 N

6. 4500 N

7. – 1000 N

8. – 7500 N

9. 20 S

10. – 75 N

11. 2 s

12. i. 8 m/s ii. 100 m

Chapter 4
GRAVITATION

Check Your Progress (Page 86)

A. 1. d **2.** c **3.** c **4.** b **5.** c

B. 1. Any two particles (or objects) in the universe attract each other with a force called the force of gravitation.

2. The phenomenon of attraction between different bodies in the universe is called gravitation. If one of the two bodies happens to be the earth, it is a special case of gravitation called gravity.

The force of gravitation exerted by the earth is called gravity.

3. Every body in the universe attracts every other body with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between them. The force acts along the line joining the centres of the two bodies.

4. See pages 86-87 of the textbook.

5. Universal Gravitational Constant is equal to the force of attraction acting between two bodies each of unit mass (i.e. 1 kg) whose centres are placed unit distance (i.e. 1 m) apart. The SI unit of Universal Gravitational Constant (G) is N m^2/kg^2.

6. Henry Cavendish

7. The value of *G* does not depend upon the nature, size or masses of the bodies.

8. The value of *G*, is same throughout the universe (because of this reason, it is called Universal Gravitational Constant). Thus the law defining this, is also applicable for whole of the universe.

9. **a-d.** The G will same for all the cases as it is a universal constant.

10. **a.** It is the gravitational force between the sun and all the eight planets which makes them move around the sun.

b. It is the gravitational force between the earth and the moon which makes the moon move around the earth.

c. It is the gravitational force exerted by the sun and the moon on the sea water leading to the formation of tides in the sea.

11. Gravitational force.

C. **1.** **a.** 3 times **b.** 4 times

c. 9 times **d.** same or no increase

2. increased 16 times

3. $F = \dfrac{6.7 \times \cancel{10^{-11}}^{\,-10} \times 25 \times 4\cancel{0}}{\cancel{10} \times 1\cancel{0}} = 6.7 \times 10^{-10}$ N

4. $G = 6.68 \times 10^{-11}$ N m^2/kg^2

5. $F = 4.15 \times 10^{23}$ N

Check Your Progress (Page 90)

A. **1.** c **2.** a **3.** c **4.** c **5.** d

6. d **7.** c **8.** b **9.** a **10.** b

B. **1.** Yes, a stone and the earth attract each other with an equal and opposite force.

2. The uniform acceleration produced in a body when it falls freely under the effect of gravity (gravitational force of earth) alone is known as acceleration due to gravity. It is denoted by the letter, g. The SI unit of g is the same as that of acceleration, i.e. m/s^2.

3. Acceleration due to gravity, $g = G\dfrac{M}{R^2}$

4. The value of acceleration due to gravity g is independent of mass, shape and size of the body but depends upon mass and radius of the earth.

5. The value of acceleration due to gravity changes with height (or altitude), depth and shape of the earth.

6. As we know that acceleration due to gravity, $g = G\,M/R^2$ so, as the radius of the object increases the value of g decreases and as the radius of object decreases, the value of g increases.

7. Earth is not a perfect sphere. It is flattened at the poles and bulges out at the equator. Equatorial radius, R_e of the earth is about 21 km greater than the polar radius. The radius of the earth is maximum at the equator, so the value of g is minimum at the equator, and since the radius of the earth is minimum at the poles, the value of g is maximum at the poles.

8. As we go up the value of g reduces. So, the value of acceleration due to gravity is lesser at the top of the mountains than on plains.

9. See page 89 of the textbook.

C. **1.** Given: mass of stone (m) = 2 kg

mass of earth (M) = 6×10^{24} kg

radius of earth (R) = 6.4×10^{-6} m

Acceleration due to gravity (g) = $\dfrac{G \times M}{R^2}$

$= \dfrac{6.67 \times 10^{-11}\ \text{Nm}^2/\text{kg}^2 \times 6 \times 10^{24}\text{kg}}{(6.4 \times 10^6 \text{m})^2}$

$= 9.8$ m/s^2

2. Given: mass of planet (M) = 6×10^{24} kg

diameter (d) = 12.8×10^3 km

= 12.8×10^6 m

So, Radius = $\dfrac{12.8 \times 10^6 \text{m}}{2} = 6.4 \times 10^6$ m

$G = 6.67 \times 10^{-11}$ Nm^2/kg^2

Acceleration due to gravity (g)

$= \dfrac{G \times M}{R^2}$

$= \dfrac{6.67 \times 10^{-11}\text{Nm}^2/\text{kg}^2 \times 6.4 \times 10^{24}\text{kg}}{(6.4 \times 10^6 \text{m})^2}$

$= 9.8$ m/s^2

3. Given: mass of moon (M_e) = 7.4×10^{22} kg

diameter of moon (d_e) = 3.48×10^3 km

= 3.48×10^6 m

So, Radius of moon (M_e) = $\dfrac{3.47 \times 10^6 \text{m}}{2}$

= 1.74×10^6 m

$G = 6.67 \times 10^{-11}$ Nm^2/kg^2

Acceleration due to gravity on the surface of moon (g_e)

$= \dfrac{G \times M_e}{{R_e}^2}$

$= \dfrac{6.67 \times 10^{-11}\text{Nm}^2/\text{kg}^2 \times 7.4 \times 10^{22}\text{kg}}{(1.74 \times 10^6 \text{m})^2}$

$= \dfrac{49.358 \times 10^{22-11}}{3.03 \times 10^{12}}$

$= \dfrac{49.358 \times \cancel{10^{11}}}{3.03 \times \cancel{10^{12}}_{10}}$

$$= \frac{49.358}{30.30} = 1.63 \text{ m/s}^2$$

4. Given: mass of planet = $\frac{6 \times 10^{24} \text{kg}}{2}$

$= 3 \times 10^{24}$ kg

radius of planet = $\frac{6.4 \times 10^6 \text{m}}{2} = 3.2 \times 10^6$ m

$G = 6.67 \times 10^{-11}$ Nm^2/kg^2

Acceleration due to gravity of the given planet

$$= \frac{G \times M}{R^2}$$

$$= \frac{6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2 \times 3 \times 10^{24} \text{kg}}{(3.2 \times 10^6 \text{m})^2}$$

$$= \frac{20.01 \times 10^{24-11}}{10.24 \times 10^{12}}$$

$$= \frac{20.01 \times \cancel{10^{13}}^{10}}{10.24 \times \cancel{10^{12}}} = \frac{200.10}{10.24} = 19.6 \text{ m/s}^2$$

5. Given: acceleration due to gravity (g_e) of moon

$= 1.67$ m/s^2

Radius of moon (R_e) = 1.74×10^6 m

$G = 6.67 \times 10^{-11}$ Nm^2/kg^2

Mass of moon (M_e) = ?

$$g_e = \frac{G \times M_e}{R_e^2}$$

or $$M_e = \frac{g_e \times R_e{}^2}{G}$$

$$= \frac{1.67 \times (1.74 \times 10^6)^2}{6.67 \times 10^{-11} \text{Nm}^2/\text{Kg}^2}$$

$$= \frac{5.06 \times 10^{12}}{6.67 \times 10^{-11}} = \frac{5.06 \times 10^{23}}{6.67}$$

$= 0.76 \times 10^{23}$

$= 7.6 \times 10^{22}$ kg

6. Mass of Sun (M_s) = 1.99×10^{30} kg

Mass of earth (M_e) = 6×10^{24} kg

Mass of moon (M_m) = 7.4×10^{22} kg

Distance beween sun and earth

$d_1 = 1.49 \times 10^8$ km

$= 1.49 \times 10^{11}$ m

Distance between moon and earth

$d_2 = 3.84 \times 10^8$ m

F_{se} = ?

F_{me} = 9

$$F_{se} = G \times \frac{M_s \times M_e}{(d_1)^2} \quad \ldots\text{(i)}$$

$$F_{me} = G \times \frac{M_m \times M_e}{(d_2)^2} \quad \ldots\text{(ii)}$$

Comparing equations (i) and (ii)

$$\frac{F_{se}}{F_{me}} = \frac{\cancel{G}\, M_s \times \cancel{M_e}}{(d_1)^2} \times \frac{(d_2)^2}{\cancel{G} \times M_m \times \cancel{M_e}}$$

$$= \frac{M_s \times (d_2)^2}{(d_1)^2 \times M_m}$$

$$= \frac{1.99 \times 10^{30} \text{kg} \square\ (3.84 \times 10^8)^2}{(1.49 \times 10^{11})^2 \times 7.4 \times 10^{22} \text{kg}}$$

$$= \frac{29.34 \times \cancel{10^{46}}^{100}}{16.43 \times \cancel{10^{44}}} = \frac{293.4}{16.43} = 178.57$$

$\simeq 180$ times

7. 5 m/s^2, since g is independent of the mass of the body.

8. *Given:* $m = 2m$

$R = 2R$

$$g = \frac{G \times m}{R^2} = 9.8 \text{ m/s}^2$$

when, $$\frac{G \times 2m}{(2R)^2} = \frac{G \times 2m}{{}_2\cancel{4}R^2} = \frac{9.8}{1}$$

$$\frac{G \times m}{R^2} = \frac{\cancel{9.8}}{\cancel{2}} = 4.9 \text{ m/s}^2$$

9. 2.45 m/s^2

Check Your Progress (Page 95)

A. **1.** b **2.** c **3.** c **4.** a **5.** a

B. **1.** Given: $g = 10$ m/s^2

$h = 80$ m

$u = 0$

$v = ?$

We know that $v^2 = u^2 + 2gh$

$v^2 = (0)^2 + 2 \times 10 \times 80$ m

$v = 1600$

$v = \sqrt{1600} = 40$ m/s

2. Given: $t = 4$s

$g = 10$ m/s^2

$u = 0$

$h = ?$

By applying equation of motion

$$h = ut + \frac{1}{2}gt^2$$

$$= 0 \times 4s + \frac{1}{2} \times 10 \times (4)^2$$

$$= 0 + \frac{1}{\cancel{2}} \times 10 \times 4 \times \cancel{4}^2 = 80 \text{ m}$$

3. Given:

$$h = 180 \text{ m}$$
$$v = 0$$
$$u = ?$$
$$g = -10 \text{ m/s}^2$$

Using formula,

$$v^2 = u^2 + 2\,gh$$
$$(0)^2 = u^2 + 2 \times (-10 \text{ m/s}^2) \times 180 \text{ m}$$
$$0 = u^2 + 20 \times 180$$
$$u^2 = 3600$$
$$u = \sqrt{3600} = 60 \text{ m/s}$$

4. Given: $u = 50$ m/s

a. $v = 0$

b.

$$v^2 = u^2 + 2gh$$
$$v^2 = (50)^2 + 2 \times (-1 \text{ m/s}^2) \times h$$
$$(0)^2 = 2500 - 20\,h$$
$$20\,h = 2500$$
$$h = \frac{2500}{20} = 125 \text{ m}$$

c.

$$v = u + gt$$
$$t = \frac{v-u}{g} = \frac{0-50}{-10} = \frac{-50}{-10} = 5 \text{ s}$$

5. Given: height of tower (h) = 180 m

$$t = ?$$
$$v = ?$$
$$g = 10 \text{ m/s}^2$$
$$u = 0$$

a.

$$S = ut + \frac{1}{2}at^2$$
$$180 = 0 \times t + \frac{1}{\cancel{2}} \times \cancel{10}^5 \times t^2$$
$$5t^2 = 180$$
$$t^2 = \frac{180}{5} = 36$$
$$t = \sqrt{36} = 6 \text{ s}$$

b.

$$v^2 = u^2 + 2\,gh$$
$$v^2 = (0)^2 + 2 \times 10 \times 180$$
$$v^2 = 3600$$
$$v = \sqrt{3600} = 60 \text{ m/s}$$

6. Given: $u = 0$

$$h_1 = 4.9 \text{ m}$$
$$g = 9.8 \text{ m/s}^2$$

a.

$$S = ut + \frac{1}{2}gt^2$$
$$4.9 \text{ m} = 0 \times t + \frac{1}{2} \times 9.8t^2$$
$$4.9 \text{ m} = 4.9 \text{ m} \times t^2$$
$$t^2 = \frac{4.9}{4.9} = 1$$
$$t = 1 \text{ s}$$

b.

$$v = u + at$$
$$= 0 + 9.8 \times 1$$
$$= 9.8 \text{ m/s}$$

c.

$$v^2 = u^2 + 2gh$$
$$v^2 = (0)^2 + 2 \times 9.8 \times 7.9$$
$$v^2 = 154.84$$
$$v = \sqrt{154.84} = 12.4 \text{ m/s}$$

d. After 1 second $g = 9.8$ m/s^2

It will be same (9.8 m/s^2) after 2 seconds.

7. For first stone

$$u = 0,\; h = 480 \text{ m},\; g = 10 \text{ m/s}^2$$

From $h = ut + \frac{1}{2}gt^2$

$$480 = 0 + \frac{1}{\cancel{2}} \times \cancel{10}^5 t^2$$
$$480 = 5t^2$$
$$t^2 = \frac{480}{5} = 96$$
$$t = \sqrt{96} = 9.79 \text{ s}$$

For second stone

$$u = ?,\; h = 480 \text{ m},\; g = 10 \text{ m/s}^2$$

Time taken ($t - 1$) = (9.79 – 1) = 8.79 s

From $h = ut + \frac{1}{2}gt^2$

$$480 = u \times 8.79 + \frac{1}{\cancel{2}} \times \cancel{10}^5 \times 8.79 \times 8.79$$
$$480 = u \times 8.79 + 386.32$$
$$u \times 8.79 = 480 - 386.32 = 93.68$$
$$u = \frac{93.68}{8.79} = 10.66 \text{ m/s}$$

8. Given: $h = 20$ m, $g = 10$ m/s^2, $u = ?$, $v = 0$

a.

$$v^2 = u^2 + 2gh$$
$$(0)^2 = u^2 + 2 \times (-10) \times 20$$
$$0 = u^2 - 400$$
$$u^2 = 400$$
$$u = \sqrt{400} = 20 \text{ m/s}$$

b. From formula,

$$t = \frac{v-u}{g} = \frac{0-20}{-10} = 2\text{s}$$

9. Given: Height of tower h = 60 m, u = 20 m/s, g = 10 m/s^2

Distance covered by ball

$$v^2 = u^2 + 2gh$$
$$(0)^2 = (20)^2 + 2 \times (-10 \text{ m/s}^2) \times h$$
$$0 = 400 - 20h$$
$$h = \frac{400}{20} = 20 \text{ m}$$

Total distance to travel by the ball to pass the man

= 20 + 20

= 40 m

Total distance from the ground = 20 + (60 + 20)

= 100 m

$$t_1 = \frac{v-u}{g} = \frac{0-20}{-10} = 2 \text{ s}$$
$$v^2 = u^2 + 2gh$$
$$v^2 = (0)^2 + 2 \times 10 \times 20$$
$$v^2 = 400$$
$$v = 20 \text{ m/s}$$
$$t = \frac{20-0}{10} = 2 \text{ s}$$

a. Total time to travel 40 m

= 2 s + 2 s = 4 s

b. $$h = ut + \frac{1}{2}gt^2$$

$$80 = 0 \times t + \frac{1}{\cancel{2}} \times \overset{5}{\cancel{10}} \times t^2$$
$$5t^2 = 80$$
$$t^2 = \frac{80}{5} = 16$$
$$t = \sqrt{16} = 4 \text{ s}$$

Total time to travel 100 m

= 2 s + 4 s = 6 s

Check Your Progress (Page 99)

A. **1.** c **2.** b **3.** b **4.** c **5.** b
6. b **7.** b **8.** b

B. **1.** The mass of a body is the quantity of matter contained in it. The SI unit of mass is kg.

2. i. Mass is a scalar quantity.
ii. The mass of a body can never be zero.
iii. The mass of a body can be measured with the help of a two-pan balance beam.

3. The weight of a body is the force with which it is attracted towards the centre of the earth. The SI unit of weight is newton (N).

4. $W = m \times g$

weight = mass × acceleration due to gravity

5. i. It is a vector quantity having direction towards the centre of the earth.
ii. Weight is measured with a spring balance or by a weighing machine.
iii. The weight of a body changes from place to place.

6. Let the mass of an object be m. Let its weight on the earth be W_e. Let the mass of the earth be M_e and its radius be R_e.

By applying Newton's Universal Law of Gravitation, the weight (force of attraction) of the body on the earth will be

$$W_e = \frac{GM_e m}{R_e^2} \quad \text{... (i)}$$

Similarly, the weight of an object on the moon is the force with which it is attracted towards the centre of the moon. The mass of the object is m. Let its weight on the moon be W_m. Let the mass of the moon be M_m and its radius be R_m.

By applying Newton's Universal Law of Gravitation, the weight (force of attraction) of the object on the moon will be

$$W_m = \frac{GM_m m}{R_m^2} \quad \text{... (ii)}$$

Dividing eq. (ii) by eq. (i), we get

$$\frac{W_m}{W_e} = \frac{\frac{GM_m m}{R_m^2}}{\frac{GM_e m}{R_e^2}} = \frac{M_m}{M_e} \times \frac{R_e^2}{R_m^2} = \frac{M_m}{M_e} \times \left(\frac{R_e}{R_m}\right)^2 \quad \text{... (iii)}$$

From the table given as follows, we conclude

$$M_e = 100M_m \text{ and}$$
$$R_e = 4R_m$$

Substituting the above values in equation (iii), we get

Physical quantity	Earth	Moon	Comparison between earth and moon
Mass (kg)	5.98×10^{24}	7.36×10^{22}	The mass ofthe earth is about 100 times more than that of the moon, i.e.
Radius (m)	6.37×10^6	1.74×10^6	The radius of the earth is about 4 times more than that of moon, i.e. $R_e = 4R_m$

$$\frac{W_m}{W_e} = \frac{M_m}{100\ M_m} \times \left(\frac{4R_m}{R_m}\right)^2$$

$$\frac{W_m}{W_e} = \frac{1}{100} \times \frac{16}{1} = \frac{16}{100}$$

$$\frac{W_m}{W_e} = \frac{1}{6}$$

$$W_m = \frac{1}{6} W_e$$

Weight of the object on the moon

$= \left(\frac{1}{6}\right) \times$ Weight of the same object on the earth

Thus, the weight of a body on the moon is 1/6th of its weight on the earth.

7. See page 97 of the textbook.
8. See pages 97-98 of the textbook.

C. 1. Because inertia of a body depends on its mass. As the mass increases its inertia increases and as the mass decreases its inertia decreases.
2. The mass of an object is the quantity of matter contained in it, which never changes. So it is constant everywhere.
3. The mass of a body can never be zero as a body contains the same quantity of matter whether it is on the earth or the moon or anywhere in the universe.
4. See page 96 of the textbook
5. See page 97 of the textbook
6. Since the weight of a body is given by $W = m \times g$ and the value of g (acceleration due to gravity) changes from place to place, therefore, the weight of a body changes from place to place.
7. We know the value of g is minimum at the equator and maximum at the poles. That is why, a body weighs more at the poles than at the equator.
8. Due to the variation in g (acceleration due to gravity).
9. Because $g = 0$ at the centre of the earth.
10. There is no acceleration due to gravity (g) in the interplanetary space.
11. Since the value of g is constant at a given place, so at a given place, the weight of an object is directly proportional to its mass.

D. 1. Weight = mass × acceleration due to gravity

$= m \times g$

$= 20 \times 10 = 200$ N

2. Mass (m) = $\frac{W}{g} = \frac{98}{9.8} = 10$ kg

3. Given: $m = 90$ kg

$g = 10$ m/s^2

Weight of the object on earth = $m \times g$

$= 90\times 10 = 900$ N

Weight on moon = $\frac{W_e}{6} = \frac{900}{6} = 150$ N

Mass on moon = 90 kg (same as on earth)

4. Given: $W = 588$ N

Mass on earth = $\frac{W}{g} = \frac{588}{9.8} = 60$ N

Mass on moon = 60 kg (as it is same everywhere)

Acceleration due to gravity on moon = $\frac{9.8}{6}$

$= 1.633$ m/s^2

5. Mass of earth = 6×10^{24} kg

Radius of earth = 6.4×10^6 m

$G = 6.67 \times 10^{-11}$ Nm^2/kg^2

g of the heavenly body

$$= \frac{6.67 \times 10^{-11} \times 2 \times 6 \times 10^{24}}{(3 \times 6.4 \times 10^6 \text{m})^2}$$

$$= \frac{6.67 \times 10^{-11} \times 12 \times 10^{24}}{19.2 \times 19.2 \times 10^{12}}$$

$$= \frac{80.04 \times \cancel{10^{13}}^{10}}{368.64 \times \cancel{10^{12}}}$$

$$= \frac{800.40}{368.64} = 2.17 \text{ m/s}^2$$

Mass of the object = $\frac{450}{9.8} = 45.91$ kg

Weight of the object on heavenly body

$= 45.91 \times 2.17 = 99.62 \simeq 100$ N

6. Given: Mass = 70 kg

$g_m = 1.6$ m/s^2

Weight of man on moon = $70 \times 1.6 = 112$ N

Mass of man on moon = 70 kg (same)

7. Given: Weight of stone = 490 N

$g = \frac{9.8}{2} = 4.9$ m/s^2

a. Mass = $\frac{W}{g} = \frac{490}{4.9} = 100$ kg

b. Weight of stone on earth = 100×9.8

$= 980$ N

EXERCISES (PAGE 101)

A. 1. $M_1 = 2m_1$

$M_2 = 2m_2$

$d = \frac{d}{2}$

$$F = G\frac{2m_1 \times 2m_2}{\left(\frac{d}{2}\right)^2} = G\frac{4m_1m_2}{\frac{d^2}{4}}$$

2. See page 88 of the textbook.

3. Because the centre of earth attracts all bodies towards itself.

4. When a spring balance, holding a mass is let fall freely, the reading will go from the maximum weight to zero.

5. Yes, a body has mass equal everywhere but that body will have zero weight places like at the centre of the earth and interstellar spaces where the value of acceleration due to gravity is zero.

6. The moon will travel in the tangential direction.

7. We know that the value of *g* is minimum at equator and maximum at the poles. The weight (*W*) of the object will increase. No, weight will not same at both the places.

8. Given:

$$F = G\frac{m_1m_2}{d^2}$$

$$F = G\frac{2m_1 \times 2m_2}{4d^2}$$

Distance should be doubled to maintain the same force.

9. Given:

Distance = 2 × radius of earth

= $2 \times 6.4 \times 10^6$ km

Mass = Mass of the earth as the object has same density

= 6×10^{24} kg

$$g = G\frac{M}{R^2}$$

$$= \frac{6.67 \times 10^{-11}\ Nm^2kg^{-2} \times 6 \times 10^{24}kg}{(2 \times 6.4 \times 10^6)^2}$$

$$= \frac{40.02 \times \cancel{10^{13}}^{10}}{163.84 \times \cancel{10}^{12}}$$

$$= \frac{400.02}{163.84} = 2.44\ m/s^2$$

10. Yes, the apple also attracts the earth, but the force is so small that it is considered negligible.

12. See pages 82–83 of the textbook.

13. See page 88 of the textbook.

a. As we go up, the value of *g* decreases.

b. As we move from equator to pole the value of *g* increases.

B. 1. Given: Mass = 60 kg

$g = 10\ m/s^2$

Weight on earth = 60 × 10 = 600 N

Weight on moon = $\frac{600}{6}$ = 100 N

2. Given: $h = 5$ m

$g = 10\ m/s^2$

$u = 0$

$v = ?$

$v^2 = u^2 + 2gh$

$v^2 = (0)^2 + 2 \times 10 \times 5$

$v^2 = 100$

$v = \sqrt{100} = 10$ m/s

3. Given: $h = 100$ m

$g = 10\ m/s^2$

$u = 0$

$v = ?$

$v^2 = u^2 + 2gh$

$v^2 = (0)^2 + 2 \times 9.8 \times 100$

$v^2 = 1960$

$v = \sqrt{1960} = 44.27$ m/s

4. Given:

Mass on earth = 30 kg

Mass on moon = 30 kg

Weight on earth = 30 × 10 = 300 N

Weight on moon = $\frac{300}{6}$ = 50 N

5. Given: Weight of man on moon = 130.4 N

$g_m = 1.63\ m/s^2$

Mass of man on moon = $\frac{130.4}{1.633}$ = 79.75 kg

Weight of man on earth = 79.75 × 9.8

= 781.55 = 781.6 N

6. Given: $h = 4.9$ m

$u = ?$

$v = 0$

$g = 9.8\ m/s^2$

$v^2 = u^2 + 2gh$

$(0)^2 = u^2 + 2 \times (-9.8) \times 4.9$

$$= u^2 - 9.8 \times 9.8$$
$$u^2 = 9.8 \times 9.8$$
$$u = \sqrt{9.8 \times 9.8} = 9.8 \text{ m/s}$$
$$v = u + gt$$
$$o = 9.8 + (-9.8) \times t$$
$$9.8\,t = 9.8$$
$$t = \frac{9.8}{9.8} = 1 \text{ s}$$

Chapter 5
PRESSURE IN FLUIDS; ATMOSPHERIC PRESSURE

Check Your Progress (Page 109)

A. **1.** b **2.** c **3.** c **4.** c **5.** b **6.** c

B. **1.** The total force exerted by a liquid normally on a surface is called thrust of the liquid. The SI unit of thrust is newton (N) and CGS unit is dyne.

2. Pressure exerted by a standing liquid due to its weight is called hydrostatic pressure.

3. See pages 102-103 of the textbook.

4. See page 102 of the textbook.

5. The pressure at a point in the liquid does not depend on
1. the shape and the size of the container.
2. the area of the surface on which it acts.

6. The five laws of liquid pressure are as follows:
1. Pressure at a point inside the liquid at a given depth increases with the increase in the density of the liquid.
2. Pressure is same in all directions, about a given point within the liquid.
3. Pressure is the same at all points in a horizontal plane at a given depth in a stationary liquid.
4. Pressure at a point inside the liquid increases with the depth from the free surface of the liquid.
5. A liquid seeks its own level.

7. A manometer is a device to measure pressures. A common simple manometer consists of a U-shaped tube of glass filled with some liquid. Typically the liquid is mercury because of its high density.

8. See page 105 of the textbook.

9. See page 105 of the textbook.

10. See page 106 of the textbook.

11. In hydraulic machines and in hydraulic jack.

12. See page 107 of the textbook. Hydraulic brakes and hydraulic jack work on this principle.

13. See pages 107-108 of the textbook.

14. See page 102 of the textbook.

15. The thrust exerted by a liquid per unit area of the surface is called the pressure of the liquid. The SI and CGS units of pressure are N/m^2 and dyne/cm^2 respectively.

16. 1. Depth of the point below the free surface of the liquid.
2. Density of the liquid.
3. Acceleration due to gravity.

17. See page 105 of the textbook.

19. See page 106 of the textbook.

C. **1.** Given: Normal air pressure = 76 cm of mercury
= 0.76 cm
g = 10 m/s^2
density of mercury = 13,600 kg/m^3

Using formula,
$$P = h\rho g$$
$$= 0.76 \times 10 \times 13{,}600$$
$$= 103360 \text{ Pa.}$$

2. Given:

Area of cross section of pump plunger
= 0.04 m^2 (a_2)

Area of cross section of a hydraulic press
= 16 m^2 (a_1)

a. By Pascal's law
$$\frac{L}{E} = \frac{a_1}{a_2}$$
$$\frac{1200 \text{ kgf}}{E} = \frac{16}{0.04}$$
$$E = \frac{1200 \times 0.04}{16 \times 100} = 3 \text{ kgf}$$

b.
$$MA = \frac{\text{Load}}{\text{Effort}}$$
$$10 = \frac{3 \text{ kgf}}{\text{Effort}}$$
$$\therefore \quad \text{Effort} = \frac{3}{10} = 0.3 \text{ kgf}$$

3. Here, $\frac{\text{Radius of press plunger}}{\text{Radius of pump plunger}} = \frac{R}{r} = \frac{25}{3}$

According to the principle of hydraulic machine
$$\frac{L}{E} = \frac{\pi R^2}{\pi r^2}$$

Putting the given values in the above equation,

$$\frac{L}{18 \text{ kgf}} = \frac{\not{\pi}}{\not{\pi}}\left(\frac{25}{3}\right)^2$$

or $$\frac{L}{18} = \frac{625}{9}$$

$$\therefore \quad L = \frac{625 \times \not{15}^{\,2}}{\not{9}} = 1250 \text{ kgf}$$

Check Your Progress (Page 115)

A. **1.** a **2.** b **3.** b **4.** c **5.** c

B. **1.** The air above us presses us down with a force equal to that exerted by a mass of 1 kg on an area of 1 cm^2. This is called the atmospheric pressure.

2. 1.013×10^6 pascal, 1.013×10^6 dyne/cm^2.

3. Page 110, Experiment to demonstrate the existence of 0 pressure.

4. 1. Sucking soft drink through a straw.
2. Filling ink in a fountain pen.
3. Working of a syringe.

5. **a.** When the nozzle of a syringe is dipped in a liquid and its piston is withdrawn, the pressure inside the syringe is lowered. The greater atmospheric pressure acting on the surface pushes the liquid into the syringe.

b. Our body maintains the blood pressure which counter balances the atmospheric pressure so we do not feel uneasy.

c. Mountaineers suffer nose bleeding at high altitudes. The atmospheric pressure is maximum on the surface of the earth. When we go on higher altitudes; the atmospheric pressure decreases since our blood is at higher pressure than the out side atmospheric pressure, some of the blood vessels burst and bleeding takes place through nose.

d. Rubber suction pads are used on the walls to hang clothes and calendars. When moistened rubber suction pad is pressed against the wall, the air between the suction pad and wall is forced out, reducing the pressure inside. The outside atmospheric pressure being greater, pushes the suction pad firmly.

e. Two holes are made in a sealed oil tin in order to drain out or pour out the oil. The atmosphere exerts pressure through one hole on the oil contained in the sealed tin, so oil comes out from the tin through the second hole.

6. Atmospheric pressure is measured by an instrument called barometer. Three types of barometer are in common use:
1. Simple barometer
2. Fortin's barometer
3. Aneroid barometer

7. When a fine tube of one metre full of mercury is kept vertical on a trough full of mercury we find that after some time the mercury level settle down about the height of 760 cm. The space above is known as Torricellian vacuum.

8. 1. Mercury is a shining and an opaque metal, therefore reading can be seen easily.
2. The density of mercury is 13.6 g/cm^3, which is the maximum for any liquid. Therefore the length of the mercury column needed to balance the atmospheric pressure is 76 cm which is manageable.
3. The freezing point of mercury is 30 °C, which is much lower than that of water.
4. Mercury can be obtained easily in its pure state.
5. Mercury does not evaporate under ordinary conditions.

9. 1. It has no protection for the glass tube and hence it may break.
2. It is not portable so it is inconvenient to move it from one place to another.
3. The surface of mercury in the trough is open. Therefore there are chances that impurities get mixed with the mercury of the trough.

10. Atmospheric pressure changes with altitude, it decreases by 1 mm Hg with every 12 m ascent.

11. It decreases as we go up.

12. **a.** It increases as we go deep inside of the earth, i.e. deep mine,

b. It increases as we go up on the top of the hill.

13. **a.** Gradual fall in the mercury level in a barometer indicates too much moisture in the air and the possibility of rain.

b. Sudden fall in the mercury level in a barometer at a place indicates low pressure, this usually results in a storm or cyclone.

c. Gradual rise in the mercury level in a barometer indicates dry weather.

d. Sudden rise in the mercury level indicates extremely dry weather.

14. It states that atmospheric pressure is equal to the weight of the column of mercury having a height of 76 cm.

15. Fig 5.14 page 113

16. Altimeter is a modified form of barometer which measures the height of the place. It works on the principle of barometer, it is used in aircrafts and used by the sky divers.

17. $\frac{F_1}{F_2} = \frac{A_1}{A_2} = \frac{4}{64} = \frac{10}{x}$ = 160 N, Pascal's law

Exercises (Page 116)

A. 1. See page 103 of the textbook.

2. $P = \frac{mg}{A} = \frac{25\text{N}}{0.5\text{m} \times 0.5\text{m}} = \frac{\cancel{25} \times 100}{0.\cancel{25}}$ 100 Pa

3. Given:

Pressure of water pipe on the ground floor

$= 39000$ Pa

Pressure of water pipe on the first floor

$= 9000$ Pa

Difference in pressure

$= (39000 - 9000)$ Pa

$= 30{,}000$ Pa

$h = ?$

Density of water

$\rho = 1000 \text{ kg/m}^3$

$g = 10 \text{ m/s}^2$

Using formula

$P = h\rho g$

$30000 \text{ Pa} = h \times 1000 \text{ kg/m}^3 \times 10 \text{ m/s}^2$

$h = \frac{3\cancel{0000} \text{ Pa}}{1\cancel{000} \text{ kg/m}^3 \times 1\cancel{0} \text{ m/s}^2} = 3 \text{ m}$

∴ Height of first floor = 3 m

4. a. Atmospheric pressure = Pa

b. Pa + hρg

c. Pa + hρg

5. 980 Pa

6. The inflated gas balloon will burst out.

7. 13.6×10^3 Pa

B. 1. 101292.8 Pa

2. 76 cm

3. 10 m

4. a. 2.5 kgf   b. 0.25 kgf

5. 3920 kgf

6. 75000 Pa

7. 97920 Pa

8. 1200 Pa

9. 700 Pa

10. 9.52 m

11. 8000 m

12. a. 10.3×10^5 Pa

b. 11.3×10^5 Pa

Chapter 6
BUOYANCY AND ARCHIMEDES' PRINCIPLE

Check Your Progress (Page 121)

A. 1. b   2. b   3. a   4. a   5. c

B. 1. When a body is partially or wholly immersed in liquid an upward dragging force is observed which is known as buoyant force and the phenomenon is known as buoyancy.

2. The weight acting downward and the upthrust acting upward.

3. Page 120, Mathematical expression for upthrust.

4. The pressure at the bottom of the immersed body is more than the pressure at the surface, this results the upthrust.

5. a. The buoyant force will increase.

b. The buoyant force decreases.

c. The buoyant force varies with the temperature.

6. It appears light in water because of the upthrust.

7. It is easier to lift a heavy stone underwater because of the buoyant force acting upward against the weight of the body.

8. The block of cork needs a force to be immersed in the water because it is lighter than water.

9. Page 121, Archimedes' principle

10. 1. Volume of the body submerged in the fluid.
2. Density of the fluid.
3. Acceleration due to gravity.
4. Temperature of the fluid.

11. The piece of the wood left under water comes to the surface of the water because the buoyant force is more than the weight of the wood.

12. It states that when a body is partially or wholly immersed in a fluid, it experiences an upthrust which is equal to the weight of the fluid displaced by the immersed part of the body.

Check Your Progress (Page 125)

A. 1. c **2.** c **3.** d **4.** d

B. 1. Mass per unit volume of any substance is known as density.

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

Unit 1. CGS: g/cm^3 **2.** SI: kg/m^3.

Relative density is the density of any substance with respect to the density of water at 4 °C, it has no unit because it is a ratio.

2. Density of a substance is defined as its mass per unit volume. The relative density of a substance is defined as the ratio of the density of the substance to the water at 4 °C.

3. 1. $8.9 \times \text{density of water} = 8.9 \frac{g}{cm^3}$

2. $8900\ kg/m^3$.

4. $\frac{13.6}{1} = 13.6$

5. Page 123, Determination of R.D. of a solid denser than water.

6. Page 124, Determination of R.D. of a solid lighter than water.

C. 1. i. $W_1 - W_2 = 80\ gf - 60\ gf = 20\ gf$

ii. $80\ cc - 60\ cc = 20\ cc$ or cm^3

iii. $\frac{\text{weight in air}}{\text{loss in the weight}} = \frac{80}{20} = 4$

iv. $4 \times 1000\ kg/m^3 = 4000\ kg/m^3$.

2. $\frac{8}{8-(-4)} = \frac{8}{12} = 0.67$

3. a. $\frac{0.700}{0.750 - 0.500} = 3$

b. $3 \times 1000\ kg/m^3 = 3000\ kg/m^3$

4. a. $\frac{40}{40-36} = 10$

b. $\frac{40-36.4}{40-36} = \frac{3.6}{4} = 0.9$

5. $\frac{70}{13.5} = 5.18$

6. $1 - \frac{3}{7} = \frac{4}{7} = 0.57$

7. $\frac{34.75}{34.75 - 31.890} = \frac{34.75}{2.86} = 12.15$ since it is less than the relative density of pure gold

8. $4 \times 4 \times 4 = 64\ cm^3 = 64\ g$

$$\text{density} = \frac{58.24}{64} = 0.91 g/cm^3.$$

Check Your Progress (Page 132)

A. 1. a **2.** b **3.** a **4.** b

B. 1. Upthrust and the weight of the body.

2. a. Body will sink.

b. It will be less than the actual weight of the body.

c. Apparent density of the body is more than the density of the liquid.

d. Diagram 6.9, page 126.

3. Verification of the principle of the floatation page 128, fig 6.12.

4. It is the point where the centre of buoyancy is centered.

5. i. Stable equilibrium

ii. Unstable equilibrium

iii. Neutral equilibrium.

6. Stable equilibrium – If the centre of gravity G of the body lies below the metacentre *M*.

7. a. C.G. lies above the metacentre.

b. When the body is heavily loaded at its top.

c. When the body is tilted it got the tendency to tilt further in the direction in which it was initially tilting.

d. Fig. 6.15 b page 130

8. Neutral equilibrium – If the centre of gravity *G* of the body coincides with the metacentre *M*.

9. a. The volume of water displaced by the nail is less while in the case of the ship the volume of the water displaced is far more, so greater upthrust acts.

b. The upthrust in the case of salt solution is more than the fresh water.

c. Density of river water is less so upthrust will be less and ship will sink to a greater depth.

10. The density of sea water is more than the river water.

11. The weight in sea water is less. It is easy to swim in sea water.

12. Principle of floatation, Page 128.

13. If a body is floating the weight of the body is counter balanced by the up-thrust which is equal to the weight of the liquid displaced.

14. If the weight of the body is equal to the weight of the liquid displaced or weight of the liquid displaced is more than the weight of the body.

Exercises (Page 134)

A. 1. See page 121 of the textbook.

2. When it is tied with a cork, because when it is tied with cork the volume of displaced water increases, results in less weight of the sinker.

3. a. 900 kg/m^3
   b. Float
4. 10
5. It may sink if the load is greater than the displaced water or it may float if the weight of the ship is less than the displaced water.
6. 900 gf
7. a. Zero
   b. No weight
8. i. The wood block will sink.
   ii. The wood block will go upside due to more upthrust.

B. 1. 0.1
2. 0.574
3. Bangle is made of pure gold.

Chapter 7
HEAT

Check Your Progress (Page 137)

A. 1. c 2. b 3. c

B. 1. According to the kinetic molecular theory, temperature of a body is the measure of the average kinetic or thermal energy of its molecules.
2. When two bodies at different temperatures are brought in contact with each other the heat flows continuously until the temperature of the two bodies become equal.
3. When objects at the same temperature in contact with each other do not exchange heat, is called thermal equilibrium.
4. SI unit of temperature is kelvin, K = 273 + °C.
5. If we touch a hot body, the thermal energy from hot body enters our hand because the hot body has a higher temperature than our hand.
6. Heat is the form of energy which is transferred from one object to another because of temperature difference.
7. Heat is a form of energy while the temperature is the degree of hotness.

Check Your Progress (Page 140)

A. 1. c 2. b 3. b

B. 1. Liquids generally expands on heating and contract on cooling. However, water is an outstanding exception to this when it is between 0 °C and 4 °C. If water initially at a temperature above 4 °C is cooled, it contracts till the temperature of water reaches 4 °C on further cooling it expands instead of contracting.
2. Graph
3. Graph
4. Hope's experiment, page 138.
5. See page 138 of the textbook.
6. Fig 7.7
7. Practical consequences of anomalous expansion of water, page 139.

Exercises (Page 141)

1. See page 136 of the textbook.
2. See page 139 of the textbook.

Chapter 8
ENERGY

Check Your Progress (Page 145)

A. 1. d 2. b 3. d

B. 1. We need energy to work, to grow and to sustain life.
2. a. Chemical to light b. Potential to kinetic.
   c. Electrical energy to light and heat energy
3. Chemical energy.
4. Fuel is called a source of energy because it produces large amount of energy on burning which can be used to do useful work.
5. Characteristics of a good source of energy:

   Large amount of work done per unit volume or mass: A good source of energy would be a large amount of work per unit mass or per unit volume. LPG is better cooking source of energy as compared to kerosene because LPG would be able to do large amount of work per unit volume as compared to kerosene.

   Safe and convenient to use: A good source of energy should be safe and convenient to use. For example, cooking gas (LPG is a safe source of energy in a house hold kitchen. But nuclear energy is not safe source of energy to be used in homes.

   Easy to transport: A good source of energy should be easy to transport. For example, coal, petrol, diesel, LPG etc., can be transported by trucks, tanks and even pipes from the place of their production to the consumers.

   Easy to store: A good source of energy should be easy to store. For example, huge storage tanks are used to store petrol, diesel, LPG etc.

   Cheap and easily available: A good source of energy should be cheap (economical) and easily available. For example, it is economical to use cooking gas (LPG). Nowadays, CNG is used in cars as it is more economical than petrol. On the other hand, commercial LPG is also economical but not easily available, so few people prefer to run cars on LPG available in petrol pumps.

Environmental pollution: A good source of energy should not cause any environmental pollution. LPG is preferred over wood in household kitchens as it does not cause any environmental pollution.

6. Renewable and non-renewable
7. The sources of energy which are exhaustible, i.e. which cannot be renewed or replaced in short intervals of time are called non renewable sources of energy. Eg., coal and petroleum
8. Those sources of energy which are inexhaustible i.e. which can be renewed at short intervals of time are called renewable sources of energy. Renewable sources of energy will be available continuously. For example, wood, water, wind, solar energy are renewable sources of energy.
9. See Table 8.1, page 144 of Textbook
10. Solar energy is considered a renewable source because it is inexhaustible.
11. Fossil fuels take hundreds of millions of years to form under the Earth's surface. Hence they cannot be replaced in short intervals of time. So essentially, all fossil fuels are considered nonrenewable.
12. Conventional and non conventional.
13. The sources of energy which are extensively used by man due to their easy availability and also meet a major portion of man's energy requirement are called conventional sources of energy. For example, fossil fuels (coal, petroleum, natural gas), hydro energy (energy of flowing water in rivers), energy from biomass (firewood, animal dung, biodegradable waste), wind energy.
14. The sources of energy which are not used extensively by man and meet man's energy requirement on a limited scale are called non – conventional sources of energy. For example, solar energy, geothermal energy, nuclear energy, etc.
15. See Table 8.2, page 145 of Textbook
16. Coal is formed from trees but its formation takes millions of years. Wood is a renewable source because trees can be planted and grown easily.

Check Your Progress (Page 150)

A. **1.** d **2.** b **3.** a **4.** c

B. **1.** See page 147 of Textbook

2. *Formation of fossils:* Millions of years ago, the earth was covered with thick forests growing in swamps. Due to natural calamities like earthquakes and volcanoes, the forests were buried under the surface of the earth and got covered with sediments like mud and soil, away from the reach of oxygen of air. Due to high temperature and pressure inside the earth, the bacterial decomposition of large plants (trees of the buried forests) in the absence of oxygen converted them into coal. Small plants and animals buried in the similar manner under similar conditions got converted into petroleum and natural gas.

3. Energy of flowing water has been traditionally used for transporting heavy logs of wood from one place to another, driving watermills to grind wheat to make flour and to drive looms which weave cloth and to run pumps for pumping water out form ground.

4. The power station where electricity is produced by using the energy of flowing water to drive generators is called hydro power plant (or hydro electric power station). The electricity produced in a hydroelectric power station is called hydroelectricity or hydroelectric power.

5. *Basic principle of producing hydroelectricity in a hydroelectric plant:* A high dam is constructed on a high altitude river (i.e. river flowing in a hilly area) to obstruct the flowing of running water. Due to this, the water is collected in a large reservoir or manmade lake behind the dam (like Gobind Sagar Lake which collects water for Bhakra Nangal Dam). In this process the kinetic energy of the flowing water gets transformed into potential energy of water stored behind the dam. The stored water in the reservoir possesses very large amount of potential energy due to its height above the ground.

The dam has sluice gates at a high level. The opening and the closing of the sluice gate is done by a control valve. The water stored in the reservoir behind the dam can pass through the sluice gate when it opens.

On opening the sluice gate, water from the high level of the dam is carried through pipes to the turbine at the bottom of the dam. Since the water falls from a high level of the dam, it flows at a very high speed. Here, the potential energy of the water gets converted into the kinetic energy of the flowing water. This kinetic energy of the flowing water rotates the blades of the turbine. Here, the kinetic energy of the flowing water is converted into mechanical energy of the turbine.

The turbine is connected with the generator through a shaft. When the turbine rotates, its shaft also rotates and makes the armature of the generator to rotate rapidly. The moving armature of the generator in the magnetic field generates electricity. Here, the mechanical energy of the turbine is converted into electrical energy in the generator.

The hydroelectricity so produced is fed to step up transformer and then supplied to homes and industries through transmission lines.

6. Potential energy of stored water in a dam A kinetic energy of flowing water A Kinetic energy of turbines A Electrical energy in generator

7. Advantages of dams are:

- It is used to store water.
- It is used in hydroelectric power generation.
- It is used in irrigation purposes.
- It prevents flooding in lower course.

8. Hydropower plants constructed to generate hydroelectricity are multipurpose projects. They help in controlling floods, enable us to use water for irrigation, develop recreational sites, etc.

9. Due to the construction of the dam, there are no annual floods in the river. The soil in the downstream becomes poor in quality (less fertile) because there are no annual foods to deposit nutrient – rich slit on the banks of the river. The crop yield also decreases in these area.

Check Your Progress (Page 153)

A. 1. c **2.** b **3.** b

B. 1. Unequal heating of the land mass and water bodies by solar radiation generates air movement and causes wind to blow.

2. In a water lifting pump, the rotatory motion of windmill's blade is utilised to lift water from a well. In a flour mill, the rotatory motion of the blades of the windmill is utilised to rotate the millstone to grind the grains like wheat and corn into flour.

3. In a water lifting pump, the rotatory motion of windmill's blade is utilised to lift water from a well. In a flour – mill, the rotatory motion of the blades of the windmill is utilised to rotate the millstone to grind the grains like wheat and corn into flour.

4. With the increasing population the non renewable sources of energy are coming to an exhaustion and wind is a clean, cheap and convenient form of energy.

5. *Construction of a wind turbine generator:* A wind turbine generator is a technologically modified windmill. It consists of a rotator to which large sized blades are fixed. The arrangement of the rotator and its blades is called wind turbine. The wind turbine is fixed over the top of a tall tower in such a way that the rotator and its blades are free to rotate. The shaft of the wind turbine is connected to the armature of an electric generator.

6. Working of a wind turbine generator: When the fast moving wind (having a speed of more than 20 km /h) strikes the blades of the wind turbine, it exerts a force on its blades. The blades of the wind turbine start rotating continuously. The shaft of the wind turbine also starts rotating.

The rotating shaft of the wind turbine rotates the armature of the generator and electricity is produced.

The electricity so produced is fed to step – up transformer and then supplied to homes and industries through transmission lines.

7. The electricity produced by a single windmill is quite less and cannot be used for commercial purposes.

8. *Wind energy farm:* The electricity produced by a single windmill is quite less and cannot be used for commercial purposes. Therefore, a large number of wind turbine generators (modified windmills) are installed over a large area. A cluster of wind turbine generators installed over a large area is called a wind energy farm.

9. *Advantages of wind energy:* The advantages of using wind energy for generating electricity are as follows: Wind energy is an environment – friendly and efficient source of energy. It does not cause any environment pollution.

Wind energy is a renewable source of energy. It is inexhaustible as long as the sun keeps shining because we know the sun's energy powers the wind on the earth. Wind energy has been derived from the sun's energy.

Wind energy is available free of cost. It requires no recurring expenses for the production of electricity through wind energy. So, it is one of the cheapest sources of energy.

10. Wind energy has been derived from the sun's energy.

11. Limitations of harnessing energy from the wind:

- The limitations of harnessing energy from the wind are discussed below.
- The wind energy farms cannot be established everywhere: Wind energy can be established only at those places where wind blows for the greater part of the year and that too blows at a high speed of more than 20 km / h to maintain the required speed of the turbine.

12. The tower and blades of the wind turbine generators are exposed to the vagaries of nature like rain, storm and cyclones, etc. They need a high level of maintenance. So, the cost incurred in its maintenance is high.

13. Traditional use of wind energy has been modified by the formation (establishment) of wind energy farms which generates electricity. Traditional use of water energy has been modified by constructing high – rise dams on the high altitude rivers to generate hydroelectricity.

Check Your Progress (Page 159)

A. **1.** c **2.** c **3.** a

B. **1.** Solar Cell

2. A solar cell consists of a 4 cm square of semiconductor silicon, in fact, it consists of a very thin sandwich of n – type and p – type wafer of silicon in which is placed a U – shaped metal grid. When exposed to sunlight, the solar radiation falls on the solar cell, the n – type wafer produces a large number of electrons. These electrons drift towards p – type wafer thereby generating an electric potential.

3. Refer to answer of question 2

4. The group of solar cells connected in specific pattern to produce desired potential difference and magnitude of current (electric power) is called solar cell panel.

5. Solar cell panels are being used to produce electricity for the purposes of street lighting, operating water pumps for domestic and agricultural works in remote / rural areas.

6. Solar cells have no moving parts, are easy to construct, and require little maintenance, can be installed in remote and very less populated areas in which laying a power transmission line may be expensive and not commercially viable; solar cell and solar cell panel are renewable sources of energy; they do not cause pollution of environment, and use of soalr cells saves fossil fuels.

7. *Expensive manufacturing:* The entire process of manufacturing is expensive because of use of expensive components.

Special grade silicon required for making solar cells is limited in nature. So, it is very expensive.

Silver used for interconnecting various cells in a solar cell panel is also expensive It is costly to store electricity in storage batteries.

8. A solar panel is mounted on a tall supporting pole or insulated on specially designed inclined roof tops so that more solar energy is incident over it. The solar energy falling on the solar cells of the solar cell panel gets converted into electricity. The electricity so produced flows to storage battery, where the electricity is stored in the form of chemical energy.

9. The electricity produced in the solar cell panel is direct current (DC) which is stored in DC batteries. Only DC devices can be operated by DC batteries. Now most of our electrical appliances operate on alternating current (AC). To operate any AC devices, we need to convert DC stored in the batteries into AC by using inverters.

10. Uses of solar cell panel: In spite of the high cost, low efficiency and conversion problem, solar cells are used for many scientific and technological appliances. Some of them are: Artificial satellites and space probes, like Mars orbiters, use solar cell panel as the main source of energy.

Radio broadcasting or TV relay stations in remote areas use solar cell panel for its transmission. This is because in remote areas, we may not find power transmission line as it is expensive and not commercially viable. Traffic signals, electric watches, calculators and many toys are fitted with solar cells. Solar cell panels are being used to produce electricity for the purposes of street lighting, operating water pumps for domestic and agricultural works in remote / rural areas.

11. See page 156 of textbook

Check Your Progress (Page 165)

A. **1.** b **2.** b **3.** b

B. **1.** The energy released by either splitting up of a heavy unstable nucleus or by fusion of two or more light nuclei is called nuclear energy.

2. The nuclear energy can be obtained by two ways a) nuclear fission b) nuclear fusion.

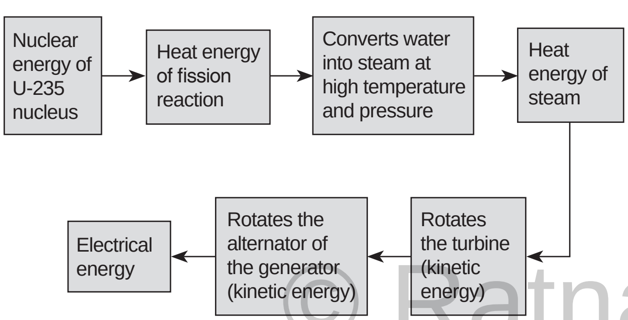
3. The process of splitting of the nucleus of a heavy atom such as ${}^{235}_{92}U$ (by bombarding with slow neutrons) into two or more lighter nuclei with the liberation of enormous amount of energy is called nuclear fission.
4. When uranium – 235 atoms are bombarded with slow moving neutrons, the heavy uranium breaks up to produce two medium – weight atoms, barium – 139 and krypton – 94 with the emission of 3 neutrons. A large amount of energy is produced during the reaction.

$$\underset{\text{Uranium}}{{}^{235}_{92}\mathrm{U}} + \underset{\text{Slow neutron}}{{}^{1}_{0}n} \xrightarrow[\text{fission}]{\text{Nuclear}} \underbrace{{}^{139}_{56}\mathrm{Ba} + {}^{94}_{36}\mathrm{Kr}}_{\text{Two medium-weight fission product}} + 3{}^{1}_{0}n + \text{Large amount of energy}$$

5. A kind of reaction where the particle which initiates (starts) the reaction is also produced during the reaction and carries on the reaction further and further to make it self – propagating and continuous is called a chain reaction.
6. Refer to Figure 8.14, page 159 of textbook
7. Refer to Table 8.3, page 162 of textbook
8. Production of heat in a controlled fashion
9. The difference between the actual mass of the original nucleus and the sum of the masses of the individual product nucleons is called mass defect.
10. $E = \Delta mc^2$ where Δm = mass defect or loss in mass, c = speed of light in vacuum (i.e 3×10^8 ms^{-1})
11. The energy released in nuclear reactions is expressed in units of electron volt (eV).

    1 electron volt = 1.602×10^{-19} joules

    1 eV = 1.602×10^{-19} J
12. The set-up used for generating electricity from the heat energy released in a controlled nuclear fission chain reaction is called a nuclear power plant.
13. The heat produced in a controlled nuclear fission is used for producing steam. The steam so produced runs the turbine. The rotatory motion of the turbine rotates the alternator of the generator and electricity is produced. Thus, in a nuclear power plant, the energy transforms in the following sequence.



14. See pages 161-162 of textbook
15. The energy produced by fission of an atom of uranium is 10 million times the energy produced by the combustion of an atom of carbon from coal.
16. See page 162 of textbook
17. The nuclear power plant produces radioactive nuclear waste. Improper waste storage and disposal leads to contamination. These nuclear radiations can cause serious damage to plants, animals (including human beings) and the environment.
18. Accidental leakage of large scale nuclear radiations took place from the nuclear power plant at 'Three Mile Island' (USA) and from the nuclear power plant at Chernobyl (former Soviet Union).
19. The process in which two lighter nuclei fuse to form a stable heavier nucleus with the liberation of enormous amount of energy is called nuclear fusion. For example, two deuterium atoms (heavy hydrogen atoms with mass number 2) combine to form a heavy nucleus of helium and a neutron is emitted. A large amount of energy is also produced during the reaction.

$$\underset{\text{Deuterium}}{{}^{2}_{1}\mathrm{H} + {}^{2}_{1}\mathrm{H}} \xrightarrow[\text{fission}]{\text{Nuclear}} \underset{\text{Helium}}{{}^{3}_{2}\mathrm{He}} + {}^{1}_{0}n + \text{Large amount of energy}$$

20. The heating of the earth's surface and its lower atmosphere by the trapping of infrared radiations (by the atmospheric gases) is called greenhouse effect.

Exercises (Page 167)

A. 1. Energy is the capacity of a physical system to perform work. All of us need energy to work, to grow and to sustain life. Living things obtain the energy from the food they eat (in case of animals) or from the food they prepare (in case of plants). Machines get energy from electricity (electrical energy) or by burning of fossils fuels (heat energy), etc .
2. Silicon and gallium
3. No. The farther away from the sun, the lesser will be the efficiency of solar cell panel.
4. The fuels formed from the prehistoric remains of dead plants and animals buried deep under the earth's crust under special conditions are called fossil fuels.
5. Kinetic energy
6. Twenty per cent
7. Potential Energy

8. See pages 148-149 of textbook
9. Nuclear fission
10. Nuclear fusion
11. A single cell of 4 cm^2 silicon develops a voltage of 0.5–1 V and can produce about 0.7 W of electricity when exposed to sun.
12. See page 155 of textbook
13. 1. Falling water, and,
    2. Ocean tides run turbines to produce electricity.
14. Wind Energy. As these regions are high wind energy regions in India.
15. **a.** Advantages of windmill

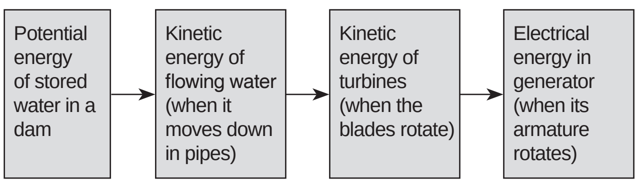
    The advantages of using windmill for generating electricity are as follows:

    1. Windmill is an environment-friendly and efficient source of energy. It does not cause any environmental pollution.
    2. Windmill is a source of renewable energy.

    b. Limitations of windmill

    1. Windmill cannot be established everywhere.
    2. Windmills need back-up facilities.

16.



17. See table 8.3, page 162 of textbook.
18. The waste materials produced during various steps of the nuclear energy production in a nuclear power plant is the nuclear waste. These materials are harmful because they contain radioactive substances like barium-139 and krypton- 94 which emit nuclear radiation. Their disposal is a serious problem because improper disposal results in environmental contamination.
19. Tides in the ocean are caused due to the gravitational pull of mainly the moon (and to some extend the sun) on the water and the earth itself.

    A tidal power plant has a dam built across a bay having the narrow opening to the sea. A turbine connected to the generator through a shaft is fixed at the opening of the dam. The dam has sluice gates. The opening and closing of the sluice gates is done by a control valve.

    During high tides, the sluice gates are opened, water from the sea is allowed to fall on the turbine. The kinetic energy of the incoming flowing water rotates the blades of the turbine. When the turbine rotates, its shaft also rotates and makes the armature of the generator to rotate rapidly. Thus, electricity is produced. As the tides fall, the sluice gates are closed. The water is trapped behind the dam. The stored water behind the dam has potential energy due to its height above the ground.

    During low tide, when water begins to recede away from land, the sluice gates are opened. The stored water is allowed to flow back through the turbine again. The rotating turbine drives generators to generate electricity. Besides this , sea wave energy is also a source of renewable energy.
20. See table 8.1 , page 144 of textbook
21. No, it is not possible to assimilate all these forms of energy in the form of wax.
22. No.

Chapter 9
REFLECTION OF LIGHT

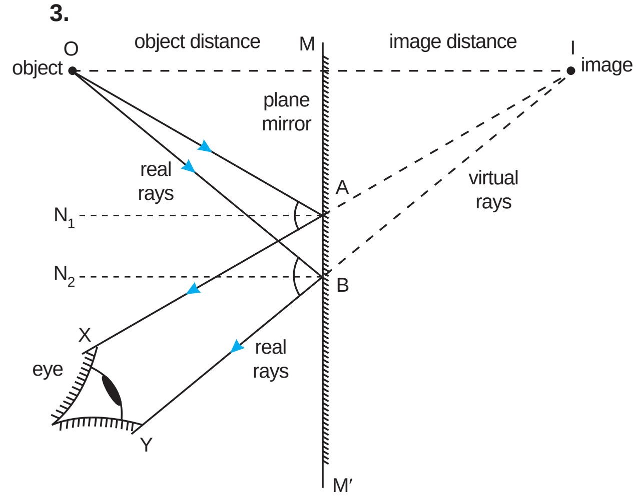
Check Your Progress (Page 173)

A. **1.** a **2.** c **3.** b **4.** b

B. **1.** When light rays strike to a plane polished surface they are sent back (thrown back). This phenomenon is known as reflection of light.

2. When light rays after reflection strikes our eyes we see the objects through which light is coming.

3.



Formation of image of a point object in a plane mirror

4. **a.** Incident ray: The light ray striking the plane polished surface is known as incident ray.

- **b.** Reflected ray: The light ray coming back after striking the polished surface (mirror) is known as reflected ray.
- **c.** Normal: The perpendicular line from the point of incidence is known as normal.
- **d.** Angle of incidence: The angle between the normal and incidence ray is known as angle of incidence.
- **e.** Angle of reflection: The angle between the normal and reflected ray is known as angle of reflection.

5. Experimental verification of laws of reflection, Page 170.

6. Real image: The image which are formed by the intersection of rays and which can be obtained on screen are known as real image.

Virtual image: The image formed by producing rays backward, and which cannot be obtained on screen.

7. Infinite images. Fig. 12.12.

8. After every successive reflection, some amount of light energy is absorbed. Thus, luminosity of images goes decreasing, till they are no longer visible and from the eye the distance goes on increasing the eye is unable to resolve the images.

9. 1. As a looking glass,
2. For signaling purposes in airports,
3. In barber's shop.
4. In construction of periscope, kaleidoscope, etc.

Exercises (Page 174)

1. **a.** Light does not propagate.
b. Light propagates easily.
c. Light bounces back i.e. reflects.

2. See page 170 of the textbook.

3. a. $\frac{360°}{45°} = 8$ b. 6
c. 4 d. 3 e. 4

4. Three images will be formed, see Fig. 9.4, page 172 of textbook here.

Chapter 10
SPHERICAL MIRRORS

Check Your Progress (Page 186)

A. **1.** b **2.** d **3.** c **4.** a **5.** b

B. **1.** A spherical mirror is that mirror whose polished, reflecting surface is the part of a hollow sphere.

2. Concave mirror : A spherical mirror whose inner hollow surface is the reflecting surface is called a concave mirror.

Convex mirror : A spherical mirror whose outer surface is the reflecting surface is called a convex mirror.

3. **a.** Aperture – The effective width of the spherical mirror from which reflection of light takes place.
b. Centre of curvature – The geometric centre of the hollow sphere of which the spherical mirror is a part is called the centre of curvature.
c. Principal axis – It is an imaginary line passing through the optical centre.
d. Principal focus of a concave mirror – If a beam of light parallel to the principal axis falls on a concave mirror, all the rays after reflection meet at a point, this point is called the focus.
e. Focal plane – An imaginary plane passing through the focal point and perpendicular to the principal axis is called the focal plane.

4. Fig. 10.3 (a) and (b) page 176

5. Relationship between the focal length and the radius of curvature of a spherical mirror, page 199.

6. **a.** Fig 10.5 **b.** Fig. 10.7 **c.** Fig 10.8

7. **a.** Fig. 10.11 **b.** Fig 10.10 **c.** Fig 10.13

8. **a.** Convex mirrors are used as rear view mirrors because of the following reasons. It always produces erect image irrespective of the position of the position of the object and it produces diminished image which provides a wide range of view to the mirror.
b. They are used for converging solar radiations in the solar cooker to generate adequate heat for cooking.

9. If the image is erect and magnified and it becomes inverted on moving the mirror away from the face, it is concave mirror. If the image is erect and of same size and it does not changes its size and nature on moving the mirror closer or away, it is plane mirror. If the image is erect and diminished and it remains erect on moving the mirror away from the face, it is convex.

10. Fig 10.9 to Fig 10.16

C. **1.** $f = \frac{r}{2} = \frac{40}{2} = 20$ cm

2. $f = \frac{r}{2}$ or, $r = 2f = 2 \times 2r = 2 \times 25 = 50$ cm

3. Object distance u = – 50 cm

Image distance v = 10 cm

Focal length = ?

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$$

$$\frac{1}{10}+\frac{1}{-50}=\frac{1}{f}$$

$$\frac{1}{10}-\frac{1}{50}=\frac{1}{-}$$

$$\frac{5-1}{50}=\frac{1}{f}$$

$$\frac{4}{50}=\frac{1}{f}$$

$$f=\frac{50}{4}=12.5 \text{ cm.}$$

Since, the focal length is positive it is a convex mirror.

4. Object distance u = – 30 cm

Focal length f = 15 cm

Image distance v = ?

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$$

$$h' = \frac{5\times 8.57}{-20} \ 2.14 \text{ cm}$$

$$\frac{1}{v}=\frac{1}{-15}+\frac{1}{30}$$

$$\frac{1}{v}=\frac{-2+1}{30}$$

$$\frac{1}{v}=\frac{-1}{30}$$

v = – 30 cm

Real and inverted height of the object h = 5 cm

$$\frac{h'}{h}=\frac{-v}{u}$$

$$\frac{h'}{5}=-\frac{(-30)}{-15}$$

$$\frac{h'}{5}=-2$$

h' = 10 cm.

5. Radius of curvature = 30 cm

Focal length = 15 cm

Object distance u = 20 cm,

v = ?

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$$

$$\frac{1}{v}+\frac{1}{-20}=\frac{1}{15}$$

$$\frac{1}{v}-\frac{1}{20}=\frac{1}{15}$$

$$\frac{1}{v}=\frac{1}{15}+\frac{1}{20}$$

$$\frac{1}{v}=\frac{1}{15}+\frac{1}{10}=\frac{2+3}{30}=\frac{5}{30}=\frac{1}{6}$$

$$V=\frac{60}{7} = 8.57 \text{ cm}$$

h = 5

h' = ?

$$\frac{h'}{h}=\frac{-v}{u}$$

$$\frac{h'}{5}=\frac{8.57}{-20}$$

$$h' = \frac{5\times 8.57}{-20} = 2.14 \text{ cm.}$$

6. Object distance u = – 10 cm

Focal length = 15 cm

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$$

$$\frac{1}{v}+\frac{1}{-10}=\frac{1}{15}$$

$$\frac{1}{v}=\frac{1}{15}+\frac{1}{10}=\frac{2+3}{30}=\frac{5}{30}=\frac{1}{6}$$

v = 6 cm.

Erect and diminished.

Exercises (Page 188)

A. 1. a. Radius of curvature: The radius of curvature of the hollow sphere of which the spherical mirror is a part is called the radius of curvature of the spherical mirror.

b. Principal axis of a convex mirror: The straight line passing through the centre of curvature and the pole of a convex mirror is called its principal axis.

c. Focal length: The distance between the pole and focus is called the focal length.

2. See page 177 of textbook

3. a. See Fig. 10.6, page 178

b. See Fig. 10.3a, page 176

4. See table 10.2, page 181

5. 1. As rear view mirrors

2. Safe view of dangerous corners in double-decker bus.

3. Street lighting

6. See page 182 of the textbook

B. 1. Object distance u = – 10 cm

Focal length = – 20 cm

We know the formula $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

$\frac{1}{v}+\frac{1}{-10}=\frac{1}{-20}$

$\frac{1}{v}-\frac{1}{10}=-\frac{1}{20}$

$\frac{1}{v}=-\frac{1}{20}+\frac{1}{10}$

$\frac{1}{v}=\frac{-1+2}{20}$

$\frac{1}{v}=\frac{1}{20}$

v = 20 cm, virtual and erect.

2. Object distance u = – 6 cm

Focal length = – 12 cm

We know the formula $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

$\frac{1}{v}+\frac{1}{-6}=\frac{1}{-12}$

$\frac{1}{v}=-\frac{1}{12}+\frac{1}{6}$

$\frac{1}{v}=\frac{-1+2}{12}$

$\frac{1}{v}=\frac{1}{12}$

v = 12 cm, virtual and erect.

3. Focal length = 200 cm

Object distance = – 400 cm

We know the formula $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

$\frac{1}{}+\frac{1}{400}=\frac{1}{200}$

$\frac{1}{v}-\frac{1}{400}=\frac{1}{200}$

$\frac{1}{v}=\frac{1}{200}+\frac{1}{400}$

$\frac{1}{v}=\frac{2+1}{400}=\frac{3}{400}$

$v=\frac{400}{3}$ = 133.3 cm

v = 133.3 cm, virtual and erect.

4. Object distance u = – 25 cm

Focal length = – 15 cm

We know the formula $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

$\frac{1}{v}+\frac{1}{-25}=\frac{1}{-15}$

$\frac{1}{v}=-\frac{1}{15}+\frac{1}{25}$

$\frac{1}{v}=\frac{-5+3}{75}$

$\frac{1}{v}=-\frac{2}{75}$

$v=\frac{75}{2}$ = 37.5 cm

5. Radius of curvature = 0.4 cm

Focal length = 0.2 cm, u = – 0.8 cm

We know the formula $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

$\frac{1}{v}+\frac{1}{-0.8}=-\frac{1}{0.2}$

$\frac{1}{v}=-\frac{1}{0.2}+\frac{1}{0.8}$

$\frac{1}{v}=\frac{4+1}{0.8}$

$\frac{1}{v}=\frac{3}{0.8}$

$v=-\frac{0.8}{3}$ m

Real and inverted.

6. Object distance, u = – 10 cm

Focal length, f = 15 cm

We know the formula $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

$\frac{1}{v}+\frac{1}{-10}=\frac{1}{15}$

$\frac{1}{v}=\frac{1}{15}+\frac{1}{10}$

$\frac{1}{v}=\frac{2+3}{30}$

$\frac{1}{v}=\frac{5}{30}$

V = 6 cm, virtual and erect.

Chapter 11
SOUND

CHECK YOUR PROGRESS (PAGE 195)

A. 1. c **2.** d **3.** c **4.** b **5.** d

B. 1. Wave motion is a vibratory disturbance produced in one part of the medium that travels to another part involving the transfer of energy but not the transfer of any matter with it.

2. a. On the basis of requirement of medium for the propagation of wave, waves are classified into two groups:

1. Mechanical waves or elastic waves.
2. Electromagnetic waves.

b. With respect to direction of the periodic changes in the medium, waves are again classified into two groups:

1. Longitudinal waves.

2. Transverse waves.

3. The characteristics of the wave motion are given below:

a. Wave motion is a periodic disturbance travelling through a medium which is produced by a vibrating body.

b. Wave motion travels at a constant speed in all directions in a medium and transfers energy in the medium.

c. The particles of the medium do not move from one place to another in wave motion. They only vibrate about their fixed positions passing on energy they possess from particle to particle.

d. The medium does not move as a whole during wave motion. Only the disturbance travels through the medium.

e. Wave motion is possible only in that medium which possess the properties of elasticity and inertia.

4. A wave in which the particles of the medium vibrate to and fro in the same direction in which the wave is moving is called a longitudinal wave. Example: Sound waves.

5. When a stone is thrown in a pond, the energy carried by the stone disturbs the water molecules close to it. By gaining the energy from the stone, the water molecules near the stone vibrating up and down. These vibrating water molecules transfer some of the energy to the next set of water molecules which also start vibrating and so on.

6. See page 191 of the textbook.

7. See page 194 of the textbook.

Check Your Progress (Page 199)

A. 1. a   2. c   3. a   4. b   5. c

B. 1. A wave is produced due to the disturbance of particles of a medium. Waves are produced when particles of a medium vibrates.

2. $\lambda/2$

3. $v = \nu \times \lambda$

wave velocity = frequency × wavelength

4. The points on a wave which are in the same state of vibration are said to be in the same phase.

5. If 512 wave cycles are produced per second, then the frequency of the periodic wave is said to be 512 Hz.

6. a. In longitudinal wave motion, the distance between two consecutive rarefactions or two consecutive compressions is called the wavelength.

b. In transverse wave motion, the distance between two consecutive crests or two consecutive troughs is called the wavelength. The SI unit of wavelength is metre (m).

7. The time required to produce one complete wave is called the time period of the wave. The SI unit of time period is second (s).

8. Relationship between wave velocity (v), Frequency (ν) and wavelength (λ):

We know that

$$\text{Wave velocity} = \frac{\text{Distance travelled by a wave}}{\text{Time taken}}$$

$$v = \frac{\lambda}{T}$$

$$v = \frac{1}{T} \times \lambda$$

$$v = \nu \times \lambda \qquad \left[\text{Since } \nu = \frac{1}{T}\right]$$

Wave velocity = Frequency × Wavelength

9. Given: $T = 0.1$ s, $\lambda = 5$ cm

$$v = \frac{1}{T} \times \lambda = \frac{1}{0.1} \times 5 = 50 \text{ cm/s}$$

10. Given: $\nu = 640$ Hz, Distance (D) = 800 m, $t = 2.55$

a. $$\text{Speed} = \frac{\text{Distance}}{\text{Time}} = \frac{800}{2.5} = 320 \text{ m/s}$$

b. $$\text{Wavelength } (\lambda) = \frac{v}{\nu} = \frac{\overset{1}{\cancel{320}}}{\underset{2}{\cancel{640}}} = 0.5 \text{ m}$$

11. The maximum displacement of the particles of a medium from their mean positions during the propagation of a wave is called the amplitude of the wave. The SI unit of amplitude is metre (m).

12. The number 384 shows the frequency of the tuning fork i.e. it will produce 384 cycles per second after hitting on a rubber pad.

13. $$\text{Frequency} = \frac{1}{\text{Time period (in seconds)}}$$

14. The distance travelled by a wave in one second is called the velocity of the wave. The SI unit of wave velocity is metre per second (m/s).

C. 1. $$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{100\text{ m}}{25\text{ m/s}} = 4\text{ s}$$

2. Given: $v = 330$ m/s

$\nu = 550$ Hz

$\lambda = ?$

$v = \nu \times \lambda$

$330 = 550 \times \lambda$

$$\therefore \lambda = \frac{\cancel{330}^{3}}{\cancel{550}_{5}} = 0.6\text{ m}$$

3. $$\text{Velocity} = \frac{\text{Distance}}{\text{Time}} = \frac{8}{0.05} = \frac{8 \times \cancel{100}^{20}}{\cancel{5}} = 160\text{ m/s}$$

4. Wavelength = Speed × Time period

= 15 m/s × 10 s = 150 m

5. Given: $\lambda = 100$ m, $v = 20$

$$\nu = \frac{v}{\lambda} = \frac{20}{100} = 0.20\text{ Hz}$$

Check Your Progress (Page 204)

A. 1. d **2.** a **3.** b **4.** d

B. 1. Sound is produced when an object vibrates, i.e. sound is produced by vibrating objects.

2. See page 201 of textbook

3. See page 200 of textbook

4. See page 200 of textbook

5. See page 200 of textbook

6. See page 200 of textbook

7. See page 201 of textbook

8. a. increases

b. increases

c. reduces the speed of sound waves

d. increaes

9. There is no effect on the speed of sound in air due to the following factors:

1. Change in frequency
2. Change in wavelength
3. Change in amplitude
4. Change in factors like phase, loudness, pitch and quality of sound
5. Change in pressure

10. See table 11.3, page 202 of textbook

11. a. A gas is a bad conductor of heat. It does not allow free exchange of heat between the compressed layers, rarefied layers and the surroundings. Thus, no exchange of heat is possible when a sound wave passes through a gas.

b. As there is no air on moon, so sound waves cannot propagate.

c. The temperature of a gas remains constant, a change in pressure of the gas changes its density in the same ratio, so there is no effect on sound waves.

d. As the speed of sound waves is more in solid iron railway- track than air.

e. The speed of sound in a gas is inversely proportional to the square root of the density of the gas.

f. The speed of sound in air increases approximately by 0.61 m/s for every 1 °C rise in temperature. So, sound would travel faster on a hot summer day than on a cold winter day.

g. The presence of water vapour in the air changes its density. The presence of water vapour reduces the density of air. Hence, the speed of sound in moist air is greater than the speed of sound in dry air. That is why sound travels faster on a rainy day than on a dry day.

h. Speed of light is much much greater than the speed of sound.

12. 20 Hz to 20000 Hz

13. Whale and elephant

14. See page 203 of textbook

15. See pages 203-204 of textbook

16. See page 204 of textbook

Exercises (Page 206)

A. 1. Wave motion is a vibratory disturbance produced in one part of the medium that travels to another part involving the transfer of energy but not the transfer of any matter with it. See page 212 of the textbook.

2. a. Solid **b.** Gas

3. See point 3, page 201 of the textbook

4. Bat and dolphin

5. See page 203 of textbook

6. It is used in ultrasonography

7. Ultrasound is used to break small stones that form in the kidneys into fine grains. These grain get flushed out with urine.

8. See pages 203-204 of textbook.

9. See table 11.1, page 193 of textbook.

10. See pages 192-194 of textbook.

11. See Fig. 11.5, page 192
12. See pages 193 of textbook
13. See page 194 of textbook
14. See page 195 of textbook

B. 1. approx 1 : 10^6
2. 1320 m
3. 5 s
4. 6.6 km
5. 1.5 cm
6. a. 340 m/s
b. 500 Hz

Chapter 12
ELECTRICITY

Check Your Progress (Page 217)

A. 1. c 2. c 3. c 4. c 5. a

B. 1. The flow of electrons in a definite direction constitutes an electric current.
2. The electric potential (or simply potential) at a point in an electric field is defined as the amount of work done in bringing a unit positive charge from infinity to that point. The SI unit of electric potential is volt.
3. When one coulomb of charge flows through a conductor in one second, then the current flowing through it is said to be one ampere.
4. a. Current will be tripled.
b. Current will be halved.
5. a. Current will be one-third.
b. Current will be doubled.
6. The electrical resistance of a conductor (or a wire) depends on the following factors:
- length of the conductor
- area of cross section of the conductor (or thickness of the conductor)
- temperature of the conductor
- nature of the material of the conductor.
7. Electrochemical shells, storage shells, electric generators or dynamos.
8. a. The metal strips (or carbon rods) through which current leaves and enters the cell are called the electrodes.
b. A substance which conducts electricity when in molten state (or when dissolved in water) is known as electrolyte.
c. The electrode of an electrochemical cell at which oxidation occurs. It is the positive terminal of an electrolytic cell.
d. The electrode of an electrochemical cell at which reduction occurs. It is the negative terminal of an electrolytic cell.
9. Voltaic cell and Daniel cell
10. A cell in which the chemical reactions which convert chemical energy into electrical energy cannot be reversed is called a primary cell. Leclanche cell and Daniel cell are the primary cells.
11. See table 12.1, page 212 of the textbook.
12. The circuit in which electric current flows is called a closed circuit. The bulb in given activity glows because the circuit is complete. It is said to be a closed circuit.

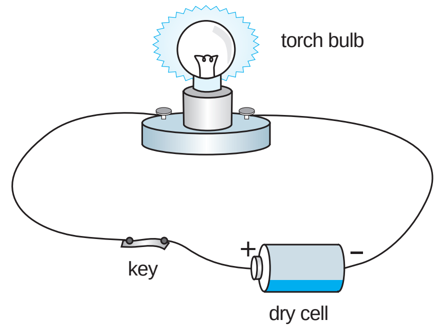


Fig. 12.13 An electric circuit

The circuit in which electrical contact at any point is broken and hence no current flows is called an open circuit. When the key in the given activity is opened, the bulb does not glow, because the circuit is incomplete. It is said to be an open circuit.
13. A diagram which shows the arrangement of various electrical components used in an electric circuit with the help of their electrical symbols is called an electric circuit diagram.
14. See page 214 of the textbook.
15. When current is passed through two bulbs connected in series:
i. The sum total of resistances in series increases with the increase in the number of bulbs, so the current flowing through each bulb decreases and each bulb glows dimly.
ii. The bulbs in series work simultaneously in the circuit. If the circuit is broken anywhere between the bulbs, none of the bulbs glow.
16. When current is passed through two bulbs connected in parallel:
i. The sum total of resistances in parallel decreases with the increase in the number of bulbs. So according to Ohm's law, more current is drawn from the cell.
However, the current passing through each bulb remains the same, so each bulb glows

with the same brightness as in case of a single bulb connected to the cell.

ii. The bulbs in parallel work independently in the circuit. If the circuit is broken anywhere between the bulbs, the remaining bulbs keep glowing.

17. The advantages of generating hydroelectricity are discussed below:

1. The generation of hydroelectricity in a hydroelectric power plant does not cause any environmental pollution.
2. The energy of the flowing water is a renewable source of energy.
3. Hydroelectricity is one of the cheapest sources of energy. The hydropower plant constructed to produce it also has a low maintenance cost.
4. Hydropower plants constructed to generate hydroelectricity are multipurpose projects. They help in controlling floods, enable us to use water for irrigation, develop recreational sites, etc.

18. Disadvantages of construction of dams to generate hydroelectricity:

1. When we construct a dam, large areas of agricultural land and human habitation (towns and villages) get submerged.
2. Many plants and trees are destroyed when submerged in the water of the reservoir (man made lake) formed for the dam. Man and animals have to migrate from this place as they are rendered homeless.
3. The people displaced from the dam site needs to be given satisfactory rehabilitation which becomes a big problem and challenge before the government. This fear of satisfactory rehabilitation led to the opposition to the construction of Tehri dam on the river Ganga and Sardar Sarovar project on the river Narmada by the people.
4. Large ecosystems are destroyed when submerged under the water in dams.
5. The vegetation (plants and trees) submerged under water rots under anaerobic conditions and produces a large amount of methane which is also a greenhouse gas (a greenhouse gas leads to global warming).
6. Hydroelectric plant produces one of the cheapest mode of electricity but these plants can be constructed only in a limited number of places, preferably in hilly terrains (areas) where high altitude river flows.
7. Due to the construction of the dam, there are no annual floods in the river. The soil in the downstream becomes poor in quality (less fertile) because there are no annual floods to deposit nutrient-rich silt on the banks of the river. The crop yield also decreases in these areas.

19. Factors responsible for increasing our energy requirements.

1. One of the major reasons for the rise in energy consumption is the growth of industries (industrialization). In our country, industries account for almost 50% of the total energy consumption.
2. Change in lifestyle is another reason for increase in demand for energy. Many more people have started using scooters, cars, TVs, refrigerators, air-conditioners, coolers, geysers, heaters, etc. now than before. To use all above equipment, we need a lot of energy. Modern lifestyle in which we use a large number of machines has improved our standard of living.
3. India is an agricultural country. Our agriculture is also now modernized. Energy is needed for the use of machines like tractors, tube wells, etc. for farming.
4. Needless to say, increase in population is also one of the major reasons for the increase in energy demand.

20. Following efforts should be taken to meet the increasing energy demand:

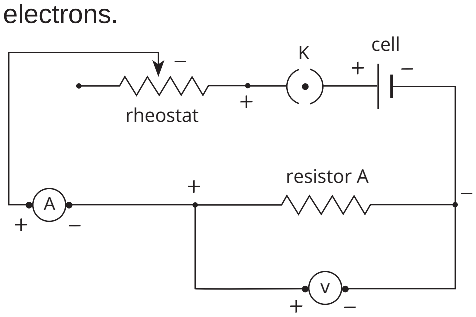
1. Develop technology to use the conventional sources of energy more efficiently.
2. Shift our preference to renewable sources of energy.
3. Develop technology to use latest sources of energy which are non-conventional sources of energy, like solar energy, energy from the sea, geothermal energy, nuclear energy, etc.

21. Following are some ways to save electricity.

1. Switch off all fans and lights when not required.
2. Don't leave electrical appliances like computers, television, stereo, etc. on standby mode.
3. Ensure all electrical appliances are used as per their requirements.
4. Light-emitting diodes (LEDs) help to save more electricity as compared to bulbs and fluorescent lights.

EXERCISES (PAGE 219)

1. According to Ohm's law, the electric current flowing through a conductor is directly proportional to the potential difference across its ends, provided the physical conditions (like temperature, pressure, etc.) do not change.
2. Potential difference and resistance
3. The electric potential (or simply potential) at a point in an electric field is defined as the amount of work done in bringing a unit positive charge from infinity to that point. The SI unit of electric potential is volt.
4. See page 208 of the textbook for answer.
5. An electrochemical cell is an apparatus which is used to produce electric current from spontaneous chemical reactions. The various chemical substances present in an electrochemical cell undergo chemical changes and produce electric current. Thus, an electrochemical cell converts the stored chemical energy of substances into electrical energy (electric current).
6. A cell in which the chemical reactions which convert chemical energy into electrical energy can be reversed by passing electricity is called a secondary cell. Lead storage cell (or lead accumulator) and nickel– cadmium cell (or nickel–cadmium accumulator) are the secondary cells.
7. The substances which have very high resistance and hence do not allow the electric current to flow through them are called the insulators. For example, rubber, plastic, wood, glass, leather, etc. are insulators. Insulators do not have free electrons in them to carry current.

   The substances which have very low resistance and hence allow the electric current to flow through them are called conductors. For example, copper, gold, silver, aluminium and electrolytic solutions are conductors. The carriers of electric current in them are the free electrons.
8. 

9. i. The bulbs will stop glowing as the circuit breaks.

   ii. The bulbs keep glowing.

Chapter 13
MAGNETISM

CHECK YOUR PROGRESS (PAGE 223)

A. **1.** c **2.** d **3.** b

B. **1.** The characteristic property of the lodestone is that it always pointed in a certain direction when it is freely suspended.

2. Magnets which are made in laboratories or factories are called artificial magnets. Artificial magnets are of various shapes and sizes, so they are used for many purposes.

3. Following are the basic properties of a bar magnet:

i. A bar magnet has the property of attracting magnetic substances.

ii. A bar magnet always points in the north-south direction.

iii. A bar magnet shows the property of attraction and repulsion.

iv. Magnetic poles always occur in pairs.

4. **Ans.** 1 : 2; 1 : 4.

5. i. Magnetic poles: The points (N, S) slightly within the ends of a magnet where most of its magnetic power is concentrated are called the poles of the magnet.

ii. Magnetic axis: An imaginary line (XY) passing through the magnetic north and south poles of a bar magnet is called its magnetic axis.

iii. Magnetic equator: An imaginary line (PQ) bisecting the effective length is called the magnetic equator.

iv. Effective length of the magnet: The distance (NS) between the magnetic north pole and the magnetic south pole is called the effective length of the magnet.

6. Magnetic induction: The phenomenon by which any magnetic substance acquires magnetic properties temporarily due to the presence of a magnet near it is called magnetic induction.

7. See page 221 of the textbook for answer.

8. North, north; south, south.

9. It is impossible to obtain a piece of magnet having only one magnetic pole or we can say that magnetic poles always occur in pairs. However, the strength of magnetism in each part is reduced. For example, if a magnet is cut into two equal parts, the magnetic strength of each part is half the magnetic strength of the original magnet.

10. When the piece of soft iron bar is brought near the north pole of the magnet, the nearer end of the soft iron bar acquires the opposite polarity, i.e. south. Since unlike poles attract each other, therefore the soft iron bar is attracted towards the end of the magnet. Thus, the soft iron bar first becomes a magnet due to magnetic induction and then it is attracted by the magnet. In other words, induction precedes attraction.

Check Your Progress (Page 231)

A. 1. c **2.** b **3.** b **4.** a **5.** c

B. 1. Magnetic field: The space around a magnet within which its effect can be experienced is called its magnetic field. Magnetic field can be represented with the help of a set of lines called magnetic field lines or magnetic lines of force.

2. Magnetic lines of force: The path along which a unit north pole moves in a magnetic field is called the magnetic line of force.

3. See Activity 4 on page 224 of the textbook.

4. See Figure 13.16, page 226 of the textbook.

5. Uniform magnetic field: The magnetic field in a region is uniform if it has the same magnetic intensity and the same direction at all points in the region. Parallel, equispaced straight lines represent uniform magnetic field.

Non-uniform magnetic field: The magnetic field in a region is non-uniform if it has different magnetic intensities at different points in the region. Converging, diverging and unequispaced lines represent non-uniform magnetic field.

6. When we place a compass needle near a magnet, it is under the influence of two magnetic fields, viz.

i. Magnetic field due to the magnet.

ii. Horizontal component (H) of the earth's magnetic field.

7. Neutral point: A point near a magnet where the magnetic field due to the magnet is completely neutralized by the horizontal component of the earth's magnetic field is called a neutral point.

Since the magnetic field due to the earth is fixed, so we shall locate the position of neutral points depending upon the position of the bar magnet in the following two ways.

i. Magnet placed with its north pole pointing towards north of the earth.

ii. Magnet placed with its south pole pointing towards north of the earth.

8. See fig 13.17 from page 227 of the textbook

9. See fig 13.18 from page 228 of the textbook

10. Null point: A point where the magnetic field due to a magnet is completely neutralized due to another magnet is called a null point.

11. i. At point A which is near the magnetic pole N.

ii. At point C which is in the middle of the magnet.

iii. It is tangentially outward at point P.

iv. As the magnetic lines starting from north pole to south pole and not equispaced. So it is non-uniform.

12. See page 223 of the textbook.

13. Two magnetic lines of force do not intersect each other. If two magnetic lines of force intersect, there would be two directions of magnetic field at same point, which is not possible.

14. See pages 229–230 of textbook.

15. Electromagnet is a solenoid with soft iron core.

Exercises (Page 232)

1. Magnet: A substance which has the property of attracting magnetic substances and rests in the north-south direction when freely suspended is called a magnet.

2. If a bar magnet is broken into two pieces, each piece, when freely suspended, will point in the north-south direction. This shows that if a bar magnet is broken into two or more smaller pieces, then, even the smallest piece is a complete magnet, having both north and south poles of equal strength.

3. If a magnet attracts the given rod it is made of iron, if not it is made of other material.

4. By using two magnets we can check the polarity of a magnet. Like poles repel each other and unlike poles attract each other. We can also use the directive property of a magnet. A freely suspended magnet always points in the north south direction.

5. A magnetic compass is used to find the direction by sailors.

6. The earth's magnetic field is uniform. The magnetic field of a bar magnet is non-uniform.

7. Magnetic intensity at any point is the force experienced by a unit north pole placed at that point. Magnetic intensity is a vector quantity.

8. Uses of magnets:

i. Magnets are used in magnetic compass, pencil boxes, soap stands, refrigerator doors, etc.

ii. Magnets are also used in cycle dynamos, loudspeakers, electric motors and telephones.

iii. Ceramic magnets are used in large computers.

iv. Magnetic tapes are used in tape recorders and video recorders.