# CHAPTER 1 - MATTER IN OUR SURROUNDINGS

**Question 1: Which of the following are matter?**
Chair, air, love, smell, hate, almonds, thought, cold, cold drink, smell of perfume.
ANSWER: Chair, air, almonds, cold drink.

**Question 2: Give reasons for the following observation: The smell of hot sizzling food reaches you several metres away, but to get the smell from cold food you have to go close.**
ANSWER- Because the rate of diffusion of particles of hot sizzling food is high due to high temperature.

**Question 3: A diver is able to cut through water in a swimming pool. Which property of matter does this observation show?**
**ANSWER- Because liquid particles have intermolecular force and has less force of attraction between them.**

**Question 4: What are the characteristics of particles of matter?**
ANSWER-(I) Particles of matter have space between them.
(ii) Particles of matter are continuously moving.
(iii) Particles of mater attract each other.

**Question 5: 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 chimney, honey, water, chalk, cotton, and iron.**
ANSWER- Air < Exhaust from chimney < Cotton < Water < Honey < Chalk < Iron

**Question 6: (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.**
ANSWER-
(a) The differences in the characteristics of states of matter:

| S. NO. | SOLID STATE | LIQUID STATE | GASEOUS STATE |
|---|---|---|---|
| 1. | It has definite shape and volume. | It has no definite shape, but has definite volume. Liquids attain the shape of the vessel in which they are kept. | It neither has a definite shape nor a definite volume. |
| 2. | It is incompressible | It is compressible to a small extent. | It is highly compressible. |
| 3. | The force of attraction between the particles of solids is highest. | The force of attraction between liquid particles is less than solid particles but greater than gas particles. | The force of attraction between the gaseous particles is least. |
| 5. | Particles of solid cannot move freely. | Liquid particles move freely. | Gaseous particles are in a continuous and random motion. |

(a) **RIGIDITY**: The tendency of matter to resist a change in shape. Compressibility: The ability to reduce in volume when force is applied.
**FLUIDITY:** It is the ability of matter to flow. Only liquid and gases can flow and are called fluid.
Filling a gas container: Gases do not have definite shape and volume. Gases take the shape of the container in which filled. By filling a gas container, it means the attainment of shape of the container by the gas.
**SHAPE:** It means a definite boundary. Only solids have definite volume.

**KINETIC ENERGY:** The energy possessed by a particle due to its motion.

**DENSITY:** Mass per unit volume.

**Question 7: Give reasons:**
**(a) A gas fills completely the vessel in which it is kept.**
**(b) A gas exerts pressure on the walls of the container.**
**(c) A wooden table should be called a solid.**
**(d) We can easily move our hand in air, but to do the same through a solid block of wood, we need a karate expert.**

ANSWER- (a) Because the gas particles move freely in all directions due to less force of attraction between the particles.
(b) Because the gas particles move freely in all directions and these particles continuously collide among themselves and they also hit the walls of the container with a greater force.
(c) Because a wooden table has a definite shape and volume.
(d) Because Air particles have large space in between them, whereas wood has little space between the particles.

**Question 8: Liquids generally have lower density as compared to solids. But you must have observed that ice floats on water. Find out why.**
ANSWER- Ice is a solid but it has large number of empty spaces in its structure.
**Question 9: Convert the following temperature to Celsius scale:**
**(a) 300 K (b) 573 K**

ANSWER- (HINT- To convert Kelvin scale into Celsius scale subtract 273 )
(a) 300 K = (300 -273) °C = 27°C
(b) 573 K = (573 -273) °C= 300°C

**Question 10: What is the physical state of water at:**
**(a) 250°C (b) 100°C**

ANSWER-
(a) Gaseous state.
(b) Both liquid and gaseous states.

**Question 11: For any substance, why does the temperature remain constant during the change of state?**
ANSWER- During a change of state, the temperature remains constant. This is because all the heat supplied to increase the temperature, is utilized to supply latent heat of vaporization.
**Question 12: Suggest a method to liquefy atmospheric gases.**
ANSWER- Atmospheric gases can be liquefied by applying pressure and reducing the temperature.
**Question 13: Why does a desert cooler cool better on a hot dry day?**
ANSWER- As we know that evaporation causes cooling. Due to high rate of evaporation on hot dry day desert cooler cool better on a hot dry day.
**Question 14: How does water kept in an earthen pot (matka) become cool during summers?**

ANSWER- An earthen pot consists of many tiny pores through which the liquid inside the pot evaporates. As we know that evaporation causes cooling. Due to high rate of evaporation the water inside the pot become cool during summers.

**Question 15: Why does our palm feel cold when we put some acetone or petrol or perfume on it?**

ANSWER- As we know that evaporation causes cooling. Due to high rate of evaporation of acetone or petrol or perfume from our palm, we feel cold palm.

**Question16: Why are we able to sip hot tea or milk faster from a saucer than a cup?**

ANSWER- Because hot tea or milk has a larger surface area in a saucer than in a cup. Rate of evaporation is faster in case of greater surface area. Thus, the liquid cools faster in a saucer than in a cup.

**Question 17: What type of clothes should we wear in summers?**

ANSWER- In summer, we should wear cotton clothes because cotton clothes can absorb more sweat from our body and exposes the liquid to the atmosphere, making evaporation faster. During this evaporation, particles on the surface of the liquid gain energy from our body surface, making the body cool.

## EXERCISE

**Question 1: Convert the following temperatures to Celsius scale.**

**(a) 300 K (b) 573 K**

ANSWER- (HINT- To convert Kelvin scale into Celsius scale subtract 273 from given temperature)

(a) 300 K = (300 - 273) °C = 27 °C

(b) 573 K = (573 - 273) °C = 300 °C

**Question 2: Convert the following temperatures to Kelvin scale.**

**(A) 25°C (b) 373°C**

ANSWER- (HINT- To convert Celsius scale into Kelvin scale add 273 in given temperature)

(a) 25 °C = (25 + 273) K = 298 K

(b) 373°C = (373 + 273) K= 646 K

**Question 3: Give reason for the following observations.**

**(a) Naphthalene balls disappear with time without leaving any solid.**

**(b) We can get the smell of perfume sitting several meters away.**

ANSWER- (a) Because Naphthalene (Camphor) converts directly into gas from solid state by process sublimation.

(b) Gaseous particles possess high kinetic energy. Hence gas Particles of perfume diffuse into air at a very faster rate and reach to our nose. This enables us to smell the perfume from a distance.

**Question 4: Arrange the following substances in increasing order of forces of attraction between particles - water, sugar, oxygen.**

ANSWER- Oxygen < Water < Sugar

**Question 5: What is the physical state of water at:**

**(a) 25°C (b) 0°C (c) 100°C**

ANSWER- (a) At 25°C, water exists in the liquid state.

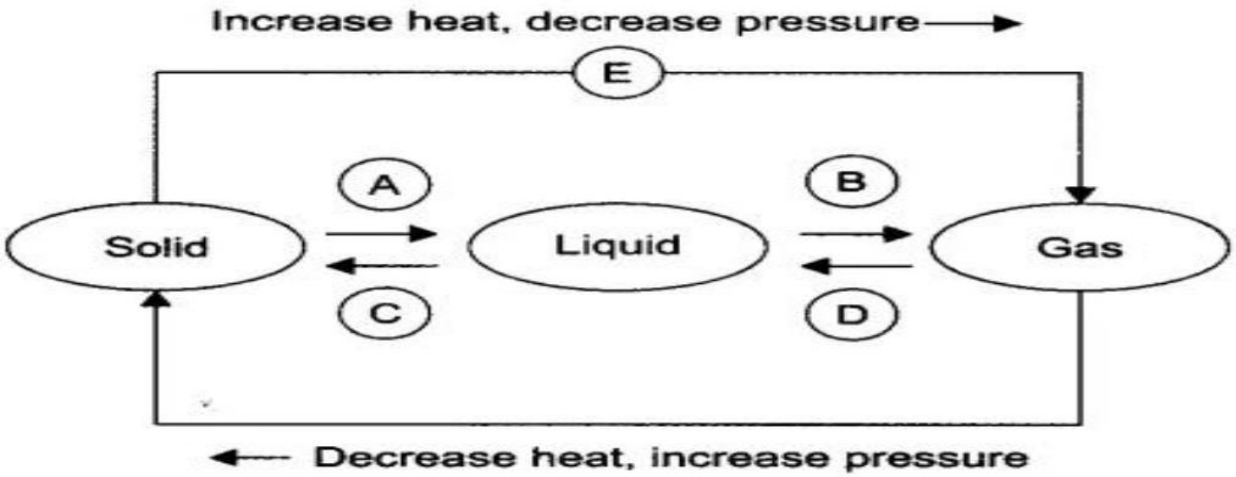
(b) At 0 °C, water can exist as both solid and liquid.
(c) At 100 °C, water can exist as both liquid and gas.

**Question 6: Give two reasons to justify:**
**(a) water at room temperature is a liquid.**
**(b) An iron almirah is a solid at room temperature.**

ANSWER- (a) Because room temperature (25 °C) is between melting point (0 °C) and boiling point (100 °C) of water, and water has no definite shape but has a fixed volume at room temperature.
(b) An iron almirah is a solid at room temperature (25 °C) because melting point of iron is much more than room temperature and iron is rigid at room temperature.

**Question 7: Why is ice at 273 K more effective in cooling than water at the same temperature?**
ANSWER- Because ice at 273 K has less energy than water because water possesses the additional energy of latent heat of fusion.
**Question 8: What produces more severe burns, boiling water or steam?**
ANSWER- Because steam has more energy than boiling water because it possesses the additional energy of latent heat of vaporization. Therefore, steam produces more severe burns than boiling water.

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




**ANSWER- A. Fusion**

**B. Vaporization**

**C. Condensation**

**D. Solidification**

**E. Sublimation**

**F. Sublimation**

# CHAPTER 2 - IS MATTER AROUND US PURE

**Question 1: What is meant by a pure substance?**
ANSWER: **A pure substance is that one that consist of a single type of particles i.e. all constituent particles of the substance have the same chemical nature.**

**Question 2: List the points of differences between homogeneous and heterogeneous mixtures. OR**
**Question 3: Differentiate between homogeneous and heterogeneous mixtures with examples.**

| HOMOGENEOUS MIXTURE | HETEROGENEOUS MIXTURE |
|---|---|
| 1) Those mixtures in which the substances are completely mixed together and are indistinguishable from one another. | Those mixtures in which the substances remain separate and one substance is spread throughout the other. |
| 2) They have uniform composition throughout its mass. | They do not have uniform composition. |
| 3) It has no visible boundaries of separation between various constituents. | It has visible boundaries. |
| 4) For Ex: Sugar solution, Salt solution, Alcohol and water, Soft drinks etc. | For Ex: Sugar and sand, Salt and Sand, Milk, Soil, Blood, Starch, Muddy water etc. |

**Question 4: How are sol (Colloid), solution and suspension different from each other?**
ANSWER- **Sol (Colloid)** is a heterogeneous mixture in which the solute particle's size is between solutions and suspensions and cannot be seen with naked eyes. They seem to be spread uniformly throughout the mixture. They show tyndall effect. For ex: Milk of magnesia, mud
**Solution** is a homogenous mixture in which solute particle's size is smallest and spread uniformly throughout the mixture. Solutions do not show Tyndall effect. For ex: Salt in water, sugar in water, iodine in water
A **suspension** is heterogeneous mixture in which solute particle's size is more than 1000 nm and are spread throughout a liquid without dissolving in it. For ex: Chalk and water, muddy water, sand and water, flour and water.
**Question 5: To make a saturated solution, 36 g of sodium chloride is dissolved in 100 g of water at 293 K. Find its concentration at this temperature.**
ANSWER: - **Mass of solute (sodium chloride) = 36 g (Given)**
**Mass of solvent (water) = 100 g (Given)**
**Then, mass of solution = Mass of solute + Mass of solvent**
**= (36 + 100) g**
**= 136 g**
**Therefore, concentration (mass by mass percentage) of the solution**

$$= \frac{Mass\ of\ solute}{Mass\ of\ solvent} \times 100\ \%$$

$$= \frac{36}{136} \times 100\ \%$$

$$= 26.4\ \%$$

**Question 6: How will you separate a mixture containing kerosene and petrol (difference in their boiling points is more than 25°C), which are miscible with each other?**

**ANSWER- A mixture of two liquids having a difference in boiling point more than 25°C can be separated by the method of distillation.**

**Question 7: Name the technique to separate**

**(I) butter from curd**

ANSWER- Centrifugation

**(ii) salt from sea-water**

ANSWER- Evaporation

**(iii) camphor from salt.**

ANSWER- Sublimation

**Question 8: What type of mixtures are separated by the technique of crystallization?**

ANSWER- The process of cooling a hot, concentrated solution of a substance to obtain crystals is called crystallisation. It is used for obtaining a pure solid substance from impure sample. For Example Impure copper sulphate can be purified by the method of crystallisation.

**Question 9: Classify the following as chemical or physical changes:**

- **cutting of trees,**
- **melting of butter in a pan,**
- **rusting of almirah,**
- **boiling of water to form steam,**
- **passing of electric current, through water and the water breaking down into hydrogen and oxygen gases,**
- **dissolving common salt in water,**
- **making a fruit salad with raw fruits, and**
- **burning of paper and wood.**

ANSWER- Cutting of trees : **Physical change**

Melting of butter in a pan: **Physical change**

rusting of almirah: **Chemical change**

Boiling of water to form steam: **Physical change**

Passing of electric current through water and the water breaking down into hydrogen and oxygen gases: **Chemical change**

Dissolving common salt in water: **Physical change**

Making a fruit salad with raw fruits: **Physical change**

Burning of paper and wood : **Chemical change**

**Question 10 Try segregating the things around you as pure substances or mixtures.**
ANSWER- Pure substances: salt, water, sugar Mixtures: soil, wood, air, book, chair, cold drink, milk, butter, food

## EXERCISE QUESTION-ANSWERS

**Question 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.**

ANSWER- a) Evaporation b) Sublimation c) Centrifugation or Filtration
d) Chromatography e) Centrifugation f) Separating funnel
g) Simple filtration h) Magnetic separation i) Winnowing
j) Centrifugation

**Question 2: Write the steps you would use for making tea. Use the words solution, solvent, solute, dissolve, soluble, insoluble, filtrate and residue.**
ANSWER- 1) Water, the solvent is taken in a kettle. This water is allowed to boil.
2) During heating, sugar and tea leaves are added as solute.
3) Milk, tea leaves and sugar together form solution. Sugar dissolves in milk.
4) Then the solution is poured on a strainer.
5) The remaining tea leaves being insoluble remains as residue.
6) Colour of the tea leaves goes into solution as filtrate.

**Question 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 water to form a saturated solution).**

| Substance Dissolved | Temperature in K | | | | |
|---|---|---|---|---|---|
| | 283 | 293 | 313 | 333 | 353 |
| | Solubility | | | | |
| 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 grams of water at 313 K?**

ANSWER- At 313 K Mass of potassium nitrate needed to produce its saturated solution in 100g of water is 62 g. Mass of potassium nitrate needed to produce its saturated solution in 50g of water is 31 g.

**(b) Pragya makes a saturated solution of potassium chloride in water at 353 K and leaves the solution to**

**cool at room temperature. What would she observe as the solution cools? Explain.**

ANSWER- The amount of potassium chloride that should be dissolved in water to make a saturated solution increases with temperature. As the solution cools down some amount of dissolved potassium chloride will reappear as undissolved solid.

**(c) What is the effect of change of temperature on the solubility of a salt?**

**ANSWER-** The solubility of salt increases with temperature.

**Question 4: Explain the following giving examples.**

**(a) Saturated solution**

ANSWER- A solution in which no more quantity of solute can be dissolved at given temperature is called saturated solution. Suppose 100 g of a solute is the maximum amount that can be dissolved in 200 g of water at 298 K. Then 300 g of solution so obtained is the saturated solution at 298 K.

**(b) Pure substance**

ANSWER-A pure substance is one which is made up of only one kind of particle (atoms or molecules) for ex: Sulphur element is made up of only one kind of sulphur atom. Water is made up of only one kind of water molecule.

**(c) Colloid** is a heterogeneous mixture in which the solute particle's size is between solutions and suspensions and cannot be seen with naked eyes. They seem to be spread uniformly throughout the mixture. They show Tyndall effect. For ex: Milk, Blood, Soap solution etc

**d) Suspension: - is** heterogeneous mixture in which solute particle's size is more than 1000 nm and are spread throughout a liquid without dissolving in it. For ex: Chalk and water, muddy water, sand and water, flour and water.

**Question 5: Classify each of the following as a homogeneous or heterogeneous mixture. Soda water, wood, air, soil, vinegar, filtered tea.**

**Answer-** Homogeneous mixture: Soda water, air, vinegar, filtered tea Heterogeneous mixture: wood, soil

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

**Answer:** Pure water has a boiling point of 373 K at 1 atmospheric pressure. If the colourless liquid boils exactly at 373 K at 1 atmospheric pressure then it is a pure water. If there is difference in boiling point then water is contaminated.

**Question 7: Which of the following materials fall in the category of a "pure substance"?**

**(a) Ice (b) Milk (c) Iron (d) Hydrochloric acid**
**(e) Calcium oxide (f) Mercury (g) Brick**
**(h) Wood (I) Air.**

**Answer:** a, c, d, e and f are pure substances.

**Question *8*- Identify the solutions among the following mixtures.**

**(a) Soil (b) Sea water (c) Air (d) Coal (e) Soda water.**

**Answer:** Solution among mixtures are: a) Sea water, b) Air, c) Soda water.

**Question 9- Which of the following will show "Tyndall effect"?**

**(a) Salt solution (b) Milk (c) Copper sulphate solution (d) Starch solution.**

**Answer:** b and d are colloids which show Tyndall effect

**Question 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) Carbon dioxide (m) Blood**

**Answer:** Elements: Sodium, silver, tin, silicon Compounds: Calcium carbonate, methane, carbon dioxide Mixtures: Soil, coal, air, soap, blood, sugar solution

**Question 11: Which of the following are chemical changes?**

**(a) Growth of a plant (b) Rusting of iron (c) Mixing of iron filings and sand**
**(d) Cooking of food (e) Digestion of food (f) Freezing of water**
**(g) Burning of a candle.**

Answer: The following changes are chemical changes:

a) Growth of plant b) Rusting of iron c) Cooking of food
d) Digestion of food e) Burning of candle

**Question 12- Write differences between mixtures and compounds.**

**ANSWER:-**

| MIXTURE | COMPOUND |
|---|---|
| 1. Elements or compounds are simply mixed so no new substance is formed | 1. Substances are reacted together with each other to make a new substance. |
| 2. Elements do not combine in a fixed ratio. | 2. Composition of the components is fixed i.e., they combine together in a fixed ratio according to their masses. |
| 3. A mixture shows the of its components | 3. Compound doesn't show the properties of component elements. |
| 4. Components can be easily separated by any mechanical method which is suitable | 4. Components can't be separated from each other by simple mechanical methods |
| 5. E.g., Mixture of iron and sulphur. | 5. E.g., Iron and sulphur react to form iron sulphide. |

# CHAPTER 5 –THE FUNDAMENTAL UNIT OF LIFE

**Question 1: Who discovered cells and how?**
ANSWER: Cell was discovered by Robert Hooke in 1665. He used self-designed microscope to observe cells in a cork slice.
**Question 2: Why the cell is called the structural and functional unit of life?**
ANSWER- The basic functions of life like respiration, assimilation and all major metabolic activities are carried inside the cell. So, cell is known as structural and functional units of living organism.
**Question 3: How do substances like $CO_2$ and water move in and out of the cell? Discuss.**

ANSWER- The substances like $CO_2$ and water move in and out of a cell through the process called diffusion from the region of high concentration to region to low concentration. When the concentration of carbon dioxide and water is higher in external environment than that inside the cell, $CO_2$ and water moves inside the cell. When the concentration outside the cell is low but it is high inside the cell, they move outwards.

**Question 4: Why the plasma membrane is called a selectively permeable membrane?**
ANSWER- Because Plasma membrane allows only some selected substances to move in and out of the cell, and prevents the other substances.
**Question 5: Can you name the two organelles we have studied that contain their own genetic material?**
ANSWER- Mitochondria and plastids their own genetic material
**Question 6: If the organization of a cell is destroyed due to some physical or chemical influence, what will happen?**
ANSWER- Some of the important function of the cell will stop and it may result in the death of the cell.
**Question 7: Why are lysosomes known as suicide bags?**
ANSWER- Lysosomes are called suicide bags because in case of any disturbance of their cellular metabolism they release their own enzymes to digest their own cell.
**Question 8: Where are proteins synthesized inside the cell?**
ANSWER- In the Ribosome

# EXERCISE QUESTION-ANSWERS

**Question 1: Make a comparison and write down ways in which plant cells are different from animal cells.**
ANSWER

| PLANT CELL | ANIMAL CELL |
|---|---|
| 1-It's shape is rectangular | 1-It's shape is oval |
| 2-Vacuole is large in size | 2-Vacuoles are small in size |
| 3-Cell wall is present | 3-Cell wall is absent |
| 4-Chloroplast is present | 4-Chloroplast is absent |
| 5-Centrisome is absent | 5-Centrosome is present. |

**Question 2: How is a prokaryotic cell different from a eukaryotic cell?**
ANSWER

| PROKARYOTIC CELLS | EUKARYOTIC CELLS |
|---|---|
| 1- Most prokaryotes are unicellular. | 1- Most eukaryotes are multicellular. |
| 2- Nucleolus is absent | 2- Nucleolus is present. |
| 3- Absence of a nuclear membrane. | 4- Presence of a nuclear membrane. |
| 4. These cells are smaller in size. | 4. These cells are bigger in size. |
| 5. It contains a single chromosome. | 5. It contains more than one chromosome. |

**Question 3: What would happen if the plasma membrane ruptures or breaks down?**

ANSWER- Then the protoplasmic material will disappear and the cell will die.

**Question 4: What would happen to the life of a cell if there was no Golgi apparatus?**

ANSWER- Golgi apparatus performs the function of a storage modification and packaging of products. If Golgi apparatus is not there then materials synthesized by cell will not be packaged and transported.

**Question 5: Which organelle is known as the powerhouse of the cell? Why?**

**Answer- Mitochondria are known as the powerhouse of cells because it releases the energy required for various activities of life.**

**Question 6: Where do the lipids and proteins constituting the cell membrane get synthesized?**

**Answer: Lipids and proteins are synthesized in ER (Endoplasmic Reticulum).**

**Question 7: How does an Amoeba obtain its food?**

**Answer: Amoeba obtain its food through the false feet called pseudopodia. Whenever food particle come in the contact of Amoeba, its flexible membrane protrudes and engulfs the food. This food is then broken down into the food vacuole which contains digestive enzymes. This process is known as endocytosis.**

**Question 8- What is osmosis?**

**Answer: Osmosis is the process of movement of the water molecules from the region of high water concentration to a region of low water concentration through a semi permeable membrane.**

# CHAPTER 8 –MOTION

## Important equations, symbols and their SI units

Initial velocity = u (m/s) Final velocity = v (m/s) acceleration = a ($m/s^2$)

Time = t (sec-s) distance (height) = S (m) mass = m (kg)

1) $v = u + at$ 2) $S = ut + \frac{1}{2} a t^2$ 3) $v^2 - u^2 = 2aS$

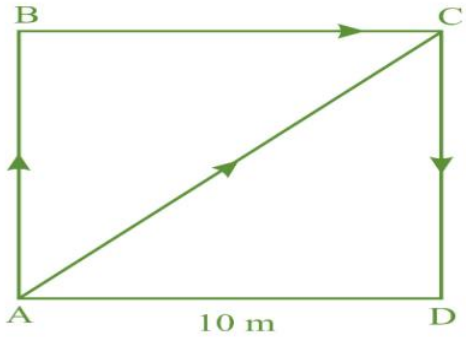
**Speed = distance/ time** **Acceleration = change in velocity/ time**

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

ANSWER: Yes, an object moving through a distance can have zero displacement. This happens when final position of the object coincides with its initial position. Example: If an object travels from point A and reaches to the same point A, then its displacement is zero.

**Question 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?**

**ANSWER- Let Farmer starts from point A**




**Time taken by farmer to complete one round = 40 sec**

**Total time = 2 min 20 sec = 2x 60+20 = 120 +20 = (40+40+40+20) sec**

**Hence After 2min 20 sec farmer will be at position C, so displacement is AC**

**AC= $\sqrt{}$ ($AB^2+BC^2$) = $\sqrt{}$ ($10^2+10^2$) = $\sqrt{}$ (100+100) = $\sqrt{}$200 = 10 $\sqrt{}$2 m**

## Question 3: Which of the following is true for displacement?

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

## Question 4: Distinguish between speed and velocity.

ANSWER

| SPEED | VELOCITY |
|---|---|
| 1. Time rate of travelling the distance is known as speed. | 1. Time rate of change of displacement is known as velocity. |
| 2. Speed = Distance / time | 2. Velocity = Displacement / time |
| 3. It is a scalar quantity. | 3. It is a vector quantity. |
| 4. It cannot be zero for a moving object. | 4. It can be zero. |
| 5. It cannot have negative value. | 5. It may have negative value. |

**Question 5: Under what condition(s) is the magnitude of average velocity of an object equal to its average speed?**

ANSWER- When object move in a straight line.

**Question 6: What does the odometer of an automobile measure?**

ANSWER- Distance travelled by a vehicle.

**Question 7: What does the path of an object look like when it is in uniform motion?**

ANSWER- A straight line.

**Question 8: 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, $3 \times 10^8$ m $s^{-1}$**

**ANSWER- Speed = $3\times10^8$ m/s**

**Time = 5 minute = 5 × 60 s = 300 s**

**We know, Distance = Speed × Time**

**⇒ Distance = $3 \times10^8 \times 300$ m = $900 \times 10^8$ m= $9.0 \times 10^{10}$ m**

**Question 9: When will you say a body is in (i) uniform acceleration? (ii) Non-uniform acceleration?**

ANSWER- (i) **UNIFORM ACCELERATION- A body is said to be moving with uniform acceleration, if it changes equal velocity in equal intervals of time**.

(ii) **NON-UNIFORM ACCELERATION- A body is said to be moving with non-uniform acceleration, if it changes unequal velocity in equal intervals of time.**

**Question 10: A bus decreases its speed from 80 km $h^{-1}$ to 60 km $h^{-1}$ in 5 s. Find the acceleration of the bus.**

$$ANSWER:-INITIAL\ SPEED = U = 80\ Kmh^{-1} = 80\times\frac{1000m}{3600s} = \frac{200}{9}\ ms^{-1}$$

$$\text{FINAL VELOCITY} = V = 60\ Kmh^{-1} = 60\times\frac{1000m}{3600s} = \frac{150}{9}\ ms^{-1}$$

**Time =t=5 sec**

$$\text{Acceleration} = a = \frac{v-u}{t} = \frac{\frac{150}{9}-\frac{200}{9}}{5} = \frac{150-200}{5X9} = \frac{-50}{5X9} = -\frac{10}{9} = -1.1\ ms^{-2}$$

**Question 11: A train starting from a railway station and moving with uniform acceleration attains a speed 40 km $h^{-1}$ in 10 minutes. Find its acceleration.**

**Answer 3:**

Here we have,

Initial velocity, u = 0 m/s

Final velocity, v = 40 km/h = $= 40\times1000/3600\ ms\text{-}1 = 100/9\ ms\text{-}1$

Time (t) = 10 minute = 60 × 10 = 600 s

**Acceleration (a) =?**

**We know that, v = u + at**

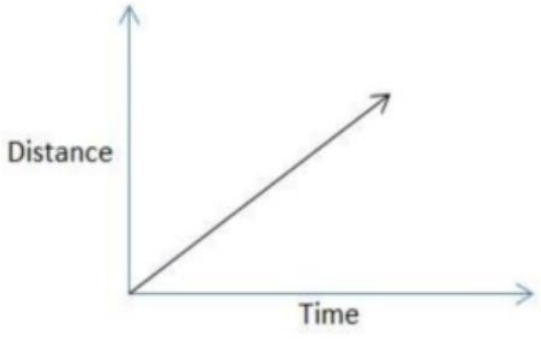
$$\Rightarrow \text{Acceleration} = a = \frac{v-u}{t} = \frac{\frac{100}{9}-0}{600} = \frac{100}{600X9} = \frac{1}{54} = 0.0185\ ms^{-2}$$

**Question 12: What is the nature of the distance-time graphs for uniform and non-uniform motion of an object?**

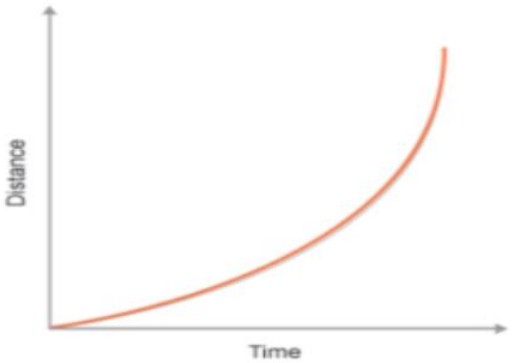
**ANSWER- (1) Distance-time graph for uniform motion is a straight line making some angle with time axis.**

**(2) Distance-time graph for non-uniform motion is parabola.**

**(Uniform Motion) (Non-uniform Motion)**




(UNIFORM MOTION)




(NON-UNIFORM MOTION)

**Question 13: What can you say about the motion of an object whose distance-time graph is a straight line parallel to the time axis?**

**ANSWER- Body is at rest.**

**Question 14: What is the quantity which is measured by the area occupied below the velocity-time graph?**

**ANSWER- Distance.**

**Question 15: A bus starting from rest moves with a uniform acceleration of 0.1 m $s^{-2}$ for 2 minutes. Find (a) the speed acquired, (b) the distance travelled.**

Here we have,

Initial velocity (u) = 0 m/s

Acceleration (a) = $0.1 ms^{-2}$

Time (t) = 2 minute = 120 seconds

**(a)** The speed acquired:

We know that, v = u + at

$\Rightarrow$ v = 0 + 0.1 × 120 m/s

$\Rightarrow$ v = 12 m/s

Thus, the bus will acquire a speed of 12 m/s after 2 minute with the given acceleration.

**(b)** The distance travelled:

We know that, $s = ut + \frac{1}{2}at^2$

$= 0 \times 120 + 1/2 \times 0.1 \times (120)^2$

$= 1/2 \times 0.1 \times 14400 \text{ m} = 720 \text{ m}$

**Thus, bus will travel a distance of 720 m in the given time of 2 minute.**

**Question 16: A train is travelling at a speed of 90 $km h^{-1}$. Brakes are applied so as to produce a uniform acceleration of – 0.5 $ms^{-2}$. Find how far the train will go before it is brought to rest.**

**ANSWER-**

Here, we have,

Initial velocity, u = 90 km/h $= \frac{90 \times 1000}{3600}$ $ms^{-1} = 25\ ms^{-1}$

Final velocity, v = 0 m/s

Acceleration, a = – 0.5 $m/s^2$

Distance travelled = ?

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

$$s = \frac{v^2 - u^2}{2a} = \frac{0^2 - 25^2}{2(-0.5)} = 625 \text{ m}$$

Therefore, train will go 625 m before it brought to rest.

**Question 17: A trolley, while going down an inclined plane, has an acceleration of 2 m $s^{-2}$. What will be its velocity 3 s after the start?**

**Answer 3:**

Here we have,

Initial velocity, u = 0 m/s

Acceleration (a) = 2 $cm/s^2$ = 0.02 $m/s^2$

Time (t) = 3 s

Final velocity, v = ?

We know that, v = u + at

Therefore, v = 0 + 0.02 × 3 m/s

⇒ v = 0.06 m/s

**Therefore the final velocity of trolley will be 0.06 m/s after start.**

**Question 18: A racing car has a uniform acceleration of 4 m $s^{-2}$. What distance will it cover in 10 s after start?**

ANSWER- **acceleration = a =4 $m/s^2$** **Time = t = 10 sec**

**Initial speed = u = 0**

**Distance Covered (S) =?**

$$\text{We know that, } s = ut + \frac{1}{2}at^2$$

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

$$\Rightarrow s = 2 \times 100 \text{ m}$$

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

,

**Thus, racing car will cover a distance of 200 m after start in 10 s with given acceleration.**

**Question 19: A stone is thrown in a vertically upward direction with a velocity of 5 m $s^{-1}$. If the acceleration of the stone during its motion is 10 m $s^{-2}$ in the downward direction, what will be the height attained by the stone and how much time will it take to reach there?**

**ANSWER**: - Here we have,

Initial velocity (u) = 5 m/s  Final velocity (v) = 0 m/s  Acceleration (a) = – 10 m/s$^2$

Height, i.e. Distance, s =?

Time (t) taken to reach the height =?

We know that, $v^2 = u^2 + 2as$

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

$\Rightarrow 0 = 25 - 20s$

$\Rightarrow$ Type equation here.$20s = 25$

$\Rightarrow s = 25/20$ m

$\Rightarrow s = 1.25$ m

Now, we know that, $v = u + at$

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

$\Rightarrow 0 = 5 - 10t$

$\Rightarrow 10t = 5$

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

$\Rightarrow t = 0.5$ s

Thus, stone will attain a height of 1.25 m and time taken to attain the height is 0.5 s.

# EXERCISE QUESTION-ANSWERS

**Question 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?**

**ANSWER- Time taken = 2 min 20 sec =140 sec**

**Diameter of circular track=200 m**

**Radius of circular track = 100 m**

**Time taken by athlete for one round= 40sec**

**in 140 sec the athlete will complete= 140 ÷ 40 = 3.5 round.**

**Distance covered by athlete in 140 sec =3.5 (2πr) = 3.5 × 2 × $\frac{22}{7}$×100 = 2200 m**

**Displacement of the athlete= Diameter of circular track =200 m**

**Question 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 speeds and velocities in jogging (a) from A to B and (b) from A to C?**

**ANSWER- (a) from A to B**

**Distance covered = 300 m** **Displacement= 300 m** **Time taken= 150 min**

**Average speed = Total distance covered/ total time taken**

**Average speed = Total distance covered ÷ Total time taken**

**= 300 m ÷ 150 sec = 2 $ms^{-1}$**

**Average velocity = Net displacement / time taken**

**Average velocity = Net displacement ÷ time taken**

**= 300 m ÷ 150 sec = 2 $ms^{-1}$**

**b) For motion A to C**

**Distance covered= 300 +100 = 400 m**

**Displacement= 300-100 =200 m**

**Time taken = 2.5 + 1 = 3.5 min = 210 sec**

Average speed = Total distance covered/ total time taken

= 400 ÷ 210 = 1.90 $ms^{-1}$.

Average velocity = Net displacement ÷ time taken

= 200 m ÷ 210 sec = **0.952 $ms^{-1}$**

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

Let one side distance = $x$ km.

Time taken for forward trip at a speed of 20 km/h = Distance / Speed = $x/20$ h.

Time taken in return trip at a speed of 30 km/h = $x/30$ h.

Total time for the whole trip =

$$\frac{x}{20} + \frac{x}{30} = \frac{3x+2x}{60} = \frac{5x}{60} \text{ h.}$$

Total distance covered = $2x$ km.

We know, Average speed = Total distance ÷ Total time

= $2x \div (5x/60)$ = 24 $kmh^{-1}$.

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

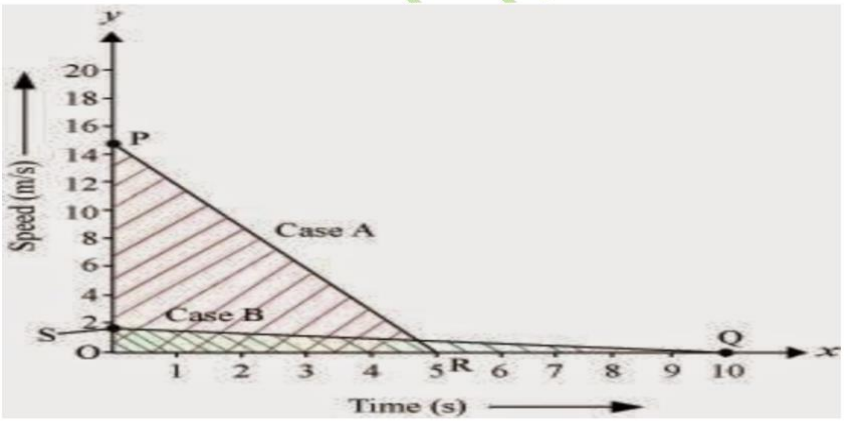
ANSWER- u = 0 m/s  a = 3 $m/s^2$  t = 8 sec

Using, $s = ut + \frac{1}{2} at^2$

$s = 0 \times 8 + \frac{1}{2} \times 3 \times 8^2 = 96$ m

**Question 5: A driver of a car travelling at 52 $kmh^{-1}$ applies the brakes and accelerates uniformly in the opposite direction. The car stops in 5 s. Another driver going at 3 $kmh^{-1}$ in another car applies his brakes slowly and stops in 10 s. On the same graph paper, plot the speed versus time graphs for the two cars. Which of the two cars travelled farther after the brakes were applied?**

**Answer :-** In in the following graph, AB and CD are the time graphs for the two cars whose initial speeds are 52 km/h(14.4 m/s) and 34 km/h(8.9 m/s), respectively.




Distance covered by the first car before coming to rest

**= Area of triangle AOB**

**= ½ × AO × BO**

**= ½ × 52 $kmh^{-1}$ × 5 s**

**= ½ x (52 × 1000 × 1/3600) $ms^{-1}$ × 5 s = 36.1 m**

**Distance covered by the second car before coming to rest**

**= Area of triangle COD**

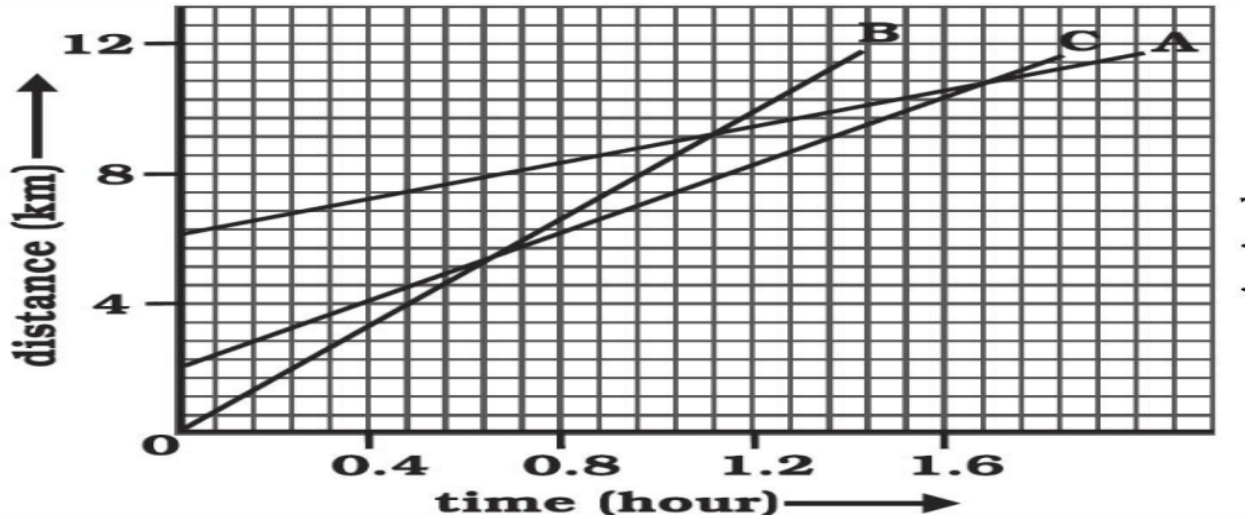
**= ½ × CO × DO**

**= ½ × 34 km $h^{-1}$ × 10 s**

= ½ × (34 × 1000 × 1/3600) $ms^{-1}$ ×10 s = 47.2 m

**Thus, the second car travels farther than the first car after they applied the brakes.**

**Question 6: Fig 8.11 shows the distance-time graph of three objects A, B and C. Study the graph and answer the following questions: Fig. 8.11**




**(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?**

**Answer 6:**

**(a) B is travelling fastest as he is taking less time to cover more distance.**

**(b) All three are never at the same point on the road.**

**(c) Approximately 6 km. [as 8 – 2 = 6]**

**(d) Approximately 7 km. [as 7 – 0 = 7]**

**Question 7: A ball is gently dropped from a height of 20 m. If its velocity increases uniformly at the rate of 10 $ms^{-2}$, with what velocity will it strike the ground? After what time will it strike the ground?**

**Answer 7:**

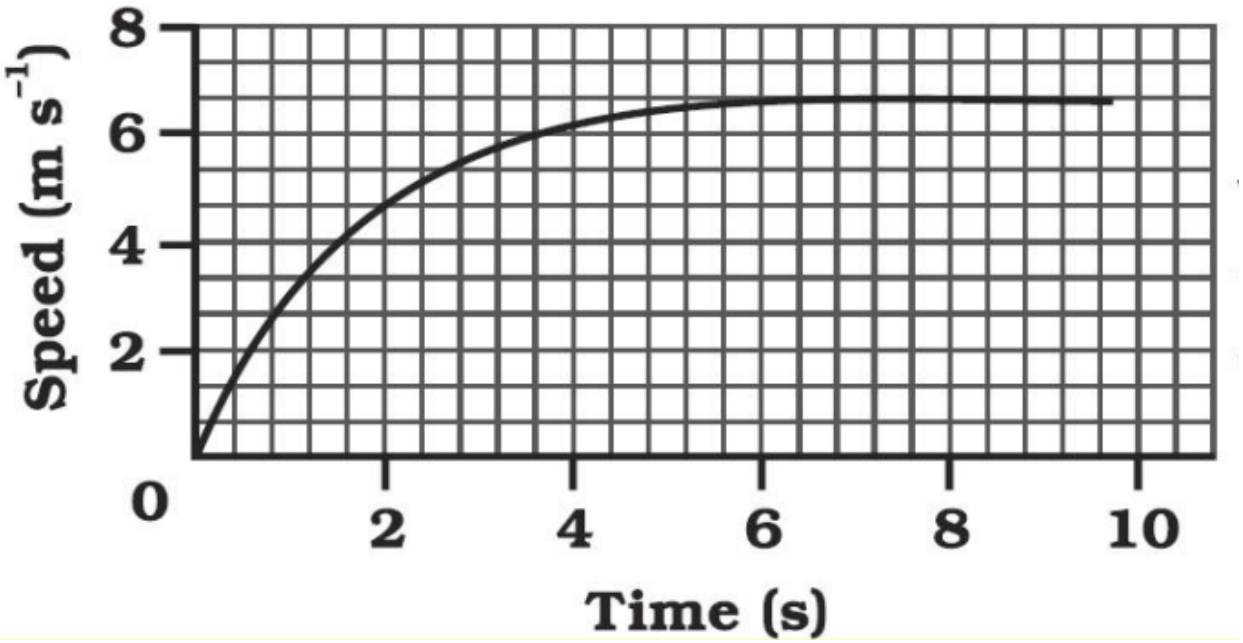
**Here, u = 0 m/s, s = 20 m, a = 10 $ms^{-2}$, v =? t = ?**

**Using $v^2 – u^2 = 2as$**

**we have, $v2 – 0^2 = 2 \times 10 \times 20 = 400 \Rightarrow v = 20\ ms^{-1}$.**

**And t = (v – u) ÷ a = 20 ÷ 10 = 2 s.**

**Question 8- The speed-time graph for a car is shown is Fig. 8.12.**

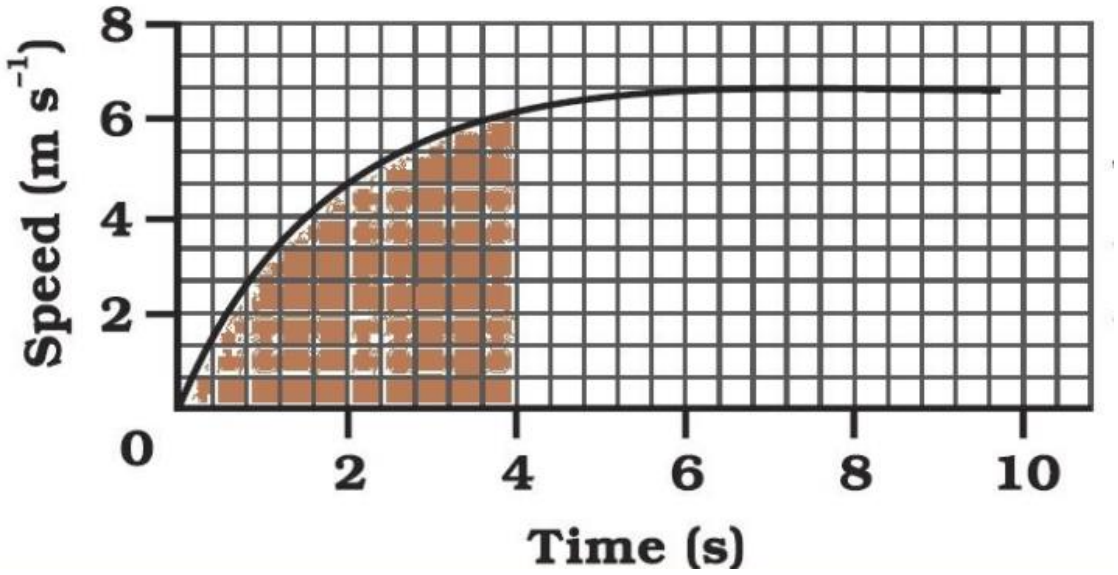



**(a) Find how far the car travels in the first 4 seconds. Shade the area on the graph that represents the distance travelled by the car during the period. (b) Which part of the graph represents uniform motion of the car?**

**Answer 8: (a) Distance covered = area under speed – time**

$\Rightarrow$ Distance $= 1\,2 \times 4 \times 6 = 12$ m

**Shaded area representing the distance travelled is as follows:**




**(b) After 6 seconds the car moves in uniform motion (at a speed of 6 m/s)**

**Question 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.**

**ANSWER- a) Yes, when a ball is thrown up at a maximum height, it has zero velocity, although it will have constant acceleration due to gravity.**
**b) Yes, when a car is moving in circular track, its acceleration is perpendicular to its direction.**

**Question 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.**

**ANSWER- R = 42250 km, and t = 24 hours**
**Speed = distance / time**
**Using Speed, $v = 2\pi r \div T$**
**$v = (2 \times 3.14 \times 42250000) \div (24 \times 60 \times 60)$ m/s**
**= 3070.9 m/s = 3.07 km/s**

# CHAPTER 9-FORCE AND LAWS OF MOTION

## IMPORTANT SYMBOLS AND EQUATIONS AND THEIR SI UNITS

**Initial velocity = u (m/s)** **Final velocity = v (m/s)** **acceleration = a (m/s$^2$)**

**Time = t (sec)** **distance (height) = S (m)** **mass = m (kg)**

**Force = F (N- newton)**

**1) v = u + at** **2) S = ut + ½ at$^2$** **3) v$^2$ – u$^2$ = 2aS**

**Force = F = ma** **Momentum = p = mv**

**Question 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-rupee coin and a one-rupee coin?**

**ANSWER: (a) A stone of the same size**

**(b) a train**

**(c) a five-rupees coin**

**Question 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.**

**ANSWER- 1) Velocity of the football changes when first player kicks the ball towards another player of his team.**

**2) Velocity of the football also changes when another player kicks the football towards the goal.**

**3) Velocity of the football also changes when the goalkeeper of the opposite team stops the football by collecting it.**

**4) Velocity of the football changes when the goalkeeper kicks it towards a player of his team.**

**Hence the velocity of football changed four times.**

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

**ANSWER- Due to the inertia of rest, the leaves tend to remain in its position and hence detaches from the tree to fall down.**

**Question 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?**

**ANSWER- When a moving bus brakes to a stop, we fall in the forward direction because though the lower part of our body comes to a stop when the bus stops but the upper part of the body continues to be in motion in the forward direction due to its inertia, thus making us fall in the forward direction. When a bus accelerates from rest, we fall backwards because though the lower part of our body starts moving with the bus but the upper part of the body tries to remain at rest due to its inertia, thus making us fall in the backward direction.**

## Question 5: If action is always equal to the reaction, explain how a horse can pull a, cart?

ANSWER- A horse pushes the ground in the backward direction. According to Newton's third law of motion, a reaction force is exerted by the ground on the horse in the forward direction. As a result, the horse moves forward along with the cart.

## Question 6: Explain, why is it difficult for a fireman to hold a hose, which ejects a large amount of water at a high velocity.

**ANSWER- The ejection of a large amount of water at a high velocity from a hose pipe results in the development of an equal force of reaction on the hosepipe in the backward direction. That is why it becomes difficult for the fireman to hold the hosepipe.**

## Question 7: From a rifle of mass 4 kg, a bullet of mass 50 g is fired with an initial velocity of 35 m/s. Calculate the initial recoil velocity of the rifle.

**ANSWER:-Before Firing- mass of rifle = $m_1$ = 4 kg**

**Velocity of rifle = $u_1$= 0**

**Mass of bullet = $m_2$ = 50 g = 0.05 kg**

**Velocity of bullet = $u_2$ = 0**

**Momentum before firing = $m_1 u_1 + m_2 u_2 = 4 \times 0 + 0.05 \times 0 = 0$**

**After Firing- mass of rifle = $m_1$ = 4 kg**

**Velocity of rifle = $v_1$=?**

**Mass of bullet = $m_2$ = 50 g = 0.05 kg**

**Velocity of bullet = $v_2$ = 35 m/s**

**Momentum after firing = $m_1 v_1 + m_2 v_2 = 4 v_1 + 0.05 \times 35$**

**According to law of conservation of momentum**

**Momentum before firing = Momentum after firing**

So, $4\ v_1 + 0.05 \times 35 = 0$

$$4\ v_1 = -\ 1.75$$

$$v_1 = -\frac{1.75}{4} = -0.4\ \text{m/s}$$

**Question 8: Two objects of masses 100 g and, 200 g are moving along the same line and direction with velocities of 2 m/s and 1 m/s respectively. They collide and after the collision the first object moves at a velocity of 1.67 m/s. determine the velocity of the second object.**

**ANSWER:-**

**Mass of one of the objects, $m_1$ = 100 g = 0.1 kg**

**Mass of the other object, $m_2$ = 200 g = 0.2 kg**

**Velocity of $m_1$ before collision, $v_1$ = 2 m/s**

**Velocity of $m_2$ before collision, $v_2$ = 1 m/s**

**Velocity of $m_1$ after collision, $v_3$ = 1.67 m/s**

**Velocity of $m_2$ after collision = $v_4$**

**According to the law of conservation of momentum:**

**Total momentum before collision = Total momentum after collision**

$m_1v_1 + m_2v_2 = m_1v_3 + m_2v_4$

$\Rightarrow 0.1\times2 + 0.2\times1 = 0.1\times1.67 + 0.2\times v_4$

$\Rightarrow 0.4 = 0.67 + 0.2\times v_4$

$\Rightarrow v_4 = 1.165$ m/s

**Hence, the velocity of the second object becomes 1.165 m/s after the collision.**

## EXERCISE QUESTION-ANSWERS

**Question 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.**

ANSWER- Yes, Object can have non-zero velocity without any force. Because according to Newton's first law of motion an object will remain in uniform motion in a straight line unless acted upon by an external force.

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

**ANSWER- Due to inertia of rest the dust particles retain their position of rest and falls down due to gravity on beating with a stick.**

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

**ANSWER- In moving bus the speed of vehicle varies and it may apply brake suddenly or takes sudden turn. The luggage will resist any change in its state of rest or motion, due to inertia and this luggage has the tendency to fall sideways, forward or backward. To avoid the fall of the luggage, it is tied with the rope.**

**Question 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 to 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**

**Question 5: A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of 400 m in 20 s. Find its acceleration. Find the force acting on it if it's mass is 7 tones (Hint: 1 tons = 1000 kg).**

Initial velocity of the truck, $u$ = 0 m/s

Time taken, t = 20 s

Distance covered by the stone, $s$ = 400 m

According to the second equation of motion:

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

We have

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

$$\Rightarrow 400 = 200a$$

$$\Rightarrow a = 2\ m/s^2$$

Now, Force = mass × acceleration

$$\Rightarrow F = 7000 \times 2 = 14000\ N$$

**Question 6: A stone of 1 kg is thrown with a velocity of 20 m/s across the frozen surface of a lake and comes to rest after travelling a distance of 50 m. What is the force of friction between the stone and the ice?**

**Answer 6:** Initial velocity of the stone, $u$ = 20 m/s

Final velocity of the stone, $v$ = 0 m/s

Distance covered by the stone, $s$ = 50 m

According to the third equation of motion:

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

Where, Acceleration, $a$

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

$a = -4$ m/s$^2$

The negative sign indicates that acceleration is acting against the motion of the stone.

Mass of the stone, $m$ = 1 kg

From Newton's second law of motion:

Force,

$F$ = Mass x Acceleration

$F = ma$

$F = 1 \times (-4) = -4$ N

Hence, the force of friction between the stone and the ice is – 4 N.

**Question 7: An 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.**

**ANSWER- (a) Force exerted by the engine, F = 40000 N**

**Frictional force offered by the track, $F_f$ = 5000 N**

**Hence, net accelerating force, $F_a = F - F_f = 40000 - 5000 =$ 35000 N**

**(b) Let acceleration of the train be a.**

**Net accelerating force on the wagons, $F_a$ = 35000 N**

**Mass of the wagons, M = Mass of a wagon × Number of wagons = 2000 x 5 = 10000 kg**

**From Newton's second law of motion:**

**Force = Mass x Acceleration**

**$F_a$ = ma**

**Hence, the acceleration of the train is 3.5** $m/s^2$

**Question 8- An automobile vehicle has a mass of 1500 kg. What must be the force between the vehicle and road if the vehicle is to be stopped with a negative acceleration of 1.7 $m/s^2$?**

**ANSWER- Mass = m = 1500 kg**

**Acceleration = a = - 1.7 $m/s^2$**

**Force = F = ma = 1500 x (-1.7) = - 2550 N**

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

**(a) $(mv)^2$ (b) $mv^2$ (c) 1/2 $mv^2$ (d) mv (✓)**

**ANSWER: -** (d) *mv*

Mass of the object = *m* Velocity = *v*

Momentum = Mass × Velocity

Momentum = *mv*

**Question 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?**

ANSWER- 200 N.

**Question 11: Two objects each of mass 1.5 kg are moving in the same straight line but in opposite directions. The velocity of each object is 2.5 m/s before the collision during which they stick together. What will be the velocity of the combined object after collision?**

**ANSWER- - Before Collision-**

**$m_1$ = 1.5 kg**

**$u_1$= 2.5 m/s**

**$m_2$ = 1.5 kg**

**$u_2$ = - 2.5 m/s**

**Momentum before collision = $m_1 u_1 + m_2 u_2$ = 1.5 x 2.5 + 1.5 x (-2.5) = 3.75 -3.75 = 0**

**After Collision objects stick together**

**so move with same velocity = V =?**

**Momentum after Collision = $(m_1 + m_2)$ V = (1.5 + 1.5) V =3 V**

**According to law of conservation of momentum**

**Momentum before Collision = Momentum after Collision**

**so, 3V= 0**

**V= 0**

**Question 12: 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 the two opposite and equal forces cancel each other. Comment on this logic and explain why the truck does not move.**

**ANSWER- Action and reaction are equal and opposite but acts on different bodies, hence will not cancel each other. Heavy truck will not move because its mass is very high so it have negligible acceleration**.

$$\left( a = \frac{F}{m} \right)$$

**Question 13: A hockey ball of mass 200 g travelling at 10 m/s is struck, by a hockey stick so as to return it along its original path with a velocity at 5 m/s. Calculate the change of momentum occurred in the motion of the hockey ball by the force applied by the hockey stick.**

**ANSWER- mass = m= 200 g = 0.2 kg**

**Initial velocity = u = 10 m/s**

**Final velocity = v = - 5 m/s**

**Change of momentum = Initial momentum – Final momentum**

**= mu – mv = m (u - v) = 0.2 x {10 –(-5)}**

**= 0.2 x 15**

**= 3 kgm/s**

**Question 14: A bullet of mass 10 g travelling horizontally with a velocity of 150 m/s strikes a stationary wooden block and comes to rest in 0.03 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.**

ANSWER- mass = m = 10 g = 0.01 kg

Initial velocity = u = 150 m/s

Final velocity = v = 0

Time = t = 0.03 sec

Distance of penetration = S =?

Force = F =?

To find force, we will find acceleration first

v = u + at

0 = 150 + a x 0.03

$$a = -\frac{150}{0.03} = -5000 \text{ m/s}^2$$

Now, $v^2 - u^2 = 2aS$

$0^2 - (150)^2 = 2(-5000)S$

$-22500 = -10000\ S$

$$S = \frac{22500}{10000} = \mathbf{2.25\ m}$$

**Now Force = F = ma = 0.01 x (-5000) = -50 N**

**Question 15: An object of mass 1 kg travelling in a straight line with a velocity of 10 m/s 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.**

**ANSWER- before Collision- $m_1$ = 1 kg $u_1$= 10 m/s**

**$m_2$ = 5 kg $u_2$ = 0**

**Momentum before collision = $m_1 u_1 + m_2 u_2$ = 1 x 10 + 5 x 0 = 10 kgm/s**

**After Collision objects stick together**

**so move with same velocity = V =?**

**Momentum after Collision = $(m_1 + m_2)$ V = (1 + 5) V = 6 V**

**According to law of conservation of momentum**

**Momentum before Collision = Momentum after Collision**

**So, 6 V= 10**

$$V = \frac{10}{6} = \mathbf{1.67\ m/s}$$

**Question 16: An object of mass 100 kg is accelerated uniformly from a velocity of 5 m/s to 8 m/s in 6 calculate the initial and final momentum of the object. Also, find the magnitude of the force exerted on the object.**

**ANSWER- mass = m = 100 kg**

**Initial velocity = u = 5 m/s**

**Final velocity = v = 8 m/s**

**Time = t = 6 sec**

**Initial momentum = mu = 100 x 5 = 500 kgm/s**

**Final momentum = mv = 100 x 8 = 800 kgm/s**

**Force = F = ma**

$$= \frac{m(v-u)}{t} = \frac{100(8-5)}{6} = \frac{100 \times 3}{6} = 50 \text{ N}$$

**Question 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 $ms^{-2}$.**

**ANSWER- momentum = mv=?**

**Initial velocity = u = 0**

**Mass = m = 10 kg**

**Height (distance) = S = 80 cm = 0.8 m**

**Acceleration = a = 10 $m/s^2$**

**We know, $v^2 - u^2 = 2aS$**

$$v^2 - 0^2 = 2 \times 10 \times 0.8$$
$$v^2 = 16$$
$$v = 4 \text{ m/s}$$

Momentum = mv = 10 x 4 = **40 kgm/s**

**Question 18: State Newton's First law of motion (law of inertia)**

**ANSWER- Newton's First Law states that an object will remain at rest or in uniform motion in a straight line unless acted upon by an external force.**

**Question 19: State Newton's second law of motion.**

**ANSWER- The second law states that the acceleration of an object is dependent upon two variables - the net force acting upon the object and the mass of the object. (F = ma)**

**OR Time Rate of change of momentum is directly proportional to external force.**

**Question 20: State Newton's third law of motion.**

**ANSWER- For every action, there is an equal and opposite reaction.**

**Question 21: State law of conservation of momentum.**

**ANSWER- The law of conservation of momentum states that for two objects colliding in an isolated system, the total momentum before and after the collision is equal.**