# SCIENCE & TECHNOLOGY (PART 1)

## SOLUTION : PRACTICE ACTIVITY SHEET 4

**Q. 1. (A)**

(i) (B)

(ii) (C)

(iii) (D)

(iv) (A)

(v) (D)

**Q. 1. (B)**

(i) magnet

(ii) 540 cal/g

(iii) False

(iv) Hypermetropia or Farsightedness

(v) Father of Indian Space Programme – Vikram Sarabhai

**Q. 2. (A)**

**(i)** (1) While writing a chemical equation, gaseous, liquid and solid states are symbolised as (*g*), (*l*) and (*s*) respectively.

(2) This is done to make it more informative and to emphasise that those reactions occur in that manner only under those conditions. Hence, physical states of reactants and products are mentioned while writing a chemical equation.

**(ii)** (1) When a pencil is partly immersed in water and held in a slanting position, the rays of light coming from the immersed part of the pencil emerge from water (a denser medium) and enter air (a rarer medium). During this propagation, they bend away from the normal on refraction.

(2) As a result, the immersed part of the pencil does not appear straight with respect to the part outside the water, but appears to be raised. Hence, a pencil dipped obliquely in water appears bent at the surface of the water.

**(iii)** (1) When we try to see a nearby object, the eye lens becomes more rounded and its focal length decreases. Then a clear image of the object is formed on the retina of the eye.

(2) The focal length of the eye lens cannot be decreased beyond some limit. Therefore we cannot clearly see an object kept at a distance less than 25 cm from the eye.

**Q. 2. (B)**

**(i)** Data : $s = 1960$ m, $a = g = 9.8$ m/s$^2$, $u = 0$ m/s.

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

$\therefore\ 1960 = 0 \times t + \frac{1}{2} \times 9.8 \times t^2$

$1960 = 4.9t^2$

$\therefore\ t^2 = \frac{1960}{4.9} = \frac{19600}{49} = 400$

$\therefore\ t = \sqrt{400} = 20$

$\therefore\ t = 20\ s.$

This is the required time.

**(ii)**

| Alternating current | Direct current |
|---|---|
| 1. Alternating current flows in periodic manner. In one half cycle it flows in one direction, and in the other half cycle, it flows in the opposite direction. | 1. Direct current flows in one direction only. |
| 2. It can be transmitted over a long distance. | 2. It cannot be transmitted over a long distance. |

**(iii)**

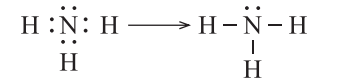
| Point | Answer |
|---|---|
| (a) Position of the object | **Between $F_1$ and O** |
| (b) Position of the image | **On the same side of the lens as the object** |
| (c) Size of the image | **Very large** |
| (d) Nature of the image | **Virtual and erect** |

**(iv)** When a piece of sodium metal is dropped in ethanoic acid, sodium acetate is formed and hydrogen gas is liberated.

$2CH_3COOH + 2Na \longrightarrow 2CH_3COONa + H_2 \uparrow$

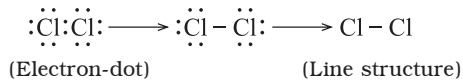
Ethanoic acid — Sodium acetate

**(v)** (a) Ammonia molecule : ($NH_3$)



(Electron-dot) (Line structure)

(b) Chlorine molecule : ($Cl_2$)



(Electron-dot) (Line structure)

**Q. 3.**

**(i)** (a) Chemical formula of rust : $Fe_2O_3.H_2O$.

(b) Reaction at anode : $Fe_{(s)} \longrightarrow Fe^{2+}_{(aq)} + 2e^-$

(c) Reaction at cathode : $O_{2(g)} + 4H^+_{(aq)} + 4e^- \longrightarrow 2H_2O_{(l)}$

**(ii)** Successful space missions as well as scientific and technological accomplishments by India in space technology have made a significant contribution in the national and social development of our country.

(1) India has indigenously built various launchers and these launchers can put the satellites having the mass up to 2500 kg in orbit.

Indian Space Research Organisation (ISRO) has designed and built two important launchers : Polar Satellite Launch Vehicle (PSLV) and Geosynchronous Satellite Launch Vehicle (GSLV).

(2) Many satellites in INSAT and GSAT series are active in telecommunication, television broadcasting, meteorological services, disaster management and in monitoring and management of natural resources.

EDUSAT is used specifically for education while satellites in IRNSS series are used for navigation.

Thumba, Sriharikota and Chandipur are Indian satellite launch centres.

(3) Vikram Sarabhai Space Centre at Thiruvananthapuram, Satish Dhawan Space Research Centre at Sriharikota and Space Application Centre at Ahmedabad are space research organisations of India.

**(iii)** The value of the acceleration due to gravity, $g$, changes from place to place on the earth. It also varies with the altitude and depth below the earth's surface. The factors affecting the value of $g$ are the shape of the earth, altitude and depth below the earth's surface.

(1) The earth is not perfectly spherical. It is somewhat flat at the poles and bulging at the equator. At the surface of the earth, the value of $g$ is maximum ($9.832\ m/s^2$) at the poles as the polar radius is minimum, while it is minimum ($9.78\ m/s^2$) at the equator as the equatorial radius is maximum.

(2) As the height ($h$) above the earth's surface increases, the value of $g$ decreases. It varies as $\frac{1}{(R+h)^2}$, where $R$ is radius of the earth.

(3) In the interior of the earth, on the average, the value of $g$ is less than that at the earth's surface. As the depth below the earth's surface increases, the value of $g$ decreases and finally it becomes zero at the centre of the earth.

**(iv)** (a) Newlands' law of octaves :

When the elements are arranged in an increasing order of their atomic masses, the properties of the eighth element are similar to those of the first.

It is found that Na is the eighth element from Li and both of them have similar properties.

(b) Limitations of Newlands' law of octaves :

(1) Newlands' law of octaves i.e. applicable to only the first few elements i.e. only up to calcium out of total 56 elements known at that time.

(2) Newlands placed two elements each in some boxes to accommodate all known elements e.g. Co and Ni, Ce and La. He placed some elements with different properties under the same note in the octave. For example, Co and Ni under the note Do along with halogens, while Fe having similarity with Co and Ni away from them along with the nonmetals O and S under the note Ti.

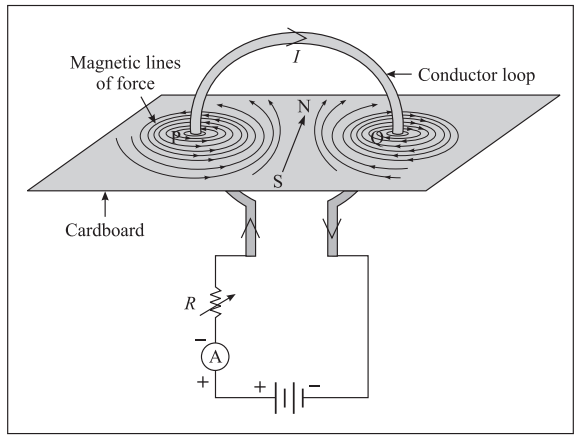
(3) Newlands' octaves did not have provision to accommodate the newly discovered elements.

**(v)** (a) Atomic number of element is 20

(b) The group of this element is 2

(c) This element belongs to period 3

**(vi)** (a) The pattern of magnetic lines of force due to a current through a circular loop is shown in the following figure :




**Magnetic field produced by a current through a loop of conducting wire**

(*I* : Current, *R* : Resistance, *A* : Ammeter)

(b) (1) It is seen that every point of the loop forms a centre of a large number of concentric magnetic lines of force forming a series. The circles are small near the wire and become large as we move away from the wire. At the centre of the loop, the arcs of these circles appear as straight lines because of very large radius of the circle.

(2) The magnetic field produced by a current-carrying wire at a given point is directly proportional to the current through the wire. If the loop has *n* turns, the field produced is *n* times that produced by a single turn (assuming that all the turns have practically the same radius and are in the same plane). The reason is the current in each turn has the same direction and the field due to each turn contributes equally to the total field.

**(vii)** Data : $m_1 = 100$ g, $c_1 = 0.1$ cal/g·°C, $T_1 = 100$ °C, $m_2 = 195$ g, $c_2 = 1$ cal/g·°C, $T_2 = 20$ °C, $m_3 = 50$ g, $c_3 = 0.1$ cal/g·°C, $T_3 = 20$ °C, $T = ?$

Heat lost by the copper sphere,

$Q_1 = m_1 c_1 (T_1 - T) = 100 \times 0.1 \times (100 - T)$

Heat absorbed by the water,

$Q_2 = m_2 c_2 (T - T_2) = 195 \times 1 \times (T - 20)$

Heat absorbed by the calorimeter,

$Q_3 = m_3 c_3 (T - T_3) = 50 \times 0.1 \times (T - 20)$

Now, $Q_1 = Q_2 + Q_3$

$\therefore 1000 - 10\ T = 195\ T - 195 \times 20 + 5T - 100$

$\therefore 210\ T = 1000 + 3900 + 100 = 5000$

$\therefore T = \frac{5000}{210} = \frac{500}{21}$

$= 23.8$ °C

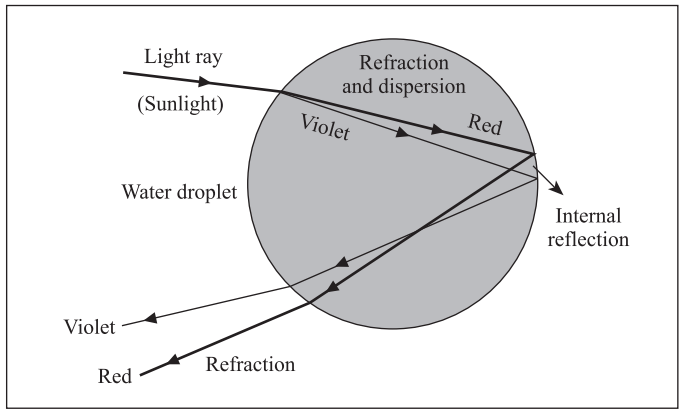
This is the maximum temperature of Water.

**(viii)** The compound acquire specific chemical properties due to these hetero atoms or the groups of atoms that contain hetero atoms, irrespective of length and nature of the carbon chain in that compound. Therefore these hetero atoms or groups of atoms containing hetero atoms are called the functional groups.

| Functional group | Compound | Formula |
|---|---|---|
| – **OH** | Ethyl alcohol | **$C_2H_5OH$** |
| – **CHO** | Acetaldehyde | **$CH_3CHO$** |

**Q. 4.**

**(i)** (1) The formation of a rainbow in the sky is a combined result of refraction, dispersion, internal reflection and again refraction of sunlight by water droplets present in the atmosphere after it has rained.




**Formation of a rainbow (Schematic diagram)**

**Here, for simplicity only violet and red colours are shown.**

**The remaining five colours lie between these two.**

(2) The sunlight is a mixture of seven colours : violet, indigo, blue, green, yellow, orange and red. After it has stopped raining, the atmosphere contains a large number of water droplets. When sunlight is incident on a water droplet, there is (i) refraction and dispersion of light as it passes from air to water (ii) internal reflection of light inside the droplet and (iii) refraction of light as it passes from water to air.

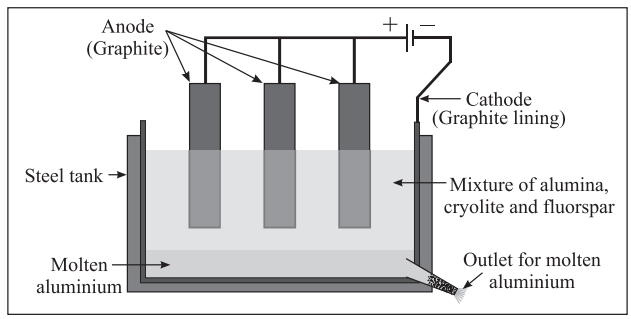
(3) The refractive index of water is different for different colours, being maximum for violet and minimum for red. Hence, there is dispersion of light (separation into different colours) as it passes from air to water. [See Figure for reference.]

(4) The combined action of different water droplets, acting like tiny prisms, is to produce a rainbow with red colour at the outer side and violet colour at the inner side. The remaining five colours lie between these two.

The rainbow is seen when the sun is behind the observer and water droplets in the front.

**(ii) Electrolytic reduction of alumina :**

(1) The electrolytic cell consists of a rectangular steel tank lined from inside with graphite.




(2) The carbon lining (graphite) acts as a cathode. The anode consists of graphite rods suspended in the molten electrolyte.

(3) Alumina has very high melting point ( > 2000 °C). The electrolysis of alumina is carried out at a low temperature by dissolving it in molten cryolite ($Na_3AlF_6$). The solution of alumina in cryolite and small amount of fluorspar ($CaF_2$) is added in the mixture to lower its melting point up to 1000 °C.

(4) On passing an electric current, alumina is electrolysed.

(5) Molten aluminium is collected at the cathode, while oxygen gas is evolved at the anode.

The electrode reactions are shown below :

$Al_2O_3 \rightarrow 2Al^{3+} + 3O^{2-}$

Anode reaction : $2O^{2-} \longrightarrow O_{2(g)} + 4e^-$

Cathode reaction : $Al^{3+} + 3e^- \longrightarrow Al$

The molten aluminium is heavier than the electrolyte. Therefore, it sinks to the bottom of the electrolyte and is removed from time to time. About 99% pure aluminium is obtained by this process.

The oxygen gas liberated reacts with carbon anode and forms carbon dioxide. As the anode gets oxidized during the electrolysis of alumina, it has to be replaced from time to time.