

MT

2018 ____ 1100

MT - SCIENCE & TECHNOLOGY -I (72) - SEMI PRELIM - I : PAPER - 2

Time : 2 Hours

(Model Answer Paper)

Max. Marks : 40

A.1.	(A) Solve the following questions :	
(1)	If objects of equal masses are given equal heat, their final temperature will be different, this is due to difference in their Specific heat capacity .	1
(2)	Zinc oxide: It is an amphoteric oxide, others are basic oxides.	1
(3)	True	1
(4)	False - When unsaturated carbon compounds burn, they give yellow flame with lots of black carbon.	1
(5)	PSLV - It is a satellite launch vehicle while others are satellite.	1
A.1.	(B) Choose the correct alternative and rewrite the sentences :	
(1)	Electrochemical reduction method is used for the purification of more reactive metals.	1
(2)	When water boils and is converted into steam, then heat is taken in and temperature remains constant .	1
(3)	If temperature of water is lowered from 4°C to 3°C; its volume increases	1
(4)	Teflon is used in nonstick cookware.	1
(5)	International space station is a Low Earth Orbit (LEO) satellite.	1
A.2.	Solve the following questions : (Any 5)	
(1)	(i) In the hall process of extracting aluminium from aluminium oxide, the electrolyte is a liquid mixture of cryolite (Na_3AlF_6) and aluminium oxide. (ii) The cathode and anodes are made of graphite. (iii) During the electrolysis process, aluminium is deposited on the	2

- cathode on passing electric current.
- (iv) Oxygen is liberated at the anode.
- (v) Some of this oxygen reacts with the carbon in the graphite to form carbon - dioxide gas then slowly burning away the anodes.
- (vi) Thus, the anodes need to be replaced from time to time during the electrolysis of alumina.

(2) **Direct current and Alternating current :**

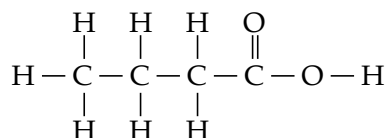
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Direct current	Alternating current
(i) A non oscillatory current flowing in one direction, in a circuit from the cell to the cell is called direct current (DC).	(i) A current changing in magnitude and direction after equal intervals of time is called alternating current (AC).
(ii) The frequency of DC is zero.	(ii) The frequency of AC is 50 Hz. in India.
(iii) DC cannot be used on a large scale for household purpose.	(iii) AC can be used on a large scale for household purpose.

(3) **Butanoic acid : Molecular formula- $C_4H_8O_2$ or $CH_3CH_2CH_2COOH$**

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Structural formula :



- (4) **Given:** Mass (m) = 5 kg
 Temp. difference (ΔT) = $100 - 20 = 80^\circ C$

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Specific heat capacity (c) = 1 kcal/kg $^\circ C$

To find: Heat energy (Q) = ?

Formula: $Q = mc\Delta T$

Solution: $Q = 5 \times 1 \times 80$
 $= 400 \text{ kcal}$

Heat energy needed is 400 kcal.

(5)	<p>When steam is passed over aluminium, aluminium oxide and hydrogen gas are formed.</p> $2\text{Al}_{(s)} + 3\text{H}_2\text{O}_{(g)} \rightarrow \text{Al}_2\text{O}_{3(s)} + 3\text{H}_{2(g)}$ <p>Aluminium Steam Aluminium Oxide Hydrogen</p>	2										
(6)	<p>Saturated and unsaturated Hydrocarbons :</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; border: 1px solid black;">Saturated Hydrocarbons</th> <th style="text-align: center; border: 1px solid black;">Unsaturated Hydrocarbons</th> </tr> </thead> <tbody> <tr> <td style="border: 1px solid black;">(i) They have carbon to carbon single bonds. [C-C]</td> <td style="border: 1px solid black;">(i) They have carbon to carbon double [C=C] or triple bonds. [C≡C]</td> </tr> <tr> <td style="border: 1px solid black;">(ii) The compounds are chemically less reactive.</td> <td style="border: 1px solid black;">(ii) These compounds are more reactive.</td> </tr> <tr> <td style="border: 1px solid black;">(iii) Substitution reaction is the characteristic property of these hydrocarbons.</td> <td style="border: 1px solid black;">(iii) Addition reaction is the characteristic property of these hydrocarbons.</td> </tr> <tr> <td style="border: 1px solid black;">(iv) The general formula is $\text{C}_n\text{H}_{2n+2}$</td> <td style="border: 1px solid black;">(iv) The general formula is C_nH_{2n} and $\text{C}_n\text{H}_{2n-2}$</td> </tr> </tbody> </table>	Saturated Hydrocarbons	Unsaturated Hydrocarbons	(i) They have carbon to carbon single bonds. [C-C]	(i) They have carbon to carbon double [C=C] or triple bonds. [C≡C]	(ii) The compounds are chemically less reactive.	(ii) These compounds are more reactive.	(iii) Substitution reaction is the characteristic property of these hydrocarbons.	(iii) Addition reaction is the characteristic property of these hydrocarbons.	(iv) The general formula is $\text{C}_n\text{H}_{2n+2}$	(iv) The general formula is C_nH_{2n} and $\text{C}_n\text{H}_{2n-2}$	2
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(7)	<p>(i) During change of state of a substance, object absorbs or rejects heat energy.</p> <p>(ii) But the temperature does not change.</p> <p>(iii) The heat energy is utilized for weakening the bonds between the atoms or molecules in the substance.</p> <p>(iv) Hence, this energy which causes a change in state and does not changes the temperature is called Latent heat.</p>	2										
A.3. Solve the following questions : (Any 5)												
(1)	<p>(i) When the current is downwards, the force experienced by the conductor will be outwards.</p> <p>(ii) If the conductor experiences a force inwards, the direction of current would be upwards.</p> <p>(iii) Fleming's Left Hand Rule.</p>	1 1 1										
(2)	<p>Given:</p> $P_1 = 1100 \text{ W}$ $P_2 = 330 \text{ W}$ $V = 220 \text{ V}$ <p>To find: $I_1 = ?$, $I_2 = ?$, $R_1 = ?$, $R_2 = ?$,</p>	3										

Formulae: $P = VI$, $P = \frac{V^2}{R}$

Solution:

$$P_1 = VI_1$$

$$I_1 = \frac{P_1}{V} = \frac{1100}{220}$$

$$I_1 = 5 \text{ A}$$

$$I_2 = \frac{P_2}{V} = \frac{330}{220} = \frac{3}{2}$$

$$I_2 = 1.5 \text{ A}$$

$$P_1 = \frac{V^2}{R_1}$$

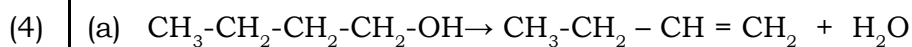
$$\therefore R_1 = \frac{V^2}{P_1} = \frac{(220)^2}{1100} = \frac{220 \times 220}{1100} = 2 \times 22$$

$$R_1 = 44 \Omega$$

$$R_2 = \frac{V^2}{P_2} = \frac{(220)^2}{330} = \frac{220 \times 220}{330} = \frac{440}{3}$$

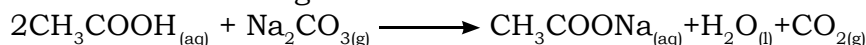
$$R_2 = 146.67 \Omega$$

- (3) (a) **Relative humidity** : The ratio of the mass of water vapour in given volume of air at a given temperature to the mass of water vapour required to saturate the same volume of air at the same temperature is called relative humidity. 3
- (b) (i) We can determine whether air is saturated with vapour or not on the basis of relative humidity.
- (ii) Relative humidity is the ratio of actual mass of vapour content in air for given volume and temperature to that required to make air saturated with vapour at the same temperature.
- (iii) If relative humidity is 100%, the air is saturated with vapour. This is called dew point.
- (iv) If its value is less than 100%, then the air is unsaturated.

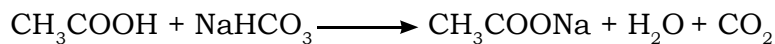


Dehydration reaction

(b) In this activity ethanoic acid reacts with the basic salt, namely, sodium carbonate, to form a salt, named sodium ethanoate, water and carbon dioxide gas.



The CO_2 gas with effervescence passes through the gas delivery tube and reacts with the lime water in the small test tube. 'Lime water turning milky' is the test of carbon dioxide gas. If sodium bicarbonate is used instead of sodium carbonate in the above activity, similar observations are obtained.



(5) **Given:**

	Q_A Steam	Q_B Ice
(m)	m_1	150g
(c)	1 cal/g°C	1 cal/g°C
t_1	100°C	0°C
t_2	50°C	50°C
L	540 cal/g	80 cal/g

To find: $m_1 = ?$

Formulae: $Q_A = Q_B$

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

Solution:

(1) Steam

$$mL \qquad \qquad \qquad mc\Delta T$$

Steam(100°C) → Water (100°C) → Water (50°C)

$$\therefore Q_A = m_1L_1 + m_1c_1\Delta T_1 \dots\dots\dots (1)$$

(2) Ice

$$mL \qquad \qquad \qquad mc\Delta T$$

Ice (0°C) → Water (0°C) → Water (50°C)

$$\therefore Q_B = mL + mc\Delta T \dots\dots\dots (2)$$

from (1) and (2)

$$Q_B = Q_A$$

$$mL + mc\Delta T = m_1L_1 + m_1c_1\Delta T$$

$$(150 \times 80) + \{150 \times 1 \times (50 - 0)\} = \{m_1 \times 540\} + \{m_1 \times 1 \times (100 - 50)\}$$

$$12000 + 7500 = m_1 (540 + 50)$$

$$19500 = m_1 \times 590$$

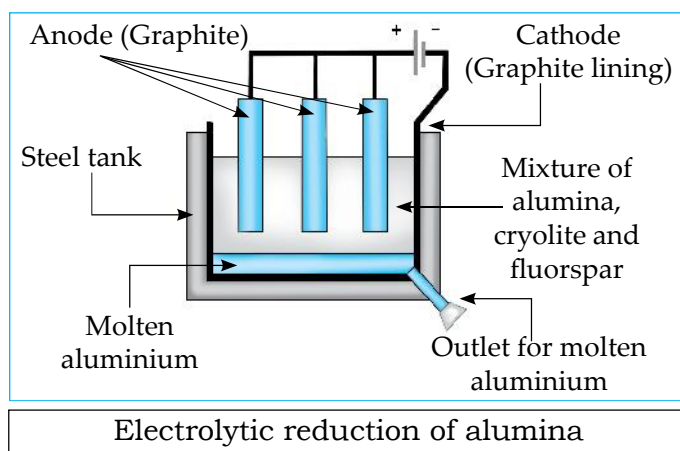
$$m_1 = \frac{19500}{590}$$

$$m_1 = 33\text{g}$$

Hence, 33g steam has to be mixed.

- (6) (a) Electrolytic reduction of alumina

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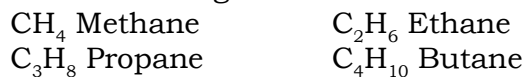
- (b) **Ores** : The minerals from which the metals can be separated economically are called ores.

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- (7) (i) You have seen that chains of different length are formed by joining the carbon atoms to each other. Moreover you have also seen that a functional group can take place of a hydrogen atom on these chains.
- (ii) As a result of this, large number of compounds are formed having the same functional groups but different length of carbon chain. For example, there are many compounds such as $\text{CH}_3\text{-OH}$, $\text{CH}_3\text{-CH}_2\text{-OH}$, $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-OH}$, $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-OH}$ which contain alcohol as the functional group.
- (iii) Though the length of the carbon chains in them is different, their chemical properties are very much similar due to the presence of the same functional group in them.
- (iv) The series of compounds formed by joining the same functional group in the place of a particular hydrogen atom on the chains having sequentially increasing length is called homologous series.
- (v) There are different homologous series in accordance with the functional group. For example, homologous series of alcohols, homologous series of carboxylic acids, homologous series of aldehydes, etc.

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(vi) All the members of the homologous series are homologues of each other. Homologous series of alkanes is:

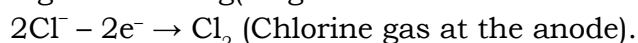
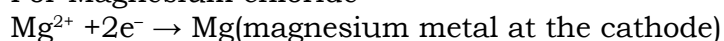


A.4. Solve the following questions : (Any 1)

(1)

(a)

(i) For Magnesium chloride

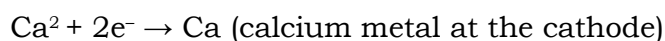


Magnesium ions gain electrons (reduction) to form magnesium atoms. Chloride ions lose electrons (oxidation) to form chlorine atoms.

The overall reaction is

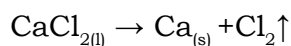


(ii) For Calcium chloride



Calcium ions gain electrons (reduction) to form calcium atoms. Chloride ions lose electrons (oxidation) to form chlorine atoms.

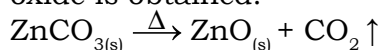
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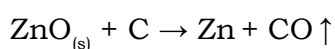
(b) The ore is carbonate ore.

Steps required to obtain the metal:

(i) Calcination: Carbonate ore is heated in limited supply of air and oxide is obtained.



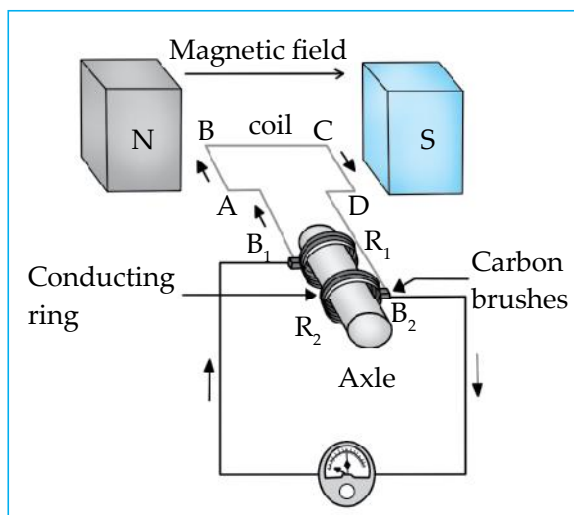
(ii) Reduction with Carbon: Oxide is heated with carbon.



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

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Electric generator

(b) **Principle of working:**

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

(c) **Working:**

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(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 the Fleming's right hand rule, the current is induced in the coil and moves from $A \rightarrow B$ and $C \rightarrow D$. 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.

