Question 1:

Which of the following are matter?

Chair, air, love, smell, hate, almonds, thought, cold, cold drink, smell of perfume.

Answer:

Anything that occupies space and has mass is called matter. Matter can exist in three physical states—solid, liquid, and gaseous.

Chair and almond are forms of matter in the solid state.

Cold drink is a liquid state of matter.

Air and smell of perfume are gaseous states of matter.

Note: The sense of smell is not matter. However, the smell or odour of a substance is classified as matter. The smell of any substance (say, perfume) is the gaseous form of that substance which our olfactory system can detect (even at very low concentrations). Hence, smell of perfume is matter.

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:

Solids diffuse at a very slow rate. But, if the temperature of the solid is increased, then the rate of diffusion of the solid particles into air increases. This is due to an increase in the kinetic energy of solid particles. Hence, the smell of hot sizzling food reaches us even at a distance, but to get the smell from cold food we have to go close.

Question 3:

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

Answer:

The ability of a diver to cut through water in a swimming pool shows that matter is made up of particles.

Question 4:

What are the characteristics of particles of matter?

Answer:

The characteristics of particles of matter are**:**

(i) Particles of matter have spaces between them.

(ii) Particles of matter are continuously moving.

(iii) Particles of mater attract each other.

Exercise:

Question 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 chimney, honey, water, chalk, cotton, and iron.

Answer:

The given substances in the increasing order of their densities can be represented as:

Air < Exhaust from chimney < Cotton < Water < Honey < Chalk < Iron

Question 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.

Answer:

(a) The differences in the characteristics of states of matter are given in the following table.

S. No.	**Solid state**	**Liquid state**	**Gaseous state**
1.	Definite shape and volume.	No definite shape. Liquids attain the shape of the vessel in which they are kept.	Gases have neither a definite shape nor a definite volume.
2.	Incompressible	Compressible to a small extent.	Highly compressible
3.	There is little space between the particles	These particles have a greater space between	The space between gas particles is the

	of a solid.	them.	greatest.
4.	These particles attract each other very strongly.	The force of attraction between liquid particles is less than solid particles.	The force of attraction is least between gaseous particles.
5.	Particles of solid cannot move freely.	These particles move freely.	Gaseous particles are in a continuous, random motion.

(b) **Rigidity** can be expressed as the tendency of matter to resist a change in shape.

Compressibility is the ability to be reduced to a lower volume when force is applied.

Fluidity is the ability to flow.

By **filling a gas container** we mean the attainment of shape of the container by gas.

Shape defines a definite boundary.

Kinetic energy is the energy possessed by a particle due to its motion.

Density is mass per unit volume.

Question 3:

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) There is little attraction between particles of gas. Thus, gas particles movefreely in all directions. Therefore, gas completely fills the vessel in which it is kept.

(b) Particles of gas move randomly in all directions at high speed. As a result, theparticles hit each other and also hit the walls of the container with a force. Therefore, gas exerts pressure on the walls of the container.

(c) A wooden table has a definite shape and volume. It is very rigid and cannot be compressed i.e., it has the characteristics of a solid. Hence, a wooden table should be called a solid.

(d) Particles of air have large spaces between them. On the other hand, wood has little space between its particles. Also, it is rigid. For this reason, we can easily move our hands in air, but to do the same through a solid block of wood, we need a karate expert.

Question 4:

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

Answer:

The mass per unit volume of a substance is called density (density = mass/volume). As the volume of a substance increases, its density decreases.

Though ice is a solid, it has large number of empty spaces between its particles. These spaces are larger as compared to the spaces present between the particles of water. Thus, the volume of ice is greater than that of water. Hence, the density of ice is less than that of water. A substance with lower density than water can float on water. Therefore, ice floats on water.

Question 1:

Convert the following temperature to Celsius scale:

(a) 300 K

(b) 573 K

Answer:

(a) 300 K = (300 − 273)°C

= 27°C

(b)573 K = (573 − 273)°C

= 300°C

Question 2:

What is the physical state of water at:

(a) 250°C

(b) 100°C

Answer:

(a) Water at 250°C exists in gaseous state.

(b) At 100°C, water can exist in both liquid and gaseous form. At this temperature, after getting the heat equal to the latent heat of vaporization, water starts changing from liquid state to gaseous state.

Question 3:

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 utilised in changing the state by overcoming the forces of attraction between the particles. Therefore, this heat does not contribute in increasing the temperature of the substance.

Question 4:

Suggest a method to liquefy atmospheric gases.

Answer:

By applying pressure and reducing the temperature, atmospheric gases can be liquefied.

Question 1:

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

Answer:

When a liquid evaporates, the particles of the liquid absorb energy from the surroundings to compensate the loss of energy during evaporation. This makes the surroundings cool.

In a desert cooler, the water inside it is made to evaporate. This leads to absorption of energy from the surroundings, thereby cooling the surroundings. Again, we know that evaporation depends on the amount of water vapour present in air (humidity). If the amount of water vapour present in air is less, then evaporation is more. On a hot dry day, the amount of water vapour present in air is less. Thus, water present inside the desert cooler evaporates more, thereby cooling the surroundings more. That is why a desert cooler cools better on a hot dry day.

Question 2:

How does water kept in an earthen pot (*matka)* become cool during summers?

Answer:

There are some pores in an earthen pot through which the liquid inside the pot evaporates. This evaporation makes the water inside the pot cool. In this way, water kept in an earthen pot becomes cool during summers.

Question 3:

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

Answer:

When we put some acetone or petrol or perfume on our palm, it evaporates. During evaporation, particles of the liquid absorb energy from the surrounding or the surface of the palm to compensate for the loss of energy, making the surroundings cool. Hence, our palm feels cold when we put some acetone or petrol or perfume on it.

Question 4:

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

Answer:

A liquid has a larger surface area in a saucer than in a cup. Thus, it evaporates faster and cools faster in a saucer than in a cup. For this reason, we are able to sip hot tea or milk faster from a saucer than a cup.

Question 5:

What type of clothes should we wear in summers?

Answer:

We should wear cotton clothes in summers. During summers, we sweat more. On the other hand, cotton is a good absorber of water. Thus, it absorbs 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.

Question 1:

Convert the following temperatures to Celsius scale.

(a) 300 K

(b) 573 K

Answer:

Kelvin is an SI unit of temperature, where 0°C = 273.16 K (approximately 273 K)

(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:

Kelvin is an SI unit of temperature, where 0°C = 273.16 K (approximately 273 K)

(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 metres away.

Answer:

(a) Naphthalene undergoes sublimation easily i.e., the change of state of naphthalene from solid to gas takes place easily. Thus, naphthalene balls disappear with time without leaving any solid.

(b) Gaseous particles possess high speed and large spaces between them. Particles of perfume diffuse into these gaseous particles at a very fast rate and reach our nostrils. 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:

Sugar is a solid; the forces of attraction between the particles of sugar are strong. Water is a liquid; the forces of attraction here are weaker than sugar. Oxygen is a gas; the forces of attraction are the weakest in gases.

Thus, the increasing order of forces of attraction between the particles of water, sugar and oxygen is

Oxygen < Water < Sugar

Question 5:

What is the physical state of water at−−

(a) 25°C

(b) 0°C

(c) 100°C

Answer:

(a) Water at 25°C is present in the liquid state.

(b) At 0 °C, water can exist as both solid and liquid. At this temperature, after getting the heat equal to the latent heat of fusion, the solid form of water i.e., ice starts changing into its liquid form i.e., water.

(c) At 100 °C, water can exist as both liquid and gas. At this temperature, after getting the heat equal to the latent heat of vaporization, water starts changing from its liquid state to its gaseous state, i.e., water vapours.

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) At room temperature (25 °C), water is a liquid because it has the following characteristic of liquid:

(i) At room temperature, water has no shape but has a fixed volume that is, it occupies the shape of the container in which it is kept.

(ii) At room temperature, water flows.

(b) An iron almirah is a solid at room temperature (25 °C) because:

(i) it has a definite shape and volume like a solid at room temperature.

(ii) it is rigid as solid at room temperature.

Question 7:

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

Answer:

Ice at 273 K has less energy than water (although both are at the same temperature). Water possesses the additional latent heat of fusion. Hence, at 273 K, ice is more effective in cooling than water.

Question 8:

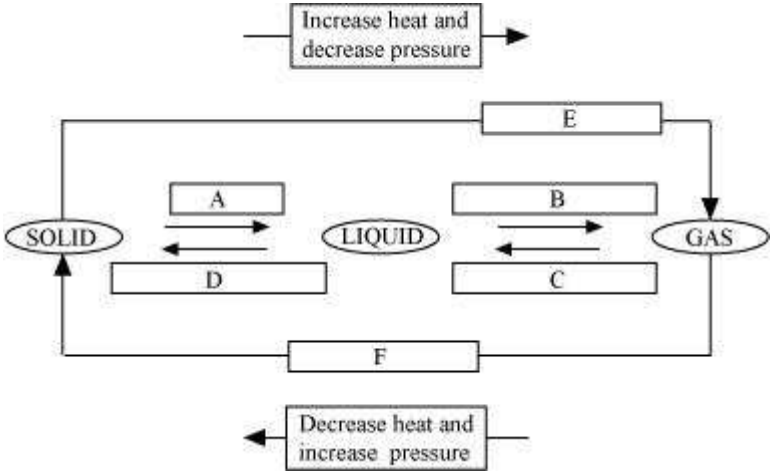
What produces more severe burns, boiling water or steam?

Answer:

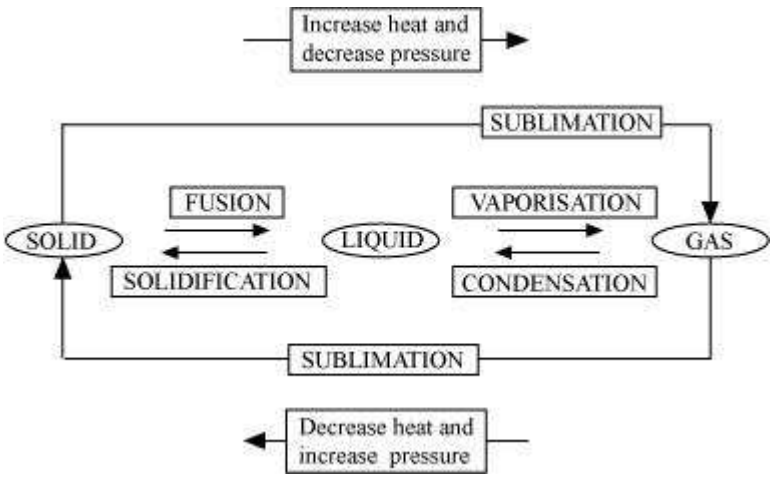
Steam has more energy than boiling water. It possesses the additional latent heat of vaporization. Therefore, burns produced by steam are more severe than those produced by boiling water.

Question 9:

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


Increase heat and decrease pressure
E
A
B
SOLID
LIQUID
GAS
D
C
F
Decrease heat and increase pressure

Answer:


Increase heat and decrease pressure
SUBLIMATION
FUSION
VAPORISATION
SOLID
LIQUID
GAS
SOLIDIFICATION
CONDENSATION
SUBLIMATION
Decrease heat and increase pressure

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Question 1:

What is meant by a pure substance?

Answer:

A pure substance is the one that consists of a single type of particles, i.e., all constituent particles of the substance have the same chemical nature. Pure substances can be classified as elements or compounds.

Question 2:

List the points of differences between homogeneous and heterogeneous mixtures.

Answer:

A homogeneous mixture is a mixture having a uniform composition throughout the mixture. For example: salt in water, sugar in water, copper sulphate in water

A heterogeneous mixture is a mixture having a non-uniform composition throughout the mixture. For example: sodium chloride and iron fillings, salt and sulphur, oil and water

Exercise

Question 1:

Differentiate between homogeneous and heterogeneous mixtures with examples.

Answer:

A homogeneous mixture is a mixture having a uniform composition throughout the mixture. For example, mixtures of salt in water, sugar in water, copper sulphate in water, iodine in alcohol, alloy, and air have uniform compositions throughout the mixtures.

On the other hand, a heterogeneous mixture is a mixture having a non-uniform composition throughout the mixture. For example, composition of mixtures of sodium chloride and iron fillings, salt and sulphur, oil and water, chalk powder in water, wheat flour in water, milk and water are not uniform throughout the mixtures.

Question 2:

How are sol, solution and suspension different from each other?

Answer:

Sol is a heterogeneous mixture. In this mixture, the solute particles are so small that they cannot be seen with the naked eye. Also, they seem to be spread uniformly throughout the mixture. The Tyndall effect is observed in this mixture. For example: milk of magnesia, mud

Solution is a homogeneous mixture. In this mixture, the solute particles dissolve and spread uniformly throughout the mixture. The Tyndall effect is not observed in this mixture. For example: salt in water, sugar in water, iodine in alcohol, alloy

Suspensions are heterogeneous mixtures. In this mixture, the solute particles are visible to the naked eye, and remain suspended throughout the bulk of the medium. The Tyndall effect is observed in this mixture. For example: chalk powder and water, wheat flour and water

Question 3:

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

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

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

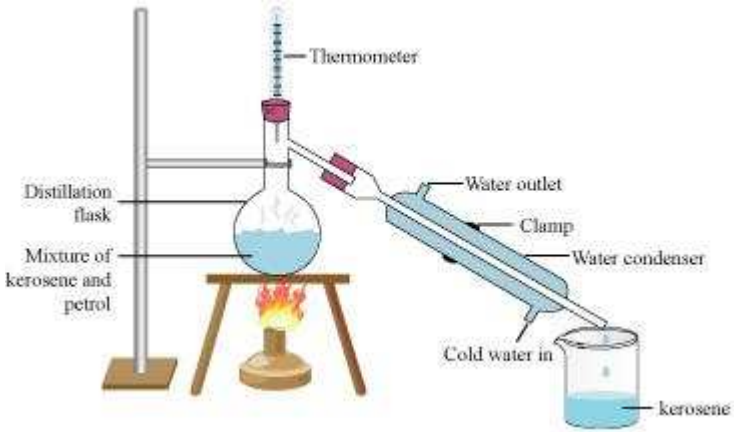
$$= 26.47\%$$

Question 1:

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 miscible liquids having a difference in their boiling points more than 25°C can be separated by the method of distillation. Thus, kerosene and petrol can be separated by distillation.



In this method, the mixture of kerosene and petrol is taken in a distillation flask with a thermometer fitted in it. We also need a beaker, a water condenser, and a Bunsen burner. The apparatus is arranged as shown in the above figure. Then, the mixture is heated slowly. The thermometer should be watched simultaneously. Kerosene will vaporize and condense in the water condenser. The condensed kerosene is collected from the condenser outlet, whereas petrol is left behind in the distillation flask.

Question 2:

Name the technique to separate

(i) butter from curd

(ii) salt from sea-water

(iii) camphor from salt

Answer:

(i) Butter can be separated from curd by centrifugation.

(ii) Salt can be separated from sea-water by evaporation.

(iii) Camphor can be separated from salt by sublimation.

Question 3:

What type of mixtures is separated by the technique of crystallization?

Answer:

By the technique of crystallization, pure solids are separated from impurities. For example, salt obtained from sea is separated from impurities; crystals of alum (*Phitkari*) are separated from impure samples.

Question 1:

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 water breaking down into hydrogen and oxygen gas
- Dissolving common salt in water
- Making a fruit salad with raw fruits
- 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 water breaking down into hydrogen and oxygen gas → 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 2:

Try segregating the things around you as pure substances or mixtures.

Answer:

Pure substance: Water, salt, sugar

Mixture: Salt water, soil, wood, air, cold drink, rubber, sponge, fog, milk, butter, clothes, food

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) Sodium chloride from its solution in water → Evaporation

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

(c) Small pieces of metal in the engine oil of a car → Centrifugation or filtration or decantation

(d) Different pigments from an extract of flower petals → Chromatography

(e) Butter from curd → Centrifugation

(f) Oil from water → Using separating funnel

(g) Tea leaves from tea → Filtration

(h) Iron pins from sand → Magnetic separation

(i) Wheat grains from husk → Winnowing

(j) Fine mud particles suspended in water → 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:

First, water is taken as a **solvent** in a saucer pan. This water (solvent) is allowed to boil. During heating, milk and tea leaves are added to the solvent as **solutes**. They form a solution. Then, the solution is poured through a strainer. The insoluble part of the solution remains on the strainer as **residue**. Sugar is added tothe **filtrate,** which dissolves in the filtrate. The resulting **solution** is the required tea.

Question 4:

Explain the following giving examples:

(a) Saturated solution

(b) Pure substance

(c) Colloid

(d) Suspension

Answer:

(a) **Saturated solution**

A saturated solution is a solution in which the maximum amount of solute has been dissolved at a given temperature. The solution cannot dissolve beyond that amount of solute at that temperature. Any more solute added will settle down at the bottom of the container as a precipitate.

Suppose 500 g of a solvent can dissolve a maximum of 150 g of a particular solute at 40°C. Then, the solution obtained by dissolving 150 g of that solute in 500 g of that solvent at 300 K is said to be a saturated solution at 300 K.

(b) **Pure substance**

A pure substance is a substance consisting of a single type of particles i.e., all constituent particles of the substance have the same chemical properties.

For example, salt, sugar, water are pure substances.

(c) **Colloid**

A colloid is a heterogeneous mixture. The size of the solutes in this mixture is so small that they cannot be seen individually with naked eyes, and seems to be distributed uniformly throughout the mixture. The solute particles do not settle down

when the mixture is left undisturbed. This means that colloids are quite stable. Colloids cannot be separated by the process of filtration. They can be separated by centrifugation. Colloids show the Tyndall effect. For example, milk, butter, foam, fog, smoke, clouds.

(d) **Suspension**

Suspensions are heterogeneous mixtures. The solute particles in this mixture remain suspended throughout the bulk of the medium. The particles can be seen with naked eyes. Suspension shows the Tyndall effect. The solute particles settle down when the mixture is left undisturbed. This means that suspensions are unstable. Suspensions can be separated by the method of filtration. For example, mixtures of chalk powder and water, wheat 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 mixtures: Soda water, air, vinegar

Heterogeneous mixtures: Wood, soil, filtered tea

Question 6:

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

Answer:

Every liquid has a characteristic boiling point. Pure water has a boiling point of 100°C (373 K) at 1 atmospheric pressure. If the given colourless liquid boils at even slightly above or below 100°C, then the given liquid is not pure water. It must boil at sharp 100°C. Thus, by observing the boiling point, we can confirm whether a given colourless liquid is pure water or not.

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:

The following materials fall in the category of a "pure substance":

(a) Ice

(c) Iron

(d) Hydrochloric acid

(e) Calcium oxide

(f) Mercury

Question 8:

Identify the solutions among the following mixtures:

(a) Soil

(b) Sea water

(c) Air

(d) Coal

(e) Soda water

Answer:

The following mixtures are solutions:

(b) Sea water

(c) Air

(e) Soda water

Question 9:

Which of the following will show the "Tyndall effect"?

(a) Salt solution

(b) Milk

(c) Copper sulphate solution

(d) Starch solution

Answer:

Milk and starch solution will show the "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

(a) Sodium
(d) Silver
(f) Tin
(g) Silicon

Compounds

(e) Calcium carbonate
(k) Methane
(l) Carbon dioxide

Mixtures

(b) Soil
(c) Sugar solution
(h) Coal
(i) Air
(j) Soap
(m) Blood

Question 11:

Which of the following are chemical changes?

(a) Growth of a plant

(b) Rusting of iron

(c) Mixing of iron fillings and sand

(d) Cooking of food

(e) Digestion of food

(f) Freezing of water

(g) Burning of candle

Answer:

The following changes are chemical changes:

(a) Growth of a plant

(b) Rusting of iron

(d) Cooking of food

(e) Digestion of food

(g) Burning of candle

Question 1:

In a reaction, 5.3 g of sodium carbonate reacted with 6 g of ethanoic acid. The products were 2.2 g of carbon dioxide, 0.9 g water and 8.2 g of sodium ethanoate. Show that these observations are in agreement with the law of conservation of mass.

Sodium carbonate + ethanoic acid → sodium ethanoate + carbon dioxide + water

Answer:

In the given reaction, sodium carbonate reacts with ethanoic acid to produce sodium ethanoate, carbon dioxide, and water.

Sodium carbonate	+	Ethanoic acid	⟶	Sodium ethanoate	+	Carbon dioxide	+	Water

Mass of sodium carbonate = 5.3 g (Given)

Mass of ethanoic acid = 6 g (Given)

Mass of sodium ethanoate = 8.2 g (Given)

Mass of carbon dioxide = 2.2 g (Given)

Mass of water = 0.9 g (Given)

Now, total mass before the reaction = (5.3 + 6) g

= 11.3 g

And, total mass after the reaction = (8.2 + 2.2 + 0.9) g

= 11.3 g

∴Total mass before the reaction = Total mass after the reaction

Hence, the given observations are in agreement with the law of conservation of mass.

Question 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 3 g of hydrogen gas?

Answer:

It is given that the ratio of hydrogen and oxygen by mass to form water is 1:8.

Then, the mass of oxygen gas required to react completely with 1 g of hydrogen gas is 8 g.

Therefore, the mass of oxygen gas required to react completely with 3 g of hydrogen gas is 8 × 3 g = 24 g.

Question 3:

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

Answer:

The postulate of Dalton's atomic theory which is a result of the law of conservation of mass is:

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

Question 4:

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

Answer:

The postulate of Dalton's atomic theory which can explain the law of definite proportion is:

The relative number and kind of atoms in a given compound remains constant.

Question 1:

Define atomic mass unit.

Answer:

Mass unit equal to exactly one-twelfth $\left(\frac{1}{12^{th}}\right)$ the mass of one atom of carbon-12 is called one atomic mass unit. It is written as 'u'.

Question 2:

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

Answer:

Thesize of an atom is so small that it is not possible to see it with naked eyes. Also, the atom of an element does not exist independently.

Question 1:

Write down the formulae of

(i) sodium oxide

(ii) aluminium chloride

(iii) sodium suphide

(iv) magnesium hydroxide

Answer:

(i) Sodium oxide $\rightarrow Na_2O$

(ii) Aluminium chloride $\rightarrow AlCl_3$

(iii) Sodium suphide $\rightarrow Na_2S$

(iv) Magnesium hydroxide $\rightarrow Mg(OH)_2$

Question 2:

Write down the names of compounds represented by the following formulae:

(i) $Al_2(SO_4)_3$

(ii) $CaCl_2$

(iii) K_2SO_4

(iv) KNO_3

(v) $CaCO_3$

Answer:

(i) $Al_2(SO_4)_3 \rightarrow$ Aluminium sulphate

(ii) $CaCl_2 \rightarrow$ Calcium chloride

(iii) $K_2SO_4 \rightarrow$ Potassium sulphate

(iv) $KNO_3 \rightarrow$ Potassium nitrate

(v) $CaCO_3 \rightarrow$ Calcium carbonate

Question 3:

What is meant by the term chemical formula?

Answer:

The chemical formula of a compound means the symbolic representation of the composition of a compound. From the chemical formula of a compound, we can know the number and kinds of atoms of different elements that constitute the compound.

For example, from the chemical formula CO_2 of carbon dioxide, we come to know that one carbon atom and two oxygen atoms are chemically bonded together to form one molecule of the compound, carbon dioxide.

Question 4:

How many atoms are present in a

(i) H_2S molecule and

(ii) PO_4^{3-} ion?

Answer:

(i) In an H_2S molecule, three atoms are present; two of hydrogen and one of sulphur.

(ii) In a PO_4^{3-} ion, five atoms are present; one of phosphorus and four of oxygen.

Question 1:

Calculate the molecular masses of H_2, O_2, Cl_2, CO_2, CH_4, C_2H_6, C_2H_4, NH_3, CH_3OH.

Answer:

Molecular mass of H_2 = 2 × Atomic mass of H

= 2 × 1

= 2 u

Molecular mass of O_2 = 2 × Atomic mass of O

= 2 × 16

= 32 u

Molecular mass of Cl_2 = 2 × Atomic mass of Cl

= 2 × 35.5

= 71 u

Molecular mass of CO_2 = Atomic mass of C + 2 × Atomic mass of O

= 12 + 2 × 16

= 44 u

Molecular mass of CH_4 = Atomic mass of C + 4 × Atomic mass of H

= 12 + 4 × 1

= 16 u

Molecular mass of C_2H_6 = 2 × Atomic mass of C + 6 × Atomic mass of H

= 2 × 12 + 6 × 1

= 30 u

Molecular mass of C_2H_4 = 2 × Atomic mass of C + 4 × Atomic mass of H

= 2 × 12 + 4 × 1

= 28 u

Molecular mass of NH_3 = Atomic mass of N + 3 × Atomic mass of H

= 14 + 3 × 1

= 17 u

Molecular mass of CH_3OH = Atomic mass of C + 4 × Atomic mass of H + Atomic mass of O

= 12 + 4 × 1 + 16

= 32 u

Question 2:

Calculate the formula unit masses of ZnO, Na_2O, K_2CO_3, given atomic masses of Zn = 65 u, Na = 23 u, K = 39 u, C = 12 u, and O = 16 u.

Answer:

Formula unit mass of ZnO = Atomic mass of Zn + Atomic mass of O

= 65 + 16

= 81 u

Formula unit mass of Na_2O = 2 × Atomic mass of Na + Atomic mass of O

= 2 × 23 + 16

= 62 u

Formula unit mass of K_2CO_3 = 2 × Atomic mass of K + Atomic mass of C + 3 × Atomic mass of O

= 2 × 39 + 12 + 3 × 16

= 138 u

Question 1:

If one mole of carbon atoms weighs 12 gram, what is the mass (in gram) of 1 atom of carbon?

Answer:

One mole of carbon atoms weighs 12 g (Given)

i.e., mass of 1 mole of carbon atoms = 12 g

Then, mass of 6.022×10^{23} number of carbon atoms = 12 g

Therefore, mass of 1 atom of carbon $=\frac{12}{6.022\times10^{23}}\ \text{g}$

$=1.9926\times10^{-23}\,\text{g}$

Question 2:

Which has more number of atoms, 100 grams of sodium or 100 grams of iron (given, atomic mass of Na = 23 u, Fe = 56 u)?

Answer:

Atomic mass of Na = 23 u (Given)

Then, gram atomic mass of Na = 23 g

Now, 23 g of Na contains = 6.022×10^{23} number of atoms

Thus, 100 g of Na contains $=\frac{6.022\times10^{23}}{23}\times100$ number of atoms

= 2.6182×10^{24} number of atoms

Again, atomic mass of Fe = 56 u(Given)

Then, gram atomic mass of Fe = 56 g

Now, 56 g of Fe contains = 6.022×10^{23} number of atoms

Thus, 100 g of Fe contains $=\frac{6.022\times10^{23}}{56}\times100$ number of atoms

$=1.0753\times10^{24}$ number of atoms

Therefore, 100 grams of sodium contain more number of atoms than 100 grams of iron.

Question 1:

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

Answer:

Mass of boron = 0.096 g (Given)

Mass of oxygen = 0.144 g (Given)

Mass of sample = 0.24 g (Given)

Thus, percentage of boron by weight in the compound = $\frac{0.096}{0.24} \times 100\%$

= 40%

And, percentage of oxygen by weight in the compound = $\frac{0.144}{0.24} \times 100\%$

= 60%

Question 2:

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

Answer:

Carbon + Oxygen $\longrightarrow$ Carbon dioxide

3 g of carbon reacts with 8 g of oxygen to produce 11 g of carbon dioxide.

If 3 g of carbon is burnt in 50 g of oxygen, then 3 g of carbon will react with 8 g of oxygen. The remaining 42 g of oxygen will be left un-reactive.

In this case also, only 11 g of carbon dioxide will be formed.

The above answer is governed by the law of constant proportions.

Question 3:

What are polyatomic ions? Give examples?

Answer:

A polyatomic ion is a group of atoms carrying a charge (positive or negative). For example, ammonium ion $\left(NH_4^+\right)$, hydroxide ion (OH^-), carbonate ion $\left(CO_3^{2-}\right)$, sulphate ion $\left(SO_4^{2-}\right)$.

Question 4:

Write the chemical formulae of the following:

(a) Magnesium chloride

(b) Calcium oxide

(c) Copper nitrate

(d) Aluminium chloride

(e) Calcium carbonate

Answer:

(a) Magnesium chloride → $MgCl_2$

(b) Calcium oxide → CaO

(c) Copper nitrate → $Cu(NO_3)_2$

(d) Aluminium chloride → $AlCl_3$

(e) Calcium carbonate → $CaCO_3$

Question 5:

Give the names of the elements present in the following compounds:

(a) Quick lime

(b) Hydrogen bromide

(c) Baking powder

(d) Potassium sulphate

Answer:

Compound	Chemical formula	Elements present
Quick lime	CaO	Calcium, oxygen
Hydrogen bromide	HBr	Hydrogen, bromine
Baking powder	$NaHCO_3$	Sodium, hydrogen, carbon, oxygen
Potassium sulphate	K_2SO_4	Potassium, sulphur, oxygen

Question 6:

Calculate the molar mass of the following substances:

(a) Ethyne, C_2H_2

(b) Sulphur molecule, S_8

(c) Phosphorus molecule, P_4 (atomic mass of phosphorus = 31)

(d) Hydrochloric acid, HCl

(e) Nitric acid, HNO_3

Answer:

(a) Molar mass of ethyne, $C_2H_2 = 2 \times 12 + 2 \times 1 = 28$ g

(b) Molar mass of sulphur molecule, $S_8 = 8 \times 32 = 256$ g

(c) Molar mass of phosphorus molecule, $P_4 = 4 \times 31 = 124$ g

(d) Molar mass of hydrochloric acid, $HCl = 1 + 35.5 = 36.5$ g

(e) Molar mass of nitric acid, $HNO_3 = 1 + 14 + 3 \times 16 = 63$ g

Question 7:

What is the mass of−−

(a) 1 mole of nitrogen atoms?

(b) 4 moles of aluminium atoms (Atomic mass of aluminium = 27)?

(c) 10 moles of sodium sulphite (Na_2SO_3)?

Answer:

(a) The mass of 1 mole of nitrogen atoms is 14 g.

(b) The mass of 4 moles of aluminium atoms is (4 × 27) g = 108 g

(c) The mass of 10 moles of sodium sulphite (Na_2SO_3) is

10 × [2 × 23 + 32 + 3 × 16] g = 10 × 126 g = 1260 g

Question 8:

Convert into mole.

(a) 12 g of oxygen gas

(b) 20 g of water

(c) 22 g of carbon dioxide

Answer:

(a) 32 g of oxygen gas = 1 mole

Then, 12 g of oxygen gas = $\frac{12}{32}\text{mole}$ = 0.375 mole

(b) 18 g of water = 1 mole

Then, 20 g of water = $\frac{20}{18}\text{mole}$ = 1.11 moles (approx)

(c) 44 g of carbon dioxide = 1 mole

Then, 22 g of carbon dioxide = $\frac{22}{44}\text{mole}$ = 0.5 mole

Question 9:

What is the mass of:

(a) 0.2 mole of oxygen atoms?

(b) 0.5 mole of water molecules?

Answer:

(a) Mass of one mole of oxygen atoms = 16 g

Then, mass of 0.2 mole of oxygen atoms = 0.2 × 16g = 3.2 g

(b) Mass of one mole of water molecule = 18 g

Then, mass of 0.5 mole of water molecules = 0.5 × 18 g = 9 g

Question 10:

Calculate the number of molecules of sulphur (S_8) present in 16 g of solid sulphur.

Answer:

1 mole of solid sulphur (S_8) = 8 × 32 g = 256 g

i.e., 256 g of solid sulphur contains = 6.022×10^{23} molecules

Then, 16 g of solid sulphur contains = $\frac{6.022 \times 10^{23}}{256} \times 16$ molecules

= 3.76×10^{22} molecules (approx)

Question 11:

Calculate the number of aluminium ions present in 0.051 g of aluminium oxide.

(*Hint*: The mass of an ion is the same as that of an atom of the same element. Atomic mass of Al = 27 u)

Answer:

1 mole of aluminium oxide (Al_2O_3) = 2 × 27 + 3 × 16

= 102 g

i.e., 102 g of Al_2O_3 = 6.022×10^{23} molecules of Al_2O_3

Then, 0.051 g of Al_2O_3 contains = $\frac{6.022 \times 10^{23}}{102} \times 0.051$ molecules

= 3.011×10^{20} molecules of Al_2O_3

The number of aluminium ions (Al^{3+}) present in one molecule of aluminium oxide is 2.

Therefore, the number of aluminium ions (Al^{3+}) present in 3.011×10^{20} molecules (0.051 g) of aluminium oxide (Al_2O_3) = $2 \times 3.011 \times 10^{20}$

= 6.022×10^{20}

Question 1:

What are canal rays?

Answer:

Canal rays are positively charged radiations. These rays consist of positively charged particles known as protons. They were discovered by Goldstein in 1886.

Question 2:

If an atom contains one electron and one proton, will it carry any charge or not?

Answer:

An electron is a negatively charged particle, whereas a proton is a positively charged particle. The magnitude of their charges is equal. Therefore, an atom containing one electron and one proton will not carry any charge. Thus, it will be a neutral atom.

Question 1:

On the basis of Thomson's model of an atom, explain how the atom is neutral as a whole.

Answer:

According to Thomson's model of the atom, an atom consists of both negatively and positively charged particles. The negatively charged particles are embedded in the positively charged sphere. These negative and positive charges are equal in magnitude. Thus, by counterbalancing each other's effect, they make an atom neutral.

Question 2:

On the basis of Rutherford's model of an atom, which subatomic particle is present in the nucleus of an atom?

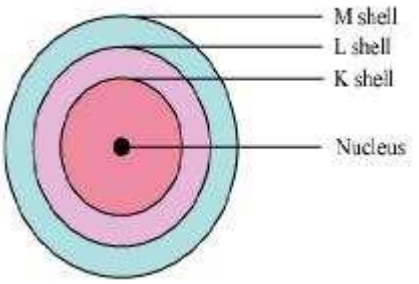
Answer:

On the basis of Rutherford's model of an atom, protons (positively-charged particles) are present in the nucleus of an atom.

Question 3:

Draw a sketch of Bohr's model of an atom with three shells.

Answer:



Bohr's model of an atom with three shells

Question 4:

What do you think would be the observation if the α-particle scattering experiment is carried out using a foil of a metal other than gold?

Answer:

If the α-scattering experiment is carried out using a foil of a metal rather than gold, there would be no change in the observation. In the α-scattering experiment, a gold foil was taken because gold is malleable and a thin foil of gold can be easily made. It is difficult to make such foils from other metals.

Question 1:

Name the three sub-atomic particles of an atom.

Answer:

The three sub-atomic particles of an atom are:

(i) Protons

(ii) Electrons, and

(iii) Neutrons

Question 2:

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

Answer:

Helium atom has two neutrons. The mass of an atom is the sum of the masses of protons and neutrons present in its nucleus. Since helium atom has two protons, mass contributed by the two protons is (2 × 1) u = 2 u. Then, the remaining mass (4 − 2) u = 2 u is contributed by $\frac{2\ \text{u}}{1\ \text{u}} = 2$ neutrons.

Question 1:

Write the distribution of electrons in carbon and sodium atoms?

Answer:

Thetotal number of electrons in a carbon atom is 6. The distribution of electrons in carbon atom is given by:

First orbit or K-shell = 2 electrons

Second orbit or L-shell = 4 electrons

Or, we can write the distribution of electrons in a carbon atom as 2, 4.

The total number of electrons in a sodium atom is 11. The distribution of electrons in sodium atom is given by:

First orbit or K-shell = 2 electrons

Second orbit or L-shell = 8 electrons

Third orbit or M-shell = 1 electron

Or, we can write distribution of electrons in a sodium atom as 2, 8, 1.

Question 2:

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

Answer:

The maximum number of electrons that can occupy K and L-shells of an atom are 2 and 8 respectively. Therefore, if K and L-shells of an atom are full, then the total number of electrons in the atom would be (2 + 8) = 10 electrons.

Question 1:

How will you find the valency of chlorine, sulphur and magnesium?

Answer:

If the number of electrons in the outermost shell of the atom of an element is less than or equal to 4, then the valency of the element is equal to the number of electrons in the outermost shell. On the other hand, if the number of electrons in the outermost shell of the atom of an element is greater than 4, then the valency of that element is determined by subtracting the number of electrons in the outermost shell from 8.

The distribution of electrons in chlorine, sulphur, and magnesium atoms are 2, 8, 7; 2, 8, 6 and 2, 8, 2 respectively.

Therefore, the number of electrons in the outer most shell of chlorine, sulphur, and magnesium atoms are 7, 6, and 2 respectively.

Thus, the valency of chlorine = 8 −7 = 1

The valency of sulphur = 8 − 6 = 2

The valency of magnesium = 2

Question 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 and (ii) what is the charge on the atom?

Answer:

(i) The atomic number is equal to the number of protons. Therefore, the atomic number of the atom is 8.

(ii) Since the number of both electrons and protons is equal, therefore, the charge on the atom is 0.

Question 2:

With the help of Table 4.1, find out the mass number of oxygen and sulphur atom.

Answer:

Mass number of oxygen = Number of protons + Number of neutrons

= 8 + 8

= 16

Mass number of sulphur = Number of protons + Number of neutrons

= 16 +16

= 32

Question 1:

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

Answer:

Symbol	**Proton**	**Neutron**	**Electron**
H	1	0	1
D	1	1	1

T	1	2	1

Question 2:

Write the electronic configuration of any one pair of isotopes and isobars.

Answer:

Two isotopes of carbon are $^{12}_{6}C$ and $^{14}_{6}C$.

The electronic configuration of $^{12}_{6}C$ is 2, 4.

The electronic configuration of $^{14}_{6}C$ is 2, 4.

[Isotopes have the same electronic configuration]

$^{40}_{20}Ca$ and $^{40}_{18}Ar$ are a pair of isobars

The electronic configuration of $^{40}_{20}Ca$ is 2, 8, 8, 2.

The electronic configuration of $^{40}_{18}Ar$ is 2, 8, 8.

Question 1:

Compare the properties of electrons, protons and neutrons.

Answer:

Electron		**Proton**		**Neutron**	
(i)	Electrons are present outside the nucleus of an atom.	(i)	Protons are present in the nucleus of an atom.	(i)	Neutrons are present in the nucleus of an atom.
(ii)	Electrons are negatively charged.	(ii)	Protons are positively charged.	(ii)	Neutrons are neutral.
(iii)	The mass of an electron is considered to negligible.	(iii)	The mass of a proton is approximately 2000 times as the mass of an electron.	(iii)	The mass of neutron is nearly equal to the mass of a proton.

Question 2:

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

Answer:

According to J.J. Thomson's model of an atom, an atom consists of a positively charged sphere with electrons embedded in it. However, it was later found that the positively charged particles reside at the centre of the atom called the nucleus, and the electrons revolve around the nucleus.

Question 3:

What are the limitations of Rutherford's model of the atom?

Answer:

According to Rutherford's model of an atom, electrons revolve around the nucleus in fixed orbits. But, an electron revolving in circular orbits will not be stable because during revolution, it will experience acceleration. Due to acceleration, the electrons will lose energy in the form of radiation and fall into the nucleus. In such a case, the atom would be highly unstable and collapse.

Question 4:

Describe Bohr's model of the atom.

Answer:

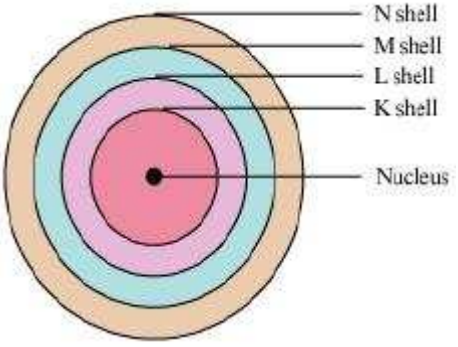
Bohr's model of the atom

Niels Bohr proposed the following postulates regarding the model of the atom.

(i) Only certain orbits known as discrete orbits of electrons are allowed inside the atom.

(ii) While revolving in these discrete orbits, the electrons do not radiate energy.

These discrete orbits or shells are shown in the following diagram.



The first orbit (i.e., for $n = 1$) is represented by letter K. Similarly, for $n = 2$, it is L − shell, for $n = 3$, it is M − shell and for $n = 4$, it is N − shell. These orbits or shells are also called energy levels.

Question 5:

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

Answer:

Thomson's model	**Rutherford's model**	**Bohr's model**
An atom consists of a positively charged sphere with electrons embedded in it.	An atom consists of a positively charged particles concentrated at the centre known as the nucleus. The size of the nucleus is very small as compared to the size of the atom. The electrons revolve around the nucleus in well-defined orbits.	There are only certain orbits known as discrete orbi inside the atom in wh n electrons revolve around the nucleus. Electrons do not radiate energy while revolving.

Question 6:

Summarize the rules for writing of distribution of electrons in various shells for the first eighteen elements.

Answer:

The rules for writing of the distribution of electrons in various shells for the first eighteen elements are given below.

(i) The maximum number of electrons that a shell can accommodate is given by the formula '$2n^2$', where 'n' is the orbit number or energy level index (n = 1, 2, 3…).

The maximum number of electrons present in an orbit of n = 1 is given by $2n^2 = 2\times1^2 = 2$

Similarly, for second orbit, it is $2n^2 = 2\times2^2 = 8$

For third orbit, it is $2n^2 = 2\times3^2 = 18$

And so on……

(ii) The outermost orbit can be accommodated by a maximum number of 8 electrons.

(iii) Shells are filled with electrons in a stepwise manner i.e., the outer shell is not occupied with electrons unless the inner shells are completely filled with electrons.

Question 7:

Define valency by taking examples of silicon and oxygen.

Answer:

The valency of an element is the combining capacity of that element. The valency of an element is determined by the number of valence electrons present in the atom of that element.

If the number of valence electrons of the atom of an element is less than or equal to four, then the valency of that element is equal to the number of valence electrons. For example, the atom of silicon has four valence electrons. Thus, the valency of silicon is four.

On the other hand, if the number of valence electrons of the atom of an element is greater than four, then the valency of that element is obtained by subtracting the number of valence electrons from eight. For example, the atom of oxygen has six valence electrons. Thus, the valency of oxygen is (8 − 6) i.e., two.

Question 8:

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

Answer:

(i) Atomic number

The atomic number of an element is the total number of protons present in the atom of that element. For example, nitrogen has 7 protons in its atom. Thus, the atomic number of nitrogen is 7.

(ii) Mass number

The mass number of an element is the sum of the number of protons and neutrons present in the atom of that element. For example, the atom of boron has 5 protons and 6 neutrons. So, the mass number of boron is 5 + 6 = 11.

(iii) Isotopes

Isotopes are atoms of the same element having the same atomic number, but different mass numbers. For example, hydrogen has three isotopes. They are protium $\left({}_{1}^{1}\mathrm{H}\right)$, deuterium, $\left({}_{1}^{2}\mathrm{H}\right)$ and tritium $\left({}_{1}^{3}\mathrm{H}\right)$.

(iv) Isobars

Isobars are atoms having the same mass number, but different atomic numbers i.e., isobars are atoms of different elements having the same mass number. For example, ${}_{20}^{40}\mathrm{Ca}$ and ${}_{18}^{40}\mathrm{Ar}$ are isobars.

Two uses of isotopes are:

(i) One isotope of uranium is used as a fuel in nuclear reactors.

(ii) One isotope of cobalt is used in the treatment of cancer.

Question 9:

Na^+ has completely filled K and L shells. Explain.

Answer:

An atom of Na has a total of 11 electrons. Its electronic configuration is 2, 8, 1. But, Na^+ ion has one electron less than Na atom i.e., it has 10 electrons. Therefore, 2 electrons go to K-shell and 8 electrons go to L-shell, thereby completely filling K and L shells.

Question 10:

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

Answer:

It is given that two isotopes of bromine are ${}_{35}^{79}\mathrm{Br}$ (49.7%) and ${}_{35}^{81}\mathrm{Br}$ (50.3%). Then, the average atomic mass of bromine atom is given by:

$$79\times\frac{49.7}{100}+81\times\frac{50.3}{100}$$
$$=\frac{3926.3}{100}+\frac{4074.3}{100}$$
$$=\frac{8000.6}{100}$$
$$=80.006\text{ u}$$
$$=80\text{ u (approx)}$$

Question 11:

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

Answer:

It is given that the average atomic mass of the sample of element X is 16.2 u.

Let the percentage of isotope ${}^{18}_{8}\mathrm{X}$ be *y*%. Thus, the percentage of isotope ${}^{16}_{8}\mathrm{X}$ will be (100 − *y*) %.

Therefore,

$$18\times\frac{y}{100}+16\times\frac{(100-y)}{100}=16.2$$
$$\Rightarrow\frac{18y}{100}+\frac{16(100-y)}{100}=16.2$$
$$\Rightarrow\frac{18y+1600-16y}{100}=16.2$$
$$\Rightarrow 18y+1600-16y=1620$$
$$\Rightarrow 2y+1600=1620$$
$$\Rightarrow 2y=1620-1600$$
$$\Rightarrow 2y=20$$
$$\Rightarrow y=10$$

Therefore, the percentage of isotope ${}^{18}_{8}\mathrm{X}$ is 10%.

And, the percentage of isotope ${}^{16}_{8}X$ is (100 − 10) % = 90%.

Question 12:

If Z = 3, what would be the valency of the element? Also, name the element.

Answer:

By Z = 3, we mean that the atomic number of the element is 3. Its electronic configuration is 2, 1. Hence, the valency of the element is 1 (since the outermost shell has only one electron).

Therefore, the element with Z = 3 is lithium.

Question 13:

Composition of the nuclei of two atomic species X and Y are given as under

X Y

Protons = 6 6

Neutrons = 6 8

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

Answer:

Mass number of X = Number of protons + Number of neutrons

= 6 + 6

= 12

Mass number of Y = Number of protons + Number of neutrons

= 6 + 8

= 14

These two atomic species X and Y have the same atomic number, but different mass numbers. Hence, they are isotopes.

Question 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 nucleons.

(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.

Answer:

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

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

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

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

Question 15:

Put tick (✓) against correct choice and cross (✗) against wrong choice in the following question:

Rutherford's alpha-particle scattering experiment was responsible for the discovery of

(a) Atomic nucleus

(b) Electron

(c) Proton

(d) Neutron

Answer:

Rutherford's alpha-particle scattering experiment was responsible for the discovery of

(a) Atomic nucleus ✓ (b) Electron ✗

(c) Proton ✗ (d) Neutron ✗

Question 16:

Put tick (✓) against correct choice and cross (✗) against wrong choice in the following question:

Isotopes of an element have

(a) the same physical properties

(b) different chemical properties

(c) different number of neutrons

(d) different atomic numbers

Answer:

Isotopes of an element have

(a) the same physical properties ✗

(b) different chemical properties ✗

(c) different number of neutrons ✓

(d) different atomic numbers ✗

Question 17:

Put tick (✓) against correct choice and cross (✗) against wrong choice in the following question:

Number of valence electrons in Cl^- ion are:

(a) 16

(b) 8

(c) 17

(d) 18

Answer:

Number of valence electrons in Cl^- ion are:

(a) 16 ✗ (b) 8 ✓ (c) 17 ✗ (d) 18 ✗

Question 18:

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

(a) 2, 8

(b) 8, 2, 1

(c) 2, 1, 8

(d) 2, 8, 1

Answer:

(d) The correct electronic configuration of sodium is 2, 8, 1.

Question 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	1	–

Answer:

Atomic number	**Mass number**	**Number of Neutrons**	**Number of protons**	**Number of electrons**	**Name of the Atomic species**
9	**19**	10	**9**	**9**	**Fluorine**
16	32	**16**	**16**	**16**	Sulphur

12	24	**12**	12	**12**	**Magnesium**
1	2	**1**	1	**1**	**Deuterium**
1	1	0	1	1	**Protium**

Question 1:

Who discovered cells and how?

Answer:

Cells were discovered in 1665 by an English Botanist, Robert Hooke. He used a primitive microscope to observe cells in a cork slice.

Question 2:

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

Answer:

Cells constitute various components of plants and animals. A cell is the smallest unit of life and is capable of all living functions. Cells are the building blocks of life. This is the reason why cells are referred to as the basic structural and functional units of life. All cells vary in their shape, size, and activity they perform. In fact, the shape and size of the cell is related to the specific functions they perform.

Question 1:

How do substances like CO_2 and water move in and out of the cell? Discuss.

Answer:

Thecell membrane is selectively permeable and regulates themovement of substances in and out of the cell.

Movement of CO_2:

CO_2 is produced during cellular respiration. Therefore, it is present in high concentrations inside the cell. This CO_2 must be excreted out of the cell. In the cell's external environment, the concentration of CO_2 is low as compared to that inside the cell. Therefore, according to the principle of diffusion, CO_2 moves from a region of higher concentration (inside the cell) towards a region of lower concentration (outside the cell). Similarly, O_2 enters the cell by the process of diffusion when the concentration of O_2 inside the cell is low as compared to its surroundings.

Movement of water:

Water moves from a region of high concentration to a region of low concentration through the plasma membrane. The plasma membrane acts as a semi-permeable membrane, and this movement of water is known as osmosis. However, the movement of water across the plasma membrane of the cell is affected by the amount of substance dissolved in water.

Question 2:

Why is the plasma membrane called a selectively permeable membrane?

Answer:

Thecell membraneor the plasma membraneis known as a selectively permeable membrane because it regulates the movement of substances in and out of the cell. This means that the plasma membrane allows the entry of only some substances and prevents the movement of some other materials.

Question 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 µm) 1 µm== 10^{-6} m	1.	Size: generally large (5-100 µm)
2.	Nuclear region: _____ and is known as _____.	2.	Nuclear region: well-defined and surrounded by a nuclear membrane
3.	Chromosome: single	3.	More than one chromosome
4.	Membrane-bound cell organelles are absent	4.	_____

Answer:

	Prokaryotic cell		**Eukaryotic cell**
1.	Size: generally small (1-10 µm) 1 µm== 10^{-6} m	1.	Size: generally large (5-100 µm)
2.	Nuclear region: poorly defined because of the absence of a nuclear membrane, and is known as nucleoid	2.	Nuclear region: well-defined and surrounded by a nuclear membrane
3.	Chromosome: single	3.	More than one chromosome
4.	Membrane-bound cell organelles are absent	4.	Membrane-bound cell organelles such as mitochondria, plastids, etc., are present

Question 1:

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

Answer:

Mitochondriaandplastids are the two organelles that contain their own genetic material. Both these organelles have their own DNA and ribosomes.

Question 2:

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

Answer:

Cell is the smallest unit of life, which is capable of all living functions. If the organisation of a cell is destroyed due to some physical or chemical influence, then the ability of the cell to perform all living functions such as respiration, nutrition, excretion, etc. would be affected.

Question 3:

Why are lysosomes known as suicide bags?

Answer:

Lysosomes are membrane-bound vesicular structures that contain powerful digestive enzymes. These enzymes are capable of breaking down any foreign food particle or microbes entering the cell. Sometimes, lysosomes can cause self-destruction of a cell by releasing these digestive enzymes within the cells. Hence, they are also known as 'suicidal bags'.

Question 4:

Where are proteins synthesized inside the cell?

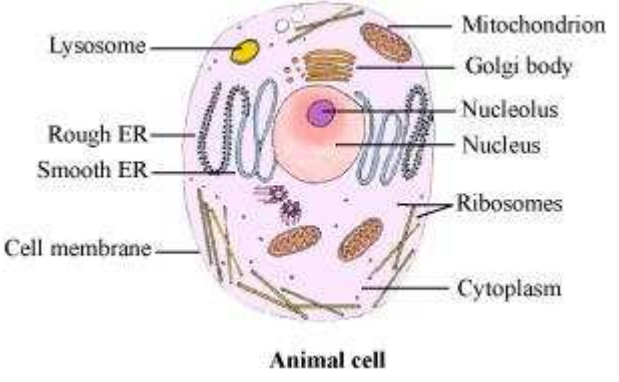
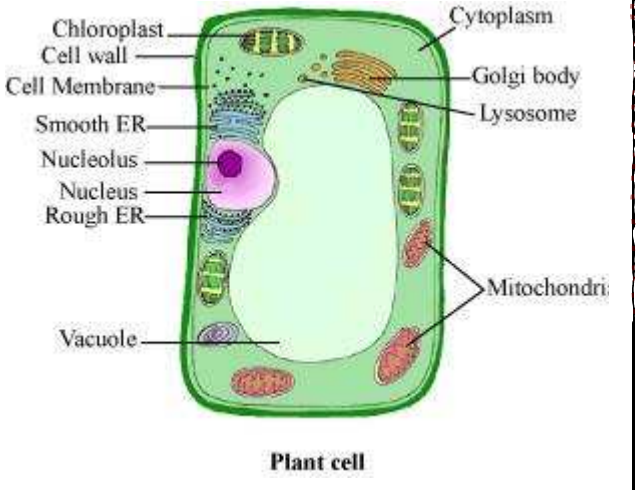
Answer:

Ribosomesare the site for protein synthesis. Ribosomes are very small structures found either in a free state, suspended in the cytoplasm, or attached to the surface of the endoplasmic reticulum. They are composed of ribonucleic acids and proteins.

Question 1:

Make a comparison and write down ways in which plant cells are different from animal cells.

Answer:

Animal cell	**Plant cell**
Animal cells are generally small in size.	Plants cells are usually larger than animal cells.
Cell wall is absent.	Cell wall is present.
Except the protozoan *Euglena*, no animal cell possesses plastids.	Plastids (chromoplasts and leucoplasts) are present.
Vacuoles are smaller in size.	Vacuoles are larger in size.
 Animal cell	 Plant cell

Question 2:

How is a prokaryotic cell different from a eukaryotic cell?

Answer:

Prokaryotic cell	Eukaryotic cell
Most prokaryotic cells are unicellular.	Most eukaryotic cells are multicellular.
Size of the cell is generally small (0.5-5 μm).	Size of the cell is generally large (50- 100 μm).
Nuclear region is poorly defined due to the absence of a nuclear membrane or the cell lacks true nucleus.	Nuclear region is well-defined and is surrounded by a nuclear membrane, or true nucleus bound by a nuclear membrane is present in the cell.
It contains a single chromosome.	It contains more than one chromosome.
Nucleolus is absent.	Nucleolus is present.
Membrane-bound cell organelles such as plastids, mitochondria, endoplasmic reticulum, Golgi apparatus, etc. are absent.	Cell organelles such as mitochondria, plastids, endoplasmic reticulum, Golgi apparatus, lysosomes, etc. are present.
Cell division occurs only by mitosis.	Cell division occurs by mitosis and meiosis.
Prokaryotic cells are found in bacteria and blue-green algae.	Eukaryotic cells are found in fungi, plants, and animal cells.

Question 3:

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

Answer:

If the plasma membrane of a cell is ruptured, then the cell will die. The plasma membrane regulates the movement of substances in and out of the cell by diffusion

or osmosis. Thus, if the plasma membrane is ruptured, then the cell might leak out its contents.

Question 4:

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

Answer:

If there was no Golgi apparatus in the cell, then most activities performed by the Golgi apparatus will not take place.

(i) Membranes of the Golgi apparatus are often connected to ER membranes. It collects simpler molecules and combines them to make more complex molecules. These are then packaged in small vesicles and are either stored in the cell or sent out as per the requirement. Thus, if the Golgi apparatus is absent in the cell, then the above process of storage, modification, and packaging of products will not be possible.

(ii) The formation of complex sugars from simple sugars will not be possible as this takes place with the help of enzymes present in Golgi bodies.

(iii) The Golgi apparatus is involved in the formation of lysosomes or peroxisomes. Thus, if the Golgi body is absent in a cell, the synthesis of lysosomes or peroxisomes will not be possible in the cell.

Question 5:

Which organelle is known as the powerhouse of the cell? Why?

Answer:

Mitochondriaare known as the powerhouse of cells. Mitochondria create energy for the cell, and this process of creating energy for the cell is known as cellular respiration. Most chemical reactions involved in cellular respiration occur in the mitochondria. The energy required for various chemical activities needed for life is released by the mitochondria in the form of ATP (Adenosine triphosphate) molecules. For this reason, mitochondria are known as the powerhouse of cells.

Question 6:

Where do the lipids and proteins constituting the cell membrane get synthesized?

Answer:

Lipids and proteinsconstituting the cell membrane are synthesized in the endoplasmic reticulum.

SER (Smooth endoplasmic reticulum) helps in the manufacturing of lipids.

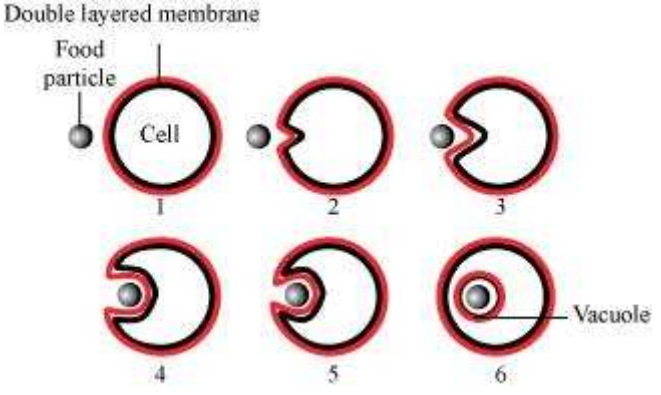
RER (Rough endoplasmic reticulum) has particles attached to its surface, called ribosomes. These ribosomes are the site for protein synthesis.

Question 7:

How does an *Amoeba* obtain its food?

Answer:

*Amoeba*obtains its food through the process of endocytosis. The flexibility of the cell membrane enables the cell to engulf the solid particles of food and other materials from its external environment.



Cell engulfing food particle

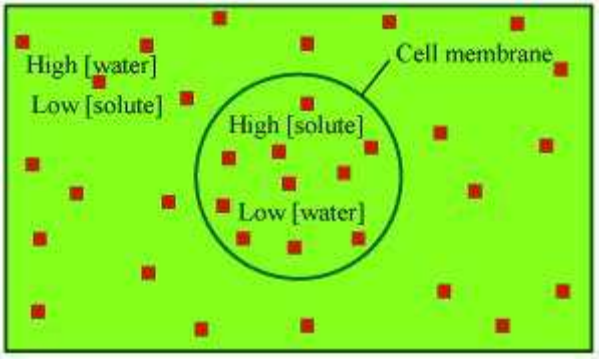
Question 8:

What is osmosis?

Answer:

The movement of water molecules from a region of high concentration to a region of low concentration through a selectively permeable membrane is called osmosis. It is a special case of diffusion, where the medium is water.

For example, if the medium surrounding the cell has a higher water concentration than the cell i.e., if the solution is a dilute solution, then the cell will gain water by osmosis.



Movement of water inside the cell

Question 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.

Answer Discussion

Experimental set up

(i) Water gathers in the hollowed portions of set-up B and C because water enters the potato as a result of osmosis. Since the medium surrounding the cell has a higher water concentration than the cell, the water moves inside by osmosis. Hence, water gathers in the hollowed portions of the potato cup.

(ii) Potato A in the experiment acts as a control set-up. No water gathers in the hollowed portions of potato A.

(iii) Water does not gather in the hollowed portions of potato A because potato cup A is empty. It is a control set-up in the experiment.

Water is not able to enter potato D because the potato used here is boiled. Boiling denatures the proteins present in the cell membrane and thus, disrupts the cell membrane. For osmosis, a semi-permeable membrane is required, which is disrupted in this case. Therefore, osmosis will not occur. Hence, water does not enter the boiled potato cup.

Question 1:

Why do we classify organisms?

Answer:

There are a wide range of life forms (about 10 million −13 million species) around us. These life forms have existed and evolved on the Earth over millions of years ago. The huge range of these life forms makes it very difficult to study them one by one. Therefore, we look for similarities among them and classify them into different classes to study these different classes as a whole. Thus, classification makes our study easier.

Question 2:

Give three examples of the range of variations that you see in life-forms around you.

Answer:

Examples of range of variations observed in daily life are:

(i) Variety of living organisms in terms of size ranges from microscopic bacteria to tall trees of 100 metres.

(ii) The colour, shape, and size of snakes are completely different from those of lizards.

(iii) The life span of different organisms is also quite varied. For example, a crow lives for only 15 years, whereas a parrot lives for about 140 years.

Question 1:

Which do you think is a more basic characteristic for classifying organisms?

(a) The place where they live.

(b) The kind of cells they are made of. Why?

Answer:

The kind of cells that living organisms are made up of is a more basic characteristic for classifying organisms, than on the basis of their habitat. This is because on the basis of the kind of cells, we can classify all living organisms into eukaryotes and prokaryotes. On the other hand, a habitat or the place where an organism lives is a very broad characteristic to be used as the basis for classifying organisms. For example, animals that live on land include earthworms, mosquitoes, butterfly, rats, elephants, tigers, etc. These animals do not resemble each other except for the fact that they share a common habitat. Therefore, the nature or kind of a cell is considered to be a fundamental characteristic for the classification of living organisms.

Question 2:

What is the primary characteristic on which the first division of organisms is made?

Answer:

The primary characteristic on which the first division of organisms is made is the nature of the cell. It is considered to be the fundamental characteristic for classifying all living organisms. Nature of the cell includes the presence or absence of membrane-bound organelles. Therefore, on the basis of this fundamental characteristic, we can classify all living organisms into two broad categories of eukaryotes and prokaryotes. Then, further classification is made on the basis of cellularity or modes of nutrition.

Question 3:

On what basis are plants and animals put into different categories?

Answer:

Plants and animals differ in many features such as the absence of chloroplasts, presence of cell wall, etc. But, locomotion is considered as the characteristic feature

that separates animals from plants. This is because the absence of locomotion in plants gave rise to many structural changes such as the presence of a cell wall (for protection), the presence of chloroplasts (for photosynthesis) etc. Hence, locomotion is considered to be the basic characteristic as further differences arose because of this characteristic feature.

Question 1:

Which organisms are called primitive and how are they different from the so-called advanced organisms?

Answer:

A primitive organism or lower organism is the one which has a simple body structure and ancient body design or features that have not changed much over a period of time. An advanced organism or higher organism has a complex body structure and organization. For example, an *Amoeba* is more primitive as compared to a starfish. *Amoeba* has a simple body structure and primitive features as compared to a starfish. Hence, an *Amoeba* is considered more primitive than a starfish.

Question 2:

Will advanced organisms be the same as complex organisms? Why?

Answer:

It is not always true that an advanced organism will have a complex body structure. But, there is a possibility that over the evolutionary time, complexity in body design will increase. Therefore, at times, advanced organisms can be the same as complex organisms.

Question 1:

What is the criterion for classification of organisms as belonging to kingdom Monera or Protista?

Answer:

The criterion for the classification of organisms belonging to kingdom Monera or Protista is the presence or absence of a well-defined nucleus or membrane-bound organelles. Kingdom Monera includes organisms that do not have a well-defined nucleus or membrane-bound organelles and these are known as prokaryotes. Kingdom Protista, on the other hand, includes organisms with a well-defined nucleus and membrane-bound organelles and these organisms are called eukaryotes.

Question 2:

In which kingdom will you place an organism which is single-celled, eukaryotic and photosynthetic?

Answer:

Kingdom Protista includes single celled, eukaryotic, and photosynthetic organisms.

Question 3:

In the hierarchy of classification, which grouping will have the smallest number of organisms with a maximum of characteristics in common and which will have the largest number of organisms?

Answer:

In the hierarchy of classification,a species will have the smallest number of organisms with a maximum of characteristics in common, whereas the kingdom will have the largest number of organisms.

Question 1:

Which division among plants has the simplest organisms?

Answer:

Thallophyta is the division of plants that has the simplest organisms. This group includes plants, which do not contain a well differentiated plant body. Their body is not differentiated into roots, stems, and leaves. They are commonly known as algae.

Question 2:

How are pteridophytes different from the phanerogams?

Answer:

Pteridophyta	**Phanerogams**
They have inconspicuous or less differentiated reproductive organs.	They have well developed reproductive organs.
They produce naked embryos called spores.	They produce seeds.
Ferns, *Marsilea, Equisetum,* etc. are examples of pteridophyta.	*Pinus, Cycas*, fir, etc. are examples of phanerogams.

Question 3:

How do gymnosperms and angiosperms differ from each other?

Answer:

Gymnosperm	**Angiosperm**
They are non-flowering plants.	They are flowering plants.
Naked seeds not enclosed inside fruits are produced.	Seeds are enclosed inside fruits.
Pinus, Cedar, fir, *Cycas,* etc. are some examples of gymnosperms.	Coconut, palm, mango, etc. are some examples of angiosperms.

Question 1:

How do poriferan animals differ from coelenterate animals?

Answer:

Porifera	**Coelenterate**
They are mostly marine, non-motile, and found attached to rocks.	They are exclusively marine animals that either live in colonies or have a solitary life-span.
They show cellular level of organisation.	They show tissue level of organisation.
Spongilla, Euplectella, etc. are poriferans.	*Hydra,* sea anemone, corals, etc. are coelenterates.

Question 2:

How do annelid animals differ from arthropods?

Answer:

Annelids	**Arthropods**
The circulatory system of annelids is closed.	Arthropods have an open circulatory system.
The body is divided into several identical segments.	The body is divided into few specialized segments.

Question 3:

What are the differences between amphibians and reptiles?

Answer:

Amphibian	**Reptiles**
They have a dual mode of life.	They are completely terrestrial.

Scales are absent.	Skin is covered with scales.
They lay eggs in water.	They lay eggs on land.
It includes frogs, toads, and salamanders.	It includes lizards, snakes, turtles, chameleons, etc.

Question 4:

What are the differences between animals belonging to the Aves group and those in the mammalia group?

Answer:

Aves	**Mammals**
Most birds have feathers and they possess a beak.	They do not have feathers and the beak is also absent.
They lay eggs. Hence, they are oviparous.	Some of them lay eggs and some give birth to young ones. Hence, they are both oviparous and viviparous.

Question 1:

What are the advantages of classifying organisms?

Answer:

There are a wide range of life forms (about 10 million-13 million species) around us. These life forms have existed and evolved on the Earth over millions of years ago. The huge range of these life forms makes it very difficult to study them one by one. Therefore, we look for similarities among them and classify them into different classes so that we can study these different classes as a whole. This makes our study easier.

Therefore, classification serves the following advantages:

(i) It determines the methods of organising the diversity of life on Earth.

(ii) It helps in understanding millions of life forms in detail.

(iii) It also helps in predicting the line of evolution.

Question 2:

How would you choose between two characteristics to be used for developing a hierarchy in classification?

Answer:

For developing a hierarchy of classification, we choose the fundamental characteristic among several other characteristics. For example, plants differ from animals in the absence of locomotion, chloroplasts, cell wall, etc. But, only locomotion is considered as the basic or fundamental feature that is used to distinguish between plants and animals. This is because the absence of locomotion in plants gave rise to many structural changes such as the presence of a cell wall for protection, and the presence of chloroplast for photosynthesis (as they cannot move around in search of food like animals). Thus, all these features are a result of locomotion. Therefore, locomotion is considered to be a fundamental characteristic. By choosing the basic or fundamental characteristic, we can make broad divisions in living organisms as the next level of characteristic is dependent on these. This goes on to form a hierarchy of characteristics.

Question 3:

Explain the basis for grouping organisms into five kingdoms.

Answer:

R.H. Whittaker proposed a five kingdom classification of living organisms on the basis of Linnaeus' system of classification. The five kingdoms proposed by Whittaker are Monera, Protista, Fungi, Plantae, and Animalia.

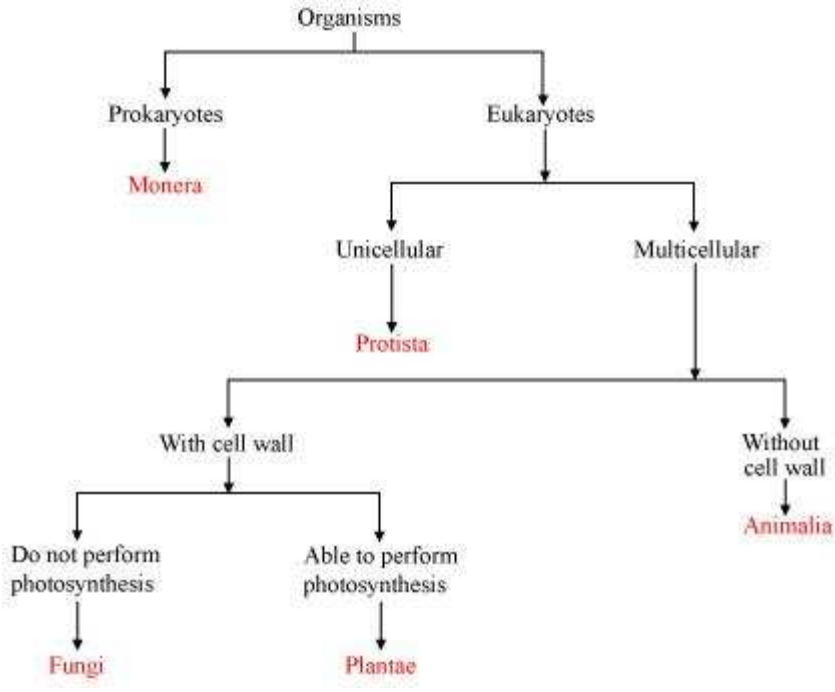
The basis for grouping organisms into five kingdoms is as follows:

(i) On the basis of the presence or absence of membrane-bound organelles, all living organisms are divided into two broad categories of eukaryotes and prokaryotes. This division lead to the formation of kingdom Monera, which includes all prokaryotes.

(ii) Then, eukaryotes are divided as unicellular and multicellular, on the basis of cellularity. Unicellular eukaryotes form kingdom Protista, and multicellular eukaryotes form kingdom Fungi, Plantae, and Animalia.

(iii) Animals are then separated on the basis of the absence of a cell wall.

(iv) Since fungi and plants both contain a cell wall, they are separated into different kingdoms on the basis of their modes of nutrition. Fungi have saprophytic mode of nutrition, whereas plants have autotrophic mode of nutrition. This results in the formation of the five kingdoms.



Question 4:

What are the major divisions in the Plantae? What is the basis for these divisions?

Answer:

The kingdom Plantae is divided into five main divisions: Thallophyta, Bryophyta, Pteridophyta, Gymnosperms, and Angiosperms.

The classification depends on the following criteria:

- Differentiated/ Undifferentiated plant body
- Presence /absence of vascular tissues
- With/without seeds
- Naked seeds/ seeds inside fruits

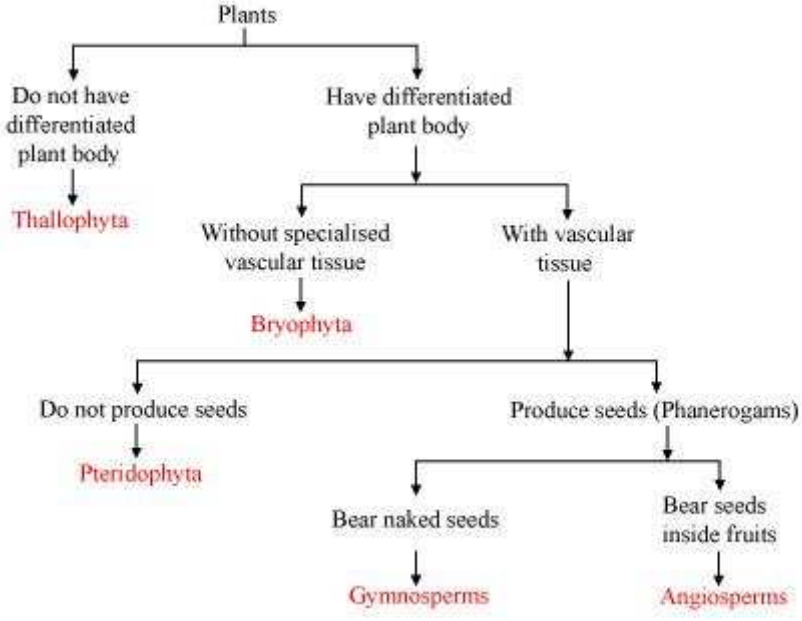
(i) The first level of classification depends on whether a plant body is well differentiated or not. A group of plants that do not have a well differentiated plant body are known as Thallophyta.

(ii) Plants that have well differentiated body parts are further divided on the basis of the presence or absence of vascular tissues. Plants without specialised vascular

tissues are included in division Bryophyta, whereas plants with vascular tissues are known as Tracheophyta.

(iii) Tracheophyta is again sub-divided into division Pteridophyta, on the basis of the absence of seed formation.

(iv) The other group of plants having well developed reproductive organs that finally develop seeds are called Phanerogams. This group is further sub- divided on the basis of whether the seeds are naked or enclosed in fruits. This classifies them into gymnosperms and angiosperms. Gymnosperms are seed bearing, non-flowering plants, whereas angiosperms are flowering plants in which the seeds are enclosed inside the fruit.



Question 5:

How are the criteria for deciding divisions in plants different from the criteria for deciding the subgroups among animals?

Answer:

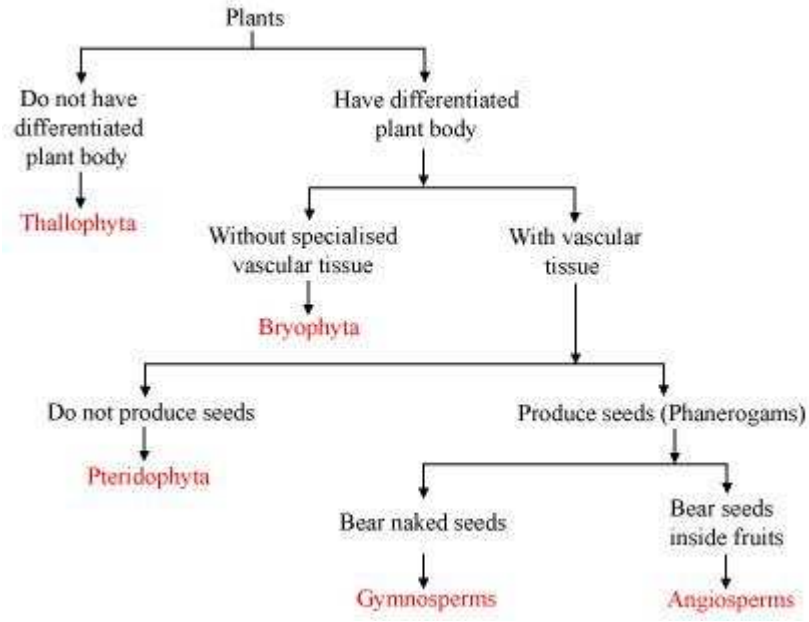
Criteria for deciding divisions in plants are:

(i) Differentiated/ Undifferentiated plant body

(ii) Presence/ absence of vascular tissues

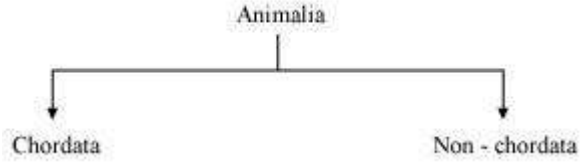
(iii) With/without seeds

(iv) Naked seeds/ seeds inside fruits



Criteria for deciding subgroups among animals are:

Kingdom Animalia is divided into two major groups on the basis of the presence or absence of a notochord.

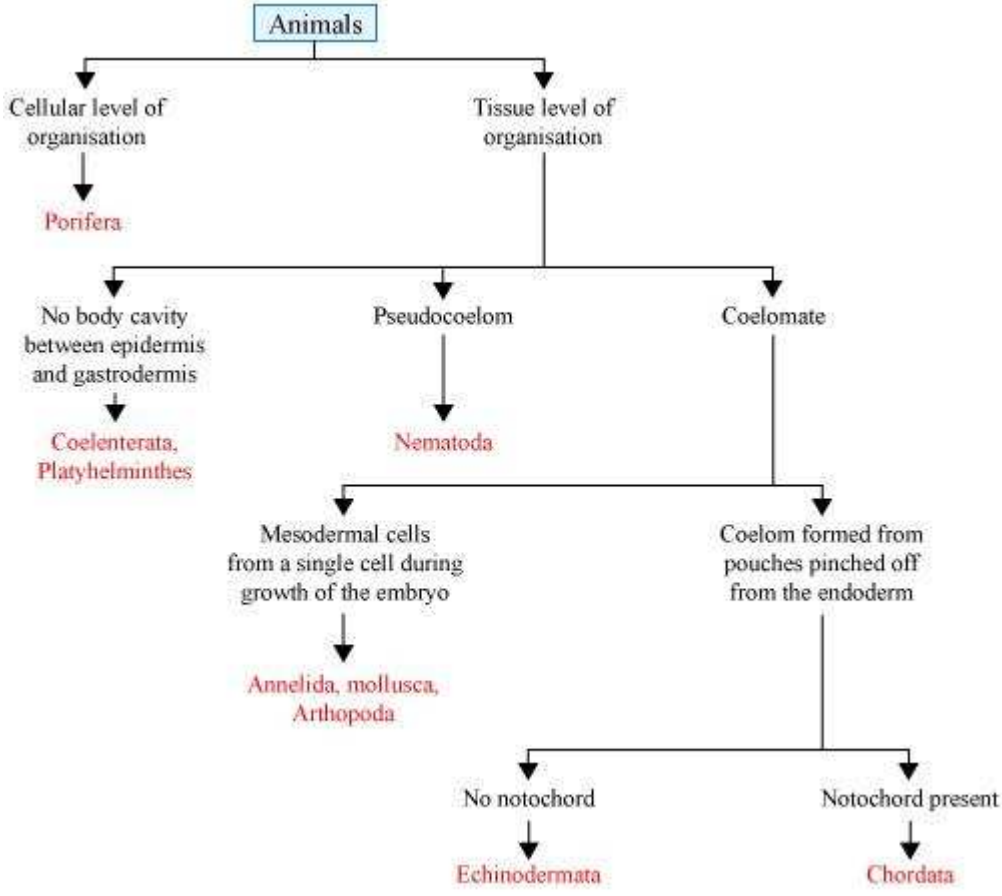


Non-chordates do not possess a notochord, while all members of the phylum chordates possess a notochord.

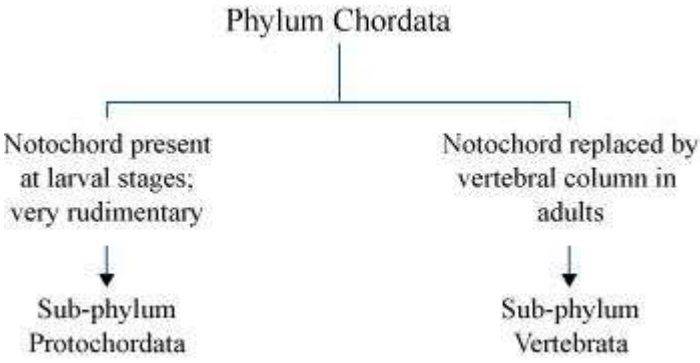
Non-chordate is further divided into subgroups on the basis of the following features:

1. True Tissue — Absent / Present
2. Body cavity — Absent / Present
3. Type of body symmetry — Radial / Bilateral
4. Type of coelom development — Acoelom / Pseudocoleom / True coleom
5. Types of true coelom — Enterocoleom / Schizocoleom

On the basis of the above features, non-chordates are divided into the following subgroups: Porifera, Coelenterate, Platyhelminthes, Nematodes, Annelids, Molluscs, Arthropoda, and Echinodermata.



All members of the phylum chordate possess a notochord. However, some animals such as *Balanoglossus, Amphioxus, Herdmania,* etc. have a notochord, which is either absent or does not run the entire length of the animal's body. Therefore, these animals are kept in a separate sub-phylum called Protochordata, and the rest of the chordates are included in the sub-phylum vertebrata. The members of the sub-phylum vertebrata are advanced chordates. They are divided into five classes: Pisces, Amphibian, Reptilia, Aves, and Mammalia.

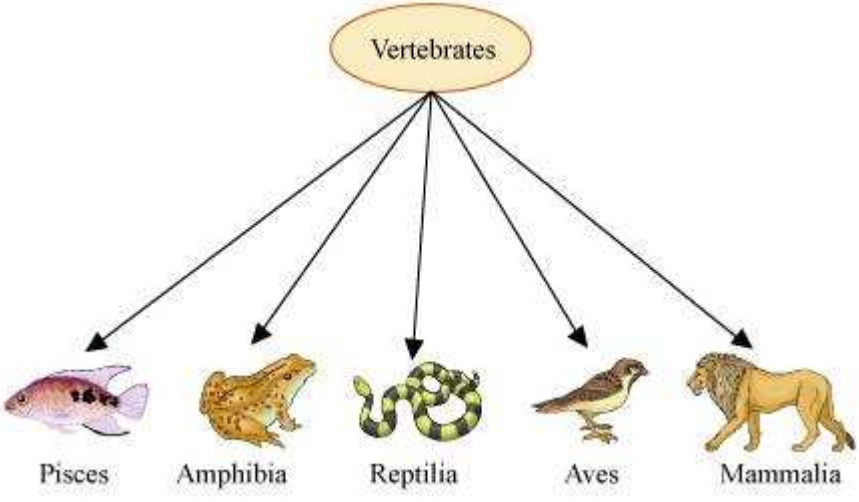


Question 6:

Explain how animals in Vertebrata are classified into further subgroups.

Answer:

Animals in Vertebrata are classified into five classes:



(i) **Class Pisces:** This class includes fish such as *Scoliodon,* tuna, rohu, shark, etc. These animals mostly live in water. Hence, they have special adaptive features such as a streamlined body, presence of a tail for movement, gills, etc. to live in water.

(ii) **Class Amphibia:** It includes frogs, toads, and salamanders. These animals have a dual mode of life. In the larval stage, the respiratory organs are gills, but in the adult stage, respiration occurs through the lungs or skin. They lay eggs in water.

(iii) **Class Reptilia:** It includes reptiles such as lizards, snakes, turtles, etc. They usually creep or crawl on land. The body of a reptile is covered with dry and cornified skin to prevent water loss. They lay eggs on land.

(iv) **Class Aves:** It includes all birds such as sparrow, pigeon, crow, etc. Most of them have feathers. Their forelimbs are modified into wings for flight, while hind limbs are modified for walking and clasping. They lay eggs.

(v) **Class Mammalia:** It includes a variety of animals which have milk producing glands to nourish their young ones. Some lay eggs and some give birth to young ones. Their skin has hair as well as sweat glands to regulate their body temperature.

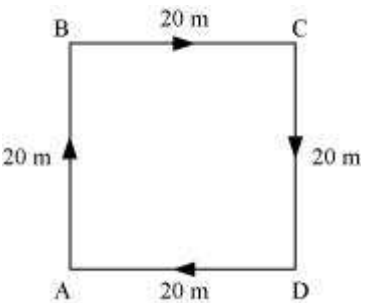
Question 1:

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

Answer:

Yes. An object that has moved through a distance can have zero displacement. Displacement is the shortest measurable distance between the initial and the final position of an object. An object which has covered a distance can have zero displacement, if it comes back to its starting point, i.e., the initial position.

Consider the following situation. A man is walking in a square park of length 20 m (as shown in the following figure). He starts walking from point A and after moving along all the corners of the park (point B, C, D), he again comes back to the same point, i.e., A.



In this case, the total distance covered by the man is 20 m + 20 m + 20 m + 20 m = 80 m. However, his displacement is zero because the shortest distance between his initial and final position 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:

The farmer takes 40 s to cover 4 × 10 = 40 m.

In 2 min and 20 s (140 s), he will cover a distance $= \frac{40}{40} \times 140 = 140 \text{ m}$

Therefore, the farmer completes $\frac{140}{40} = 3.5$ rounds (3 complete rounds and a half round) of the field in 2 min and 20 s.

That means, after 2 min 20 s, the farmer will be at the opposite end of the starting point.

Now, there can be two extreme cases.

Case I: Starting point is a corner point of the field.

In this case, the farmer will be at the diagonally opposite corner of the field after 2 min 20 s.

Therefore, the displacement will be equal to the diagonal of the field.

Hence, the displacement will be $\sqrt{10^2 + 10^2} = 14.1\,\text{m}$

Case II: Starting point is the middle point of any side of the field.

In this case the farmer will be at the middle point of the opposite side of the field after 2 min 20 s.

Therefore, the displacement will be equal to the side of the field, i.e., 10 m.

For any other starting point, the displacement will be between 14.1 m and 10 m.

Question 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.

Answer:

(a) Not true

Displacement can become zero when the initial and final position of the object is the same.

(b) Not true

Displacement is the shortest measurable distance between the initial and final positions of an object. It cannot be greater than the magnitude of the distance travelled by an object. However, sometimes, it may be equal to the distance travelled by the object.

Question 1:

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:

Radius of the circular orbit, r = 42250 km

Time taken to revolve around the earth, t = 24 h

Speed of a circular moving object, $v = \frac{2\pi r}{t}$

$$= \frac{2 \times 3.14 \times 42250}{24} = 1.105 \times 10^4 \text{ km/h} = 3.069 \text{ km/s}$$

Hence, the speed of the artificial satellite is 3.069 km/s.

Question 1:

Distinguish between speed and velocity.

Answer:

Speed	**Velocity**
Speed is the distance travelled by an object in a given interval of time. It does not have any direction.	Velocity is the displacement of an object in a given interval of time. It has a unique direction.
Speed is given by the relation: $\text{Speed} = \frac{\text{Distance travelled}}{\text{Time taken}}$	Velocity is given by the relation: $\text{Velocity} = \frac{\text{Displacement}}{\text{Time interval}}$
The speed of an object can never be negative. At the most, it can become zero. This is because distance travelled can never be negative.	The velocity of an object can be negative, positive, or equal to zero. This is because displacement can take any of these three values.

Question 2:

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

Answer:

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

$$\text{Average velocity} = \frac{\text{Displacement}}{\text{Total time taken}}$$

If the total distance covered by an object is the same as its displacement, then its average speed would be equal to its average velocity.

Question 3:

What does the odometer of an automobile measure?

Answer:

The odometer of an automobile measures the distance covered by an automobile.

Question 4:

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

Answer:

An object having uniform motion has a straight line path.

Question 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, 3×10^8 m s^{-1}.

Answer:

Time taken by the signal to reach the ground station from the spaceship

= 5 min = 5 × 60 = 300 s

Speed of the signal = 3×10^8 m/s

$$\text{Speed} = \frac{\text{Distance travelled}}{\text{Time taken}}$$

∴Distance travelled = Speed × Time taken = $3 \times 10^8 \times 300 = 9 \times 10^{10}$ m

Hence, the distance of the spaceship from the ground station is 9×10^{10} m.

Question 1:

When will you say a body is in (i) uniform acceleration? (ii) non-uniform acceleration?

Answer:

(i) A body is said to have uniform acceleration if it travels in a straight path in such a way that its velocity changes at a uniform rate, i.e., the velocity of a body increases or decreases by equal amounts in an equal interval of time.

(ii) A body is said to have non-uniform acceleration if it travels in a straight path in such a way that its velocity changes at a non-uniform rate, i.e., the velocity of a body increases or decreases in unequal amounts in an equal interval of time.

Question 2:

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 of the bus, u = 80 km/h $= 80 \times \frac{5}{18} = 22.22 \text{ m/s}$

Final speed of the bus, v = 60 km/h $= 60 \times \frac{5}{18} = 16.66 \text{ m/s}$

Time take to decrease the speed, t = 5 s

$$\text{Acceleration, } a = \frac{v-u}{t} = \frac{16.66-22.22}{5} = -1.112 \text{ m/s}^2$$

Here, the negative sign of acceleration indicates that the velocity of the car is decreasing.

Question 3:

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:

Initial velocity of the train, u = 0 (since the train is initially at rest)

Final velocity of the train, v = 40 km/h $= 40 \times \frac{5}{18} = 11.11 \text{ m/s}$

Time taken, t = 10 min = 10 × 60 = 600 s

$$\text{Acceleration, } a = \frac{v-u}{t} = \frac{11.11-0}{600} = 0.0185 \text{ m/s}^2$$

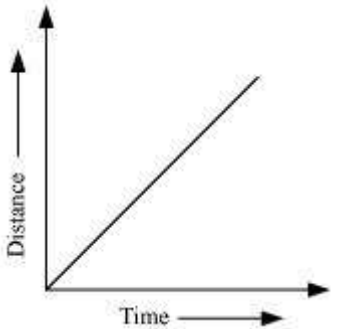
Hence, the acceleration of the train is 0.0185 m/s^2.

Question 1:

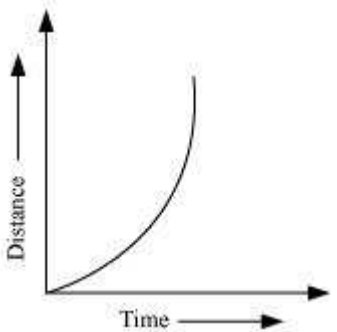
What is the nature of the distance–time graphs for uniform and non-uniform motion of an object?

Answer:

The distance–time graph for uniform motion of an object is a straight line (as shown in the following figure).



The distance–time graph for non-uniform motion of an object is a curved line (as shown in the given figure).

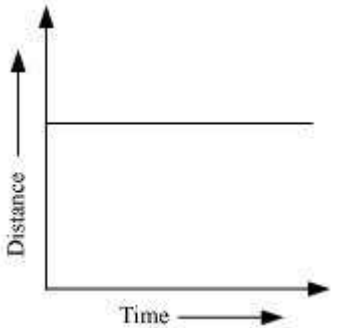


Question 2:

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

Answer:

When an object is at rest, its distance–time graph is a straight line parallel to the time axis.



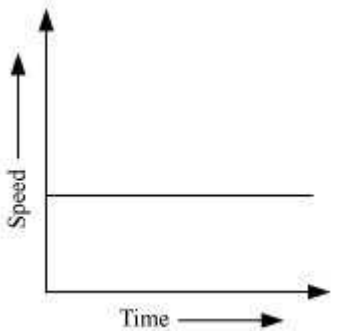
A straight line parallel to the *x*-axis in a distance−-time graph indicates that with a change in time, there is no change in the position of the object. Thus, the object is at rest.

Question 3:

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

Answer:

Object is moving uniformly.



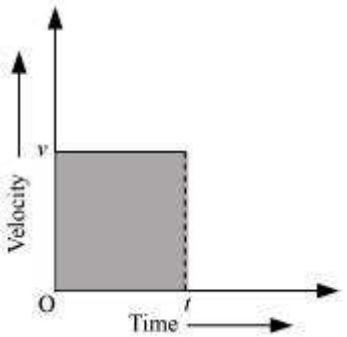
A straight line parallel to the time axis in a speed−time graph indicates that with a change in time, there is no change in the speed of the object. This indicates the uniform motion of the object.

Question 4:

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

Answer:

Distance



The graph shows the velocity–time graph of a uniformly moving body.

Let the velocity of the body at time (*t)* be *v*.

Area of the shaded region = length × breath

Where,

Length = *t*

Breath = *v*

Area = *vt* = velocity × time …(*i*)

We know,

$$\text{Velocity} = \frac{\text{Distance}}{\text{Time}}$$

∴ Distance = Velocity × Time…(*ii*)

From equations (*i*) and (*ii*),

Area = Distance

Hence, the area occupied below the velocity–time graph measures the distance covered by the body.

Question 1:

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.

Answer:

(a) 12 m/s (b) 720 m

(a) Initial speed of the bus, u = 0 (since the bus is initially at rest)

Acceleration, a = 0.1 m/s^2

Time taken, t = 2 minutes = 120 s

Let v be the final speed acquired by the bus.

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

$$0.1 = \frac{v-0}{120}$$

$\therefore v$ = 12 m/s

(b) According to the third equation of motion:

$v^2 - u^2 = 2as$

Where, s is the distance covered by the bus

$(12)^2 - (0)^2 = 2(0.1)\, s$

s = 720 m

Speed acquired by the bus is 12 m/s.

Distance travelled by the bus is 720 m.

Question 2:

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 m s^{-2}. Find how far the train will go before it is brought to rest.

Answer:

Initial speed of the train, u = 90 km/h = 25 m/s

Final speed of the train, v = 0 (finally the train comes to rest)

Acceleration = −0.5 m s^{-2}

According to third equation of motion:

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

$(0)^2 = (25)^2 + 2(-0.5)\ s$

Where, s is the distance covered by the train

$$s = \frac{(25)^2}{2(0.5)} = 625 \text{ m}$$

The train will cover a distance of 625 m before it comes to rest.

Question 3:

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

Answer:

Initial velocity of the trolley, $u = 0$ (since the trolley was initially at rest)

Acceleration, $a = 2$ cm $s^{-2} = 0.02$ m/s^2

Time, $t = 3$ s

According to the first equation of motion:

$v = u + at$

Where, v is the velocity of the trolley after 3 s from start

$v = 0 + 0.02 \times 3 = 0.06$ m/s

Hence, the velocity of the trolley after 3 s from start is 0.06 m/s.

Question 4:

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

Answer:

Initial velocity of the racing car, $u = 0$ (since the racing car is initially at rest)

Acceleration, $a = 4$ m/s^2

Time taken, $t = 10$ s

According to the second equation of motion:

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

Where, s is the distance covered by the racing car

$$s = 0 + \frac{1}{2} \times 4 \times (10)^2 = \frac{400}{2} = 200 \text{ m}$$

Hence, the distance covered by the racing car after 10 s from start is 200 m.

Question 5:

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:

Initially, velocity of the stone,u = 5 m/s

Final velocity, v = 0 (since the stone comes to rest when it reaches its maximum height)

Acceleration of the stone, a = acceleration due to gravity, g = 10 m/s^2

(in downward direction)

There will be a change in the sign of acceleration because the stone is being thrown upwards.

Acceleration, a = −10 m/s^2

Let s be the maximum height attained by the stone in time t.

According to the first equation of motion:

$v = u + at$

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

$$\therefore t = \frac{-5}{-10} = 0.5 \text{ s}$$

According to the third equation of motion:

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

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

$$s = \frac{5^2}{20} = 1.25 \text{ m}$$

Hence, the stone attains a height of 1.25 m in 0.5 s.

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:

Diameter of a circular track, d = 200 m

Radius of the track, $r = \frac{d}{2} = 100 \text{ m}$

Circumference = $2\pi r = 2\pi (100) = 200\pi$ m

In 40 s, the given athlete covers a distance of 200π m.

In 1 s, the given athlete covers a distance = $\frac{200\pi}{40}$ m

The athlete runs for 2 minutes 20 s = 140 s

$\therefore$Total distance covered in $140 \text{ s} = \frac{200 \times 22}{40 \times 7} \times 140 = 2200 \text{ m}$

The athlete covers one round of the circular track in 40 s. This means that after every 40 s, the athlete comes back to his original position. Hence, in 140 s he had completed 3 rounds of the circular track and is taking the fourth round.

He takes 3 rounds in 40 × 3 = 120 s. Thus, after 120 s his displacement is zero.

Then, the net displacement of the athlete is in 20 s only. In this interval of time, he moves at the opposite end of the initial position. Since displacement is equal to the shortest distance between the initial and final position of the athlete, displacement of the athlete will be equal to the diameter of the circular track.

$\therefore$ Displacement of the athlete = 200 m

Distance covered by the athlete in 2 min 20 s is 2200 m and his displacement is 200 m.

Question 2:

Joseph jogs from one end A to the other end B of a straight 300 m road in 2 minutes 50 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) 1.765 m/s, 1.765 m/s (b) 1.739 m/s, 0.87 m/s

(a) From end A to end B

Distance covered by Joseph while jogging from A to B = 300 m

Time taken to cover that distance = 2 min 50 seconds = 170 s

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

Total distance covered = 300 m

Total time taken = 170 s

$$\text{Average speed} = \frac{300}{170} = 1.765\,\text{m/s}$$

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

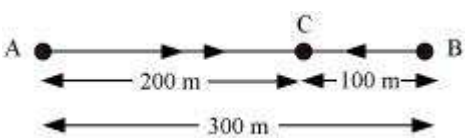
Displacement = shortest distance between A and B = 300 m

Time interval = 170 s

$$\text{Average velocity} = \frac{300}{170} = 1.765\ \text{m/s}$$

The average speed and average velocity of Joseph from A to B are the same and equal to 1.765 m/s.

(b) From end A to end C



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

Total distance covered = Distance from A to B + Distance from B to C

= 300 + 100 = 400 m

Total time taken = Time taken to travel from A to B + Time taken to travel from B to C = 170 + 60 = 230 s

$$\text{Average speed} = \frac{400}{230} = 1.739\,\text{m/s}$$

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

Displacement from A to C = AC = AB − BC = 300 − 100 = 200 m

Time interval = time taken to travel from A to B + time taken to travel from B to C = 170 + 60 = 230 s

$$\text{Average velocity} = \frac{200}{230} = 0.87\ \text{m s}^{-1}$$

The average speed of Joseph from A to C is 1.739 m/s and his average velocity is 0.87 m/s.

Question 3:

Abdul, while driving to school, computes the average speed for his trip to be 20 km h^{-1}. On his return trip along the same route, there is less traffic and the average speed is 40 km h^{-1}. What is the average speed for Abdul's trip?

Answer:

Case I: While driving to school

Average speed of Abdul's trip = 20 km/h

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

Total distance = Distance travelled to reach school = d

Let total time taken = t_1

$$\therefore 20 = \frac{d}{t_1}$$

$$t_1 = \frac{d}{20} \ldots(i)$$

Case II: While returning from school

Total distance = Distance travelled while returning from school = d

Now,total time taken = t_2

$$\therefore 40 = \frac{d}{t_2}$$

$$t_2 = \frac{d}{40} \quad ...(ii)$$

$$\text{Average speed for Abdul's trip} = \frac{\text{Total distance covered in the trip}}{\text{Total time taken}}$$

Where,

Total distance covered in the trip = $d + d = 2d$

Total time taken, t = Time taken to go to school + Time taken to return to school

$= t_1 + t_2$

$$\therefore \text{Average speed} = \frac{2d}{t_1 + t_2}$$

From equations (i) and (ii),

$$\text{Average speed} = \frac{2d}{\frac{d}{20} + \frac{d}{40}} = \frac{2}{\frac{2+1}{40}} = \frac{80}{3} = 26.67 \text{ m/s}$$

Hence, the average speed for Abdul's trip is 26.67 m/s.

Question 4:

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

Answer:

Initial velocity, u = 0 (since the motor boat is initially at rest)

Acceleration of the motorboat, a = 3 m/s^2

Time taken, t = 8 s

According to the second equation of motion:

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

Distance covered by the motorboat, s

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

Hence, the boat travels a distance of 96 m.

Question 5:

A driver of a car travelling at 52 km h^{-1} applies the brakes and accelerates uniformly in the opposite direction. The car stops in 5 s. Another driver going at 3 km h^{-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:

Case A:

Initial speed of the car, u_1 = 52 km/h = 14.4 m/s

Time taken to stop the car, t_1 = 5 s

Final speed of the car becomes zero after 5 s of application of brakes.

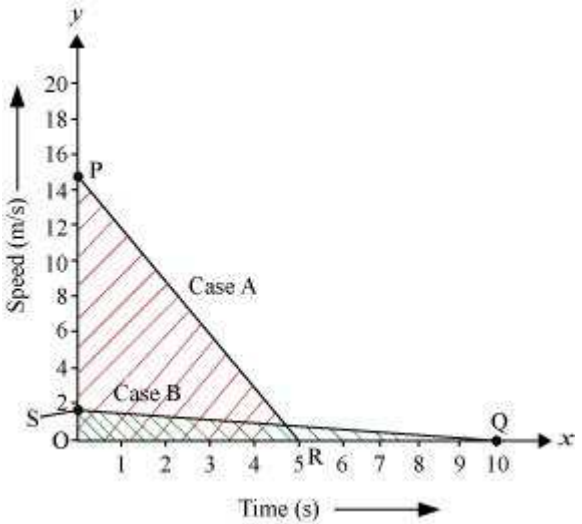
Case B:

Initial speed of the car, u_2 = 3 km/h = 0.833 m/s ≅ 0.83 m/s

Time taken to stop the car, t_1 = 10 s

Final speed of the car becomes zero after 10 s of application of brakes.

Plot of the two cars on a speed−time graph is shown in the following figure:



Distance covered by each car is equal to the area under the speed–time graph.

Distance covered in case A,

$$s_1 = \frac{1}{2} \times OP \times OR = \frac{1}{2} \times 14.4 \times 5 = 36 \text{ m}$$

Distance covered in case B,

$$s_2 = \frac{1}{2} \times OS \times OQ = \frac{1}{2} \times 0.83 \times 10 = 4.15 \text{ m}$$

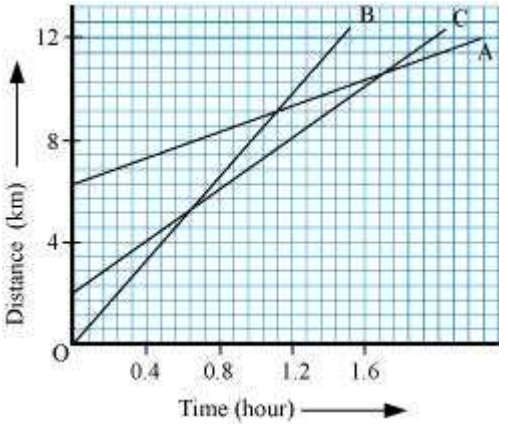
Area of ΔOPR > Area of ΔOSQ

Thus, the distance covered in case A is greater than the distance covered in case B.

Hence, the car travelling with a speed of 52 km/h travels farther after brakes were applied.

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:



(a) Which of the three is travelling the fastest?

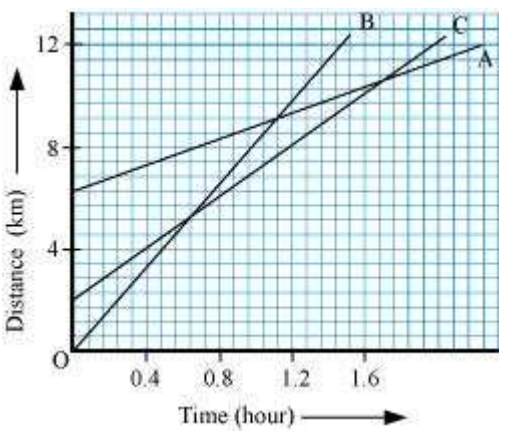
(b) Are all three ever at the same point on the road?

(c) How far has C travelled when B passes A?

(d)How far has B travelled by the time it passes C?

Answer:

(a) Object B (b) No (c) 5.714 km (d) 5.143 km



(a) $\text{Speed} = \dfrac{\text{Distance}}{\text{Time}}$

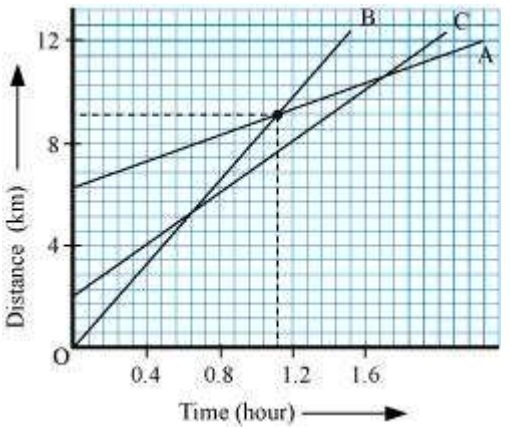
$$\text{Slope of graph} = \frac{y-\text{axis}}{x-\text{axis}} = \frac{\text{Distance}}{\text{Time}}$$

∴Speed = slope of the graph

Since slope of object B is greater than objects A and C, it is travelling the fastest.

(b) All three objects A, B and C never meet at a single point. Thus, they were never at the same point on road.

(c)



On the distance axis:

7 small boxes = 4 km

$\therefore$1 small box $= \frac{4}{7}\text{km}$

Initially, object C is 4 blocks away from the origin.

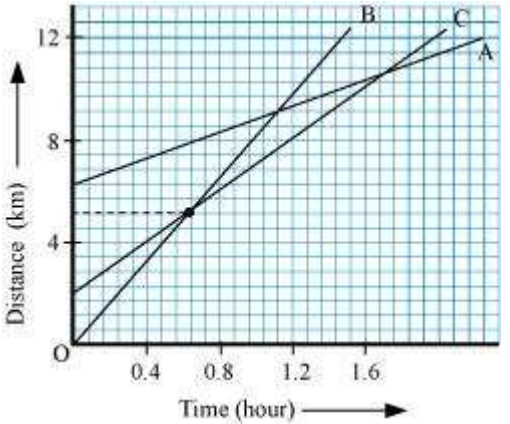
$\therefore$Initial distance of object C from origin= $\frac{16}{7}\text{km}$

Distance of object C from origin when B passes A = 8 km

Distance covered by C $= 8 - \frac{16}{7} = \frac{56-16}{7} = \frac{40}{7} = 5.714 \text{ km}$

Hence, C has travelled a distance of 5.714 km when B passes A.

(d)



Distance covered by B at the time it passes C = 9 boxes

$$=\frac{4}{7}\times 9=\frac{36}{7}=5.143 \text{ km}$$

Hence, B has travelled a distance of 5.143 km when B passes A.

Question 7:

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

Answer:

Distance covered by the ball, s = 20 m

Acceleration, a = 10 m/s^2

Initially, velocity, u = 0 (since the ball was initially at rest)

Final velocity of the ball with which it strikes the ground, v

According to the third equation of motion:

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

$v^2 = 0 + 2\ (10)\ (20)$

v = 20 m/s

According to the first equation of motion:

$v = u + at$

Where,

Time, t taken by the ball to strike the ground is,

$20 = 0 + 10\ (t)$

$t = 2$ s

Hence, the ball strikes the ground after 2 s with a velocity of 20 m/s.

Question 8:

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

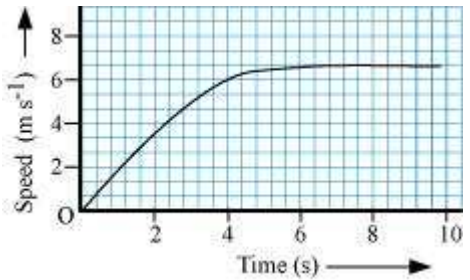


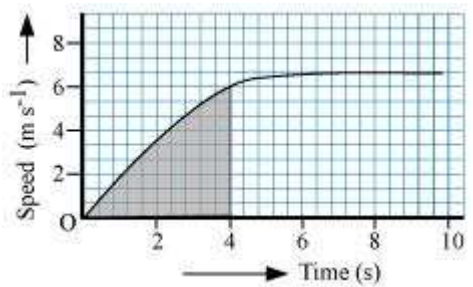
Fig. 8.12

(a) Find out 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?

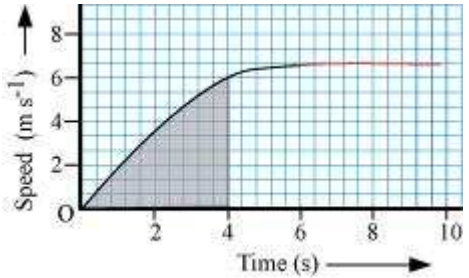
Answer:

(a)



The shaded area which is equal to $\frac{1}{2} \times 4 \times 6 = 12$ m represents the distance travelled by the car in the first 4 s.

(b)



The part of the graph in red colour between time 6 s to 10 s represents uniform motion of the car.

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) Possible

When a ball is thrown up at maximum height, it has zero velocity, although it will have constant acceleration due to gravity, which is equal to 9.8 m/s^2.

(b) Possible

When a car is moving in a circular track, its acceleration is perpendicular to its direction.

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-rupees coin and a one-rupee coin?

Answer:

Inertia is the measure of the mass of the body. The greater is the mass of the body; the greater is its inertia and vice-versa.

(a) Mass of a stone is more than the mass of a rubber ball for the same size. Hence, inertia of the stone is greater than that of a rubber ball.

(b) Mass of a train is more than the mass of a bicycle. Hence, inertia of the train is greater than that of the bicycle.

(c) Mass of a five rupee coin is more than that of a one-rupee coin. Hence, inertia of the five rupee coin is greater than that of the one-rupee 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:

The velocity of the ball changes four times.

As a football player kicks the football, its speed changes from zero to a certain value. As a result, the velocity of the ball gets changed. In this case, the player applied a force to change the velocity of the ball. Another player kicks the ball towards the goal post. As a result, the direction of the ball gets changed. Therefore, its velocity also changes. In this case, the player applied a force to change the velocity of the ball. The goalkeeper collects the ball. In other words, the ball comes to rest. Thus, its speed reduces to zero from a certain value. The velocity of the ball has changed. In this case, the goalkeeper applied an opposite force to stop/change the velocity of the ball. The goalkeeper kicks the ball towards his team players. Hence, the speed of the

ball increases from zero to a certain value. Hence, its velocity changes once again. In this case, the goalkeeper applied a force to change the velocity of the ball.

Question 3:

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

Answer:

Some leaves of a tree get detached when we shake its branches vigorously. This is because when the branches of a tree are shaken, it moves to and fro, but its leaves tend to remain at rest. This is because the inertia of the leaves tend to resist the to and fro motion. Due to this reason, the leaves fall down from the tree when shaken vigorously.

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:

Due to the inertia of the passenger

Every body tries to maintain its state of motion or state of rest. If a body is at rest, then it tries to remain at rest. If a body is moving, then it tries to remain in motion. In a moving bus, a passenger moves with the bus. As the driver applies brakes, the bus comes to rest. But, the passenger tries to maintain his state of motion. As a result, a forward force is exerted on him. Similarly, the passenger tends to fall backwards when the bus accelerates from rest. This is because when the bus accelerates, the inertia of the passenger tends to oppose the forward motion of the bus. Hence, the passenger tends to fall backwards when the bus accelerates forward.

Question 1:

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 Earth on the horse in the forward direction. As a result, the cart moves forward.

Question 2:

Explain, why is it difficult for a fireman to hold a hose, which ejects large amounts of water at a high velocity.

Answer:

Due to the backward reaction of the water being ejected

When a fireman holds a hose, which is ejecting large amounts of water at a high velocity, then a reaction force is exerted on him by the ejecting water in the backward direction. This is because of Newton's third law of motion. As a result of the backward force, the stability of the fireman decreases. Hence, it is difficult for him to remain stable while holding the hose.

Question 3:

From a rifle of mass 4 kg, a bullet of mass 50 g is fired with an initial velocity of 35 m s^{-1}. Calculate the initial recoil velocity of the rifle.

Answer:

Mass of the rifle, $m_1 = 4\,\text{kg}$

Mass of the bullet, $m_2 = 50\,\text{g} = 0.05\ \text{kg}$

Recoil velocity of the rifle = v_1

Bullet is fired with an initial velocity, $v_2 = 35\ \text{m/s}$

Initially, the rifle is at rest.

Thus, its initial velocity, $v = 0$

Total initial momentum of the rifle and bullet system $= (m_1 + m_2)v = 0$

Total momentum of the rifle and bullet system after firing:

$= m_1 v_1 + m_2 v_2 = 4(v_1) + 0.05 \times 35 = 4v_1 + 1.75$

According to the law of conservation of momentum:

Total momentum after the firing = Total momentum before the firing

$4v_1 + 1.75 = 0$

$v_1 = -\frac{1.75}{4} = -0.4375 \text{ m/s}$

The negative sign indicates that the rifle recoils backwards with a velocity of 0.4375 m/s.

Question 4:

Two objects of masses 100 g and 200 g are moving along the same line and direction with velocities of 2 m s^{-1} and 1 m s^{-1}, respectively. They collide and after the collision, the first object moves at a velocity of 1.67 m s^{-1}. 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, $v_3 = 1.67 \text{ m/s}$

Velocity of m_2 after collision = v_4

According to the law of conservation of momentum:

Total momentum before collision = Total momentum after collision

$\therefore m_1 v_1 + m_2 v_2 = m_1 v_3 + m_2 v_4$

$(0.1)2 + (0.2)1 = (0.1)1.67 + (0.2)v_4$

$0.4 = 0.167 + 0.2\, v_4$

$\therefore v_4 = 1.165 \text{ m/s}$

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

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. Even when an object experiences a net zero external unbalanced force, it is possible that the object is travelling with a non-zero velocity. This is possible only when the object has been moving with a constant velocity in a particular direction. Then, there is no net unbalanced force applied on the body. The object will keep moving with a non-zero velocity. To change the state of motion, a net non-zero external unbalanced force must be applied on the object.

Question 2:

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

Answer:

Inertia of an object tends to resist any change in its state of rest or state of motion. When a carpet is beaten with a stick, then the carpet comes to motion. But, the dust particles try to resist their state of rest. According to Newton's first law of motion, the dust particles stay in a state of rest, while the carpet moves. Hence, the dust particles come out of the carpet.

Question 3:

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

Answer:

When the bus accelerates and moves forward, it acquires a state of motion. However, the luggage kept on the roof, owing to its inertia, tends to remain in its state of rest. Hence, with the forward movement of the bus, the luggage tends to remain at its original position and ultimately falls from the roof of the bus. To avoid this, it is advised to tie any luggage kept on the roof of a bus with a 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.

Answer:

(c) A batsman hits a cricket ball, which then rolls on a level ground. After covering a short distance, the ball comes to rest because there is frictional force on the ball opposing its motion.

Frictional force always acts in the direction opposite to the direction of motion. Hence, this force is responsible for stopping the cricket ball.

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 its mass is 7 metric tonnes (*Hint*: 1 metric tonne = 1000 kg).

Answer:

Initial velocity, u = 0 (since the truck is initially at rest)

Distance travelled, s = 400 m

Time taken, t = 20 s

According to the second equation of motion:

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

Where,

Acceleration = a

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

$$400 = \frac{1}{2}a(400)$$

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

1 metric tonne = 1000 kg (Given)

$\therefore$ 7 metric tonnes = 7000 kg

Mass of truck, m = 7000 kg

From Newton's second law of motion:

Force, F = Mass × Acceleration

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

Hence, the acceleration of the truck is 2 m/s^2 and the force acting on the truck is 14000 N.

Question 6:

A stone of 1 kg is thrown with a velocity of 20 m s^{-1} 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:

Initial velocity of the stone, u = 20 m/s

Final velocity of the stone, v = 0 (finally the stone comes to rest)

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 × 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:

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.

Answer:

(a) 35000 N (b) 1.944 m/s^2 (c) 28000 N

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

Frictional force offered by the track, F_f = 5000 N

Net accelerating force, $F_a = F - F_f$ = 40000 − 5000 = 35000 N

Hence, the net accelerating force is 35000 N.

(b)Acceleration of the train = a

The engine exerts a force of 40000 N on all the five wagons.

Net accelerating force on the wagons, F_a = 35000 N

Mass of the wagons, m = Mass of a wagon × Number of wagons

Mass of a wagon = 2000 kg

Number of wagons = 5

$\therefore m = 2000 \times 5 = 10000$ kg

Mass of the engine, m' = 8000 kg

Total mass, M = $m + m'$ = 18000 kg

From Newton's second law of motion:

$F_a = Ma$

$$a = \frac{F_a}{M} = \frac{35000}{18000} = 1.944 \text{ m/s}^2$$

Hence, the acceleration of the wagons and the train is 1.944 m/s^2.

(c)Mass of all the wagons except wagon 1 is 4 × 2000 = 8000 kg

Acceleration of the wagons = 3.5 m/s^2

Thus, force exerted on all the wagons except wagon 1

$= 8000 \times 3.5 = 28000$ N

Therefore, the force exerted by wagon 1 on the remaining four wagons is 28000 N.

Hence, the force exerted by wagon 1 on wagon 2 is 28000 N.

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 of the automobile vehicle, m = 1500 kg

Final velocity, v = 0 (finally the automobile stops)

Acceleration of the automobile, $a = -1.7$ ms^{-2}

From Newton's second law of motion:

Force = Mass × Acceleration = $1500 \times (-1.7) = -2550$ N

Hence, the force between the automobile and the road is −2550 N, in the direction opposite to the motion of the automobile.

Question 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

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:

A force of 200 N is applied in the forward direction. Thus, from Newton's third law of motion, an equal amount of force will act in the opposite direction. This opposite force is the fictional force exerted on the cabinet. Hence, a frictional force of 200 N is exerted on the cabinet.

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^{-1} before the collision during which they stick together. What will be the velocity of the combined object after collision?

Answer:

Mass of one of the objects, m_1 = 1.5 kg

Mass of the other object, m_2 = 1.5 kg

Velocity of m_1 before collision, v_1 = 2.5 m/s

Velocity of m_2, moving in opposite direction before collision, v_2 = −2.5 m/s

(Negative sign arises because mass m_2 is moving in an opposite direction)

After collision, the two objects stick together.

Total mass of the combined object = $m_1 + m_2$

Velocity of the combined object = v

According to the law of conservation of momentum:

Total momentum before collision = Total momentum after collision

$m_1v_1 + m_2 v_1 = (m_1 + m_2) v$

$1.5(2.5) + 1.5 (-2.5) = (1.5 + 1.5) v$

$3.75 - 3.75 = 3 v$

$v = 0$

Hence, the velocity of the combined object after collision is 0 m/s.

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:

The truck has a large mass. Therefore, the static friction between the truck and the road is also very high. To move the car, one has to apply a force more than the static friction. Therefore, when someone pushes the truck and the truck does not move, then it can be said that the applied force in one direction is cancelled out by the frictioal force of equal amount acting in the opposite direction.

Therefore, the student is right in justifying that the two opposite and equal cancel each other.

Question 13:

A hockey ball of mass 200 g travelling at 10 m s^{-1} is struck by a hockey stick so as to return it along its original path with a velocity at 5 m s^{-1}. Calculate the change of momentum occurred in the motion of the hockey ball by the force applied by the hockey stick.

Answer:

Mass of the hockey ball, m = 200 g = 0.2 kg

Hockey ball travels with velocity, v_1 = 10 m/s

Initial momentum = mv_1

Hockey ball travels in the opposite direction with velocity, v_2 = −5 m/s

Final momentum = mv_2

Change in momentum = $mv_1 - mv_2$ = 0.2 [10 − (−5)] = 0.2 (15) = 3 kg m s^{-1}

Hence, the change in momentum of the hockey ball is 3 kg m s^{-1}.

Question 14:

A bullet of mass 10 g travelling horizontally with a velocity of 150 m s^{-1} 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:

Now, it is given that the bullet is travelling with a velocity of 150 m/s.

Thus, when the bullet enters the block, its velocity = Initial velocity, u = 150 m/s

Final velocity, v = 0 (since the bullet finally comes to rest)

Time taken to come to rest, t = 0.03 s

According to the first equation of motion, $v = u + at$

Acceleration of the bullet, a

$0 = 150 + (a \times 0.03\ s)$

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

(Negative sign indicates that the velocity of the bullet is decreasing.)

According to the third equation of motion:

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

$0 = (150)^2 + 2\ (-5000)\ s$

$$s = \frac{-(150)^2}{-2(5000)} = \frac{22500}{10000} = 2.25\ \text{m}$$

Hence, the distance of penetration of the bullet into the block is 2.25 m.

From Newton's second law of motion:

Force, F = Mass × Acceleration

Mass of the bullet, m = 10 g = 0.01 kg

Acceleration of the bullet, a = 5000 m/s^2

$F = ma = 0.01 \times 5000 = 50$ N

Hence, the magnitude of force exerted by the wooden block on the bullet is 50 N.

Question 15:

An object of mass 1 kg travelling in a straight line with a velocity of 10 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.

Answer:

Mass of the object, m_1 = 1 kg

Velocity of the object before collision, v_1 = 10 m/s

Mass of the stationary wooden block, m_2 = 5 kg

Velocity of the wooden block before collision, v_2 = 0 m/s

$\therefore$ Total momentum before collision = $m_1 v_1 + m_2 v_2$

= 1 (10) + 5 (0) = 10 kg m s^{-1}

It is given that after collision, the object and the wooden block stick together.

Total mass of the combined system = $m_1 + m_2$

Velocity of the combined object = v

According to the law of conservation of momentum:

Total momentum before collision = Total momentum after collision

$m_1 v_1 + m_2 v_2 = (m_1 + m_2) v$

1 (10) + 5 (0) = (1 + 5) v

$$v = \frac{10}{6} = \frac{5}{3} \text{ m/s}$$

The total momentum after collision is also 10 kg m/s.

Total momentum just before the impact = 10 kg m s^{-1}

Total momentum just after the impact = $(m_1 + m_2) v = 6 \times \frac{5}{3} = 10 \text{ kg m s}^{-1}$

Hence, velocity of the combined object after collision = $\frac{5}{3}$ m/s

Question 16:

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

Answer:

Initial velocity of the object, u = 5 m/s

Final velocity of the object, v = 8 m/s

Mass of the object, m = 100 kg

Time take by the object to accelerate, t = 6 s

Initial momentum = mu = 100 × 5 = 500 kg m s^{-1}

Final momentum = mv = 100 × 8 = 800 kg m s^{-1}

Force exerted on the object, $F = \frac{mv - mu}{t}$

$$= \frac{m(v-u)}{t} = \frac{800-500}{6} = \frac{300}{6} = 50 \text{ N}$$

Initial momentum of the object is 500 kg m s^{-1}.

Final momentum of the object is 800 kg m s^{-1}.

Force exerted on the object is 50 N.

Question 17:

Akhtar, Kiran and Rahul were riding in a motorocar that was moving with a high velocity on an expressway when an insect hit the windshield and got stuck on the windscreen. 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 said that both the motorcar and the insect experienced the same force and a change in their momentum. Comment on these suggestions.

Answer:

According to the law of conservation of momentum:

Momentum of the car and insect system before collision = Momentum of the car and insect system after collision

Hence, the change in momentum of the car and insect system is zero.

The insect gets stuck on the windscreen. This means that the direction of the insect is reversed. As a result, the velocity of the insect changes to a great amount. On the other hand, the car continues moving with a constant velocity. Hence, Kiran's suggestion that the insect suffers a greater change in momentum as compared to the car is correct. The momentum of the insect after collision becomes very high because the car is moving at a high speed. Therefore, the momentum gained by the insect is equal to the momentum lost by the car.

Akhtar made a correct conclusion because the mass of the car is very large as compared to the mass of the insect.

Rahul gave a correct explanation as both the car and the insect experienced equal forces caused by the Newton's action-reaction law. But, he made an incorrect statement as the system suffers a change in momentum because the momentum before the collision is equal to the momentum after the collision.

Question 18:

How much momentum will a dumbbell of mass 10 kg transfer to the floor if it falls from a height of 80 cm? Take its downward acceleration to be 10 m s^{-2}.

Answer:

Mass of the dumbbell, m = 10 kg

Distance covered by the dumbbell, s = 80 cm = 0.8 m

Acceleration in the downward direction, a = 10 m/s^2

Initial velocity of the dumbbell, u = 0

Final velocity of the dumbbell (when it was about to hit the floor) = v

According to the third equation of motion:

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

$v^2 = 0 + 2\ (10)\ 0.8$

v = 4 m/s

Hence, the momentum with which the dumbbell hits the floor is

$= mv = 10 \times 4 = 40$ kg m s^{-1}

Question 1:

The following is the distance-time table of an object in motion:

Time in seconds	Distance in metres
0	0
1	1
2	8
3	27
4	64
5	125
6	216
7	343

(a) What conclusion can you draw about the acceleration? Is it constant, increasing, decreasing, or zero?

(b)What do you infer about the forces acting on the object?

Answer:

(a) There is an unequal change of distance in an equal interval of time.

Thus, the given object is having a non – uniform motion. Since the velocity of the object increases with time, the acceleration is increasing.

(b)According to Newton's second law of motion, the force acting on an object is directly proportional to the acceleration produced in the object. In the given case, the increasing acceleration of the given object indicates that the force acting on the object is also increasing.

Question 2:

Two persons manage to push a motorcar of mass 1200 kg at a uniform velocity along a level road. The same motorcar can be pushed by three persons to produce an acceleration of 0.2 m s^{-2}. With what force does each person push the motorcar? (Assume that all persons push the motorcar with the same muscular effort)

Answer:

Mass of the motor car = 1200 kg

Only two persons manage to push the car. Hence, the acceleration acquired by the car is given by the third person alone.

Acceleration produced by the car, when it is pushed by the third person,

a = 0.2 m/s^2

Let the force applied by the third person be F.

From Newton's second law of motion:

Force = Mass × Acceleration

F = 1200 × 0.2 = 240 N

Thus, the third person applies a force of magnitude 240 N.

Hence, each person applies a force of 240 N to push the motor car.

Question 3:

A hammer of mass 500 g, moving at 50 m s^{-1}, strikes a nail. The nail stops the hammer in a very short time of 0.01 s. What is the force of the nail on the hammer?

Answer:

Mass of the hammer, m = 500 g = 0.5 kg

Initial velocity of the hammer, u = 50 m/s

Time taken by the nail to the stop the hammer, t = 0.01 s

Velocity of the hammer, v = 0 (since the hammer finally comes to rest)

From Newton's second law of motion:

$$\text{Force, } F = \frac{m(v-u)}{t} = \frac{0.5(0-50)}{0.01} = -2500 \text{ N}$$

The hammer strikes the nail with a force of −2500 N. Hence, from Newton's third law of motion, the force of the nail on the hammer is equal and opposite, i.e., +2500 N.

Question 4:

A motorcar of mass 1200 kg is moving along a straight line with a uniform velocity of 90 km/h. Its velocity is slowed down to 18 km/h in 4 s by an unbalanced external force. Calculate the acceleration and change in momentum. Also calculate the magnitude of the force required.

Answer:

Mass of the motor car, m = 1200 kg

Initial velocity of the motor car, v = 90 km/h = 25 m/s

Final velocity of the motor car, u = 18 km/h = 5 m/s

Time taken, t = 4 s

According to the first equation of motion:

$v = u + at$

$25 = 5 + a\ (4)$

$a = 5\ m/s^2$

Change in momentum = $mv - mu = m\ (v-u)$

$= 1200\ (25 - 5) = 24000\ kg\ m\ s^{-1}$

Force = Mass × Acceleration

$= 1200 \times 5 = 6000\ N$

Acceleration of the motor car = $5\ m/s^2$

Change in momentum of the motor car = $24000\ kg\ m\ s^{-1}$

Hence, the force required to decrease the velocity is 6000 N.

Question 5:

A large truck and a car, both moving with a velocity of magnitude v, have a head-on collision and both of them come to a halt after that. If the collision lasts for 1 s:

(a) Which vehicle experiences the greater force of impact?

(b) Which vehicle experiences the greater change in momentum?

(c) Which vehicle experiences the greater acceleration?

(d)Why is the car likely to suffer more damage than the truck?

Answer:

Let the mass of the truck be M and that of the car be m.

Thus, $M > m$

Initial velocity of both vehicles, v

Final velocity of both vehicles, $v' = 0$ (since the vehicles come to rest after collision)

Time of impact, $t = 1$ s

(a) From Newton's second law of motion, the net force experienced by each vehicle is given by the relation:

$$F_{car} = \frac{m(v'-v)}{t} = -mv$$

$$F_{Truck} = \frac{M(v'-v)}{t} = -Mv$$

Since the mass of the truck is greater than that of the car, it will experience a greater force of impact.

(b) Initial momentum of the car = mv

Final momentum of the car = 0

Change in momentum = mv

Initial momentum of the truck = Mv

Final momentum of the truck = 0

Change in momentum = Mv

Since the mass of the truck is greater than that of the car, it will experience a greater change in momentum.

(c) From the first equation of motion, acceleration produced in a system is independent of the mass of the system. The initial velocity, the final velocity, and the time of impact remain the same in both cases. Hence, both the car and the truck experience the same amount of acceleration.

(d)According to Newton's third law of motion, for every action there is an equal and opposite reaction that acts on different bodies. Since the truck experiences a greater force of impact (action), this larger impact force is also experienced by the car (reaction). Thus, the car is likely to suffer more damage than the truck.

Question 1:

State the universal law of gravitation

Answer:

The universal law of gravitation states that every object in the universe attracts every other object with a force called the gravitational force. The force acting between two objects is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers.

For two objects of masses m_1 and m_2 and the distance between them r, the force (F) of attraction acting between them is given by the universal law of gravitation as:

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

Where, G is the universal gravitation constant given by:

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

Question 2:

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

Answer:

Let M_E be the mass of the Earth and m be the mass of an object on its surface. If R is the radius of the Earth, then according to the universal law of gravitation, the gravitational force (F) acting between the Earth and the object is given by the relation:

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

Question 1:

What do you mean by free fall?

Answer:

Gravity of the Earth attracts every object towards its centre. When an object is released from a height, it falls towards the surface of the Earth under the influence of gravitational force. The motion of the object is said to have free fall.

Question 2:

What do you mean by acceleration due to gravity?

Answer:

When an object falls towards the ground from a height, then its velocity changes during the fall. This changing velocity produces acceleration in the object. This acceleration is known as acceleration due to gravity (g). Its value is given by 9.8 m/s^2.

Question 1:

What are the differences between the mass of an object and its weight?

Answer:

S. No.	**Mass**	**Weight**
I.	Mass is the quantity of matter contained in the body.	Weight is the force of gravity acting on the body.
II.	It is the measure of inertia of the body.	It is the measure of gravity.
III.	Mass is a constant quantity.	Weight is not a constant quantity. It is different at different places.
IV.	It only has magnitude.	It has magnitude as well as direction.
V.	Its SI unit is kilogram (kg).	Its SI unit is the same as the SI unit of force, i.e., Newton (N).

Question 2:

Why is the weight of an object on the moon $\frac{1}{6}^{\text{th}}$ its weight on the earth?

Answer:

Let M_E be the mass of the Earth and m be an object on the surface of the Earth. Let R_E be the radius of the Earth. According to the universal law of gravitation, weight W_E of the object on the surface of the Earth is given by,

$$W_E = \frac{GM_E m}{R_E^2}$$

Let M_M and R_M be the mass and radius of the moon. Then, according to the universal law of gravitation, weight W_M of the object on the surface of the moon is given by:

$$W_M = \frac{GM_M m}{R_M^2}$$

$$\frac{W_M}{W_E} = \frac{M_M R_E^2}{M_E R_M^2}$$

Where, $M_E = 5.98 \times 10^{24}$ kg, $M_M = 7.36 \times 10^{22}$ kg

$R_E = 6.4 \times 10^6$ m, $R_M = 1.74 \times 10^6$ m

$$\therefore \frac{W_M}{W_E} = \frac{7.36 \times 10^{22} \times (6.37 \times 10^6)^2}{5.98 \times 10^{24} \times (1.74 \times 10^6)^2} = 0.165 \approx \frac{1}{6}$$

Therefore, weight of an object on the moon is $\frac{1}{6}$ of its weight on the Earth.

Question 1:

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

Answer:

It is difficult to hold a school bag having a thin strap because the pressure on the shoulders is quite large. This is because the pressure is inversely proportional to the surface area on which the force acts. The smaller is the surface area; the larger will be the pressure on the surface. In the case of a thin strap, the contact surface area is very small. Hence, the pressure exerted on the shoulder is very large.

Question 2:

What do you mean by buoyancy?

Answer:

The upward force exerted by a liquid on an object immersed in it is known as buoyancy. When you try to immerse an object in water, then you can feel an upward force exerted on the object, which increases as you push the object deeper into water.

Question 3:

Why does an object float or sink when placed on the surface of water?

Answer:

If the density of an object is more than the density of the liquid, then it sinks in the liquid. This is because the buoyant force acting on the object is less than the force of gravity. On the other hand, if the density of the object is less than the density of the liquid, then it floats on the surface of the liquid. This is because the buoyant force acting on the object is greater than the force of gravity.

Question 1:

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

Answer:

When you weigh your body, an upward force acts on it. This upward force is the buoyant force. As a result, the body gets pushed slightly upwards, causing the weighing machine to show a reading less than the actual value.

Question 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 other. Can you say which one is heavier and why?

Answer:

The iron bar is heavier than the bag of cotton. This is because the surface area of the cotton bag is larger than the iron bar. Hence, more buoyant force acts on the bag than that on an iron bar. This makes the cotton bag lighter than its actual value. For this reason, the iron bar and the bag of cotton show the same mass on the weighing machine, but actually the mass of the iron bar is more that that of the cotton bag.

Question 1:

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

Answer:

According to the universal law of gravitation, gravitational force (*F*) acting between two objects is inversely proportional to the square of the distance (*r)* between them, i.e.,

$$F \propto \frac{1}{r^2}$$

If distance *r* becomes *r*/2, then the gravitational force will be proportional to

$$\frac{1}{\left(\frac{r}{2}\right)^2} = \frac{4}{r^2}$$

Hence, if the distance is reduced to half, then the gravitational force becomes four times larger than the previous value.

Question 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?

Answer:

All objects fall on ground with constant acceleration, called acceleration due to gravity (in the absence of air resistances). It is constant and does not depend upon the mass of an object. Hence, heavy objects do not fall faster than light objects.

Question 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 6×10^{24} kg and radius of the earth is 6.4×10^{6} m).

Answer:

According to the universal law of gravitation, gravitational force exerted on an object of mass *m* is given by:

$$F = \frac{GMm}{r^2}$$

Where,

Mass of Earth, $M = 6 \times 10^{24}$ kg

Mass of object, $m = 1$ kg

Universal gravitational constant, $G = 6.7 \times 10^{-11}$ Nm^2 kg^{-2}

Since the object is on the surface of the Earth, r = radius of the Earth (R)

$r = R = 6.4 \times 10^6$ m

Gravitational force, $F = \frac{GMm}{R^2}$

$$= \frac{6.7 \times 10^{-11} \times 6 \times 10^{24} \times 1}{(6.4 \times 10^6)^2} = 9.8 \text{ N}$$

Question 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?

Answer:

According to the universal law of gravitation, two objects attract each other with equal force, but in opposite directions. The Earth attracts the moon with an equal force with which the moon attracts the earth.

Question 5:

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

Answer:

The Earth and the moon experience equal gravitational forces from each other. However, the mass of the Earth is much larger than the mass of the moon. Hence, it accelerates at a rate lesser than the acceleration rate of the moon towards the Earth. For this reason, the Earth does not move towards the moon.

Question 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?

Answer:

(i) Doubled (ii) One-fourth and one-ninth (iii) four times

According to the universal law of gravitation, the force of gravitation between two objects is given by:

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

(i) *F* is directly proportional to the masses of the objects. If the mass of one object is doubled, then the gravitational force will also get doubled.

(ii) *F* is inversely proportional to the square of the distances between the objects. If the distance is doubled, then the gravitational force becomes one-fourth of its original value.

Similarly, if the distance is tripled, then the gravitational force becomes one-ninth of its original value.

(iii) *F* is directly proportional to the product of masses of the objects. If the masses of both the objects are doubled, then the gravitational force becomes four times the original value.

Question 7:

What is the importance of universal law of gravitation?

Answer:

The universal law of gravitation proves that every object in the universe attracts every other object.

Question 8:

What is the acceleration of free fall?

Answer:

When objects fall towards the Earth under the effect of gravitational force alone, then they are said to be in free fall. Acceleration of free fall is 9.8 m s^{-2}, which is constant for all objects (irrespective of their masses).

Question 9:

What do we call the gravitational force between the Earth and an object?

Answer:

Gravitational force between the earth and an object is known as the weight of the object.

Question 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 him 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].

Answer:

Weight of a body on the Earth is given by:

$W = mg$

Where,

m = Mass of the body

g = Acceleration due to gravity

The value of *g* is greater at poles than at the equator. Therefore, gold at the equator weighs less than at the poles. Hence, Amit's friend will not agree with the weight of the gold bought.

Question 11:

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

Answer:

When a sheet of paper is crumbled into a ball, then its density increases. Hence, resistance to its motion through the air decreases and it falls faster than the sheet of paper.

Question 12:

Gravitational force on the surface of the moon is only $\frac{1}{6}$ as strong as gravitational force on the Earth. What is the weight in newtons of a 10 kg object on the moon and on the Earth?

Answer:

Weight of an object on the moon $= \frac{1}{6} \times$ Weight of an object on the Earth

Also,

Weight = Mass × Acceleration

Acceleration due to gravity, g = 9.8 m/s^2

Therefore, weight of a 10 kg object on the Earth = 10 × 9.8 = 98 N

And, weight of the same object on the moon $= \frac{1}{6} \times 98 = 16.3 \text{ N}$

Question 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.

Answer:

(i) 122.5 m (ii) 10 s

According to the equation of motion under gravity:

$v^2 - u^2 = 2gs$

Where,

u = Initial velocity of the ball

v = Final velocity of the ball

s = Height achieved by the ball

g = Acceleration due to gravity

At maximum height, final velocity of the ball is zero, i.e., $v = 0$

u = 49 m/s

During upward motion, g = − 9.8 m s^{-2}

Let h be the maximum height attained by the ball.

Hence,

$$0 - (49)^2 = 2 \times (-9.8) \times h$$

$$h = \frac{49 \times 49}{2 \times 9.8} = 122.5 \text{ m}$$

Let t be the time taken by the ball to reach the height 122.5 m, then according to the equation of motion:

$v = u + gt$

We get,

$0 = 49 + t \times (-9.8)$

$9.8t = 49$

$t = \frac{49}{9.8} = 5 \text{ s}$

But,

Time of ascent = Time of descent

Therefore, total time taken by the ball to return = 5 + 5 = 10 s

Question 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.

Answer:

According to the equation of motion under gravity:

$v^2 - u^2 = 2gs$

Where,

u = Initial velocity of the stone = 0

v = Final velocity of the stone

s = Height of the stone = 19.6 m

g = Acceleration due to gravity = 9.8 m s^{-2}

$\therefore v^2 - 0^2 = 2 \times 9.8 \times 19.6$

$v^2 = 2 \times 9.8 \times 19.6 = (19.6)^2$

$v = 19.6 \text{ m } s^{-1}$

Hence, the velocity of the stone just before touching the ground is 19.6 m s^{-1}.

Question 15:

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

Answer:

According to the equation of motion under gravity:

$v^2 - u^2 = 2gs$

Where,

u = Initial velocity of the stone = 40 m/s

v = Final velocity of the stone = 0

s = Height of the stone

g = Acceleration due to gravity = -10 m s^{-2}

Let h be the maximum height attained by the stone.

Therefore,

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

$$h = \frac{40\times 40}{20} = 80 \text{ m}$$

Therefore, total distance covered by the stone during its upward and downward journey = 80 + 80 = 160 m

Net displacement of the stone during its upward and downward journey

= 80 + (−80) = 0

Question 16:

Calculate the force of gravitation between the earth and the Sun, given that the mass of the earth = 6×10^{24} kg and of the Sun = 2×10^{30} kg. The average distance between the two is 1.5×10^{11} m.

Answer:

According to the universal law of gravitation, the force of attraction between the Earth and the Sun is given by:

$$F = \frac{G\, M_{\text{Sun}} M_{\text{Earth}}}{R^2}$$

Where,

M_{Sun} = Mass of the Sun = 2×10^{30} kg

M_{Earth} = Mass of the Earth = 6×10^{24} kg

R = Average distance between the Earth and the Sun = 1.5×10^{11} m

G = Universal gravitational constant = $6.7 \times 10^{-11}\ Nm^2\ kg^{-2}$

$$F = \frac{6.7\times10^{-11}\times2\times10^{30}\times6\times10^{24}}{(1.5\times10^{11})^2} = 3.57\times10^{22}\ N$$

Question 17:

A stone is allowed to fall from the top of a tower 100 m high and at the same time another stone is projected vertically upwards from the ground with a velocity of 25 m/s. Calculate when and where the two stones will meet.

Answer:

Let the two stones meet after a time *t*.

(i) For the stone dropped from the tower:

Initial velocity, $u = 0$

Let the displacement of the stone in time *t* from the top of the tower be *s.*

Acceleration due to gravity, $g = 9.8\ m\ s^{-2}$

From the equation of motion,

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

$$= 0\times t + \frac{1}{2}\times9.8\times t^2$$

$$\therefore s = 4.9t^2 \qquad (1)$$

(ii) For the stone thrown upwards:

Initial velocity, $u = 25\ m\ s^{-1}$

Let the displacement of the stone from the ground in time *t* be *s*'.

Acceleration due to gravity, $g = -9.8\ m\ s^{-2}$

Equation of motion,

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

$$= 25t - \frac{1}{2}\times9.8\times t^2$$

$$\therefore s' = 25t - 4.9t^2 \qquad (2)$$

The combined displacement of both the stones at the meeting point is equal to the height of the tower 100 m.

$$\therefore s + s' = 100$$

$$\frac{1}{2}gt^2 + 25t - \frac{1}{2}gt^2 = 100$$

$$\therefore t = \frac{100}{25} = 4 \text{ s}$$

In 4 s, the falling stone has covered a distance given by equation (1) as

$$s = \frac{1}{2} \times 10 \times 4^2 = 80 \text{ m}$$

Therefore, the stones will meet after 4 s at a height (100 − 80) = 20 m from the ground

Question 18:

A ball thrown up vertically returns to the thrower after 6 s. Find

(a) the velocity with which it was thrown up,

(b) the maximum height it reaches, and

(c) its position after 4 s.

Answer:

(a) 29.4 m/s (b) 44.1 m (c) 39.2 m above the ground

(a) Time of ascent is equal to the time of descent. The ball takes a total of 6 s for its upward and downward journey.

Hence, it has taken 3 s to attain the maximum height.

Final velocity of the ball at the maximum height, $v = 0$

Acceleration due to gravity, $g = -9.8 \text{ m s}^{-2}$

Equation of motion, $v = u + gt$ will give,

$0 = u + (-9.8 \times 3)$

$u = 9.8 \times 3 = 29.4 \text{ ms}^{-1}$

Hence, the ball was thrown upwards with a velocity of 29.4 m s^{-1}.

(b) Let the maximum height attained by the ball be h.

Initial velocity during the upward journey, $u = 29.4 \text{ m s}^{-1}$

Final velocity, $v = 0$

Acceleration due to gravity, $g = -9.8\ m\ s^{-2}$

From the equation of motion, $s = ut + \frac{1}{2}at^2$

$$h = 29.4 \times 3 + \frac{1}{2} \times -9.8 \times (3)^2 = 44.1\ m$$

(c) Ball attains the maximum height after 3 s. After attaining this height, it will start falling downwards.

In this case,

Initial velocity, $u = 0$

Position of the ball after 4 s of the throw is given by the distance travelled by it during its downward journey in 4 s − 3 s = 1 s.

Equation of motion, $s = ut + \frac{1}{2}gt^2$ will give,

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

Total height = 44.1 m

This means that the ball is 39.2 m (44.1 m − 4.9 m) above the ground after 4 seconds.

Question 19:

In what direction does the buoyant force on an object immersed in a liquid act?

Answer:

An object immersed in a liquid experiences buoyant force in the upward direction.

Question 20:

Why does a block of plastic released under water come up to the surface of water?

Answer:

Two forces act on an object immersed in water. One is the gravitational force, which pulls the object downwards, and the other is the buoyant force, which pushes the object upwards. If the upward buoyant force is greater than the downward gravitational force, then the object comes up to the surface of the water as soon as it

is released within water. Due to this reason, a block of plastic released under water comes up to the surface of the water.

Question 21:

The volume of 50 g of a substance is 20 cm^3. If the density of water is 1 g cm^{-3}, will the substance float or sink?

Answer:

If the density of an object is more than the density of a liquid, then it sinks in the liquid. On the other hand, if the density of an object is less than the density of a liquid, then it floats on the surface of the liquid.

Here, density of the substance = $\frac{\text{Mass of the substance}}{\text{Volume of the substance}} = \frac{50}{20} = 2.5 \text{ g cm}^{-3}$

The density of the substance is more than the density of water (1 g cm^{-3}). Hence, the substance will sink in water.

Question 22:

The volume of a 500 g sealed packet is 350 cm^3. Will the packet float or sink in water if the density of water is 1 g cm^{-3}? What will be the mass of the water displaced by this packet?

Answer:

Density of the 500 g sealed packet $= \frac{\text{Mass of the packet}}{\text{Volume of the packet}} = \frac{500}{350} = 1.428 \text{ g cm}^{-3}$

The density of the substance is more than the density of water (1 g cm^{-3}). Hence, it will sink in water.

The mass of water displaced by the packet is equal to the volume of the packet, i.e., 350 g.

Question 1:

A force of 7 N acts on an object. The displacement is, say 8 m, in the direction of the force (Fig. 11.3). Let us take it that the force acts on the object through the displacement. What is the work done in this case?

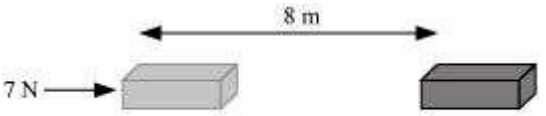


Fig 11.3

Answer:

When a force *F* acts on an object to displace it through a distance *S* in its direction, then the work done *W* on the body by the force is given by:

Work done = Force × Displacement

$W = F \times S$

Where,

$F = 7$ N

$S = 8$ m

Therefore, work done, $W = 7 \times 8$

= 56 Nm

= 56 J

Question 1:

When do we say that work is done?

Answer:

Work is done whenever the given conditions are satisfied:

(i) A force acts on the body.

(ii) There is a displacement of the body caused by the applied force along the direction of the applied force.

Question 2:

Write an expression for the work done when a force is acting on an object in the direction of its displacement.

Answer:

When a force F displaces a body through a distance S in the direction of the applied force, then the work done W on the body is given by the expression:

Work done = Force × Displacement

$W = F \times s$

Question 3:

Define 1 J of work.

Answer:

1 J is the amount of work done by a force of 1 N on an object that displaces it through a distance of 1 m in the direction of the applied force.

Question 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?

Answer:

Work done by the bullocks is given by the expression:

Work done = Force × Displacement

$W = F \times d$

Where,

Applied force, F = 140 N

Displacement, d = 15 m

$W = 140 \times 15 = 2100$ J

Hence, 2100 J of work is done in ploughing the length of the field.

Question 1:

What is the kinetic energy of an object?

Answer:

Kinetic energy is the energy possessed by a body by the virtue of its motion. Every moving object possesses kinetic energy. A body uses kinetic energy to do work. Kinetic energy of hammer is used in driving a nail into a log of wood, kinetic energy of air is used to run wind mills, etc.

Question 2:

Write an expression for the kinetic energy of an object.

Answer:

If a body of mass *m* is moving with a velocity *v*, then its kinetic energy E_K is given by the expression,

$$E_k = \frac{1}{2}mv^2$$

Its SI unit is Joule (J).

Question 3:

The kinetic energy of an object of mass, *m* moving with a velocity of 5 m s^{-1} is 25 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?

Answer:

Expression for kinetic energy is $E_k = \frac{1}{2}mv^2$

m = Mass of the object

v = Velocity of the object = 5 m s^{-1}

Given that kinetic energy, E_K = 25 J

(i) If the velocity of an object is doubled, then *v* = 5 × 2 = 10 m s^{-1}.

Therefore, its kinetic energy becomes 4 times its original value, because it is proportional to the square of the velocity. Hence, kinetic energy = 25 × 4 = 100 J.

(ii) If velocity is increased three times, then its kinetic energy becomes 9 times its original value, because it is proportional to the square of the velocity. Hence, kinetic energy = 25 × 9 = 225 J.

Question 1:

What is power?

Answer:

Power is the rate of doing work or the rate of transfer of energy. If *W* is the amount of work done in time *t*, then power is given by the expression,

$$\text{Power} = \frac{\text{Work}}{\text{Time}} = \frac{\text{Energy}}{\text{Time}}$$

$$P = \frac{W}{T}$$

It is expressed in watt (W).

Question 2:

Define 1 watt of power:

Answer:

A body is said to have power of 1 watt if it does work at the rate of 1 joule in 1 s, i.e.,

$$1\ \text{W} = \frac{1\ \text{J}}{1\ \text{s}}$$

Question 3:

A lamp consumes 1000 J of electrical energy in 10 s. What is its power?

Answer:

Power is given by the expression,

$$\text{Power} = \frac{\text{Work done}}{\text{Time}}$$

Work done = Energy consumed by the lamp = 1000 J

Time = 10 s

$$\text{Power} = \frac{1000}{10} = 100\ \text{J s}^{-1}$$

= 100 W

Question 4:

Define average power.

Answer:

A body can do different amount of work in different time intervals. Hence, it is better to define average power. Average power is obtained by dividing the total amount of work done in the total time taken to do this work.

$$\text{Average Power} = \frac{\text{Total work done}}{\text{Total time taken}}$$

Question 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.

Answer:

Work is done whenever the given two conditions are satisfied:

(i) A force acts on the body.

(ii) There is a displacement of the body by the application of force in or opposite to the direction of force.

(a) While swimming, Suma applies a force to push the water backwards. Therefore, Suma swims in the forward direction caused by the forward reaction of water. Here, the force causes a displacement. Hence, work is done by Seema while swimming.

(b) While carrying a load, the donkey has to apply a force in the upward direction. But, displacement of the load is in the forward direction. Since, displacement is perpendicular to force, the work done is zero.

(c) A wind mill works against the gravitational force to lift water. Hence, work is done by the wind mill in lifting water from the well.

(d) In this case, there is no displacement of the leaves of the plant. Therefore, the work done is zero.

(e) An engine applies force to pull the train. This allows the train to move in the direction of force. Therefore, there is a displacement in the train in the same direction. Hence, work is done by the engine on the train.

(f) Food grains do not move in the presence of solar energy. Hence, the work done is zero during the process of food grains getting dried in the Sun.

(g)Wind energy applies a force on the sailboat to push it in the forward direction. Therefore, there is a displacement in the boat in the direction of force. Hence, work is done by wind on the boat.

Question 2:

An object thrown at a certain angle to the ground moves in a curved path and falls 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?

Answer:

Work done by the force of gravity on an object depends only on vertical displacement. Vertical displacement is given by the difference in the initial and final positions/heights of the object, which is zero.

Work done by gravity is given by the expression,

$W = mgh$

Where,

h = Vertical displacement = 0

$W = mg \times 0 = 0$ J

Therefore, the work done by gravity on the given object is zero joule.

Question 3:

A battery lights a bulb. Describe the energy changes involved in the process.

Answer:

When a bulb is connected to a battery, then the chemical energy of the battery is transferred into electrical energy. When the bulb receives this electrical energy, then it converts it into light and heat energy. Hence, the transformation of energy in the given situation can be shown as:

$$\text{Chemical Energy} \rightarrow \text{Electrical Energy} \rightarrow \text{Light Energy} + \text{Heat energy}$$

Question 4:

Certain force acting on a 20 kg mass changes its velocity from 5 m s^{-1} to 2 m s^{-1}. Calculate the work done by the force.

Answer:

Kinetic energy is given by the expression,

$$(E_k)_v = \frac{1}{2}mv^2$$

Where,

E_k = Kinetic energy of the object moving with a velocity, v

m = Mass of the object

(i) Kinetic energy when the object was moving with a velocity 5 m s^{-1}

$$(E_k)_5 = \frac{1}{2} \times 20 \times (5)^2 = 250 \text{ J}$$

(ii) Kinetic energy when the object was moving with a velocity 2 m s^{-1}

$$(E_k)_2 = \frac{1}{2} \times 20 \times (5)^2 = 40 \text{ J}$$

Work done by force is equal to the change in kinetic energy.

Therefore, work done by force = $(E_k)_2 - (E_k)_5$

= 40 − 250 = −210 J

The negative sign indicates that the force is acting in the direction opposite to the motion of the object.

Question 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.

Answer:

Work done by gravity depends only on the vertical displacement of the body. It does not depend upon the path of the body. Therefore, work done by gravity is given by the expression,

$W = mgh$

Where,

Vertical displacement, $h = 0$

$\therefore W = mg \times 0 = 0$

Hence, the work done by gravity on the body is zero.

Question 6:

The potential energy of a freely falling object decreases progressively. Does this violate the law of conservation of energy? Why?

Answer:

No. The process does not violate the law of conservation of energy. This is because when the body falls from a height, then its potential energy changes into kinetic energy progressively. A decrease in the potential energy is equal to an increase in the kinetic energy of the body. During the process, total mechanical energy of the body remains conserved. Therefore, the law of conservation of energy is not violated.

Question 7:

What are the various energy transformations that occur when you are riding a bicycle?

Answer:

While riding a bicycle, the muscular energy of the rider gets transferred into heat energy and kinetic energy of the bicycle. Heat energy heats the rider's body. Kinetic energy provides a velocity to the bicycle. The transformation can be shown as:

$$\text{Muscular Energy} \rightarrow \text{Kinetic Energy} + \text{Heat Energy}$$

During the transformation, the total energy remains conserved.

Question 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?

Answer:

When we push a huge rock, there is no transfer of muscular energy to the stationary rock. Also, there is no loss of energy because muscular energy is transferred into heat energy, which causes our body to become hot.

Question 9:

A certain household has consumed 250 units of energy during a month. How much energy is this in joules?

Answer:

1 unit of energy is equal to 1 kilowatt hour (kWh).

1 unit = 1 kWh

1 kWh = 3.6×10^6 J

Therefore, 250 units of energy = $250 \times 3.6 \times 10^6 = 9 \times 10^8$ J

Question 10:

An object of mass 40 kg is raised to a height of 5 m 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.

Answer:

Gravitational potential energy is given by the expression,

$W = mgh$

Where,

h = Vertical displacement = 5 m

m = Mass of the object = 40 kg

g = Acceleration due to gravity = 9.8 m s^{-2}

$\therefore W = 40 \times 5 \times 9.8 = 1960$ J.

At half-way down, the potential energy of the object will be $\frac{1960}{2}$ = 980 J.

At this point, the object has an equal amount of potential and kinetic energy. This is due to the law of conservation of energy. Hence, half-way down, the kinetic energy of the object will be 980 J.

Question 11:

What is the work done by the force of gravity on a satellite moving round the earth? Justify your answer.

Answer:

Work is done whenever the given two conditions are satisfied:

(i) A force acts on the body.

(ii) There is a displacement of the body by the application of force in or opposite to the direction of force.

If the direction of force is perpendicular to displacement, then the work done is zero.

When a satellite moves around the Earth, then the direction of force of gravity on the satellite is perpendicular to its displacement. Hence, the work done on the satellite by the Earth is zero.

Question 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.

Answer:

Yes. For a uniformly moving object

Suppose an object is moving with constant velocity. The net force acting on it is zero. But, there is a displacement along the motion of the object. Hence, there can be a displacement without a force.

Question 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.

Answer:

Work is done whenever the given two conditions are satisfied:

(i) A force acts on the body.

(ii) There is a displacement of the body by the application of force in or opposite to the direction of force.

When a person holds a bundle of hay over his head, then there is no displacement in the bundle of hay. Although, force of gravity is acting on the bundle, the person is not applying any force on it. Hence, in the absence of force, work done by the person on the bundle is zero.

Question 14:

An electric heater is rated 1500 W. How much energy does it use in 10 hours?

Answer:

Energy consumed by an electric heater can be obtained with the help of the expression,

$$P = \frac{W}{T}$$

Where,

Power rating of the heater, P = 1500 W = 1.5 kW

Time for which the heater has operated, T = 10 h

Work done = Energy consumed by the heater

Therefore, energy consumed = Power × Time

= 1.5 × 10 = 15 kWh

Hence, the energy consumed by the heater in 10 h is 15 kWh.

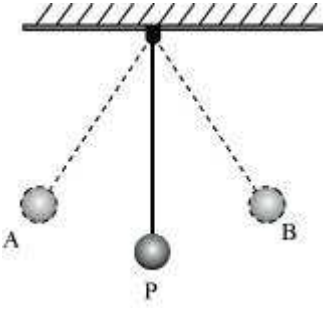
Question 15:

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?

Answer:

The law of conservation of energy states that energy can be neither created nor destroyed. It can only be converted from one form to another.

Consider the case of an oscillating pendulum.



When a pendulum moves from its mean position P to either of its extreme positions A or B, it rises through a height h above the mean level P. At this point, the kinetic energy of the bob changes completely into potential energy. The kinetic energy becomes zero, and the bob possesses only potential energy. As it moves towards point P, its potential energy decreases progressively. Accordingly, the kinetic energy

increases. As the bob reaches point P, its potential energy becomes zero and the bob possesses only kinetic energy. This process is repeated as long as the pendulum oscillates.

The bob does not oscillate forever. It comes to rest because air resistance resists its motion. The pendulum loses its kinetic energy to overcome this friction and stops after some time.

The law of conservation of energy is not violated because the energy lost by the pendulum to overcome friction is gained by its surroundings. Hence, the total energy of the pendulum and the surrounding system remain conserved.

Question 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?

Answer:

Kinetic energy of an object of mass, *m* moving with a velocity, *v* is given by the expression,

$$E_k = \frac{1}{2}mv^2$$

To bring the object to rest, $\frac{1}{2}mv^2$ amount of work is required to be done on the object.

Question 17:

Calculate the work required to be done to stop a car of 1500 kg moving at a velocity of 60 km/h?

Answer:

Kinetic energy, $E_k = \frac{1}{2}mv^2$

Where,

Mass of car, *m* = 1500 kg

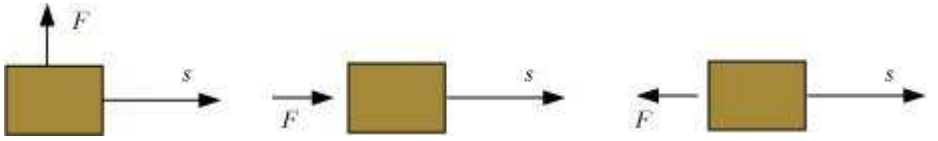
Velocity of car, *v* = 60 km/h $= 60 \times \frac{5}{18}\ \mathrm{m\,s^{-1}}$

$$\therefore E_k = \frac{1}{2} \times 1500 \times \left(60 \times \frac{5}{18}\right)^2 = 20.8 \times 10^4 \text{ J}$$

Hence, 20.8×10^4 J of work is required to stop the car.

Question 18:

In each of the following a force, *F* is acting on an object of mass, *m*. The direction of 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.



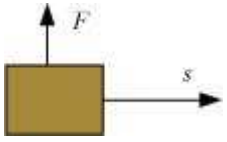
Answer:

Work is done whenever the given two conditions are satisfied:

(i) A force acts on the body.

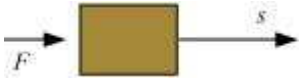
(ii) There is a displacement of the body by the application of force in or opposite to the direction of force.

Case I



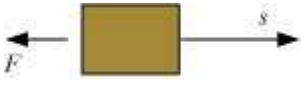
In this case, the direction of force acting on the block is perpendicular to the displacement. Therefore, work done by force on the block will be zero.

Case II



In this case, the direction of force acting on the block is in the direction of displacement. Therefore, work done by force on the block will be positive.

Case III



In this case, the direction of force acting on the block is opposite to the direction of displacement. Therefore, work done by force on the block will be negative.

Question 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?

Answer:

Acceleration in an object could be zero even when several forces are acting on it. This happens when all the forces cancel out each other i.e., the net force acting on the object is zero. For a uniformly moving object, the net force acting on the object is zero. Hence, the acceleration of the object is zero. Hence, Soni is right.

Question 20:

Find the energy in kW h consumed in 10 hours by four devices of power 500 W each.

Answer:

Energy consumed by an electric device can be obtained with the help of the expression for power,

$$P = \frac{W}{T}$$

Where,

Power rating of the device, P = 500 W = 0.50 kW

Time for which the device runs, T = 10 h

Work done = Energy consumed by the device

Therefore, energy consumed = Power × Time

= 0.50 × 10 = 5 kWh

Hence, the energy consumed by four equal rating devices in 10 h will be 4 × 5 kWh = 20 kWh = 20 Units.

Question 21:

A freely falling object eventually stops on reaching the ground. What happens to its kinetic energy?

Answer:

When an object falls freely towards the ground, its potential energy decreases and kinetic energy increases. As the object touches the ground, all its potential energy gets converted into kinetic energy. As the object hits the hard ground, all its kinetic energy gets converted into heat energy and sound energy. It can also deform the ground depending upon the nature of the ground and the amount of kinetic energy possessed by the object.

Question 1:

How does the sound produced by a vibrating object in a medium reach your ear?

Answer:

When an object vibrates, it forces the neighbouring particles of the medium to vibrate. These vibrating particles then force the particles adjacent to them to vibrate. In this way, vibrations produced by an object are transferred from one particle to another till it reaches the ear.

Question 1:

Explain how sound is produced by your school bell.

Answer:

When the school bell vibrates, it forces the adjacent particles in air to vibrate. This disturbance gives rise to a wave and when the bell moves forward, it pushes the air in front of it. This creates a region of high pressures known as compression. When the bell moves backwards, it creates a region of low pressure know as rarefaction. As the bell continues to move forward and backward, it produces a series of compressions and rarefactions. This makes the sound of a bell propagate through air.

Question 2:

Why are sound waves called mechanical waves?

Answer:

Sound waves force the medium particles to vibrate. Hence, these waves are known as mechanical waves. Sound waves propagate through a medium because of the interaction of the particles present in that medium.

Question 3:

Suppose you and your friend are on the moon. Will you be able to hear any sound produced by your friend?

Answer:

Sound needs a medium to propagate. Since the moon is devoid of any atmosphere, you cannot hear any sound on the moon.

Question 1:

Which wave property determines (a) loudness, (b) pitch?

Answer:

(a) Amplitude (b) Frequency

(a) The loudness of a sound depends on its amplitude. If the amplitude of a sound is large, then the sound produced will also be loud.

(b) The pitch of a sound depends on its frequency. A sound will be considered a high pitched sound, if its frequency is high.

Question 2:

Guess which sound has a higher pitch: guitar or car horn?

Answer:

The frequency of the vibration of a sound produced by a guitar is greater than that produced by a car horn. Since the pitch of a sound is proportional to its frequency, the guitar has a higher pitch than a car horn.

Question 1:

What are wavelength, frequency, time period and amplitude of a sound wave?

Answer:

Wavelength: The distance between two consecutive compressions or two consecutive rarefactions is known as the wavelength. Its SI unit is metre (m).

Frequency: The number of complete oscillations per second is known as the frequency of a sound wave. It is measured in hertz (Hz).

Amplitude: The maximum height reached by the crest or trough of a sound wave is called its amplitude.

Question 2:

How are the wavelength and frequency of a sound wave related to its speed?

Answer:

Speed, wavelength, and frequency of a sound wave are related by the following equation:

Speed (v) = Wavelength (λ) × Frequency (υ)

$$v = \lambda \times \upsilon$$

Question 3:

Calculate the wavelength of a sound wave whose frequency is 220 Hz and speed is 440 m/s in a given medium.

Answer:

Frequency of the sound wave, υ = 220 Hz

Speed of the sound wave, v = 440 m s^{-1}

For a sound wave,

Speed = Wavelength × Frequency

$$v = \lambda \times \upsilon$$

$$\therefore \lambda = \frac{v}{\upsilon} = \frac{440}{220} = 2 \text{ m}$$

Hence, the wavelength of the sound wave is 2 m.

Question 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?

Answer:

The time interval between two successive compressions is equal to the time period of the wave. This time period is reciprocal of the frequency of the wave and is given by the relation:

$$T = \frac{1}{\text{Frequency}} = \frac{1}{500} = 0.002 \text{ s}$$

Question 1:

Distinguish between loudness and intensity of sound.

Answer:

Intensity of a sound wave is defined as the amount of sound energy passing through a unit area per second. Loudness is a measure of the response of the ear to the sound. The loudness of a sound is defined by its amplitude. The amplitude of a sound decides its intensity, which in turn is perceived by the ear as loudness.

Question 1:

In which of the three media, air, water or iron, does sound travel the fastest at a particular temperature?

Answer:

The speed of sound depends on the nature of the medium. Sound travels the fastest in solids. Its speed decreases in liquids and it is the slowest in gases.

Therefore, for a given temperature, sound travels fastest in iron.

Question 1:

An echo returned in 3 s. What is the distance of the reflecting surface from the source, given that the speed of sound is 342 m s^{-1}?

Answer:

Speed of sound, v = 342 m s^{-1}

Echo returns in time, t = 3 s

Distance travelled by sound = $v \times t$ = 342 × 3 = 1026 m

In the given time interval, sound has to travel a distance that is twice the distance of the reflecting surface and the source.

Hence, the distance of the reflecting surface from the source $= \frac{1026}{2}\ \text{m} = 513\ \text{m}$

Question 1:

Why are the ceilings of concert halls curved?

Answer:

Ceilings of concert halls are curved so that sound after reflection (from the walls) spreads uniformly in all directions.

Question 1:

What is the audible range of the average human ear?

Answer:

The audible range of an average human ear lies between 20 Hz to 20,000 Hz. Humans cannot hear sounds having frequency less than 20 Hz and greater than 20,000 Hz.

Question 2:

What is the range of frequencies associated with

(a) Infrasound?

(b) Ultrasound?

Answer:

(a) Infrasound has frequencies less than 20 Hz.

(b) Ultrasound has frequencies more than 20,000 Hz.

Question 1:

A submarine emits a sonar pulse, which returns from an underwater cliff in 1.02 s. If the speed of sound in salt water is 1531 m/s, how far away is the cliff?

Answer:

Time taken by the sonar pulse to return, t = 1.02 s

Speed of sound in salt water, v = 1531 m s^{-1}

Distance of the cliff from the submarine = Speed of sound × Time taken

Distance of the cliff from the submarine $= 1.02 \times 1531 = 1561.62$ m

Distance travelled by the sonar pulse during its transmission and reception in water = 2 × Actual distance = 2d

$$\text{Actual distance, } d = \frac{\text{Distance of the cliff from the submarine}}{2}$$

$$= \frac{1561.62}{2} = 780.31 \text{ m}$$

Question 1:

What is sound and how is it produced?

Answer:

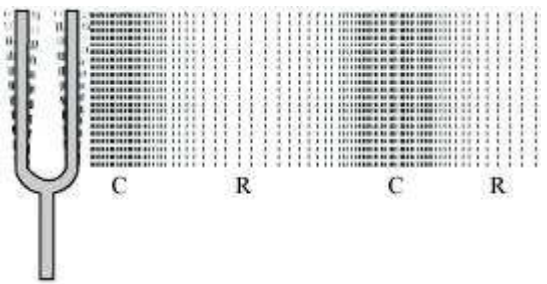
Sound is produced by vibration. When a body vibrates, it forces the neighbouring particles of the medium to vibrate. This creates a disturbance in the medium, which travels in the form of waves. This disturbance, when reaches the ear, produces sound.

Question 2:

Describe with the help of a diagram, how compressions and rarefactions are produced in air near a source of sound.

Answer:

When a vibrating body moves forward, it creates a region of high pressure in its vicinity. This region of high pressure is known as compressions. When it moves backward, it creates a region of low pressure in its vicinity. This region is known as a rarefaction. As the body continues to move forward and backwards, it produces a series of compressions and rarefactions (as shown in the following figure).

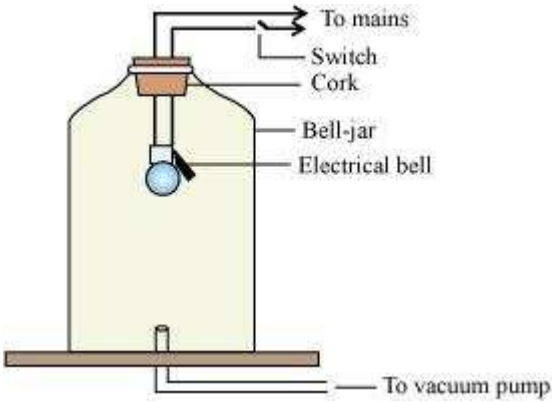


Question 3:

Cite an experiment to show that sound needs a material medium for its propagation.

Answer:

Take an electric bell and hang this bell inside an empty bell-jar fitted with a vacuum pump (as shown in the following figure).



Initially, one can hear the sound of the ringing bell. Now, pump out some air from the bell-jar using the vacuum pump. It will be observed that the sound of the ringing bell decreases. If one keeps on pumping the air out of the bell-jar, then at one point, the glass-jar will be devoid of any air. At this moment, no sound can be heard from the ringing bell although one can see that the prong of the bell is still vibrating. When there is no air present inside, we can say that a vacuum is produced. Sound cannot travel through vacuum. This shows that sound needs a material medium for its propagation.

Question 4:

Why is sound wave called a longitudinal wave?

Answer:

The vibration of the medium that travels along or parallel to the direction of the wave is called a longitudinal wave. In a sound wave, the particles of the medium vibrate in the direction parallel to the direction of the propagation of disturbance. Hence, a sound wave is called a longitudinal wave.

Question 5:

Which characteristics of the sound helps you to identify your friend by his voice while sitting with others in a dark room?

Answer:

Quality of sound is that characteristic which helps us identify a particular person. Sound produced by two persons may have the same pitch and loudness, but the quality of the two sounds will be different.

Question 6:

Flash and thunder are produced simultaneously. But thunder is heard a few seconds after the flash is seen, why?

Answer:

The speed of sound $(344\ \text{m/s})$ is less than the speed of light $(3\times10^{8}\ \text{m/s})$. Sound of thunder takes more time to reach the Earth as compared to light. Hence, a flash is seen before we hear a thunder.

Question 7:

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 m s^{-1}.

Answer:

For a sound wave,

Speed = Wavelength × Frequency

$v = \lambda \times \upsilon$

Given that the speed of sound in air = 344 m/s

(i) For, υ = 20 Hz

$$\lambda_1 = \frac{v}{\upsilon_1} = \frac{344}{20} = 17.2\ \text{m}$$

(ii) For, $\upsilon_2 = 20{,}000\ \text{Hz}$

$$\lambda_2 = \frac{v}{\upsilon_2} = \frac{344}{20{,}000} = 0.0172\ \text{m}$$

Hence, for humans, the wavelength range for hearing is 0.0172 m to 17.2 m.

Question 8:

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 aluminium to reach the second child.

Answer:

Let the length of the aluminium rod be *d*.

Speed of sound wave in aluminium at 25°C, $v_{Al} = 6420\ \text{m s}^{-1}$

Therefore, time taken by the sound wave to reach the other end,

$$t_{Al} = \frac{d}{v_{Al}} = \frac{d}{6420}$$

Speed of sound wave in air at 25°C, $v_{Air} = 346\ \text{m s}^{-1}$

Therefore, time taken by sound wave to reach the other end,

$$t_{Air} = \frac{d}{v_{Air}} = \frac{d}{346}$$

The ratio of time taken by the sound wave in air and aluminium:

$$\frac{t_{Air}}{t_{Al}} = \frac{\frac{d}{346}}{\frac{d}{6420}} = \frac{6420}{346} = 18.55$$

Question 9:

The frequency of a source of sound is 100 Hz. How many times does it vibrate in a minute?

Answer:

Frequency is defined as the number of oscillations per second. It is given by the relation:

$$\text{Frequency} = \frac{\text{Number of oscillations}}{\text{Total time}}$$

Number of oscillations = Frequency × Total time

Given, Frequency of sound = 100 Hz

Total time = 1 min = 60 s

Number of oscillations/Vibrations = 100 × 60 = 6000

Hence, the source vibrates 6000 times in a minute, producing a frequency of 100 Hz.

Question 10:

Does sound follow the same laws of reflection as light does? Explain.

Answer:

Sound follows the same laws of reflection as light does. The incident sound wave and the reflected sound wave make the same angle with the normal to the surface at the point of incidence. Also, the incident sound wave, the reflected sound wave, and the normal to the point of incidence all lie in the same plane.

Question 11:

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?

Answer:

An echo is heard when the time interval between the original sound and the reflected sound is at least 0.1 s. The speed of sound in a medium increases with an increase in temperature. Hence, on a hotter day, the time interval between the original sound and the reflected sound will decrease. Therefore, an echo can be heard only if the time interval between the original sound and the reflected sound is greater than 0.1 s.

Question 12:

Give two practical applications of reflection of sound waves.

Answer:

(i) Reflection of sound is used to measure the distance and speed of underwater objects. This method is known as SONAR.

(ii) Working of a stethoscope is also based on reflection of sound. In a stethoscope, the sound of the patient's heartbeat reaches the doctor's ear by multiple reflection of sound.

Question 13:

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 m s^{-2} and speed of sound = 340 m s^{-1}.

Answer:

Height of the tower, s = 500 m

Velocity of sound, v = 340 m s^{-1}

Acceleration due to gravity, g = 10 m s^{-2}

Initial velocity of the stone, u = 0 (since the stone is initially at rest)

Time taken by the stone to fall to the base of the tower, t_1

According to the second equation of motion:

$$s = ut_1 + \frac{1}{2}gt_1^2$$

$$500 = 0 \times t_1 + \frac{1}{2} \times 10 \times t_1^2$$

$$t_1^2 = 100$$

$$t_1 = 10 \text{ s}$$

Now, time taken by the sound to reach the top from the base of the tower,

$$t_2 = \frac{500}{340} = 1.47 \text{ s}$$

Therefore, the splash is heard at the top after time, t

Where, $t = t_1 + t_2 = 10 + 1.47 = 11.47 \text{ s}$

Question 14:

A sound wave travels at a speed of 339 m s^{-1}. If its wavelength is 1.5 cm, what is the frequency of the wave? Will it be audible?

Answer:

Speed of sound, v = 339 m s^{-1}

Wavelength of sound, λ = 1.5 cm = 0.015 m

Speed of sound = Wavelength × Frequency

$$v = \lambda \times \upsilon$$

$$\therefore \upsilon = \frac{v}{\lambda} = \frac{339}{0.015} = 22600 \text{ Hz}$$

The frequency range of audible sound for humans lies between 20 Hz to 20,000 Hz. Since the frequency of the given sound is more than 20,000 Hz, it is not audible.

Question 15:

What is reverberation? How can it be reduced?

Answer:

Persistence of sound (after the source stops producing sound) due to repeated reflection is known as reverberation. As the source produces sound, it starts travelling in all directions. Once it reaches the wall of a room, it is partly reflected back from the wall. This reflected sound reaches the other wall and again gets reflected partly. Due to this, sound can be heard even after the source has ceased to produce sound.

To reduce reverberations, sound must be absorbed as it reaches the walls and the ceiling of a room. Sound absorbing materials like fibreboard, rough plastic, heavy curtains, and cushioned seats can be used to reduce reverberation.

Question 16:

What is loudness of sound? What factors does it depend on?

Answer:

A loud sound has high energy. Loudness depends on the amplitude of vibrations. In fact, loudness is proportional to the square of the amplitude of vibrations.

Question 17:

Explain how bats use ultrasound to catch a prey.

Answer:

Bats produce high-pitched ultrasonic squeaks. These high-pitched squeaks are reflected by objects such as preys and returned to the bat's ear. This allows a bat to know the distance of his prey.

Question 18:

How is ultrasound used for cleaning?

Answer:

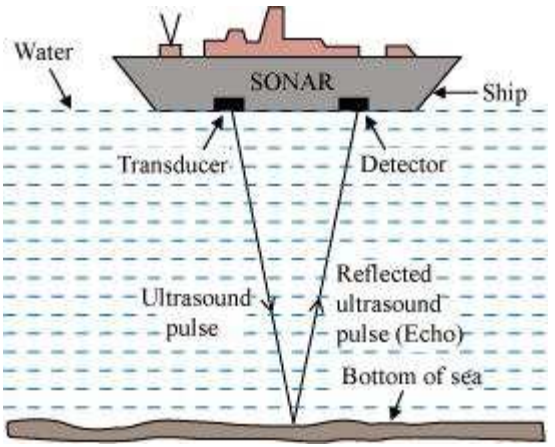
Objects to be cleansed are put in a cleaning solution and ultrasonic sound waves are passed through that solution. The high frequency of these ultrasound waves detaches the dirt from the objects.

Question 19:

Explain the working and application of a sonar.

Answer:

SONAR is an acronym for **S**ound **N**avigation **A**nd **R**anging. It is an acoustic device used to measure the depth, direction, and speed of under-water objects such as submarines and ship wrecks with the help of ultrasounds. It is also used to measure the depth of seas and oceans.



A beam of ultrasonic sound is produced and transmitted by the transducer (it is a device that produces ultrasonic sound) of the SONAR, which travels through sea water. The echo produced by the reflection of this ultrasonic sound is detected and recorded by the detector, which is converted into electrical signals. The distance (d) of the under-water object is calculated from the time (t) taken by the echo to return with speed (v) is given by $2d = v \times t$. This method of measuring distance is also known as 'echo-ranging'.

Question 20:

A sonar device on a submarine sends out a signal and receives an echo 5 s later. Calculate the speed of sound in water if the distance of the object from the submarine is 3625 m.

Answer:

Time taken to hear the echo, t = 5 s

Distance of the object from the submarine, d = 3625 m

Total distance travelled by the sonar waves during the transmission and reception in water = 2*d*

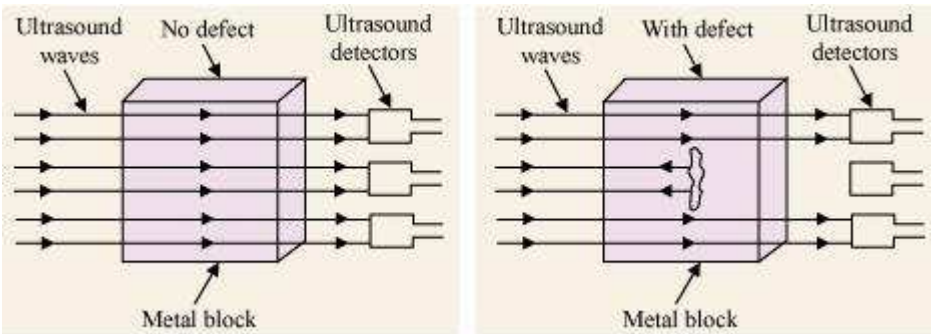
Velocity of sound in water, $v = \frac{2d}{t} = \frac{2 \times 3625}{5} = 1450 \text{ m s}^{-1}$

Question 21:

Explain how defects in a metal block can be detected using ultrasound.

Answer:

Defects in metal blocks do not allow ultrasound to pass through them and they are reflected back. This fact is used to detect defects in metal blocks. Ultrasound is passed through one end of a metal block and detectors are placed on the other end. The defective part of the metal block does not allow ultrasound to pass through it. As a result, it will not be detected by the detector. Hence, defects in metal blocks can be detected using ultrasound.



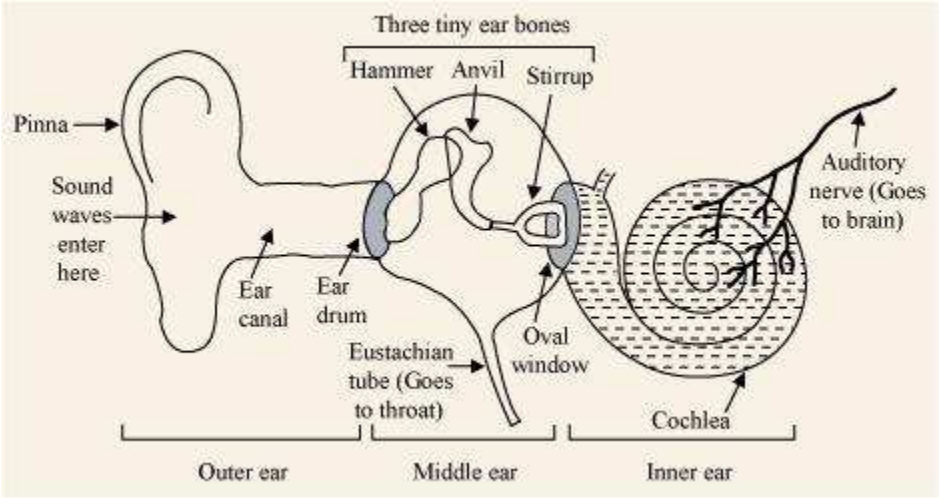
Question 22:

Explain how the human ear works.

Answer:

Different sounds produced in our surroundings are collected by pinna that sends these sounds to the ear drum via the ear canal. The ear drum starts vibrating back and forth rapidly when the sound waves fall on it. The vibrating eardrum sets the small bone hammer into vibration. The vibrations are passed from the hammer to the second bone anvil, and finally to the third bone stirrup. The vibrating stirrup strikes on the membrane of the oval window and passes its vibration to the liquid in the cochlea. This produces electrical impulses in nerve cells. The auditory nerve

carries these electrical impulses to the brain. These electrical impulses are interpreted by the brain as sound and we get a sensation of hearing.



Question 1:

State any two conditions essential for good health.

Answer:

The twoconditions essential for good health are:

(i) An individual must have better health facilities and more professionals to deal with health problems.

(ii) All basic necessary conditions to prevent diseases must be present. For example, proper garbage collection and disposal, clearing of drains, supply of healthy drinking water, etc.

Question 2:

State any two conditions essential for being free of disease.

Answer:

The twoconditions essential for being free of diseases are:

(i) Personal hygiene and cleanliness are necessary to stay away from diseases.

(ii) Individuals should take a balanced diet that contains carbohydrates, fats, proteins, vitamins, fibres, and proper quantity of water.

Question 3:

Are the answers to the above questions necessarily the same or different? Why?

Answer:

No. The answers to the above questions may not necessarily be the same. This is because a disease free state is not the same as being healthy. Good health is the ability of an individual to realise his or her full potential. Individuals can have poor health without having any identifiable disease. Also, health is related to society and community, whereas having a disease is about an individual sick person. Hence, the conditions for good health and for being disease free can be same or even different.

Question 1:

List any three reasons why you would think that you are sick and ought to see a doctor. If only one of these symptoms were present, would you still go to the doctor? Why or why not?

Answer:

Symptoms such as a headache, stomach pain, nausea, vomiting, fever, etc., make us feel that we are sick and must visit a doctor. These symptoms basically indicate that there might be a disease, but we cannot predict the kind of disease. Therefore, it becomes necessary to visit a doctor so that the disease can be identified and can be treated with proper medication.

However, if only one of these symptoms is present, we usually do not visit a doctor. This is because such symptoms do not have much effect on our general health and ability to work. However, if a person is experiencing these symptoms for quite sometime, then he needs to visit a doctor for proper treatment.

Question 2:

In which of the following case do you think the long-term effects on your health are likely to be most unpleasant?

- If you get jaundice,
- if you get lice,
- If you get acne.

Why?

Answer:

Jaundice is a disease that can cause long-term effects on our health. It is a chronic disease that lasts for a long period of time. Jaundice does not spread rapidly, but it develops slowly over a period of time.

Question 1:

Why are we normally advised to take bland and nourishing food when we are sick?

Answer:

We are normally advised to consume bland and nourishing food when we are sick so that we can get the nutrients and energy quickly to fight off the foreign disease-causing agents.

Question 2:

What are the different means by which infectious diseases are spread?

Answer:

Diseases can be spread through various means such as air, water, sexual contact, blood, and vector.

(i) Certain disease-causing micro-organisms are expelled in **air** by coughing, sneezing, talking, etc. These micro-organisms can travel through dust particles or water droplets in air to reach other people. For example, tuberculosis, pneumonia, etc. spread through air.

(ii) Sometimes causal micro-organisms get mixed with drinking **water** and spread water borne diseases. Cholera for example is water borne disease.

(iii) **Sexual** act between two people can lead to the transfer of diseases such as syphilis, gonorrhoea, AIDS, etc.

(iv) Certain diseases such as AIDS can spread via **blood to blood** contact during blood transfusion or pregnancy.

(v) Certain diseases spread by animals called **vectors.** For example mosquitoes spread malaria.

Question 3:

What precautions can you take in your school to reduce the incidence of infectious diseases?

Answer:

Precautions to reduce incidence of infectious diseases are:

(i) Stay away from the diseased person.

(ii) Cover your mouth or nose while coughing or sneezing to prevent the spread of disease.

(iii) Drink safe water.

(iv) Keep the environment clean to prevent mosquitoes from breeding.

Question 4:

What is immunization?

Answer:

Immunizationis defined as protection of the body from communicable diseases by administration of some agent that mimics the microbe. This suspension of killed microbes that mimics the disease-causing microbes is known as vaccine.

Question 5:

What are the immunization programmes available at the nearest health centre in your locality? Which of these diseases are the major health problems in your area?

Answer:

The immunization programmes available at the nearest health centre are DPT (Diphtheria, Pertusis, and Tetanus), polio vaccine, hepatitis B, MMR (Measles, Mumps, and Rubella), jaundice, typhoid, etc.

Of all these diseases, jaundice and typhoid are major health problems.

Question 1:

How many times did you fall ill in the last one year? What were the illnesses?

(a) Think of one change you could make in your habits in order to avoid any of /most of the above illnesses.

(b) Think of one change you would wish for in your surroundings in order to avoid any of/most of the above illnesses.

Answer:

This varies from person to person. Some people fall ill several times in a year, while others do not fall ill at all. A person's immune system and hygiene-related habits play a major role in determining the person's health.

Question 2:

A doctor/nurse/health-worker is exposed to more sick people than others in the community. Find out how she/he avoids getting sick herself/himself.

Answer:

The following precautions must be taken by a doctor/ nurse/ health-worker:

(i) Wearing a mask when in contact with a diseased person.

(ii) Keeping yourself covered while moving around an infected place.

(iii) Drinking safe water.

(iv) Eating healthy and nutritious food.

(v) Ensuring proper cleanliness and personal hygiene.

Question 3:

Conduct a survey in your neighbourhood to find out what the three most common diseases are. Suggest three steps that could be taken by your local authorities to bring down the incidence of these diseases.

Answer:

Three most common diseases are:

(i) Tuberculosis

(ii) Typhoid

(iii) Jaundice

Steps to be taken to bring down the incidence of these diseases are:

(i) Proper disposal of sewage.

(ii) Ensuring supply of safe drinking water.

(iii) Providing a clean environment and preventing mosquitoes from breeding.

Question 4:

A baby is not able to tell her/his caretakers that she/he is sick. What would help us to find out

(a) that the baby is sick?

(b) what is the sickness?

Answer:

(a) The baby is sick can be determined by his/her behavioural changes such as constant crying of baby, improper intake of food, frequent mood changes, etc.

(b) The sickness is determined by symptoms or indications that can be seen in the baby. The symptoms include vomiting, fever, loose motion, paleness in the body, etc.

Question 5:

Under which of the following conditions is a person most likely to fall sick?

(a) when she is recovering from malaria.

(b) when she has recovered from malaria and is taking care of someone suffering from chicken-pox.

(c) when she is on a four-day fast after recovering from malaria and is taking care of someone suffering from chicken-pox.

Why?

Answer:

(c)A person is more likely to fall sick when she is on a four day fast after recovering from malaria and is taking care of someone who is suffering from chicken pox. This is because she is fasting during recovery, and her immune system is so weak that it is not able to protect its own body from any foreign infection. If she is taking care of someone suffering from chicken pox, then she has more chances of getting infected from chicken pox virus and will get sick again with this disease.

Question 6:

Under which of the following conditions are you most likely to fall sick?

(a) when you are taking examinations.

(b) when you have travelled by bus and train for two days.

(c) when your friend is suffering from measles.

Why?

Answer:

(c)You are more likely to fall sick when your friend is suffering from measles. This is because measles is highly contagious and can easily spread through respiration i.e., through air. Thus, if your friend is suffering from measles, stay away from him otherwise you might easily get infected with the disease.

Question 1:

How is our atmosphere different from the atmospheres on Venus and Mars?

Answer:

Earth's atmosphere is different from those of Venus and Mars. This difference lies essentially in their compositions. Earth's atmosphere is a mixture of nitrogen (79%), oxygen (20%), and a small fraction of carbon dioxide, water vapours and other gases. This makes the existence of life possible on Earth. However, the atmospheres on Venus and Mars mainly consist of carbon dioxide. The amount of carbon dioxide on these planets can range from 95% to 97%.

Question 2:

How does the atmosphere act as a blanket?

Answer:

The atmosphere acts as a blanket by performing the following functions:

(a) It keeps the average temperature of the Earth fairly constant during day time and even during the course of whole year.

(b) It prevents a sudden increase in the temperature during day time.

(c) It slows down the escape of heat from the surface of the Earth into outer space during night time.

Question 3:

What causes winds?

Answer:

An uneven heating of the Earth's surface causes winds. On being heated, air becomes lighter and rises up. As a result, a region of low pressure is created. Then, air from a high pressure region moves to a low pressure region, causing wind.

Question 4:

How are clouds formed?

Answer:

During day time, on being heated, a large amount of water evaporates from various water bodies and goes into the air. A part of this water vapour also reaches the atmosphere through biological activities such as transpiration and respiration. This

causes the air in the atmosphere to heat up. When this heated air rises, it expands and cools, which results in the condensation of water vapour forming water droplets. The presence of dust and other suspended particles in air also facilitates the process of condensation. The formation of water droplets leads to the formation of clouds.

Question 5:

List any three human activities that you think would lead to air pollution.

Answer:

The following three human activities would lead to air pollution:

(i) Burning of fossil fuels such as coal and petroleum

(ii) Industrialization

(iii) Deforestation

Question 1:

Why do organisms need water?

Answer:

Organisms need water for the following reasons:

(i) All cellular processes need water as a medium. Usually, the reactions that take place in our body or within the cells occur between substances that are dissolved in water.

(ii) Since most of the substances are transported in a dissolved form, water is necessary.

Question 2:

What is the major source of fresh water in the city/town/village where you live?

Answer:

River is a major source of fresh water.

Question 3:

Do you know of any activity which may be polluting this water source?

Answer:

The discharge of waste water from homes, industries, hospitals, etc. into the river pollutes this fresh water source.

Question 1:

How is soil formed?

Answer:

Soil is formed by breaking down of rocks at or near the surface of the Earth through various physical, chemical, and biological processes by various factors such as the sun, water, wind, and living organisms.

(i) Sun:

During day time, the rocks are heated. This causes the rocks to expand. During night time, these rocks cool down and contract. Since all parts of the rock do not undergo expansion and contraction at the same rate, this causes the formation of cracks in these rocks. These cracks lead to the breaking up of huge rocks into smaller pieces.

(ii) Water:

Water catalyses the process of formation of soil in two ways.

(a) Water goes into the cracks and crevices formed in the rocks. When this water freezes, its volume increases. As a result, the size of the cracks also increases. This helps in the weathering of rocks.

(b) Running water wears away hard rocks over long periods of time. Water moving in fast speed carries big and small particles of rock downstream. These rocks rub against each other, resulting in breaking down of rocks. These smaller particles are carried away by running water and deposited down its path.

(iii) Wind:

Strong winds carry away rocks, which causes rubbing of rocks. This results in the breaking down of rocks into smaller and smaller particles.

(iv) Living organisms:

Some living organisms like lichens help in the formation of soil. Lichens also grow on rocks. During their growth, lichens release certain substances, which cause the rock surface to powder down forming a thin layer of soil. On this thin layer of soil, some small plants like moss also grow. They further cause the breaking down of the rock particles.

Question 2:

What is soil erosion?

Answer:

The blowing away or washing away of land surface by wind or water is known as soil erosion.

Question 3:

What are the methods of preventing or reducing soil erosion?

Answer:

The methods of preventing or reducing soil erosion are:

(i) Prevention of deforestation

(ii) Plantation of trees

Question 1:

What are the different states in which water is found during the water cycle?

Answer:

During the water cycle, water is found in solid state (snow, ice, etc.), liquid state (ground water, river water, etc.), and gaseous state (water vapours).

Question 2:

Name two biologically important compounds that contain both oxygen and nitrogen.

Answer:

Two biologically important compounds that contain both oxygen and nitrogen are:

(i) Amino acids

(ii) Deoxyribonucleic acid (DNA) and Ribonucleic acid (RNA)

Question 3:

List any three human activities which would lead to an increase in the carbon dioxide content of air.

Answer:

(i) Burning of fuels in various processes like heating, cooking, transportation, and industry.

(ii) Human induced forest fires

(iii) The process of deforestation includes the cutting down of trees. This decreases the uptake of carbon dioxide for photosynthesis. Eventually, the content of carbon dioxide increases.

Question 4:

What is the greenhouse effect?

Answer:

Some gases like carbon dioxide, methane, nitrous oxide prevent the escape of heat from the Earth's surface by trapping it. This increases the average temperature of the Earth. This is called the green house effect. An increase in the content of such gases would lead to a situation of global warming.

Question 5:

What are the two forms of oxygen found in the atmosphere?

Answer:

The two forms of oxygen found in the atmosphere are:

(i) Diatomic molecular form with chemical formula O_2.

(ii) Triatomic molecular form with chemical formula O_3 known as ozone.

Question 1:

Why is the atmosphere essential for life?

Answer:

The atmosphere is essential for life because it maintains an appropriate climate for the sustenance of life by carrying out the following activities:

(i) Atmosphere keeps the average temperature of the Earth fairly constant during day time.

(ii) It prevents a sudden increase in temperature during day time.

(iii) It also slows down the escape of heat from the surface of the Earth into outer space during night time.

Question 2:

Why is water essential for life?

Answer:

Water is essential for life because of the following reasons:

(i) Most biological reactions occur when substances are dissolved in water. Thus, all cellular processes need water as a medium to take place.

(ii) Transportation of biological substances needs water as a medium.

Question 3:

How are living organisms dependent on the soil? Are organisms that live in water totally independent of soil as a resource?

Answer:

Almost all living organisms are dependent on soil. Some depend directly, while some depend indirectly.

Plants need soil for getting support as well as nutrients to prepare their food.

On the other hand, organisms depend on plants for food and other substances that are essential for life. Herbivores depend directly upon plants, and carnivores depend upon animals, which in turn depend upon plants for food. This makes them depend on soil indirectly.

Organisms that live in water are not totally independent of soil as a resource. These organisms depend on aquatic plants for food and other substances. These aquatic

plants in turn require minerals for their sustenance. These minerals are carried to water bodies from soil by rivers, rain water, etc. Without the supply of minerals from the soil to the water bodies, it is impossible to imagine aquatic life.

Question 4:

You have seen weather reports on television and in newspapers. How do you think we are able to predict the weather?

Answer:

The meteorological department of the government collects data on the elements of weather such as maximum and minimum temperatures, maximum and minimum humidity, rainfall, wind speed, etc. They are able to study these elements using various instruments. The maximum and minimum temperature of a day is measured by a thermometer known as the maximum–minimum thermometer. Rain fall is measured by an instrument known as the rain gauge. Wind speed is measured by anemometers. There are various instruments used to measure humidity.

Question 5:

We know that many human activities lead to increasing levels of pollution of the air, water-bodies and soil. Do you think that isolating these activities to specific and limited areas would help in reducing pollution?

Answer:

Yes. Isolating human activities to specific areas would help in reducing levels of pollution. For example, setting up of industries in isolated regions will control pollution to some extent. The pollution caused by these industries will not contaminate water resources, agriculture land, fertile land, etc.

Question 6:

Write a note on how forests influence the quality of our air, soil and water resources.

Answer:

Forests influence the quality of our air, soil, and water resources in various ways. Some of them are:

(i) Forests balance the percentages of carbon dioxide and oxygen in the atmosphere. The increasing amount of carbon dioxide caused by human activities is balanced by a

larger intake of carbon dioxide by plants during the process of photosynthesis. Simultaneously, a large amount of oxygen is released.

(ii) Forests prevent soil erosion. Roots of plants bind the soil tightly in a way that the surface of the soil cannot be eroded away by wind, water, etc.

(iii) Forests help in the replenishment of water resources. During the process of transpiration, a huge amount of water vapour goes into the air and condenses to form clouds. These clouds cause rainfall that recharge water bodies.

Question 1:

What do we get from cereals, pulses, fruits and vegetables?

Answer:

(i) Cereals provide us with carbohydrates. Also, they are a rich source of energy.

(ii) Pulses give us proteins.

(iii) Fruits and vegetables are a rich source of vitamins and minerals. A small amount of proteins, carbohydrates, and fats are also present in them.

Question 1:

How do biotic and abiotic factors affect crop production?

Answer:

A variety of biotic factors such as pests, nematodes, diseases, etc. can reduce the net crop production. A pest causes damage to agriculture by feeding on crops. For example, boll weevil is a pest on cotton. It attacks the cotton crop, thereby reducing its yield. Weeds also reduce crop productivity by competing with the main crop for nutrients, light, and space.

Similarly, abiotic factors such as salinity, temperature, etc. affect the net crop production. Some natural calamities such as droughts and floods are unpredictable. Their occurrence has a great impact on crops sometimes, destroying the entire crop.

Question 2:

What are the desirable agronomic characteristics for crop improvements?

Answer:

The desirable agronomic characteristics for crop improvements are:

(i) Tallness and profuse branching in any fodder crop.

(ii) Dwarfness in cereals.

These desirable agronomic characteristics help in increasing crop productivity.

Question 1:

What are macro-nutrients and why are they called macro-nutrients?

Answer:

Macro-nutrientsare nutrients required in relatively large quantities for growth and development of plants. They are six in number. Since they are required in large quantities, they are known as macro-nutrient. The six macro-nutrients required by plants are nitrogen, phosphorus, potassium, calcium, magnesium, and sulphur.

Question 2:

How do plants get nutrients?

Answer:

Plants require sixteen essential nutrients from nature for their growth and development. All these nutrients are obtained from air, water, and soil. Soil is the major source of nutrients. Thirteen of these nutrients are available from soil. The remaining three nutrients (carbon, oxygen, and hydrogen) are obtained from air and water.

Question 1:

Compare the use of manure and fertilizers in maintaining soil fertility.

Answer:

Manures increase soil fertility by enriching the soil with organic matter and nutrients as it is prepared by the decomposition of animal excreta and plant wastes. On the other hand, fertilizers are mostly inorganic compounds whose excessive use is harmful to the symbiotic micro-organisms living in soil. Their excessive use also reduces soil fertility. Hence, fertilizers are considered good for only short term use.

Question 1:

Which of the following conditions will give the most benefits? Why?

(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.

Answer:

(c)Farmers using good quality seeds, adopting irrigation, using fertilizers, and using crop protection measures will derive most benefits.

(i) The use of good quality seeds increases the total crop production. If a farmer is using good quality seeds, then a majority of the seeds will germinate properly, and will grow into a healthy plant.

(ii) Proper irrigation methods improve the water availability to crops.

(iii) Fertilizers ensure healthy growth and development in plants by providing the essential nutrients such as nitrogen, phosphorus, potassium, etc.

(iv) Crop protection measures include various methods to control weeds, pests, and infectious agents. If all these necessary measures are taken by a farmer, then the overall production of crops will increase.

Question 1:

Why should preventive measures and biological control methods be preferred for protecting crops?

Answer:

Preventive measures and biological control methods should be preferred for protecting crops because excessive use of chemicals leads to environmental problems. These chemicals are also poisonous for plants and animals. Preventive measures include proper soil and seed preparation, timely sowing of seeds, intercropping and mixed cropping, usage of resistant varieties of crops, etc. On the other hand, biological control methods include the usage of bio-pesticides that are less toxic for the environment. An example of bio-pesticides is *Bacillus thuringenesis*,which is an insect pathogen that kills a wide range of insect larvae. Therefore, both preventive measures and biological control methods are considered eco- friendly methods of crop protection.

Question 2:

What factors may be responsible for losses of grains during storage?

Answer:

During the storage of grains, various biotic factors such as insects, rodents, mites, fungi, bacteria, etc. and various abiotic factors such as inappropriate moisture, temperature, lack of sunlight, flood, etc. are responsible for losses of grains. These factors act on stored grains and result in degradation, poor germinability, discolouration, etc.

Question 1:

Which method is commonly used for improving cattle breeds and why?

Answer:

Cattle farming is commonly used for improving cattle breeds. The purpose of cattle farming is to increase the production of milk and draught labour for agricultural work. Dairy animals (females) are used for obtaining milk and draught animals (males) are engaged in agricultural fields for labour work such as carting, irrigation, tilling, etc. Cross breeding between two good varieties of cattle will produce a new improved variety. For example, the cross between foreign breeds such as Jersey Brown, Swiss (having long lactation periods) and Indian breeds such as Red Sindhi, Sahiwal (having excellent resistance power against diseases) produces a new variety having qualities of both breeds.

Question 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."

Answer:

Poultry in India is the most efficient converter of low fibre food stuff into highly nutritious animal protein food. In poultry farming, domestic fowls are raised to produce eggs and chicken. For this, the fowls are given animal feeds in the form of roughage, which mainly consists of fibres. Thus, by feeding animals a fibre rich diet, the poultry gives highly nutritious food in the form of eggs and chicken.

Question 1:

What management practices are common in dairy and poultry farming?

Answer:

Common management practices in dairy and poultry farming are:

(i) Proper shelter facilities and their regular cleaning.

(ii) Some basic hygienic conditions such as clean water, nutritious food, etc.

(iii) Animals are kept in spacious, airy, and ventilated place.

(iv) Prevention and cure of diseases at the right time is ensured.

Question 2:

What are the differences between broilers and layers and in their management?

Answer:

Layersare meant for egg production, whereas broilers are meant for poultry meat. Nutritional, environmental, and housing conditions required by broilers are different from those required by egg layers. A broiler chicken, for their proper growth, requires vitamin rich supplements especially vitamin A and K. Also, their diet includes protein rich food and enough fat. They also require extra care and maintenance to increase their survival rate in comparison to egg layers.

Question 1:

How are fish obtained?

Answer:

Fish can be obtained by two ways:

(i) Capture fishing: It is the process of obtaining fish from natural resources.

(ii) Culture fishery: It is the practice of farming fishes. Farming can be done in both freshwater ecosystem (which includes river water, pond water) and marine ecosystem.

Question 2:

What are the advantages of composite fish culture?

Answer:

An advantage of composite fish culture is that it increases the yield of fish. In a composite fish culture, five or six different species are grown together in a single fish pond. Fishes with different food habitats are chosen so that they do not compete for food among themselves. Also, this ensures a complete utilization of food resources in the pond. As a result, the survival rate of fish increases and their yield also increases.

Question 1:

What are the desirable characters of bee varieties suitable for honey production?

Answer:

Bee varieties having the following desirable characters are suitable for honey production:

(i) They should yield high quantity of honey.

(ii) They should not sting much.

(iii) They should stay in the beehive for long durations.

(iv) They should breed very well.

Question 2:

What is pasturage and how is it related to honey production?

Answer:

Pasturage is the availability of flowers from which bees collect nectar and pollen. It is related to the production of honey as it determines the taste and quantity of honey.

Question 1:

Explain any one method of crop production which ensures high yield.

Answer:

Crop rotationis one of the methods of crop production that ensures high yield. It is the method of growing two or more varieties of crops on the same land in sequential seasons. A crop utilises some particular nutrients in larger quantities from the soil. Then, if the same crop is grown in subsequent seasons those nutrients will get depleted in the soil. Therefore, crops having different nutrient requirements are rotated. For example, legumes which have nitrogen-fixing bacteria in their root nodules supply the soil with nitrogen. Therefore, these legumes are rotated with nitrogen requiring cereals such as wheat and maize. This method reduces the need of fertilizers, thereby increasing the overall yield of crops.

Question 2:

Why are manures and fertilizers used in fields?

Answer:

Manures and fertilizers are used in fields to enrich the soil with the required nutrients. Manure helps in enriching the soil with organic matter and nutrients. This improves the fertility and structure of the soil. On the other hand, fertilizers ensure a healthy growth and development in plants. They are a good source of nitrogen, phosphorus, and potassium. To get an optimum yield, it is instructed to use a balanced combination of manures and fertilizers in the soil.

Question 3:

What are the advantages of inter-cropping and crop rotation?

Answer:

Inter-cropping and crop rotation both play an important role in increasing the yield of crops. Inter-cropping helps in preventing pests and diseases to spread throughout the field. It also increases soil fertility, whereas crop rotation prevents soil depletion, increases soil fertility, and reduces soil erosion. Both these methods reduce the need for fertilizers. It also helps in controlling weeds and controls the growth of pathogens and pests in crops.

Question 4:

What is genetic manipulation? How is it useful in agricultural practices?

Answer:

Genetic manipulationis a process where the gene for a particular character is introduced inside the chromosome of a cell. When the gene for a particular character is introduced in a plant cell, a transgenic plant is produced. These transgenic plants exhibit characters governed by the newly introduced gene.

For example, let us assume there is a wild plant that produces small fruits. If the gene responsible for a larger fruit size is introduced in this plant, this plant becomes transgenic, and starts producing larger fruits. Similarly, genes for higher yield, disease resistance, etc. can be introduced in any desired plant.

Therefore, gene manipulation plays an important role in agricultural practices. It helps in improving crop variety. It ensures food security and insect resistant crops. It also improves the quality and yield of crops.

Question 6:

How do good animal husbandry practices benefit farmers?

Answer:

Cattle farming is one of the methods of animal husbandry that is most beneficial for farmers. Using this method, better breeds of draught animals can be produced. Such draught animals are engaged in agricultural fields for labour work such as carting, irrigation, tilling, etc.

Question 7:

What are the benefits of cattle farming?

Answer:

Benefits of cattle farming:

(i) Good quality and quantity of milk can be produced.

(ii) Draught labour animals can be produced for agricultural work.

(iii) New variety that are resistant to diseases can be produced by crossing two varieties with the desired traits.

Question 8:

For increasing production, what is common in poultry, fisheries and bee-keeping?

Answer:

The common factor for increasing production in poultry, fisheries, and bee keeping is the proper management techniques that are to be followed. Regular cleaning of farms is of utmost importance. Maintenance of temperature and prevention and cure of diseases is also required to increase the number of animals.

Question 9:

How do you differentiate between capture fishing, mariculture and aquaculture?

Answer:

Capture fishing	**Mariculture**	**Aquaculture**
It is the method of obtaining fishes from natural resources.	It is the culture of marine fishes for commercial use.	It involves the production of aquatic animals that are of high economic value such as prawns, lobsters, fishes, crabs, etc.