



# Matter in Our Surroundings

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NCERT SOLUTIONS



## What's inside

- In-Chapter Q's (solved)
- Textbook Exercise Q's (solved)

## IN-CHAPTER QUESTIONS

### Test Yourself

1. Which of the following are matters ? Chair, air, affection, smell, hate, almond, thoughts, cold, cold drink, fragrance of perfume.

**Ans.** Matter: Chair, Air, Almond, Cold Drink, Fragrance of perfume.

2. Give reasons for the following observation : The smell of hot sizzling foods reaches your several metres away, but to get the smell from cold, food, you have to go to close.

**Ans.** We know that particles of matter are always in motion. The motion of particles increases when temperature is increased. The particles of hot sizzling food get heat as result the particles move very fast and reach us diffusing with air particles. The motion of particles of cold food is not so fast, therefore they don't reach us diffusing with air particles. Thus to get the smell from cold food we have to go to close.

3. A diver is able to cut through water in a swimming pool. Which property of matter does this observation show ?

**Ans.** Water is present in swimming Pool. The intermolecular force between particles of water is weak. So diver is able to cut through water. To Cut through water in swimming pool by a diver proves that intermolecular force between particles of water is weak.

4. What are the characteristics of the particles of matter?

**Ans.** Following are the characteristics of the particles of matter:

- (i) Particles of matter are continuously moving.
- (ii) Particles of matter have space between them.
- (iii) Particles of matter attract each other.

### Test Yourself

1. The mass per unit volume of a substance is called density (density = mass/volume).

Arrange the following in order of increasing density-air, exhaust from chaimnays, honey, water, chalk, cotton and iron.

**Ans.** Density of matter in order of increasing—air < exhaust from chaimna < cotton < water < honey < chalk < iron.

2. (a) Tabulate the differences in the characteristics of states of matter.

(b) Comment upon the following:

Rigidity, Compressibility, fluidity, filling a gas container, shape, kinetic energy and density.

**Ans.(a)**

Solid	Liquid	Gas
(I) They have both fixed volume and shape.	They have fixed volume but not fixed shape.	They don't have fixed volume and shape
(II) They cannot be compressed	They can be partially compressed	They can be compressed very much
(III) They do not flow	They flow	They flow
(IV) They have high density	They have density less than solid	They have very less density

**(b) Rigidity:** The intermolecular force of solid substances are very strong by which they strongly bind with each other. This is why they can neither be compressed nor separate from each other. This property of solid is called rigidity.

**Compressibility:** Only gases have the property of compressibility. Maximum gas can be easily filled in small vessels. This property of gases is called compressibility.

**Fluidity:** The substance which can flow easily is called fluid and this property of substance to flow is called fluidity.

**Filling a gas container:** To keep a large volume of gas in a less volume vessel by compressing is called filling a gas container.

**Shape:** Space occupied by any object is called its shape.

**Kinetic energy:** The energy generated by motion of any object is called its Kinetic energy.

$$K.E. = \frac{1}{2}mv^2$$

**Density:** The mass per unit volume of any object is called its density.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

### 3. Give reasons :

- A gas fills completely the vessel in which it is kept.
- A gas exerts pressure on the walls of the container.
- A wooden table should be called a solid.
- We can easily move our hand in air but to do the same through a solid block of wood we need a karate expert.

**Ans.(a)** The particles of gas are separated from each other and they have large space between them, due to this they have ability to flow. Thus gas fills completely in the vessel.

- The gas particles move randomly here and there. So they exert pressure on the wall of container.
- The particles of wood are bound with strong molecular force. So it is named as solid wooden. Table is a converted form of wood so it is a solid.

(d) We can move our hand in air because there is enough space between particles of air by which they can be easily resist. So, less force works in the air. There is very small space between particles of wood so. We cannot move our hand between them by applying a large force. If you force, you will end up hurting your hand, hurting your hand we force we will hurt air hand. Therefore it is solid that for moving hand in wood we should be proficient in Karate.

**4. Liquids generally have lower density as compared to solids. But you must have observed that ice floats on water. Find out Why?**

**Ans.** It happens because, particles of ice are adjacent to each other, but due to separation of water molecules, water has no fixed shape and when we put ice into water, the ice removes volume of water's less than it's weight. So, we observe that ice floats on water.

**Test Yourself**

**1. Convert the following temperature to celsius scale :**

- (a) 300 K              (b) 573 K

**Ans.** Kelvin temperature = Celsius temperature + 273

$$\text{Celsius temperature} = \text{Kelvin temperature} - 273$$

- (a) 300 K

$$\text{Celsius temperature} = 300 - 273$$

$$= 27^{\circ}\text{C}$$

- (b) 573 K

$$\text{Celsius temperature} = 573 - 273$$

$$= 300^{\circ}\text{C}$$

**2. What is the physical state of water at :**

- (a)  $250^{\circ}\text{C}$               (b)  $100^{\circ}\text{C}$

**Ans.**(a) at  $250^{\circ}\text{C}$  temperature water gets evaporated.

(b) at  $100^{\circ}\text{C}$  temperature water starts boiling and also evaproates.

**3. For any substance, why does the temperature remain Constant during the change of state ?**

**Ans.** Because of latent heat for any substance the temperature remains constant during the change of state.

**4. Suggest a method to liquify atmospheric gases.**

**Ans.**The only main method to liquify atmospheric gases is condensation. To show condensation process take a bottle filled with cold water from fridge and put if on a table at room temperature. After same time, water droplets appeared around the

bottle. We can collect the water keeping the bottle in a vessel the clouds in the sky are made by the process of condensation.

### Test Yourself

#### 1. Why does a desert cooler cool better on a hot dry day ?

**Ans.** On a hot dry day, quantity of water vapours is low in atmosphere by which rate of evaporation is increased. Strong wind is flown by running cooler and due to atmospheric heat the rate of evaporation is increased. Therefore while running desert cooler the temperature of room gets cold.

#### 2. How does the water kept in an earthen pot(matka) become cool during summer.

**Ans.** The earthen pot has many small holes by which water leaks and evaporates from the surface of earthen pot. The required latent heat for evaporation is obtained from the water. Water loses heat and water becomes cool.

#### 3. Why does our palm feel cold when we put some acetone or petrol or perfume on it ?

**Ans.** Evaporation of acetone or petrol or perfume takes place on palm. It obtains the required latent heat for evaporation from our palm. The palm loses heat and becomes cold.

#### 4. Why are we able to slip. Hot tea or milk faster from a saucer rather than a Cup?

**Ans.** Saucer has more surface area than up. It leads more evaporation. The liquid particles absorb energy from its surroundings. In this way due to absorb energy from its surroundings, tea becomes cold. So we are able to sip hot tea or milk faster from a saucer, rather than a cup.

#### 5. What type of Clothes should be wear in summer ?

**Ans.** We should wear cotton and white or light coloured clothes in summer because cotton cloth absorbs more sweat and white or light coloured clothes are good reflectors of heat by which we feel cold.

### NCERT EXERCISES

#### 1. Convert the following temperatures into celsius unit—

- (a) 293K (b) 470K

**Sol. :** (a) 293K

$$\begin{aligned}\text{Celsius temperature} &= \text{Kelvin Temperature} - 273 \\ &= 293 - 273 \\ &= 20^{\circ}\text{C}\end{aligned}$$

$$(\text{b}) \text{Celsius Temperature} = \text{Kelvin Temperature} - 273$$

$$\begin{aligned} &= 470 - 273 \\ &= 197^\circ\text{C} \end{aligned}$$

## 2. Convert the following temperatures into Kelvin Unit.

- (a)  $25^\circ\text{C}$  (b)  $373^\circ\text{C}$

Sol. : (a) Kelvin Temperature = Celsius Temperature + 273  
=  $25 + 273$   
= 298K

(b) Kelvin Temperature = Celsius Temperature + 373  
=  $373 + 273$   
= 646 K

## 3. Write the reasons for the following observations.

- (a) Naphthalene disappears with time without leaving any solid.  
(b) The smell of perfume reaches us even after sitting far away.

Sol.: (a) Naphthalene (or phenyl) is a sublimation substance which disappears with time without leaving any solid, because due to sublimation they mixed with air and blows. It means Naphthalene get converted into Gaseous phase without converting into liquid phase.  
(b) Perfume gets automatically changed into vapour at normal or room temperature. So its particles automatically spread out all around mixing with air particles. That is, their particles are diffused very quickly in air. So, the person sitting far away also sense its smell.

## 4. Arrange the following matters according to increase of force between their particles.

- (a) Water (b) Sugar (c) oxygen

Sol. : Oxygen < Water < Sugar

## 5. What is the physical state of water at the following temperatures ?

- (a)  $25^\circ\text{C}$  (b)  $0^\circ\text{C}$  (c)  $100^\circ\text{C}$

Sol. : At  $0^\circ\text{C}$  temperature, water (liquid) changes into ice (solid), whereas at  $100^\circ\text{C}$  water (liquid) changes into gaseous phase. Therefore water remains in liquid state between  $0^\circ\text{C}$  and  $100^\circ\text{C}$  so—

- (a) at  $25^\circ\text{C}$  temperature water is in liquid state.  
(b) at  $0^\circ\text{C}$  temperature water is in liquid/solid state.  
(c) at  $100^\circ\text{C}$  temperature water is in liquid/gaseous state.

## 6. Give reason for confirmation—

- (a) Water is liquid at room temperature.  
(b) an iron almirah is solid at room temperature.

**Sol. :**(a) At normal temperature water remains in liquid phase and it does not have any definite shape. It occupies the shape of jar in which it is contained. It flows easily so it is better to say it fluid instead of saying liquid.

(b) Iron almirah is solid at room temperature because both their size and volume are definite and they are rigid, do not flow.

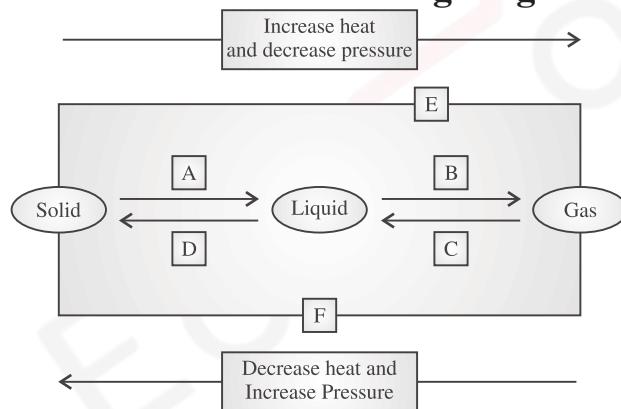
**7. Why is ice at 273K more effective in cooling than water at the same temperature ?**

**Sol. :**At 273K on cooling ice and water, ice absorbs more heat from atmosphere equal to its latent heat than water. So, at 273K ice is more effective in cooling than water at the same temperature.

**8. What Produces more severe burns, boiling water or steam.**

**Sol.:**At the same temperature energy of steam particles is more than water particles. It happens due to the absorption of extra energy due to latent heat of vapour by the particles of steam. Thus when steam comes in contact with skin then it leaves more heat energy than boiling water at same temperature. So, at the same temperature steam burns more severe than boiling water.

**9. Name A, B, C, D E and F in the following diagram showing change in its state.**



**Sol.:**A = melting (Liquification)

B = Boiling (Evaporation)

C = Liquification (Condensation)

D = Solidification (Freezing)

E = Sublimation

F = Sublimation



# Is Matter Around Us Pure?

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NCERT SOLUTIONS



## What's inside

- In-Chapter Q's (solved)
- Textbook Exercise Q's (solved)

## IN-CHAPTER QUESTIONS

### Test Yourself

#### 1. What is meant by substances ?

**Ans.** A pure substance is, which consist of a single type of particles (atoms or molecules) like—oxygen, Hydrogen, Iron.

#### 2. List the Points of differences between homogeneous and heterogeneous mixtures.

**OR**

Differentiate between homogeneous and heterogeneous mixtures with examples

**Ans.**

	<b>Homogenous Mixture</b>	<b>Heterogenous Mixture</b>
	Homogenous mixture is that which have some composition of it's constituent substances	Heterogeneous mixture is that which does not have same composition of it's constituent substances.
	Constituent substances be seen in it cannot.	Constituent substances can be seen in it.
	Generally made up of pure substances	Generally made up of impure substances
	All solution and alloys are homogenous mixture, like—sugar and water solution.	All mixtures are heterogeneous except solution and alloys like—air, and iron fillings.

### Test Yourself

#### 1. How are solution and suspension are different from each other ?

**Ans.Sol (Colloid):** Sol or Colloid is the state of solution in which size of solute particles, are intermediate that of real solution and suspension.

**Solution:** Solution is a homogenous mixture of two or more than two substances. Lemon, water, soda water, cold drinks, etc are examples of solution.

**Suspension:** Suspension is a heterogenous mixture in which particles of solute are suspended throughout the solvent. Suspended particles can be seen with naked eyes

#### 2. To make a saturated solution 36g of sodium chloride is dissolved in 100 g of water at 293K. Kind its concentration at this temperature.

**Ans.** Mass of sodium chloride = 36g

Mass of solvent (water) = 100g

We know that,

$$\begin{aligned}\text{Mass of solution} &= \text{Mass of solute} + \text{mass of solvent} \\ &= 36\text{g} + 100\text{g}\end{aligned}$$

$$= 136 \text{ g}$$

$$\text{Concentration} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100$$
$$= \frac{36}{136} \times 100 = 26.47\%$$

## Test Yourself

1. Classify the following as chemical or physical changes.

**Ans.** (i) Cutting of trees.

(ii) Melting of butter in a Pan.

(iii) Rusting of almirah.

(iv) Boiling of water to form steam.

(v) Passing of electric current, through water and the water breaking down into hydrogen and oxygen gas.

(vi) Dissolving common salt in water.

(vii) Making a fruit salad with raw fruits and

(viii) burning of paper and wood.

2. Try segregating the things around you as pure substances or mixture.

**Ans. Pure substance:** Water, bread, sugar and gold, etc.

**Mixtures:** Steel, Plastic, paper, talc, milk and air.

## NCERT EXERCISES

1. Which separation techniques will you apply for the separation of the following?

(a) Sodium chloride from its solution in water

(b) Ammonium chloride from a mixture containing sodium chloride and ammonium chloride

(c) Small pieces of metal in the engine oil of a car

(d) Different pigments from an extract of flower petals

(e) Butter from curd

(f) Oil from water

(g) Tea leaves from tea

(h) Iron pins from sand

(i) Wheat grains from husk

(j) Fine mud particles suspended in water

2. Write the steps you would use for making tea. Use the words solution, solvent, solute dissolve, soluble, insoluble, filterate and residue.

**Ans.** Steps for making tea—

1. Take a cup of water in a container as solvent and heat it.

2. Add sugar in it which is solute. Heat it till all sugar get dissolves.
3. Now you get a solution of water and sugar.
4. Sugar is soluble in water completely.
5. Add half tea-spoon of tea leaves, it is insoluble in water.
6. Boil the content, add milk which is also soluble in water and boil again.
7. Filter the tea with the help of tulip strainer, the tea collected in cup is filtrated and the tea leaves collected on the strainer is residue.

**3. Pragya tested the solubility of three different substances at different temperatures and collected the data as given below (results are given in the following table, as grams of substance dissolved in 100 grams of waters to form a saturated solution).**

**Substance Dissolved      Temperature in K**

	283	293	313	333	353
Potassium Nitrate	21	32	62	106	167
Sodium Chloride	36	36	36	37	37
Potassium Chloride	35	35	40	46	54
Ammonium Chloride	24	37	41	55	66

- (a) What mass of potassium nitrate would be needed to produce a saturated solution of potassium nitrate in 50 gram of water at 313K.
- (b) Pragya makes a saturated solution of potassium chloride in water at 353K and leaves the solution to cool at room temperature what would she observe as the solution cools? Explain.
- (c) Find the solubility of each salt at 293K. Which salt has the highest solubility at this temperature ?
- (d) What is the effect of change of temperature on the solubility of salt ?

**Ans.**

- (a) ∵ Solubility of Potassium nitrate at 313K is 62 gm.  
i.e., 62 g Potassium nitrate is soluble in 100 g water.  
∴ Solubility of Potassium nitrate in 50 g water  
 $= \frac{62}{100} \times 50 = 31 \text{ g}$

- (b) On leaving the saturated solution of potassium chloride (at 353k) to cool at room temperature, the solid potassium chloride will separate and form crystals. Since, decrease in temperature, decreases the solubility of solid in liquid.

- (c) Solubility of the salts at 293 k are—

$$\text{Potassium nitrate} = 32$$

Sodium Chloride = 36

Potassium Chloride = 35

Ammonium Chloride = 37

Thus Ammonium chloride has the maximum solubility (37) at 293 K

- (d) Solubility of solid (salt) decreases with fall in temperature, while it increase with rise in temperature.

**4. Explain the following with example—**

- (a) Saturated solution
- (b) Pure substance
- (c) Colloid
- (d) Suspension

**Ans.** (a) See Page No.

(b) See Page No.

(c) See Page No.

(d) See Page No.

**5. Classify each of the following as a homogeneous or heterogeneous mixture.**

**Soda water, wood, air, soil, vinegar, filtered tea and ice.**

**Ans.** Soda Water—Homogeneous mixture

Wood—Heterogeneous mixture

Air—Heterogeneous mixture

Soil—Heterogeneous mixture

Vinegar—Homogeneous mixture

Filtered tea—Homogeneous mixture

Ice—Heterogeneous mixture

**6. How would you confirm that a colourless liquid given to you is pure water ?**

**Ans.** Pure water boils at 100°C (373K) at atmospheric pressure and salt water boils above 100°C temperature. If the liquid boils at 100°C at atmospheric temperature then it is a pure water otherwise it is impure.

**7. Which of the following things are pure substances?**

- (a) Ice, (b) Milk, (c) Iron, (d) Hydrochloric Acid, (e) Calcium oxide,
- (f) Mercury, (g) Brick, (h) Wood, (i) Air.

**Ans.** (a) Ice, (c) Iron, (d) Hydrochloric acid, (e) Calcium oxide, (f) Mercury are pure substances.

**8. Identify the solution among the following mixtures.**

- (a) Soil      (b) Sea Water    (c) Air
- (d) Coal      (e) Soda

**Ans.** (b) Sea Water (e) Soda Water.

**9. Which of the following will show ‘Tyndall effect’ ?**

- (a) Salt Solution
- (b) Milk
- (c) Copper Sulphate Solution
- (d) Starch Solution

**Ans.** Salt solution and starch solution will show Tyndall effect.

**10. Classify the following into elements, compounds and mixtures.**

- |                       |                   |
|-----------------------|-------------------|
| (a) Sodium            | (b) Soil          |
| (c) Sugar solution    | (d) Silver        |
| (e) Calcium Carbonate | (f) Tin           |
| (g) Silicon           | (h) Coal          |
| (i) Air               | (j) Soap          |
| (k) Methane           | (l) Carbondioxide |
| (m) Blood.            |                   |

**Ans.** Element, Compound.

- (a) Sodium (e) Calcium Carbonate
- (d) Silver (j) Soap
- (f) Tin (k) Methane
- (g) Silicon (l) Carbon dioxide mixture.
- (b) Soil (c) sugar solution
- (h) Coal (i) Air
- (m) blood.

**11. 10 gram sodium nitrate is dissolved in 35 gram saturated solution of sodium nitrate at 25°C temperature. Calculate solubility of sodium nitrate.**

**Ans.** Mass of Solution = 35 g

Mass of Sodium Nitrate = 10 g

Mass of solvent =  $35 - 10 = 25 \text{ g}$

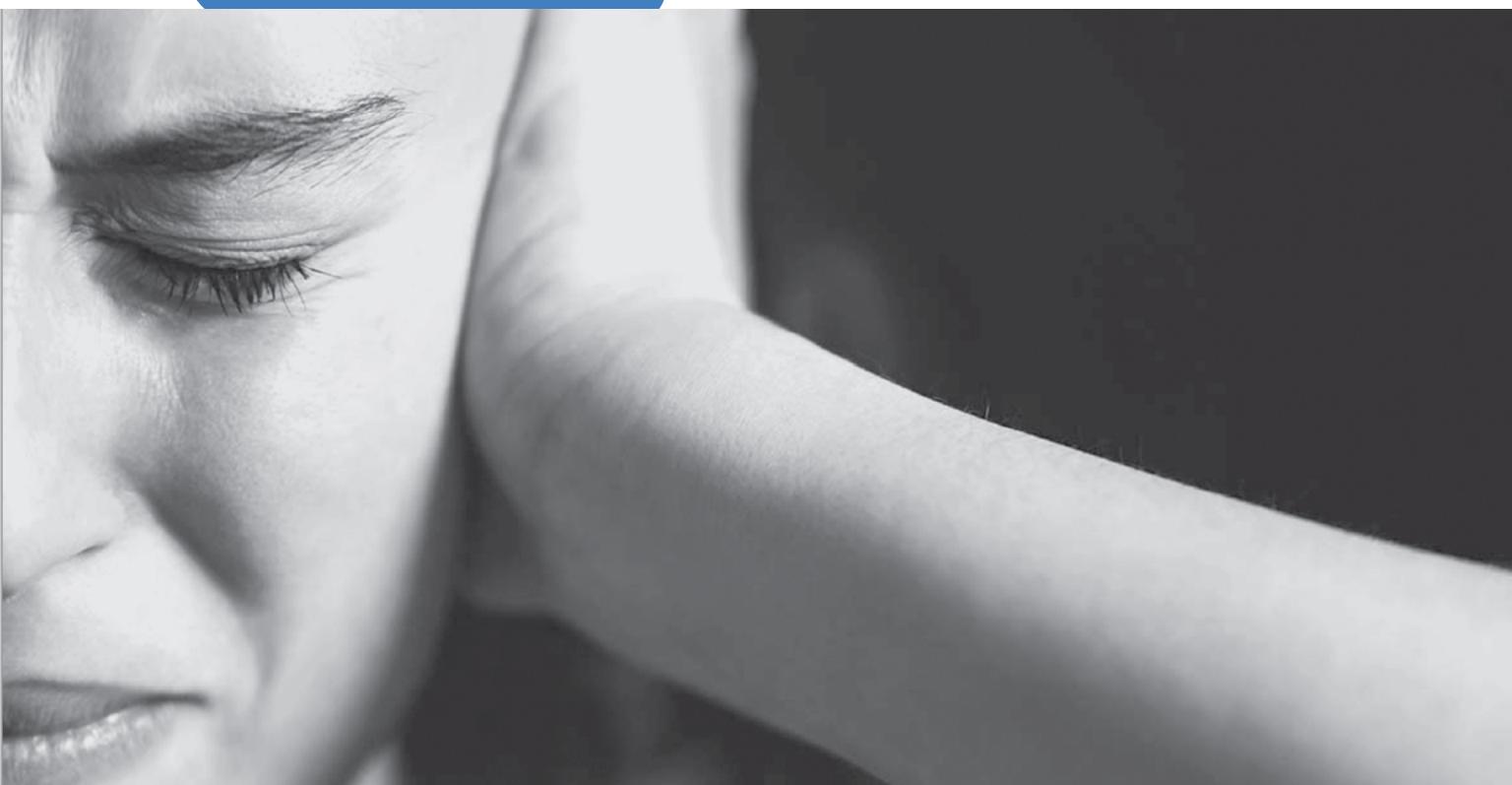
$$\begin{aligned}\text{Solubility of sodium nitrate} &= \frac{10}{25} \times 100 \\ &= 40 \text{ g}/100 \text{ g solvent}\end{aligned}$$



# Atoms and Molecules

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NCERT SOLUTIONS



## What's inside

- *In-Chapter Q's (solved)*
- *Textbook Exercise Q's (solved)*

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## IN-CHAPTER QUESTIONS

### Test Yourself

1. In a reaction 5.3g of Sodium carbonate reacted with 6g of ethanoic acid.

The products were 2.2g of Carbon dioxide, 0.9g water and 8.2g of Sodium ethanoate. Show that these observations are in agreement with the law of conservation of mass.  $\text{Sodium carbonate} + \text{Ethanoic acid} \rightarrow \text{Sodium Ethanoate} + \text{Carbon dioxide} + \text{Water}$ .

**Ans.** Mass of Sodium Carbonate = 5.3g

Mass of acetic acid = 6.0g

Mass of reactants =  $5.3\text{g} + 6.0\text{g} = 11.3\text{g}$

Mass of carbon dioxide = 2.2g

Mass of sodium acetate = 8.2g

Mass of Products =  $2.2 + 8.2 + 0.9 = 11.3\text{g}$

$\therefore$  Mass of reactants = Mass of Products

Therefore the given data shows that observations are in agreement with the law of conservation of mass.

2. Hydrogen and oxygen combine in the ratio of 1 : 8 by mass to form water. What mass of oxygen gas would be required to react completely with 3g of hydrogen gas ?

**Ans.** Given that hydrogen and oxygen form water by combining in the ratio of 1:8 by mass .

i.e., 1g of hydrogen gas is required for 8g of oxygen gas.

3g of hydrogen gas requires =  $8 \times 3 = 24\text{g}$  of oxygen gas

3. Which postulate of Dalton's atomic theory is the result of the law of conservation of mass ?

**Ans.** Atoms are indivisible smallest particles, which can neither be created nor be destroyed in a chemical reaction.

4. Which postulate of Dalton's atomic theory can explain the law of definite proportions ?

**Ans.** Atoms of different elements combine together to form a compound in a definite proportion of small whole numbers.

### Test Yourself

1. Define the atomic mass unit.

**Ans.** The atomic mass unit is equal to one twelfth the mass of one atom of carbon-12.

It is denoted by  $\mu$ .

$\therefore$  Atomic mass unit =  $\frac{1}{12}$  of mass of atom of C-12.

## 2. Why it is not possible to see an atom with naked eyes ?

**Ans.** Atom is a structured unit of a substance (matter) . Whose size is very smaller than our imagination. So, it is not possible to see an atom with naked eyes.

### Test Yourself

#### 1. Write down the formula of

- (a) Sodium oxide
- (b) Aluminium chloride
- (c) Sodium sulphide
- (d) Magnesium hydroxide

**Ans.** (a) Sodium oxide -  $\text{Na}_2\text{O}$

- (b) Aluminium chloride -  $\text{AlCl}_3$
- (c) Sodium sulphide -  $\text{Na}_2\text{S}$
- (d) Magnesium hydroxide -  $\text{Mg}(\text{OH})_2$

#### 2. Write down the name of compounds represented by the following formula :—

- (a)  $\text{Al}_2(\text{SO}_4)_3$
- (b)  $\text{CaCl}_2$
- (c)  $\text{K}_2\text{SO}_4$
- (d)  $\text{KNO}_3$
- (e)  $\text{CaCO}_3$

**Ans.** (a)  $\text{Al}_2(\text{SO}_4)_3$  - Aluminium Sulphate

- (b)  $\text{CaCl}_2$  - Calcium Chloride
- (c)  $\text{K}_2\text{SO}_4$  - Potassium Sulphate
- (d)  $\text{KNO}_3$  - Potassium Nitrate
- (e)  $\text{CaCO}_3$  - Calcium Carbonate

#### 3. What is meant by the term chemical formula ?

**Ans.** The chemical formula of a substance (element or compound) represents the composition of its components. E.g.; Chemical formula of water is  $\text{H}_2\text{O}$ . It means that there are two hydrogen atom and one oxygen atom present in one molecule of water.

#### 4. How many atoms are present in a

- (a)  $\text{H}_2\text{S}$  molecule and
- (b)  $\text{PO}_4^{3-}$  ion ?

**Ans.** (a)  $\text{H}_2\text{S}$  molecule consists of 2 hydrogen atoms and one sulphate atom.

$\therefore$  3 atoms are present in  $\text{H}_2\text{S}$ .

- (b)  $\text{PO}_4^{3-}$  ion consists of one atom of phosphorus and four atoms of oxygen.
- $\therefore$  Five atoms are present in  $\text{PO}_4^{3-}$

## Test Yourself

- Calculate the molecular masses of H<sub>2</sub>, O<sub>2</sub>, Cl<sub>2</sub>, CO<sub>2</sub>, CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>2</sub>H<sub>4</sub>, NH<sub>3</sub>, CH<sub>3</sub>OH.
- Calculate the formula unit masses of ZnO, Na<sub>2</sub>O, K<sub>2</sub>CO<sub>3</sub>, given atomic masses of Zn = 65 u, Na = 23 u, K = 39 u, C = 12 u, and O = 16 u.

### NCERT EXERCISES

1. An 0.24g sample of a compound of oxygen and boron was found by analysis to contain 0.096g of boron and 0.144g of oxygen. Calculate the percentage composition of the compound by weight.

Ans. Mass of boron = 0.096g  
Mass of oxygen = 0.144g  
Mass of compound = 0.24g  
Percentage of boron =  $\frac{0.096}{0.24} \times 100$   
 $= \frac{96 \times 100}{100 \times 24}$   
 $= 40\%$

Percentage of oxygen =  $\frac{0.144}{0.24} \times 100$   
 $= \frac{144 \times 100}{1000 \times 24} \times 100$   
 $= 60\%$

2. When 3.0g of carbon is burnt in 8.00g oxygen, 11.00g of carbon dioxide is produced what mass of carbon dioxide will be formed when 3.00g of carbon is burnt in 50.00g of oxygen ? Which law of chemical combination will govern your answer ?

Ans. I – C + O<sub>2</sub>  $\square$  CO<sub>2</sub>  
Mass of Carbon = 3g  
Mass of Oxygen = 8g  
Total mass of reactants = 3 + 8 = 11g  
Mass of Product CO<sub>2</sub> = 11g  
Thus, total mass of reactants = Total mass of Products  
Mass of Carbon = 3g  
Mass of Oxygen = 50g  
Total mass of reactants = 3 + 50 = 53g  
By using law of mass conservation,  
Total mass of reactants = Total mass of Products  
 $\square$  Total mass of product CO<sub>2</sub> = 53  
Therefore this chemical reaction is based on the law of mass conservation.

### 3. What are polyatomic ions ? Give example

**Ans.** The group of atoms which behaves like ion, is known as polyatomic ion. It has a fixed charge on it.

Example : Carbonate ion ( $\text{CO}_3^{2-}$ ), Nitrate ion ( $\text{NO}_3^{2-}$ ) Hydroxide ion ( $\text{OH}^-$ ) etc.

### 4. Write the chemical formula of the following.

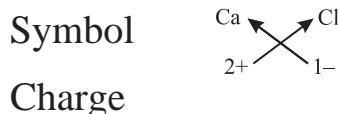
- (a) Magnesium chloride      (b) Calcium chloride  
(c) Copper Nitrate            (d) Aluminium chloride  
(e) Calcium carbonate

**Ans.** (a) Magnesium chloride



$\therefore$  Formula would be  $\rightarrow \text{MgCl}_2$

(b) Calcium chloride



$\therefore$  Formula would be  $\rightarrow \text{CaCl}_2$

(c) Copper nitrate  $\rightarrow \text{Cu}(\text{NO}_3)_2$

(d) Aluminium chloride  $\rightarrow \text{AlCl}_3$

(e) Calcium carbonate  $\rightarrow \text{CaCO}_3$

### 5. Give the name of the elements present in the following compounds.

- (a) Quick lime      (b) Hydrogen bromide  
(c) Baking Powder    (d) Potassium Sulphate

**Ans.** (d)

	Name of compound	Chemical formula	Elements Present
(a)	Quick lime	$\text{Ca}(\text{OH})_2$	Calcium, oxygen and hydrogen
(b)	Hydrogen bromide	HBr	Hydrogen and bromine

(c)	Baking Powder	$\text{NaHCO}_3$	Sodium, Hydrogen, Carbon and Oxygen
(d)	Potassium Sulphate	$\text{K}_2\text{SO}_4$	Potassium, Sulphur, Oxygen

**6. Calculate the molar mass of the following substances.**

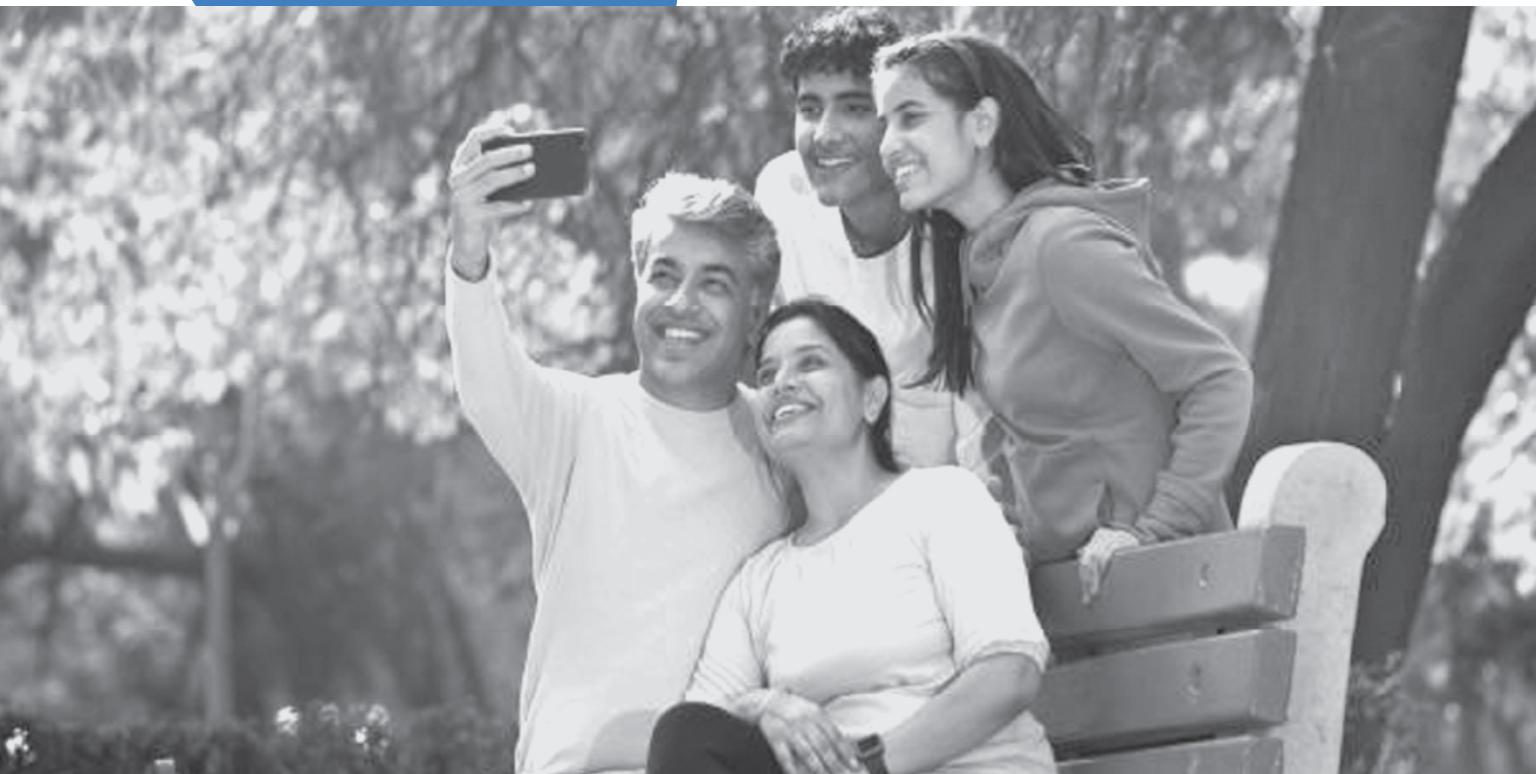
- (a) Ethyne,  $\text{C}_2\text{H}_2$
- (b) Sulphur molecule,  $\text{S}_8$
- (c) Phosphorus molecule,  $\text{P}_4$  (Atomic mass of phosphorus= 31)
- (d) Hydrochloric acid,  $\text{HCl}$
- (e) Nitric acid,  $\text{HNO}_3$



# Structure of the Atom

4

NCERT SOLUTIONS



## What's inside

- In-Chapter Q's (solved)
- Textbook Exercise Q's (solved)

## IN-CHAPTER QUESTIONS

### Test Yourself

#### 1. What are canal rays?

**Ans.** Goldstein found in the experiment that a special type of beam, passing through the holes of the cathode, from the anode illuminate the discharge tube. These rays are called canal rays.

#### 2. If number of electrons in an atom is 8 and number of protons is also 8, then

(i) What is the atomic number of the atom?

(ii) What is the charge on the atom?

**Ans.** (i) Atomic number = Number of protons  
= 8

(ii) Number of protons = 8  
Positive charge = 8  
Number of electrons = 8  
Negative charge = 8  
Net charge =  $8 + (-8)$   
= 0

### Test Yourself

#### 1. On the basis of Thomson's atomic model explain how the atom is neutral as a whole.

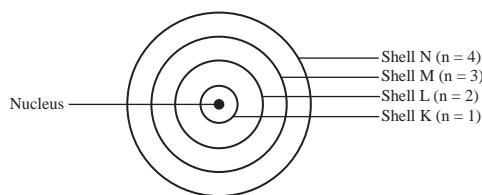
**Ans.** Thomson presented a model related to the structure of the atom which was like a Christmas cake. According to him, the atom was a positively charged sphere in which electrons were like the dry fruits in a Christmas cake. The example of watermelon can also be given.

#### 2. On the basis Rutherford's model of an atom, which sub-atomic particle is present in the nucleus of an atom?

The positively charged subatomic particle, proton is present in the nucleus of the atom.

#### 3. Draw a Sketch of Bohr's model of an atom with three shells.

**Ans.**



**4. What do you think would be the observation if the  $\alpha$ -particle Scattering experiment is carried out using a foil of a metal other than gold?**

**Ans.** Thin gold sheets are used because gold has the highest malleability and it does not react with  $\alpha$ -particles. So other than gold,  $\alpha$ -particles scattering is also possible with the foil of other metal which is malleable and does not react with  $\alpha$ -particles like silver, platinum, copper, etc.

### Test Yourself

**1. Name the three Sub-atomic particles of an atom.**

**Ans.** Followings are the three sub-atomic particles of an atom :

- (i) Electron ( $_0e^{-1}$ )
- (ii) Proton ( $_2p^{+1}$ )
- (iii) Neutron ( $_1n^0$ )

**2. Helium atom has an atomic mass of 4u and two protons in its nucleus. How many neutrons does it have?**

**Ans.** Mass number = Atomic mass  
= 4

$$\begin{aligned}\text{Mass number} &= p + n \\ 4 &= 2 + n \\ n &= 4 - 2 \\ n &= 2\end{aligned}$$

### Test Yourself

**1. Write the distribution of electrons in Carbon and Sodium atoms.**

**Ans.** Atomic number of carbon = 6

Electronic configuration of carbon = 2,4

Atomic number of sodium = 11

Electronic configuration of sodium = 2,8,1

**2. If K and L shells of an atom are full, then what would be the total number of electrons in the atom?**

**Ans.** Number of electron in K shell = 2

Number of electron in L shell = 8

Total number of electrons =  $2 + 8 = 10$  (Neon)

## Test Yourself

1. How will you find the Valency of Chlorine, Sulphur and Magnesium?

Ans.

Elements	Atomic Number	Electronic Configuration	Valency
Chlorine	17	2,8,7	1
Sulphur	16	2,8,6	2
Magnesium	12	2,8,2	2

## Test Yourself

1. If number of electrons in an atom is 8 and number of protons is also 8, then

- (i) What is the atomic number of the atom?
- (ii) What is the charge on the atom?

Ans. (i) Atomic number = Number of protons

$$= 8$$

(ii) Number of protons = 8  
Positive charge = 8  
Number of electrons = 8  
Negative charge = 8  
Net charge =  $8 + (-8)$   
= 0

2. With the help of given find out the mass number of oxygen and sulphur atom.

Ans. Mass number = No. of proton + No. of neutron

No. of protons in oxygen atom = 8  
No. of neutrons in oxygen atom = 8  
 Mass number of oxygen atom =  $8 + 8 = 16$   
No. of proton in sulphur atom = 16  
No. of neutrons in sulphur atom = 16  
 Mass number of sulphur atom = 32

## Test Yourself

1. For the Symbol H, D and T tabulate three sub-atomic particles found in each of them.

Ans. H, D and T are the isotopes of Hydrogen, the following is the table of their subatomic particles :

Isotope	Symbol	Mass Number	Number of electrons	Number of Protons	Number of Neutrons

Hydrogen	H	1	1	1	0
Deuterium	D	2	1	1	1
Tritium	T	3	1	1	2

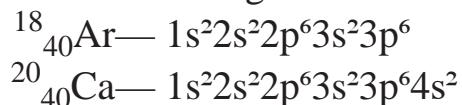
## 2. Write the electronic configuration of any one pair of isotopes and isobar

**Ans.** Isotopes are atoms having the same atomic number but have different mass numbers. So their electronic configuration will be the same.

For example carbon has two isotopes  $^{12}_6\text{C}$   $^{13}_6\text{C}$ , as the configuration requires only no of electrons and isotopes have the same number of electrons.

$$\begin{aligned} {}^{12}_6\text{C} &= 1s^2 2s^2 2p^2 \\ {}^{13}_6\text{C} &= 1s^2 2s^2 2p^2 \end{aligned}$$

Isobars are atoms of different elements having the same mass number *i.e.* protons and neutrons. For example Argon and Calcium are the Isobar of each other. As the configuration requires only no of electrons and Isobars have a different number of electrons so their configuration varies.



## NCERT EXERCISES

### 1. Compare the properties of electrons, protons and neutrons.

**Ans.**

Particles	Symbol	mass (in kg)	Charge
Electron	$-ie$	$9.108 \times 10^{-31}$	Negative unit charge ( $-1.602 \times 10^{-19}$ C)
Proton	$+ip$	$1.676 \times 10^{-27}$	Positive unit charge ( $+1.602 \times 10^{-19}$ C)
Neutron	$o'n$	$1.676 \times 10^{-22}$	neutron (zero charge)

### 2. What are the limitations of J.J. Thomson's model of the atom?

**Ans.** While showing the limitation of the atomic model, J.J. Thomson mentioned the neutral nature of the atom very well, but such model can not be shown by other scientists.

### 3. Describe Bohr's model of the atom.

**Ans.** Bohr proposed the atomic model in 1912 AD. It was called Bohr's atomic model. It's main postulates are as follow—

- (i) The electrons in an atom revolve around the nucleus in a definite circular path these paths are called electronic orbit. It is known as the energy level.

- (ii) The electronic orbit is free from energy.
- (iii) Electron energy levels are denoted by K, L, M..... or 1, 2, 3.....
- (iv) An electron can lose or gain only a certain and required energy.

#### **4. What are the limitations of Rutherford's model of the atom ?**

**Ans.** The major drawback of Rutherford's atomic model was that it did not reveal the stability of the atom. When a charged particle is accelerated, energy is generated from it. The electronic energy would be reduced by this emission of radiation. These will be a contraction of the size of its orbit. After a short time electron would collide with the nucleus. Rutherford was unable to explain. Why such an effect occurs.

#### **5. Compare all the proposed models of an atom given in this chapter.**

**Ans.**

<b>Thomson's atomic model</b>	<b>Rutherford's atomic model</b>	<b>Bohr's atomic model</b>
No explanation about nucleus	Nucleus is explained	Nucleus is explained
The positive charge exists in the form of a sphere.	A positive charge, called proton, is present inside the nucleus.	A positive charge called proton is present inside the nucleus.
Electrons are studded in a positively charged sphere	Electrons keep revolving around the nucleus in orbits.	Electrons keep revolving in fixed orbits. (in energy levels) around the nucleus.
This is a nuclear model	Rutherford's model had many drawbacks.	Bohr improved Rutherford's model.

#### **6. Summarise the rules for writing of distribution of electrons in various shells for the first eighteen elements.**

**Ans.** The different energy levels are written as follows—

- (i) The electron in the given energy level or orbit are written according to the formula  $2n^2$ —
  - In the first orbit (in K orbit)  $2n^2 = 2 \times 1^2 = 2$  electrons
  - In the second orbit ( in L orbit)  $2n^2 = 2 \times 2^2 = 8$  electrons
  - In the third orbit (in M orbit)  $2n^2 = 2 \times 3^2 = 18$  electron
- (ii) If there is an outermost orbit then the electron in it will not be more than 8.
- (iii) Electrons are filled stepwise in different energy levels.

## 7. Define Valency by taking examples of silicon and oxygen.

**Ans.**

Name of Element	Atomic Number	Electronic configuration			Valency Electron	Valency of Electron
		K	L	M		
Oxygen	8	2	6	0	6	2
Silicon	14	2	8	4	4	4

$$\therefore \text{Valency of oxygen} = 2$$

$$\text{Valency of silicon} = 4$$

## 8. Explain with examples

- (i) Atomic number, (ii) Mass number,  
(iii) Isotopes and (iv) Isobars. Give any two uses of isotopes.

## 9. $\text{Na}^+$ has completely filled K and L shells. Explain.

**Ans.** K shell is full of 2 electrons and L shell is full of 8 electron.  $\text{Na}^+$  has a total of 10 electrons so K and L shells are completely filled.

## 10. If bromine atom is available in the form of say, two isotopes [ ${}_{35}^{79}\text{Br}(49.7\%)$ and ${}_{35}^{81}\text{Br}(50.3\%)$ ] then calculate the average atomic mass of bromine atom.

$$\begin{aligned}\text{Ans. Mass number of bromine atom} &= 79 \times \frac{49.7}{100} + \frac{81 \times 50.3}{100} \\ &= 79 \times 0.497 + 81 \times 0.503 \\ &= 39.263 + 40.743 \\ &= 80.006\end{aligned}$$

## 11. The average atomic mass of a sample of an element X is 16.2u. What is the percentage of isotopes ${}_{8}^{16}\text{X}$ and ${}_{8}^{18}\text{X}$ in the sample?

**Ans.** Let the percentage of  ${}_{8}^{16}\text{X}$  be  $x$  then the percentage of  ${}_{8}^{18}\text{X}$  be  $100 - x$

$$\text{Thus the mass number of X} = 16 \times \frac{x}{100} + 18 \times \frac{100-x}{100}$$

$$16.2 = \frac{16x}{100} + \frac{1800}{100} - \frac{18x}{100}$$

$$1620 = -2x + 1800$$

$$x = \frac{180}{2} = 90\%$$

$$\text{Percentage of sample } {}_{8}^{16}\text{X} = 90\%$$

$$\text{Percentage of sample } {}_{8}^{18}\text{X} = 100 - 90$$

$$= 10\%$$

**12. If Z = 3, What would be the valency of the element ? Also name the element.**

**Ans.** Atomic number of element (Z) = 3

Electronic configuration = 2, 1

Number of electron in K = 2 and L = 1

∴ Valence electron = 1

Valency = 1

Name of element = Lithium

**13. Composition of the nuclei of two atomic species X and Y are given below :**

	X	Y
Protons	6	6
Neutron	6	8

**Give the mass number of X and Y. What is the relation between the two species ?**

**Ans.** Mass number = Number of Proton Number of Neutron

Mass number of Y =  $6 + 6 = 12$

Mass number of Y =  $6 + 8 = 14$

and Atomic number = Number of Proton

Atomic number of X = 6

Atomic number of Y = 6

Since, X and Y have same atomic number but have different mass number so they are isotopes.

**14. For the following statements, write T for true and F for false.**

(a) J.J. Thomson proposed that the nucleus of an atom contains only nucleus.

(b) A neutron is formed by an electron and a proton combining together. Therefore it is neutral.

(c) The mass of an electron is about  $\frac{1}{2000}$  times that of proton.

(d) An isotope of iodine is used for making tincture iodine. Which is used as a medicine

**Ans :** (a)-F, (b)-F, (c)-T, (d)-F

**15. Rutherford's alpha particle scattering experiment was responsible for the discovery of.**

**Ans.** (a) Atomic nucleus.

### **16. Isotopes of an element have**

- (a) the same physical properties
  - (b) different chemical properties
  - (c) different number of neutrons
  - (d) different atomic numbers

**Ans.** (c) different number of neutrons

17. Number of valence electrons in  $\text{Cl}^-$  ion are—

- (a) 16 (b) 8 (c) 17 (d) 18

**Ans.** (b) 8

**18. Which one of the following is a correct electronic configuration of sodium ?**



**Ans.** (d) 2, 8, 1

**19. Complete the following table—**

Atomic number	Mass number	Number of Neutrons	Number of Protons	Number of electrons	Name of the atomic species
9	—	10	—	—	—
16	32	—	—	—	sulphur
—	24	—	12	—	—
—	2	—	1	—	—
—	1	0	1	0	—

**Ans :**

Atomic number	Mass number	Number of Neutrons	Number of Protons	Number of electrons	Name of the atomic species
9	19	10	9	9	Fluorene

16	32	16	16	16	Sulphur
12	24	12	12	12	Magnesium
1	2	1	1	1	Hydrogen (deuterium)
1	1	0	1	0	Hydrogen (Protium)



# The Fundamental Unit of Life

5

NCERT SOLUTIONS



## What's inside

- In-Chapter Q's (solved)
- Textbook Exercise Q's (solved)

EduCart

## IN-CHAPTER QUESTIONS

### Test Yourself

#### 1. Who discovered cells, and how?

**Ans.** The cell was first discovered by Robert Hooke. He observed the cell in a thin section of cork with the help of rough microscope in 1665. Thus he was the first to discover the cell.

#### 2. Why is the cell called the structural and functional unit of life?

**Ans.** The cell is called the structure and functional unit of life because the body is formed only by the combination of cells. Since the function of the whole body are the by products of the actions of the cells. Therefore, the cell is also called the functional unit of life.

### Test Yourself

#### 1&2. How do substances like $\text{CO}_2$ and water move in and out of the cell? Discuss Why is the plasma membrane called a selectively permeable membrane?

**Ans.** The concentration of  $\text{CO}_2$  in the outer environment of the cell is less than the concentration of  $\text{CO}_2$  present in the cells. As there is a difference in the concentration of  $\text{CO}_2$  inside and outside the cell, at the same time  $\text{CO}_2$  is expelled from the cell by diffusion from high concentration to low concentration. Similarly when the oxygen concentration in the cell decreases,  $\text{O}_2$  moves from outside to the inside of cell by diffusion.

### Test Yourself

#### 1. Fill in the gaps in the following table illustrating differences between prokaryotic and eukaryotic cells.

Prokaryotic Cell	Eukaryotic Cell
1. Size : generally small ( $1 - 10$ mm) $1 \text{ mm} = 10^{-6} \text{ m}$	1. Size : generally large (5-100 mm)
2. Nuclear region: _____ _____ and known as _____	2. Nuclear region: well defined and surrounded by a nuclear membrane.
3. Chromosome: single	3. More than one chromosome
4. Membrane-bound organelles absent	4. _____ _____

Ans.	Prokaryotic Cell	Eukaryotic Cell
1.	<b>Size :</b> generally small (1 – 10 mm) $1\text{ mm} = 10^{-6}\text{ m}$	<b>Size :</b> generally large (5-100 mm)
2.	Nuclear region: is poorly defined due to absence of a nuclear membrane and known as nucleoid.	Nuclear region: well defined and surrounded by a nuclear membrane.
3.	There is a single chromosome.	There are more than one chromosomes.
4.	Membrane-bound cell organelles absent	Membrane bound cell organelles present.

## Test Yourself

**1. Can you name the two organelles we have studied that contain their own genetic material?**

**Ans.** Yes, Mitochondria and plastids contain their own genetic material.

**2. If the organisation of a cell is destroyed due to some physical or chemical influence, what will happen?**

**Ans.** If the organisations of a cell is destroyed due to some physical or chemical influence, it will die. Organisation of cell is necessary for life necessary for life.

**3. Why are lysosomes known as suicide bags?**

**Ans.** If the cell gets damaged then one of the lysosomes burst and release some digestive enzymes. The released enzymes then digest their own cell and ultimately the cell dies. Hence, lysosomes are called suicide bags.

**4. Where are proteins synthesised inside the cell?**

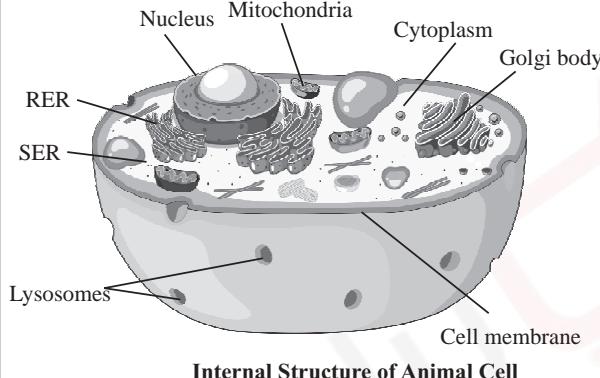
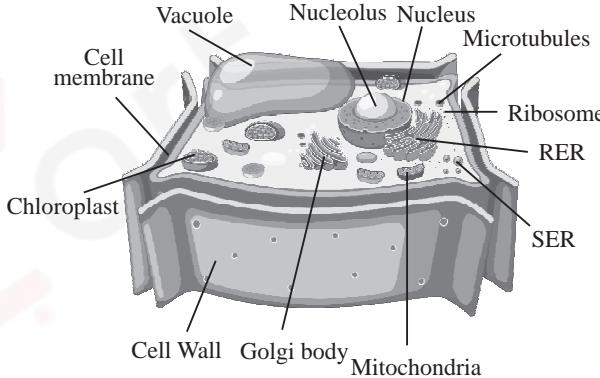
**Ans.** Ribosomes are the site of protein synthesis inside a cell

## NCERT EXERCISES

**1. Compare the plant cell and animal cell.**

**Ans.** Difference between Plant and Animal cell.

S.No.	Plant Cell	Animal Cell
1.	In plant cell a solid cell wall is found outside the cell membrane.	Cell wall is absent in it.
2.	Plastids are found in it.	Plastids are absent in it.
3.	Photosynthesis can take place.	Photosynthesis does not take place.

4.	Centrosome is found in less developed plants, but not found in more developed plants.	Centrosome is absent in less developed animals but it is found in more developed animals.
5.	Large vacuole containing juice is found.	Flexible vacuole is found for water control whereas food vacuole is found for food digestion.
6.	All the cells of most plants are completely effective. Therefore, even a small piece can grow a whole plant.	Animal cells, normally, are not totipotent. Exception: Interstitial cells of hydra and Archaeocyte of sponges.
7.	Centriole is not found in plant cell.	Centriole is present in animal cell.
8.	Stored carbohydrate foods are usually starch in them.	Stored food contains glycogen in them.
9.	During cell division a cell plate is formed.	During cell division, there is a contraction between daughter cells.
10.	Due to Chloroplast, they are autotrophs.	They are heterotrophs.
	 <p style="text-align: center;"><b>Internal Structure of Animal Cell</b></p>	 <p style="text-align: center;"><b>Internal Structure of Plant Cell</b></p>

## 2. How is a eukaryotic cell differ from prokaryotic cells?

**Ans.**

S.No.	Prokaryotic cell	Eukaryotic cell
1.	These cells are usually small in size ( $1\text{-}10 \mu\text{m}$ ) ( $1\mu\text{m} = 10^{-6} \text{ m}$ ).	Their size is usually large ( $5\text{-}100 \mu\text{m}$ ).
2.	The nuclear region or nucleoid is not surrounded by any membrane.	The nuclear region is surrounded by a membrane.
3.	Only one chromosome is found in them.	They have more than one chromosomes.
4.	They don't have nucleus or nucleolus.	The nucleus is found in them.
5.	Cell organelles are not found in them.	Cell organelles are found in them.

6.	Cell division takes place by budding in them. Point division does not occur.	Cell division takes place by mitosis or meiosis in them.
7.	Chloroplast is not found.	Chloroplast is found in plant cells.
8.	Present only in bacteria and cyanobacteria.	Present in all plants and animals.

### 3. What would happen if the plasma membrane ruptures or breaks down?

**Ans.** If plasma membrane bursts, the cytoplasm will come out and all the cell organelles will also come out with it and get destroyed thus the cell will die.

### 4. What would happen to the life of a cell if there was no Golgi apparatus?

**Ans.** If the Golgi apparatus is not present in the cell, the exchange of substances produced in the endoplasmic reticulum inside or outside the cell, will stop. This will lead to the lack of lysosomes and no removal of waste material from the cell will take place. As a result, the life of the cell will be dead.

### 5. Which organelle is known as the power house of the cell? Why?

**Ans.** Energy is generated by mitochondria in the cell. It is stored in the form of A.T.P. It is utilised in many biological activities. As mitochondria generates the energy, so it is called power house of the cell.

### 6. Where do the lipids and proteins constituting the cell membrane get synthesised?

**Ans.** The lipids and proteins that make up the cell membrane are synthesised in the endoplasmic reticulum.

**Movement of substances in the cell:** There is movement of different types of substances within the cells. But the cell membrane or plasma membrane allows only specialised substances to pass through it. Therefore, the plasma membrane is called a selectively permeable membrane.

The movement of substances in cells takes place in two ways:

- (i) Diffusion
- (ii) Osmosis

**(1) Diffusion:** The movement of substances through cells is accomplished by the process of diffusion. When a substance (like  $\text{CO}_2$  or  $\text{O}_2$ ) moves from a higher concentration to a lower concentration, that process is called diffusion. The exchange of gases between the leaves of plants and the atmosphere takes place by the process of diffusion.

#### Importance of diffusion:

- (a) Different substances in the cytoplasm move from one place to another due to diffusion.
- (b) Flowers attract pollinators by spreading their fragrance by diffusion.

- (c) When a perfume bottle is opened, its molecules are evenly dispersed in the air.
- (d) The rate of diffusion higher in the gases than in solids and liquids.
- (e) Diffusion helps in transpiration of water from plants in the form of water vapour.  
It is beneficial for the plants.
- (f) Diffusion helps in the exchange of substances required by the organism.

**(2) Osmosis:** The movement of substances in the liquid state takes place in the cells by another process, which is called osmosis. When water molecules move from high water concentration to low water concentration through a selectively permeable membrane, this process is called osmosis.

That is, "**Osmosis is the process in which molecules of a solvent (water) move from a region of pure water or a solution of less solute to a solution of more solute through a semi permeable membrane.**"

#### **Importance of Osmosis:**

- (a) The absorption of water by the roots of plants takes place through osmosis.
- (b) The crunching speed of some plants is based on osmosis.
- (c) Stomata of leaves open and close by osmosis.
- (d) Unicellular, saltless (fresh) aquatic organisms take in water by osmosis.
- (e) Cells absorb water by osmosis.

Solutions are divided into three parts on the basis of rate of osmosis:

1. Low osmotic pressure solution.
2. Semi osmotic pressure solution.
3. Super osmotic pressure solution.

**1. Low osmotic pressure solution:** The solution which produces low osmotic pressure is called low osmotic pressure solution, for example: if a cell is placed in such a solution of sugar or salt in which the amount of sugar or salt is very less relative to amount of water, then water starts going inside the cell by osmosis. Such solution of water are called low osmotic pressure solution.

Cell starts swelling by this phenomenon.

**2. Semi osmotic pressure solution:** The solution whose concentration is exactly equal to the concentration of the substance of the cell, are called semi osmotic pressure solution.

**3. Super osmotic pressure solution:** If the solution outside the cell is more concentrated or thicker than the substance inside the cell, the water inside the cell will start coming out by osmosis. Such solution is called super osmotic pressure solution. When cell is placed in highly osmotic pressure solution, excess amount of water comes out from the cell, hence the cell gets compressed. It can be understood by the following examples:

- (a) The outer shell of the egg which is made up of calcium carbonate can be removed by soaking with dilute hydrochloric acid. There is a membrane inside it. In this state, if the egg is immersed in pure water for 5 minutes then egg get swelled due to osmosis.
- (b) If a shellless egg is placed in a concentrated solution of salt, then the egg shrinks because the water of egg comes out in the salt solution.
- (c) If raisins are kept in a normal water, they swell after absorbing water. This process is also called imbibition. Conversely, if they are kept in a concentrated solution, their water gets into the solution and they shrink.

## 7. How does amoeba get its food?

**Ans.** Amoeba is a unicellular animal. Vacuoles are present in its cell. There is a food vacuoles present in them. The food vacuoles is filled with food from which the amoeba obtains food. Food enters the amoeba through a food vacuole.

## 8. What is Osmosis?

**Ans.** The movement of water molecules from a region of higher concentration to a region of lower concentration by permeable membrane is called osmosis. The Osmotic speed of water depends on the dissolved substances.

## 9. Carry out the following osmosis experiment:

**Take four peeled potato halves and scoop each one out to make potato cups One of these potato cups should be made from a boiled potato. Put each potato cup in a trough containing water. Now**

- (a) Keep cup A empty
- (b) Put one teaspoon sugar in cup B
- (c) Put one teaspoon salt in cup C
- (d) Put one teaspoon sugar in the boiled potato cup D.

**Keep these for two hours. Then observe the four potato cups and answer the following:**

- (i) Explain why water gathers in the hollowed portion of B and C.
- (ii) Why is potato A necessary for this experiment?
- (iii) Explain why water does not gather in the hollowed out portions of A and D.

## 10. Which type of cell division is required for growth and repair of body and which type is involved in formation of gametes?



# Tissues **6**

**NCERT SOLUTIONS**



## **What's inside**

- *In-Chapter Q's (solved)*
- *Textbook Exercise Q's (solved)*

## **IN-CHAPTER QUESTIONS**

## Test Yourself

1. Define the term “tissue”.
  2. How many types of elements together make up the xylem tissue? Name them

## Test Yourself

- ## **1.Name types of simple tissues.**

**Ans.** There are three types of simple tissues—

- (i) Parenchyma
  - (ii) Collenchyma
  - (iii) Sclerenchyma

- ## **2. Where is apical meristem found?**

**Ans.** Apical meristem is found in the growing part of roots and stem and it increases their length.

- ### **3.Which tissue makes up the husk of coconut?**

## **Ans. Sclerenchyma.**

- #### **4. What are the constituents of phloem?**

(iii) Phloem parenchyma (iv) Sclerenchyma.

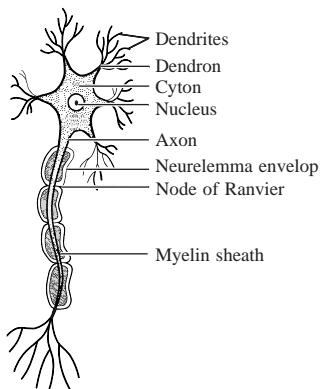
# Test Yourself

- ## **1. Name the tissue responsible for movement in our body.**

**Ans.** Muscular tissue is responsible for movement in our body.

- ## 2. What does a neuron look like?

**Ans.** The cells of nervous tissue are called neurons. These cells contain nucleus and cytoplasm. Long and thin hair-like branches are emerged from it. It consist of a long stem called an axon and many short branched stems are called dendrites. A neuron is one meter long. It appears like a branch as shown in figure.



### **3. Give three features of cardiac muscles.**

**Ans.** Following are the three characteristics of cardiac muscle tissues:

- (i) They are involuntary muscles which keep on rhythmic contracting and expanding throughout the life under normal condition.
- (ii) It is cylindrical with branches and a nucleate.
- (iii) These tissues have lighter and less dark linings.

### **4. What are the functions of areolar tissue?**

**Ans.**(i)It fills the space between the limbs.

(ii)It supports the internal organs.

(iii)It also helps in repairing of tissues.

## **NCERT EXERCISES**

### **1. Define the term tissue.**

**Ans.**On the basis of origin and structure, the group of similar cells which is specialized for single function is called tissue.

### **2. How many types of elements together make up the xylem tissues?**

**Ans.**Four types of elements together make up the xylem tissues—(i) Tracheids, (ii) Vessels, (iii) Xylem fibres, (iv) Xylem parenchyma

### **3. How are simple tissues different from complex tissues in plants?**

**Ans.**

<b>Simple tissues</b>	<b>Complex tissues</b>
(i) They are made up of same type of cell like—parenchyma, collenchyma and sclerenchyma	(i) They are made up of different types of cells like—xylem, phloem.
(ii) These layers form the basal packing of the tissue.	(ii) They form the vascular bundles.
(iii) It is made up of simple cells with thin walls.	(iii) Their cell wall is thick.
(iv) These are living cells.	(iv) Most of the xylem cells are dead.

### **4. Differentiate between parenchyma, collenchyma and sclerenchyma on the basis of their cell wall.**

**Ans.**

<b>Parenchyma</b>	<b>Collenchyma</b>
(i) These are thin walled cells.	(i) It is thick and bulky due to excess deposition of cellulose and pectic substances at the corners.
(ii) It is a soft tissue.	(ii) It is soft as well as strong tissue.
(iii) It performs the function of storing food.	(iii) It provides mechanical support.

(iv) It is alive because it has a lot of intercellular space.	(iv) It does not have intercellular space.
(v) It is found in almost all parts of the plants.	(v) It is not found in monocot plants.

Collenchyma	Sclerenchyma
(i) This tissue is made up of living cells	(i) This tissue is made up of dead cells
(ii) It is metabolically active in which protoplasm is found	(ii) These are dead cells and do not contain protoplasm.
(iii) Due to the deposition of cellulose and pectic substances at their corners, they are bulky	(iii) Their cells have a uniform thickening and this is due to the presence of lignin.
(iv) This tissue provides flexible firmness (or rigidity)	(iv) This tissue provides mechanical strength to all parts of plants.

## 5. What are the functions of the stomata?

**Ans.** The prime function of stomata is to exchange the gases by closing and opening the pores in the leaves. It assists in eradicating excess water from the leaves.

## 6. Diagrammatically show the difference between the three types of muscle fibres.

**Ans.**



Fig. : Striated muscle

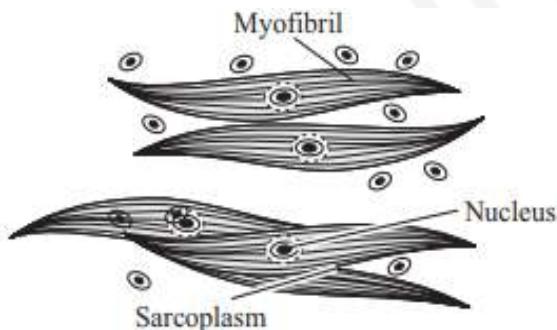


Fig.: Unstriated Muscle fibre

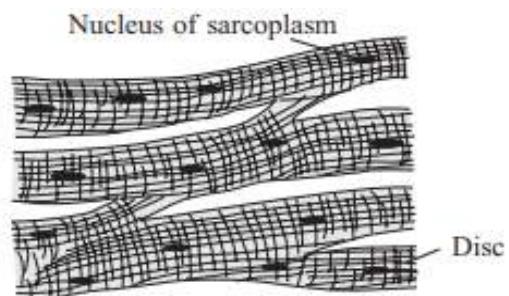


Fig.: Cardiac muscle

## 7. What is the specific function of the cardiac muscle?

**Ans.** Cardiac muscles keep on contracting and dilated rhythmically throughout the life of a person.

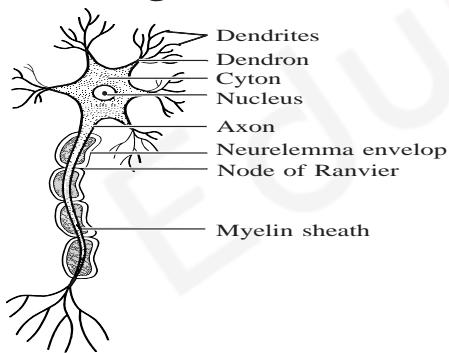
## 8. Differentiate between, striated, unstriated and cardiac muscles the basis of their structure and site/location in the body.

**Ans.**

S.No.	Striated (Voluntary muscles)	Unstriated (Involuntary muscles)	Cardiac muscles
(i)	Shape–It is long, narrow, cylindrical and unbranched.	Shape–It is long and tapered	Shape–It is cylindrical, having branched containing strips.
(ii)	Muscle fibre is $2.4\mu\text{m}$ long and $10\text{-}30\mu\text{m}$ wide	Muscle fibre is $100\text{-}200\mu\text{m}$ long and $10\mu\text{m}$ wide	Muscle fibre is $50\text{-}100\mu\text{m}$ long and $20\mu\text{m}$ wide.
(iii)	They are found in the hands and feet	They are found in walls of digestive tract, bladder and vessels.	They are found in the heart.
(iv)	They are in the form of bundles	They appear as clusters of tubules.	They are in the form of a network.
(v)	Sarcolemma is found in them	Sarcolemma is not found in them	Plasma membrane is found with sarcolemma in them.
(vi)	They are voluntary	They are involuntary	They are involuntary
(vii)	Many nuclei are found in them which are towards preiphery	One nucleus is found in each cell in them which are in the middle	One or more nuclei are found in the central part in them
(viii)	They get tired quickly	They do not get tired	They are always active and never get tired
(ix)	Bandages are present in them	Bands are absent in the cells	Only transverse bands are found.
(x)	They are unbranched	They are unbranched	They are connected with each other.

## 9. Draw a labelled diagram of a neuron.

**Ans.**



## 10. Name the following–

- (a) Tissues that forms the inner lining of our mouth
- (b) Tissues that connects muscle to bone in humans
- (c) Tissue that transports food in plants
- (d) Tissue that stores fat in our body.
- (e) Connective tissue with a fluid matrix.
- (f) Tissue present in the brain.

**Ans.**(a)Epithelium

- (b)Tendon

- (c)Phloem
- (d)Adipose Tissue
- (e)Blood
- (f)Nervous tissue

## 11. Identify the type of tissue in the following–

**Skin, bark of tree, bone, lining of kidneys tubule, vascular bundle.**

**Ans.**(i) Skin—Striated squamous epithelium

- (ii)Bark of tree—Meristematic tissue
- (iii)Bone—Connective tissue
- (iv)Lining of kidney tubule—Cuboidal epithelium tissue
- (v)Vascular bundle—Complex tissue

## 12. Name the regions in which parenchyma tissue is present.

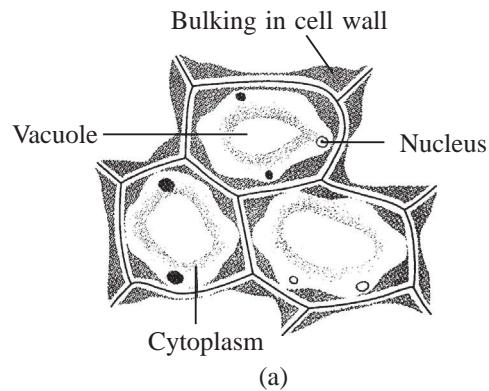
**Ans.**In the tender (soft) parts of the stem and root.

**(2)Collenchyma—**When cellulose accumulates at the corners of the parenchyma, they become bulky and flexible. A group of such cells is called a collenchyma. Their characteristics are as follows—

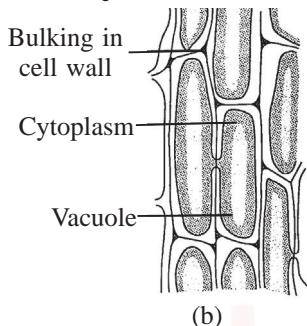
- (i) Their cells are nucleated, elongated or oval or polygonal.
- (ii)Their cells are living and vacuolated.
- (iii)The wall of these cells are thick and unsightly (lewd).
- (iv)There is very little space between their cells
- (v)Their cells are found in new parts of the plant
- (vi)They are mainly found under the epidermis of the stem, in the leaf petiole and peduncles but are not found in roots.
- (vii)Vacuoles are found in the protoplasm of their cells.

## Functions—

- (i)It provides mechanical support to the plants.
- (ii)When chloroplast is found in it, it makes food in sunlight.
- (iii)It provides flexibility and mechanical strength to the stems.
- (iv)Due to their presence, the stems of many plants do not break even after bending.



**Fig.: Collenchyma (a) cross section**



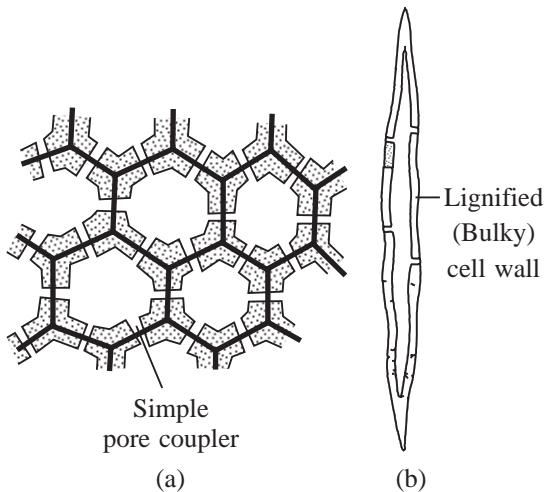
**Fig.: Collenchyma (b) longitudinal section**

**(3) Sclerenchyma**—These tissues are formed by the combination of elongated cells whose edges are narrow. These tissues are hard and strong. Their characteristics are as follows—

- (i) The cells of these tissues die on maturity
- (ii) Their cells are dead, elongated, narrow and pointed at both ends.
- (iii) They do not contain protoplasm.
- (iv) Their wall is thick due to the deposition of lignin.
- (v) These tissues provide mechanical support and flexibility to the plants.

#### **Functions—**

- (i) They provide mechanical strength to the plants and protects the internal parts.
- (ii) They perform protective functions in the outer parts of plants.
- (iii) They provide strength, rigidity and flexibility to the plants.



**Fig.: Sclerenchyma. (a) Transverse section (TS)  
(b) Longitudinal section (LS), (c) Aerenchyma**

### 13. What is the role of epidermis in plants?

**Ans.**(i)It protects the plants by reducing the loss of water.

(ii)It forms a waterproof layer on its surface.

(iii)It protects plants from mechanical shock and entry of parasitic fungi.

(iv)Epidermis cells found in roots perform the function of water absorption.

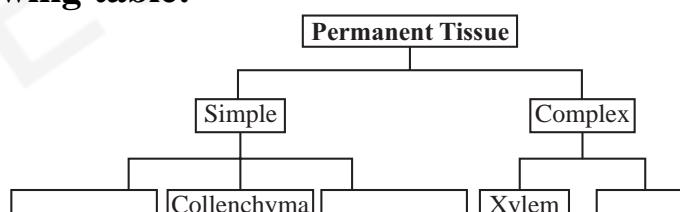
### 14. How does the cork act as a protective tissue?

**Ans.**Cork provides protection to plant and it prevents loss of water from plant body.

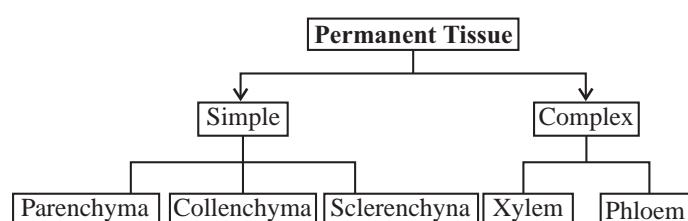
Cork protects the plants from infection and mechanical injury. Cork is light in weight and it cannot catch fire. Because of this property it is used as insulators.

Cork is hard in nature hence it is used to make sports goods.

### 15. Complete the following table:



**Ans.**





# Motion

7

NCERT SOLUTIONS



## What's inside

- *In-Chapter Q's (solved)*
- *Textbook Exercise Q's (solved)*

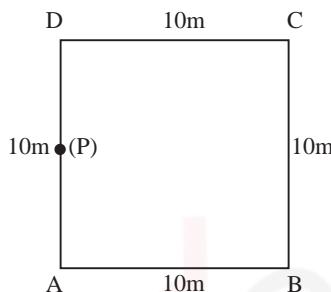
## IN-CHAPTER QUESTIONS

### Test Yourself

**1. An object has moved through a distance. Can it have zero displacement? If yes, support your answer with an example.**

**Ans.** Yes, it can have zero displacement. If an object moves in a circular path for one complete revolution, then its initial point and final point are the same, so displacement becomes zero.

**2. A farmer moves along the boundary of a square field of side 10 m in 40 s. What will be the magnitude of displacement of the farmer at the end of 2 minutes 20 seconds from his initial position?**



**Ans.** Given,  $AB = 10 \text{ m}$

Time taken to travel from A to B ( $t_1$ ) = 40s

Time taken by the farmer ( $t_2$ ) = 2 min 20 seconds  
= 140 s

Displacement ( $d$ ) = ?

Time taken in one revolution

$$\begin{aligned} &= (AB + BC + CD + DA) \times t_1 \\ &= 40 \times 40 \\ &= 160 \text{ s} \end{aligned}$$

Since to complete one revolution farmer requires 160s but given time is 140 i.e., the revolution will be incomplete.

Hence, at first three edges (AB, BC, CD) 120 seconds requires and the last 20 seconds remains for the fourth edge (DA).

$\therefore$  time remain for edge DA = 20 seconds

(sufficient to complete half distance)

Distance completed in 20 seconds

$$= \frac{10}{2} = 5 \text{ m}$$

Hence, final position of farmer will be at point (P) which is 5m from point A as well as D.??

Initial position (A) and Final Position (P) then the  
Displacement (AP) = 5m

### 3. Which of the following is true for displacement?

- (a) It cannot be zero.
- (b) Its magnitude is greater than the distance travelled by the object.

**Ans.** Neither of the statements is true.

- (a) is false because the displacement of an object which travels a certain distance and comes back to its initial position is zero.
- (b) is false because the displacement of an object can be equal to, but never greater than the distance travelled.

## Test Yourself

### 1. Distinguish between speed and velocity.

Ans.	Speed	Velocity
	(i) The rate of change of distance is called speed	(i) The rate of change of displacement is called velocity.
	(ii) Speed is a scalar quantity	(ii) Velocity is a vector quantity
	(iii) Speed of a moving object is not zero	(iii) The velocity of a moving object can be zero.
	(iv) Change in distance causes difference in speed.	(iv) Change in velocity can be caused by a change in magnitude or direction of displacement

### 2. Under what condition(s) is the magnitude of average velocity of an object equal to its average speed?

**Ans.** If the distance covered by the object and the magnitude of displacement are the same then the average velocity will be equal to the average speed.

### 3. What does the odometer of an automobile measure?

**Ans.** Odometer of an automobile measures the distance travelled.

### 4. What does the path of an object look like when it is in uniform motion?

**Ans.** The path of an object in uniform motion appears to be a linear.

### 5. During an experiment, a signal from a spaceship reached the ground station in five minutes. What was the distance of the spaceship from the ground station? The signal travels at the speed of light, that is, $3 \times 10^8 \text{ ms}^{-1}$

**Ans.** Distance = time × speed

$$\text{Time} = 5 \text{ minutes} \times 60 = 300 \text{ seconds}$$

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

$$\text{Distance} = 300 \times 3 \times 10^8$$

$$= 9 \times 10^{10} \text{ m}$$

$$= 9 \times 10^7 \text{ km}$$

## Test Yourself

**1. When will you say a body is in**

- (i) uniform acceleration?
- (ii) non-uniform acceleration?

**Ans.** (i) If the rate of change of velocity of a moving object remains the same for a small interval of time, then the acceleration produced in the object is called uniform acceleration.

(ii) If the rate of change of velocity of a moving object varies at different intervals of time, then the acceleration of the object is called the uniform acceleration.

**2. A bus decreases its speed from  $80 \text{ km h}^{-1}$  to  $60 \text{ km h}^{-1}$  in 5 s. Find the acceleration of the bus.**

**Ans.** Since, initial velocity

$$u = 80 \times \frac{5}{18} \text{ ms}^{-1} = \frac{400}{18} \text{ ms}^{-1}$$

Final velocity,

$$v = 60 \times \frac{5}{18} \text{ ms}^{-1} = \frac{300}{18} \text{ ms}^{-1}$$

Time interval = 5s

$$\therefore a = \frac{v-u}{t} = \frac{\frac{300}{18} - \frac{400}{18}}{5} = \frac{100}{90} \text{ ms}^{-2}$$

$$a = -\frac{10}{9} \text{ ms}^{-2}$$

$\therefore$  Therefore, retardation in bus =  $\frac{10}{9} \text{ ms}^{-2}$

$$= 1.11 \text{ ms}^{-2}$$

**3. A train starting from a railway station and moving with uniform acceleration attains a speed of  $40 \text{ km h}^{-1}$  in 10 minutes. Find its acceleration.**

**Ans.** Initial velocity  $u = 0 \text{ ms}^{-1}$ , uniform acceleration  $a = ?$

Final velocity

$$v = 40 \times \frac{5}{18} \text{ ms}^{-1}$$

$$= \frac{200}{18} \text{ ms}^{-1}$$

$$\text{Time} = 10 \text{ minutes} = \frac{10}{60} \times 60 = \frac{10}{60} \times 600 \text{ s.}$$

$$a = \frac{v-u}{t} = \frac{\frac{200}{18} - 0}{600} = \frac{200}{18 \times 600} \text{ ms}^{-2}$$

$$a = \frac{1}{54} \text{ ms}^{-2}$$

$$\text{Acceleration (a)} = \frac{1}{54} \text{ ms}^{-2} = 0.019 \text{ m/s}^2$$

## Test Yourself

- What is the nature of the distance-time graphs for uniform and non-uniform motion of an object?

**Ans.** The graph for uniform motion is in the form of a straight line, whereas for non-uniform motion it is in a curved line.

- What can you say about the motion of an object whose distance-time graph is a straight line parallel to the time axis?

**Ans.** The motion of the object is in a state of uniform motion.

- What can you say about the motion of an object if its speed-time graph is a straight line parallel to the time axis?

**Ans.** The object is moving with a uniform velocity, but it has zero acceleration.

- What is the quantity which is measured by the area occupied below the velocity-time graph?

**Ans.** The quantity which is measured by area occupied below the velocity-time graph is distance (resultant of displacement) travelled by the object in given time interval.

## Test Yourself

- A bus starting from rest moves with a uniform acceleration of  $0.1 \text{ m s}^{-2}$  for 2 minutes. Find (a) the speed acquired, (b) the distance travelled.

- A train is moving with a speed of  $90 \text{ km/h}$ . When brakes are applied, a retardation of  $0.5 \text{ m/s}^2$  is produced. How much distance will the train cover before it stops and how long will it take?

**Ans.** Given that,

$$u = 90 \text{ km/h} = \frac{90 \times 1000 \text{ m}}{3600 \text{ s}} = 25 \text{ m/s}$$

$$a = -0.5 \text{ m/s}^2$$

$$v = 0 \text{ m/s}, s = ?, t = ?$$

form the equation  $v^2 = u^2 + 2as$ , the distance travelled

$$s = \frac{v^2 - u^2}{2a}$$

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

$$s = 625 \text{ m}$$

from the equation  $v = u + at$ , the time taken

$$t = \frac{v - u}{a}$$
$$= \frac{0 \text{ m/s} - 25 \text{ m/s}}{-0.5 \text{ m/s}^2}$$

$$t = 50 \text{ s.}$$

3. A trolley, while going down an inclined plane, has an acceleration of  $2 \text{ cm s}^{-2}$ . What will be its velocity 3 s after the start?
4. A racing car has a uniform acceleration of  $4 \text{ m s}^{-2}$ . What distance will it cover in 10 s after start?

**Ans.** ∵ Initial velocity of car  $u = 0$

Uniform acceleration of car,  $a = \text{ums}^{-2}$

Time ( $t$ ) = 10 s

$$\text{From the formula } s = ut + \frac{1}{2} at^2$$

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

$$s = 200 \text{ m}$$

5. A stone is thrown in a vertically upward direction with a velocity of  $5 \text{ ms}^{-1}$ . If the acceleration of the stone during its motion is  $10 \text{ ms}^{-2}$  in the downward direction, what will be the height attained by the stone and how much time will it take to reach there?

**Ans.** Here,  $u = 5 \text{ ms}^{-1}$

$$a = 10 \text{ ms}^{-2}$$

Final velocity  $v = 0$

$$\text{From, } v^2 - u^2 = 2as$$

$$0^2 - 5^2 = 2 \times (-10) \times s$$

$$s = \frac{25}{20} = 1.25 \text{ m}$$

The height attained by the stone = 1.25 m

From the formula,  $v = u + at$

$$0 = 5 + (-10) \times t$$

$$t = \frac{5}{10}$$

$$= 0.5 \text{ s}$$

Thus, time taken by the stone to reach the maximum height is 0.5 s.

### NCERT EXERCISES

1. An athlete completes one round of a circular track of diameter 200 m in 40 s. What will be the distance covered and the displacement at the end of 2 minutes 20 s?
2. Joseph jogs from one end A to the other end B of a straight 300 m road in 2 minutes 30 seconds and then turns around and jogs 100 m back to point C in another 1 minute what are Joseph's average speed and velocities in jogging (a)

**from A to B and (b) from A to C.**

**Ans.** The time when Joseph is at point A is  $t = 0$  (say)

The time when Joseph is at B is  $t = 150\text{s}$

The time when Joseph is at C is  $t = 20\text{s}$ .

(i) From A to B

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

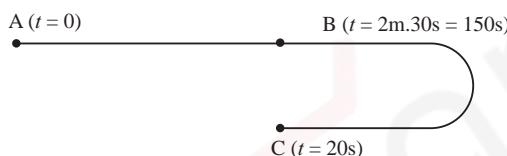
$$= \frac{300\text{m}}{150\text{s}}$$

$$= 2 \text{ ms}^{-1}$$

$$\text{Average velocity} = \frac{\text{Displacement}}{\text{time interval}}$$

$$= \frac{300\text{m}}{150\text{s}}$$

$$= 2 \text{ ms}^{-1}$$



(ii) From A to C

$$\begin{aligned}\text{Displacement (AC)} &= AB - BC \\ &= 300 \text{ m} - 100 \text{ m} \\ &= 200 \text{ m}\end{aligned}$$

$$\begin{aligned}\therefore \text{Average velocity} &= \frac{\text{Displacement}}{\text{time interval}} \\ &= \frac{200\text{m}}{210\text{s}} \\ &= \frac{20}{21} \text{ ms}^{-1}\end{aligned}$$

Distance covered by Joseph in travelling from A to C,

$$\begin{aligned}\text{ABC} &= AB + BC \\ &= 300 + 100 \\ &= 400 \text{ m}\end{aligned}$$

$$\begin{aligned}\text{Average speed of Joseph} &= \frac{\text{Distance Covered}}{\text{time interval}} \\ &= \frac{400\text{m}}{210\text{s}} \\ &= \frac{40}{21} \text{ m/s.}\end{aligned}$$

**Note:** The average speed and average velocity is same from A to B.

- 3. Abdul, while driving to school, computes the average speed for his trip to be  $20 \text{ km h}^{-1}$ . On his return trip along the same route, there is less traffic and the average speed is  $30 \text{ km h}^{-1}$ . What is the average speed for Abdule's trip?**

**Ans.** Let the distance from home to school is  $s$  and time taken to go from home to school is  $t_1$  average speed from home to school.

$$v_1 = \frac{s}{t_1} \quad \dots \text{(i)}$$

If time taken to go from school to home is  $t_2$  then average speed from school to home.

$$v_2 = \frac{s}{t_2} \quad \dots \text{(ii)}$$

Average speed for the entire journey from home to school and returning back.

$$v = \frac{s+s}{t_1+t_2} = \frac{\frac{s+s}{s} + \frac{s}{v_1}}{\frac{s}{v_1} + \frac{s}{v_2}} \quad [\text{from eqn. (i) and (ii)}]$$

$$v = \frac{2sv_1v_2}{s(v_1+v_2)} = \frac{2v_1 \times v_2}{v_1 + v_2}$$

$$v = \frac{2 \times 20 \times 30}{20+30} = \frac{40 \times 30}{50}$$

$$v = 24 \text{ km h}^{-1}.$$

- 4. A motorboat starting from rest on a lake accelerates in a straight line at a constant rate of  $3.0 \text{ m/s}^{-2}$  for 8.0s. How far does the boat travel during this time?**

**Ans.** Given that,

$$u = 0 \text{ m/s}, a = 3.0 \text{ m/s}^2$$

$$t = 8.0\text{s},$$

$$\text{from the formula } s = ut + \frac{1}{2}at^2$$

$$s = (0 \text{ m/s})(8.0\text{s}) + \frac{1}{2} (3.0 \text{ m/s}^2).(8.0\text{s})$$

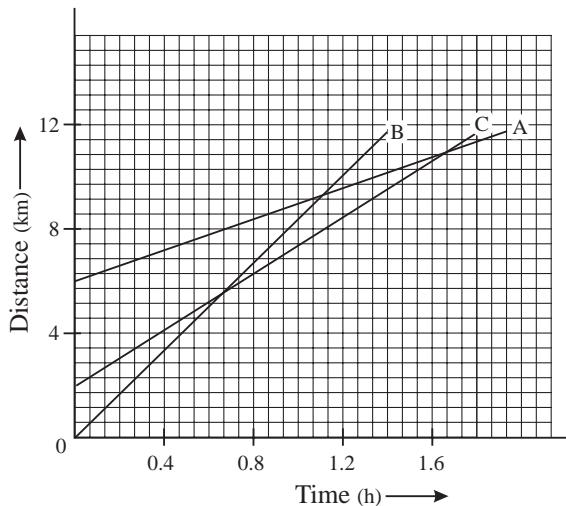
$$s = 96 \text{ m}$$

Therefore, the distance travelled by motor boat  
= 96 m

- 5. A driver of a car travelling at  $52 \text{ km h}^{-1}$  applies the brakes Shade the area on the graph that represents the distance travelled by the car during the period.**

**(b) Which part of the graph represents uniform motion of the car?**

**6. Figure shows the distance-time graph of three objects A, B and C. Study the graph and answer the following questions.**



- (a) Which of the three is travelling the fastest?**
- (b) Are all three ever at the same point on the road?**
- (c) How far has C travelled when B passes A?**
- (d) How far has B travelled by the time it passes C?**

**Ans.**(a)The value of velocity is greater when inclination of x-t graph from the time-axis is greater.

The inclination of x-t graph of object B is the highest so B is moving at the fastest speed.

(b)All three x-t graph do not meet at any one point. Hence A, B and C will never be at the same point on the road.

(c)B overtakes A at 0.7 h. It is clear from the x-t graph of C that the position of C at  $t = 0.7\text{h}$  is  $x = 15 \text{ km}$ .

Initial position of C (at  $t = 0$ )  $x = 8 \text{ km}$

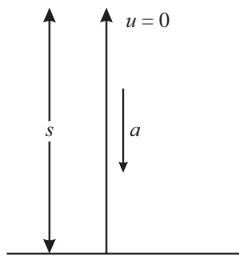
Hence, the distance covered by C from  $t = 0$  to  $t = 0.7 \text{ h}$  is  $= 15 \text{ km} - 8 \text{ km} = 7 \text{ km}$

(d)The value of time of B passing through C is  $t = 1 \text{ h}$  at  $t = 1 \text{ h}$ , the position of B is  $18 \text{ km}$  at  $t = 0$ , The position of B is  $0$ .

Hence the distance covered by B from  $t = 0$  to  $t = 1 \text{ h}$  is  $= 18 - 0 = 18 \text{ km}$ .

**7. A ball is gently dropped from a height of 20m. If its velocity increases. Uniformly at the rate of  $10 \text{ m/s}^2$  with what velocity will it strike the ground? After what time will it strike the ground?**

**Ans.**According to question,



$$u = 0 \text{ m/s}^{-2}, s = 20\text{m} \text{ and } a = 10 \text{ m/s}^{-2}$$

From the equation,

$$v^2 = u^2 + 2as$$

$$v^2 = (0 \text{ m/s})^2 + 2(10 \text{ m/s}^2) \times 20\text{m}$$

$$v^2 = 400 \text{ m}^2/\text{s}^2$$

$$v = 20 \text{ m/s}$$

Thus, the ball will strike the ground with velocity 20 m/s

From the equation,

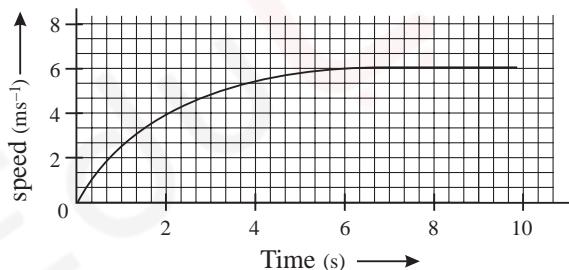
$$v = u + at$$

$$20 \text{ m/s} = 0 \text{ m/s}^{-1} (10 \text{ m/s}^2)t$$

$$\therefore t = 2\text{s}$$

Thus, the ball will strike the ground after 2s.

### 8. The speed time graph for a car is shown in the figure.



(a) Find how far does the car travel in the first 4 seconds. Shade the area on the graph that represents the distance travelled by the car during the period.

(b) Which part of the graph represents uniform motion of the car?

Ans.(a) Here, 4 squares on  $t$ -axis = 4s

$$1 \text{ square} = 1\text{s}$$

$$2 \text{ squares on } v\text{-axis} = 2 \text{ ms}^{-1}$$

$$1 \text{ square} = 1 \text{ ms}^{-1}$$

$$\text{Hence area of 1 square} = 1 \times 1 = 1 \text{ m}$$

from  $t = 0$  to  $t = 4\text{s}$ , the number of squares of the region between the  $v\text{-t}$  graph and  $t$ -axis =  $n = 20$  (more than half the squares have been considered).

$$\begin{aligned}\text{Area of 20 squares} &= 20 \times \frac{2}{3} \\ &= \frac{40}{3} \text{ m}.\end{aligned}$$

Hence the distance covered by the car is 13.33 m through the dotted squares.

(b) Here the speed of car is uniform after  $t = 7$  seconds.

**9. State which of the following situations are possible and give an example for each of these.**

- (a) An object with a constant acceleration but with zero velocity.
- (b) An object moving in a certain direction with an acceleration in the perpendicular direction.

**Ans.** (a) The highest position of a ball thrown vertically upward is an example of this situation. The velocity of the ball at the highest position, is zero. But both the value and direction of its acceleration  $g$  are constant. The value of this constant acceleration is,  $g = 9.8 \text{ ms}^{-2}$  and its direction is vertically downwards.

(b) This situation is not possible, because the direction of motion changes every moment, when the acceleration is perpendicular to the motion (velocity) and the particle cannot move in the same direction.

**10. An artificial satellite is moving in a circular orbit of radius 42250 km. Calculate its speed if it takes 24 hours to revolve around the earth.**

**Ans.** Hence,  $r = 42250 \text{ km}$

$$t = 24 \text{ hours} = 24 \times 60 \times 60 \text{ s}$$

$$v = ?$$

$$\text{Speed } (v) = \frac{\text{distance}}{\text{time}}$$

$$= \frac{2\pi r}{t}$$

$$= \frac{2 \times \frac{22}{7} \times 42250 \text{ km}}{24 \times 60 \times 60 \text{ s}}$$

$$= \frac{11 \times 4225}{7 \times 6 \times 360}$$

$$= \frac{11 \times 4225}{7 \times 2160}$$

$$= \frac{11 \times 845}{432 \times 7}$$

$$= 3.07 \text{ km/s}^{-1}$$



# Force and Laws of Motion

8

NCERT SOLUTIONS



## What's inside

- In-Chapter Q's (solved)
- Textbook Exercise Q's (solved)

EduCart

## IN-CHAPTER QUESTIONS

### Test Yourself

**1. Which of the following has more inertia:**

- (A) a rubber ball and a stone of the same size?
- (B) a bicycle and a train?
- (C) a five rupees coin and a one-rupee coin?

**Ans.**(a) A stone has more inertia than a rubber ball.

- (b) A Train has more inertia than a bicycle.
- (c) A five rupees coin has more inertia than a one rupee coin.

**2. In the following example, try to identify the number of times the velocity of the ball changes: “A football player kicks a football to another player of his team who kicks the football towards the goal. The goalkeeper of the opposite team collects the football and kicks it towards a player of his own team”. Also identify the agent supplying the force in each case.**

**Ans.** Velocity of the ball changes three times.

- (i) First of all, when the first player applies force can the ball and due to the force the velocity of the ball increases. Agent supplying the force is first player.
- (ii) For the second time, the second player stops the ball by reducing the force exerts first, which decreases the velocity of the ball. Then again he increases the velocity of the ball. Applies power to the ball and accelerates it towards the goal. Agent supplying the force is second player.
- (iii) for the third time the goalkeeper applies power to the ball and stops the ball. Due to this the velocity of the ball becomes zero. The goal keeper guides him to a player of his team. This time the ball is again in motion. Agent of supplying force is goalkeeper.

**3. Explain why some of the leaves may get detached from a tree if we vigorously shake its branch.**

**Ans.**The branches and leaves of the tree remain in rest. When the branch is shaken, that branch becomes in motion and the leaves try to remain at rest due constant inertia. Due to this a force is exerted on the leaves due to which some leaves break and fall down.

**4. Why do you fall in the forward direction when a moving bus brakes to a stop and fall backwards when it accelerates from rest?**

**Ans.**A passenger sitting in a moving bus, U is moving with a same speed in the direction of the bus, But only the lower part of the passenger remains in contact with the bus and the upper part remains free. When the bus stops suddenly, the free upper part

of the passenger falls forward. The same situation happens when the bus stops. Suddenly. But this time passenger falls backward, not forward. This situation is due to the principles of inertia and rest.

## NCERT EXERCISES

**1. An object experiences a net zero external unbalanced force. Is it possible for the object to be travelling with a non-zero velocity? If yes, state the conditions that must be placed on the magnitude and direction of the velocity. If no, provide a reason.**

**Ans.** It has two conditions:

- (i) In the first condition, if the object is in a state of rest then the answer of the question will be "no" because in the absence of an unbalanced force from Newton's first law of motion, the object would not remain in its former position.
- (ii) In the second condition, if the resultant force of the forces acting on a moving object is zero, then the resultant force of the total forces on the object will be zero. In such a condition the answer to question would be 'Yes'.

**2. When a carpet is beaten with a stick dust comes out of it. Explain.**

**Ans.** When a carpet is beaten with a stick, the carpet becomes in motion, due to inertia, the dust particles want to remain at rest. Due to this the dust particles come out.

**3. Why is it advised to tie any luggage kept on the roof of a bus with a rope?**

**Ans.** The luggage kept on the roof of the bus are tied with a rope so that it remains stable at one place and does not fall down because this luggage is not attached to the bus. When the bus is moving, the luggage on the bus may fall backwards from the roof of the bus, similarly when the bus stops suddenly, the luggage can fall forward. In such a condition the luggage is tied with a rope. This is due to inertia of rest luggage tends to keep moving when bus is moving and to remain stationary when it is stopped.

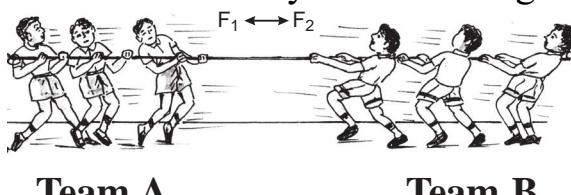
**4. A batsman hits a cricket ball which then rolls on a level ground. After covering a short distance, the ball comes to rest. The ball slows a stop because:**

- (a) The batsman did not hit the ball hard enough.
- (b) Velocity is proportional to the force exerted on the ball.
- (c) There is a force on the ball opposing the motion.
- (d) There is no unbalanced force on the ball, so the ball would want to come to rest.

**Ans.(c)** There is a force on the ball opposing the motion.

## Explanation of unbalanced force

The unbalanced force can be understood by the following experiment.



- 5.** A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of 400 m in 20s. Find its acceleration. Find the force acting on it if its mass is 7 tonnes (Hint) tonne = 1000 kg

**Ans.** Given that, initial velocity,  $u = 0$

distance travelled,  $s = 400 \text{ m}$

time taken,  $t = 20 \text{ s}$

from the formula,  $s = ut + \frac{1}{2}at^2$

or

$$400 = 0 \times 20 + \frac{1}{2}a(20)^2$$

$$a = \frac{400 \times 2}{400} = 2 \text{ ms}^{-2}$$

mass,  $m = 7 \times 1000 = 7000 \text{ kg}$

$$a = 2 \text{ ms}^{-2}$$

$$F = ma = 7000 \times 2 = 14000 \text{ N}$$

- 6.** A stone of 1 kg is thrown with a velocity of  $20 \text{ ms}^{-1}$  across the frozen surface of lake and comes to rest after travelling a distance of 50 m. What is the force of friction between the stone and the ice?

**Ans.** According to question,

$m = 1 \text{ kg}$ , initial velocity  $u = 20 \text{ ms}^{-1}$

final velocity  $v = 0$ , distance  $s = 50 \text{ m}$

$\therefore$  from the formula  $v^2 = u^2 + 2as$

$$0 = 20^2 + 2 \times a \times 50$$

$$a = \frac{-400}{100}$$

$$a = -4 \text{ ms}^{-2}$$

Frictional force  $F = ma$

$$= 1 \times (-4) = -4 \text{ N.}$$

- 7.** A 8000 kg engine pulls a train of 5 wagons each of 2000 kg along a horizontal track. If the engine exerts a force of 40000 N and the track offers a friction

**force of 5000 N then calculate:**

- (a) the net accelerating force.
- (b) the acceleration of the train, and
- (c) the force of wagon 1 on wagon 2

**Ans.(a)** Mass of train along with wagons

$$\begin{aligned} &= \text{mass of train} + \text{mass of 5 wagons} \\ &= 8000 + 5 \times 2000 \\ &= 18000 \text{ kg} \end{aligned}$$

$$\begin{aligned} \text{Net accelerating force} &= 40000 - 5000 \text{ N} \\ &= 35000 \text{ N} \end{aligned}$$

$$\begin{aligned} \text{(b) Acceleration} &= \frac{F}{m} = \frac{35000}{10000} \\ &= 3.5 \text{ ms}^{-2} \end{aligned}$$

$$\begin{aligned} \text{(c) } F &= ma = 2000 \times 1.9 \\ F &= 3800 \text{ N} \end{aligned}$$

**8. An automobile vehicle has a mass of 1500 kg. What must be the force between the vehicle and the road if the vehicle is to be stopped with a negative acceleration of  $1.7 \text{ ms}^{-2}$ ?**

**Ans.** According to question

$$\begin{aligned} \text{Mass of vehicle, } m &= 1500 \text{ kg} \\ \text{Acceleration } a &= 1.7 \text{ ms}^{-2} \end{aligned}$$

$$\begin{aligned} \therefore F &= ma = 1500 \times (-1.7) \\ F &= -2550 \text{ N} \end{aligned}$$

The force of 2550 N, in the opposite direction of motion of vehicle.

**9. What is the momentum of an object of mass  $m$ , moving with a velocity  $v$  ?**

- (a)  $(mv)^2$
- (b)  $mv^2$
- (c)  $\frac{1}{2}mv^2$
- (d)  $mv$

**Ans.** (d)  $mv$

**10. Using a horizontal force of 200 N, we intend to move a wooden cabinet across a floor at a constant velocity. What is the friction force that will be exerted on the cabinet?**

**Ans.** The friction force exerted on the cabinet will be 200 N, in the opposite direction of motion of cabinet.

**11. According to the third law of motion when we push on an object, the object pushes back on us with an equal and opposite force. If the object is a massive**

**truck parked along the roadside. It will probably not move, A student justifies this by answering that two opposite and equal forces cancel each other comment on this logic and explain why the truck does not move.**

**Ans.**The mass of the truck in question is large so that its inertia is also high. Due to greater inertia, the truck is at rest. This is from Newton's first law of motion.

The statement given by the student is not correct. Two equal and opposite forces cancel each other, when they act on the same object. According to Newton's third law of motion, two equal and opposite forces act on two different objects, so they do not cancel each other. Due to large mass of truck, the acceleration produced in it is negligible so truck can not move.

- 12. A hockey ball of mass 200 g travelling at  $10 \text{ ms}^{-1}$ . It struck by a hockey stick so as to return. It along it's original path with a velocity at  $5 \text{ ms}^{-1}$ . Calculate the change of momentum occured in the motion of the hockey ball by the force applied by the hockey stick.**

**Ans.**mass of ball  $m = 200 \text{ g}$

$$= 0.2 \text{ kg}$$

initial velocity of ball  $u$

$$= 10 \text{ ms}^{-1}$$

final velocity of ball  $v$

$$= 5 \text{ ms}^{-1}$$

initial momentum of ball

$$= mu = 0.2 \times 10 = 2 \text{ kgm/s.}$$

final momentum of ball

$$= mv = 0.2 \times (-5) = -1 \text{ kgm/s}$$

Change in momentum

$$= mv - mu$$

$$= -1 - 2$$

$$= -3 \text{ kg-m/s}$$

- 13. A bullet of mass 10 g travelling horizontally with a velocity of  $150 \text{ m s}^{-1}$  strikes a stationary wooden block and comes to rest in  $0.03 \text{ s}$ . Calculate the distance of penetration of the bullet into the block. Also calculate the magnitude of the force exerted by the wooden block on the bullet.**

- 14. An object of mass 1 kg travelling in a straight line with a velocity of  $10 \text{ m s}^{-1}$  collides with, and sticks to, a stationary wooden block of mass 5 kg. Then they both move off together in the same straight line. Calculate the total momentum just before the impact and just after the impact. Also, calculate the velocity of the combined object.**

- 15. An object of mass 100 kg is accelerated uniformly from a velocity of  $5 \text{ ms}^{-1}$  to  $8 \text{ ms}^{-1}$  in  $6 \text{ s}$ . Calculate the initial and final momentum of the object. Also find, the magnitude of the force exerted on the object.**

**Ans.**According to question,

$$m = 100 \text{ kg}$$

$$t = 6 \text{ sec}$$

$$u = 5 \text{ m/s}$$

$$v = 8 \text{ m/s}$$

$$\begin{aligned}\text{initial momentum} &= mu = 100 \times 5 \\ &= 500 \text{ kg-m/s}\end{aligned}$$

$$\begin{aligned}\text{final momentum} &= mv = 100 \times 8 \\ &= 800 \text{ kg-m/s}\end{aligned}$$

$$\begin{aligned}\text{force exerted on the object} &= \frac{\text{Change in momentum}}{\text{time taken}} \\ &= \frac{800 - 500}{6} = \frac{300}{6} \\ &= 50 \text{ N}\end{aligned}$$

**16.** Akhtar, Kiran and Rahul were riding in a motorcar that was moving with a high velocity on an expressway when an insect hit the windshield and got stuck on the windscreens. Akhtar and Kiran started pondering over the situation. Kiran suggested that the insect suffered a greater change in momentum as compared to the change in momentum of the motorcar (because the change in the velocity of the insect was much more than that of the motorcar). Akhtar said that since the motorcar was moving with a larger velocity, it exerted a larger force on the insect. And as a result the insect died. Rahul while putting an entirely new explanation FORCE AND LAWS OF MOTION 99 said that both the motorcar and the insect experienced the same force and a change in their momentum. Comment on these suggestions.

**17.** How much momentum will a dumb-bell of mass 10 kg transfer to the floor if it falls from a height of 80 cm? Take its downward acceleration to be  $10 \text{ ms}^{-2}$ .

**Ans.** According to question,

$$m = 10 \text{ kg}$$

$$s = 80 \text{ cm}$$

$$= \frac{80}{100} \text{ m}$$

$$a = 10 \text{ ms}^{-2}$$

$$u = 0$$

$$\text{momentum } P = ?$$

from the formula  $v^2 = u^2 + 2as$

$$v^2 = 0 + 2 \times 10 \times \frac{80}{100} = 16$$

$$v = 4 \text{ m/s}$$

$\therefore$  momentum  $P = mv = 10 \times 4$

$$P = 40 \text{ kg m/s}$$



# Motion

7

NCERT SOLUTIONS



## What's inside

- *In-Chapter Q's (solved)*
- *Textbook Exercise Q's (solved)*

## IN-CHAPTER QUESTIONS

### Test Yourself

#### 1. State the universal law of gravitation.

**Ans.** The force between two objects is directly proportional to the product of the masses of the two objects and inversely proportional to the square of the distance between them. This is the universal law of gravitation.

#### 2. Write the formula to find the magnitude of the gravitational force between the earth and an object on the surface of the earth.

**Ans.** The formula to find the magnitude of the gravitational force between the earth and an object on the surface of the earth.

$$\Rightarrow F = G \frac{M_1 M_2}{r^2}$$

### Test Yourself

#### 1. What do you mean by free fall?

**Ans.** Whenever an object falls freely from top to bottom then that object is called free fall. Due to the force of gravity, the object falls towards the earth. There is no external force in these.

#### 2. What do you mean by acceleration due to gravity?

**Ans.** When an object falls from top to bottom towards the earth, the magnitude of the velocity changes due to the attraction of the earth. This change in velocity produces acceleration. This acceleration is due to the gravitational force of the earth. Therefore this acceleration is called the acceleration due to gravity.

### Test Yourself

#### 1. What is the reason for the occurrence of tides in the oceans ?

**Ans.** Tides are caused by the gravitational pull of the Moon and the Sun on the Earth.

#### 2. If the masses of two objects are almost equal then what will be the acceleration due to the force of gravitation ?

**Ans.** If the masses of two objects are almost equal, then the acceleration due to gravitational will be  $g = GM/R^2$ , since the value of  $g$  does not depend on the mass.

### Test Yourself

#### 1. Why is it difficult to hold a school bag having a strap made of a thin and strong string?

**Ans.** The strap of the school bag is made of thin string. It is difficult to lift the bag. The reason is that more force has to be applied in less space of the hand which makes it difficult to lift the bag.

## **2.What do you mean by buoyancy?**

**Ans.**The property of a fluid due to which it exerts an upward force when an object is immersed in it. So that the object does not sink it is called buoyancy by the liquid.

## **3.Why does an object float or sink when placed on the surface of water?**

**Ans.**Objects of density less than the density of water float on the surface of water whereas thin objects with a density greater than the density of water sink in water.

### **Test Yourself**

- 1. You find your mass to be 42 kg on a weighing machine. Is your mass more or less than 42 kg?**

**Ans.** If our weight on a weighing machine be 42 kg then our mass will be equal to 42 kg. If we don't change our place. It can be more or less on changing the place.

- 2. You have a bag of cotton and an iron bar, each indicating a mass of 100 kg when measured on a weighing machine. In reality, one is heavier than the other. Can you say which one is heavier and why?**

**Ans.**An iron rod is heavy because its density is more than that of cotton kilogram per cubic meter ( $\text{kgm}^{-3}$ ). So the rod will be heavy and the cotton sack will be alight.

### **NCERT EXERCISES**

- 1. How does the force of gravitation between two objects change when the distance between them is reduced to half ?**

**Ans.**We know that,

$$\text{Gravitational force } F = \frac{G m_1 m_2}{r^2} \quad \dots(i)$$

According to question,

if the distance between them is reduced to half, then,

$$r' = \frac{r}{2}$$

$$\therefore F' = \frac{G m_1 m_2}{\left(\frac{r}{2}\right)^2}$$

$$F' = \frac{G m_1 m_2}{r^2} \cdot 4 \quad \dots(ii)$$

From equation (i) and (ii)

$$\frac{F'}{F} = \frac{1}{4}$$

$$\Rightarrow F' = 4F$$

Thus the force of attraction between them increases to four times.

**2. Gravitational force acts on all objects in proportion to their masses. Why then, a heavy object does not fall faster than a light object ?**

**Ans.** The acceleration with which an object falls towards the earth is constant and its value is equal to the value of the acceleration due to gravity of the earth. Thus all objects whether light or heavy fall with the uniform acceleration due to gravity. This is the reason why a heavy object does not fall faster than a lighter object.

**3. What is the magnitude of the gravitational force between the earth and a 1 kg object on its surface? (mass of the earth is  $6 \times 10^{24}$  kg and radius of the earth is  $6.4 \times 10^6$ m).**

$$\begin{aligned} \text{Ans. } F &= \frac{Gmm}{R^2} \\ &= \frac{6.67 \times 10^{-11} \times 6 \times 10^{24} \times 1}{(6.4 \times 10^6)^2} \end{aligned}$$

$$F = 9.8 \text{ N}$$

**4. The earth and the moon are attracted to each other by gravitational force. Does the earth attract the moon with a force that is greater or smaller or the same as the force with which the moon attracts the earth ? Why ?**

**Ans.** The force with which the earth attracts the moon is equal to the force with which the moon attracts the earth because both action and reaction are equal.

**5. If the moon attracts the earth, why does the earth not move towards the moon ?**

**Ans.** The moon and the earth both attract each other with equal force.  
from the second law of Newton,

$$a = \frac{F}{m}$$

Here the mass of the earth is much greater than the mass of the moon (about 81 times). As a result, the acceleration produced in the earth is negligible, so the earth does not move towards the moon.

**6. What happens to the force between two objects, if**

- (i) The mass of one object is doubled.
- (ii) The distance between the objects is doubled and tripled.
- (iii) The masses of both objects are doubled.

**Sol.** We know that, the gravitational force

$$F = G \cdot \frac{m_1 m_2}{r^2} \quad \dots(i)$$

- (i) If the mass of one object is doubled,

then  $F_1 = \frac{G(2m_1)m_2}{(2r)^2}$

$$F_1 = \frac{2Gm_1m_2}{r^2}$$

$$F_1 = 2F$$

Therefore, the gravitational force will be two times.

(ii) If the distance between the objects is doubled.

then  $F_2 = \frac{G(m_1)m_2}{(2r)^2} = \frac{1}{4} \frac{G.m_1m_2}{r^2}$

$$F_2 = \frac{F}{4}$$

Therefore, the gravitational force will be one-fourth.

If the distance between the objects is tripled.

then  $F_3 = \frac{G.m_1m_2}{(3r)^2} = \frac{1}{9} \frac{G.m_1m_2}{r^2}$

$$F_3 = \frac{F}{9}$$

Therefore, the gravitational force will be 1/9 times.

(iii) If the masses of both objects are double

then  $F_4 = \frac{G.(2m_1)(2m_2)}{r^2} = \frac{4.G.m_1m_2}{r^2}$

$$F_4 = 4F$$

Therefore the gravitational force will be four times.

## 7. What is the importance of universal law of gravitation?

**Ans.** The importance of the universal law of gravitation has been given earlier.

### Newton's third law of motion and gravitation.

According to Newton's third law of motion, for every action there is an equal and opposite reaction. That is, action and reaction forces act on different objects. or we can say that a force of the same magnitude acts on the first object but in opposite directions to each other.

For example, a piece of stone falling freely from a height, falls towards the center of the earth. That is, it is accelerated this acceleration is produced due to the force of gravitation on the piece of stone.

A piece of stone also attracts the earth towards itself with the same gravitational force. Here's the question, why can't we see the earth being pulled towards the stone?

To answer this question, we assume that the mass of a piece of stone is 1 kg, the

distance of the stone from the centre of the earth = the radius of the earth = 6400 km.

Hence, the magnitude of the gravitational force

$$\begin{aligned} F &= \frac{GMm}{R^2} \\ &= \frac{(6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2 / \text{kg}^2)(6.0 \times 10^{24} \text{ kg})(1\text{kg})}{(6.4 \times 10^6 \text{ m})^2} \\ &= 9.8\text{N} \end{aligned}$$

By, the Newton's second law of motion acceleration of stone,

$$\begin{aligned} a &= \frac{F}{m} = \frac{9.8\text{N}}{1\text{kg}} \\ a &= 9.8 \text{ m/s}^2 \end{aligned}$$

Since the stone also attracts the earth towards itself with a force of 9.8N by Newton's third law of motion.

acceleration of the earth.

$$\begin{aligned} a_1 &= \frac{F}{m} = \frac{9.8\text{N}}{6.0 \times 10^{24} \text{ kg}} \\ a_1 &= 1.6 \times 10^{-24} \text{ m/s}^2 \end{aligned}$$

The acceleration of the earth is very small compared to the acceleration of the stone, so we can not see the earth pulling towards the stone.

#### 8. What is the acceleration of free fall ?

**Ans.** Acceleration of free fall is  $9.8 \text{ m/s}^2$ .

#### 9. What do we call the gravitational force between the earth and an object.

**Ans.** Force due to gravitation or gravity.

#### 10. Amit buys few grams of gold at the poles as per the instruction of one of his friends. He hands over the same when he meets his friend at the equator will the friend agree with the weight of gold bought ? If not, why ?

[Hint : The value of  $g$  is greater at the poles than at the equator]

**Ans.** No, his friend will not agree with the weight of gold bought, Because the value of  $g$  at the pole is greater than the value of  $g$  at the equator. Therefore, the weight of the gold will be less at equator than at the pole.

#### 11. Why will a sheet of paper fall slower than one that is crumpled into a ball ?

**Ans.** The area of a sheet of paper is greater than that of a ball made by twisting or crumpling the same sheet, so the opposing force exerted by the wind on the sheet of paper is greater than that of the ball. Hence the sheet of paper falls slower than the ball made by crumpling the same type of the paper.

- 12. Gravitational force on the surface of the moon is only 1/6 as strong gravitational force on the earth. What is the weight in newtons of a 10 kg object on the moon and on the earth ?**

**Ans.** Weight on the earth =  $mg$   
 $= 10 \times 9.8 = 98 \text{ N}$

Weight on the moon =  $\frac{1}{6}mg$   
 $= \frac{1}{6} \times 10 \times 9.8 = 16.33 \text{ N}$

- 13. A ball is thrown vertically upwards with a velocity of 49 m/s Calculate.**

- (i) The maximum height to which it rises.  
(ii) The total time it takes to return to the surface of the earth.

**Ans.** According to question,  $u = 49 \text{ m/s}$   
at the maximum height

$$v = 0, g = 9.8 \text{ m/s}^2$$

(i) From the equation

$$\begin{aligned} v^2 &= u^2 - 2gh \\ 0 &= (49)^2 - 2 \times 9.8 \times h \\ 19.6 h &= 49 \times 49 \\ h &= \frac{49 \times 49}{19.6} \\ h &= 122.5 \text{ m} \end{aligned}$$

(ii) While throwing upward

$$\begin{aligned} v &= u - gt \\ t &= \frac{u-v}{-g} = \frac{-49}{-9.8} \end{aligned}$$

$$t = 5 \text{ s}$$

$\therefore$  The ball takes the same time to reach the surface from the maximum height  
 $\therefore$  total time =  $(5 + 5)\text{s} = 10\text{s}$

- 14. A stone is released from the top of a tower of height 19.6 m calculate its final velocity just before touching the ground.**

**Ans.** According to question,  $u = 0, h = 19.6 \text{ m}, g = 9.8 \text{ m/s}^2$   
from the equation,  $v^2 = u^2 + 2gh$

$$\begin{aligned} v^2 &= 0 + 2 \times 9.8 \times 19.6 \\ v^2 &= (19.6)^2 \\ v &= 19.6 \text{ m/s} \end{aligned}$$

- 15. A stone is thrown vertically upward with an initial velocity of 40 m/s. Taking  $g = 10 \text{ m/s}^2$  find the maximum height reached by the stone. What is the net displacement and the total distance covered by the stone ?**

**Ans.** from the question,  $u = 40 \text{ m/s}$ ,  $g = 10 \text{ m/s}^2$

$$h = ?, v = 0, s = ?$$

(i) from the formula,  $v^2 = u^2 - 2gh$

$$0 = (40)^2 - 2 \times 10 \times h$$

$$20h = 1600$$

$$h = \frac{1600}{20}$$

$$h = 80 \text{ m}$$

(ii) Net displacement = 0 (Because the stone returns back to the surface after reaching the maximum height.)

(iii) Total distance covered by the stone =  $80 \text{ m} + 80 \text{ m} = 160 \text{ m}$

- 16. Calculate the force of gravitation between the earth and the sun, given that the mass of earth =  $6 \times 10^{24} \text{ kg}$ . and of the sun =  $2 \times 10^{30} \text{ kg}$ . The average distance between the two is  $1.5 \times 10^{11} \text{ m}$ .**

**Ans.** Mass of the earth  $M_e = 6 \times 10^{24} \text{ kg}$

Mass of the sun  $M_s = 2 \times 10^{30} \text{ kg}$

The average distance between the two ( $r$ ) =  $1.5 \times 10^{11} \text{ m}$

$$\therefore \text{Gravitational force } (f) = \frac{G m_e m_s}{R^2}$$

$$= \frac{6.67 \times 10^{-11} \times 6 \times 10^{24} \times 2 \times 10^{30}}{(1.5 \times 10^{11})^2}$$

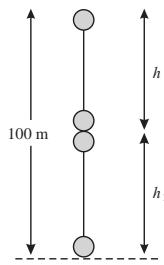
$$= 3.56 \times 10^{22} \text{ N}$$

- 17. A stone is allowed to fall from the top of a tower 100m high and at the same time another stone is projected vertically when and where the two stones will meet.**

**Ans. Case-I**

$$\text{In order to fall, } h_1 = ut + \frac{1}{2}at^2$$

$$h_1 = o \times t + \frac{1}{2}gt^2$$



**Case-II,** In order to throw up,

$$h_2 = ut - \frac{1}{2}gt^2$$

$$h_2 = 25 \times t - \frac{1}{2}gt^2 \quad \dots(i)$$

from eqn (i) and (ii)

$$h_1 + h_2 = 25t$$

$$100 = 25t$$

$$t = \frac{100}{25}$$

$$t = 4\text{s}$$

Therefore the two stones will meet after 4s.

$\therefore$  Putting  $t = 4\text{s}$  in equation (i)

$$h_1 = \frac{1}{2} \times 9.8 \times 4 \times 4$$

$$h_1 = 78.4 \text{ m}$$

Therefore both the stone will meet at 78.4m from the top or  $(100 - 78.4) = 21.6 \text{ m}$  from the bottom.

**18. A ball thrown up vertically returns to the thrower after 6s find.**

**(a)the velocity with which it was thrown up.**

**(b)the maximum height it reaches and**

**(c)it's position after 4s.**

**Ans.** Time taken to reach the maximum height

$$t = \frac{6}{2} = 3\text{s}$$

$$v = 0$$

$$(a) \qquad u = ?$$

from the equation,  $v = u - gt$

$$0 = u - 9.8 \times 3$$

$$u = 29.4 \text{ m/s}$$

(b) from the equation.  $v^2 = u^2 - 2gt$

$$0 = u - 9.5 \times 3$$

$$0 = (29.4)^2 - 2 \times 9.8 \times h$$

$$h = \frac{29.4 \times 29.4}{2 \times 9.8}$$

$$h = 44.1 \text{ m}$$

Thus the maximum height reached by the ball, 44.1 m

(c)  $t = 4\text{s}$  (given)

but the ball reaches the maximum height after 3s. Therefore the distance covered after falling from the maximum height after 1s.

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

$$h = 0 + \frac{1}{2} \times 9.8 \times 1 \times 1$$

$$h = 4.9 \text{ m}$$

**19. In what direction does the buoyant force on an object immersed in a liquid act ?**

**Ans.** The buoyant force on an object immersed in a liquid acts upwards.

**20. Why does a block of plastic released under water come up to the surface of water ?**

**Ans.** Density of plastic piece is less than the density of water. Also, when the block is thrown under water the buoyant force is greater than its weight. Therefore, when a plastic block is released under water, it comes up to the surface of water.

**21. The volume of 50 g of a substance is  $20 \text{ cm}^3$ . If the density of the water is  $1 \text{ g cm}^{-3}$  will the substance float or sink ?**

**Ans.** According to question–

Mass of the substance  $m = 50 \text{ g}$

Volume of the substance  $v = 20 \text{ cm}^3$

Density of water  $= 1 \text{ g cm}^{-3}$

Density of the substance  $= \frac{\text{Mass}}{\text{Volume}} = \frac{50}{20} = 2.5 \text{ g cm}^{-3}$

The density of the substance is  $2.5 \text{ g cm}^{-3}$  and it is greater than the density of water so. The substance will sink.

**22. The volume of a 500 g sealed packet is  $350 \text{ cm}^3$  will the packet float or sink in water if the density of water is  $1 \text{ g cm}^{-3}$  ? What will be the mass of the water**

**displaced by this packet ?**

**Ans.** Mass of the packet = 500g

Volume of the packet = 350 cm<sup>3</sup>

density of water = 1 g cm<sup>-3</sup>

$$\text{density of packet} = \frac{\text{Mass}}{\text{Volume}} = \frac{500}{300} = \frac{10}{7} = 1.43 \text{ g cm}^{-3}$$

Since the density of packet is more than the density of water so the packet will sink.

The mass of water displaced by the packet =  $350 \times 1$

$$= 350 \text{ g}$$

The mass of displaced water = 350 g



# Work and Energy

# 10

NCERT SOLUTIONS



## What's inside

- *In-Chapter Q's (solved)*
- *Textbook Exercise Q's (solved)*

## IN-CHAPTER QUESTIONS

### Test Yourself

1. A force of 7 N acts on an object. The displacement is, say 8 m, in the direction of the force (Fig. 10.3). Let us take it that the force acts on the object through the displacement. What is the work done in this case?

### Test Yourself

1. When do we say that work is done?

**Ans.** According to science, we say that work is done when a force is applied to the object and it gets displaced under the influence of the force.

2. Write an expression for the work done when a force is acting on an object in the direction of its displacement.

**Ans.** If a force F acts on an object and has a displacement in the direction of force.

Then

Work = Force  $\times$  displacement in the direction of force.

$$W = F \times s$$

3. Define 1 J of work.

**Ans.** 1J in the amount of work done on an object when a force of 1N displaces the object by 1m in the direction of the force's line of action.

4. A pair of bullocks exerts a force of 140 N on a plough. The field being ploughed is 15 m long. How much work is done in ploughing the length of the field?

**Ans.** Given:

$$\text{Force (F)} = 140\text{N}$$

$$\text{Displacement (s)} = 15\text{m}$$

$$\text{Work done} = \text{Force} \times \text{displacement}$$

$$W = F \times s$$

$$W = 140\text{N} \times 15\text{m}$$

$$= 2100\text{Nm}$$

$$W = 2100 \text{ J}$$

Therefore the work done = 2100J.

### Test Yourself

1. What is the kinetic energy of an object?

**Ans.** The energy possessed by an object due to its motion is called kinetic energy.

$$\text{Kinetic energy (E}_K\text{)} = \frac{1}{2}mv^2$$

where,  $m$  = mass of object  
 $v$  = velocity of the object

## 2. Write an expression for the kinetic energy of an object.

**Ans.** The kinetic energy =  $\frac{1}{2}mv^2$

where,  $m$  = mass of the object  
 $v$  = velocity of the object

## 3. The kinetic energy of an object of mass, $m$ moving with a velocity of $5\text{ ms}^{-1}$ is $25\text{ J}$ . What will be its kinetic energy when its velocity is doubled? What will be its kinetic energy when its velocity is increased three times?

**Ans.** Mass of the object =  $m$ , velocity of the object =  $5\text{ ms}^{-1}$ , kinetic energy  $E_k = 25\text{ J}$

and  $E_k = \frac{1}{2}mv^2$

So,  $25 = \frac{1}{2}m \times 5^2$

$$m = \frac{25 \times 2}{25} = 2\text{ Kg}$$

**Case (i)** when the velocity is doubled.

Mass of the object =  $m = 2\text{ kg}$

And,  $v = 2 \times 5\text{ ms}^{-1} = 10\text{ ms}^{-1}$

$\square$  Kinetic energy ( $E_K$ ) =  $\frac{1}{2}mv^2$

$$= \frac{1}{2} \times 2 \times 10^2$$

$$= 100\text{ J}$$

**Case (ii)** when the velocity is increased three times

i.e.,  $v = 3 \times 5 = 15\text{ ms}^{-1}$

$m = 2\text{ kg}$

Kinetic energy ( $E_K$ ) =  $\frac{1}{2}mv^2$

$$= \frac{1}{2} \times 2 \times 15^2$$

$$E_K = 225\text{ J}$$

## Test Yourself

### 1. What is power?

**Ans.** The rate of doing work or the rate of conversion of energy is called power.

$$\text{Power} = \frac{\text{Work}}{\text{time}}$$

where,  $P$  = Power,

$W$  = Work,  $t$  = time.

## **2. Define 1 watt of power.**

**Ans.** 1 watt is the power of the agent which does 1J of work in one second. In other words, if the rate of energy used is  $1 \text{ Js}^{-1}$  then the Power will be 1 w.

## **3. A lamp consumes 1000 J of electrical energy in 10 s. What is its power?**

**Ans.** We can obtain the average power by dividing the total energy used by the total time taken.

$$\text{So, Average power} = \frac{\text{Total energy used}}{\text{Total time taken}}$$

Note: The term average power is used when the power of agent (such as an instrument or device) changes over time. That is, if works at different rates in different time intervals.

## **4. Define average power.**

$$\text{Ans. Power} = \frac{\text{Energy consumed (or work)}}{\text{time taken}}$$

$$W = 100 \text{ J}, t = 10 \text{ s}$$

$$\text{i.e., } P = \frac{W}{t} = \frac{1000 \text{ J}}{10 \text{ s}} = 100 \text{ J/s}$$

$$P = 100 \text{ w}$$

## NCERT EXERCISES

### **1. Look at the activities listed below. Reason out whether or not work is done in the light of your understanding of the term "work".**

- Suma is swimming in a pond.
- A donkey is carrying a load on its back.
- A wind-mill is lifting water from a well.
- A green plant is carrying out photosynthesis.
- An engine is pulling a train.
- Food grains are getting dried in the sun.
- A sailboat is moving due to wind energy.

**Ans.** Work done in both negative and positive conditions is considered to be work done. Explanation is given below:

- Yes, work is done, but it is negative, because Suma is pushing water backwards.
- No, the work is not done, because the donkey is standing and the load placed on its back is perpendicular to the horizontal displacement.
- Yes, work is done, because the water is being lifted up against the force of gravity.
- No, work is done, because the leaves of the plant are in rest.
- Yes, it is working, because the engine is pulling the train and the wagons are being displaced in the same direction.

- No, because the grains are at rest.
- Yes, the work is done, because the wind is pushing the sail-boat in favourable directions.

**2. An object thrown at a certain angle to the ground moves in a curved path and fall back to the ground. The initial and the final points of the path of the object lie on the same horizontal line. What is the work done by the force of gravity on the object.**

**Ans.**No, work is done by the object or the force of gravity. The reason is that the displacement of the object is taking place in the horizontal direction, whereas, the force of gravity is acting downwards in the vertical direction.

**3. A battery lights a bulb. Describe the energy change involved in the process.**

**Ans.**First the chemical energy of the battery is converted into electrical energy. Then the bulb converts the electrical energy into heat and light energy.

**4. Certain force acting on a 20 kg mass changes it's velocity from  $5 \text{ ms}^{-1}$  to  $2 \text{ ms}^{-1}$ . Calculate the work done by the force.**

**Ans.**Mass of the object  $m = 20 \text{ kg}$

$$\text{Initial velocity } u = 5 \text{ ms}^{-1}$$

$$\text{Final velocity } v = 2 \text{ ms}^{-1}$$

Work done = change in kinetic energy

$$W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2 = \frac{1}{2}m(v^2 - u^2)$$

$$= \frac{1}{2} \times 20 \times (2^2 - 5^2)$$

$$= 10 \times (4 - 25) = - 210 \text{ J}$$

Hence, work done is Negative in nature.

**5. A mass of 10 kg is at a point A on a table. It is moved to a point B. If the line joining A and B is horizontal, what is the work done on the object by the gravitational force? Explain your answer.**

**Ans.**Mass  $m = 10 \text{ kg}$ , acceleration due to gravity  $g = 10 \text{ ms}^{-2}$ , work done by the force of gravity =  $mgh$ .

In this case the amount of work done by gravitational force on the object will be zero because the line joining the points A and B lie in same horizontal plane. Its gravitational force does not act any component of displacement. Because it is vertical  $W = F_s \cos 90^\circ = 0$ .

**6. The potential energy of a freely falling object decreases progressively. Does this violate the law of conservation of energy? Why?**

**Ans.**No, it does not violate the law of conservation of energy here. The reason is that there is a proportional and equal relationship between potential energy and kinetic energy. That is, the total energy of the object is always conserved.

**7. What are the various energy transformations that occur when you are riding a bicycle?**

**Ans.**Muscular energy is used in riding the bicycle. Then the muscular energy is transforms into mechanical energy and kinetic energy.

**8. Does the transfer of energy take place when you push a huge rock with all your might and fail to move it? Where is the energy you spend going?**

**Ans.**In pushing a huge rock no transfer of muscular energy takes place because when we fail to push it, then that muscular energy is spent in working against the friction between the earth and the rock and no work is done as no displacement occurs.

**9. A certain household has consumed 250 units of energy during a month. How much energy is this in joules?**

**10. An object of 40 kg in raised to a height of 5m above the ground. What is its potential energy? If the object is allowed to fall, find its Kinetic energy when it is half-way down. ( $g = 10 \text{ ms}^{-2}$ )**

**Ans.**Mass of the object  $m = 40 \text{ kg}$

$$\text{Height } h = 5\text{m}$$

Acceleration due to gravity,

$$g = 10 \text{ ms}^{-2}$$

$$\begin{aligned}\therefore \text{Potential energy} &= mgh \\ &= 40 \text{ kg} \times 5\text{m} \times 10 \text{ ms}^{-2} \\ &= 2000 \text{ J}\end{aligned}$$

When the object is half-way down, then the mass of the object

$$= 40 \text{ kg}$$

$$\text{height } h = 2.5\text{m}$$

Acceleration due to gravity,

$$g = 10 \text{ ms}^{-2}$$

From the third equation of motion

$$v^2 - u^2 = 2as$$

$$v^2 = u^2 + 2as$$

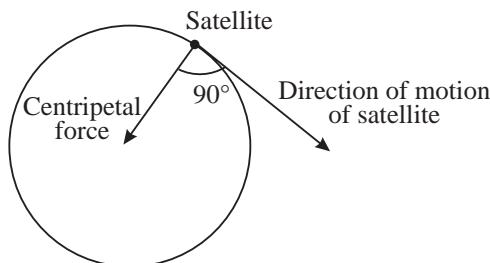
$$v^2 = 0 + 2 \times 10 \times 2.5$$

$$\begin{aligned}\text{Kinetic energy K.E.} &= \frac{v^2}{2} = \frac{1}{2}mv^2 \\ &= \frac{1}{2} \times 40 \times 50\end{aligned}$$

$$= 1000 \text{ J}$$

- 11. What is the work done by the force of gravity on a satellite moving round the earth? Justify your answer.**

**Ans.** The amount of work done on a satellite revolving around the earth is zero when the satellite moves in its circular orbit. In such a situation, the centripetal force acts along the radius of the orbit towards the center and the direction of motion of the satellite is perpendicular to the orbit. Thus the direction of force and displacement are perpendicular to each other.



$$\text{Therefore work} = F \times s \times \cos \theta = F s \cos 90^\circ = 0$$

Hence, work done in case of uniform circular motion is zero.

- 12. Can there be displacement of an object in the absence of any force acting on it? Think. Discuss this question with your friends and teacher.**

**Ans.** No, no object can displace in the absence of force. Some people give the example of rain drops that they move without applying force, but it should be understood that the force of attraction of the earth acts on it. Therefore, an object cannot be displaced without applying a force.

- 13. A person holds a bundle of hay over his head for 30 minutes and gets tired. Has he done some work or not? Justify your answer.**

**Ans.** Of course, the person does not do any work on a bundle of hay. For this the reason is, no displacement is taking place in the bundle. There is no work in standing with a burden on head. There must be displacement for work.

- 14. An electric heater is rated 1500 W. How much energy does it use in 10 hours?**

**Ans.** Power of electric heater

$$P = 1500 \text{ W}$$

$$\text{Time, } t = 10 \text{ hour}$$

$$\text{The energy used} = \text{Power} \times \text{time}$$

$$= 1500 \text{ W} \times 10 \text{ h}$$

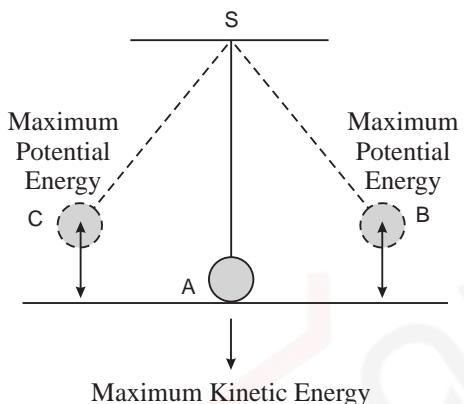
$$= 15000 \text{ Wh}$$

$$= 15 \text{ Wh}$$

$$= 15 \text{ unit} \quad [\because 1 \text{ kWh} = 1 \text{ unit}]$$

- 15. Illustrate the law of conservation of energy by discussing the energy changes which occur when we draw a pendulum bob to one side and allow it to oscillate. Why does the bob eventually come to rest? What happens to its energy eventually? Is it a violation of the law of conservation of energy?**

**Ans.** When the bob of a simple pendulum is drawn to one side and released, it starts oscillating. Let the bob be released from point B, then the mean passes through position A to reach point C. Again reaches back to B from C. Thus, point B has maximum potential energy. There is no kinetic energy here. Again when the bob reaches the mean position A, it has maximum kinetic energy. There is no potential energy.



In the same way, when the bob reaches again from point A to point C, then this point has maximum potential energy. There is no kinetic energy. Hence, maximum potential energy is converted into maximum kinetic energy and maximum kinetic energy into maximum potential energy which explains the law of conservation of energy. Due to the friction of air, the bob gradually comes to rest and all the kinetic energy is converted into heat energy. That is, energy is transformed from one form to another.

- 16. An object of mass  $m$  is moving with a constant velocity  $v$ . How much work should be done on the object in order to bring the object to rest?**

**Ans.** Mass =  $m$ ,  $u = v$ ,  $v = 0$

From the work-energy theorem

work done = Change in kinetic energy

$$= \frac{1}{2}mv^2 - \frac{1}{2}mu^2$$

$$= \frac{1}{2}m(v^2 - u^2)$$

$$= \frac{1}{2}m(0 - v^2)$$

$$= -\frac{1}{2}v^2$$

The work done on the object

$$= \frac{1}{2}v^2$$

- 17. Calculate the work required to be done to stop a car 1500 kg moving at a velocity of 60 km/h?**

**Ans.**  $u = 60 \text{ km/h}$

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

$$= \frac{50}{3} \text{ m/s}$$

$$v = 0$$

$$m = 1500 \text{ kg}$$

From the work-energy theorem the work done

$W = \text{change in kinetic energy}$

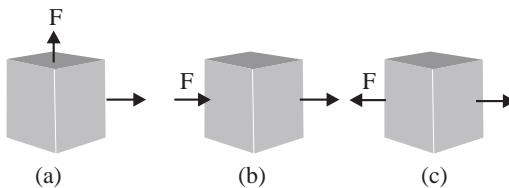
$$= \frac{1}{2}m(v^2 - u^2)$$

$$= \frac{1}{2} \times 1500 \left[ 0 - \frac{2500}{9} \right]$$

$$= -750 \times \frac{2500}{9}$$

$$= -208333.3 \text{ J}$$

- 18. In each of the following a force  $F$  is acting on an object of mass  $m$ . The direction of the displacement is from west to east shown by the longer arrow, observe the diagrams carefully and state whether the work done by the force is negative, positive or zero.**



**Ans.(a)**Zero, because there is an angle of  $90^\circ$  between the direction of force and the direction of displacement, that is, perpendicular to each other.

**(b)**Positive, because the displacement is in the direction of the force.

**(c)**Negative, because the direction of displacement is opposite to the direction of force.

- 19. Soni says that the acceleration in an object could be zero even when several forces are acting on it. Do you agree with her? Why?**

**Ans.**Soni is right because when the object is at rest and its speed is zero, the acceleration becomes zero. An object can have many forces acting simultaneously, but they can cancel or neutralize each other, when the object is in motion with the same velocity, in that case the acceleration is zero. Even in such a situation many balancing forces can act on an object simultaneously.

- 20. Find the energy in joules consumed in 10 hours by four devices of power 500 W each.**
- 21. A freely falling object eventually stops on reaching the ground. What happens to its kinetic energy?**

**Ans.**The Kinetic energy is converted into sound energy and heat energy.



# Sound **11**

**NCERT SOLUTIONS**



## **What's inside**

- *In-Chapter Q's (solved)*
- *Textbook Exercise Q's (solved)*

## IN-CHAPTER QUESTIONS

### Test Yourself

1. How does the sound produced by a vibrating object in a medium reach your ear?

**Ans.** When an object vibrates, it also vibrates the particles of the medium around it. These particles do not reach our ears by moving from the vibrating object themselves, but the particles of the medium closest to the vibrating object get displaced from their balanced state, which displaces then by applying force on their nearest particle and the initial particle returns to its original state. This process continues in the medium until the sound reaches our ears. In this way the disturbance produced by sound in the medium (not the particles of the medium) is propagated through the medium.

2. Explain how sound is produced N by your school bell.

**Ans.** The bell of our school is made of alloy which vibrates by striking the hammer. Vibration causes disturbance in the air. A wave is a disturbance that vibrates and forth in the air and reaches our ears. The particles of the medium simply oscillate and the disturbance proceeds.

3. Why are sound waves called mechanical waves?

**Ans.** For the propagation of sound waves, a medium such as air, water, steel, etc. is required. It cannot move through vacuum. Sound waves can be propagated only when the particles of its medium vibrate back and forth and the disturbance moves forward. Hence sound waves are called mechanical waves.

4. Suppose you and your friend are on the moon. Will you be able to hear any sound produced by your friend?

**Ans.** No, because a medium is required for the propagation of sound waves whereas there is no atmosphere on the moon. Therefore, sound cannot propagate in a vacuum.

### Test Yourself

1. Which wave property determines (a) loudness, (b) pitch?

**Ans.(a)Loudness:** The loudness of the sound is determined by the amplitude of the vibration. The higher the amplitude, the louder the sound.

**(b)Pitch:** The pitch of the sound determines by the frequency of the vibration. The higher the frequency, the higher the pitch.

2. Guess which sound has a higher pitch: guitar or car horn?

The guitar has a higher pitch because the particles vibration frequency is higher in guitar compared to a car horn.

## Test Yourself

### 1. What are wavelength, frequency, time period and amplitude of a sound wave?

**Ans. Wavelength:** The distance between two consecutive compressions (C) or consecutive rarefaction (R) is called wavelength.

**Alternatively:** The distance travelled by a wave in one complete oscillation is called wavelength.

**Frequency:** The total number of oscillations that occur in unit time is called frequency.

The S.E. unit of frequency in hertz which is represented by the symbol Hz.

**Time period:** The time taken by a wave to complete one complete oscillation of the density of the medium is called time period (T). In other words, the time taken by two consecutive compression or consecutive rarefactions to pass through a fixed point is called the time period of the wave it's S.I. unit is second (s).

**Amplitude:** The maximum displacement (or disturbance) of the particles of the medium on either side of the mean position in propagation of a wave is called amplitude. It is denoted by the symbol "A". It's unit is meter. The loudness or softness of sound is determined by it's amplitude.

### 2. How are the wavelength and frequency of a sound wave related to its speed?

**Ans.** Speed of wave = frequency × wavelength

$$v = n\lambda$$

### 3. Calculate the wavelength of a sound wave whose frequency is 220 Hz and speed is 440 m/s in a given medium.

**Ans.** Given: Frequency of sound wave

$$v = 220 \text{ Hz}$$

Speed of sound  $v = 440 \text{ m/s}$

$$\begin{aligned} \text{Wavelength of sound wave } l &= \frac{v}{\nu} \\ &= \frac{440 \text{ m/s}}{220 \text{ Hz}} \\ &= 2 \text{ m} \end{aligned}$$

### 4. A person is listening to a tone of 500 Hz sitting at a distance of 450 m from the source of the sound. What is the time interval between successive compressions from the source?

**Ans.** Frequency  $v = 500 \text{ Hz}$

and distance  $d = 450 \text{ m}$

$$\text{Time period } T = \frac{1}{v} = \frac{1}{500} = 0.002 \text{ s}$$

**Note:** [The time taken or time period T between consecutive compression does not depend on the position of the object (distance  $d = 450 \text{ m}$ ), it is given to confuse only so that the skill of the students can be accurately tested.]

## Test Yourself

### 1. Distinguish between loudness and intensity of sound.

Ans.	Loudness	Intensity
	1. Loudness is the measure of sensitivity of the ear to sound which can differentiate between loud and soft sound.	1. The amount of sound energy passing through a unit area in one second is called the intensity of sound.
	2. Loudness may be different for different observers that depends on the sensitivity of the ears.	2. It does not depend on the sensitivity of the ears.
	3. Its unit is decibel (dB).	3. Its unit is watt/m <sup>2</sup> .

### 2. In which of the three media, air, water or iron, does sound travel the fastest at a particular temperature?

**Ans.** From the given media, sound travels fastest in iron at a certain temperature.

## Test Yourself

### 1. An echo is heard in 3s. What is the distance of the reflecting surface from the source, given that the speed of sound is $342 \text{ ms}^{-1}$ ?

**Ans.** Speed of sound in air =  $342 \text{ m/s}$

Time to hear the echo = 3 s

Distance from the source to the reflecting surface,

$$d = \frac{v \times t}{2}$$

$$d = \frac{342 \times 3}{2}$$

$$d = 513 \text{ m}$$

## Test Yourself

### 1. Why are the ceilings of concert halls curved?

**Ans.** The roofs of concert halls are made to be curved, so that after reflection the sound

reaches all parts of the hall. Curved ceiling actually act like a large concave sound board that reflects and transmits the sound to all the audience below.

## Test Yourself

### 1. What is the audible range of the average human ear?

**Ans.** The hearing range for the normal human ear is 20 hz to 20,000 Hz (or 20 KHz).

### 2. What is the range of frequencies associated with

(a) Infrasound?

(b) Ultrasound?

**Ans.** (a) The sound of frequency less than 20 Hz are called infrasound.

(b) The sound of frequency above 20 KHz or 20,000 Hz are called ultrasound.

## NCERT EXERCISES

### 1. What is sound and how is it produced?

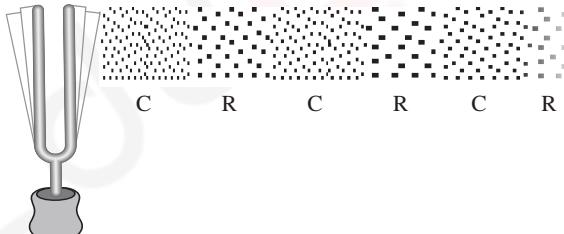
**Ans.** Sound is a form of energy. Which is produced by the vibration of the medium.

There are also methods of it's generation-by striking, by pulling, by blowing, by rubbing etc.

It is clear from the following experiments that sound is produced by vibration.

### 2. Describe with the help of a diagram, how compressions and rarefactions are produced in air near a source of sound.

**Ans.**



Sound travels mostly through air. When a vibrating object moves forward, it compresses the air in front of it by applying force, which creates a region of high pressure that the region is called compression (C). [in figure] when this vibrating region starts moving away from the object, then the vibrating object moves forming a region of low pressure. This region is called rarefaction (R). As the object vibrates that is, moves back and forth with high intensity a series of compressions and rarefactions are generated in the air. Thus propagation of sound takes place in the air.

### 3. Why is sound wave called a longitudinal wave?

**Ans.** When sound wave propagates, the air molecules move along the direction of wave motion. Therefore sound waves are longitudinal waves.

- 4. Which Characteristic of the sound helps you to identify your friend by his voice while sitting with others in a dark room?**

**Ans.** Quality of sound is the characteristics which helps us to identify the voice.

- 5. Flash and Thunder are produced simultaneously. But thunder is heard a few seconds after the flash is seen. Why?**

**Ans.** Since, the speed of sound is much less than the speed of light. That is why thunder and flash are produced simultaneously. But thunder is heard a few seconds after the flash is seen.

### Difference between Loudness and Intensity

Loudness	Intensity
(i) It depends on the sensitivity of the human ear.	(i) It does not depend on the sensitivity of the human ear.
(ii) Loudness cannot be measured in terms of a physical quantity.	(ii) The intensity of sound can be measured as a physical quantity.
(iii) Since, it is not a Physical quantity so it has no S.I. unit.	(iii) Its S.I. unit is watt/m <sup>2</sup> .

- 6. A person has a hearing range from 20 Hz to 20 KHz. What are the typical wavelengths of sound waves in air corresponding to these two frequencies? Take the speed of sound in air as  $344 \text{ ms}^{-1}$ ?**

**Ans.** Speed of sound in air  $v = 344 \text{ ms}^{-1}$

$$\text{Frequency } v = 20 \text{ Hz}$$

$$\text{Wavelength } \lambda = ?$$

From, Velocity = wavelength  $\times$  frequency

$$344 \text{ ms}^{-1} = \lambda \times 20 \text{ Hz}$$

$$\lambda = \frac{344 \text{ ms}^{-1}}{20 \text{ Hz}} = 17.2 \text{ m}$$

$$\lambda = \frac{17.2 \text{ m}}{1000}$$

[For  $v = 20 \text{ KHz}$  or  $20000 \text{ Hz}$ ]

$$\lambda = 0.0172 \text{ m}$$

This is, the wavelengths of sound corresponding to the range from 20 Hz to 20 KHz are 17.2m and 0.0172m respectively.

- 7. Two children are at opposite ends of an aluminium rod. One strikes the end of the rod with a stone. Find the ratio of times taken by the sound wave in air and in aluminum to reach the second child.**

**Ans.** Velocity of sound in air  $v_1 = 346 \text{ ms}^{-1}$

Velocity of sound in aluminium  $v_2 = 6420 \text{ ms}^{-1}$

Let the length of aluminium pipe =  $x$  m.

$$\therefore \text{Time} = \frac{\text{distance}}{\text{velocity}}$$

$$\text{Time taken in the air} = \frac{x\text{m}}{346\text{ms}^{-1}} = \frac{x}{346}\text{s}$$

$$\text{Time taken in aluminium} = \frac{x\text{m}}{6420\text{ms}^{-1}} = \frac{x}{6420}\text{s}$$

$$\begin{aligned}\text{Required ratio} &= \frac{x}{346}\text{s} : \frac{x}{6420}\text{s} \Rightarrow \frac{x}{346} \times \frac{6420}{x} \\ &= 18.55\end{aligned}$$

- 8. The frequency of a source of sound is 100 Hz. How many times does it vibrate in a minute?**

**Ans.** Frequency  $v = 100$  Hz

$$\text{time } t = 1 \text{ minute} = 60 \text{ seconds}$$

$$\begin{aligned}\therefore \text{Number of vibrations} &= \text{frequency} \times \text{time} \\ &= 100 \text{ Hz} \times 60 \text{ seconds} \\ &= 600 \text{ vibrations.}\end{aligned}$$

- 9. Does sound follow the same laws of reflection as light does? Explain.**

**Ans.** Yes, sound also follows the same laws of reflection as light does. Their laws are:

- (i) The direction of incidence sound, The direction of reflected sound and normal placed at the point of incidence are all on the same plane.
- (ii) The angle of incidence and the angle of reflection are equal.

- 10. When a sound is reflected from a distant object, an echo is produced. Let the distance between the reflecting surface and the source of sound production remains the same. Do you hear echo sound on a hotter day?**

**Ans.**  $\therefore \text{Time} = \frac{\text{Distance}}{\text{speed (velocity)}}$

that is, time and velocity (speed) have an inverse ratio. Increasing the temperature of any medium increases the speed of sound. Therefore, on a hot day, due to the higher temperature, the speed of sound will increase and we will hear the echo sooner than the cold days.

- 11. Give two practical applications of reflection of sound waves?**

**Ans.** The practical applications of reflection of sound waves:

- (i) Echo
- (ii) Reverberation.

- 12. A stone is dropped from the top of a tower 500 m high into a pond of water at the base of the tower, when is the splash heard at the top? Given  $g = 10 \text{ ms}^{-2}$  and speed of sound =  $340 \text{ ms}^{-1}$ .**

**Ans. Case-I,**  $u = 0$ ,  $s = 500$  m,  $g = 10$  m/s $^2$

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

$$500 = 0 + \frac{1}{2} \times 10 \times t_1^2$$

$$t_1^2 = 100$$

$$t_1 = 10 \text{ sec.}$$

time taken by the stone to reach the surface of water  
= 10 seconds

**Case-II,** Again,  $s = 500$  m,  $v = 340$  ms $^{-1}$

form  $s = vt_2$

$$t_2 \frac{s}{v} = \frac{500}{340}$$

$$= 1.47 \text{ sec.}$$

time taken to hear the sound at the top.

$$t = t_1 + t_2$$

$$t = 10 + 1.47$$

$$t = 11.47 \text{ sec.}$$

**13. A sound wave travels at a speed of 339 ms $^{-1}$ . If its wavelength is 1.5 cm, what is the frequency of the wave? Will it be audible?**

**Ans.** Here  $v = 339$  m/s.,  $\lambda = 1.5$  cm =  $1.5 \times 10^{-2}$  m,  $V = ?$

$$\text{We know that, } V = \frac{v}{\lambda} = \frac{339}{1.5 \times 10^{-2}}$$

$$V = 22600 \text{ Hz}$$

It is not audible to the human ear, because the audible limit is 20,000 Hz

**14. What is reverberation? How can it be reduced?**

**Ans.** We see that the sound produced in a large auditorium due to repeated reflection from the walls of the hall persists for some time until it is heard very little. Due to this repeated reflection of sound, there is a persistence, which is called reverberation. To reduce this fibers and other materials are applied to the walls and ceilings of the auditorium so that they absorb the sound.

**15. What is loudness of sound? What factors does it depend on?**

**Ans.** Loudness of a sound is the intensity of sound. It depends on its amplitude. Such a sound which has more energy is called its loudness.

The loudness depends on the following factors:

(i) Amplitude

(ii) Energy

(iii) Intensity

**(iv)Wave Velocity**

The sound passing through a unit area in unit time is called loudness.

**16. How is ultrasound used for cleaning?**

**Ans.** Ultrasound is used for such places of objects which are out of reach. Such as spiral tubes, complex shaped mechanical parts etc. To clean them, cleaning rags are kept in the solution. Ultrasound waves are sent in this solution. Due to the high frequency, the particles of dust, grease and dirt are separated and fall down. In this process objects become very clear.

**17. Explain how defects in a metal block can be detected using ultrasound?**

**Ans.** Ultrasound is used to detect defects in blocks made of metals. Cracks or holes in metal blocks that are not visible from outside. Ultrasound waves are passed through metal blocks and detectors which are used to detect the transmitted waves. If there is even a slight defect, then the ultrasound waves get reflected. These reflected waves. Explain the presence of the defect.



# Improvement in Food Resources

12

NCERT SOLUTIONS



## What's inside

- In-Chapter Q's (solved)
- Textbook Exercise Q's (solved)

## IN-CHAPTER QUESTIONS

### Test Yourself

#### 1. What do we get from cereals, pulses, fruits and vegetables?

Ans.

Food Items	Nutrients obtained
Cereals	Carbohydrate
Pulses	Protein
Fruits	Sugar, Protein, Minerals, Vitamins
Vegetables	Vitamins, Protein, Minerals.

### Test Yourself

#### 1. How do biotic and abiotic factors affect crop production?

Ans. Biological factors such as pathogenic micro-organisms, insects, birds etc.

damage the crops and reduce the production. Abiotic factors such as heavy rains, storms, hail, frost, drought, etc. reduce the production by damaging the crops.

#### 2. What are the desirable agronomic characteristics for crop improvements?

Ans. Followings are the desirable characteristics for crop improvement :

- (i) Long and dense branches for fodder crops.
- (ii) Dwarf plants for grain.
- (iii) Weather resistant species.
- (iv) Disease resistant species.
- (v) High yielding improved varieties.

### Test Yourself

#### 1. What are macronutrients and why are they called macronutrients?

Ans. Nitrogen, phosphorus, potassium, calcium, magnesium and sulphur are called macronutrients. These are called macronutrients because crops require these elements in large quantities.

#### 2. How do plants get nutrients?

Ans. Plants get their nutrients from air, water and soil through their roots and leaves.

### Test Yourself

#### 1. Compare the use of manure and fertilizers in maintaining soil fertility.

Ans.

Manure	Fertilizers
1. Manure increases the fertility of the soil and improves its structure.	Fertilizers temporarily increase the fertility of the soil. Fertilizers bring changes in basic structure of the soil.

2. Manure contains less nutrients and is slowly absorbed by plants.	Fertilizers are absorbed quickly.
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## Test Yourself

### 1. Which of the following conditions will give the most benefits? Why?

- Ans.**(A)Farmers use high-quality seeds, do not adopt irrigation or use fertilizers.  
 (B)Farmers use ordinary seeds, adopt irrigation and use fertilizer.  
 (C)Farmers use quality seeds, adopt irrigation, use fertilizer and use crop protection measures.  
 (D)Because this is the most efficient way to increase crop production.

## Test Yourself

### 1. Why should preventive measures and biological control methods be preferred for protecting crops?

**Ans.**Preventive measures are good for the protection of the crop because they are easy to adopt and there is no cost in it, biological control destroys pests and avoids crop damage. Although some expenditure has to be incurred in the pesticides, but if the pesticides are used within a limit then the cost will also be less and it will not have any side effects.

### 2. What factors may be responsible for losses of grains during storage?

**Ans.**In the process of storage, biotic and abiotic factors are responsible for the loss of grain.

- (i)**Biological factors :** Insects, rats, fungi, mites, bacteria.
- (ii)**Abiotic factors :** excess moisture, unsuitable temperature.

## Test Yourself

### 1. Which method is usually used for improving cattle breeds and why?

**Ans.**The method of cross-breeding is widely used to improve cattle breeds. Cross-breeding of two good cattle varieties will lead to a new improved variety.

## Test Yourself

### 1. Discuss the implications of the following statement: “It is interesting to note that poultry is India’s most efficient converter of low fibre food stuff (which is unfit for human consumption) into highly nutritious animal protein food.”

**Ans.**Poultry is given low fiber foods. These foods are not suitable for human. In this way, the short fiber material unsuitable for human is eaten by poultry. These

substances in their bodies make up the high protein meat that humans eat. In this way, poultry converts the low fiber substances unsuitable for humans into highly nutritious animal proteins. Thus, poultry farming is a profitable business.

### Test Yourself

#### 1. What management practices are common in dairy and poultry farming?

**Ans.** Common management practices in dairy and poultry are :

- (i) Proper housing arrangement
- (ii) Hybridization
- (iii) Disease control and vaccination
- (iv) Nutrients.

#### 2. What are the differences between broilers and layers and in their management?

**Ans.** **Broilers** : The poultry bird raised for meat purposes is called a broiler. Broilers feed on protein-rich adequate-fat food. The level of vitamins A and K is kept high in poultry feeds.

**Layers** : The egg-laying poultry bird is called a layer. The housing, environmental and nutritional requirements of broilers vary from those of egg layers. Layers require proper lighting and enough space.

### Test Yourself

#### 1. How are fish obtained?

**Ans.** Fishes are obtained from fresh water ponds, lakes, rivers, etc. Fishes are also obtained from the saline water of sea.

#### 2. What are the advantages of composite fish culture?

**Ans.** The advantage of mixed/composite fish culture is that many types of fish can be found in the same pond. Each type of fish obtains its diet from a certain place. When catla comes to the surface of the water and chooses her diet, Rohu takes food from the middle of the pond. Mrigal and common work takes food from the bottom of the pond. There is a fish called gross carp, which eats grass and weeds. In this way, by raising many types of fish with less food. i.e. more profit is obtained from mixed fish farming.

### Test Yourself

#### 1. What are the desirable characters of bee varieties suitable for honey production?

**Ans.** The bee used for honey production should have the capacity to produce more honey. The Italian species “*Apis mellifera*” is a suitable species. It stings less and it produces a lot of offspring.

## **2. What is pasturage and how is it related to honey production?**

**Ans.** The area where beekeeping is done, is called pasturage. Bee collect pollen from the flowers found here. The variety of flowers available in this region determines the taste of honey.

### **NCERT EXERCISES**

#### **1. Explain any one method of crop production which ensures high yield.**

**Ans.** One method of crop production is crop rotation method in which higher yield is obtained. In this method the crop is sown alternately. It cereal crops are planted in one year, pulses are planted in the second year. Due to this, the yield power of the field is maintained and there is no decline in the yield.

Fertilizer is also not required much in crop rotation method, only manure works.

#### **2. Why are manure and fertilizers used in fields?**

**Ans.** Since manure and fertilizers are the main artificial or synthetic nutrients of the crop, so manure and fertilizers are used in the fields to increase the yield of crop.

#### **3. What are the advantages of intercropping and crop rotation?**

**Ans.** Advantages of inter-cropping:

- (i) Two types of crops can be grown simultaneously by this method.
- (ii) By this method pests and diseases can be prevented from spreading to all plants.

Advantages of crop-rotation:

- (i) It increases the production and also maintains the fertility of the soil.
- (ii) It leads to proper utilization of nutrients.

#### **4. What is genetic manipulation? How is it useful in agricultural practices?**

**Ans.** The introduction of genes with desirable properties into plants so that the desired result can be achieved is called genetic modification or manipulation. Good quality of crops are developed by this method.

#### **5. How do storage grain losses occur?**

**Ans.** The loss of grain in storehouses is due to biotic and abiotic factors.

- (i) **Biotic factors:** Rats, molds, squirrels etc.
- (ii) **Abiotic factors:** Moisture, temperature etc.

#### **6. How do good animal husbandry practices benefit farmers?**

**Ans.** (i) The economic condition of farmers becomes good with good animal husbandry methods.

(ii) Farmers get balanced and nutritious food with good animal husbandry methods.

## **7. What are the benefits of cattle farming?**

**Ans.** There are many benefits of animal husbandry-milk, curd, ghee, meat, leather etc. are obtained. Now big dairies are also being run by rearing more cows, buffaloes and goats together milk is supplied from there in the cities.

## **8. For increasing production, what is common in poultry, fisheries and bee keeping?**

**Ans.**(i)We get nutrients from animal husbandry

(ii)Animal husbandry helps us in agricultural activities.

(iii)Animal husbandry improves the economic condition of the farmers.

## **9. How do you differentiate between capture fishing, mariculture and aquaculture.**

**Ans.**

<b>Capture fishing</b>	<b>Mariculture</b>	<b>Aquaculture</b>
<i>Under this process fishes are caught from any natural source</i>	<i>(i) Fishes are obtained from mariculture</i>	<i>In this, the fishes are reared in artificial ponds etc.</i>
<i>It is done from any kind of source</i>	<i>(ii) It is done in sea and lagoon.</i>	<i>It is done with fresh/soft water source.</i>