CHAPTER 4 – STRUCTURE OF THE ATOM

Question 1: What are canal rays?

Answer- The positively charged particles moving from anode to cathode in cathode ray tube are known as canal rays or anode rays.

Question 2: If an atom contains one electron and one proton, will it carry any charge or not?

Answer- Since a proton is a positively charged particle and an electron is a negatively charged particle, the net charge becomes neutral as both the particles neutralize each other.

Question 3: On the basis of Thomson's model of an atom, explain how the atom is neutral as a whole.

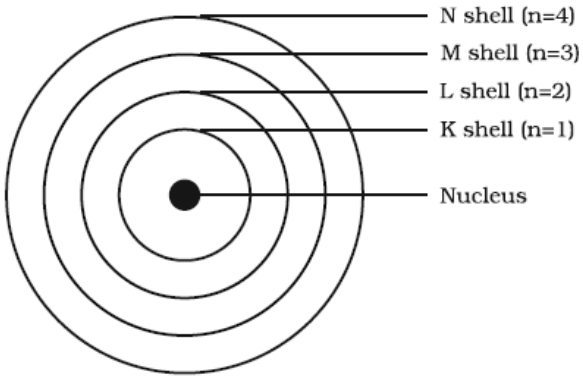
Answer- As per Thomson's model of an atom, electrons and protons are equal in number hence an atom on the whole is electrically neutral.

Question 4: On the basis of Rutherford's model of an atom, which subatomic particle is present in the nucleus of an atom?

Answer- Protons.

Question 5: Draw a sketch of Bohr's model of an atom with three shells.

Answer-



Question 6: What do you think would be the observation if the ∝– particle scattering experiment is carried out using a foil of a metal other than gold?

Answer- In the ∝ – particle scattering experiment, when any other metal foil is used instead of gold, the observation would almost remain the same. But as other metals are not as malleable as gold, so more number of alpha particles will bounce back.

Question 7: Name the three subatomic particles of an atom.

Answer- Protons, Electrons and Neutrons.

Question 8: Helium atom has an atomic mass of 4 u and two protons in its nucleus. How many neutrons does it have?

Answer- Number of neutrons = A-P = 4 – 2 = 2.

Question 9: Write the distribution of electrons in Carbon and Sodium atoms.

Answer- Carbon (Z=6) = 2, 4.

Sodium (Z=11) = 2, 8, 1.

Question 10: If K and L shells of an atom are full, then what would be the total number of electrons in the atom?

Answer- Total electrons = 2 + 8 = 10.

Question 11: How will you find the valency of chlorine, sulphur and magnesium?

Answer- (i) Chlorine (Z=17) = 2, 8, 7

Clearly Chlorine requires 1 electron to complete its outermost shell, So its valency is **-1.**

(ii) Sulphur (Z=16) = 2, 8, 6

Clearly Sulphur requires 2 electron to complete its outermost shell, So its valency is **-2.**

(iii) Magnesium (Z=12) = 2, 8, 2

Clearly Magnesium requires 2 electrons to eject from its outermost shell to be fully vacant, So its valency is **+2.**

Question 12: If the 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) Atomic number (Z) of the atom = 8.

(ii) Total charge on the atom is zero as number of protons (positive charge) and electrons (negative charge) are same.

Question 13: With the help of Table 4.1, find out the mass number of oxygen and sulphur atom.

Answer- Mass number (A) of Oxygen = No. of protons + No. of neutrons = 8+8 = **16.**

Mass number (A) of Sulphur = No. of protons + No. of neutrons = 16+16 = **32.**

Table 4.1: Composition of Atoms of the First Eighteen Elements with Electron Distribution in Various Shells

Name of Element	Symbol	Atomic Number	Number of Protons	Number of Neutrons	Number of Electrons	Distribution of Electrons				Vale-ncy
						K	L	M	N	
Hydrogen	H	1	1	-	1	1	-	-	-	1
Helium	He	2	2	2	2	2	-	-	-	0
Lithium	Li	3	3	4	3	2	1	-	-	1
Beryllium	Be	4	4	5	4	2	2	-	-	2
Boron	B	5	5	6	5	2	3	-	-	3
Carbon	C	6	6	6	6	2	4	-	-	4
Nitrogen	N	7	7	7	7	2	5	-	-	3
Oxygen	O	8	8	8	8	2	6	-	-	2
Fluorine	F	9	9	10	9	2	7	-	-	1
Neon	Ne	10	10	10	10	2	8	-	-	0
Sodium	Na	11	11	12	11	2	8	1	-	1
Magnesium	Mg	12	12	12	12	2	8	2	-	2
Aluminium	Al	13	13	14	13	2	8	3	-	3
Silicon	Si	14	14	14	14	2	8	4	-	4
Phosphorus	P	15	15	16	15	2	8	5	-	3,5
Sulphur	S	16	16	16	16	2	8	6	-	2
Chlorine	Cl	17	17	18	17	2	8	7	-	1
Argon	Ar	18	18	22	18	2	8	8		0

Question 14: For the symbol H, D and T, tabulate three subatomic particles found in each of them.

Answer-

Isotope	Symbol	Mass no.	Atomic no.	No. of electrons	No. of protons	No. of neutrons
Hydrogen	H	1	1	1	1	0
Deuterium	D	2	1	1	1	1
Tritium	T	3	1	1	1	2

Question 15: Write the electronic configuration of any one pair of isotopes and isobar.

Answer- (a) **Isotopes**: Isotopes are atoms of same element, which have different mass number. Example: Carbon molecule exists as $_6C^{12}$ and $_6C^{14}$ but when their electronic configuration is noticed, both have 2, 4.

(b) **Isobars**: Isobars are atoms of different element ,which have the same mass number but differ in the atomic number. Example: Electronic configuration of $_6C^{14}$ =2,4. Electronic configuration of $_7N^{14}$ = 2,5.

EXERCISE

Question 1: Compare the properties of electrons, protons and neutrons.

Answer-

Property	Electrons	Protons	Neutrons
Charge	Negatively charged	Positively charged	No charge.
Location	Located outside the nucleus	Located within the nucleus	Located inside the nucleus of an atom

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

Answer- (i) It could not explain the result of scattering experiment performed by Rutherford.

(ii) It did not have any experiment support.

Question 3: What are the limitations of Rutherford's model of the atom?

Answer- (i) It failed to explain the stability of an atom.

(ii) It doesn't explain the spectrum of hydrogen and other atoms.

Question 4: Describe Bohr's model of the atom.

Answer- (i) All the positive charge and nearly all the mass (P+N) is concentrated in the center of the atom, known as nucleus.

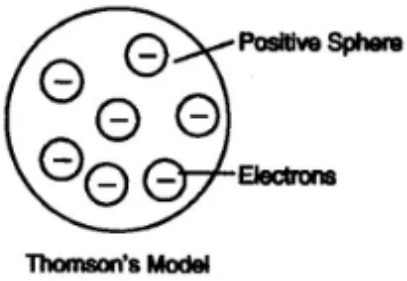
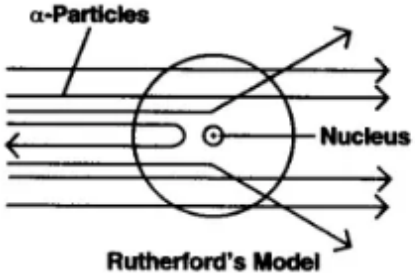
(ii) Negatively charged electrons revolve around the nucleus in some discrete orbits.

(iii) Electrons do not radiate energy when they are in their orbits.

(iv) The distinct orbits are named as K, L, M, N orbits. Numbers used to denote them are n=1, 2, 3, 4

Question 5: Compare all the proposed models of an atom given in this chapter.

Ansewr-

Thomson	Rutherford	Bohr
• Sphere of positive charge	• Sphere of positive charge in centre called nucleus. All mass of an atom resides in the nucleus	• Positive charge in centre called nucleus.
• Electrons are spread randomly all over in the sphere	• Electrons revolve around the nucleus in well defined orbits.	• Electrons revolve in discrete orbits and do not radiate energy.
•  Thomson's Model	•  Rutherford's Model	•  Bohr's Model
• Positive charge = Negative charge. • Atom is electrically neutral.	• Size of nucleus is very small as compared to size of atom.	• The orbits were termed as energy shells labelled as K, L, M, N or $n = 1, 2, 3, 4$ (numbered)

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

Answer- Electrons in n^{th} shell are $2n^2$. So for first 18 elements electron distribution is: 2, 8, 8.

Question 7: Define valency by taking examples of silicon and oxygen.

Answer- The definite combining capacity of the atoms of each element, where electrons are lost, gained or shared to make the octet of electrons present in the outermost shell is defined as valency.

For Silicon (Z=14) = 2, 8, 4

Thus, the valency of silicon is 4 as these electrons can be shared with others to complete octet.

For Oxygen (Z=8) = 2, 6

Clearly Oxygen requires 2 electrons to complete its outermost shell, So its valency is **-2.**

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 (Z)-** Total number of protons present in an atom. For example Carbon has 6 protons in its nucleus, So its atomic number is 6.

(ii) **Mass Number (A)-** Sum of protons and neutrons present in an atom. For example Carbon has 6 protons and 6 neutrons in its nucleus, So its mass number is 12.

(iii) **Isotopes**: Isotopes are atoms of same element, which have different mass number. Example: Isotopes of Carbon are ${}_6C^{12}$ and ${}_6C^{14}$.

(iv) **Isobars**: Isobars are atoms of different element, which have same mass number but differ in the atomic number. Example: ${}_6C^{14}$ and ${}_7N^{14}$.

Uses of isotopes: (i) The isotope of Iodine atom is used to treat Goitre and iodine deficient disease.

(ii) In the treatment of cancer, an isotope of cobalt is used.

(iii) Fuel for nuclear reactors is derived from the isotopes of the Uranium atom.

Question 9: Na^+ has completely filled K and L shells. Explain.

Answer- Electronic configuration of Sodium-Na (Z=11) is = 2, 8, 1

Electronic configuration of Sodium ion-Na^+ is = 2, 8

Clearly Na^+ has completely filled K (2) and L (8) shells.

Question 10: If bromine atom is available in the form of, say, two isotopes ${}_{35}Br^{79}$ (49.7%) and ${}_{35}Br^{81}$ (50.3%), calculate the average atomic mass of Bromine atom.

Answer- Average atomic mass of bromine atom is = $79\ X\frac{49.7}{100} + \ 81\ X\ \frac{50.3}{100}\ = \frac{3926.3}{100} + \frac{4074.3}{100}$

$$= \frac{8000.6}{100} = 80.006\,u$$

Question 11: The average atomic mass of a sample of an element X is 16.2 u. What are the percentages of isotopes ${}_8X^{16}$ and ${}_8X^{18}$ in the sample?

Answer- Average atomic mass = 16.2 u.

Let the percentage of isotope ${}_8X^{16}$ is = y %

Then, the percentage of isotope ${}_8X^{18}$ is = (100- y) %

So, $18\ X\frac{y}{100} + \ 16\ X\frac{100-y}{100} = 16.2$

$\frac{18y + 1600 - 16y}{100} = 16.2$

18y +1600 -16y = 1620

2y = 1620 – 1600 = 20

$y = \frac{20}{2} = 10.$

Therefore, the percentage of isotope ${}_8X^{16}$ is = **10 %**

Then, the percentage of isotope ${}_8X^{18}$ is = **90 %**

Question 12: . If Z=3, what would be the valency of the element? Also, name the element.

Answer- Atom with atomic number 3 is Lithium (Li).

For Lithium (Z=3) = 2, 1

So valency is +1.

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: Protons + neutrons = 6+6 = 12

Mass number of Y: Protons + neutrons = 6+8 = 14

They are isotopes of the same element.

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. **(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 $\frac{1}{1837}$ times that of proton. **(T)**

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

Question 15: Put a tick (✓) against correct choice and cross (x) against wrong choice in questions 15, 16 and 17.

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

(a) **Atomic nucleus (✓)** (b) Electron **(x)** (c) Proton **(x)** (d) Neutron **(x)**

Question 16: Isotopes of an element have

(a) The same physical properties **(x)** (b) Different chemical properties **(x)**

(c) **Different number of neutrons (✓)** (d) Different atomic numbers. **(x)**

Question 17: Number of valence electrons in Cl^- ion are:

(a) 16 **(x)** (b) **8 (✓)** (c) 17 **(x)** (d) 18 **(x)**

Question 18: Which one of the following is a correct electronic configuration of Sodium?

(a) 2, 8 **(x)** (b) 8, 2, 1 **(x)** (c) 2, 1, 8 **(x)** (d) **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	19	10	9	9	Flourine
16	32	16	16	16	Sulphur
12	24	12	12	12	Magnesium
1	2	1	1	1	Deuterium
1	1	0	1	0	Hydrogen ion

CHAPTER 11 –WORK AND ENERGY

Question 1: A force of 7 N acts on an object. The displacement is, say 8 m, in the direction of the force. Let us take it that the force acts on the object through the displacement. What is the work done in this case?

Answer- Work done = Force (F) x Displacement (S)

= 7 x 8 = 56 J (joules).

Question 2: When do we say that work is done?

Answer- Work is said to be done if:

(i) A force acts on the body.

(ii) There is a displacement of the body in the direction (or opposite) of applied force.

Question 3: Write an expression for the work done when a force is acting on an object in the direction of its displacement.

Answer- Work done = Force (F) x Displacement (S)

$W = F \times S$

Question 4: 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 5: 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 = Force (F) x Displacement (S)

= 140 x 15 = 2100 J (joules).

Question 6: What is the kinetic energy of an object?

Answer- The energy possessed by a body by the virtue of its motion is termed as kinetic energy.

Question 7: Write an expression for the kinetic energy of an object.

Answer- Kinetic Energy = $\frac{1}{2}mv^2$. {where m= mass and v is velocity of a body.}

Question 8: The kinetic energy of an object of mass, m moving with a velocity of 5 ms^{-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- As K.E. = $\frac{1}{2}mv^2$. So by doubling velocity K.E. will become 4 times i.e. 25 x 4 = 100 J.

Similarly K.E. will become 9 times if velocity is increased 3 times, i.e. 25 x 9 = 225 J.

Question 9: What is power?

Answer- Rate of doing work is known as power. SI unit of power is watt (W).

$$Power = \frac{Work}{Time}.$$

Question 10: Define 1 watt of power.

Answer- Power of an object is said to be 1 W if it does 1 joule of work in 1 second.

Question 11: A lamp consumes 1000 J of electrical energy in 10 s. What is its power?

Answer- Energy = W = 1000 J

Time = t = 10 sec

Power = $P = \frac{W}{t} = \frac{1000}{10} = 100$ watt (W).

Question 12: Define average power.

Answer- Average power is the ratio of total work done to total time taken.

$$\text{Average power} = \frac{Total\ work\ done}{Total\ time\ taken}$$

EXERCISE QUESTION-ANSWERS

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'.

(a) Suma is swimming in a pond.

Answer- Suma is doing work. She is applying force to move horizontally.

(b) A donkey is carrying a load on its back.

Answer-Donkey is not doing any work. Here, the displacement and the force are at 90°.

(c) A wind-mill is lifting water from a well.

Answer-Work is done by the windmill. The water is lifted against force of gravity.

(d) A green plant is carrying out photosynthesis.

Answer-No work is done by a green plant during photosynthesis.

(e) An engine is pulling a train.

Answer-The engine applies a pulling force on the train, and the train moves in the direction of this force. Therefore, engine is doing work.

(f) Food grains are getting dried in the sun.

Answer-During drying of food grains in the sun no work is done.

(g) A sailboat is moving due to wind energy.

Answer-Work is done by the wind. The sailboat moves in the direction of the force exerted by wind.

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- Zero. Because here, angle between force of gravity and displacement is 90 degree (90°).

Now, Work = W = F S Cosθ = FS x Cos90° = 0 (because Cos90°= 0)

Question 3: A battery lights a bulb. Describe the energy changes involved in the process.

Answer- A battery converts chemical energy into electrical energy. This electrical energy is converted into heat and then light energy. The sequence of energy changes is as follows :

Chemical energy —> Electrical energy —> Heat Energy —>Light energy.

Question 4: Certain force acting on a 20 kg mass changes its velocity from 5 ms^{-1} to 2 ms^{-1} . Calculate the work done by the force.

Answer- Mass = m = 20 kg

Initial velocity = u = 5 m/s

Final velocity = v = 2 m/s

Work done by force = change in Kinetic energy = $(KE)_f - (KE)_i$

$$W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2 = \frac{1}{2} \times 20 \times (2)^2 - \frac{1}{2} \times 20 \times (5)^2 = 10 \times (4-25) = 10 \times (-21) = \mathbf{-210\ J}$$

Here negative sign indicates the direction of force is opposite to the direction of motion

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- Zero. Because here angle between force of gravity and displacement is 90 degree (90°).

Now Work = W = F S Cosθ = FS Cos90° = 0 (because Cos90°= 0)

Question 6: The potential energy of a freely falling object decreases progressively. Does this violate the law of conservation of energy? Why?

Answer- As the potential energy of the freely falling object decreases, its kinetic energy increases. The sum total of the potential energy and the kinetic energy of the object during its free fall remains the same. Thus, 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- During riding a bicycle, the muscular energy of the rider is transformed into heat and mechanical energy. Kinetic energy provides motion to the bicycle and warmth energy heats our body.

Muscular energy → mechanical energy + heat

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- No transfer of energy takes place when we push a huge rock unsuccessfully. The energy is spent for the physical activity of muscles.

Question 9: A certain household has consumed 250 units of energy during a month. How much energy is this in joules?

Answer- Energy = 250 kWh (units) = 250 x 3.6 x 10^6 Joules (because 1 kWh = 3.6 x 10^6 J)

= 9 x 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 halfway down.

Answer- Mass = m = 40 kg

Height = h = 5 m

Acceleration due to gravity = g = 9.8 ms^{-2}

Potential Energy = mgh = 40 x 9.8 x 5 = 1960 J

Kinetic energy in halfway = PE/2 = $\frac{1960}{2}$ = 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- Zero. Because, here angle between force of gravity and displacement of satellite is 90 degree (90°).

Now Work = W = F S Cosθ = FS Cos90° = 0 (because Cos90°= 0)

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. In the case of uniform motion in a straight line, a body keeps in motion even without any 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- Not any work is done by the person, because his displacement is zero.

Question 14: An electric heater is rated 1500 W. How much energy does it use in 10 hours?

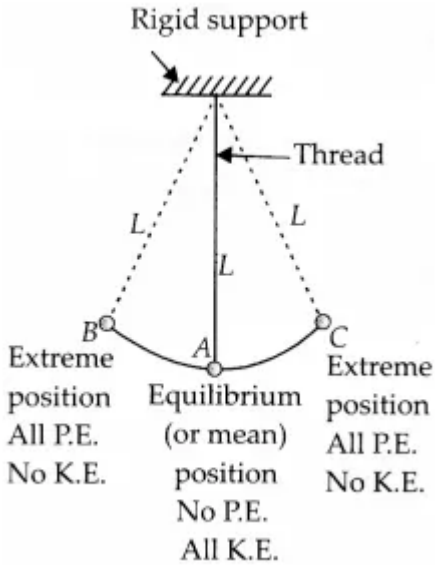
Answer- Power = P= 1500 W = $\frac{1500}{1000}$ kW = 1.5 kW

Time = t = 10 hours

Energy used = P x t = 1.5 x 10 kWh = **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- Consider the case of following pendulum:



The bob is at its highest position at the extreme positions and at lowest at its mean position. So it has maximum potential energy at extreme positions with zero kinetic energy, and maximum kinetic energy with zero potential energy at mean position. At every point sum of kinetic and potential energy remains constant. So it is not the violation of law of conservation of energy. Bob comes to rest eventually due to fraction of air.

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- Same as its kinetic energy i.e. $\frac{1}{2}$ mv^2.

Question 17: Calculate the work required to be done to stop a car of 1500 kg moving at a velocity of 60 km/h?

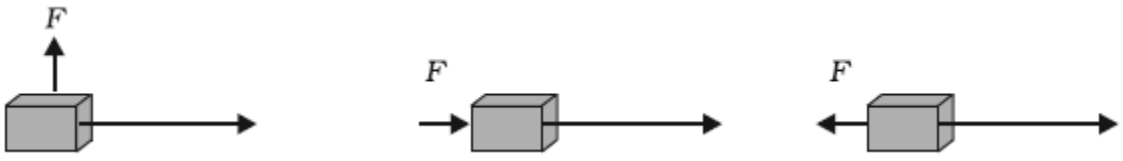
Answer- Mass = m = 1500 kg

Velocity = v = 60 km/h = 60 x $\frac{5}{18}\ m/s = \frac{50}{3}\ m/s$

Work required to be done to stop a car = Kinetic energy of car = $\frac{1}{2}$ mv^2 = $\frac{1}{2}\ X\ 1500\ X\ (\frac{50}{3})^2$

= 750 x $\frac{2500}{9}$ = **208333.3 J.**

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- (1) Here, the force acts at right angle to the displacement. So, work done by the force = 0

(2) Here, the direction of displacement is the same as that of the force. So, work done by the force is positive.
(3) Here, the body moves in a direction opposite to the direction of the force. So, work done by the force is 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- The acceleration of an object can be zero even if several forces are acting on it provided the resultant force (F) is zero.

Question 20: Find the energy in kWh consumed in 10 hours by four devices of power 500 W each.

Answer- Time = t = 10 hours

Power = P = 500 W = 0.5 kW

Energy consumed by 4 devices = 4 x P x t = 4 x 0.5 x 10 = **20 kWh.**

Question 21: A freely falling object eventually stops on reaching the ground. What happens to its kinetic energy?

Answer- When a freely falling body eventually stops on reaching the ground, its kinetic energy gets converted into the heat energy, sound produced due to collision, potential energy of configuration of the body and the ground.

CHAPTER 12 –SOUND

Question 1: How does the sound produced by a vibrating object in a medium reach your ear?

Answer- When a disturbance is created on an object, it starts vibrating and sets the particles of the medium to vibrate. These vibrating particles take the sound from object to our ear through the medium.

Question 2: Explain how sound is produced by your school bell.

Answer- When the school bell is struck with a hammer, it starts vibrating and as a result of these vibrations, sound waves are produced.

Question 3: Why are sound waves called mechanical waves?

Answer- Because sound waves require a medium to propagate to interact with the particles present in it.

Question 4: Suppose you and your friend are on the moon. Will you be able to hear any sound produced by your friend?

Answer- No, we will not be able to hear the sound because sound requires a medium for its propagation. On the moon there is no atmosphere, i.e., there is vacuum.

Question 5: Which wave property determines (a) loudness, (b) pitch?

Answer- (a) Loudness is determined by the amplitude of the sound wave which in turn depends on the force with which the object is made to vibrate.

(b) Pitch of a sound is determined by its frequency.

Question 6: Guess which sound has a higher pitch: guitar or car horn?

Answer- Guitar.

Question 7: What are wavelength, frequency, time period and amplitude of a sound wave?

Answer-**(a) Wavelength(λ) :** The distance between two consecutive compressions (C) or two consecutive rarefactions (R) is called the wavelength, unit-metre.

(b) Frequency : The number of oscillations per unit time is called frequency, unit-Hz.

(c) Time period : The time taken by two consecutive compressions or rarefactions to cross a fixed point is called the time period.

(d) Amplitude : The magnitude of the maximum disturbance in the medium on either side of the mean value is called the amplitude of the wave.

Question 8: How are the wavelength and frequency of a sound wave related to its speed?

Answer- Speed = Wavelength x Frequency.

Question 9: Calculate the wavelength of a sound wave whose frequency is 220 Hz and speed is 440 m/s in a given medium.

Answer- Frequency = f = 220 Hz

Speed of sound = v = 440 m/s

Wavelength = $\lambda = \frac{v}{f} = \frac{440}{220} =$ **2 m.**

Question 10: 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- Frequency = f = 500 Hz

Time between successive compressions = Time period of sound wave = T = $\frac{1}{f} = \frac{1}{500} =$ **0.002 sec.**

Question 11: Distinguish between loudness and intensity of sound.

Answer-

Loudness of sound	Intensity of sound
1. Loudness refers to how loud or soft a sound seems to a listener.	1. Intensity is defined as the power carried by sound waves per unit area.
2. Loudness of sound is determined of amplitude.	2. Intensity of the sound wave is determined by frequency of sound waves.
3. The unit of loudness is the decibel (dB).	3. The unit of intensity of sound is watt per square meter (W/m^2).

Question 12: In which of the three media, air, water or iron, does sound travel the fastest at a particular temperature?

Answer- Iron (Solid).

Question 13: An echo is heard in 3 s. What is the distance of the reflecting surface from the source, given that the speed of sound is 342 ms^{-1} ?

Answer- Time = 3 sec

Speed of sound = v = 342 m/s

Let the distance of reflecting surface from the source is = S

Then, total distance travelled by sound is = 2S

Now, Speed = $\frac{Distance}{Time}$

342 = $\frac{2S}{3}$; 2S = 342 x 3 ; S = $\frac{1026}{2}$ **=513 m.**

Question 14: Why are the ceilings of concert halls curved?

Answer- Ceilings of concert halls are curved to uniformly spread sound in all directions after reflecting from the walls.

Question 15: What is the audible range of the average human ear?

Answer- 20 Hz to 20,000 Hz.

Question 16: What is the range of frequencies associated with (a) Infrasound? (b) Ultrasound?

Answer- (a) **Infrasound**: Less than 20 Hz ; (b) **Ultrasound**: More than 20000 Hz

Question 17: 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 = t = 1.02 sec

Speed of sound = v = 1531 m/s

Let the distance of cliff from the submarine is = S

Then, total distance travelled by sound is = 2S

Now, Speed = $\frac{Distance}{Time}$

$1531 = \frac{2S}{1.02}$; $2S = 342 \times 1.02$; $S = \frac{1561.62}{2} =$ **780.8 m.**

EXERCISE QUESTION-ANSWERS

Question 1: What is sound and how is it produced?

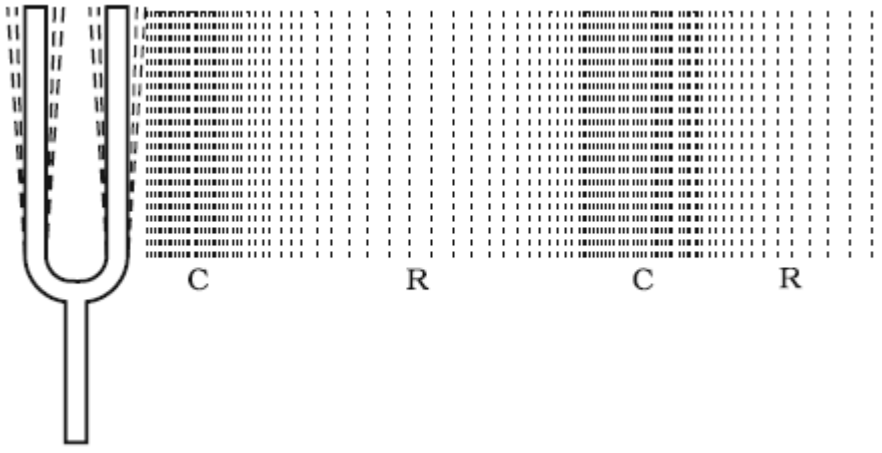
Answer- Sound is a form of energy and it is produced due to vibrations of different types of objects.

Question 2: Describe with the help of a diagram, how compressions and rarefactions are produced in the air near a source of sound.

Answer- (1) When a vibrating object moves forward, it pushes the air in front of it and compresses the air creating a region of high pressure called compression (C).

(2) It starts moving away from the surface of the vibrating object.

(3) As this occurs the surface moves backward creating a region of low pressure called rarefaction (R)

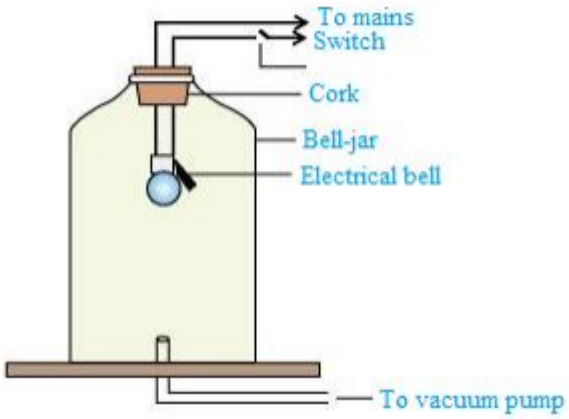


Question 3: Cite an experiment to show that sound needs a material medium for its propagation.

Answer- Take an electric bell and an air tight glass bell jar. The electric bell is suspended inside an air tight glass jar which is connected to a vacuum pump. **Working:**

1. When we press the switch, we will be able to hear the bell.

2. When the air in the jar is pumped out gradually, the sound becomes feeble although the same amount of current is flowing through the bell.
3. When the air is removed completely, are will not be able to hear the sound of the bell. Conclusion: This experiment shows that sound requires a medium for its propagation.



Question 4: Why sound wave is called a longitudinal wave?

Answer- A sound wave is called a longitudinal wave as it travels in a medium by the vibration of particles in a direction which is parallel to the direction of propagation of the sound wave.

Question 5: Which characteristics of the sound help you to identify your friend by his voice while sitting with others in a dark room?

Answer- The quality (or timbre), pitch and loudness of sound.

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 light is much higher than speed of sound. Due to this reason, the thunder takes more time to reach the Earth as compared to the light. Hence, lightning is seen before whenever we hear the 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.

Answer- Speed of sound = v = 344 m/s.

For Minimum audible frequency

Frequency = f = 20 Hz

Wavelength = $\lambda = \frac{v}{f} = \frac{344}{20} = 17.2$ m

For Maximum audible frequency

Frequency = f = 20000 Hz

Wavelength = $\lambda = \frac{v}{f} = \frac{344}{20000} = 0.0172$ m

Question 8: Two children are at opposite ends of an aluminum rod. One strikes the end of the rod with a stone. Find the ratio of times taken by the sound wave in the air and in aluminum to reach the second child.

Answer- Speed of sound in air = V_{air} = 344 m/s

Speed of sound in aluminum = $V_{aluminum}$ = 6420 m/s

As time is inversely proportional to the speed hence:

$T_{air} / T_{aluminum} = V_{aluminum} / V_{air}$ = 6420 / 344 = 1605 **:** 86

Question 9: The frequency of a source of sound is 100 Hz. How many times does it vibrate in a minute?

Answer- Frequency = 100 Hz

Number of vibrations in 1 second = 100

Number of vibrations in 60 second = 100 x 60

Number of vibrations in 1 minute = **6000.**

Question 10: Does sound follow the same laws of reflection as light does? Explain.

Answer- Yes, sound follows the same laws of reflection as light does because,

(1) Angle of incidence of sound is always equal to angle of reflection of sound waves.

(2) The direction in which sound is incident, the direction in which it is reflected and normal 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 time interval between the reflected sound and the original sound is at least 0.1 second. As the temperature increases, the speed of sound in a medium also increases. On a hotter day, the time interval between the reflected and original sound will decrease and an echo is audible only if the time interval between the reflected sound and the original 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 speed and distance of underwater objects. This method is called SONAR.

(ii) Working of a stethoscope - the sound of patient's heartbeat reaches the doctor's ear through multiple reflections 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 ms^{-2} and speed of sound = 340 ms^{-1} .

Answer- Height of tower = S = 500 m

Acceleration due to gravity = g = 10 m/s^2

Initial speed of stone = u = 0

By equation of motion, $S = ut + \frac{1}{2}at^2$

$$500 = 0 \times t + \frac{1}{2} \times 10 \times t^2$$

$$t^2 = \frac{500}{5} = 100$$

Hence, t = 10 sec

Now time taken by sound to reach to the top of tower $= T = \frac{Distance}{Speed\ of\ sound} = \frac{500}{340} = 1.47$ sec

Total time takes to hear splash after dropping the stone = t + T = 10 + 1.47 = **11.47 sec.**

Question 14: A sound wave travels at a speed of 339 m/s. 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

Wavelength = λ = 1.5 cm = $\frac{1.5}{100}$ = 0.015 m

Frequency = $\frac{v}{\lambda} = \frac{339}{0.015} = 22600$ Hz

The sound is not audible as its frequency lies beyond the audible range (20 Hz to 20000 Hz).

Question 15: What is reverberation? How can it be reduced?

Answer- The continuous multiple reflections of sound in a big enclosed space is reverberation. It can be reduced by covering walls and ceiling of enclosed space with the help of sound absorbing materials such as loose woollens, fibre boards.

Question 16: What is loudness of sound? What factors does it depend on?

Answer- Loudness refers to how loud or soft a sound seems to a listener. Loudness of sound is determined of amplitude. The unit of intensity is the decibel (dB).

Question 17: Explain how bats use ultrasound to catch prey.

Answer- The ultrasonic waves emitted by the bat are reflected from the prey (e.g., an insect) and are detected by its ears . The nature of reflected waves tells the bat about the location and the nature of its prey.

Question 18: How is ultrasound used for cleaning?

Answer- Objects that need to be cleansed are put in a cleaning solution and ultrasonic sound waves are passed through the solution. The high frequency of ultrasound waves helps in detaching the dirt from the objects.

Question 19: Explain the working and application of a SONAR.

Answer- SONAR;(-Sound Navigation and Ranging).It consists of a transmitter and a detector and is installed in a boat or a ship as shown in figure:

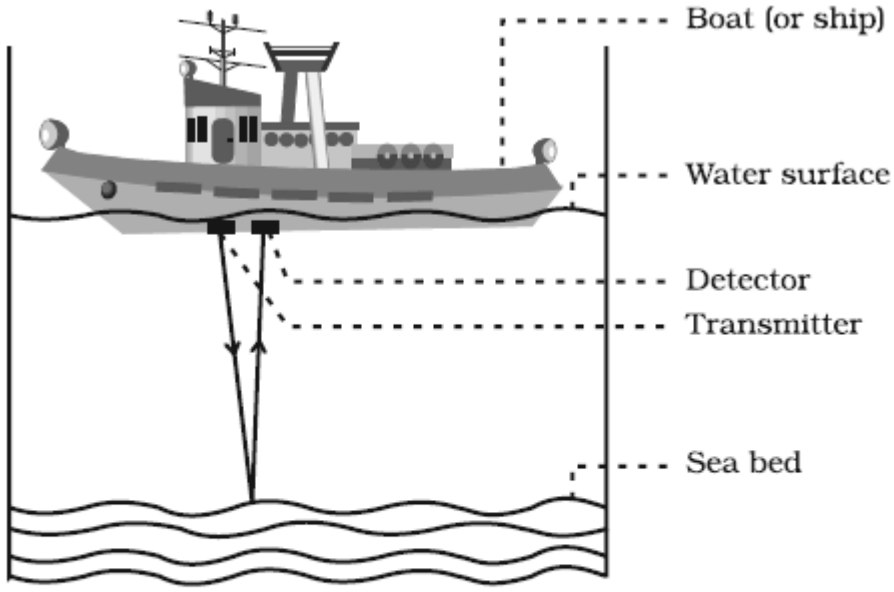


Fig.12.17: *Ultrasound sent by the transmitter and received by the detector.*

The transmitter produces and transmits ultrasonic waves. These waves travel through water and after striking the object on the sea bed, get reflected back and are sensed by the detector. SONAR calculates the distance (d) of the object by measuring time taken for transmission and reception of signal (t) by formula:

$\mathbf{d = \frac{v\,X\,t}{2}}$ **:** Where v is speed of sound in sea water.

The SONAR technique is used to determine the depth of the sea and to locate the underwater hills, valleys, submarines, icebergs and sunken ships etc.

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 = t = 5 sec

Distance of object from submarine = d = 3625 m

Using, $d = \frac{v\,X\,t}{2}$

Speed of sound in water = $v = \frac{2\,Xd}{t} = \frac{2\,X\,3625}{5} =$ **1450 m/s**

Question 21: Explain how defects in a metal block can be detected using ultrasound.

Answer- Ultrasounds can be used to detect cracks and flaws in metal blocks. Ultrasonic waves are allowed to pass through the metallic block and detectors are used to detect the transmitted waves. If there is even a small defect, the ultrasound gets reflected back indicating the presence of the flaw or defect.

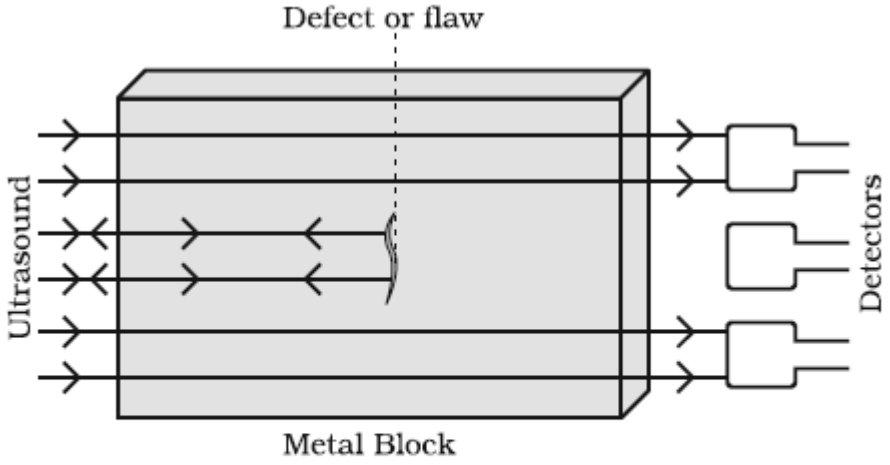


Fig 12.16: *Ultrasound is reflected back from the defective locations inside a metal block.*

Question 22: Explain how the human ear works.

Answer- Various sounds produced by particles in our surroundings are collected by pinna that transfers these sounds to the ear drum through the ear canal. The eardrum begins to vibrate back and forth briskly as soon as the sound waves fall on it. The vibrating Eardrum initiates the small bone hammer to vibrate. These vibrations are passed from the hammer to the third bone stirrup via the second bone anvil. The stirrup strikes the membrane of the oval window to pass its vibration to the cochlea. The liquid in the cochlea produces electrical impulses in the nerve cells. These electrical impulses are carried to the brain by the auditory nerve. They are interpreted by the brain as sound and hence we get a sensation of hearing.

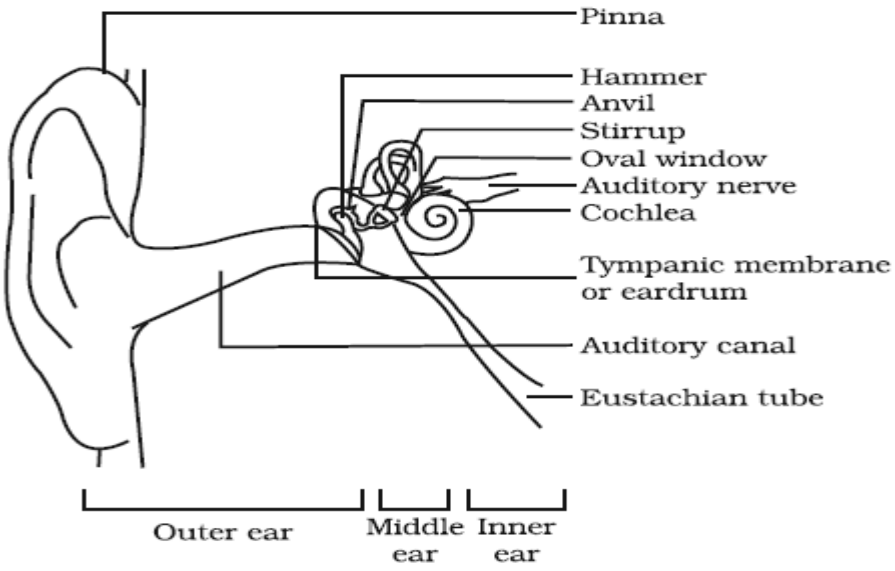


Fig. 12.19: *Auditory parts of human ear.*

CHAPTER 13 –WHY DO WE FALL ILL

Question 1: State any two conditions essential for good health.

Answer- (1) Better sanitation or clean surroundings

(2) Mental ,social and physical well being.

Question 2: State any two conditions essential for being free of disease.

Answer- (1) To be free from any specific disease.

(2) Get vaccination against infectious disease whenever required.

Question 3: Are the answers to the above questions necessarily the same or different? Why?

Answer-The answers to the above questions are different because a person may be free of disease but not be good mentally, socially, and economically

Question 4: 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 (i) having high body temperature ; (ii) having diarrhoea (loose motions), and ; (iii) having cough/cold.

If only one symptom persists, then also one should go to a doctor. The doctor will diagnose on the basis of the symptoms. Doctor will also get laboratory tests done to pin point the disease further.

Question 5: 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 causes a long term effect on our health. This chronic disease lasts for a long period of time. Jaundice develops slowly and does not spread rapidly.

Question 6: Why are we normally advised to take bland and nourishing food when we are sick?

Answer- Bland food is soft and can be easily digested and assimilated in body. Nourishing food increases resistance for disease and is essential for repair and growth of body tissue.

Question 7: What are the different means by which infectious diseases are spread?

Answer- Infectious diseases are generally spread through air, water, sexual contact, vectors, physical contact with affected person and through articles of use of affected person.

Question 8: What precautions can you take in your school to reduce the incidence of infectious diseases?

Answer- (a). Trying to stay away from students who are infected.

(b). Covering mouth and nose while coughing and sneezing.

(c). Keeping the school environment clean.

(d). Consuming safe clean water.

Question 9: What is immunization?

Answer- The method to boost our immune system with the help of vaccines that help the body to fight against infectious diseases is called immunization

Question 10: What are the immunization programs available at the nearest health center in your locality? Which of these diseases are the major health problems in your area?

Answer- The immunization programs available at the nearest health centers are Measles, Mumps, and Rubella (MMR), polio vaccine, jaundice, Diphtheria, Pertussis, and Tetanus (DPT), typhoid and hepatitis B.

From above typhoid and jaundice create major health problems.

EXERCISE QUESTION-ANSWERS

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- I suffered last year from cough and cold (twice) and malaria (once).

(a) Change in habits : Wear suitable clothes in order to give protection to the body during changing season and against mosquito bite.

(b) Change in surroundings :

- Improve the sanitary conditions in the surroundings,
- Do not allow water to collect near the houses, because it provides the breeding ground for mosquitoes.

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- A doctor/nurse/health-worker take following precautions to avoid become sick themselves:

(i) Get immunization done against all the infectious diseases.

(ii) Take balanced diet (rich in proteins especially) to strengthen their immune system.

(iii) Dispose off blood samples, urine or stool, sputum, etc., carefully.

(iv) Wear masks while diagnosing mouth or chest infections.

(v) Clean their hands and wear gloves even while doing minor surgeries.

Question 3: Conduct a survey in your neighborhood 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- The following three are the most common diseases in any neighborhood: Cold and cough, loose motions, and malaria. Some of the preventive measures that can be taken are:

(a). By providing fresh, uncontaminated, and clean drinking water.

(b). By maintaining hygienic sanitary conditions.

(c). By educating people about various preventive measures with the help of posters, and pamphlets.

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). It can be found out by observing the behavioral changes of the child such as: Improper food intake Constant crying, Mood changes frequently.

(b). The sickness can be determined with the help of symptoms or indications shown by the child. The symptoms could be loose motion, vomiting, paleness in body, and fever.

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- In condition **(c)** a person is most likely to fall sick. Because she is fasting, when her immune system is still weak. At this stage her body will not be able to fight against infection and if she is taking care of someone else suffering from chicken pox even she can get infected with chickenpox virus and will fall sick again.

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- I will be most likely to fall sick when my friend is suffering from measles and I come in contact with him because measles is contagious disease and also spreads by droplet infection.