Chapter -1

Heat

1 Mark Questions

1. Define temperature?

Temperature:- 1**.** The degree of hotness or coldness is called temperature.

2. The SI unit of temperature is Kelvin (K). It can also be expressed as degree Celsius (^{0}C).

2. What is thermal equilibrium?

Thermal equilibrium:- The state of a thermal equilibrium denotes a state of body where it neither receives nor gives out heat energy.

3. What is "Heat"? Write their units?

Heat:- Heat is a form of energy which flows from hot body to cold body.

Units :- 1. Joule (J) (in S.I system)

2. Calorie(cal) (in C.G.S system)

4. Define "Calorie"?

Calorie:- 1**.**The amount of heat required to raise the temperature of 1 gram of water by 1^{0}C is called calorie.

2. It is the C.G.S. unit of "Heat".

5. Write the definition of "Specific Heat" (S).

Specific Heat(S):- 1**.** The specific heat of a substance is the amount of heat required to raise the temperature of unit mass of the substance by one unit.

Units :- 1. J/Kg-K (in S.I System).

2. Cal/gm -^{0}C (in C.G.S Unit).

6. How much heat energy is required to raise the temperature of 1g mass of water to 14.5^{0}C to 15.5^{0}C?

One calorie

7. What is evaporation?

Evaporation:- 1. The process of escaping of molecules from the surface of a liquid at any temperature is called evaporation.

2. Evaporation is a cooling process.

(OR)

The change of phase from liquid to gas that occurs at the surface of the liquid is called evaporation.

8. What is condensation?

Condensation:- 1. The phase change from gas to liquid is called condensation.

2. It is a warming process.

9. What is meant by melting?

Melting :- 1. This process of converting solid into a liquid is called "**Melting**".

2. Melting point of a water is at 0^{0}C or 273K.

10. What is meant by freezing?

Freezing :- 1. The process in which a substance in liquid phase changes to solid phase by losing some of its energy is called freezing.

2. Freezing of water takes place at 0°C temperature and at one atmospheric pressure.

11. What is “dew”?

Dew: The water droplets condensed on window panes, flower, grass etc during the winter nights is dew.

12. What is “Fog”?

Fog: 1**.** During the low temperature, the water molecules presents in vapour condense on the dust particles in air and form small droplets of water.

2. These droplets keep floating in the air and form a thick mist. This thick mist is called fog.

13. Define Boiling?

Boiling:- 1. Boiling is a process in which the liquid phase changes to gaseous phase at a constant temperature at a given pressure.

2. Boiling point of a water is 100^0C or 373K.

14. What is humidity ?

Humidity : The amount of water vapour present in air is called 'humidity'.

15. Covert 20^0C into Kelvin scale. (AS1) (TQ)

Temperature in Kelvin =273 + Temperature in Celsius degrees.

20^0C =273+20 =293 K

16. What happens to the water when wet clothes dry? (AS3) (TQ)

When wet clothes are dried, the water in them is escaped as water vapor due to evaporation and mixes with the air.

17. Equal amounts of water are kept in a cap and in a dish. Which will evaporate faster? Why? (TQ)

1. The evaporation is a surface phenomenon and the rate of evaporation increases with increase in surface area.
2. So the water kept in dish will evaporate faster than the cap because dish has more surface area than cap.

18. Why does ice floats on water ?

The density of ice is less than the density of water. So ice floats on water.

19. If we keep the glass bottle into the fridge for a few hours which is completely filled with water and fix the lid tightly will break. Why ?

1**.** If we keep the glass bottle into the fridge for a few hours, the water in the bottle freezes to ice.

2. The volume increases. So the bottle is broken.

20. A samosa appears to be cool outside but it is hot when we eat it. Why ?

A samosa appears to be cool outside but it is hot when we eat it because the curry inside the samosa contains ingredients with higher specific heats.

21. Write the formula for the amount of heat absorbed (released) by a substance and explain the terms in it ?

The amount of heat, $Q = m\ S\ \Delta T$

Where Q = Amount of heat absorbed by a substance

m = Mass of the substance

S = Specific heat of the substance

ΔT = Change in temperature.

22. On which factors the rate of evaporation depends?

The rate of evaporation depends on its surface area, temperature and amount of water, vapour already present in the surrounding air.

23. What is meant by a absolute temperature?

Absolute temperature:- Temperature measured on Kelvin scale is called absolute temperature.

24. How would you convert degree Celsius to Kelvin?

Temperature in Kelvin = 273+ Temperature in degree Celsius

Add 273 to the value of temperature in degree Celsius to get the temperature on the Kelvin scale.

25. What are the principles of methods of mixtures?

Net heat lost= Net heat gain

This is known as principle of method of mixtures.

26. What is the difference between heat and temperature?

1. Heat is the energy that flows from a hotter to a colder body.
2. Temperature is a quantity that denotes which body is hotter and which is colder.
3. So temperature determines direction of heat (energy) flow, whereas heat is the energy that flows.

27. What is meant by a internal energy?

Internal energy:- 1. The molecules of the system have different forms of energies such as linear kinetic energy, rotational kinetic energy, vibrational energy and potential energy between molecules.

2. The total energy of the system is called internal energy of the system.

2 Marks Questions

1. What would be the final temperature of a mixture of 50g of water at 20^0C temperature and50g of water at 40^0C temperature? (AS1) (TQ)

Solution: - Given $m_1 = 50g$ $T_1 = 20^0C$

$m_2 = 50\ g$ $T_2 = 40^0C$

Final temperature, T= ?

Formula :- $T = \frac{m_1T_1 + m_2T_2}{m_1 + m_2} = \frac{50\ X\ 20+50\ X\ 40}{50+50} = \frac{1000+2000}{100}$

$= \frac{3000}{100}$

$= 30^0C$

∴ The final temperature of a mixture is 30^0C.

2. Why do we get dew on the surface of a cold soft drink bottle kept in open air? (AS1) (TQ)

1. We know that air contain a large number of water molecules in the form of vapour.
2. This vapour may come from evaporation of water from the surface of rivers, lakes, ponds and from the drying of wet cloths, sweat and so on.
3. When a cold soft drink bottle is kept in open air the water vapour present in the surrounding air condenses on the bottle.
4. These water molecules are slow down and stick to surface of the bottle as its surface is cold.
5. These water droplets are appeared as dew on the surface of the bottle.
6. This is a condensation process.

3. Does the surrounding air become warm or cool when vapors phase of H_2O condenses? Explain? (AS1) (TQ)

The surrounds air becomes warm when vapor phase of H_2O condenses.

Explanation: - 1. When vapour phase of H_2O condenses it losses energy.
2. The energy losses by vapour phase of H_2O is gained by the surrounding air.
3. Thus the surrounding temperature increases.
4. So the surrounding air becomes warm.

4. Answer these. (AS1) (TQ)

a) How much energy is transferred when 1gm of boiling water at 100^0C condenses to water at 100^0C?

Given Mass of water, m = 1gm.
Latent heat of vaporization, L = 540 cal/gm

$Q = m \times L_v$

$Q = 1g \times 540\ cal/gm = 540\ cal.$

b) How much energy is transferred when 1gm of boiling water at 100^oC cools to water at 0^oC?

100^0C		0^0C
Water	—	Water

Mass of water, m= 1gm
Initial Temperature, $T_1 = 0^0C$
Final temperature, $T_2 = 100^0C$
Specific heat of water, S = 1 cal/gm-^oC

$Q = m \times S\ (T_2 - T_1) = 1 \times 1 \times (100-0) = 100\ Cal$

c) How much energy is released or observed when 1gm of water at 0^0C freezes to ice at 0^0C?

Given Latent heat of ice = 80 cal/gm.
Mass of ice = 1 gm.
Heat energy released or observed, $Q = m L = 1 \times 80 = 80\ cal$

d) How much energy is released or observed when 1gm of steam at 100^0C turns to ice 0^0C?

$\underset{\text{Steam}}{100^0C} \rightarrow \underset{\text{Water}}{100^0C} \rightarrow \underset{\text{Water}}{0^0C} \rightarrow \underset{\text{Ice}}{0^0C}$

Steam $\rightarrow$ water, Q_1 = 540 cal/gm.
Water at $100^oC \rightarrow$ Water at 0^oC , Q_2 = 100 cal (From point (b))
Water at $0^oC \rightarrow$ Ice at 0^oC, Q_3 = 80 cal (From point (c))

$\therefore$ Total energy released, $Q = Q_1 + Q_2 + Q_3 = 540+100+80 = 720\ cal.$

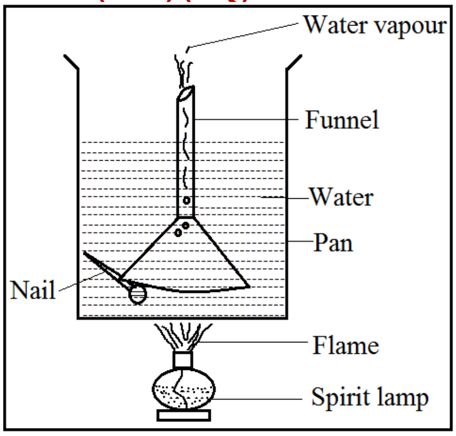
5. What role does specific heat capacity play in a watermelon to keep it cool for long time after removing it from a fridge on a hot day? (AS7) (TQ)

1. Water melon contains large percentage of water.
2. Water has higher specific heat value.
3. greater specific heat means to increase the temperature of 1gm of water by 1^0C.
4. It requires 1 calorie of heat to reach 1^0C, its takes place for a long time.
5. Hence watermelon cools for a long time after removing it from a fridge on a hot day.

6. Write the differences between evaporation and boiling? (AS1) (TQ)

Evaporation	Boiling
1. The process of escaping of molecules from the surface of a liquid at any temperature is called evaporation.	1. The process in which the liquid phase changes to gaseous phase at a constant temperature is called boiling.
2. Evaporation takes place at any temperature.	2. Boiling takes place at constant temperature.
3. It is a cooling process.	2. It is a heating process.
4. Temperature of the system falls during evaporation.	4. Temperature of the system remains constant during this process.
5. When the evaporation process starts, the temperature of the system decreases.	5. When the boiling process starts, the temperature of the liquid cannot be raised.

7. Place a Pyrex funnel with its mouth-down in a sauce pan with full of water, in such a way that the stem tube of the funnel is above the water or pointing upward into air. Rest the edge of the bottom portion of the funnel on a nail or on a coin so that water can get under it. Place the pan on a stove and heat it till it begins to boil. Where do the bubbles form first? Why? Can you explain how a Geyser works using above experience? (AS4) (TQ)



1. The boiling point of the water increases with increasing the pressure.
2. So the bubbles first form at the top of the funnel.

Working of Geyser: - 1. The Geyser works on the principle of electrical energy converted into heat energy.
2. When heat energy increases, the pressure inside of the Geyser is also increases.
3. So, the bubbles of water will come out from the top portion of the Geyser.
4. This is the laboratory demonstration of working of Geyser.

8. Suppose that to 1 litre of water is heated for a certain time to rise and its temperature by 2^0C. If 2 liter of water for the same time, by how much will its temperature rises? (AS7) (TQ)

Solution:- Given $m_1 = 1$Kg $\quad \Delta T_1 = 2^0$C

$m_2 = 2$Kg $\quad \Delta T_2 = ?$

Formula:- $\frac{m_1}{m_2} = \frac{\Delta T_1}{\Delta T_2}$

$\Rightarrow \frac{1}{2} = \frac{\Delta T_2}{2}$

$\Rightarrow \Delta T_2 = 1^oC$

$\therefore$ Rise in temperature is 1^oC.

9. If you are chilly outside the shower stall, why do you feel warm after the bath if you stay in bathroom? (AS7) (TQ)

1. We fell warm after finish our bath under the shower on a hot day.
2. In the bathroom the number of vapour molecules per unit volume is greater than the number of Vapour molecules per unit volume outside the bathroom.
3. When we try to dry ourselves with a towel, the vapour molecules surrounding us condense on our skin.
4. Condensation is a warming process.
5. Hence we feel warm.

10. What is Latent Heat of Vaporization? Write their units?

Latent Heat of Vaporization:- 1. This heat energy is used to change the state of water from liquid to vapour (gas). This is called latent heat of vapourization.

2. Latent heat of vaporization, L = $\frac{Q}{m}$.
3. Latent heat of vaporization is 540 cal/gm.

Units :- 1. SI unit is J/kg.
2. CGS unit of is cal/gm.

11. What is Latent Heat of Fusion? Write their units?

Latent Heat of Fusion:- 1. The heat energy required to converted 1g of solid completely into liquid at a constant temperature is called Latent Heat of fusion.

2. Latent heat of fusion, L = $\frac{Q}{m}$
3. Latent heat of fusion is 80 cal/gm**.**

Units :- 1. SI unit is J/kg.
2. CGS unit of is cal/gm.

12. Derive the equation for specific heat of a substance?

1. The amount of heat (Q) absorbed by a substance is directly proportional to its mass (m).

$$\text{i.e } Q \propto m \text{ -------(1)}$$

2. For the same mass (m) of water the change in temperature is proportional to amount of heat (Q) absorbed by it.

$$\text{i.e } Q \propto \Delta T \text{ --------(2)}$$

3. From equation (1) and (2), we get $Q \propto m\,\Delta T$

$$\Rightarrow Q = mS\,\Delta T$$

4. Where ‘s’ is a constant for a given substance. This constant is called “specific heat” of the substance.

4 Marks Questions

1. Explain why dogs pant during hot summer days using the concept of evaporation? (AS1) (TQ)

1. During hot summer days the temperature of the skin becomes higher and water in the sweat glands starts evaporating.
2. The process of evaporation cools our body.
3. That’s why we sweat to regulate our temperature since we have unobstructed pores all over the body.
4. Dogs do not have sweat pores on their skin and they do not have this facility.
5. When dogs pant, the water molecules present on the tongue and in the mouth starts to evaporate.
6. Evaporation is the cooling phenomenon.
7. This helps to cool the interior parts of the dogs body.
8. So, dog pant regulate their body temperature.

2. Your friend is not able to differentiate between evaporation and boiling. What questions do you? Ask to make him know the differences between evaporation and boiling? (AS2) (TQ)

1. What is meant by evaporation?
2. What is meant by boiling?
3. At what temperature evaporation takes place?
4. At what temperature boiling point takes places?
5. Why evaporation takes place at any temperature?
6. Why boiling takes place at constant temperature?
7. Which one is the cooling process?
8. Which one is the warming process?
9. In which process energy of the system increases?
10. In which process the energy of the system decreases?

3. Suggest an experiment to prove that rate of evaporation of liquid depends on its surface area and vapour already present in surrounding air? (AS3) (TQ)

1. Rate of evaporation depends on surface area.

Aim: -To prove that rate of evaporation of liquid depends on its surface area.

Apparatus: -Two dishes of different surface area and water.

Procedure: - 1. Take a small amount of water in a china dish and a cap.
2. Keep the dishes and cap under the fan and switch on the fan.
3. After some time observe the quantity of water in both dishes.
4. It is proved that the dishes contain larger surface area of water is fastly evaporated.
5. From this observation we concluded that rate of evaporation depends on its surface area.

2. Rate of evaporation depends on vapour already present in it.

Aim :- To show the rate of evaporation depends on vapour present in it.

Apparatus:- Two China dishes, spirit.

Procedure:- Take a few drops of spirit in two dishes.
2. One of the dish is placed in the AC room and another one is at normal room.
3. After some time we noticed that the spirit in the normal room disappears quickly.
4. This means that the rate of evaporation depends upon the vapour already present in surrounding area.

4. Explain the procedure of finding specific heat of solid experimentally? (AS1) (TQ)

Aim: -To find the specific heat of given solid experimentally.
Apparatus: -Calorimeter, thermometer, stirrer, water, steam heater, wooden box and lead shots.
Procedure: -1. The mass of the calorimeter along with stirrer is determined by using the physical balance and noted as ‘ m_1’ gm.
2. One third of the volume of the calorimeter is filled with water and its mass is ‘ m_2’ gm.
3. The mass of the water = m_2-m_1 gm
4. The calorimeter is placed in a wooden box and the temperature is measured by using the thermometer and noted as T_1^{0}C.
5. Take a few lead shots and place them in hot water or steam heater.
6. Heat them up to a temperature 100^{o}C. Let this temperature be T2.
7. Transfer the hot lead shots quickly into the calorimeter with minimum loss of heat.
8. Determine the mass of calorimeter, water and lead shots are noted as m_3 gm.
9. The mass of the lead shots = m_3-m_2 gm.
10. Contents in the calorimeter are stirred and then resultant temperature is noted as T_3^{0}C.
11. Let the specific heats of the calorimeter, led shots and water are S_c, S_l and S_w respectively.

12. According to the principles of methods of mixtures,

Heat lost by the solid = Heat gain by the calorimeter + Heat gain by the water.

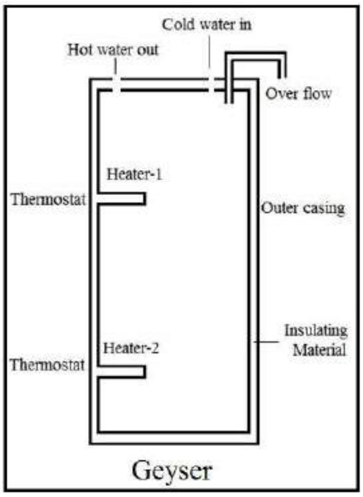
$$(m_3 - m_2)S_l\,(T_2 - T_3) = m_1\,S_c\,(T_3 - T_1) + (m_2 - m_1)\,S_w\,(T_3 - T_1)$$

$$(m_3 - m_2)S_l\,(T_2 - T_3) = [\,m_1\,S_c + (m_2 - m_1)S_w\,](T_3 - T_1)$$

$$S_l = \frac{[m_1 S_c + (m_2 - m_1)\,S_w]\,(T_3 - T_1)}{(m_3 - m_2)\,(T_2 - T_3)}$$

By using the above formula we calculate the specific heat of the solids (lead shots) experimentally.

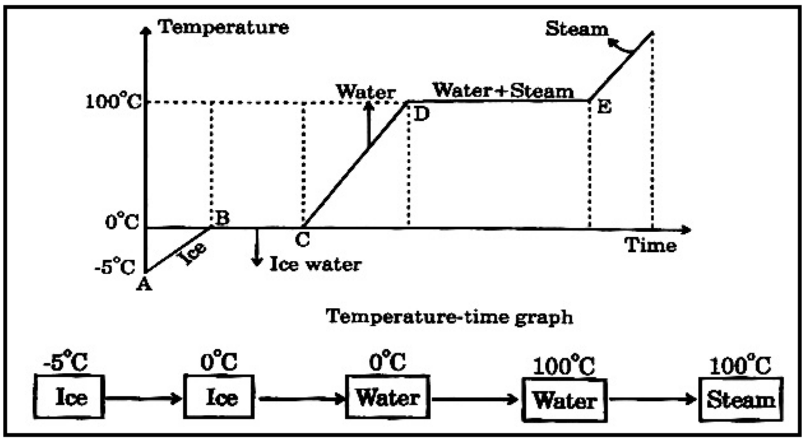
5. Collect the information about working of geyser and prepare a report. (AS4) (TQ)



<u>Working of Geyser</u>: - 1. Geyser is an electrical device which converts the electrical energy into heat energy.

2. It has two way of water pipes. Cool water enter into one pipe and hot water is out in another pipe.
3. A geyser has inner heating element made up of Nichrome.
4. The water in the geyser observes the heat energy from the heating element.
5. Thermostat unit was attached to heating element to control the temperature by switching off the element, once the desired temperature has been reached.
6. The water reaches to certain temperature the heating element does not transfer the heat energy.
7. To prevent the loss of heat energy from geyser to surrounds it is enclosed by an insulating material.
8. All this arrangement is kept in a metallic cylinder and has a facility to fix on the wall.

6. Assume that heat is being supplied continuously to the ice at -5^{0}C. You know that ice melts at 0^{0}C and boils at 100^{0}C. Continue the heating till it starts boiling. Note the temperature for every minute. Draw a graph between temperature and heat using the values you get. What do you understand from the graph? Write the conclusions. (AS5) (TQ)



Given that Ice is at -5^0C.

1. Ice gains heat energy from A to B until the temperature becomes 0^oC, the melting point of ice and so temperature increases from -5^0C to 0^oC.
2. At 0^0C (from B to C), the temperature of the ice remains constant.
3. After the temperature increases, up to 100^0C and remains constant for some time(from C to D).
4. At 100^0C water is converted into water vapour nothing but boiling point of water(from D to E).
5. Then after temperature increases (after E).

Conclusions: - From the graph we concluded that,

1. The temperature remains constant at 0^0C, till all the ice is converted in to water.
2. The temperature remains constant at 100^0C, until all the water is converted in to water.
3. The amount of heat energy required to change the liquid to gas is more than the solid to liquid.
4. Time taken to convert the liquid to gas is more than the solid to liquid.

7. How do you appreciate the role higher specific capacity value of water in stabilizing atmospheric temperature during winter and summer seasons? (AS6) (TQ)

The specific heat of a water is 4.2 J/gm-^{o}C. So, every 1 gm of water will absorb 4.2 Joules of heat energy, when its temperature rises by 1^oC only. This property of water has a profound effect on our day to day life.

1. The sun delivers a large amount of energy to the Earth daily.
2. The water sources on Earth, particularly the oceans, absorb this energy for maintaining a relatively constant temperature.
3. The oceans behave like heat "store houses" for t he earth.
4. They can absorb large amounts of heat at the equator without appreciable rise in temperature due to high specific heat of water.
5. Therefore, oceans moderate the surrounding temperature near the equator.
6. Ocean water transports the heat away from the equator to areas closer to the north and south poles.
7. This transported heat helps moderate the climates in parts of the Earth that are far from the equator.
8. So, appreciate the role higher specific capacity value of water in stabilizing atmospheric temperature.

Chapter 2

Chemical Reactions and Equations

1 Mark Questions

1. What is meant by Chemical reaction?

The making and breaking of chemical bonds are called Chemical reactions.

2. What is meant by a antioxidants?

Antioxidants:- The substances which prevents the oxidation are called antioxidants.

Ex:- Vitamin C and vitamin E etc.

3. $MnO_2 + 4\ HCl \rightarrow MnCl_2 + 2\ H_2O + Cl_2$ In the above equation, name the compound which is oxidized and which is reduced? (AS1)(TQ)

1. Removal of oxygen is reduced. Oxygen id removed from MnO_2. So, reduced compound is MnO_2.
2. Removal of hydrogen is oxidation. Hydrogen is removed from HCl. So, oxidized compound is HCl.

4. In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write the reaction involved? (AS1)(TQ)

When copper metal is placed in a silver nitrate solution, copper is more reactive than silver, so it displace silver from silver nitrate.

Ex: $2AgNO_3 + Cu \rightarrow Cu\ (NO_3)_2 + 2Ag$

5. What is the use of keeping food in air tight containers? (AS7) (TQ)

1. Keeping food in air tight containers helps to slow down oxidation process.
2. So that we can avoid the spoiling of food(rancidity).

6. Write the substances which undergoes chemical reaction?

The substances which undergo chemical change in the reaction are called reactants.

7. Write a chemical change between Barium chloride and Sodium Sulphate? Determine the colour of the end product for the above reaction?

Sodium sulphate reacts with barium chloride to give white precipitate of barium sulphate and sodium chloride.

$$Na_2\ SO_4 + BaCl_2 \rightarrow BaSO_4\downarrow + NaCl$$

8. What are the changes do you observed between the chemical reaction of Zinc and dilute hydro chloric acid in conical flask?

Zinc metal reacts with dilute HCl to form Zinc chloride ($ZnCl_2$) and liberates Hydrogen gas.

$$Zn + HCl \rightarrow ZnCl_2 + H_2\uparrow$$

9. What is meant by chemical equation ? Write chemical equation of the reaction between Barium chloride and Sodium Sulphate?

Chemical Equation:- 1. Describing a chemical reaction using least possible words or symbols is called a chemical equation.

2. Sodium sulphate reacts with barium chloride to give white precipitate, barium sulphate and sodium chloride.

$$Na_2\ SO_4 + BaCl_2 \rightarrow BaSO_4\downarrow + NaCl$$

10. State one basic difference between a physical change and a chemical change?

1. In a physical change, no new substance is formed.
2. In a chemical change a new substance is formed and sometimes heat energy is observed or liberated.

11. State the type of chemical reaction?

A) $C_{(g)} + O_{2\,(g)} \rightarrow CO_2 + Q$

B) $N_{2(g)} + O_{2\,(g)} \rightarrow 2NO(g) - Q$

A) Exothermic Reaction.

B) Endothermic Reaction.

12. Define Oxidation? Give an example?

<u>Oxidation</u>:- 'Oxidation' is a reaction that involves the addition of oxygen or removal of hydrogen.

<u>Ex</u>:- $Cu(s) + O_{2(g)} \xrightarrow{Heat} 2\ CuO_{(S)}$

13. Define reduction? Give an example?

<u>Reduction</u>:- 'Reduction' is a reaction that involves the addition of hydrogen or removal of oxygen.

<u>Ex</u>:- $CuO_{\,(s)} + H_{2(g)} \xrightarrow{Heat} Cu_{\,(s)} + H_2O$

14. Write balanced chemical reaction between Calcium Oxide and water?

$CaO + H_2O \rightarrow Ca(OH)_2$

15. Why photosynthesis is considered an endothermic reaction?

Photosynthesis is an endothermic reaction as it takes energy from the sun.

16. Which type of reaction involved when silver chloride is exposed to sunlight?

Photo chemical reaction.

17. Write the substances which are present left side and right side of the arrow mark in the chemical equation ?

The reactants are written on the left side of arrow and the products are written on the right side of the arrow.

<u>Ex</u>:- $Zn + HCl \rightarrow ZnCl_2 + H_2\uparrow$

(Reactants) (Products)

18. Why should a magnesium ribbon cleaned before burning in air?

1. Magnesium ribbon should be cleaned before burning in air, because it forms magnesium oxide by reacting with oxygen present in the air.
2. This oxide layer should be removed and we burn only pure magnesium metal.

19. Why does the chemical decomposition reactions are considered as endothermic?

1. A chemical decomposition requires a energy in the form of heat, light and electricity.
2. So, Chemical decomposition reactions are endothermic.

20. Write word equation of Zn + dil. $HCl \rightarrow ZnCl_2 + H_2$?

Zinc + dil. Hydro chloric acid → Zinc Chloride + Hydrogen

21. Which two gases are evolved on heating Ferrous sulphate?

Sulphur dioxide(SO_2) and Sulphur tri oxide(SO_3).

22. Why are certain reagents like silver bromide stored in dark bottles?

1. Reagents or chemicals like silver bromide decompose when exposed to light.
2. Hence, these are stored in dark bottles.

23. Why do we apply paint on iron articles?(AS7)(TQ)

1. When iron articles are exposed to moisture, acids etc, they undergo rusting.
2. We apply paint on iron articles to shield their surfaces from oxygen and moisture to prevent them from rusting.

24. Why potato chips manufacturers fill the packet of chips with nitrogen gas?

To prevent potato chips from oxidation, fill the packet of chips with nitrogen gas.

25. A student has mixed the solutions of lead nitrate and potassium iodide. State the colour of the precipitate formed?

Yellow coloured precipitate.

26. Why the surface of some metals lose their brightness when kept in air for a long time?

Metals get corroded due to exposure to air and moisture and a rough oxide film is formed on the surface.

27. X react with Y and forms $Ca(OH)_2$ and Heat. Name X and Y the substances in the reaction?

X : Cao Y : H_2O

28. What are anti oxidants? Give examples?

Anti oxidants:- The substances which prevent oxidation are called anti oxidants.

Ex:- Vitamin C and Vitamin E.

30. When does the reactions are said to be endothermic chemical reactions?

1. The reactions require energy in the form of heat, light or electricity for converting the reactants to products.
2. The reactions are Called endothermic Reactions.

31. Why they add dil. HCl in electrolysis of water?

The dil. HCl is added to water in the electrolysis process for improve the Conductivity of Electricity.

32. How to you determine the realeased gas is CO_2 in the chemical reaction?

In the chemical reaction the gas is put off burning match stick with "TUP" sound then is confirmed the released gas is CO_2.

33. Which substance has undergone oxidation reaction in the following? $H_2S + Br \rightarrow 2\ HBr + S$

In the above reactions H_2S lost its Hydrogen. So H2S is oxidized by Bromine.

34. In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write the reaction involved?

1. Copper displaces silver from silver nitrate solution.

$$2Ag\ NO_3 + Cu \rightarrow Cu\ (No_3)_2 + Ag$$

2. Copper is more reactive than silver. So, copper displaces the silver.

35. Write the role of Vitamin C & E in preservation of food?

1. Generally substances which prevent oxidation (Antioxidants) are added to food.
2. The spoilage of food can be prevented by adding preservatives like Vitamin C and Vitamin E.

36. What is meant by alloy? Give some examples?

Alloy:- The metallic substance mixing or fusing two or more metals and non metal , to obtain desirable qualities such as hardness, lightness and strength is known as alloy.

Ex:- Brass, bronze, and steel.

37. Write the chemical reaction, which colour the silver metal exposed to moisture?

$$4Ag + 2H_2S + O_2 \rightarrow 2Ag_2S + 2H_2O$$

In this chemical reaction the colour of the silver when exposed to moisture is block.

38. Write the name of metal which is not undergone oxidation process?

Gold and Platinum.

39. 1. $AgNO_{3(aq)}$ + Nacl $_{(aq)}$ → $AgCl_{(s)}$ ↓ + $NaNO_{3\ (aq)}$
2. FeS + H_2SO_4 → $FeSO_4$ + H_2S↑
Consider the above mentioned two chemical equations with two different kinds of arrows (↑ and ↓) along with product. What do these different arrows indicate?

'↓' Indicates silver chloride is precipitated.
'↑' Indicates that H_2S is formed in gaseous form.

40. Write the substances are used for manufacturing of stainless steel?
Iron is mixed with carbon, nickel and chromium to get an alloy stainless steel.

41. Name any four metals which can not displace hydrogen from dilute acids?
Copper, Plattinum, Silver and Gold.

42. What is galvanizing? Write their uses?
Galvanizing:- 1. Galvanizing is a method of coating a metal with a thin layer of Zinc.
2. It is essential for protection of metals from rusting.

43. Define combustion? What are the products in the combustion of hydrocarbons?
Combustion:- The process of burning of a substance in the presence of oxygen is called combustion.
Ex:- $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$.

44. Why does freshly cut fruits and vegetables such as apples, pears , bananas and potatoes turns brown after some time?
Apples, pears, bananas and potatoes etc., contain enzyme called polyphenol oxidise or tyrosinane, which reacts with oxygen and change the colour on the cut surface of the fruit.

2 Marks Questions

1. What is a balanced chemical equation? Why should chemical equations be balanced? (AS1) (TQ)
Balanced chemical equation: A chemical equation in which the numbers of atoms of different elements on the reactants side (left side) are same as those on product side (right side) is called a balanced reaction.
A chemical equation should be balanced because,
1. According to the law of conservation of mass, the total mass of the products formed in chemical reaction must be equal to the mass of reactants consumed.
2. The number of atoms of each element before and after reaction must be the same.
3. Atoms are neither created nor destroyed in chemical reactions.

Ex:- $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

2. What is a chemical equation? Illustrate with an example?
Chemical equation:- 1. A chemical reaction using least possible words or symbols is called a chemical equation.
2. For emxaple, the reaction of zinc with dilute sulphuric acid to produce zinc sulphate and hydrogen is given by the following chemical equation.
Ex:- $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2\uparrow$

3. Why does respiration considered as an exothermic reaction? Explain (AS1)(TQ)
1.The reactions which involves with the evolution of heat energy is called exothermic reactions.
2. In respiration, glucose combine with oxygen in the cells of our body and releases the energy.
3. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + Q$ (Energy).
4. So respiration is considered as an exothermic reaction.

4. What is the difference between displacement and double displacement reactions? Write equations for these reactions?(AS1)(TQ)

Displacement Reaction	Double displacement Reactions
1. In a displacement reaction one element displace another element from its compound.	1. In a double displacement reaction two reactants exchange their constituents chemically and form two new compounds.
2. **Ex:-** $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$	2. **Ex:-** $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$
3. In this reaction one of the reactant must be an element.	3. In this reqction both the reactants must be the Ionic compounds.
4. In this reactions generally change of colour takes place.	4. In this reactions generally precipitated are formed.

5. Give two examples of oxidation – Reduction(redox reactions) reaction?(AS1)(TQ)

Redox Reactions:- 1. A chemical reaction in which one substance is oxidized and the other is reduced is called redox reaction.

2. Tedox reactions are also called as oxidation-reduction reactions.

Ex:- 1. Carbon combines with oxygen to form carbon dioxide. Hence carbon is oxidized. Iron loses oxygen to form iron, hence iron is reduced.

$$2Fe_2O_{3\,(s)} + 3C_{(s)} \rightarrow 4Fe_{(s)} + 3CO_{2\,(g)}$$

In this reaction Carbon is oxidized and Fe_2O_3 is reduced.

2. Carbon combines with oxygen to form carbon dioxide. Hence carbon is oxidized. Lead loses oxygen to form lead, hence lead is reduced.

$$2Pbo_{(s)} + C_{(s)} \rightarrow 2pb_{(s)} + CO_{2\,(g)}$$

In this reaction Carbon is oxidized and Pbo is reduced.

6. What do mean by corrosion? How can you prevent it?(AS1) (TQ)

Corrosion:- 1. When some metals are exposed to moisture, acids etc, they tarnish due to the formation of respective metal oxide on their surface.

2. This process is called corrosion.

$$Fe + O_2 + H_2O \rightarrow \underset{\text{(Rust)}}{Fe_2O_3 . x\,H_2O}$$

Prevention:- 1. Corrosion can be prevented or at least minimized by shielding the metal surface from oxygen and moisture.

2. It can be prevented by painting, oiling, greasing.
3. It can be prevented by galvanizing, chrome plating or making alloys.
4. Galvanizing is a method of protecting iron from rusting by coating them a thin layer of Zinc.

7. How chemical displacement reactions differ chemical decomposition reaction? Explain with an example for each? (AS1) (TQ)

1. Chemical displacement reaction:- In a displacement reaction one element replaces another element from its compound.

Ex:- Zn + CuSO4 →ZnSO4 + Cu.

Zinc is more reactive than copper, it can displace copper from copper sulphate solution.

2. Chemical decomposition reaction:- In a decomposition reaction one substance (reactant) decomposes into two or more new compounds.

Ex:- $CaCO_3 \xrightarrow{\text{Heat}} CaO + CO_2$

8. A shiny brown coloured element 'X' on heating in air becomes black in colour. Can you predict the Element 'X' and the black coloured substance formed? How do you support your predictions? (AS2)(TQ)

The shiny brown coloured element 'X' may be Cu.

Explanation:- 1. Copper(shiny brown colour metal) reacts with oxygen present in the atmosphere to form copper oxide(black coloured substance).

$$\underset{\text{(Brown)}}{2Cu} + O_2 \rightarrow \underset{\text{(Block)}}{2CuO}$$

2. Therefore shiny brown coloured element 'X' is nothing but copper.

9. Which gas evolved with brown colour in the Heat reaction of Lead Nitrate?

1. On heating lead nitrate decomposes to lead oxide, oxygen and Nitrogen dioxide. You observe the brown fumes liberating in the boiling tube.
2. These brown fumes are of Nitrogen dioxide (NO_2).

$$2Pb\,(NO_3)_2 \rightarrow 2PbO_{(s)} + 4NO_{2(g)} + O_{2(g)}$$

10. Explain rancidity? How can you prevent it? (AS1)(TQ)

Rancidity:- 1. When the fat/oil containing food maternal left for a long time, they are oxidized and change their smell and taste.
2. The oxidation of fats or oils in the food material is called Rancidity.
3. Rancidity is an oxidation process.

Prevention:- Rancidity can be prevented by,
1. Storing food material in air tight container.
2. Adding preservatives such as vitamin C and E to the food materials.
3. Antioxidents are added to food containing fats and oils to prevent spoilage of food.
4. Flushing nitrogen gas into the bags containing food material to prevent the oxidation.

11. What do you mean by precipitation reaction? (AS1)(TQ)

Precipitation reaction:- 1. Sometimes the products in the chemical reactions are in soluble in water is called precipitate.
2. Such type of chemical reactions are called precipation reactions.

Ex:- 1. Lead nitrate solution react with potassium iodide solution,a yellow colour substance which is insoluble in water, is formed.
2. This insoluble substance in known as precipitate, and the reactions are called precpitative reactions.

$$Pb(NO_3)_{2(aq)} + 3Kl_{(aq)} \rightarrow PbI_{2(s)} + 2KNO_{3(aq)}$$

12. Write the reaction involved in the whitening of walls?

1. A solution of slaked lime produced in the reaction is used to white wash walls.
2. Calcium hydroxide reacts slowly with the carbon dioxide in air to form a thin layer of calcium carbonate on the walls.
3. It gives a shiny finish to the walls.

$$Ca(OH)_{2(aq)} + CO_{2(g)} \rightarrow CaCO_{3(s)} + H_2O_{(l)}$$

13. When you dippled iron nails in Copper sulphate solution, becoming brown. Write causes for loss of colour of copper sulphate solution?

1. The Iron nail dipped in copper sulphate solutions compared before and after the experiment.

$$Fe_{(S)} + CuSO_{4(s)} \rightarrow FeSO_{4(aq)} + Cu_{(g)}$$

2. Iron is more reactive than copper, so it displaces copper from copper sulphate.

14. What is meant by a skeletal chemical equation? Give one example?

Skeletal chemical equation:- 1. If the number of atoms of any element in a chemical equation is not equal on both sides, then it is a skeletal equation.

Ex:- $Mg + HCl \rightarrow MgCl_2 + H_2$

3. Here, the number of chlorine and hydrogen atoms are not equal on both sides.

15. Write the bleaching reaction of chlorine?

Bleaching of coloured objects using moist chlorine.

$$Cl_2 + H_2O \rightarrow HOCl + HCl$$

$$HOCl \rightarrow HCl + (O)$$

Coloured object + (O) $\rightarrow$ Colourless object.

16. List out four observations that help us to determine whether a chemical reaction has taken place?

When a chemical reaction occurs, one or more of the following changes take place. They are,

1. A change that changes state and colour of substance.
2. A change that release heat energy.
3. A change which forms an insoluble substance as precipitate.
4. A change that liberate a gas.

17. Write the skeletal equation for the following reactions.

(a) Hydrogen sulphide reacts with sulphur dioxide to form sulphur and water.

(b) Methane on burning combines with oxygen to produce carbon dioxide and water.

(a) $H_2S + SO_2 \rightarrow S + H_2O$

(b) $CH_4 + O_2 \rightarrow CO_2 + H_2O$

18. Define Chemical combination ? Explain with Examples?

Chemical combination:- If two or more reactants combine to form a single product is called chemical combination reactions.

Ex:- Magnesium and oxygen combine to form a new substance magnesium oxide.

$$2\,Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(g)}$$

19. Define Chemical decomposition ? Explain with examples?

Chemical decomposition:- In a decomposition reaction a single substance decomposes to give two or more products.

Ex:- $CaCO3_{\ (s)} \rightarrow CaO_{(S)} + CO_{2(g)}$

It is a thermal decomposition reaction. When a decomposition reaction is carried out by heating, it is called thermal decomposition reaction.

20. Define displacement reaction ? Explain with Examples?

Displacement reaction:- In a displacement reaction one element displaces another element from its compound.

Ex:- $Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_{2(aq)} + H_{2(g)}$

In reaction the element zinc has displaced hydrogen from Hydrochloric acid. This is displacement reaction.

21. Define double displacement reaction ? Explain with Examples?

Double displacement reaction:- If two reactants exchange their constituents chemically and form two products, then the reaction is called as double displacement reaction.

Ex:- $Pb(NO_3)_{2(aq)} + 3Kl_{(aq)} \rightarrow PbI_{2(s)} + 2KNO_{3(aq)}$

In the above reaction, lead ion and Potassium ion exchange their places each other. Lead ion combines with iodide ion and forms PbI_2 as precipitate and KNO_3.

4 Marks Questions

1. Name the reactions taking place in the presence of sunlight? (AS1)(TQ)

Photo chemical reactions:- 1. The reactions which takes place in the presence of sunlight is called photo chemical reactions.

2. There are two types of photochemical reactions. They are,

i. Photo synthesis.

ii. Photochemical reactions.

i. Photo synthesis:- 1. Photosynthesis is a chemical reaction in which green pigment of the plants called chlorophyll preparing the food starch material in the presence of sun light.

2. It is also called as Photochemical reaction.

$$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6O_2.$$

ii. Decomposition of Silver bromide:- 1. Silver bromide decomposes to silver and bromine in sunlight.

2. Light yellow coloured silver bromide turns to gray due to sunlight.

$$\underset{\textbf{(Yellow)}}{2AgBr_{(S)}} \xrightarrow{\text{Sunlight}} \underset{\textbf{(Gray colour)}}{2Ag_{(S)}} + Br_{2(g)}$$

2. Balance the following chemical equations.(AS1)(TQ)

a) $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$

b) $Hg\ (NO_3)_2 + KI \rightarrow Hg\ I_2 + KNO_3$

c) $H_2 + O_2 \rightarrow H_2O$

d) $KClO_3 \rightarrow KCl + O_2$

e) $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$

Balanced chemical equations:-

a) $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$

b) $Hg\ (NO_3)_2 + 2KI \rightarrow Hg\ I_2 + 2KNO_3$

c) $2H_2 + O_2 \rightarrow 2H_2O$

d) $2KClO_3 \rightarrow 2KCl + 3O_2$

e) $C_3H_8 + 5O_2 \rightarrow 3\ CO_2 + 4H_2O$

3.Write the balanced chemical equations for the following reactions. (AS1).(TQ)

a) Zinc + Silver nitrate → Zinc nitrate + Silver.

b) Aluminum + copper chloride → Aluminum chloride + Copper.

c) Hydrogen + Chlorine. → Hydrogen chloride.

d) Ammonium nitrate → Nitrogen + Carbon dioxide + water.

e) Ammonium nitrate → Nitrous Oxide + water.

Balanced chemical equations:-

a) Zinc + Silver nitrate → Zinc nitrate + Silver.

$Zn + 2AgNO_3 \rightarrow Zn\ (NO_3)_2 + 2Ag.$

b) Aluminum + copper chloride → Aluminum chloride + Copper.

$2\ Al + 3\ Cu\ Cl_2 \rightarrow 2\ Al\ Cl_3 + 3Cu$

c) Hydrogen + Chlorine→ Hydrogen chloride.

$H_2 + Cl_2 \rightarrow 2\ HCl$

d) Ammonium nitrate → Nitrogen + Oxygen + water.

$2NH_4NO_3 \rightarrow 2N_2 + O_2 + 4H_2O$

e) Ammonium nitrate → Nitrous Oxide + water.

$NH_4NO_3 \rightarrow N_2O + 2H_2O$

4. Write the balanced chemical equation for the following and indentify the type of reaction in each Case? (AS1) (TQ)

a) Calcium hydroxide (aq) + Nitric acid (aq) → Water (l) + Calcium nitrate (aq)

$Ca(OH)_2$ (aq) + $2HNO_3$ (aq) → H_2O (liquid) +$Ca(No_3)_2$ (aq)

This is a chemical double displacement reaction.

b) Magnesium (s) + Iodine (g) → Magnesium Iodide. (s)

Mg (s) +I_2 (g) → Mg I_2 (s)

This is a chemical combination reaction.

c) Magnesium(s) + Hydrochloric acid (aq) → Magnesium chloride (aq) + Hydrogen (g)

Mg (S) + 2Hcl (aq) → Mg Cl_2 (aq) + $H_2\uparrow$ (g)

This is a chemical displacement reaction.

d) Zinc(s) + Calcium chloride (aq) → Zinc Chloride (aq) + Ca(s)

Zn (s) +Ca Cl_2 (aq)→Zn cl_2 (aq) +Ca (s)

This is a chemical displacement reaction.

3. Write an equation for decomposition reaction where energy is supplied in the form of heat/light/electricity? (AS1)(TQ)

Heat:- On heating calcium carbonate ($CaCO_3$) decomposes to calcium oxide (CaO) and carbon dioxide (CO_2)

$$\underset{\text{(Lime stone)}}{CaCO_3} \xrightarrow{\text{Heat}} \underset{\text{(quick lime)}}{CaO} + CO_2$$

Light (photo chemical reaction):- 1. Silver bromide decomposes to form silver and bromine in the presence of sun light.

2. Such reactions are called photo chemical reactions.

3. The light yellow coloured silver bromide turns to gray due to sunlight.

$$\underset{\textbf{(Yellow)}}{2AgBr} \xrightarrow{\text{Sunlight}} \underset{\textbf{(Gray colour)}}{2Ag + Br_2}$$

Electricity (electrolysis):- When electricity is passes through acidified water, it dissociates to hydrogen and oxygen.

$$2H_2O\ (\ell) \xrightarrow{\text{electricity}} 2H_2\uparrow(g) + O_2\uparrow\ (g)$$

4. Balance the following chemical equations including the physical states. (AS1)(TQ)

a) $C_6H_{12}O_6 \rightarrow C_2H_5OH + CO_2$

b) $Fe + O_2 \rightarrow Fe_2O_3$

c) $NH_3 + Cl_2 \rightarrow N_2H_4 + NH_4Cl$

d) $Na + H_2O \rightarrow NaOH + H_2$

Balanced chemical equations:-

a) $C_6H_{12}O_6$ (s) →$2C_2H_5OH_{(\ell)}$ + $2CO_{2(g)}$

b) 4Fe(s) + $3O_2$ (g)→$2Fe_2O_3$(s)

c) $4NH_{3(\ell)}$+ $Cl2_{(g)}$→$N_2H_{4(\ell)}$+$2NH_4Cl$(g)

d) 2Na(s) + $2H_2O_{(\ell)}$→$2NaOH_{(aq)}$ + $H_{2(g)}$

17. Balance the chemical equation by including the physical state of the substances for the following reactions. (AS1)(TQ)

a) Barium chloride and Sodium sulphate aqueous solutions react to give insoluble Barium sulphate and aqueous solution of solution of sodium chloride.

b) Sodium hydroxide reacts with Hydrochloric acid to produce Sodium chloride and water.

c) Zinc pieces react with dilute hydrochloric acid to liberate hydrogen gas and forms Zinc chloride.

Balanced chemical equations:-

a) $BaCl_{2(aq)} + Na_2SO_{4(aq)} \rightarrow BaSO_4(\downarrow) + 2NaCl_{(aq)}$

b) $NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(\ell)}$

c) $Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_2(\downarrow) + H_{2(g)}$

2. Balance the following chemical equation?(AS1) (TQ)

a) $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$

b) $Fe_2O_3 + Al \rightarrow Fe + Al_2O_3$

c) $CO_2 + H_2O \rightarrow C_6H_{12}O_6 + O_2$

d) $Pb(NO_3)_2 \rightarrow PbO + NO_2 + O_2$

Balanced chemical equations:-

a) $2C_3H_8 + O_2 \rightarrow 6CO_2 + 8H_2O$

b) $Fe_2O_3 + 2Al \rightarrow 2Fe + Al_2O_3$

c) $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

d) $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$

16. Balance the following chemical equations including the physical states?

a) $C_6H_{12}O_6 \rightarrow C_2H_5OH + CO_2$

b) $Fe + O_2 \rightarrow Fe_2O_3$

c) $NH_3 + Cl_2 \rightarrow N_2H_4 + NH_4Cl$

d) $Na + H_2O \rightarrow NaOH + H_2$

Balanced chemical equations:-

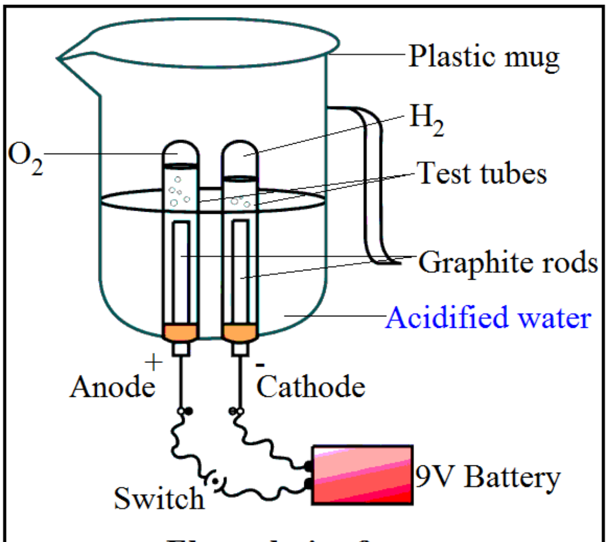
a) $C_6H_{12}O_6\ (s) \rightarrow 2C_2H_5OH_{(\ell)} + 2CO_{2(g)}$

b) $4Fe(s) + 3O_2\ (g) \rightarrow 2Fe_2O_3(s)$

c) $4NH_{3(\ell)} + Cl2_{(g)} \rightarrow N_2H_{4(\ell)} + 2NH_4Cl_{(g)}$

d) $2Na(s) + 2H_2O_{(\ell)} \rightarrow 2NaOH_{(aq)} + H_{2(g)}$

12. Explain the Electrolysis experiment to release of H_2 and O_2 ?



Electrolysis of water

1. Take a plastic mug. Drill two holes at its base.
2. Fit two rubber stoppers in these holes.
3. Insert two carbon electrodes in these rubber stoppers.
4. Connect the electrodes to 6V battery as shown in figure.
5. Fill the mug with water, so that the electrodes are immersed.
6. Add few drops of dilute sulphuric acid to water.
7. Take two test tubes filled with water and invert them over the two carbon electrodes.
8. Switch on the current and leave the apparatus undisturbed for some time.
9. The liberation of gas bubbles at both the electrodes.
10. These bubbles displace the water in the test tubes.
11. Once the test tubes are filled with gases take them out carefully.
12. Test both the gases separately by bringing a burning candle near the mouth of each test tube.
13. In the above activity on passing the electricity, water dissociates to Hydrogen and oxygen.

$$2H_2O_{(l)} \rightarrow 2\ H_{2(g)} + O_{2(g)}$$

14. Hence it is a example of electrolysis of water.

Chapter -3

Reflection of light on different surfaces

1 Mark Questions

1. State Fermat's principle? (AS1)

Fermat's principle:- Fermat's principle states that the light selects the path which takes the least time to travel.

2. It is also applicable to to reflection of light.

2. Why concave and convex mirrors are called spherical mirrors? (AS1)(TQ)

1. The reflecting surface of concave and convex mirrors can be considered to form a part of the surface of a sphere.
2. Such mirrors, whose reflecting surfaces are spherical are called spherical mirrors.

3. Define the following terms in connection with spherical mirrors.(AS1) (TQ)

a) Pole b) Principal axis c) Focal point (focus) d) Centre of curvature e) Object distance f) Image distance g) Focal length h) Radius of curvature i) Magnification

a) Pole(P):- The geometrical centre of the spherical mirror is called a pole.

b) Principal Axis:- The horizontal line passes through the centre of curvature and pole is called principle axis or central axis.

c) Focus(F):- It is a point on the principle axis where a beam of light parallel to the principal axis either actually converges to or appears to diverge from, after reflection from a mirror.

d) Centre of curvature(C):- It is the centre of the sphere of which the mirror forms a part.

e) Object distance (u):- The distance between the pole of the mirror and object is known as object distance(u).

f) Image distance (v):- The distance between the pole of the mirror and image is known as image distance(v).

g)Focal length(f):-The distance between the focus and the pole of the mirror is called focal length.

h) Radius of curvature(R):- The distance between pole and centre of curvature is called radius of curvature(R).

i) Magnification(m):- The ratio of the height of the image to the height of the object is called magnification.

$$\text{Magnification (m)} = \frac{\text{Height of the image}(h_i)}{\text{Height of the object }(h_o)}$$

(or) The ratio of image distance to object distance is called magnification(m).

$$\text{Magnification (m)} = \frac{-\text{Image distance (v)}}{\text{Object distance(u)}}$$

$$\therefore \text{Magnification (m)} = \frac{\text{Height of the image}(h_i)}{\text{Height of the object }(h_o)} = \frac{-\text{Image distance (v)}}{\text{Object distance(u)}}$$

4. The magnification produced by a plane mirror is +1. What does this mean? (AS1) (TQ)

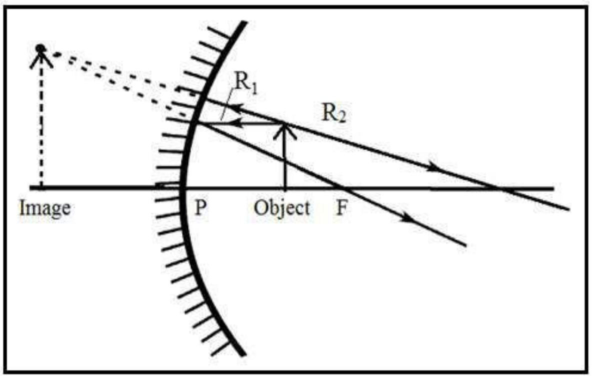
Magnification (m) = $\frac{\text{Height of the image}(h_i)}{\text{Height of the object }(h_o)} = +1$

Magnification +1 indicates that,

1. The size of the image is equal to size of the object.
2. The '+'sign of magnification indicates that the image is erect.

5. How do you get a virtual image using a concave mirror?(AS1) (TQ)

When an object is placed between pole and focus of a concave mirror, virtual, erect and enlarged image is formed behind the mirror.



6. Why does an image of plane mirror suffer lateral (right-left) inversion ?

1. The light rays which come from our right ear get reflected from the plane mirror and reach our eye.
2. Our brain feels that the ray (reflected ray) is coming from the inside of the mirror.
3. That is why our right ear looks like left ear in the image.

7. What is a plane of reflection?

Plane of reflection:- The plane in which the incident ray, refracted ray and normal will lie is the plane of reflection.

8. Which rays are called paraxial rays?

Paraxial Rays:- 1. The rays which are very nearer to the principle axis are called paraxial rays.
2. Paraxial rays are inclined at the angle less than 10^0 to the principle axis and the other rays away from the principle axis are called marginal rays.

+Ve magnification:- The image is erect and virtual.
- Ve Magnification:- The image is inverted and real.

9. Write the mirror formula and explain the terms.

Mirror formula, $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$.

Here f = focal length
u = object distance
v = image distance.

10. When does a concave mirror form virtual image?

A concave mirror forms virtual image when the object is placed between pole and focal point.

11. What are the values of radius of curvature and focal length of a plane mirror?

The focal length and the radius of curvature of a plane mirror is infinite.

12. What happens to image when an object is moved towards a concave mirror from infinity?

The image moves away from mirror staring from focal point to infinity.

13. What is the relation between radius of curvature and focal length of a concave mirror?

1. The focal point is the midpoint of centre of curvature and pole.
2. So, focal length is half of radius of curvature.

i.e 2f = R (or) f = $\frac{R}{2}$

14. How do you find magnification produced by a spherical mirror?

There are two ways of finding the magnification. They are,

1. The ratio of size of the image to object distance (m) = $\frac{\text{Height of the image}(h_i)}{\text{Height of the object }(h_o)}$

2. The ratio of image distance to object distance (m) = $\frac{-\text{ Image distance (v)}}{\text{Object distance (u)}}$

15. Can a convex mirror burn a paper? If not? Why?

We cannot burn a paper by using a convex mirror, because the rays coming parallel to principal axis after reflection diverge from the mirror.

16. Which mirror has wider field view?

A convex mirror has wider field view.

17. Why does our image appear thin or bulged?

Due to converging or diverging of height rays from the mirror.

18. Can we focus sunlight at a point using a mirror instead of magnifying glass?

Yes, by using concave mirror we can focus sun light at a point.

19. Why is angle of incidence is equal to angle of reflection when a light ray reflected from a surface?

The angle of incident is equeal to angle of reflection because light selects the path which takes the least time to travel.

20. Are angle of reflection and angle of incidence equal for curved surface?

Yes, they are equal for curved surfaces like spherical mirrors.

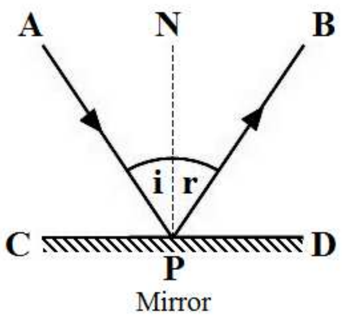
2 Mark Questions

1. State the laws of reflection of light? (AS1)(TQ)

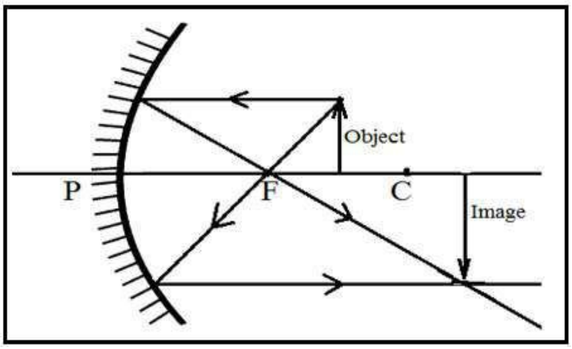
First Law:- 1. When light gets reflected from a surface, the angle of reflection is equal to the angle of incidence.

Second law:- 2. The incident ray, the normal at the point of incidence and the reflected ray all lie in the same plane.

CD = Plane mirror.
AP = Incident ray.
PB = Reflected ray.
PN = Normal to reflecting surface.
P = Point of incidence.
i = Angle of incident.
r = Angle of reflection.



2. Where will the image form when we place an object, on the principal axis of a concave mirror at a point between focus and centre of curvature (AS1) (TQ)

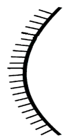


When an object is placed between focus and centre of curvature on the principal axis of a concave mirror, a real inverted and enlarged image is formed beyond the centre of curvature.

3. Distinguish between real and virtual image? (AS1) (TQ)

Real Image	Virtual Image
1. Real image formed due to converging of light rays.	1. Virtual image formed due to diverging of light rays.
2. Real image can be formed on the screen.	2. This image cannot be formed on the screen.
3. Real image is always inverted.	3. Virtual image is always erected.
4. Real image is formed infront of the mirror.	4. Virtual images are formed behind the mirror.
5. Real images can be diminished, magnified or same size of the object depending on the object distance.	5. Virtual images are always diminished irrespective of position of the object.
6. **Ex:-** The image formed on a cinema screen.	6. **Ex:-** The image of our face in a plane mirror.

4. State the differences between convex and concave mirrors. (AS1) (TQ)

Convex mirror	Concave mirror
1. A spherical mirror whose reflecting surface is curved outward is called convex mirror.	1. A speherical mirror whose reflecting surface is curved inward is called concave mirror.
2. The shape of a convex mirror is, 	2. The shape of a concave mirror is, 
2. It is also known as diverging mirror.	2. It is also known as converging mirror.
3. After reflection from the mirror the light rays diverge.	3. After reflection from the mirror the light rays converge.
4. Center of curvature and principle focus lie behind the mirror on the principle axis.	4. Center of curvature and principle focus lie infront of the mirror on the principle axis.
5. It always forms virtual, erect and diminished image of a real object.	5. It can forms different types of image of a real object.
6. It is used as rear view mirrors of motor vehicles to see the Traffic behind them.	6. ENT doctors use these mirrors to examine the eyes, ears, nose and throat.

5. Write the rules of sign convention?(AS1) (TQ)

Rules of sign convention:-

1.All distances should be measured from the pole.

2. The distances measured in the direction or incident light, to be taken positive and those measured in the direction opposite to incident light to be taken negative.
3. Height of object (h_0) and height of image (h_i) are positive if measured upwards from the axis and negative if measured downwards.

6. Imagine that spherical mirrors were not known to human beings. Guess the consequences? (AS2) (TQ)

1. A driver cannot see the traffic behind him in rare-view mirror. So safe driving in automobile will not be possible.
2. Automobile head lights, torch light, search lights cannot give bright lighting.
3. Constructions of reflecting telescopes would not be possible.
4. Constructions of solar cookers would not be possible.
5. ENT specialists may not have proper diagnosis of ear, nose and throat.
6. Dentists may not have proper diagnosis of teeth.

7. By observing steel vessels and different images in them, Surya a third class student asked some questions his elder sister Vidya. What may be those questions?(AS2) (TQ)

1. Why the image is not clearly visible?
2. Why the image is blurred?
3. Why the image is not as clear as in mirror?
4. Why the image seems to be small sometimes?
5. How steel vessels form images like mirrors ?
6. Why the image is small when we look outside of the vessel(Convex surface)?
7. Why the image is bigger than the objects when we look inside of the vessel(Concave surface)?
8. Why the image size is changing when the vessel is moved away or towards the face?

8. How do you appreciate the role of spherical mirrors in daily life ?(AS6) (TQ)

Spherical mirros are very useful to our life.

1. Concave mirrors are used as reflectors in torches and vehicle head lights.
2. Spherical mirrors are used in telescopes.
3. Convex mirrors are used as rear view mirrors in vehicles.
4. Concave mirrors are used in solar furnaces.
5. Concave mirrors are used by ENT specialists to see the affected part more visible.
6. Concave mirrors are used by dentists to see the large images of the teeth of patient.
7. So, I appreciate the role of spherical mirrors in daily life.

9. How do you appreciate the use of reflection of light by a concave mirror in making of antenna dishes?(AS6) (TQ)

1. TV antenna dishes contains the concave surface to receive the signals from the distinct communication satellites.
2. The concave (parabolic) shape of a dish antenna helps to reflect the signal to the focal point of the dish.
3. A device known as feed horn is mounted at the focal point which gathers the signals and sends them to a LNB(Low Noise Block down converter).
4. The LNB converts these electromagnetic waves into electrical signals and shifts to the receiver(T.V Set).
5. This is all possible only with the help of concave shape of dish antennas.
7. So, I appreciate the use of reflection of light by a concave mirror in making of antenna dishes.

10. Have you ever observed the image of the sky in rain water pools on earth? Explain the reflection of light in this context?(AS6) (TQ)

1. Sky form an image in the rain water pool on the earth.
2. The surface of rain water pool acts as a plane mirror.
3. So, we can observe a virtual image of the sky due to reflection of light from surface of rain water pool.

11. Why do we prefer a convex mirror as a rear-view mirror in the vehicles ?(AS7)(TQ)

We use convex mirror as a rear view mirror in the vehicles because,

1. Convex mirror always forms virtual, erect and diminished images irrespective of distance of the object.
2. A convex mirror enables a driver to view large area of the traffic behind him.
3. Convex mirror forms very small image than the object.
4. Due to these reasons convex mirrors are used as rear view mirrors in vehicles.

12. Write any two useas of each of concave and convex mirrors in our daily life? (AS7) (TQ)

Useas of convex mirror:- 1. It is used as a rear view mirror in automobiles.
2. It is used as a reflector for street lights.
3. It is used as a security mirror.

Useas of concave mirror:- 1. It is used as a shaving mirror.
2. Concave mirrors are used in solar furnaces.
3. Concave mirrors are used by ENT specialists to see the affected part more visible.
4. Concave mirrors are used by dentists to see the large images of the teeth of patient.

13. Write the characteristics of an image formed by a plane mirror?

Characteristics of a plane mirror:-

1. The image formed by a plane mirror is virtual and erect.
2. The image formed by a plane mirror suffers lateral invertion(left-right invertion).
3. The image is formed as far behind the mirror as the object is infront of it.
4. The size of image formed by a plane mirror is equeal to that of the object.

14. Why does the size of the image seem to be decreased when you move the object towards your eye ?

1. When we move the object from the mirror to our eye the image in the mirror seems to move back in the mirror.
2. Then the distance from the image to our eye increases.
3. The angle made by image at our eye is smaller than the angle made by the object.
4. That is why the image looks smaller than the object.

15. How will our image be in concave and convex mirror?

Concave mirror:-

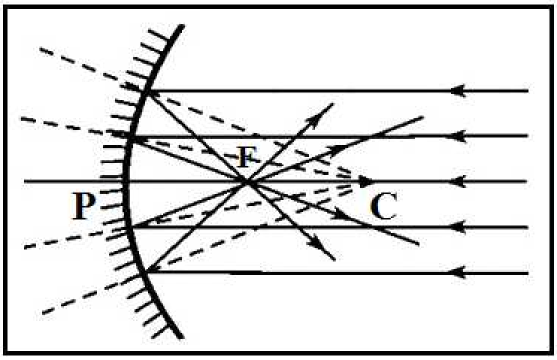
1. In concave mirrors our image is thin and enlarged.
2. As we move away from the mirror, the image will be diminished.

Convex mirror:

1. In convex mirror, our image is bulged and size of image is diminished.
2. As we move away from the mirror, the image is further diminished.

4 Mark Questions

1. How do you find the focal length of a concave mirror?(AS1)(TQ)

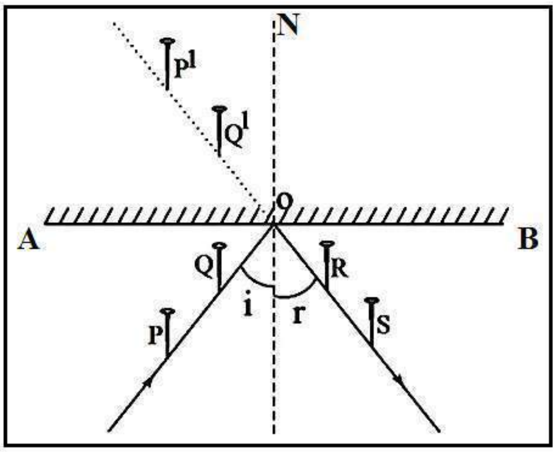


1. Hold a concave mirror perpendicular to the direction of sunlight.
2. Take a small paper and slowly move it in front of the mirror and find out the point where you get smallest and brightest spot, which will be the image of the sun.
3. The rays coming from sun parallel to concave mirror are converging at a point.
4. This point is called focus or focal point of the concave mirror.
5. Measure the distance of this spot from the pole of the mirror.
6. This distance is the focal length(f) of the given concave mirror.
7. The radius of curvature(R) will be twice of this distance.(R =2f)

2. How do you verify the 1st law of reflection of light with an experiment?(AS3) (TQ)

Aim: To verify the 1st law of reflection of light.

Required material: Mirror strip, drawing board, white paper, plane mirror, pins, clamps etc.



Procedure:- 1. Take a drawing board and fix a white paper on it with the help of clamps.
2. Draw a straight line AB at the centre of the paper and also a normal (ON) to AB at the point 'O'.
3. Draw a straight line PQ making certain angle (angle i) with ON as shown in figure.
4. Fix two pins at the points P and Q on the paper vertically.
5. Observe the image P' of the pin P and Q' of the pin Q, in the mirror kept along the line AB.
6. Fix two more pins R and S such that they are in the same line as that of P' and Q'.
7. Join R, S and O as shown in figure. Measure the angle between RS and ON (angle of reflection).

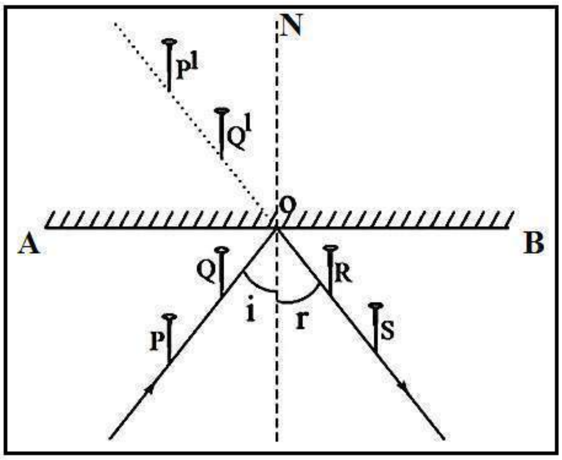
Observations:- 1. You will find that angle of incidence(i) = angle of reflection(r).
2. Repeat the experiment for different angles of incidence(i) and measure the corresponding angles of reflection (r).

Conclusion:- 1. In all the cases the angle of incidence is equal to the angle of reflection.
2. Hence 1st law of reflection of light is verified.

3. How do you verify the 2nd Law of reflection of light with an experiment?(AS3)

Aim:- To verify the 2nd law of reflection.

Required material:- Mirror strip, white paper, drawing board, plane mirror, clamps etc.



Procedure:- 1. Take a drawing board and fix a white paper on it with the help of clamps.
2. Draw a straight line AB at the centre of the paper and also a normal (ON) to AB at the point ‘O’.
3. Draw a straight line PQ making certain angle (angle i) with ON as shown in figure.
4. Fix two pins at the points P and Q on the paper vertically.
5. Observe the image P^I of the pin P and Q^I of the pin Q, in the mirror kept along the line AB.
6. Fix two more pins R and S such that they are in the same line as that of P^I and Q^I.
7. Join R, S and O as shown in figure.
8. The incident ray is the ray which is passing through the points ‘P’ and ‘Q’ touching the paper.
9. The reflected ray is the ray which is passing through the points ‘R’ and ‘S’ touch the same paper and ‘ON’ is the normal to the mirror point ‘O’ .

Observation:- 1. The incident ray and reflected ray are in the plane parallel to the plane of the paper.
2. Repeat the experiment with different angles of incidence.

Conclusion:- 1. In all observations incident ray and reflected ray are present in the same plane.
2. Hence 2nd law of reflections of light is verified.

4. Think about the objects which act as concave or convex mirrors in your surroundings. Make a table and display in your class room?(AS4) (TQ)

Convex mirror	Concave mirror
1. Rear view mirrors.	1. Head light of motorcycle.
2. Globe	2. Inner surface of glasses
3. Calling Bell	3. Shaving mirror.
4. Outer surface of the steel flask.	4. Inner surface of glasses.
5. Outer surface the pens.	5. Inner surface of cooking vessel.
6. Spoon bulged out wards.	**6.** Spoon bulged inwards.
7. Water glass surface.	7. Lunch plates.
8. Surface of steel flask.	8. Inner surfaces of glasses.

5. What do you infer from the experiment which you did with concave mirrors and measure the distance of object and distance of image?(AS3) (TQ)

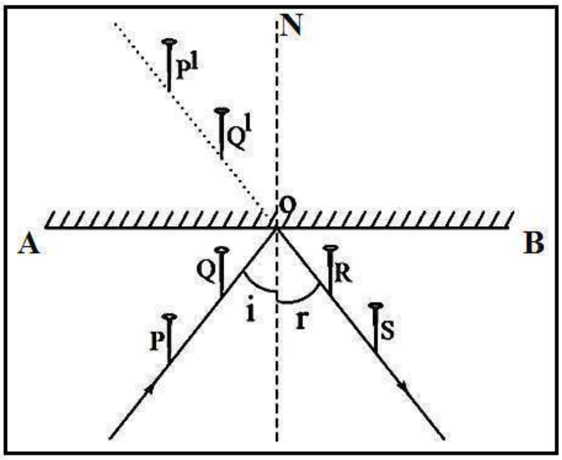
S.No	Position of the object	Position o the image	Enlarged/ Diminshed	Inverted/ Erected	Real/ Virtual
1	Between mirror and F	Beind the mirror	Enlarged	Erect	Virtual
2	At focal point(F)	At infinity	-------	-------	-------
3	Between F and C	beyond C	Enlarged	Inverted	Real
4	At centre of of curvature(C)	At centre of curvature C	Same size	Inverted	Real
5	Beyond C	Between F and C	Diminished	Inverted	Real
6	at infinity Very	At focus	Diminished	Inverted	Real

6. Find the plane of the reflection experimentally for the incident ray which passes through the heads of the pins pierced in front of the mirror? (AS3) (TQ)

Aim:- To find the plane of reflection experimentally for the incident ray which passes through the heads of the pins pierced in front of the mirror.

Required material:- Mirror strip, white paper, drawing board, plane mirror, clamps etc.

Plane of reflection:- The plane in which the incident ray, reflected ray and normal will lie is the plane of reflection.



Procedure:- 1. Take a drawing board and fix a white paper on it with the help of clamps.
2. Draw a straight line AB at the centre of the paper and also a normal (ON) to AB at the point 'O'.
3. Draw a straight line PQ making certain angle with ON.
4. Fix two pins at the points P and Q on the paper vertically.
5. Observe the image p' of the pin P and Q' of the pin Q, in the mirror kept along the line AB.
6. Fix two more pins R and S such that they are in the same line as that of P' and Q'.Join R, S and O.
7. Assume that the heads of all pins observed at the points P, Q, R and S are in the same height.
8. If the incident ray is the ray which is passing through the heads of pins those are localized at P and Q and reflected rays is the ray which is passing through the heads of pins those are located at points R and S, then the normal lies along the plane of PQRS.
9. Then the plane along PQRS is known as plane of reflection.

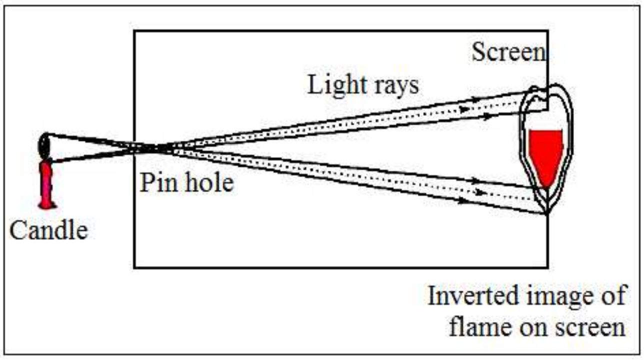
7. Collect information about the history of spherical mirrors in human civilization. Display it in your class room?(AS4)(TQ)

1. The idea of mirror came into existence long back when people saw their images in water on polluted surfaces etc.
2. The earliest manufactured mirrors were pieces of polished stone such as obsidian a naturally occurring volcanic glass.

3. The Romans also developed a technique for creating crude mirrors by coating blown glass with molten lead.
4. In China, people began making mirrors with the use of silver-mercury amalgams as early as 500 AD.
5. The first modern silver-glass mirror was created by Justus von Liebig, a German chemist in 1835.
6. The invention of glass blowing method during the 14^{th} century led to the discovery of spherical mirrors, which increased the popularity of glass mirrors.
7. By the end of 18^{th} century, decorative mirrors were widely used.
8. New cheaper techniques of mirror production in the 19th century led to a great proliferation of their use.

8. Draw and explain the process of formation of image with a pin hole camera? (AS5) (TQ)

<u>Process of formation of image with a pin hole camera</u>:-



1. The light from candle travels straight in all directions from each point of the flame of the candle.
2. But only the light coming in some particular directions can enter into the camera through its pin hole.
3. Light which comes from the point at the top of the flame goes straight towards the bottom of the screen.
4. Light which comes from the point at the bottom of the flame goes straight towards the top of the screen as shown in the figure.
5. The other rays are blocked by the black sheet.
6. This leads to the formation of an inverted image.

9. Make a solar heater/cooker and explain in process of making?(AS5)(TQ)

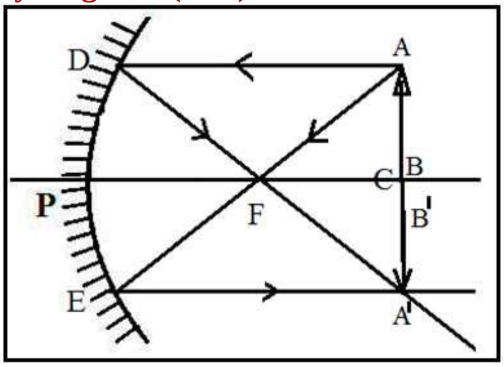
<u>Making a solar cooker</u>:- 1. A concave mirror focus the parallel sun rays at focal point of the mirror.
2. So with a small concave mirror we can heat up and burn a paper.
3. In the same way a big concave mirror can be used to heat up a vessel.
4. Make a wooden /iron frame in the shape of TV dish.
5. Cut acrylic mirror sheets into 8 or 12 pieces in the shape of isosceles triangles with a height equal to the radius of your dish antenna.
6. The bases of the 8 or 12 triangles together make the circumference of the dish.
7. Stick the triangle mirrors to the dish.
8. Arrange it so that concave part faces sun. Find its focal point and place a vessel at that point.
9. It will get heated. One can even cook rice in that vessel.

10. How do you appreciate the role of spherical mirrors in our daily life? (AS6)(TQ)

Spherical mirrors (concave and convex mirrors) are very useful to our life. They are,
1. Concave mirrors are used by dentists to see the large images of the teeth of patient.
2. ENT doctors uses the Spherical mirrors to examine the ear, nose and throat.
3. Spherical mirrors are used in telescopes.
4. Concave mirrors are used as reflectors in torches and vehicle head lights.

5. Concave mirrors are used in solar furnaces.
6. Convex mirrors are used as rear view mirrors in vehicles.
7. Concave mirrors are used as a shaving mirror.
8. Convex mirrors are used as reflectors in street lights.
8. So, we appreciate the role of spherical mirrors in our daily life.

11. To form the image on the object itself, how should we plane the object in front of a concave mirror? Explain with a ray diagram?(AS5)



To form the image on the object itself, the object should be kept at centre of curvature a concave mirror.

Explanation:- 1. Let the object 'AB' placed at the centre of curvature C on the concave mirror.
2. A ray of light AD which is parallel to the principal axis passes through the focus 'F' after reflection.
3. The second ray of light passing through the focus, after reflection its passes parallel to principle axis.
4. The reflected ray DA^I and EA^I meet at a point A^I.
5. So a real inverted and same size of the object is formed at A^1.
6. This A^1B^1 is the real image of the object AB.

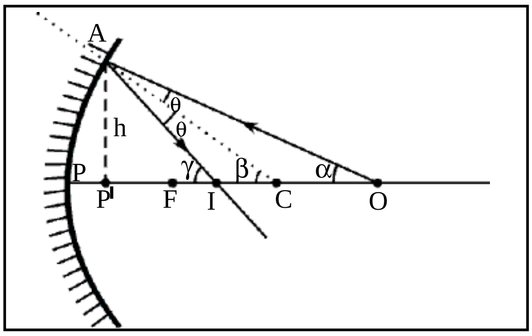
12. Discuss the merits and demerits of using mirrors in building elevation? (AS7) (TQ)

Merits:- 1. Mirrors can be cut into different shapes or sizes.
2. Mirrors provide safety and make the building attractive.
3. Some mirrors they cools inside the building .
4. The mirrors used in elevating buildings are rain forced, tough and laminated glasses.
5. Mirrors do not rust.

Demerits:- 1. Elevation with mirrors is very expansive.
2. Mirrors are broken very easily.
3. Birds like sparrows; crow will get confusion while flying on roads.
4. They are also not safe enough to the buildings, which causes easy access thieves.
5. Glass elevation is not environmental friendly, becomes natural air does not enter into the building.

13. Derive the formula for curved mirrors? (or) Derive the formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$?

Derivation of formula for curved mirrors:-



1. A ray coming from the point O falls on the mirror at point A which is at height ‘h’ from the axis and after reflection, passes through point I.
2. Here AC is the normal. The angle of incidence (angle OAC) and the angle of reflection (angle CAI) are equal and they are denoted by θ in the figure.
3. Line segment AP^I is the perpendicular drawn to the axis from the point A.
4. Let the angles at the vertices O, C and I of three triangles be α, β and γ respectively as shown in figure.

5.In a triangle, sum of the interior angles is equal to the exterior angle.

6. From the triangle AOC; $\beta = \alpha + \theta$

$$\Rightarrow \theta = \beta - \alpha \quad \text{-------}(1)$$

7. From the triangle ACI; $\gamma = \beta + \theta$

$$\gamma = \beta + \beta - \alpha \quad (\text{Since } \theta = \beta - \alpha)$$

$$2\beta = \alpha + \gamma \quad \text{-------}(2)$$

8. When ‘h’ becomes very small, P^I may coincide with point P, which is pole of the mirror. Then we can say $P^IO = PO$, $P^IC = PC$ and $P^II = PI$.

9. $\text{Tan } \alpha = \frac{P^1A}{P^1O} = \frac{h}{P^1O} = \frac{h}{Po}$

$\text{Tan } \beta = \frac{P^1A}{P^1C} = \frac{h}{P^1C} = \frac{h}{Pc}$

$\text{Tan } \gamma = \frac{P^1A}{P^1I} = \frac{h}{P^1I} = \frac{h}{PI}$

10. When an angle θ becomes very small, then the value of Tan θ is taken as θ. That is $\text{Tan } \theta \approx \theta$.

Similarly here, $\text{Tan } \alpha = \alpha = \frac{h}{PO}$, $\text{Tan } \beta = \beta = \frac{h}{PC}$ and $\text{Tan } \gamma = \gamma = \frac{h}{PI}$

11. By substituting the values of α, β and γ in the equation-(1).

We get, $\frac{2h}{PC} = \frac{h}{PO} + \frac{h}{PI}$

$$\Rightarrow \frac{2}{PC} = \frac{1}{PO} + \frac{1}{PI} \text{ .... } (3)$$

12. According to the rules for sign convenction, Radius of curvature PC = –R

Object distance PO = –u

Image distance PI = –v

$$\frac{2}{-R} = \frac{1}{-u} + \frac{1}{-v}$$

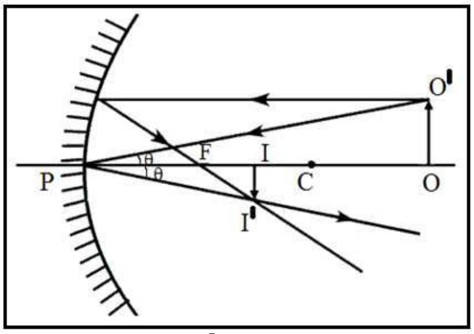
$$\Rightarrow \frac{2}{R} = \frac{1}{u} + \frac{1}{v}$$

$$\Rightarrow \frac{2}{2f} = \frac{1}{u} + \frac{1}{v} \quad (\text{Since } R=2f)$$

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

This mirror formula should be used according to the sign convention in every situation.

14. Derive the formula for magnification?



Magnification(m):- 1. A ray coming from O^{I} is incident at pole with an angle of incidence θ, and get reflected with same angle θ.

2. From the triangle POO^{I} , Tan θ = $\frac{OO^1}{PO}$ ------ (1)

3. From the triangle PIII, Tan θ = $\frac{II^I}{PI}$ ------ (2)

4. From (1) & (2) $\frac{OO^1}{PO} = \frac{II^I}{PI} \Rightarrow \frac{II^I}{OO^1} = \frac{PI}{PO}$ ------ (3)

5. According to sign convention PO = –u; PI = –v; OO^{I} = h_0; II^{I} = –h_i

6. Substituting the above values in equation (3). We have $\frac{h_i}{h_o} = \frac{-v}{u}$

∴ Magnification m = $\frac{h_i}{h_o} = \frac{-v}{u}$.

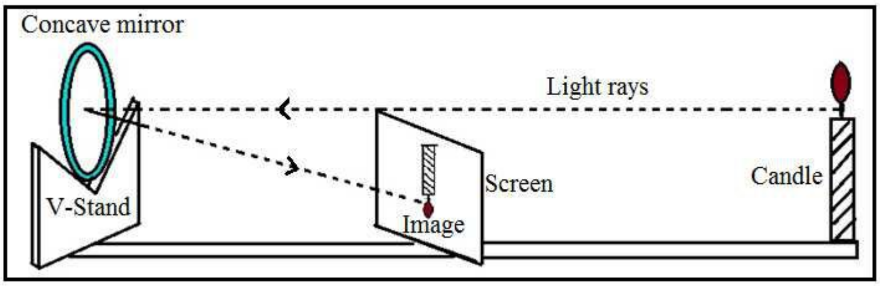
7. We define the magnification, m = $\frac{\text{Height of the image}(h_i)}{\text{Height of the object }(h_o)}$

8. In all cases it can be shown that, m = $\frac{-\text{ Image distance (v)}}{\text{Object distance(u)}}$

15. How do you find the focal length of a concave mirror experimentally?

Aim:- To find the focal length of a concave mirror experimentally.

Material required:- A candle, paper, concave mirror (known focal length), V-stand, meter scale.



Procedure:- 1. Place the concave mirror on V-stand, a candle and meter scale as shown in figure.

2. light the candle and keep the candle at 80 cm(object distance) distances from the mirror.

3. Adjust the distance of the screen such that you get the sharp image of candle on screen.

4. Measure the distance between the screen and mirror and noted as image distance(v).

5. The same experiment is repeated with various distances of candle from the mirror and in each case noted the image distance.

S.No	Object distance, ucm	Image distance, vcm	f = $\frac{uv}{u+v}$
1	80		
2	70		
3	60		
4	50		

Practice the following problems

1. If the radius of curvature of a spherical mirror is 20 cm what is its focal length ? Ans:- 10 cm.

Given:- Radius of curvature of a spherical mirror, R = 20Cm

Focal length, f = ?

Formula:- f = $\frac{R}{2} = \frac{20}{2}$ = 10 cm.

∴ The focal length of a spherical mirror is 10 cm.

2. Find the distance of the image when an object is placed on the principal axis at a distance of 10 cm in front of a concave mirror whose radius of curvature is 8 cm? Ans. 6.67 cm.

Given:- Radius of curvature of the concave mirror R = - 8 cm.

Focal length of the concave mirror f = $\frac{R}{2} = \frac{-8}{2}$ = - 4cm

Object distance (u) = - 10cm

Image distance (v) =?

Formula:- $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ $\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-4} - \frac{1}{-10} = \frac{-5+2}{20} = \frac{-3}{20}$.

$\Rightarrow$ v = $\frac{-20}{3}$ = - 6.67 cm.

∴ The image is real, inverted and formed at a distance of 6.66 cm from the mirror.

3. An object is placed at a distance of 10 cm from a convese mirror of focal length 15 cm. Find the position and nature of the image? Ans :- 6 Cm

Given:- Radius of curvature R = 3m

Focal length f = $\frac{R}{2} = \frac{3}{2}$ = 1.5 m

Object distance (u) = - 5m

Image distance (v) =?

Formula:- $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ $\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{1.5} - \frac{1}{-5} = \frac{10}{15} + \frac{1}{5} = \frac{10+3}{15} = \frac{13}{15}$.

$\Rightarrow$ v = $\frac{15}{13}$ = 1.15 cm

∴ Virtual, erect and diminished image is formed at a distance of 1.15cm behind the mirror.

4. A convex mirror with a radius of curvature of 3 m is used as rear view in an automobile. If a bus is located at 5 m from this mirror, find the position and size of the image. Ans :- 1.15m

Given:- Radius of curvature of the convex mirror, R = 3 m.

Focal length of the concave mirror f = $\frac{R}{2} = \frac{3}{2}$ = 1.5 cm.

Object distance (u) = - 5 m.

Image distance (v) =?

Formula:- $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ $\Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{1.5} - \frac{1}{-5} = \frac{10}{15} + \frac{1}{5} = \frac{10+3}{15} = \frac{13}{15}$.

$\Rightarrow$ v = $\frac{15}{13}$ = 1.15 m.

∴ Virtual, erect and diminished image is formed at a distance of 1.15 m behind the mirror.

5. An object 4 cm in size is placed at 25 cm in front of a concave mirror of focal length 15cm. At what distance from the mirror would a screen be placed in order to obtain a sharp image? Find the nature and size of the image? Ans:- -37.5 cm, -6 cm.

Given:- Focal length, f = -15cm
Object distance (u) = - 25cm
Object height (h_0) = +4cm
Image distance (v) =?
Image height h_i =?

Formula:- $\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \Rightarrow \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-15} - \frac{1}{-25} = \frac{-1}{15} + \frac{1}{25} = \frac{-5+3}{75} = \frac{-2}{75}$

$\Rightarrow v = \frac{-75}{2} = -37.5$ cm.

∴ The image is real, inverted and formed at a distance of 37.5 cm from the mirror.

$$\text{Magnification (m)} = \frac{\text{Height of the image}(h_i)}{\text{Height of the object }(h_o)} = \frac{-\text{ Image distance (v)}}{\text{Object distance(u)}}$$

$$\Rightarrow \frac{h_i}{4} = \frac{-37.5}{25} \Rightarrow h_i = -4 \times \frac{37.5}{25} = \frac{-150}{25} = -6 \text{ cm.}$$

∴ So, the image is real, inverted and enlarged.

6. An object is placed at a distance of 10cm from a convex mirror of focal length 15cm find the position and nature of the image. Ans:- 6cm, 0.6cm

Given:- Object distance (u) = - 10cm
Focal length (f) =15cm
Image distance (v) =?

Formula:- $\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \Rightarrow \frac{1}{v} = \frac{1}{15} - \frac{1}{-10} = \frac{1}{15} + \frac{1}{10} = \frac{2+3}{30} = \frac{5}{30} = \frac{1}{6}$.

$\Rightarrow v = 6$ cm.

Magnification $m = \frac{-v}{u} = \frac{-6}{-10} = 0.6$

∴ Virtual, erect and diminished image is formed at a distance of 6 cm behind the mirror.

Chapter-4

ACIDS, BASES AND SALTS

1 Mark Questions

1. What is the source of common Salt?

Sea water and Rock salts.

2. What are antacids?

Antacids:- 1. Antacids are mild alkalis.

2. These are used for getting relief from acidity and indigestion.

Ex:- Milk of magnesia[$Mg(OH)_2$].

3. What type of reaction takes place in stomach when an antacid tablet is consumed?

Neutralization reaction takes place in stomach when an antacid tablet is consumed.

4. Give some examples of natural weak acids or bases?

Litmus, extract of red cabbage, turmeric solution and extracts of coloured petals of some flowers contain dye molecules which are weak acids or bases.

5. What are olfactory indicators? Give an example?

Olfactory indicators:- Olfactory indicators are substances which have different odour in acid and base solutions.

Ex:- Onion, vanilla essence and clove oil etc.

6. Which gas is usually liberated when an acid reacts with a metal?

Hydrogen (H_2) gas.

7. Write the suitable chemical reaction between acids with metals?

When acids react with metals to form salt and liberate hydrogen gas.

$$\text{Acid} + \text{Metal} \rightarrow \text{Salt} + \text{Hydrogen}$$

Ex:- $2\,HCl_{(aq)} + Zn_{(s)} \rightarrow Zn\,Cl_{2\,(aq)} + H2_{(g)}$

8. Which substance involved in the chemical reaction for formation of Sodium Zinkate.

When zinc metal is react with sodium hydroxide (NaOH) solution , forms a sodium zincate.

$$2\,NaOH + Zn \rightarrow \underset{\text{(Sodium zincate)}}{Na_2ZnO_2} + H_2\uparrow$$

9. Write the reaction of carbonates with Acids?

Acids react with carbonates to form salt, water and liberate carbon dioxide.

$$\text{Metal carbonate} + \text{acid} \rightarrow \text{salt} + \text{carbon dioxide} + \text{water.}$$

Ex:- $Na_2\,CO_{3\,(S)} + 2\,HCl_{(aq)} \rightarrow 2\,NaCl_{(aq)} + H_2O_{(l)} + CO_{2\,(g)}$

10. Write the reaction of metal hydrogen carbonates with Acids?

Acids react with metal hydrogen carbonates to form salt, water and liberate carbon dioxide.

$$\text{Metal hydrogen carbonate} + \text{acid} \rightarrow \text{salt} + \text{carbon dioxide} + \text{water}$$

Ex:- $NaHCO_{3\,(S)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)} + CO_{2\,(g)}$

11. Write the reaction between bases with non-metal oxides with suitable examples?

Calcium hydroxide is a base, reacts with carbon dioxide to produce a salt and water.

$$Ca(OH)_{2(aq)} + CO_{2(g)} \rightarrow CaCO_3 + H_2O_{(l)}$$

12. A calcium compound react with Dil.HCl and forms a gas with hiss sound. The released gas convert the lime water into milky white. In this reaction the product formed is Calcium Chloride. Write balanced equation for the above reaction?

$$Ca(OH)_{2(aq)} + CO_{2(g)} \rightarrow CaCO_3 + H_2O_{(l)}$$

13. Write the reaction of metal oxides with Acids?

When metal oxides are react with acids to form salt and water.

Metal oxide + Acid $\rightarrow$ Salt + Water

<u>Ex</u>:- $CuO + 2HCl \rightarrow CuCl_2 + H_2O$.

14. Write the reactions of non-metal oxides with base?

When non-metal oxides are react with base to form salt and water.

Non-metal oxide + Base $\rightarrow$ Salt + Water.

<u>Ex</u>:- $Ca(OH)_{2(aq)} + CO_{2(g)} \rightarrow CaCO_3 + H_2O_{(l)}$

15. How does the hydronium ions are formed?

1. Hydrogen ions cannot exist as bare ions.
2. They associate with water molecules and exist as hydronium ions (H_3O^+).

$$H^+ + H_2O \rightarrow H_3O^+$$

16. What happened when water is added to acids or base? (AS7)(TQ)
(or) What is meant by a dilution of acids/bases?

1. Mixing an acid or base with water result in decrease in the concentration of ions (H_3O^+/OH^-) per unit volume.
2. Such a process is called dilution of acids.

17. How do you reduce the pain when someone stung by the honey-bee?

1. Honey-Bee sting leaves an acid which causes pain and irritation.
2. Use of a mild base like baking soda on the stung area gives relief.

18. Define salts?

<u>Salts</u>:- Salts are the ionic compounds which are produced by the neutralization of acid with base.

<u>Ex</u>:- KNO_2, NaCl, KCl

19. What are the salts obtained from common salt?

The various salts obtained from common salt are sodium hydroxide, baking soda, washing soda, bleaching powder and many more.

20. Write the chemical names of two salts belongs to sodium family?

Na_2SO_4, NaCl, $NaNO_3$, Na_2CO_3.

21. How to prepared brine solution.

An aqueous solution of sodium chloride is called brine, it is prepared by dissolving of NaCl in distilled water.

22. Which substance are you added for making of the cake soft and spongy?

1. Baking powder is a mixture of baking soda and a mild edible acid such as tartaric acid.
2. When baking powder is heated or mixed in water, the following reaction takes place.

$$NaHCO_3 + H^+ \rightarrow CO_2 + H_2O + \text{Sodium Salt of acid.}$$

3. Carbon dioxide produced during the reaction causes bread or cake to rise making them soft and spongy.

23. Why the plaster of pairs is called Calcium Sulphatre Hemi Hydrate?

1. The two formula units of CaSO4 share one molecule of water.
2. So $\frac{1}{2}$ molecule of water present in each Plaster of paris unit.
3. So Plaster of paris is called Calcium Sulphatre Hemi Hydrate.

24. Why the formers add Cao or CaSO4.2H2O or CaCO3 to the soil. Give the reasons?

The formers are used the CaO or $CaSO_4.2H_2O$ or $CaCO_3$ to the soil to increase the P^H of soil and to reach the ideal soil p^H for the growth of plants.

25. Write the common name of Sodium hydrogen carbonate?

Baking soda ($NaHCO_3$).

26. What are alkalis?

Bases which are soluble in water are called alkalis.

27. What are the difference between metals and non- metals with respect to the nature of their oxides?

Metals give basic oxides and non metals give acidic oxides.

28. Name the acids present in (i) Nettle sting (ii) Curd?

(i) Methanoic acid (Formic acid) (ii) Lactic acid.

29. Why Tartaric acidis used as an ingredient in a baking powder?

Tartaric acid($C_6H_4O_6$) acts as preservation and also reacts with baking soda to give carbon dioxide.

30. What is P^H scale?

P^H is defined as the negative logarithm of hydrogen ions[H^+] concentration.

(or) A scale for measuring hydrogen ion concentration in a solution is called p^H scale.

$$P^H = - \log H^+$$

31. Who introduced the PH scale?

Sorenson

32. Give the chemical names of acids present in. (a) ants (b) lemon (c) milk (d) tomato.

1. Ants	Formic acid.
2. Lemon	Citric acid.
3. Milk	Lactic acid.
4.Tomato	Oxalic acid.
5. Tamarind	Tartaric acid
6. Vinegar	Acetic acid.

33. What is neutralization reaction?

Neutralization reaction:- The reaction of an acid with a base to give a salt and water is known as a neutralization reaction.

$$\text{Base + Acid} \rightarrow \text{Salt + Water.}$$

Ex:- $HCl + NaOH \rightarrow NaCl + H_2O$

34. What is the range of pH scale?

The range of PH scale is from 0 to 14.

35. What is water of crystallization?

Water of crystallization is the fixed number of water molecules present in one formula unit of salt.

36. Write the reaction of copper oxide with hydrochloric acid?

$$Cuo_{(s)} + 2HCl_{(aq)} \rightarrow CuCl_{2(aq)} + H_2O_{\ (l)}$$

37. Where acid is added to water, what type of reaction is it?

When acid is added to water, it is an exothermic reaction.

38. How do you decide the strength of acid or base?

The strength of acid or base can be decided on the basis of no of H_3O + ions or OH^- ions produced in solution.

39. What is bleaching powder? Write its formula?

1. Beaching powder is produced by the action of chlorine on dry slaked lime.

$$Ca\ (OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$$

2. Chemical formula of bleaching powder is $CaOCl_2$.

40. Write the balanced chemical equation for preparation of baking soda?

$$NaCl + H_2O + CO_2 + NH_3 \rightarrow NH_4Cl + NaHCO_3$$

40. What happened when we add a baking soda during cooking? Write the balanced equation?

Baking soda(is mild non-corrosive base).

$$2\ NaHCO_3 \xrightarrow{\text{Heat}} Na_2CO_3 + H_2O + CO_2$$

2 Marks Questions

1. What are antacids? Give an example?

Antacids:- 1. Antacids are mild alkaloids(Bases).

2. These are used for getting relief from acidity and indigestion and some times even head ache.
3. When it take orally, it react with hydrochloric acid present in the stomach and reduces its strength by consuming some of it.

Ex:- Milk of Magnesia[$Mg(OH)_2$] is an antacid.

2. Why does tooth decay start when the pH of mouth is lower than 5.5 ? (AS1)(TQ)

1. The pH value of saliva is 6.4 to 6.9. It is almost neutral in nature.
2. Tooth enamel, made of calcium phosphate.
3. It is the hardest substance in the body.
4. It does not dissolve in water, but is corroded by an acids.
5. Bacteria present in the mouth produce acids by the degradation of sugars and food particles remaining in the mouth.
6. Due to the formation of acids, the pH of the mouth is shifted to acidic.
7. Hence, tooth decay starts when the pH of the mouth is lower than 5.5.

3. Dry hydrogen chloride gas does not turn blue litmus to red. Whereas hydrochloric acid does. Why? (AS1)(TQ)

1. Hydrochloric acid disassociated in the presence of water to produce H^+ ions.
2. The dissociation will be as follows.

$$HCl \xrightarrow{\text{Aquous}} H^+ + Cl^-$$

3. So, aqueous HCl solution is an acid and change the colour of blue litmus to red.
4. But dry HCl will not considered as acid because in the absence of water HCl will not produce H^+ ions.
5. Hence, dry HCl can't change the colour of blue litmus to red.

4. Why does not distilled water conduct electricity? (AS2)(TQ)

1. Liquids conduct electricity only due to their ions.
2. Distilled water is prepared by the distillation of tap water.
3. In distilled water, the concentration of both H_3O^+ and OH^- is same.
4. Hence they do not form ions.
5. As there is no formation of ions in electrolysis, distilled water do not conduct electricity.
6. On the other hand while rain water falling to earth through the atmosphere dissolve some acidic gaseous like CO_2, SO_2 and N_2O and forms acids such as H_2CO_3, H_2SO_3 and HNO_3.
7. These acids produce ions. Due to the presence of ions rain water conducts electricity.

5. Why pure acetic acid does not turn blue litmus to red? (AS2)(TQ)

1. Disassociation of acids takes place in the presence of water to produce H^+ ions.
2. The formation of these ions change the colour of the litmus paper.
3. Pure acetic acid will not show acidic character in the absence of water.
4. Because dissociation of molecule will not occur and do not form the ions.
5. So, pure acetic acid does not turn blue litmus to red.

6. A milkman adds a very small amount of baking soda to fresh milk.
a) Why does he shift pH of the fresh milk from 6 to slightly alkaline?
b) Why does this milk take a long time to set as curd? (AS1)(TQ)

a) 1. The chemical name of the compound is sodium hydrogen carbonate (Na HCO3) and its p^H value is 8.1.
2. When milk man adds a little baking soda to fresh milk to make it slightly alkaline.
3. So the pH of the fresh milk shift to 6 and make it slightly alkaline.
4. Thus the spoilage of milk can slow down.

b) 1. Lactic acid which was formed initially reduces the basic nature of the baking soda.
2. Then more lactic acid is needed to convert milk into curd.
3. That is why it takes time to produce more lactic acid and hence the milk takes a long time to become curd.

7. Plaster of Paris should be stored in moisture-proof container. Explain? (AS2)(TQ)

1. Plaster of Paris chemical name is calcium sulphate hemihydrates ($CaSO_4.\frac{1}{2}H_2O$).
2. It is a white powder and on mixing with water, it sets into hard solid mass due to the formation of gypsum($CaSO_4.\ 2H_2O$).

$$\underset{\text{(plaster of Paris)}}{CaSO_4.\frac{1}{2}H_2O} + 1\frac{1}{2}H_2O \rightarrow \underset{\text{(Gypsum)}}{CaSO_4.\ 2H_2O}$$

3. Because of the above reason plaster of Paris should be stored in moisture proof container.

8. Fresh milk has a pH of 6. Explain why the pH changes as it turns into curd? (AS3)(TQ)

1. Fresh milk has a p^H of 6. Hence it is an acid.
2. The p^H of the milk decreases as milk turns to curd.
3. We have to achieve this, add a small quantity of buttermilk to milk.
4. Fermentation takes place and lacto bascillus bacteria turns milk to curd by releasing lactic acid.
5. During this process, the pH of the milk changes and sets as curd.
6. Thus, the pH of the milk decreases from 6 to acidic(5.5-4.5) as it turns to curd.

9. Equal lengths of magnesium ribbons are taken in test tubes A and B. Hydrochloric acid is added to tube A, while acetic acid is added to test tube B. Amount and concentration of the both the acids is same. In which test tube the fizzing occurs more vigorously and why?(AS4) (TQ)

1. Magnesium is a metal.
2. Strong acids vigorously reacts with metals and liberates the Hydrogen(H_2) gas.
3. Test tube ‘A’ contains hydrochloric acid which is a strong acid than acetic acid present in test tube ‘B’.
4. Even though the concentration of the Hydrochloric acid and acetic acid are same.
5. But the number of H^+ ions produced by the two aids are different.
6. Hydrochloric acid can produce a large number of H+ ions then acetic acid.
7. So in test tube ‘A’ the reaction occurs vigourously as it contains strong acid(Hydrochloric acid).

10. How does the flow of acid rain into a river make the survival of aquatic life in a river difficult? (AS7)(TQ)

1. Living organisms can survive only in a narrow range of pH change.
2. Acid rains have some acids like carbonic acid(H_2CO_3), sulphuric acid (H_2SO_4) and nitric acid (HNO_3).
3. If the pH of rain water is less than 5.6, it is called acid rain.
4. When acid rain flows into rivers, it lower the pH of river water.
5. Due to less pH, the river water becomes acidic and hence the aquatic life in a river difficult.
6. The high acidity of river water can even kill the aquatic animals like fish.

11. What is backing powder? How does it make the cake soft and spongy? (AS7)(TQ)

1. Baking powder is a mixture of baking soda and a mild edible acid such as tartaric acid.
2. When baking powder is heated or mixed in water, then $NaHCO_3$ reacts with tartaric acid to evolve carbon dioxide gas.

$$NaHCO_3 + H^+ \rightarrow CO_2 + H_2O + \text{sodium salt of acid.}$$

3. Carbon dioxide produced during the reaction causes bread or cake to rise making them soft and spongy.

12. Give two important uses of washing soda and baking soda? (AS7) (TQ)

Uses of washing soda(Na_2CO_3):- 1. It is used in glass, soap and paper industries.
2. It is used in the manufacture of sodium compound such as borax.
3. Sodium carbonate can be used as a cleaning agent for domestic purpose.
4. It is used for removing permanent hardness of water.

Uses of baking soda($NaHCO_3$):- 1. It is used to prepare baking powder. (Sodium bicarbonate + tartaric acid)
2. It is used as an antacid to neutralise the acidity in the stomach.
3. It is used in soda-acid fire extinguishers.
4. It is used as mild antiseptic.

13. What will happen if the PH value in your body increases?

1. Our body works well with in a narrow PH range of 7.0 to 7.8.
2. If due to some reason this PH range gets disturbed in the body of a person, then many ailments can occur.

14. Classify the following examples as acid, base(or)salt?

$Mg(OH)_2$, H_3PO_4, KNO_2, $Ba(OH)_2$, KCl, HBr, NaCl, HFO_4, HCl, $Al(OH)_3$

Acid	H_3PO_4, HBr, HFO_4, Hcl
Basis	$Mg(OH)_2$, $Ba(OH)_2$, $Al(OH)_3$
Salts	KNO_2, NaCl, KCl.

15. While diluting an acid, why is it recommended that the acid should be added to water and not water to the acid?

1. The process of dissolving an acid or a base in water is an exothermic process.
2. Care must be taken while mixing concentrated acid with water.
3. The acid must always be added slowly to water with constant stirring.
4. If water is added to a concentrated acid, the heat generated may cause the mixture of splash out and cause burns.
5. The glass container may also break due to excessive local heating.

16. What are the uses of acid – base universal indicators?

1. The universal indicator can be used to know the strength of acid or base.
2. Universal indicator is a mixture of several indicators.
3. The universal indicator shows different colours at different concentrations of hydrogen ions in a solution.

17. Write the PH value and nature of the each solution on the basis of the following table?

S.No	Solution	p^H	Nature
1	Battery acid	0.2	Strong acid
2	Vinegar	3	Weak acid
3	Milk	6.4	Weak acid
4	Blood	7.4	Weak Base
5	Ammonia solution	11.4	Strong base
6	Sodium Hydroxide solution	13.8	Strong base

18. What are the factors influence on PH of salts?

1. Salt of a strong acid and a strong base are neutral and the pH value is 7.
2. The salts of a strong acid and weak base are acidic and the pH value is less than 7.
3. The salts of a strong base and weak acid are basic in nature and the pH value is more than 7.

19. How is bleaching powder manufactured? Write their useas?

1. Chlorine gas is used for the manufacture of bleaching power.
2. Bleaching power is manufactured by the action of chlorine on dry slaked lime [$Ca(OH)_2$].

$$Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$$

Uses of Bleaching Powder:- 1. It is used textile industry and laundry shops.
2. It is used as an oxidizing agent in many chemical industries.
3. It is used for disinfecting drinking water to make it free of germs.
4. It is used as a reagent in the preparation of chloroform.

20. What is plaster of paris? How it is prepared?

Plaster of paris:- 1. $CaSO_4.\frac{1}{2}H_2O$(Calcium sulphate hami-hydrate) is a plaster of paris.
2. This is prepared by heating gypsum at 120-130^{0}C.

$$2\ CaSO_4\ 2\ H_2O \rightarrow 2\ CaSO_4.\frac{1}{2}H_2O + 3\ H_2O$$

21. A white powder has used for supporting of fractured bones.
a) State the name of white powder?
b) Write the chemical name of it?
c) Write the reaction between white powder and water?

A) Plaster of paris.

B) $CaSO_4.\frac{1}{2}H_2O$.

C) $2\ CaSO_4.\frac{1}{2}H_2O + 3\ H_2O \rightarrow 2\ CaSO_4\ .\ 2\ H_2O$.

22. What is meant by strong acids and weak acids? Give some examples?

Strong acids:- An acid which is completely ionized in water and thus produces a large amount of hydrogen ions is called strong acid.

Ex:- HCl, H_2SO_4, HNO_3 etc.

Weak acids:- An acid which is partially ionized in water and thus produces a small amount of hydrogen ions is called a weak acid.

Ex:- CH_3COOH, H_2CO_3, H_2SO_3

23. what is meant by strong bases and weak bases?

Strong base:- A base which completely ionizes in water and thus produces a large amount of hydroxide ions (OH^-) is called strong base.

Ex:- NaOH, KOH etc.

Weak base:- A base which is partially ionized in water and thus produces a small amount of hydroxide ions is called a weak base.

Ex:- NH_4OH, $Ca(OH)_2$, $Mg(OH)_2$

4 Marks Questions

1. Five solutions A, B, C, D and E when tested with universal indicator showed pH as 4, 1, 11, 7 and 9 respectively, Which solution is,
a) neutral b) strongly alkaline c) strongly acidic d) weakly acidic e) Weakly alkaline.
Arrange the PH in increasing order of hydrogen ion concentration (AS1)(TQ)

a) Solution 'D' is neutral.
b) Solution 'C' is strongly alkaline.
c) Solution 'B' is strongly acidic.
d) Solution 'A' is weakly acid.
e) Solution 'E' is weakly alkaline.

S.No	Solution	P^H
1	A	4
2	B	1
3	C	11
4	D	7
5	E	9

We know, $pH = -\log [H^+]$

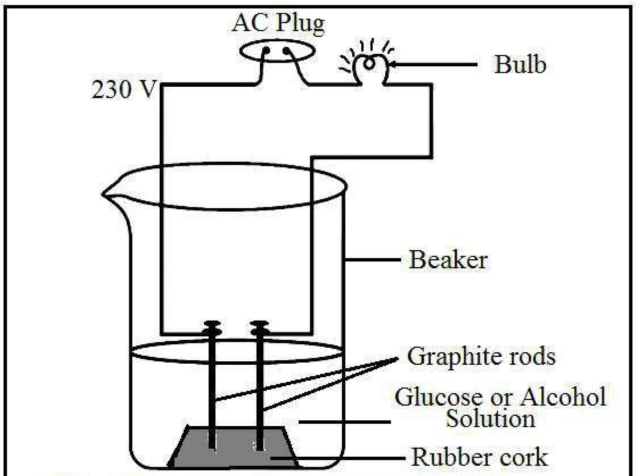
A) $4 = -\log [H^+] \Rightarrow [H^+] = 10^{-4}$
B) $1 = -\log [H^+] \Rightarrow [H^+] = 10^{-1}$
C) $11 = -\log [H^+] \Rightarrow [H^+] = 10^{-11}$
D) $7 = -\log [H^+] \Rightarrow [H^+] = 10^{-7}$
E) $9 = -\log [H^+] \Rightarrow [H^+] = 10^{-9}$

Increasing order of hydrogen ion concentration is $10^{-11}, 10^{-9}, 10^{-7}, 10^{-4}, 10^{-1} \Rightarrow 11<9<7<4<1$
i.e C, E, D, A, B.

2. Compounds such as alcohols and glucose contain hydrogen but are not categorized as acids. Describe an activity to prove it? (AS3) (TQ)

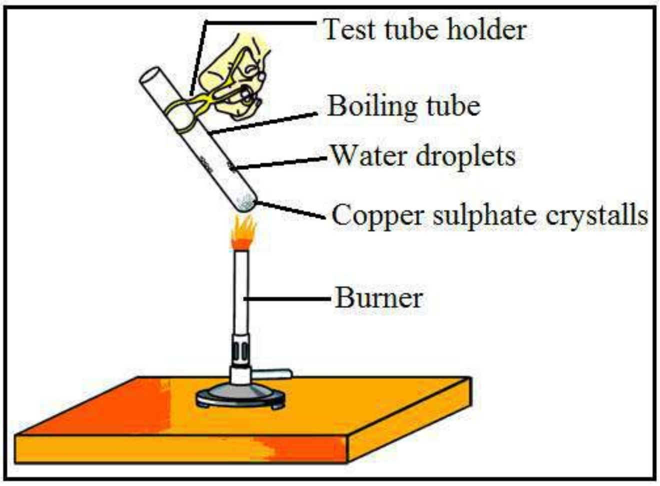
1. Prepare solutions of glucose and alcohol.
2. Fix two iron nails on a rubber cork and place the cork in a beaker as shown in the figure.
3. Connect the iron nails to the two terminals of a battery through a switch and a bulb.
4. Now pour some solution of glucose ($C_6H_{12}O_6$) and switch on the current.
5. We will notice that bulb does not glow.
6. This shows that glucose solution does not conduct electricity.
7. Repeat this experiment with alcohol solution in the beaker.
8. The bulb does not glow again, that means alcohol solution does not conduct electricity.
9. This indicates the absence of ions(H+ ions) in the glucose and alcohol solutions.

10. Glucose and alcohol do not disassociate in water to produce H^+ ions even though they contain hydrogen.
11. Hence glucose and alcohol are not categorised as acids because they do not produce H^+ ions in water.



Acid solution in water conducts electricity

3. What is meant by "Water of Crystallization" of a substance? Describe an activity to show the water of crystallization?(AS3)(TQ)



Water of Crystallization:- 1. Water of crystallizations is the fixed number of water molecules present in one formula unit of salt.

2. The salts which contain water of crystallization are called hydrated salts.

Ex:- $CusO_4.5H_2O$.

3. It means that five water molecules are present in one formula unit of copper sulphate.

Activity:- 1. Take a few crystals of copper sulphate in dry test tube.

2. Heat the dry crystals strongly over the flame of a burner for some time.
3. The water present in the crystals are evaporated and the blue colour of salt turns to white.
4. We also see tiny water droplets on the walls of the test tube.

$$CuSO_4.\,5H_2O \rightarrow CuSO_4 + 5H_2O$$

Hydrated copper sulphate (Blue colour) — Anhydrous copper sulphate (White colour)

5. Now cool the test tube and add 2 – 3 drops of water to the sample of anhydrous copper sulphate.
6. We observe the blue colour of copper sulphate crystals is restored.
7. From this activity we conclude that some water molecules are fixed in the blue coloured copper sulphate crystals.

4. How do you prepare your own indicator using beetroot? Explain (AS5)(TQ)

1. Take a beetroot and cut it into small pieces.
2. Add little water and boil for half an hour in a beaker.
3. After allowing the beaker to cool for 15 minutes, collect the filtrate.
4. Dip a filtrate paper into the beetroot juice. The filtrate paper change into red colour.
5. Now add a few drops of acidic solution on the piece of beetroot paper.
6. Observe the colour of the beetroot paper. There is no change in colour.
7. Add a few drops of basic solution on the piece of beetroot paper.
8. The beetroot paper colour turns to yellow.
9. From this observation we concluded that beetroot paper acts as a natural indicator.
10. It does not change the colour in acidic medium and change the yellow colour in basic medium.

5. Write the tests to identify the nature of substances which acts as acids and bases?

1. Blue litmus, red litmus, methyl orange, phenolphthalein indicators are used to indent the acidic and basic nature substances in solution.

S.No	Substance	Test	Colour
1	Acidic Solution	Blue Litmus	Red
2	Basic Solution	Red Litmus	Blue
3	Acidic Solution	Methyl orange	Red
4	Basic Solution	Methyl orange	Yellow
5	Acidic Solution	Phenolphthalein	No colour
6	Basic Solution	Phenolphthalein	Pink

6. Give reasons :-

(a) Tap water conducts electricity where as distilled water does not.

(b) Solution of Sulphuric acid conducts electricity where as alcohol does not.

(c) Dry ammonia gas has no action on litmus paper but a solution of ammonia in water turns red litmus paper blue.

a). 1. Tap water contains some impurities in the form of salts.
2. Due to the presence of salts, it conducts electricity.
3. Distilled water is free from all kinds of salts and hence does not conduct electricity.

b). Solution of Sulphuric acid has charged ions H+ ions which helps in conducting electricity where as alcohol does not give any ions in water.

c). Dry ammonia has no H+ or OH- ions where as ammonia in water gives OH- ions which turns red litmus to blue.

7. Give the important uses of the following substances?

1. Bleaching powder 2. Washing soda 3. Baking soda 4. Plaster of Paris

1. Bleaching powder ($CaOCl_2$):- 1. It is used for bleaching purpose.
2. It is used as an oxidising agent.
3. It is esed for disinfection of drinking water to make it free of germs.
4. It is used as reagent in the preparation of chloroform.

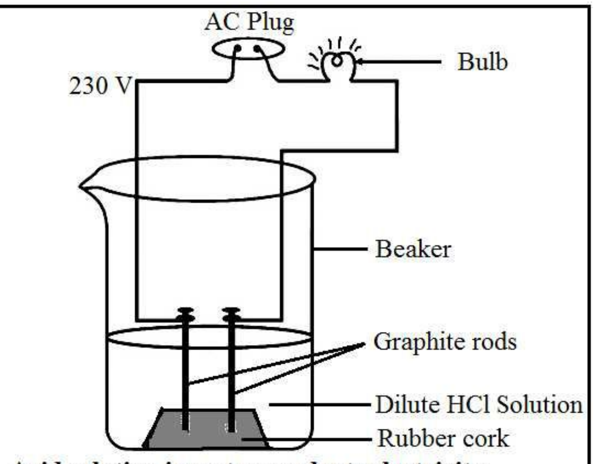
2. Washing soda (Na_2CO_3):- 1. Sodium carbonate is used in glass, soap and paper industries.
2. It is used in the manufacture of Borax.
3. It can be used as a cleaning agent for domestic purposes.
4. It is used for permanent hardness of water.

3. Baking soda($NaHCO_3$):-1. Baking soda causes bread or cake to rise, making them soft and spongy.
2. It is also used in soda acid fire extinguishers.
3. It acts as mild anti septic.

4. It is an ingredient in antacids. Being alkaline it neutralizes excess acid in the stomach and provides relief.

<u>4. Plaster of Paris ($CaSO_4$. ½ H_2O)</u>:- 1. It is used in making chalks and fire proof materials.
2. Doctors use as plaster for supporting fractured bones in the right position.
3. It is used as a cement in ornamental casting and for making moulds in pottery work.
4. It is used for making toys, materials for decoration.

8. Draw a neat diagram showing acid solution in water conducts electricity? (AS5) (TQ)



Acid solution in water conducts electricity

Chapter-5
REFRACTION OF LIGHT AT PLANE SURFACES

1 Mark Questions

1. What is refraction of light?

Refraction of light:- The process of changing speed at an interface when light travels from one medium to another medium, resulting in changes in direction is called refraction of light.

2. Define rarer medium?

Rarer Medium:- A medium in which the speed of light is more is known as optically rarer medium.

3. Define denser medium?

Denser medium:- A medium in which the speed of light is less is known as optically denser medium.

4. What is the reason for refraction? (or) Why light rays deviate at the interface of two media?

The incident light ray changes its direction (deviate) at the interface separating the two media due to change its speed.

5. What is the speed of light in vacuum?

Speed of light in vacuum, $c = 3 \times 10^8$ m/s.

6. Define refractive index (n)? Write the formula for refractive index?

Refractive index (n):- 1. The ratio of the speed of light in vacuum to the speed of light in that medium is defined as refraction index (n).

2. It is also called as absolute refractive index.

$$\text{Refractive index, } n = \frac{\text{Speed of light in vaccum(c)}}{\text{Speed of light in medium(v)}}$$

8. Write the formula for relative refractive index?

$$\text{Relative refractive index, } n_{21} = \frac{\text{Refractive index of second medium}(n_2)}{\text{Refractive index of first medium}(n_1)}$$

$$\text{(or) Relative refractive index, } n_{21} = \frac{\text{Speed of light in first medium}(v_1)}{\text{Speed of light in second medium}(v_2)}$$

9. What is the use of refractive index of a light?

Refractive index gives the idea of how fast or how slow the light travels in a medium.

10. For which medium refractive index is minimum and maximum?

1. The Refractive index is minimum for vacuum (n = 1).
2. The Refractive index is maximum for diamond (n = 2.42).

11. Which factor decides the speed of light in the medium?

Refraction index (n) decides the speed of light in the medium.

12. On what factors does the refractive index of a medium depend?

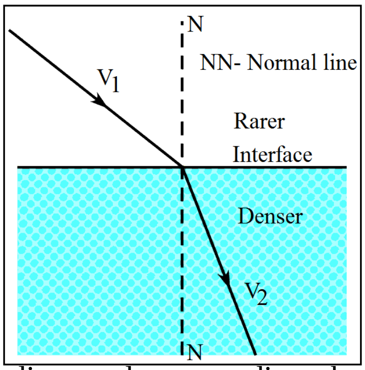
Refractive index of the material depends on the following factors.

1. Nature of the material.
2. Wavelength of light used.

13. What is the reason behind the shining of diamonds?

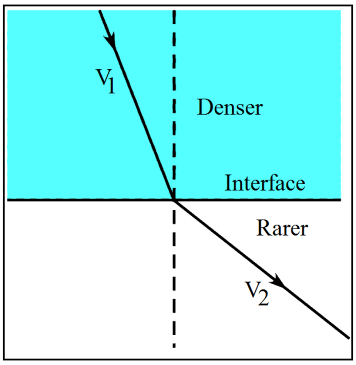
Total internal reflection is the main reason for brilliance of diamonds.

14. How light ray moves when it enters from rarer medium to denser medium?



If light ray enters from rarer medium to denser medium then refracted ray moves towards the normal.

15. How light ray moves when it enters from denser medium to rarer medium?



If light ray enters from denser medium to rarer medium then refracted ray moves away from the normal.

16. Define critical angle?

Critical angle(c):- At what angle of incidence do you notice that the refracted ray grazes the interface separating the two media (air and glass). This angle of incidence is known as critical angle(c).

(or)The angle of incidence at which the light ray travelling from denser to rarer medium grazes the interface is called 'Critical angle' for denser medium.

(or) The angle of incidence in the denser medium for which the angle of refraction in the rarer medium is 90^0 is called 'Critical angle'.

17. What is the critical angle of a diamond?

Critical angle of a diamond is 24.4^0.

18. What is mirage?

Mirage:- Mirage is an optical illusion where it appears that water has collected on the road at a distant place but when we get there we don't find any water.

19. How do you appreciate the role of Fermat principle in drawing ray diagrams? (AS6) (TQ)

1. Fermat's principle says that light selects a shortest path to travel.
2. This is the basic reason for the straight line propagation of light.
3. Using this principle, we can draw ray diagram to trace the image formed by mirrors to understand reflection and refraction.

20. Observe the following table.

Medium	Water	Crown glass
Refreactive Index	1.33	1.52

i) Which is the denser medium in water and crown glass?

Crown glass is the denser medium.

21. By observing the following table, answer the following questions?

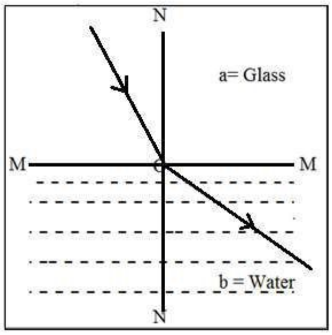
Media (Material)	Ice	Water	Benzene	Carbon disulphide
Refractive index	1.31	1.33	1.5	1.63

i) In which material, speed of light is high?
ii) In which material, speed of light is low?

1. In Ice speed of light is high.
2. In carbon disulphide speed of light is low.

22. What is Snell's law?

Snell's law:- $n_1 \sin i = n_2 \sin r$ (or) $\frac{Sin\ i}{Sin\ r}$ = Constant.

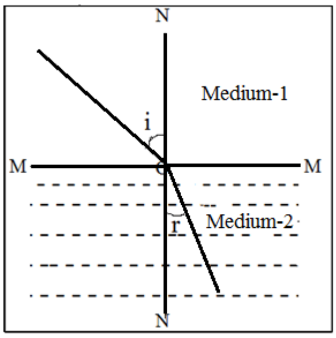


23. In the following figure, MM is the plane separating two media 'a' and 'b'. NN is the normal drawn at '0' to the plane MM.
1. Then, in a and b which is the denser medium?
2. Which is the rarer medium?

'a' is the denser medium and b is the rarer medium.

24. By observing the following figure, write the answer for the following questions?
1. What is the relation between i and r?
2. In first and second media, which is denser?

1. i > r (or) r < i
2. Second medium is denser.



2 Mark Questions

1. Write the laws of refraction of light?

First law:- The incident ray, the refracted ray and the normal to interface of two transparent media at the point of incidence all lie in the same place.

Second law:- During the refraction light follows Snell's law is constant.

$$n_1 \sin i = n_2 \sin r \text{ (or) } \frac{\text{Sin i}}{\text{Sin r}} = \text{Constant.}$$

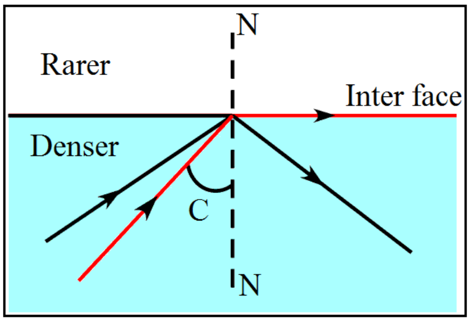
2. Why is it difficult to shoot a fish swimming in water? (AS-1)(TQ)

1. Due to refraction of light, it is difficult to shoot a fish swimming in water.
2. The fish and observer are in two different media.
3. When the fish is in water (denser medium) and observer is in air (rarer medium) due to refraction at water-air interface, the fish appears to be raised and seems to be close to surface which is called 'Apparent position'.
4. The shooter aims the gun to apparent position of the fish instead of real position.
5. Hence it is difficult to shoot a fish swimming in water.

3. What is the reason behind the shining of diamond and how do you appreciate it? (AS6) (TQ)

1. Total internal reflection is the main cause for brilliance of diamonds.
2. The critical angle of diamonds is very low (24.4^0).
3. Diamond sparkles due to repeated internal reflections.
4. The faces of diamond are cut in such a way; the angle of incidence is greater than the critical angle(c).
5. So that total internal reflection takes place again and again.
6. Due to the total internal reflection we appreciate the shining of a diamond.

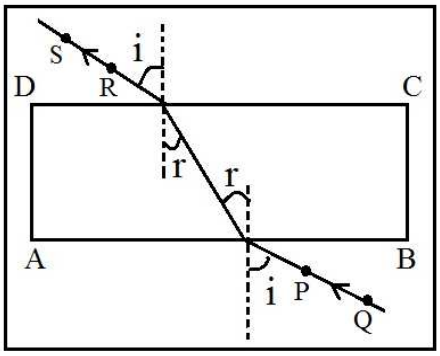
4. Define Total internal reflection? Given two examples?



Total internal Reflection:- 1. When the angle of incidence is greater than critical angle, the light ray gets reflected into the denser medium at the interface i.e. light never enter the rarer medium.
2. This phenomenon is called internal reflection.

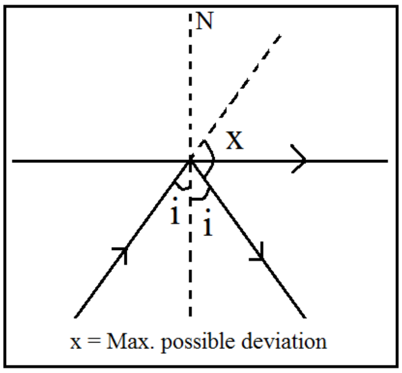
Ex:- 1. Formation of mirages.
2. Brilliance of diamonds.
3. Working of an optical fibre.

5. What is the angle of deviation produced by a glass slab? Explain with ray diagram (AS7)? (TQ)



Angle of Deviation:- 1. The angle between incident ray and emergent ray is known as angle of deviation.
2. The angle of deviation produced by a glass slab is 0^0.
3. Because the incident ray and emergent rays are parallel to each other.

6. A ray of light travels from an optically denser to rarer medium. The critical angle of two media is 'c'. What is the maximum possible deviation of the ray? (AS7)(TQ)



1. If the light incident at an angle $i \geq c$ as shown in the figure the angle of deviation is given by, $x = \pi - 2i$ (Since $i + x + i = \pi$)
2. The maximum value of δ occurs when $i = c$ and is equal to,

$$x_{max} = \pi - 2c.$$

7. When we sit at a camp fire, objects beyond the fire is seen swaying. Give the reason for it? (AS7)(TQ)

1. From the campfire, heat is carried into surrounding air by the process of convection.
2. During this process the density of surrounding air changes continuously, thus changes its refractive index slightly.
3. This continuous change in refraction index gives rise to continuous change in angle of refraction .
4. Due to this result the object beyond the camp fire is seen swaying.

8. Why do stars appear twinkling? (AS7) (TQ)

1. The twinkling of a star is due to atmospheric multiple refraction of star light.
2. Star light reaches to the surface of the earth through many layers of atmosphere.
3. These layers have different optical densities and they offer different refractive index values to the incoming light.
4. The star light on entering the earth's atmosphere, under goes refraction continuously before it reaches the earth.
5. So, the light bends many times giving different apparent positions of the star.
6. Due to this fluctuations of refractive index of layers, stars appear twinkling.

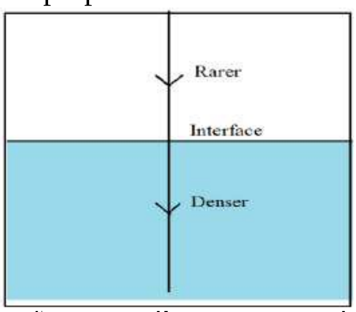
9. Why does a diamond shine more than a glass piece cut to the same shape? (AS7) (TQ)

1. The critical angle of a diamond is very low (24.4^0).
2. When light falls on a face of diamond, it suffers total internal reflection and make the diamond shines more.
3. The critical angle of a glass (42^0) is more than the diamond.
4. Hence most of the incident rays reflect and less number of rays gets total internal reflection.
5. So, diamond shine more than a glass piece cut to the same shape.

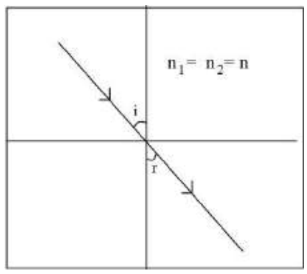
10. In what cases does a light ray not deviate at interface of two media? (AS7) (TQ)
(or) Write the cases at which angle of incidence in equation in angle of refraction?

<u>Case (1):-</u> When a light ray is incident in perpendicular to the interface of surface of two media.

Here $\angle i = 0$
$\angle r = 0$



<u>Case (2):-</u> When the refractive indexes of two mediums are equal.



Here n1 = n2 = n.

From Snell's law, $n_1 \sin i = n_2 \sin r$

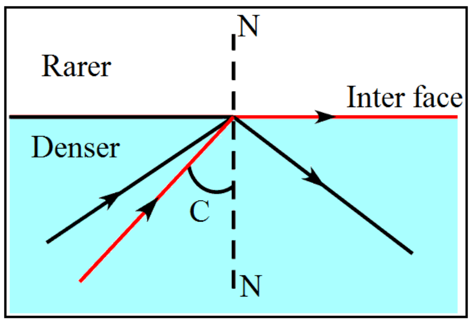
$n \sin I = n \sin r$

$\sin i = \sin r$

$\angle i = \angle r$

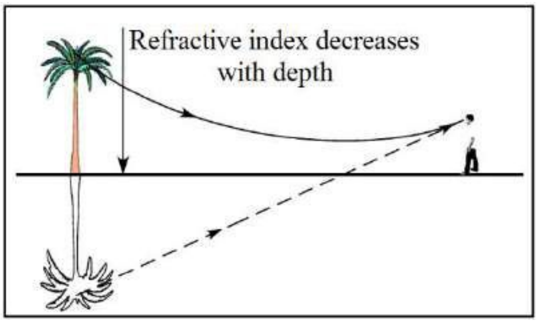
Hence the ray passes without any deviation at the boundary.

<u>Case (3):-</u> When a light ray incident is more than critical angle, it does not undergo deviation but it reflects into the same medium. Such phenomenon is called total internal reflection.



4 Mark Questions

1. Explain the formation of mirage? (AS1) (TQ)



Mirage:- Mirage is an optical illusion where it appears that water has collected on the road at a distant place but when we get there, we don't find any water.

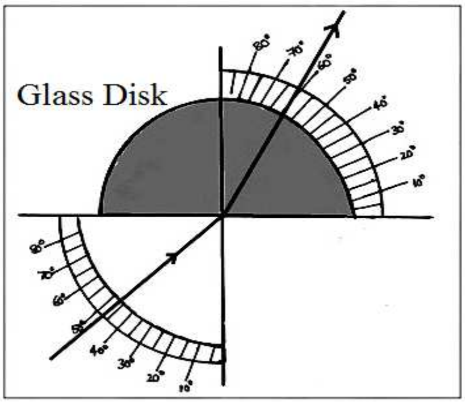
Explanation:- 1. During a hot summer day, air just above the road surface is very hot and the air at higher altitudes is cool.

2. It means that the temperature decreases with height.
3. As a result density of air increases with height.
4. We know that refractive index of air increases with density.
5. Thus the refractive index of air increases with height.
6. So, the cooler air at the top has greater refractive index than hotter air just above the road.
7. Light travels faster through the thinner hot air than through the denser cool air above it.
8. When the light from a tall object such as tree or from the sky passes through a medium just above the road, whose refractive index decreases towards the ground.
9. When light from tall object, it suffers refraction and takes a curved path because of total internal reflection.
10. This appears to the observer as if the ray is reflected from the ground.
11. Hence we feel the illusion of water being present on road which is the virtual image of the sky (mirage) and an inverted image of tree on the road.

2. How do you verify experimentally that $\frac{\text{Sin i}}{\text{Sin r}}$ is a constant? (AS1) (TQ)

Aim:- Obtaining a relation between angle of incidence and angle of refraction.

Materials required:- A plank, white chart, protractor, scale, small black painted plank, a semi circular glass disc of thickness nearly 2cm, pencil and laser light.



Procedure:- 1. Take a wooden plank which is covered with white chart.

2. Draw two perpendicular lines, passing through the middle of the paper as shown in the figure.
3. Let the point of intersection be o. Mark one line as NN which is normal to another line marked as MM.
4. Here MM represents the line drawn along the interface of two media and NN represents the normal drawn to this line at 'o'.

5. Take a protractor and place it along NN in such way that it centre coincides with 'O' as shown in figure.
6. Then mark the angles from 0^0 to 90^0 on both sides of the line NN as shown in the figure.
7. Repeat the same on the other side of line NN.
8. The angles should be indicated on the curved line.
9. Now place a semi-circular glass disc so that its diameter coincides with the inter face line (MM) and its centre coincides with the point 'o'.
10. Send laser light along a line which makes 15^0 with NN.
11. Measure its corresponding angle of refraction.
12. Repeat the experiment for 20^0, 30^0, 40^0, 50^0 and 60^0 and noted the corresponding angles of refraction and noted down in the table.

S.No	i	r	Sin i	Sin r	$\frac{\text{Sin i}}{\text{Sin r}}$
1	15^0				
2	20^0				
3	30^0				
4	40^0				
5	50^0				
6	60^0				

13. Find the values of every i and r and evaluate $\frac{\text{Sin i}}{\text{Sin r}}$ for every incident angle i.

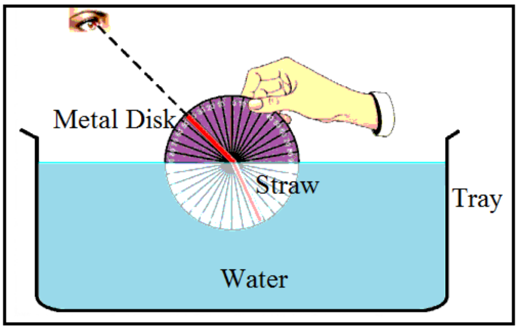
Observation:- Finally we will get the ratio $\frac{\text{Sin i}}{\text{Sin r}}$ is a constant.

Conclusion:- 1. This ratio of $\frac{\text{Sin i}}{\text{Sin r}}$ gives the value of refractive index of glass.
2. In the above experiment we might have noticed that 'r' is less than 'i' in all cases and the refracted ray bends towards the normal in each case.

3. Explain the phenomenon of total internal reflection with one or two activities? (AS1)(TQ)

Activity:-1. Take a transparent glass tumbler and coin.
2. Place the coin on a table and place glass tumbler on the coin.
3. Observe the coin from the side of the glass.
4. Now fill the glass tumbler with water and observe the coin from the side of the glass tumbler.
5. Now the coin is disappears from our view because of total internal reflection.

4. How do you verify experimentally that the angle of refraction is more than angle of incidence when light ray travel from the denser to rarer medium? (AS1)(TQ)



When light ray travel from the denser to rarer the angle of refraction is more than the angle of incidence. This can be verified by the below experiment.

Procedure:- 1. Take a metal disc and mark angles along its edge using protractor.
2. Arrange two straws at the centre of disk.
3. Adjust one of the straws to make an angle 10^0.
4. Immerse the half of disc in transparent vessel containing water vertically.
5. The straw should be at an angle 10^0 inside the water.

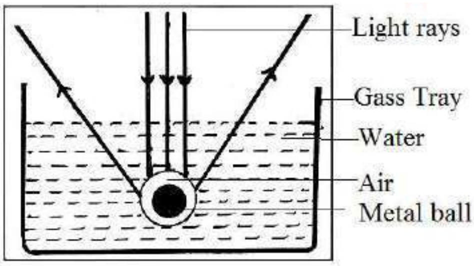
6. Adjust the other straw which is outside the water until both straws appear to be in a single straight line.
7. Take the disc out of the water and observe the two straws on it.
8. We will find that the two straws are not in straight line.
9. Measure the angle between the normal and second straw and noted down in the below table.
10. Do the same for various angles of incidence (i) and note down corresponding angles of refraction (r) in the given table.

S.No	Angle of incidence (i)	Angle of refraction (r)
1		
2		
3		
4		

Observation:- We will find the angle of refraction is more than angle of incidence.

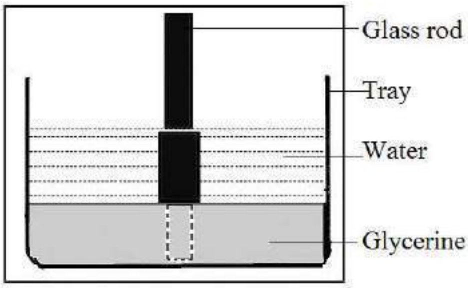
Conclusion:- When light travels from douser (water) to rarer (air) it bends away from the normal.

5. Take a bright metal ball and make it black with soot in a candle flame immerses it in water. How does it appear and why? (Make hypothesis and do the above experiment) (AS2)(TQ)



1. If a metal ball coated with soot of candle flame is immersed in water, then it appears shining.
2. Soot is non-stick to water. A thin air film is formed in between water and soot as shown in the figure.
3. The light ray is travelling from water(denser medium) to air(Rarer medium).
4. The angle of incidence is greater than the critical angle, total internal reflection takes place.
5. As the ray reflects at water air interface, the metal ball appears shining.
6. It is similar to shining of air bubble in water.

6. Take a bright glass vessel and pour some glycerine into it and then pour water up to the brim. Take a Quartz glass rod. Keep it in the vessel. Observe glass rod from the sides of the glass vessel. What change of you notice? What could be the reasons for these changes? (AS2)(TQ)



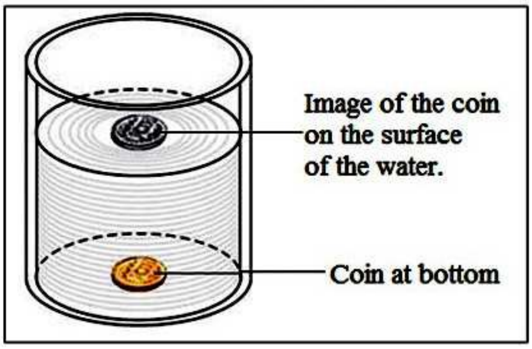
1. When this arrangement is viewed from side, the size of the glass rod appears increased in water and glass rod disappeared in glycerine.

Reason:-

2. As shown in the figure, the vessel contains glycerine (n = 1.47) and water (n = 1.33) when glass rod immersed into the liquid the part in the glycerine disappears.
3. This is due to the fact that both glass rod (n = 1.5) and glycerine (1.47) have same refractive index.

4. When refractive Indies are same the speed of light is same in both media.
5. So no bending is takes place and hence no refraction takes place.
6. The part of the glass rod in water appears as larger than the original size of the rod. This is due to refraction.

7. Do activity-7 again. How can you find critical angle of water? Explain your steps briefly. (AS3)(TQ)



Activity:- 1. Take a cylindrical transparent vessel (you may use 1 L beaker).
2. Place a coin at the bottom of the vessel.
3. Now pour water until you get the image of the coin on the water surface (look at the surface of water from a side).
4. The image of the coin is formed at the surface of the water because total internal reflection.

Calculate the critical angle of water:-
1. You might have observed a coin kept at the bottom of a vessel filled with water appears to be raised.
2. The refractive index of water is 1.33
3. So critical angle of water, Sin C = $\frac{1}{Refractiveindex\ (n)} = \frac{1}{1.33}$

Sin C = 0.7518

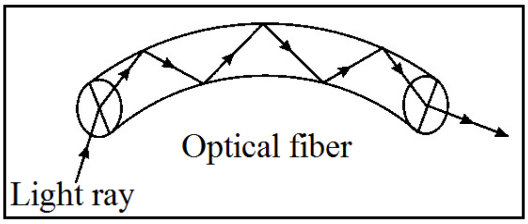
Sin C = Sin $48.7^0 \Longrightarrow C = 48.7^0$

4. The critical angle of water = 48.7^o

8. Collect the values of refractive index of following media? (AS4) (TQ)

S.No	Material Medium	Refractive index
1	Water	1.33
2	Coconut oil	1.44
3	Flint glass	1.65
4	Crown glass	1.52
5	Diamond	2.42
6	Benzene	1.50
7	Hydrogen gas	1.000132

9. Collect the information on working of optical fibres. Prepare a report about various uses of optical fibres our daily life. (AS4) (TQ)
(or)
While doing heart operation Sreekar observed that a thin pipe is passed to observe internal parts on a computer screen. He comes to know that it was an optical fibre. How does the optical fibre works?

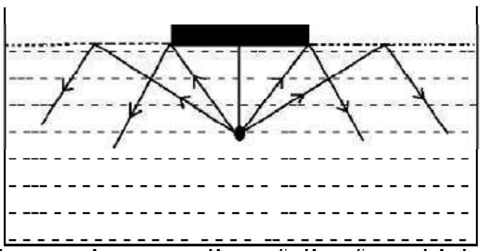


Optical Fibres:- 1. Total internal reflection is the basic principle behind working of optical fibre.
2. An optical fibre is very thin fibre made of glass or plastic having radius about a 10^{-6} meter.
3. A bunch of such thin fibres form a light pipe.

Working:- 1. Because of small radius of the fibre, light goes into it makes a nearly glancing incidence on the wall.
2. The angle of incidence is greater than the critical angle and hence total internal reflection takes place.
3. The light is thus transmitted along the fibre.

Uses:- 1. Optical fibres are used in endoscopy to see the internal organs of our body.
2. Optical fibres are used in transmitting communication signals through light pipes.
3. Optical fibres are used in international telephone cables laid under the sea, in large computer network etc.
4. Optical fibres are used in photometric sensors to measuring blood flow in the heart.

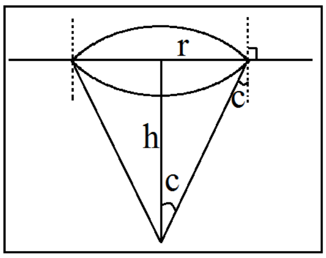
10. Take a thin thermocol sheet. Cut it in circular discs of different radii like 2cm, 3cm, 4cm, 4.5cm, 5cm etc and mark canters with nearly 6 cm. pin a needle to each disc at its centre vertically. Take water in a large opaque tray and place the disc with 2 cm radius in such a way that the needle is inside the water as shown in figure.
Now try to view the tree end (head) of the needle from surface of water.
a) Are you able to see the head of the needle? Now do the same with other discs of different radii. Try to see the head of the needle, each time.
Note:- The position of your eye and the position of the disc on water surface should not be changed while repeating the activity with other discs.
b) At what maximum radius of disc, were you not able to see the free end of the needle?
c) Why were you not able to view the head of the hail for certain radii of the discs?
d) Does this activity help you to find the critical angle of the medium (water)?
e) Draw a diagram to show the passage of light ray from the head of the nail in different situations.



First we have to calculate the maximum radius of disc for which we can able to see the free end of the needle.

Here, c = critical angle of water.
r = radius of circular disc
h = height of the needle = 6 cm.

From Snell's law, $n_{water} \times \sin c = n_{air} \times \sin r$



$$\sin c = \frac{1 \times \sin 90^0}{n_{Water}}$$

$$\sin c = \frac{1}{\frac{4}{3}} = \frac{3}{4} \quad (\text{Since } n_{water} = \frac{4}{3})$$

From right angle triangle, $\tan c = \frac{r}{h}$ $\quad$ (Since $\tan c = \frac{\sin C}{\cos C}$)

$$\cos c = \sqrt{1 - \sin^2 C} = \sqrt{1 - (\tfrac{3}{4})^2} = \sqrt{1 - \frac{9}{16}} = \sqrt{\frac{16-9}{16}} = \sqrt{\frac{7}{16}} = \frac{\sqrt{7}}{4}$$

Now $\text{Tan } c = \frac{r}{h}$

$$\Rightarrow \frac{\text{Sin C}}{\text{Cos C}} = \frac{r}{h} \Rightarrow \frac{\frac{3}{4}}{\frac{\sqrt{7}}{4}} = \frac{r}{6} \Rightarrow \frac{r}{6} = \frac{3}{4} \times \frac{4}{\sqrt{7}} \Rightarrow \frac{r}{6} = \frac{3}{\sqrt{7}} \Rightarrow r = \frac{6 \times 3}{\sqrt{7}} = \frac{18}{\sqrt{7}} = 6.8 \text{ cm.}$$

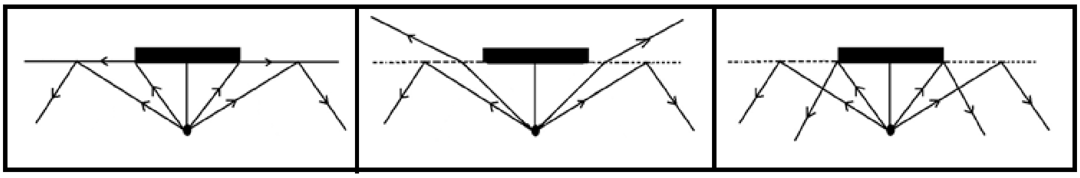
a) Yes, we can see head of the needle.

b) At radius 6.8 cm, we cannot see the free end of the needle.

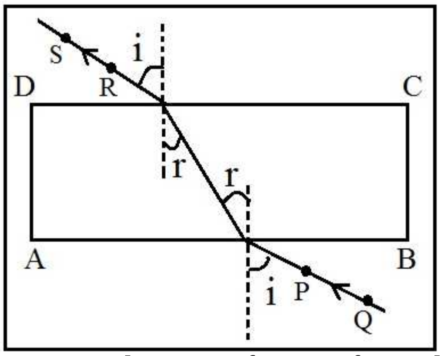
c) As the angle of incidence on water surface is greater than critical angle total internal reflection takes place no light ray incident on eye. Hence needle head cannot be seen.

d) Yes, applying Snell's law to water – air interface. $\sin c = \frac{3}{4} \Rightarrow c = 48.7^0$

e) $r < 6.8$ cm $\quad$ $r = 6.8$ cm $\quad$ $r > 6.8$ cm



11. Explain the refraction of light through a glass slab with a neat ray diagram? Identify lateral shift? (or) How do you conduct an experiment to determine the position and nature of image formed by a glass slab? (TQ)



Aim :- Determination of position and nature of image formed by a glass slab.

Material required :- Plank, chart paper, Clamps, Scale, Pencil, Thin glass slab and pins.

Procedure :- 1. Place a piece of chart (paper) on a plank clamp it.

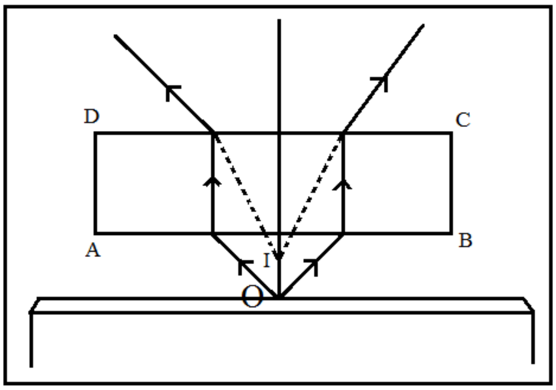
2. Place of glass slab in the middle of the paper. Draw border line along the edges of the slab by using a pencil.
3. Remove the glass slab. We will get a figure of a rectangle. Name the vertices of the rectangle as A, B, C and D.
4. Draw a perpendicular at a point 'L' on the longer side 'AB' of the rectangle.
5. Now draw a line from 'L' in such a way that it makes 30^0 angle with normal. Mark two points P, Q on this line.
6. The line PQ represents the incident ray. The angle it makes with normal represents the angle of incidence ($i = 30^0$)
7. Now place the glass slab in the rectangle ABCD. Fix two identical pins at 'P' and 'Q' such that they stand vertically with equal height.
8. By looking at the two pins from other side (CD) of the slab, fix two more pins at R, S in such a way that all pins appear to be along a straight line.
9. Remove glass slab and the pins. Draw a straight line by joining R, S up to the edge CD of the rectangle. This line (RS) represents emergent ray of the light.
10. Draw a perpendicular to the line CD at 'M' where the line 'RS' meets the line 'CD'.
11. Measure the angle between emergent ray (RS) and normal. This is called 'angle of emergence.

Observation:- The angles of incidence and emergence are equal ($\angle i = \angle e$).

Conclusion:- 1. The incident and emergent rays (PQ, RS) are parallel.

2. Measure the distance between the parallel rays (PQ, RS). This distance is called 'Lateral shift'.

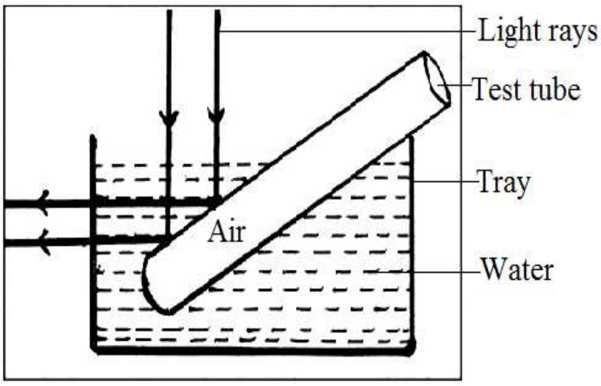
12. Place an object on the table. Look at the object through the transparent glass slab. You will observe that it will appear closer to you. Draw a ray diagram to show the passage of light in this situation? (AS5) (TQ)



ABCD = Glass Slab
O = Object
I = Virtual image of the object seen by you.

If a glass slab is placed in the path of a converging or diverging beam of light them point of convergence or point of divergence appears to be shifted as shown in the figure.

13. Explain why a test tube immersed at a certain angle in a tumbler of water appears to have a mirror surface for a certain viewing position. (AS7)(TQ)



When a test tube is immersed at a certain angle in a tumbler of water appears to have a mirror surface for a certain viewing position.

<u>Explanation</u>:- 1. The critical angle of glass si 42^0.

2. The glass acts as a denser medium and air in the test tube acts as a rarer medium.
3. As light tries to enter air in the test tube it under goes total internal reflection bouncing back into water from the surface of the test tube.
4. When these reflected rays reaches the eye, they appear to come from the surface of test tube itself.
5. Due to this reason the test tube acts as a mirror.

Problems

1. The absolute refractive index of water is 4/3. What is the critical angle of it? (AS1) (Ans: 48.5^0)(TQ)

Given :- The absolute refractive index of water = 4/3

$$\frac{1}{\sin c} = \frac{4}{3} \Rightarrow \text{Sin C} = \frac{3}{4}$$
$$\Rightarrow \text{Sin C} = 0.75$$
$$\Rightarrow \text{Sin C} = \sin 48.5^o$$
$$\Rightarrow C = 48.5^0$$

∴ The critical angle of water is 48.5^0.

2. Determine the refractive index of benzene if the critical angle of it is 42^0. (AS1) (Ans: 1.51)(TQ)

Given:- The critical angle of Benzene = 42^0.

$$\text{Refractive index of Benzene, } = \frac{1}{\text{Sin c}} = \frac{1}{Sin\ 42^0} = \frac{1}{0.6691} = \frac{10000}{6691} = 1.51$$

∴ The refractive index of a benzene is 1.51.

3. Refractive index of glass relative to water is $\frac{9}{8}$. What is the refractive index of water relative to glass? (AS1) (TQ)

Given:- Refractive index of glass relative to water is $= \frac{9}{8} = \frac{\text{Speed of light in water}}{\text{Speed of light in air}}$

Refractive index of water relative to glass $= \frac{\text{Speed of light in air}}{\text{Speed of light in water}} = \frac{8}{9}$.

4. The speed of light in a diamond is 1, 24,000 km/s. Find the refractive index of diamond if the speed of light in air is 3, 00,000 km/s. (AS–1) (TQ)

Given that, Speed of light in air, c = 3, 00,000 km/s;
Speed of light in a diamond, v = 1, 24,000 km/s

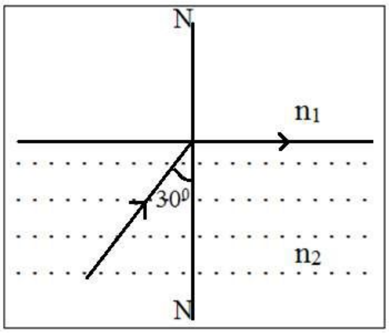
$$\text{Refractive index of diamond, n} = \frac{\text{Speed of light in air(c)}}{\text{Speed of light in a diamond (v)}}$$

$$= \frac{3{,}00{,}000}{1{,}24{,}000}$$

$$= 2.42$$

∴ Refractive index of diamond, n = 2.42.

5. Look at the picture.
a) What is the value of critical angle?
b) Find the refractive index of denser medium with respect rarer medium?



a) Critical angle c = 30^0

b) Refractive index of denser medium w.r.t rarer medium = n_{21}

$n_{21} = \frac{1}{\text{Sin c}} = \frac{1}{\text{Sin } 30^0} = \frac{1}{\frac{1}{2}} = 2.$

6. A light ray is incident on air-liquid interface at 45^0 and is refracted at 30^0. What is the refractive index of the liquid? For what angle of incidence will the angle between reflected ray and refracted ray is 90^0? (AS7) (Ans: 1.414, 54.7^0)(TQ)

Given: - The angle of incidence, i = 45^0

The angle of refraction, r = 30^0

Refractive index of a liquid (n) = $\frac{\sin i}{Sin\, r} = \frac{Sin\, 45}{Sin\, 30} = \frac{\frac{1}{\sqrt{2}}}{\frac{1}{2}} = \frac{1}{\sqrt{2}} \text{ x } \frac{2}{1} = \sqrt{2} = 1.414$

The refractive index of a liquid is 1.414

We know angle of refraction, r = 90- Angle of incident = 90-i

Refractive index (n) = $\frac{\sin i}{Sin\, r}$

$\Longrightarrow 1.414 = \frac{\sin i}{Sin\,(90-i)}$

$\Longrightarrow \frac{Sin\, i}{Cos\, i} = 1.414$

$\Longrightarrow$ tan i = 1.414

$\Longrightarrow$ tan i = tan 54.7^0

$\Longrightarrow \angle i = 54.7^0$

$\therefore$ Critical angle, c = 54.7^0

Chapter-6

REFRACTION OF LIGHT AT CURVED SURFACES

1 Mark Questions

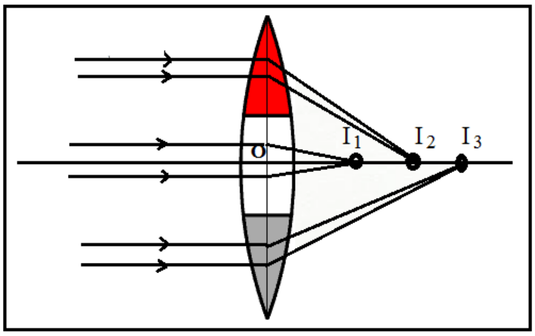
1. Can a virtual image be photographed by a camera? (AS2)(TQ)

Yes, a virtual image can be photographed by a camera.

Examples:- 1. We are able to photograph the virtual images formed by plane mirrors.

2. Our eye works on the principle of camera with this we are able to see virtual images.

2. A convex lens is made up of three different materials as shown in the figure. How many images does it forms? (AS–2)(TQ)



1. Given convex lens is made up to three different materials have different refractive indexes.
2. So the given lens has three different focal lengths. Hence it forms three images.

3. Suppose you are inside the water in a swimming part near an edge. A friend standing on the edge. Do you find your friend taller or shorter than his usual height? Why? (AS7)(TQ)

My friend appears to be taller than his usual height.

Reason:- 1. The light rays of my friend travelling from rarer (air) to denser (water) medium.

2. These rays bends towards normal line.
3. So, apparent image of my friend which appears to be taller due to refraction.

4. How does a light ray behave when it is passing through the focus of a lens?

When a light ray passing through the focus will take a path parallel to principal axis after refraction.

5. Define one dioptre of a power of a lens?

One dioptre is the power of a lens of focal length 1m.

6. When does Snell's law fail?

Snell's law fail when light is incident normally on the surface of a refracting medium.

7. Write the lens formula and explain the terms in it?

Lens formula:- $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

Where, f = the focal length of the lens.
u = object distance.
v = image distance.

8. Write the formula for formation of image by curved surfaces?

Image formula:- $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$

Where, n_1 = refractive index of the first medium.
n_2 = refractive index of the second medium.
u = image distance.
v= Object distance.
R = Radius of curvature.

9. What happens to the image formed by a convex lens if its lower part is blackend?

1. Every part of a lens forms a complete image.
2. If the lower part of the lens is blackend the complete image will be formed but its intensity will decreases.

10. What type of lens behaviour will an air bubble inside the water show?

It will act as a diverging lens.

11. Is it possible for a lens to act as a convergent lens in one medium and a divergent lens in another medium?

1. The convex lens behaves as a converging lens, if it is kept in a medium with refractive index less than the refractive index of the lens.
2. It behaves like a diverging lens when it is kept in a transparent medium with greater refractive index than that of the lens.

2 Mark Questions

1. A man wants to get a picture of a zebra. He photographed a white donkey after fitting a glass, with black stripes, on to the lens of his camera. What photo will he get? Explain? (AS1)(TQ)

Photographer will get a picture of white donkey only.

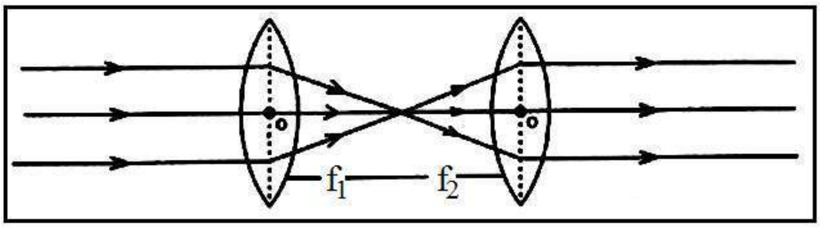
Explanation:- 1. A glass with block strips is fitted on the lens on a camera.
2. This camera is used to take photograph of a white donkey.
3. The photographer will not get the photograph of zebra.
4. Instead of he will obtain a photograph of the white donkey with reduced brightness.
5. This happens because the block stripes on the glass block light from the object reducing intensity of the image.

2. Write the lens makers formula and explain the terms in it? (AS1)(TQ)

Lens makers formula is, $\frac{1}{f} = (n-1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$

Where, f = focal length of lens.
n = refractive index of lens.
R_1 = Radius of curvature of first surface.
R_2 = Radius of curvature of second surface.

3. Two converging lenses are to be placed in the path of parallel rays so that the rays remain parallel after passing through both lenses. How should the lenses be arranged? Explain with a neat ray diagram. (AS–1)(TQ)



1. A parallel beam of light rays will converge on focal point of the lens.
2. Light rays passes through the focal point will parallel to principal axis after refraction.
3. So the two lenses are arranged on a common principal axis such that their focal points coincide with each other.
4. Hence the two lenses should be kept at a distance equal to $f_1 + f_2$.

4. Harsha tells Siddhu that the double convex lens behaves like a convergent lens. But Siddhu knows that Harsha's assertion is wrong and corrected Harsha by asking some questions. What are the questions asked by Siddhu? (AS2)(TQ)

1. What is meant by convergent lens?
2. What is meant by a double convex lens?
3. How does the lens behaves if it is kept in water?
4. How does the air bubble in water behave?
5. Does the convex lens behaves like a converging lens, if it is placed in a liquid of refractive index greater than the refractive index of the material of the prism?
6. Is it possible for a lens to act as a convergent lens in one medium and a divergent lens in another medium?

5. How will you decide whether a given piece of glass is a convex lens, concave lens or a plane glass?

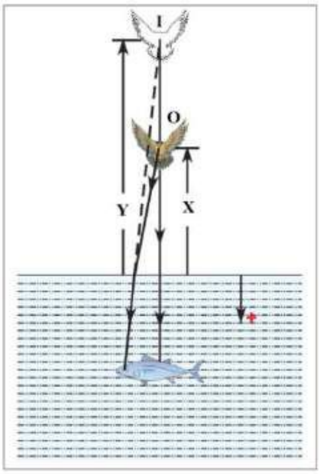
1. Hold the given piece of glass over some printed material.
2. If the letters appeared magnified, the given lens is a convex lens.
3. If the letters appeared diminished, the given lens is a concave lens.
4. If the letters appear to be of the same size, then it is a plane glass.

6. Assertion (A): A person standing on the land appears taller than his actual height to a fish inside a pond. (AS2)(TQ)

Reason (R):- Light bends away from the normal as it enters air from water.

Which of the following is correct? Explain?

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true and R is not the correct explanation of A.
c) A is true but R is false.
d) Both A and R are false.
e) A is false but R is true.



Both A and R are true and R is the correct explanation of A.

Explanation:- 1. Let the actual height of the person be 'x' feet.

2. $\frac{\text{Refractive index of air}}{\text{refractive index of water}} = \frac{\text{Actual height of the man}}{\text{Apparent height of the man}}$

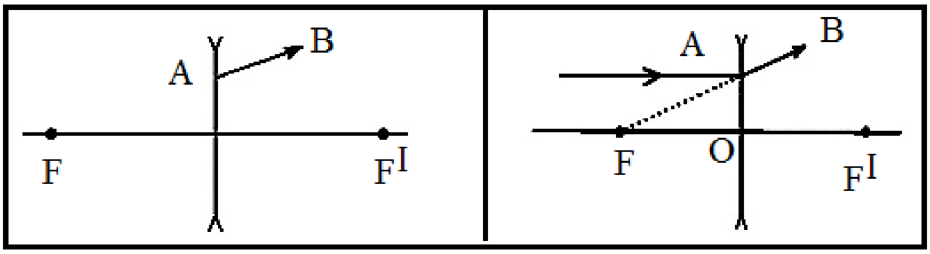
3. $\frac{1}{1.33} = \frac{x}{\text{Apparent height of the man}}$

4. Apparent height of the man = $1.33 \times x$

= $1.33 \times$ times of the actual height of the person.

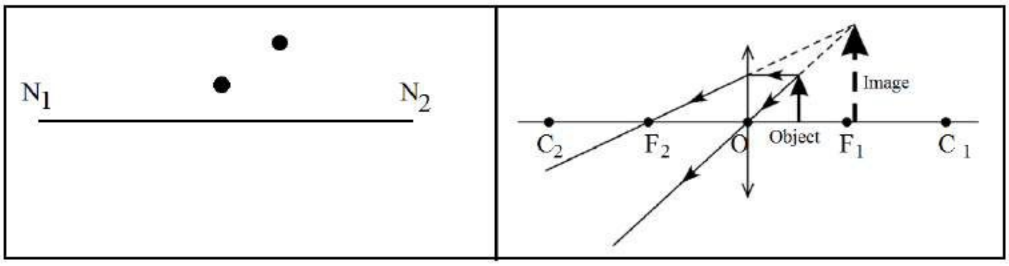
5. Hence the standing on the land appears taller than his actual height to a fish inside a pond.

7. Figure shows ray AB that has passed through a divergent lens. Construct the path of the ray up to the lens if the position of focal is known? (AS5) (TQ)

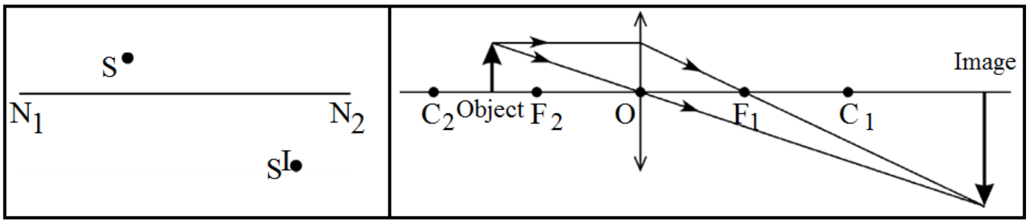


A light passing parallel to principal axis, after refraction appears to be diverging from the focus of the lens.

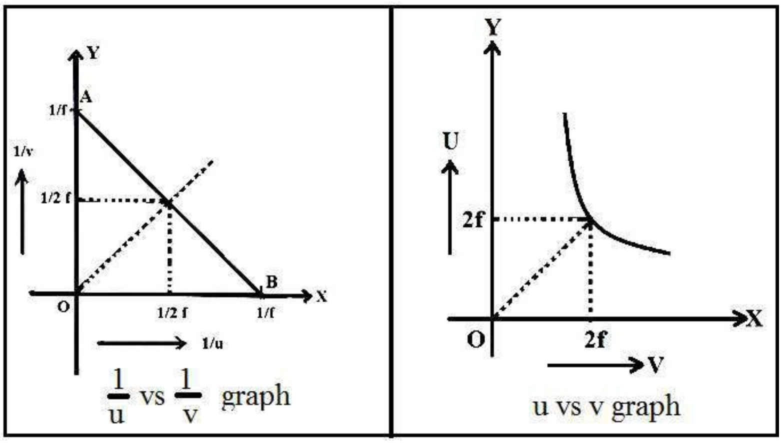
8. Figure shows a point light source and its image produced by a lens with an optical axis N_1N_2. Find the position of the lens and its focal using a ray diagram? (AS5) (TQ)



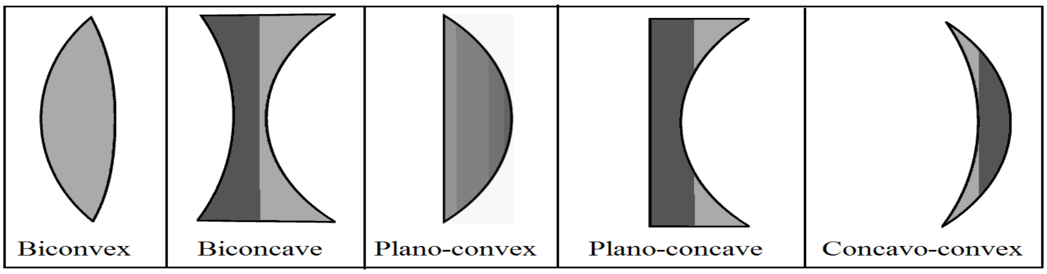
9. Find the focus by drawing a ray diagram using the position of source 'S' and image 'S^1' given in figure? (AS5) (TQ)



10. Draw the graphs of u *vs.* v and $\frac{1}{u}$ *vs.* $\frac{1}{v}$. ? (AS5) (TQ)



11. Write the names of different types of lenses. Draw their diagrams?

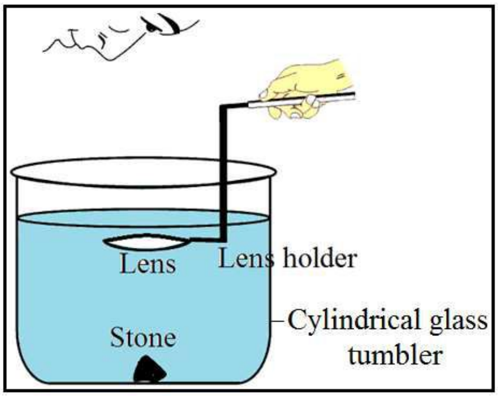


4 Mark Questions

1. How do you verify experimentally that the focal length of a convex lens is increased when it is kept in water? (AS1)(TQ)

Aim:- To verify the focal length of a convex lens is increased when it is kept in water.

Apparatus:- Convex lens of known focal length, circular lens holder, tall cylindrical glass tumbler, block stone and water.



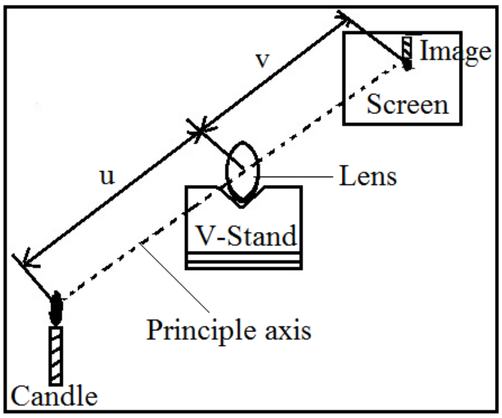
Procedure:- 1.Take a cylindrical glass tumbler, whose height is greater than the focal length of the lens and filled it with water.
2. Keep a black stone at the bottom of the vessel.
3. Now dip the lens horizontally using a circular lens holder.
4. Set the distance between stone and the lens that is equal to or less than focal length of lens.
5. Now look at the stone through lens.
6. We can see the image of the stone if the distance between lens and stone is less than the focal length of lens.
7. Now increase the distance between lens and stone until you can't see the image of stone.
8. When the lens is dipped to a height which is greater than the focal length of lens in air but we can see the image.
9. This shows that the focal length of lens has increased in water.

Conclusion:- The focal length of the lens depends upon surrounding medium.

2. How do you find the focal length of a lens experimentally? (AS1)(TQ)
(or) You have a lens suggest an experiment to find out the focal length of the lens? (AS3)(TQ)

Aim:- To determine the focal length of a convex lens.

Apparatus:- Convex lens, meter scale, V-stand, screen, candle (object).



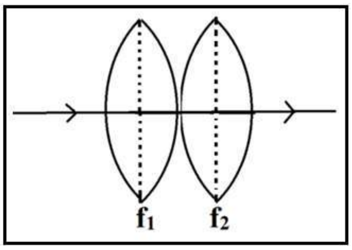
Procedure:- 1. Take a v – stand and place it on a long table at the middle.
2. Place a convex lens on the v – stand.

3. Light the candle and place it at a distance of 60cm from the lens on the principal axis.
4. Adjust the screen which is on the other side of lens to get an image on it.
5. Measure the distance between the candle and the stand of the lens, this value is noted as object distance(u).
6. Measure the distance of the image from the stand of the lens, this value is noted as image distance (v).
7. Repeat the experiment for various object distances (u) like, 50cm, 40cm, 30cm and measure the distance of image (υ) in all cases and noted in the following table.

S.No.	Object distance (u)	Image distance(v)	Focal length, f $=\frac{uv}{u+v}$
1	60 cm		
2	50 cm		
3	40 cm		
4	30 cm		

8. From the above table f $=\frac{uv}{u+v}$ value is constant.
9. This constant value gives the focal length of the given lens.

3. Let us assume a system that consists of two lenses with focal length f1 and f2 respectively. How do you find the focal length of system experimentally. When,
i. Two lenses are touching each other.
ii.They are separated by distance 'd' common principal axis (AS3) (TQ)

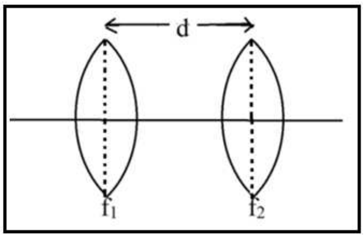


i. The focal length of two lenses having f_1 and f_2 respectively, if they touch each other then the focal length of the system is,

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

$$\frac{1}{F} = \frac{f_1 + f_2}{f_1\, f_2} \Rightarrow F = \frac{f_1\, f_2}{f_1 + f_2}.$$

ii. If the lenses are separately by a distance 'd' with common optical axis then their focal length of the system is,



$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1\, f_2}.$$

$$\frac{1}{F} = \frac{\mathbf{f_2 + f_1 - d}}{\mathbf{f_1 f_2}} \Rightarrow \mathbf{F} = \frac{\mathbf{f_1\, f_2}}{\mathbf{f_1 + f_2 - d}}$$

4. Collect the information about the lenses available in an optical shop. Find out how the focal length of lens may be determined by given 'power' in lens. (AS4)(TQ)

Lenses available in an optical shop are,

1. Plano convex lens
2. Double convex lens
3. Plano concave lens
4. Double concave lens
5. Cylindrical lens
6. IR lens
7. UV lens

Power of lens (p):- 1. The reciprocal of focal length of the lens is called power of lens.
2. It is denoted by the letter 'p'.

Power of lens, p $= \frac{1}{f(\text{in m})}$ (or) P $= \frac{100}{f(\text{in cm})}$.

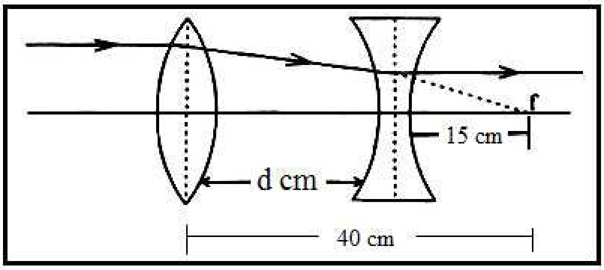
3. The S.I unit of optical power of the lens is dioptre.

4. The focal length of a converging lens is positive therefore its power is positive.
5. Similarly the power of a diverging lens is negative.

5. Collect the information about lenses used by Galileo in his telescope? (AS5)(TQ)

Galileo telescope:- 1. It consists of two lenses.
2. Objective lens (close to the object or towards the object).
3. It is a convex lens of large focal length.
4. Eye piece (close to eye or towards the eye)
5. It is a diverging (concave) lens of short focal length.
6. The image of the object is formed at focal point of the objective lens.
7. This image acts as virtual object for eyepiece.
8. The eyepiece forms the final erect and magnified image.

6. A parallel beam of rays is incident on a convergent lens with a focal length of 40 cm. where should a divergent lens with a focal length of 15cm be placed for the beam of rays to remain parallel after passing through two lenses? Draw a ray diagram? (AS5)(TQ)



1. The focal length of conversing lens is 40 cm.
2. The focal length of diverging lens is 15 cm.
3. The separation between them (d) = 40-15=25 Cm.

(Or)
Let focal length of convergent lens = f_1 = 40cm
Focal length of divergent lens = f_2 = –15 cm
Let the 'd' is the distance between two lenses. Then $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} - \frac{d}{f_1 f_2}$

$\Rightarrow \frac{1}{\alpha} = \frac{1}{40} + \frac{1}{-15} - \frac{d}{40 \times (-15)}$ (For emergent parallel beam, F = α)

$\Rightarrow 0 = \frac{1}{40} - \frac{1}{15} + \frac{d}{600} \Rightarrow \frac{d}{600} = \frac{1}{15} - \frac{1}{40} \Rightarrow \frac{d}{600} = \frac{40-15}{600} \Rightarrow$ d = 25 cm

∴ Distance between two lens = 25cm.

7. How do you appreciate the coincidence of the experimental facts with the results obtained by a ray diagram in terms of behaviour of images formed by lenses? (AS7)(TQ)

We are getting exactly same type of image as prescribed in ray diagrams by lenses.

The following conclusions may be obtained for a convex lens:-
1. A convex lens will form a real image for a real object when the object is placed beyond focus.
2. When the object is placed between focus and optical pole then virtual images are formed.
3. The formation of the real image is always inverted and virtual image is always erect.

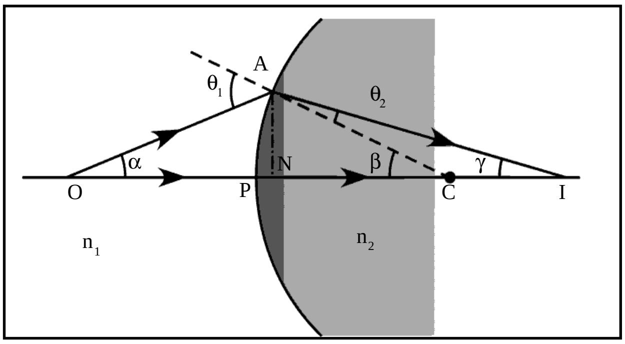
The following conclusions may be obtained for a concave lens:-
1. A concave lens always forms a virtual image for a real object.
2. The image formed by a concave lens is always erect and diminished in size.

3. A concave lens can form a real image if the object is virtual.

So, I appreciate the coincidence of the experimental facts with the results obtained by a ray diagram in terms of behaviour of images formed by lenses.

8. Derive the image formula for a curved surface?

Image formula ($\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$):-



1. Consider a curved surface separating two media of refractive indexes n_1 and n_2.
2. A point size object is placed on the principal axis at point O.
3. The ray, which forms an angle ‘α’with principal axis, meets the interface (surface) at A.
4. The refracted ray meet at I and the image is formed there.
5. Let the angle made by the refracted ray with principal axis be γ and the angle between the normal and principal axis be β.
6. From the figure the angle of incident is θ_1 and the angle of refraction is θ_2.
7. In the triangle ACO, $\theta_1 = \alpha + \beta$ and in the triangle ACI, $\beta = \theta_2 + \gamma \Rightarrow \theta_2 = \beta - \gamma$
8. According to Snell’s law, we know $n_1 \sin \theta_1 = n_2 \sin \theta_2$.
9. Substituting the values of θ_1 and θ_2 we get, $n_1 \sin(\alpha + \beta) = n_2 \sin(\beta - \gamma)$--------(1)
10. If the rays move very close to the principal axis, then $\sin(\alpha + \beta) = \alpha + \beta$ and $\sin(\beta - \gamma) = \beta - \gamma$.
11. Substituting in equation (1). We have,

$$n_1(\alpha + \beta) = n_2(\beta - \gamma) \Rightarrow n_1\alpha + n_1\beta = n_2\beta - n_2\gamma \text{ ....(2)}$$

12. Since all angles are small, we can write

$$\text{Tan } \alpha = \frac{AN}{NO} \Rightarrow \alpha = \frac{AP}{PO}$$

$$\text{Tan } \beta = \frac{AN}{NC} \Rightarrow \beta = \frac{AP}{PC}$$

$$\text{Tan } \gamma = \frac{AN}{NI} \Rightarrow \gamma = \frac{AP}{PI}$$

13. Substitute α, β and γ values in equation (2), We have, $n_1 \frac{AP}{PO} + n_1 \frac{AP}{PC} = n_2 \frac{AP}{PC} - n_2 \frac{AP}{PI}$.

$$\Rightarrow n_1 \frac{AP}{PO} + n_2 \frac{AP}{PI} = n_2 \frac{AP}{PC} - n_1 \frac{AP}{PC} \Rightarrow AP\left(\frac{n_1}{PO} + \frac{n_2}{PI}\right) = (n_2 - n_1)\left(\frac{AP}{PC}\right)$$

$$\Rightarrow \frac{n_1}{PO} + \frac{n_2}{PI} = \frac{n_2 - n_1}{PC} \text{ ---------- (3)}$$

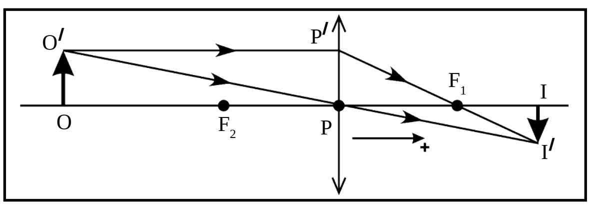
14. According to sign convention, PO = -u ; PI = v ; PC = R.

15. Substituting these values in equation (3) we get, $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$.

This is called an image formula of a curved surface.

9. Derive the equation for lens formula?

Lens formula ($\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$):-



1. Let OO^I is the object, II^I is the formation of the image.
2. Po, PI and PF_1 are the Object distance (u), image distance (v) and focal length (f) respectively.
3. From the figure, triangle PP^IF1 and triangle $F1II^I$ are similar triangles,

$$\Rightarrow \frac{PP^I}{II^I} = \frac{PF_1}{f_1 I} \Rightarrow \frac{PP^I}{II^I} = \frac{PF_1}{PI - PF_1} \text{ ---------- (1)} \quad (\text{Since } f_1 I = PI - PF_1)$$

4. We have another set of similar triangles OO^IP and PII^I.

From these triangles we get, $\frac{OO^I}{II^I} = \frac{PO}{PI} \Rightarrow \frac{PP^I}{II^I} = \frac{PO}{PI}$ ---------- (2) (Since $OO^I = PP^I$)

5. From equation (1) and (2), $\frac{PO}{PI} = \frac{PF_1}{PI - PF_1} \Rightarrow \frac{PI}{PO} = \frac{PI - PF_1}{PF_1} \Rightarrow \frac{PI}{PO} = \frac{PI}{PF_1} - 1$

6. On dividing the equation by PI, we get $\frac{1}{PO} = \frac{1}{PF_1} - \frac{1}{PI} \Rightarrow \frac{1}{PO} + \frac{1}{PI} = \frac{1}{PF_1}$ -------- (3)

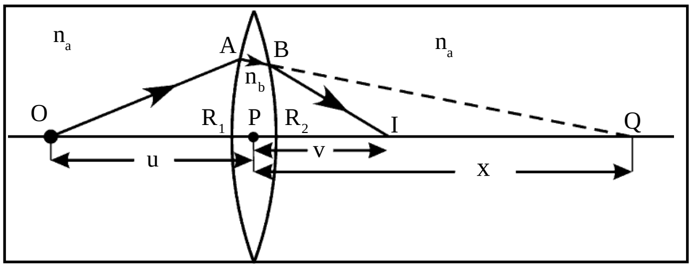
7. According to the sign convention, PO = -u; PI = v; PF_1 = f.

8. Substituting these values in equation (3), we get $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$.

This is called a lens formula.

10. Derive the equation for Len's maker's formula?

<u>Len's maker's formula</u> [$\frac{1}{f}$ = (n- 1) ($\frac{1}{R_1} + \frac{1}{R_2}$)]:-



1. Let us imagine a point object 'O' placed on the principal axis of the thin lens as shown in figure.
2. Let this lens be placed in a medium of refractive index n_a and let refractive index of lens medium be n_b.
3. Let us assume that, it forms image at Q, if there were no concave surface.
4. From the figure, Object distance PO = –u;
   Image distance v = PQ = x
   Radius of curvature R = R_1
   $n_1 = n_a$ and $n_2 = n_b$
4. Substitute the above values in the equation, $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$. $\Rightarrow \frac{n_b}{x} + \frac{n_a}{u} = \frac{n_b - n_a}{R}$.-------(1)
5. The image Q of the object due to the convex surface is taken as object for the concave surface.
6. So, we can say that I is the image of Q for concave surface.
7. From the figure, Object distance u = PQ = + x
   Image distance PI = v
   Radius of curvature R = $-R_2$
   $n_1 = n_b$ and $n_2 = n_a$
8. Substituting the above values in equation $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R} \Rightarrow \frac{n_a}{v} - \frac{n_b}{x} = \frac{n_a - n_b}{-R_2}$ -------- (2)
9. By adding (1) and (2) we get, $\frac{n_a}{v} + \frac{n_a}{u} = (n_b - n_a)\left(\frac{1}{R_1 - R_2}\right)$
10. Dividing both sides by n_a, we get $\frac{1}{v} + \frac{1}{u} = \left(\frac{n_b}{n_a} - 1\right)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$

11. We know $\frac{n_b}{n_a}$ = n_{ba} called refractive index of lens with respect to surrounding medium.

$$\frac{1}{v} + \frac{1}{u} = (n_{ba} - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

12. According to rules for sign conversion, $\frac{1}{v} - \frac{1}{u} = (n_{ba} - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$.

$$\Rightarrow \frac{1}{f} = (n_{ba} - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right). \text{ (Since } \frac{1}{v} - \frac{1}{u} = \frac{1}{f}\text{)}$$

13. If the surrounding medium is air, then the relative refractive index could be absolute refractive index of the lens.

$$\Rightarrow \frac{1}{f} = (n - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right).$$

14. This formula can be used only when the lens is kept in air. Where n is absolute refractive index and this equation is called lens maker's formula.

Problems

1. The focal length of a converging lens is 20cm. An object is 60cm from the lens. Where will the images be formed and what kind of image is it? (AS1) (TQ)

Given: - Focal length, f = 20 Cm
Object distance, u = - 60 Cm (In front of lens take 'u' as – ve sign)
Image distance, v =?

Formula:- $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{v} = \frac{1}{f} + \frac{1}{u} \Rightarrow \frac{1}{v} = \frac{1}{20} + \frac{1}{-60} \Rightarrow \frac{1}{v} = \frac{1}{20} - \frac{1}{60} \Rightarrow \frac{1}{v} = \frac{3-1}{60} \Rightarrow \frac{1}{v} = \frac{2}{60}$

$\Rightarrow$ v = 30 cm

∴ Hence image is real, inverted and formed other side of the lens.

2. A double convex lens has two surfaces of equal radii 'R' and refractive index n = 1.5. Find the focal length 'f'. (AS1) (TQ)

Given:- Refractive index = 1.5
Let R_1 =R and R_2 = -R (With respect to sign convention)
Lens makers formula is $\frac{1}{f} = (n-1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$

$$= (1.5-1)\left(\frac{1}{R} - \frac{1}{-R}\right)$$

$$= (1.5-1)\left(\frac{1}{R} + \frac{1}{R}\right)$$

$$= 0.5\left(\frac{1+1}{R}\right)$$

$$= 0.5 \times \frac{2}{R}$$

$$\frac{1}{f} = \frac{1}{R}$$

$$\therefore f = R$$

∴ The focal length is equal to radii of curvature.

3. Find the refractive index of the glass which is a symmetrical convergent lens if its focal length is equal to the radius of curvature of its surface. (AS7) (Ans: 1.5) (TQ)

1. The given lens is a symmetrical convergent lens. i.e. R_1=R_2=R and f=R.
2. Let n be the refractive index of the lens.

3. $\frac{1}{f} = (n-1)\left[\frac{1}{R1} - \frac{1}{R2}\right]$ $\Rightarrow \frac{1}{R} = (n-1)\left[\frac{1}{R} - \frac{1}{(-R)}\right]$ (Since R_1=R , R_2= -R w.r.to sign convention)

$\Rightarrow \frac{1}{R} = (n-1)\left[\frac{1}{R} + \frac{1}{(R)}\right]$

$\Rightarrow \frac{1}{R} = (n-1)\left[\frac{2}{R}\right]$

$\Rightarrow 2(n-1) = 1$

$\Rightarrow n-1 = \frac{1}{2}$

$\Rightarrow n = 1+\frac{1}{3}$

$\Rightarrow n = \frac{3}{2}$

$\Rightarrow n = 1.5$

∴ The refractive index of the glass is 1.5.

4. Find the radii of curvature of a convexo –concave convergent lens made of glass with refractive index n=1.5 having focal length of 24cm. One of the radii of curvature is double the other? (AS7)

Given: - Refractive index of the glass, n=1.5 **(TQ)**
Focal length, f= 24 cm
Let the radius of curvature of convex surface = R_1
Let the radius of curvature of concave surface = $R_2 = 2R_1$
(For convexo-concave convergent lens R_1 and R_2 are positive)

Formula: - $\frac{1}{f} = (n-1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right] \Rightarrow \frac{1}{24} = (1.5-1)\left[\frac{1}{R_1} - \frac{1}{2R_1}\right]$

$\Rightarrow \frac{1}{24} = (0.5)\left[\frac{2-1}{2R_1}\right]$

$\Rightarrow \frac{1}{24} = (0.5)\left[\frac{1}{2R1}\right]$

$\Rightarrow \frac{1}{2R1} = \frac{1}{24x0.5}$

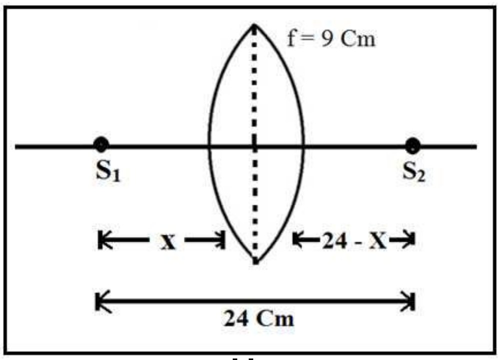
$\Rightarrow 2R_1 = 24 \times 0.5$

$\Rightarrow R_1 = \frac{24 \times 0.5}{2} = 6$ Cm

$R_2 = 2R_1 = 2 \times 6 = 12$ Cm

∴ R_1 = 6cm and R_2 = 12 cm

5. The distance between two point sources of light is 24cm .Where should a convergent lens with a focal length of f=9cm be placed between them to obtain the images of both sources at the same point? (AS7) (TQ)



Given :- Focal length, f = 9 Cm

1. For first Source, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{9} = \frac{1}{v} - \frac{1}{-x} \Rightarrow \frac{1}{9} = \frac{1}{v} + \frac{1}{x}$ -------(1) (w.r.t sign convention v=v, u = -x)

2. For second Source, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{9} = \frac{1}{-v} - \frac{1}{-(24-x)}$

$\Rightarrow \frac{1}{9} = -\frac{1}{v} + \frac{1}{24-x}$ ----(2) (w.r.t sign convention, v = -v, u = -(24-x))

3. (1) + (2) $\Rightarrow \frac{1}{9} + \frac{1}{9} = \frac{1}{v} + \frac{1}{x} - \frac{1}{v} + \frac{1}{24-x}$

$\Rightarrow \frac{2}{9} = \frac{1}{x} + \frac{1}{24-x}$

$\Rightarrow \frac{2}{9} = \frac{24-x+x}{x(24-X)}$

$\Rightarrow \frac{2}{9} = \frac{24}{24x - x^2}$

$\Rightarrow 2(24x - X^2) = 216$

$\Rightarrow x^2 - 24x + 108 = 0$

$\Rightarrow x^2 - 24x + 108 = 0$

$\Rightarrow x^2 - 18x - 6x + 108 = 0$

$\Rightarrow (x - 6)(x - 18) = 0$

$\Rightarrow x = 6, 18$

$\therefore$ Lens should be placed 18 cm and 6 cm to the right side of the first object.

Chapter – 7

Human eye and Colourful world

1 Mark Questions

1. What is least distance of distinct vision? What is its value for a human being?

1. The minimum distance at which an object is to be placed so that it can be viewed distinctly and comfortably is known as least distance of distinct vision.
2. The value of least distance of distinct vision is 25 cm.

2. What is angle of vision? What is its value for healthy human being?

1. The maximum angle at which we are able to see the whole object is called angle of vision.
2. The angle of vision of human being is 60^0.

3. What is accommodation of eye lens?

The ability of eye lens to change its focal length is called accommodation of lens.

4. Which type of images forms by eye lens?

The eye-lens forms a real and inverted image of an object on the retina.

5. Name the receptors are there in the human eye?

1. Cones 2. Rods

6. What is the role of rods and cones in human eye?

Rods – identify the colour.

Cones – Identify the intensity of light.

7. How many number of receptors are there in the human eye?

125 Millions.

8. How many number of optic-nerve fibres are there in the human eye?

1 Million.

9. What is the function of optical nerve in the eyes?

The optical nerve transmits visual information from retina to the brain.

10. What are the maximum and minimum focal lengths of eye lens?

Maximum focal length of eye lens = 2.5 cm

Minimum focal length of eye lens = 2.27 cm.

11. How many types of eye defects? What are they?

There are mainly three common defects of vision. They are 1. Myopia 2. Hypermetropia 3. Presbyopia.

12. What is the meant by a far point?

Far point:- The point of maximum distance at which the eye lens can form an image on the retina is called 'far point'.

13. What is the meant by a near point?

Near point:- The point of minimum distance at which the eye lens can form an image on the retina is called near point.

14. What is meant by angle of deviation?

Angle of deviation:- The angle between incident ray and emergent ray is called angle of deviation.

15. If you correct the eye defect Myopia then mention the focal length of bi-concave lens?

To correct the Myopia,

The focal length of bi-concave lens is f = – D.

Here D = Distance to far point from eye.

16. If you correct the eye defect Hypermetropia then mention the focal lengths of bi-convex lens?

To correct the Hypermetropia,

The foal length of bi–convex lens is $f = \frac{25\,d}{d-25}$

Here d = Distance to near point from eye.

17. What is meant by a Presbyopia?

Presbyopia:- Presbyopia is a vision defect when the ability of accommodation of the eye usually decreases with ageing.

18. How can you correct the eye defect presbyopia?

Presbyopia was corrected by using bi-focal lens which are formed using both concave and convex lenses.

19. Define power of lens? What are its units?

Power of lens(P):-
1. The reciprocal of focal length is called power of lens.
2. Let 'f ' be the focal length of lens,
3. Power of lens, $P = \frac{1}{f\,(\text{in m})}$ (or) $P = \frac{100}{f\,(\text{in cm})}$
4. The unit of power of lens is 'Dioptre' (D)

20. What is meant by a prism?

Prism:- A prism is a transparent medium separated from the surrounding medium by at least two plane surfaces which are inclined at a certain angle in such a way that, light incident on one of the plane surfaces emerges from the other plane surface.

21. What is meant by a 'angle of minimum deviation'?

Angle of minimum deviation:- 1. When the angle of incidence is equal to angle of emergence the angle of deviation attains least value.

2. This is known as 'angle of minimum deviation'.

22. Write a formula to find the refractive index of the material of the prism and explain the terms?

Refractive index of the material of a prism, $n = \frac{\sin\frac{A+D}{2}}{\sin\frac{A}{2}}$

Where, A = Angle of the prism.

D = Angle of minimum deviation.

23. What is Dispersion of light? Give an example?

Dispersion of light:- The splitting of white light into different colours (VIBGYOR) is called dispersion.

Ex:- Rainbow is formed due to the dispersion of sun light.

24. Name the component of white light that deviates the least and the most while passing through a prism?

Least deviation:- Red.

Most deviation:- Violet.

25. What is meant by a scattering of light? Give an example?

Scattering of light:- The process of re-emission of absorbed light in all directions with different intensities by atoms or molecules is called scattering of light.

Ex:- The blue colour of the sky is due to scattering of light.

26. What is meant by an intensity of light?

Intensity of light:- The intensity of light is the energy of light passing through unit area of plane, taken normal to the direction of propagation of light, in one second.

27. What is meant by an angle of scattering?

Angle of scattering:- The angle between the incident light and a direction in which the intensity of scattered light is called angle of scattering.

28. If a white sheet of paper is stained with oil the paper turns transparent. Why? (AS7)(TQ)

The refractive index of oil and refractive index of paper is same then light passes from oil to paper without scattering hence the paper becomes transparent.

29. Can you guess the reason, why sun does not appear red during noon hours?

1. During noon hours, sun light travels less distance through the atmosphere then the morning and evening times.
2. Therefore all the colours reaches without much scattering, thus the sun appear white at noon.

30. A rainbow viewed from an airplane may form a complete circle. Where will the shadow of airplane appear?

A rainbow viewed from an airplane may form a complete circle.

31. Avantika can read a book but she does not able to read the letters on backboard clearly.
i) What is the eye defect of Avantika?
ii) Which type of lens she has to use to correct her eye defect?

i) Avantika has eye defect 'Myopia'.
ii) She has to use 'Biconcave lens' to correct her eye defect.

32. Sreekar can see the name boards of buses cearly from long distance. But he can't read the news paper clearly.
i) What type of eye defect has Sreekar?
ii) What kind of lens does Sreekar use to correct his eye defect?

i) Sreekar has eye defect – 'Hypermetropia'
ii) 'Hypermetropia' can be corrected by using 'biconvex lens'.

2 Mark Questions

1. Explain briefly the reason for the blue of the sky? (AS1)(TQ)

1. The blue colour of the sky is due to scattering of sun light.
2. We know that our atmosphere contains different types of molecules and atoms.
3. The reason to blue of the sky is due to the molecules N_2 and O_2.
4. The sizes of these molecules are comparable to the wavelength of the blue light.
5. These molecules act as a scattering centre for scattering of blue light.
6. So, sky appears to be blue in colour.

2. Assertion (A):- The refractive index of a prism depends only on the kind of glass of which it is made of and the colour of light.

Reason(R):- The refractive index of a prism depends on the refracting angle of the prism and on the angle of minimum direction (AS2) (TQ)

Both A and R are true and R is not the correct explanation of A

Explanation:- 1. It is found that as the angle of deviation decreases refractive index of material decreases.

2. This means, the angle of deviation depends on the refractive index of the material of the prism.

3. Assertion (A):- Blue colour of sky appears due to scattering of light.

Reason(R):- Blue colour has shortest wavelength among all the colours of white light. (AS2)(TQ)

(A) is true and (R) is false.

Explanation:- 1. Sky appears blue due to scattering of light.

2. Violet colour has the shortest wavelength among all the colours of white light.

4. Light wave length (λ_1) enters a medium with refractive index n2 from medium with refractive index n_1. Then what is the wave length of light to second medium? (AS1)(TQ)

Wave length in first medium $=\lambda_1$

Wave length in second medium $=\lambda_2$

Refractive index of first medium $=n_1$

Refractive index of second medium$=n_2$

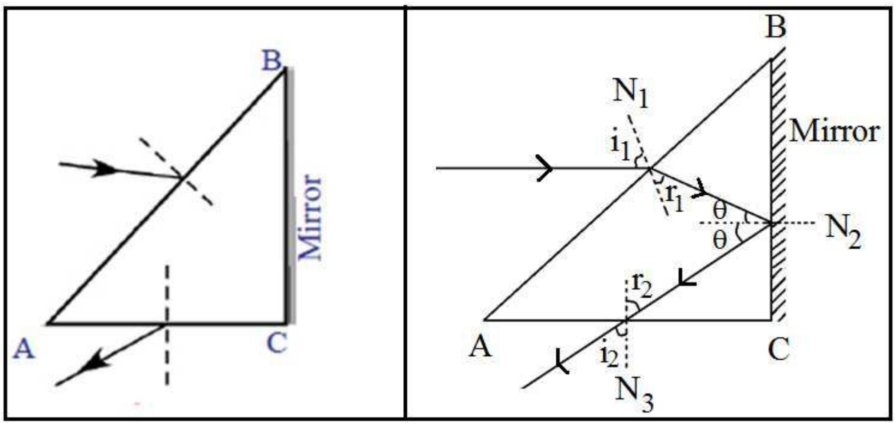
The relation among velocity (v), wavelength (λ) and frequency (ν) is $v = \nu\lambda$.

$$\frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} \text{ ------- (1)}$$

We know $n = \frac{c}{v} \Rightarrow n \propto \frac{1}{v} \Rightarrow n_1 v_1 = n_2 v_2 \Rightarrow \frac{v_1}{v_2} = \frac{n_2}{n_1}$ ------- (2)

From (1) and (2), we have $\frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1} \Rightarrow \lambda_2 = \frac{\lambda_1 n_1}{n_2}$

5. Incident ray in one of the face (AB) of a prism and emergent ray from the face are given in figure. Complete the ray diagram. (AS5) (TQ)



1. From the figure; AB, AC are refracting surface and BC is reflecting surface.
2. Incident ray enters into prism (denser medium) from air (rarer medium) so it bends towards normal.
3. Emergent ray comes into (rarer medium) air from prism (denser medium)
4. So, it bends away from normal

<u>For mirror</u>:- **1.** angle of incidence(θ) = angle of reflection(θ).
2. N_1, N_2, N_3 are normal's i_1- angle of incidence, i_2- angle of emergence
3. r_1, r_2- angle of refraction -angle of incidence, reflection for the mirror.

6. How do you appreciate the role of molecules in the atmosphere for the blue colour of the sky? (AS6)(TQ)

1. The blue colour of the sky is due to scattering of light.
2. We know that our atmosphere contains different types of molecules and atoms.
3. The reason to blue sky is due to the molecules N2 and O2.
4. The sizes of these molecules are comparable to the wavelength of blue light.
5. These molecules act as a scattering centre for scattering of blue light.
6. So, we should appreciate the role of molecules N2 and O_2, which are scattering centre of blue colour.

7. Eye is the only organ to visualize the colourful world around as this is possible due to accommodation of eye lens. Prepare a six line stanza explaining your wonderful feelings?(AS6)(TQ)

Oh! Wonderful eyes,
Eyes are very helpful.
Which makes our world colourful.
Eyes make you beautiful.
If you take the eyes careful.
Our life is always Wonderful.
Finally we live peaceful.

8. Glass is known to be a transparent material. But ground glass is opaque and white in colour. Why? (AS7)(TQ)

1. Glass is general a transparent material because it transmits most of the light incident on it.
2. When glass is ground, its surface becomes rough due to microscopic unevenness.
3. When light is incident on such a rough surface, it is reflected in many different directions.
4. This type of reflection is known as diffuse reflection.
5. Due to this reason ground glass is opaque and white in colour.

9. A person is viewing an extended object. If a converging lens is placed in front of his eye, will he feel that the size of the object has increased? Why? (AS7)

1. The person feels that the size of the object has increased.
2. He used the converging lens, i.e, convex lens and the image is an extended object.
3. The image formed by convex lens depends on the position of the object.
4. Here the nature of the object is extended object.
5. If extended object is viewed through a conversing lens he feels that the size of the object has increased.
6. It acts like a magnifying glass (or) simple microscope.

10. What is the reason for appearance the white colour during noon hours?

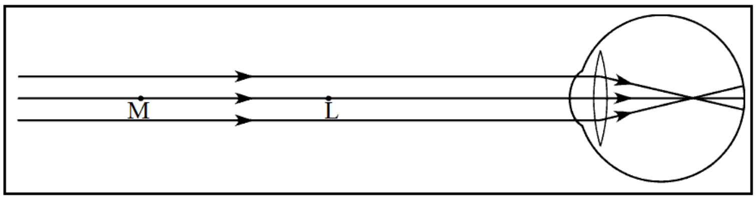
1. During noon hours, the distance to be travelled by the sun rays in the atmosphere is less than that compared to morning and evening hours.
2. Therefore all colours reach your eye without much scattering. Hence the Sun appears white during noon hours.

4 Mark Questions

1. How do you correct the eye defects myopia? (AS1) (TQ)

Myopia:- 1. Some people cannot see object at long distances but can see nearby objects clearly.
2. This type of vision defect is called myopia (near sightedness).

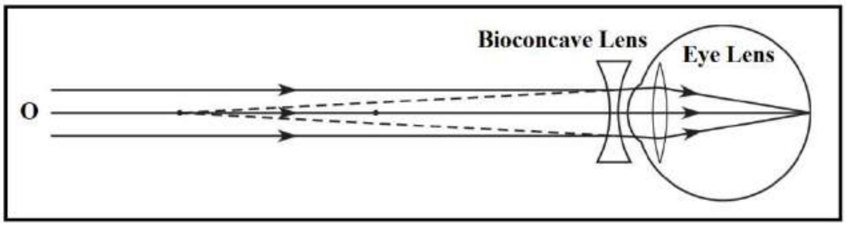
Cause of myopia:- 1. For the people of myopia, maximum focal length is less than 2.5 cm so that the rays coming from distant object after refraction through the eye lens form an image before the retina as shown in the figure.



2. The point of maximum distance at which the eye lens can form an image on the retina is called far point (M).
3. The eye lens can form clear image on the retina when an object is placed between far point (M) and point of least distance of distinct vision (L).

4. If we are able to bring the image of the object kept beyond far point, between far point and the point of least distance of distinct vision using a lens.
5. This image acts as an object for the eye lens. This can be possible only when a bi-concave lens is used.

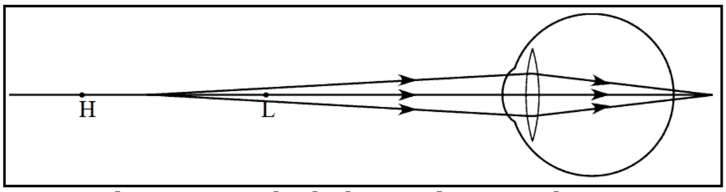
Correction of myopia:- 1. To correct one's myopia, we need to select a lens which forms an image at the far point for an object at infinity.
2. We need to select bi-concave lens to achieve this.



2. Explain the correction of the eye defect hypermetropia? (AS1) (TQ)

Hypermetropia:- 1. Some people can see the distant objects clearly but cannot see objects at near distances.
2. This type of vision defect is called hypermetropia (far sightedness).

Cause of hypermetropia:- 1. The minimum focal length of eye for the person of hypermetropia is greater than 2.27 cm.
2. In such cases the rays coming from a nearby object, after refraction at eye lens, forms an image beyond the retina as shown in figure.

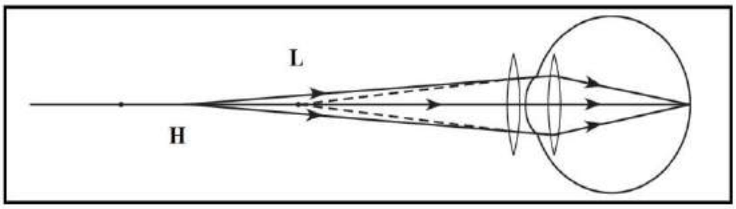


3. The point of minimum distance at which the eye lens can form an image on the retina is called near point.

4. The people with defect of hypermetropia cannot see objects placed between near point (H) and point of least distance of distinct vision (L).
5. Eye lens can form a clear image on the retina when any object is placed beyond near point.

Correction of hypermetropia:-1. To correct the vision defect hypermetropia, we need to use a lens which forms an image of an object beyond near point (H), when the object is between near point (H) and least distance of distinct vision (L).

2. This is possible only when a double convex lens is used.

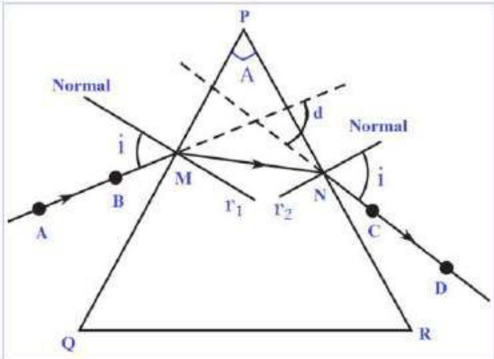


3. How do you find experimentally the refractive index of material of a prism (AS1)? (TQ)

Aim:- To find the refractive index of the prism.

Material required:- Prism, Piece of white chart, pencil, pens, scale and protractor.

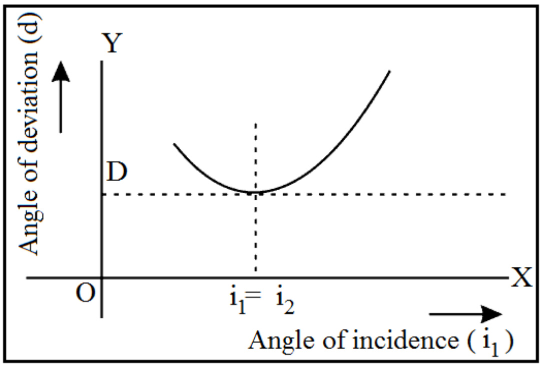
Procedure: -



1. Take a prism and place it on the white chart and draw the boundary lines by using a pencil.
2. Remove the prism and name the vertices as P, Q and R.
3. Calculate the angle of the prism ($A=60^0$) and noted in your book.
4. Draw a normal to PQ at M and draw a line with 30^0 to the normal.
5. This is incident ray AB. Fix two ball pins on this ray at A and B.
5. Place the prism in its exact position and fix another two pins at C and D such that all four pins appear to lie along the same line by seeing the images of pins through the prism from the other side PR.
6. Draw line joining C and D and extend it to meet PR at N this is emerging ray.
7. Draw normal at PR at N and measure the angle between normal at N and emergent ray.
8. If we extent the incident ray AB and emergent ray CD, they meet at O.
9. Measure angle between these two rays and note as angle of deviation (d).
10. The same experiment repeated for different angles of incidence and measure corresponding angle of deviation and noted down in the following table.

S.No	Angle of incidence (i_1)	Angle of emergence (i_2)	Angle of deviation (d)
1	30^0		
2	40^0		
3	50^0		
4	60^0		
5	70^0		

11. We draw a graph by taking angles of incident on X-axis and angles of deviation (d) on y-axis.
12. The graph is a curved line as shown in the figure. Find angle of minimum deviation (D).



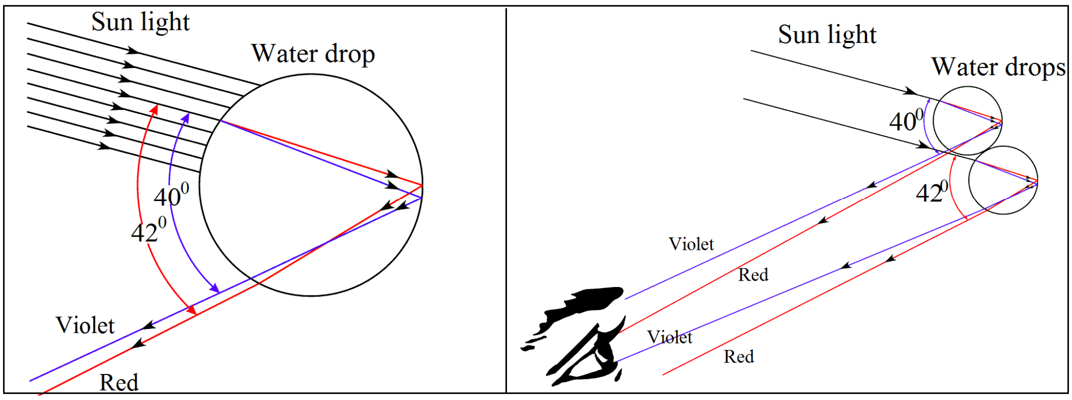
13. Now we can calculate the refractive index of the material of the prism by using the formula,

$$n = \frac{Sin(\frac{A+D}{2})}{Sin(\frac{A}{2})}$$

4. Explain the formation of rainbow? (AS1)(TQ)

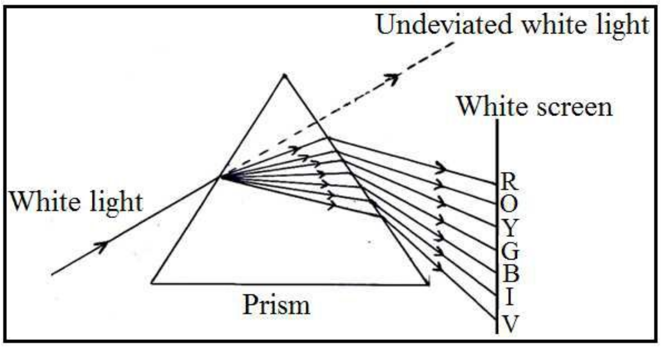
Formation of rainbow:- 1. The beautiful colours of the rainbow are due to dispersion of the sunlight by millions of tiny water droplets.

2. The rays of sunlight enter the drop near its top surface.
3. At this first refraction, the white light is dispersed into its spectrum of colours, violet being deviated the most and red the least.
4. Reaching the opposite side of the drop, each colour is reflected back into the drop because of total internal reflection.
5. At the second refraction the angle between red and violet rays further increases when compared to the angle between those at first refraction.
6. The angle between the incoming and outgoing rays can be anything between 0^0 and about 42^0.
7. We observe rain bow when the angle between incoming and outgoing rays is near the maximum angle of 42^0.
8. The colour red will be seen when the angle between a beam of sunlight and light sent back by a drop is 42^0.
9. The colour violet is seen when the angle between a sun beam and light sent back by a drop is 40^0.
10. If we look at an angle between 40^0 and 42^0 we can observe the remaining colours of VIBGYOR.

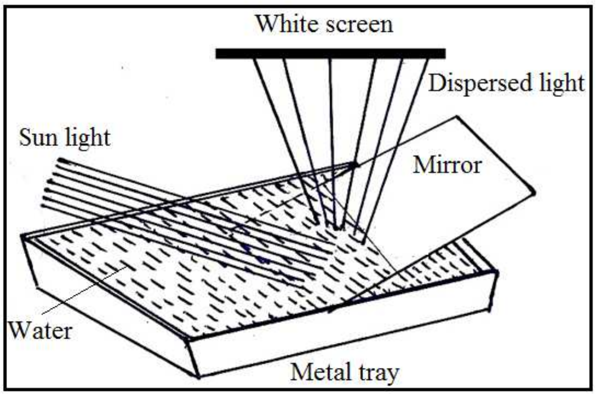


5. Explain Two activities for the formation of artificial rainbow? (AS1)(TQ)

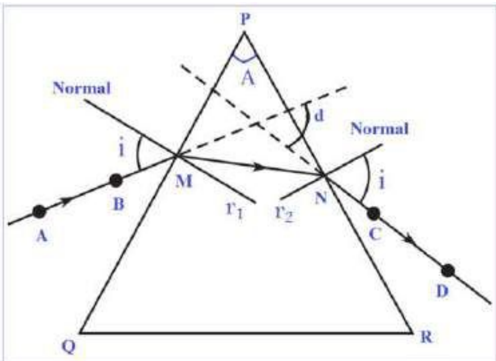
Activity-1: - 1. Take a prism and place it in between the light source and white wall.
2. Sent a light source such that the rays are falls on the prism through the narrow slit of a wooden plank.
3. Switch on the light. Adjust the height of the prism such that the light falls on one of the lateral surfaces.
4. We observed that the emergent light forms an artificial rainbow on the white wall.



Activity-2: - 1. Take a tray and fill it with water.
2. Place a mirror in the water such that it makes an angle to the water surface.
3. Now focus white light on the mirror through the water as shown in figure.
4. Try to obtain colour on a white card board sheet kept above the water surface.
5. We can observe the seven colours of VIBGYOR on the cardboard sheet.



6. Derive the refractive index of the material in the case of prism? (AS1) (TQ)



PQR –Glass triangular shaped prism
PQ, PR- refracting surfaces of prism
QR- Base of prism
A- Angle of prism
AB – incident ray
CD- emergent ray
MN- refracted ray
d- Angle of deviation.

1. Consider the following ray diagram, from triangle OMN, we get $d = (i_1 + i_2)-(r_1 + r_2)$ ----- (1)
2. From triangle PMN, $A = r_1 + r_2$----- (2)
3. From (1) and (2), we have $A+d = r_1 + r_2 + (i_1 + i_2)-(r_1 + r_2)$

$$= r_1 + r_2 + i_1 + i_2 - r_1 - r_2$$

$$A+d = i_1 + i_2 \text{----- (3)}$$

4. Using Snell's law at M, $n_1 = 1$, $I = i_1$, $n_2 = n$ and $r = r_1$ gives, $\text{Sin } i_1 = n \text{ Sin } r_1$----- (4)
5. At N with $n_1 = n$, $I = r_2$, $n_2 = 1$ and $r = i_2$ gives $n \text{ Sin } r_2 = \text{Sin } i_2$----- (5)
6. When $i_1 = i_2$, angle of deviation (d) becomes angle of minimum deviation (D).
7. Then equation (3) becomes $A+D = i_1+i_1 = 2i_1 \Rightarrow i_1 = \frac{(A+D)}{2}$
8. If $i_1 = i_2$, then $r_1 = r_2$. So from equation (2), we get $2r_1 = A$ (or) $r_1 = \frac{A}{2}$.
9. Substitute i_1 and r_1 in equation (4), we get $\text{Sin } (\frac{A+D}{2}) = n. \text{ Sin } (\frac{A}{2})$

$$\therefore n = \frac{\text{Sin } (\frac{A+D}{2})}{\text{Sin } (\frac{A}{2})}$$

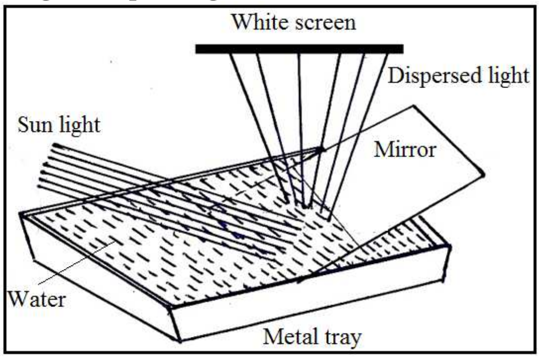
10. This is the refractive index of the prism.

7. Suggest an experiment to produce a rainbow in your classroom and explain the procedure?

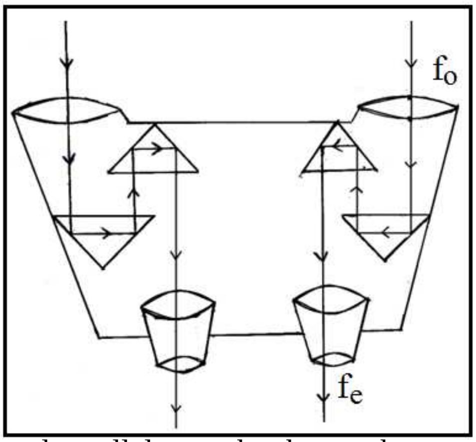
Aim:- To produce rainbow a classroom. **(AS3)(TQ)**

Apparatus:- Light source, mirror, plastic tray, water etc.

Procedure:- 1. Take a tray and fill it with water.
2. Place a mirror in the water such that it makes an angle to the water surface.
3. Now focus white light on the mirror through the water as shown in figure.
4. Try to obtain colour on a white card board sheet kept above the water surface.
5. We observe that a white ray of light splits into certain different colours called VIBGYOR.
6. We know that the white light is splitting into certain different colour as rainbow.



8. Prism used in binoculars. Collects information why prisms are used in binoculars? (AS4) (TQ)



1. If two telescopes are mounted parallel to each other so that an object can be seen by both the eyes simultaneously the arrangement is called binocular.
2. The length of each tube is reduced by using a set of totally reflecting prisms.

3. They provide intense, erect image free from lateral inversion.

f_0-focal length of objective lens.

f_e- focal length eyepiece.

4. Through a binocular we get two images of the same object from different angles at same time.
5. Their super position gives the perception of depth also with length and breadth.
6. Binocular vision gives proper 3D image.
7. By using total reflecting prisms there is no loss of intensity.

9. How do you appreciate the working of ciliary muscle in the eye? (AS6) (TQ)

1. The Ciliary muscle is helpful to change its focal length by changing radii of curvature of eye lens.
2. When the eye is focused on a distant object, the ciliary muscles are relaxed so that the focal length of eye lens has its maximum value.
3. So, we see the distant object clearly.
3. When the eye is focused on a closer object the ciliary muscles are strained and focal length of eye-lens decreases.
4. Hence we see the closer objects clearly.
5. This process of adjusting focal length is called "accommodation".
6. Due to this accommodation ability of the ciliary muscles we see the objects clearly.
7. Hence the role of ciliary muscles is highly appreciable.

10. Why does the sky sometimes appear white? (AS7)(TQ)

1. Our atmosphere contains atoms and molecules of different sizes.
2. According to their sizes, they are able to scatter different wavelengths of light.
3. For example, the size of the water molecule is greater than the size of the N_2 or O_2.
4. It acts as a scattering centre for other frequencies which are lower than the frequency of blue light.
5. On a hot day, due to rise in the temperature, water vapour enters into atmosphere which leads to abundant presence of water molecules in the atmosphere.
6. These water molecules scatter the colours of other frequencies other than blue.
7. All such colours of other frequencies reach your eye and the sky appears white.

11. Why the reasons for appearance the red colour of sun during sunrise and at sunset?

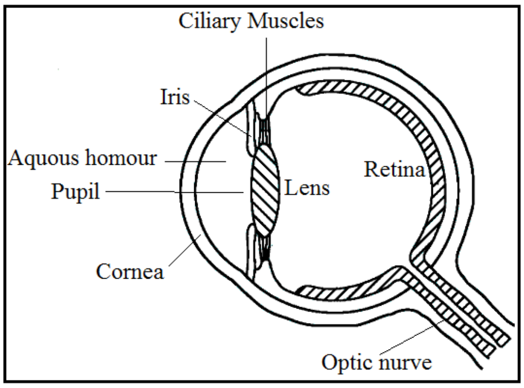
1. The atmosphere contains free molecules and atoms with different sizes.
2. These molecules and atoms scatter light of different wavelengths which are comparable to their size.
3. Molecules having a size that is comparable to the wavelength of red light are less in the atmosphere.
4. Hence scattering of red light is less when compared to the other colours of light.
5. The light from the sun needs to travel more distance in atmosphere during sunrise and sunset to reach our eye.
6. In morning and evening times, during sunrise and sunset except red light all colours scatter more and vanish before they reach us.
7. Since scattering of red light is very small, it reaches 4s. As a result sun appears red in colour during sunrise and sun set.

12. How do you demonstrate the scattering of light with an activity?

1. Take a solution of sodium-thio-sulphate (hypo) and sulphuric acid in a glass beaker.
2. Place the beaker in the presence of sunlight. We noticed that sulphur precipitates are starts to form.
3. At the beginning, the grains of sulphur appear blue in colour at the beginning and slowly their colour becomes white as their size increases.
4. At the beginning, the size of grains is small and almost comparable to the wave length of blue light.
5. Hence they appear blue in the beginning.

6. As the size of grains increases, their size becomes comparable to wave lengths of other colours.
7. As a result of this, they act as scattering centres for other colours.
8. The combination of all these colours appears as white.

13. Explain the structure of Human eye?



Structure of Human Eye:- 1. The human eye is one of the most important sense organs. It enables us to see the object and colours around us.
2. The eye ball is nearly spherical in shape.
3. The front portion is more sharply curved and is covered by a transparent protective membrane called the 'cornea'.
4. Behind the cornea, there is place filled with a liquid called aqueous humour.
5. Behind the aqueous humour a crystalline lens which is responsible for the image formation.
6. Between the aqueous humour and the lens, we have a muscular diaphragm called 'iris'.
7. Iris has a small hole in it called pupil. Iris is the coloured part that we see in an eye.
8. The pupil appears black because any light falling on it goes into the eye and there is almost no chance of light coming back to the outside.
9. Iris helps in controlling the amount of light entering the eye through 'pupil'.
10. The light that enters the eye forms an image on the retina.
11. The distance between the lens and retina is about 2.5 cm.

Problems

1. A light ray falls on one of the faces of prism at an angle 40^0 so that it suffers angle of minimum deviation of 30^0. Find the angle of prism and angle of refraction at the given surface? (AS7) (TQ)

Given:- Angle of incident $i_1 = 40^0$
Angle of minimum deviation, $D = 30^0$

We know $A+D = 2i \Rightarrow A= 2i-D= 2x40^0-30^0 =80^0-30^0 = 50^0 \Rightarrow A = 50^0$

Angle of refraction $= \frac{A}{2} = \frac{50}{2} = 25^0$

2. The focal length of a lens suggested to a person with Hypermetropia is 100cm. Find the distance of near point and power of the lens? (AS7) (TQ)

Given:- The focal length of the lens, f= 100cm
Image distance (V) = Distance of near point = -d
Object distance, u = -25 cm

Lens formula, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{100} = \frac{1}{d} - \frac{1}{(-25)} \Rightarrow \frac{1}{d} = \frac{1}{25} - \frac{1}{100} \Rightarrow \frac{1}{d} = \frac{4-1}{100} \Rightarrow \frac{1}{d} = \frac{3}{100} \Rightarrow d = \frac{100}{3}$ =33.33cm.

Power of lens, p= $\frac{100}{f}$ = $\frac{100}{100}$ =1 Diopter.

3. Doctor advised to use 2D lens. What is its focal length?

Given:- Power of the lens P = 2D.

Formula:- $P = \frac{100}{f\ (Cm)} \Rightarrow f = \frac{100}{p} \Rightarrow\ f = \frac{100}{2} = 50cm.$

∴ The focal length of the lens is 50cm.

4. A prism with an angle A = 60^0 produces an angle of minimum deviation of 30^0. Find the refractive index of material of the prism?

Given:- Angle of prism A = 60^0
Angle of minimum deviation D = 30^0
Refractive index of the material of the prism = ?

Formula:- Refractive index, $n= \frac{\text{Sin}\left(\frac{A+D}{2}\right)}{\text{Sin}\left(\frac{A}{2}\right)} = \frac{\text{Sin}\left(\frac{60^0+30^0}{2}\right)}{\text{Sin}\left(\frac{60^0}{2}\right)} = \frac{\text{Sin}\left(\frac{90^0}{2}\right)}{\text{Sin}\left(\frac{60^0}{2}\right)} = \frac{Sin\ 45^0}{Sin\ 30^0} = \frac{\frac{1}{\sqrt{2}}}{\frac{1}{2}} = \sqrt{2} = 1.414$

∴ Refractive index of the material of the prism is 1.414

5. A person is unable to see the objects nearer than 50 cm. He wants to read a book placed at distance of 25 cm.

i) Name the defect of the vision he is suffering from

ii) How can it be corrected?

iii) What is the power of such lens?

i) Since the person is not able to see the objects nearer than 50 cm.

ii) This defect of vision 'hypermetropia' can be corrected by using 'bi–convex lens'.

iii) Given that distance of near point d = 50 cm

If f be the focal length of the bi convex lens we have, $f = \frac{25\ d}{d-25} = \frac{25 \times 50}{50-25} = \frac{25 \times 50}{25} = 50$ cm

Now power of lens $p = \frac{100}{f(in\ cm)} = \frac{100}{50} = 2D$

By using convex lens of power 2D, we can correct given defect of vision.

6. A person cannot see objects beyond a distance of 2 m. Then find

i) What type of eye defect he has ?

ii) What kind of lens he has to use to overcome his eye defect?

iii) What is focal length of the lens?

iv) What is power of the lens he has to use?

i) Since the person is not able to see the objects beyond 2m, he is suffering from 'Myopia' or short sightedness.

ii) This defect of vision – myopia can be corrected by using 'bi–concave lens'.

iii) Given that distance of far point D = 2m

We know that focal length of lens using to correct myopia is f = –D
Where D is distance of far point.

∴Focal length of f = – 2m = – 200 cm

iv) Now power of lens $p = \frac{100}{f(in\ cm)} = \frac{100}{-200} = \frac{-1}{2} = -0.5$ Dioptre.

Here – sign indicates that it is a concave lens.