

# MT

2018 \_\_\_\_ 1100

MT - SCIENCE & TECHNOLOGY -I (72) - SEMI PRELIM - I : PAPER - 4

**Time : 2 Hours**

**(Model Answer Paper)**

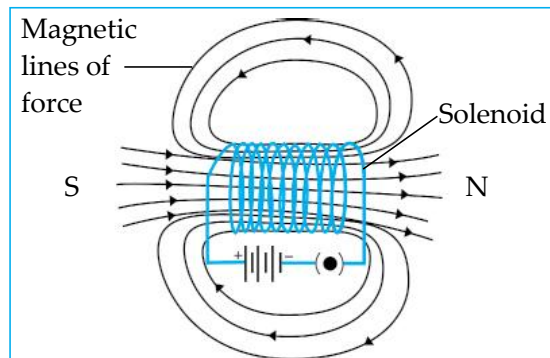
**Max. Marks : 40**

<b>A.1. (A) Solve the following questions :</b>	
(1) If height of orbit of a satellite from earth's surface is increased, the tangential velocity of the satellite will <b>decrease</b> .	<b>1</b>
(2) Antimony: It is a metalloid and rest are alloys.	<b>1</b>
(3) <b>False</b> - The escape velocity is responsible to launch a rocket in space which can overcome the earth's gravitational force. Hence, its velocity should be more than the escape velocity.	<b>1</b>
(4) <b>False</b> : Covalent compound have low melting and boiling points	<b>1</b>
(5) The specific heat capacity of a substance is measured using principle of heat exchange. It states that, Heat lost by hot object = Heat gained by cold object.	<b>1</b>
<b>A.1. (B) Choose the correct alternative and rewrite the sentences :</b>	
(1) <b>Manganese and Magnesium</b> react with dil.HNO <sub>3</sub> to evolve hydrogen gas.	<b>1</b>
(2) The magnetic lines of force are in concentric circles with the wire as the centre, in a plane perpendicular to the conductor.	<b>1</b>
(3) If the potential difference across a wire is 2 V and the current through the wire is 1 A, the electric power <b>2 W</b> .	<b>1</b>
(4) Gas evolved during fermentation <b>CO<sub>2</sub></b> .	<b>1</b>
(5) Ice is a substance which <b>contracts on heating</b> .	<b>1</b>

<b>Q.2. Solve the following questions : (Any 5)</b>		
(1)	(i) Sodium is a highly reactive metal. (ii) It reacts with the water vapour present in air to form sodium hydroxide and hydrogen. (iii) Hydrogen released catches fire in presence of oxygen due to liberation of heat during this reaction. (iv) Sodium does not react with Kerosene and it sinks in it. (v) Thus to prevent sodium from coming in contact with air it is immersed in kerosene.	<b>2</b>
(2)	We can increase the strength of magnetic field by two ways: (i) Increase the magnitude of current in the circuit (ii) Increase the number of turns of the coil.	<b>2</b>
(3)	<b>2 - Chlorobutane : Molecular formula C<sub>4</sub>H<sub>9</sub>Cl</b> Structural formula : $  \begin{array}{ccccccc}  & \text{H} & \text{H} & \text{Cl} & \text{H} & & \\  &   &   &   &   & & \\  \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{H} & \\  &   &   &   &   & & \\  & \text{H} & \text{H} & \text{H} & \text{H} & &   \end{array}  $	<b>2</b>
(4)	(i) During change of state of a substance, object absorbs or rejects heat energy. (ii) But the temperature does not change. (iii) The heat energy is utilized for weakening the bonds between the atoms or molecules in the substance. (iv) Hence, this energy which causes a change in state and does not change the temperature is called Latent heat.	<b>2</b>
(5)	<b>Extraction of copper from its sulphide ore.</b> $  \begin{array}{ccccccc}  2\text{Cu}_2\text{S} & + & 3\text{O}_2 & \rightarrow & 2\text{Cu}_2\text{O} & + & 2\text{SO}_2\uparrow \\  \text{Copper} & & \text{Oxygen} & & \text{Copper} & & \text{Sulphur} \\  \text{sulphide} & & & & \text{oxide} & & \text{dioxide}  \end{array}  $ $  \begin{array}{ccccccc}  2\text{Cu}_2\text{O} & + & \text{Cu}_2\text{S} & \rightarrow & 6\text{Cu} & + & \text{SO}_2\uparrow \\  \text{Copper} & & \text{Copper} & & \text{Copper} & & \text{Sulphur} \\  \text{oxide} & & \text{sulphide} & & & & \text{dioxide}  \end{array}  $	<b>2</b>

(6)	<b>Covalent compounds and Ionic compounds :</b>	<b>2</b>												
<table border="1"> <thead> <tr> <th data-bbox="312 421 791 465"><b>Covalent compounds</b></th> <th data-bbox="794 421 1299 465"><b>Ionic compounds</b></th> </tr> </thead> <tbody> <tr> <td data-bbox="312 470 791 586">(i) These compounds are formed due to sharing of electrons.</td> <td data-bbox="794 470 1299 586">(i) These compounds are formed due to transfer of electrons.</td> </tr> <tr> <td data-bbox="312 591 791 685">(ii) They exist as solid, liquid and gases.</td> <td data-bbox="794 591 1299 685">(ii) They exist as solids.</td> </tr> <tr> <td data-bbox="312 689 791 801">(iii) Covalent compounds have low melting and boiling points.</td> <td data-bbox="794 689 1299 801">(iii) Ionic compounds have high melting and boiling points.</td> </tr> <tr> <td data-bbox="312 806 791 900">(iv) They are generally insoluble in water.</td> <td data-bbox="794 806 1299 900">(iv) They are mostly soluble in water.</td> </tr> <tr> <td data-bbox="312 904 791 1016">(v) They do not conduct electricity in molten or in aqueous solution.</td> <td data-bbox="794 904 1299 1016">(v) They conduct electricity in molten state and in aqueous solution.</td> </tr> </tbody> </table>			<b>Covalent compounds</b>	<b>Ionic compounds</b>	(i) These compounds are formed due to sharing of electrons.	(i) These compounds are formed due to transfer of electrons.	(ii) They exist as solid, liquid and gases.	(ii) They exist as solids.	(iii) Covalent compounds have low melting and boiling points.	(iii) Ionic compounds have high melting and boiling points.	(iv) They are generally insoluble in water.	(iv) They are mostly soluble in water.	(v) They do not conduct electricity in molten or in aqueous solution.	(v) They conduct electricity in molten state and in aqueous solution.
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(7)	Fleming's Right Hand Rule : Stretch the thumb, the index finger and the middle finger in such a way that they will be perpendicular to each other. In this position, the thumb indicates the direction of motion of the conductor, the index finger the direction of the magnetic field, and the middle finger shows the direction of the induced current.	<b>2</b>												
<b>Q.3. Solve the following questions : (Any 5)</b>														
(1)	<p>(a) <b>Solenoid :</b></p> <p>(i) When a copper wire with a resistive coating is wound in a chain of loops (like a spring) it is called solenoid.</p> <p>(ii) When an electric current is passed through a solenoid, magnetic field is produced in it.</p> <p>(iii) The magnetic lines of force are similar to that of the lines of a bar magnet.</p> <p>(iv) Solenoid has all properties of the field produced by a bar magnet.</p> <p>(v) One end of the coil acts as a south pole, while the other end as north pole.</p>	<b>3</b>												

(b)



Magnetic lines of force of a magnetic field produced by a current passing through a solenoid coil.

**Various components are:**

- (a) Copper wire with Resistive coating,
- (b) Battery
- (c) Plug key

(2) **Given:**  $h = 35780 \text{ km}$

$$V = 3.08 \text{ km/s}$$

$$M = 4 \text{ M}$$

$$R = 6400 \text{ km}$$

**To find:**  $T = ?$

**Formula :**  $V = \sqrt{\frac{GM}{R+h}}, V = \frac{2\pi r}{T}$

**Solution:**  $V = \sqrt{\frac{GM}{R+h}} \dots(i)$

$$V_n = \sqrt{\frac{GM_n}{R+h}} \sqrt{\frac{GM_n}{R+h}}$$

$$V_n = \sqrt{\frac{G \times 4M}{R+h}}$$

$$V_n = \sqrt{4 \times \frac{GM}{R+h}}$$

$$V_n = 2 \times \sqrt{\frac{GM}{R+h}}$$

$$V_n = 2V \quad \text{[from (i)]}$$

Also,  $V_n = \frac{2\pi r}{T_n}$

3

$$T_n = \frac{2\pi r}{V_n}$$

$$T_n = \frac{2\pi r}{2V}$$

$$T_n = \frac{3.14}{3.08} \times (35780 + 6400)$$

$$T_n = \frac{3.1}{3.1} \times 42180$$

$$T_n = 42180 \text{ s}$$

**Note: 3.14  $\approx$  3.1**

**3.08  $\approx$  3.1**

$$\text{or } T_n = \frac{42180}{3600} = 11.71 \text{ hrs} \sim 12 \text{ hrs}$$

**$\therefore$  This taken would be  $\sim$  12 hrs.**

- (3) (a) AB  
 (b) BC  
 (c) The heat energy absorbed at constant temperature during transformation of liquid into gas is called Latent heat of vapourization.

3

- (4) (a)  $\text{CH}_3\text{-CH}_2\text{-COOH} + \text{NaOH} \rightarrow \text{CH}_3\text{-CH}_2\text{-COONa} + \text{H}_2\text{O}$   
Neutralization

1

- (b)  $2\text{Na} + 2\text{CH}_3\text{-CH}_2\text{-OH} \rightarrow 2\text{CH}_3\text{-CH}_2\text{-ONa} + \text{H}_2$   
 All the alcohols react with sodium metal to liberate hydrogen gas and form sodium alkoxide salts. In the reaction of ethanol with sodium metal, hydrogen gas and sodium ethoxide are formed as products.

2

(5) **Given:**

	$Q_A$ Water/Ice	$Q_B$ Ammonia
(m)	2kg	$m_1$
(c)	1 kcal/kg $^\circ\text{C}$	-
$t_1$	20 $^\circ\text{C}$	-
$t_2$	0 $^\circ\text{C}$	-
L	80 kcal/kg	341 kcal/g

3

**To find:**  $m_1 = ?$

**Formulae:**  $Q_A = Q_B$

$Q = mc\Delta T, Q = mL$

**Solution:**

**(1) Water**

$mc\Delta T$   $mL$

Water (20°C)  $\longrightarrow$  Water (0°C)  $\rightarrow$  Ice (0°C)

$$Q_A = mc\Delta T + mL \dots\dots\dots (1)$$

**(2) Ammonia**

$$Q_B = m_1 L_1 \dots\dots\dots (2)$$

**from (1) and (2)**

$$Q_A = Q_B$$

$$mc\Delta T + mL = m_1 L_1$$

$$2 \times 1 \times (20 - 0) + (2 \times 80) = m_1 \times 341$$

$$40 + 160 = m_1 \times 341$$

$$200 = m_1 \times 341$$

$$200$$

$$m_1 = \frac{200}{341}$$

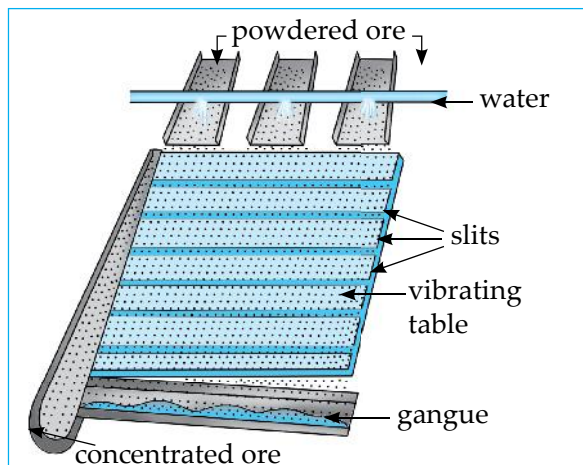
$$m_1 = 0.5865 \text{ kg}$$

or

$$m_1 = 586.5 \text{ g}$$

**Hence, 586.5g of ammonia has to be evaporated.**

(6) (a)



Wilfley table method

2

(b) **Gangue** : Ores contain metal compounds with some of the impurities like soil, sand, rocky substances etc. These impurities are called gangue.

1

(7) A macromolecule formed at regular repetition of a small unit is called polymer. Most of the structure of living things are composed of natural polymers.

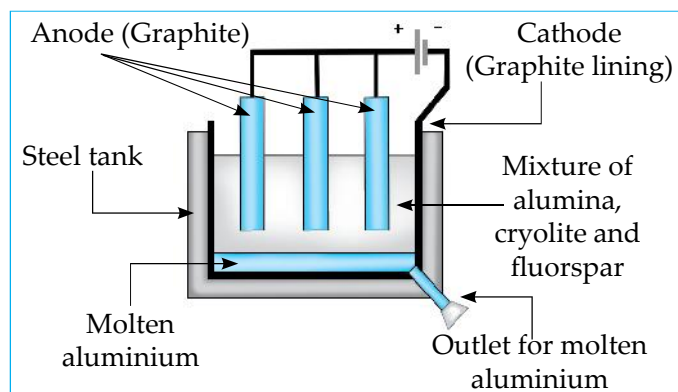
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Polymer	Name of the monomer	Occurrence
Polysaccharide	Glucose	Starch and Cellulose
Proteins	Alpha amino acids	Muscles, hair, enzyme, skin egg.
DNA	Nucleotide (base-deoxy ribose phosphate)	Chromosomes of animals

**Q.4. Solve the following questions : (Any 1)**

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

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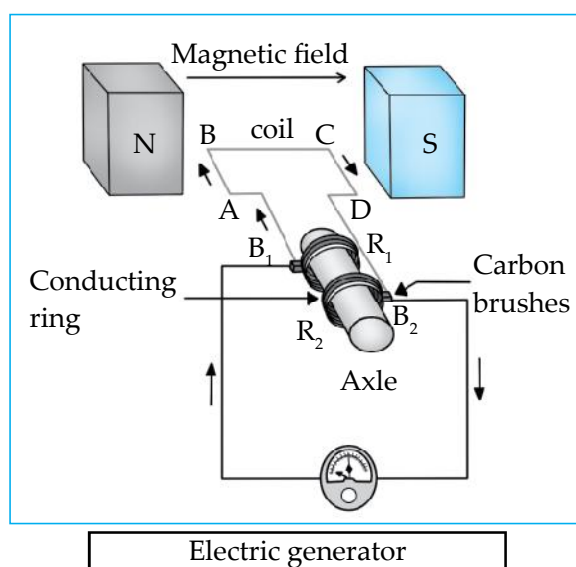
- During the process of electrolytic reduction of aluminium, a molten mixture of pure alumina (m.p. is  $> 2000^{\circ}\text{C}$ ) is electrolysed in a steel tank.
- This tank is lined inside with carbon which acts as cathode and a set of graphite rods dipped in the molten electrolyte acts as anode.
- Cryolite ( $\text{Na}_3\text{AlF}_6$ ) and Fluorspar ( $\text{CaF}_2$ ) are also added to the mixture to lower the melting point to about  $1000^{\circ}\text{C}$ . Current is

passed through the electrolyte and aluminium is formed at the cathode.

- (iv) The molten aluminium sinks to the bottom of the tank as it is heavier from there it is removed periodically.
- (v) Oxygen is liberated at the anode.
- (vi) The reaction occurring at the cathode and anode are:  
Cathode reaction:  $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}(\text{l})$  (Reduction)  
Anode reaction:  $2\text{O}^{2-} + 4\text{e}^- \rightarrow \text{O}_2 + 4\text{e}^-$  (Oxidation)
- (vii) The oxygen liberated reacts with the carbon anode to form carbon dioxide gas.
- (viii) As a result of this oxidation, carbon anode have to be replaced at intervals.

(2) (a) **AC Generator :**

5



(b) **Principle of working:**

- (i) Electric generators work on the principle of electromagnetic induction.

(c) **Working:**

- (i) When the armature coil ABCD is rotated by an external force in the magnetic field provided by strong magnets, it cuts the magnetic lines of force. Thus, the changing magnetic field produces induced current in the coil.
- (ii) After rotation of axle, arm AB moves upwards, while arm CD moves downwards. Therefore, ABCD rotates in the clockwise direction. As per Fleming's right hand



rule, the current is induced in the coil and moves from  $A \longrightarrow B$  and  $C \longrightarrow D$ . Current flows in the direction ABCD.

- (iii) Current flows from  $B_2$  to  $B_1$  in the first half of the revolution in the external circuit.
- (iv) After half revolution, arm AB comes to the position of arm CD and arm CD takes the position of arm AB. Due to this, the induced current flows in the direction DCBA. But, arm AB is in contact with  $B_1$ , through slip ring and arm CD is in contact with  $B_2$ .
- (v) In the second half, in the external circuit, electric current flows from  $B_1$  to  $B_2$ , i.e. opposite to the previous half rotation.
- (vi) This repeats after every half rotation, and alternating current is produced.

This is what is called AC Generator.

