Model Answer of (Second Week)
Final and Graduated Exams 2017

Question (1)

(A) The scientific expressions :

1- rate of chemical reaction .
2- Law of mass action.
3- Galvanic cells .
4- The electromotive series.
5- Baeyr's reaction.
6- Markownikoff's Rule .
7- Inter Metallic Alloys.
8- Roasting.
9- Zinc sulphide (ZnS).
10- Catalyst.

(B)

$$CH_3COOH + H_2O \rightleftharpoons \underset{\text{Acetate Ion}}{CH_3COO^-} + \underset{\text{hydronium Ion}}{(H_3O)^+}$$

Ionization of Acetic acid takes place on two steps :

$$CH_3COOH \rightleftharpoons CH_3COO^- + \cancel{H^+}$$

$$\cancel{H^+} + H_2\ddot{O} \longrightarrow (H_3O)^+$$

$$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + (H_3O)^+$$

To simplify this equation can be written :

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$ $HCl \longrightarrow Cl^- + H^+$	$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$ $NaOH \longrightarrow Na^+ + OH^-$
← Backward direction	→ Forward direction
∴ decrease acetate ion concentration	∴ Increase acetate ion concentration

(C) The Role of each of the following :

1- a) The salt bridge connects between the solutions of the two half cells without allowing a direct contact between them .
b) It neutralizes both the positive and negative charges which forms in the solutions of two half cells as a result of the oxidation reduction reaction in the Znic and Copper half cells .
2- It acts as Cathode .
3- It acts as Electrolyte .
4- It acts as Oxidizing agent .
5- It acts as Acidic medium (Because water is a weak electrolyte so sulphuric acid is added to increase the concentration of hydrogen ions to be able to break down the double bond present in Ethene .
6- It acts as Catalyst .
7- To remove phosphine gas (pH_3) and Hydrogen sulphide gas (H_2S) they are produced from the impurities found in Calcium Carbide .
8- To neutralize the vapours of H_2SO_4 .
9- It acts as oxidizing agent .
10- It acts as Electrolyte .

(D)

	Wrong (mistake)	Correct (proper) answer
①	2,3-diethyl butane $CH_3 - \underset{\underset{C_2H_5}{|}}{CH} - \underset{\underset{C_2H_5}{|}}{CH} - CH_3$	$CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_2}{|}}{CH}} - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_2}{|}}{CH}} - CH_3$ 3, 4- dimethyl Hexane
②	2-ethyl-3-butyne $CH_3 - \underset{\underset{C_2H_5}{|}}{CH} - C \equiv CH$	$CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_2}{|}}{CH}} - C \equiv CH$ 3-methyl-1-pentyne
③	2-ethyl-3-methyl butane $CH_3 - \underset{\underset{C_2H_5}{|}}{CH} - \underset{\underset{CH_3}{|}}{CH} - CH_3$	$CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_2}{|}}{CH}} - \underset{\underset{CH_3}{|}}{CH} - CH_3$ 2,3-dimethyl pentane
④	2,2-dimethyl-3-pentene $CH_3 - \underset{\underset{CH_3}{|}}{C} - CH = CH - CH_3$	$CH_3 - \underset{\underset{CH_3}{|}}{C} - CH = CH - CH_3$ 4,4-dimethyl-2-pentene
⑤	3-bromo-2-methyl butae $CH_3 - \underset{\underset{CH_3}{|}}{CH} - \underset{\underset{Br}{|}}{CH} - CH_3$	$CH_3 - \underset{\underset{CH_3}{|}}{CH} - \underset{\underset{Br}{|}}{CH} - CH_3$ 2-bromo-3-methyl butane
⑥	2-bromo-3-butyne $CH_3 - \underset{\underset{Br}{|}}{CH} - C \equiv CH$	$CH_3 - \underset{\underset{Br}{|}}{CH} - C \equiv CH$ 3-bromo-1-butyne
⑦	2-ethyl pentane $CH_3 - \underset{\underset{C_2H_5}{|}}{CH} - CH_2 - CH_2 - CH_3$	$CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_2}{|}}{CH}} - CH_2 - CH_2 - CH_3$ 3-methyl hexane
⑧	3-ethyl-1-butyne $CH_3 - \underset{\underset{C_2H_5}{|}}{CH} - C \equiv CH$	$CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_2}{|}}{CH}} - C \equiv CH$ 3-methyl 1-pentyne
⑨	1,1- dimethyl ethane $\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} = CH_2$	$\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} = CH_2$ 2-methyl-1-propene
⑩	2-methyl-3-bromo-1-hexene $CH_2 = \underset{\underset{CH_3}{|}}{C} - \underset{\underset{Br}{|}}{CH} - CH_2 - CH_2 - CH_3$	$CH_2 = \underset{\underset{CH_3}{|}}{C} - \underset{\underset{Br}{|}}{CH} - CH_2 - CH_2 - CH_3$ 3-bromo-2-methyl 1-hexene

(E) Symbolic chemical equations :

(1) $CaC_{2(s)} + 2H_2O_{(\ell)} \xrightarrow[\text{wise}]{\text{drop}} C_2H_{2(g)} + Ca(OH)_{2(aq)}$

$C_2H_{2(g)} + H_2O_{(\ell)} \xrightarrow[H_2SO_4, 60^\circ]{HgSO_4} CH_3CHO_{(\ell)}$

Ethyne — Ethanal (Acetaldehyde)

(2) $C_2H_5 - O - SO_3H_{(aq)} + HOH_{(\ell)} \xrightarrow{110^\circ} C_2H_5OH_{(\ell)} + H_2SO_{4(aq)}$

Ethyl hydrogen sulphate — Ethyl alcohol

(3) $C_2H_5 - O - SO_3H_{(aq)} \xrightarrow{180^\circ} C_2H_{4(g)} + H_2SO_{4(aq)}$

(4) $CH_2 = \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}} - CH_{3\,(g)} + HBr_{(g)} \xrightarrow{\text{Markownikoff's rule}} CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle Br}{\overset{|}{\underset{|}{C}}}} - CH_{3\,(g)}$

2-bromo-2-methyl propane

(5) $\begin{matrix} COO \\ | \\ COO \end{matrix}\!\!>\!Fe_{(s)} \xrightarrow[\text{absence air}]{\text{heat}} FeO_{(s)} + CO_{(g)} + CO_{2(g)}$

$FeO_{(s)} + H_2SO_{4(aq)} \xrightarrow{\text{dil}} FeSO_{4(aq)} + H_2O_{(\ell)}$

(6) $Fe_3O_{4(s)} + 4H_2SO_{4(aq)} \xrightarrow[\text{heat}]{\text{Conc.}} FeSO_{4(aq)} + Fe_2(SO_4)_{3(aq)} + 4H_2O_{(\ell)}$

(7) $3BaCl_{2(aq)} + 2Na_3PO_{4(aq)} \longrightarrow 6NaCl_{(aq)} + Ba_3(PO_4)_{2(s)}$

(8) $Na_2SO_{4(aq)} + (CH_3COO)_2Pb \longrightarrow 2CH_3COONa_{(aq)} + PbSO_{4(s)}$

(9) $Zn_{(s)} + CuSO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + Cu_{(s)}$

blue — Colourless

This reaction is spontaneous Redox reaction and can be expressed by the following equation :

$$Zn_{(s)} \xrightarrow{\text{Oxidation}} Zn^{+2}_{(aq)} + 2e^-$$

$$Cu^{+2}_{(aq)} + 2e^- \xrightarrow{\text{Reduction}} Cu^{0}_{(s)}$$

(10) $2NaBr_{(s)} + H_2SO_{4(aq)} \xrightarrow{\text{Conc. heat}} Na_2SO_{4(aq)} + 2HBr_{(g)}$

$2HBr_{(g)} + H_2SO_{4(aq)} \xrightarrow{\text{Conc. heat}} 2H_2O_{(v)} + SO_{2(g)} + Br_{2(v)}$

(E)

Element	A	B
Oxidation potential	+ 0.4 volt	- 0.6 volt
Type of electrode :	Anode	Cathode
The symbol of the cell	$A / A^{+2} // B^{+2} / B$	
The e.m.f of the cell	= Oxidation potential of (A) – Oxidation potential of (B) = + 0.4 – (- 0.6) = ⊕ 1 volt So, the cell gives electric current because its e.m.f is positive.	

Question (2)

(A) Choose the correct answer :

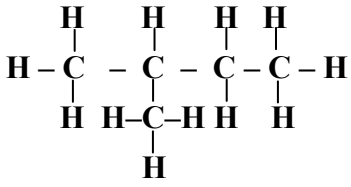
(1) ethanoic acid
(2) PVC
(3) 2-bromo propane
(4) negative pole at which oxidation process takes place.
(5) graphite lithium
(6) oxygen
(7) Waage and Guldberg
(8) catalyst
(9) $r_1 = r_2$
(10) FeO
(11) $(CO + H_2)$ water gas
(12) (a and b) together

(B) How can you differentiate between :

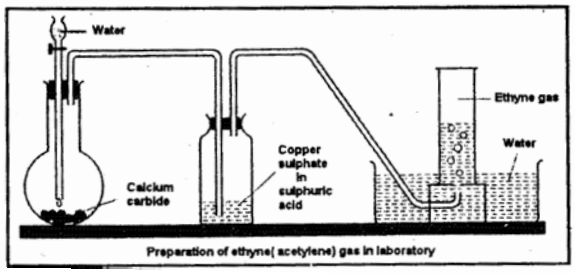
① Experiment	(Fe + Zn) alloy	(Cu = Zn) alloy
By adding dilute hydrochloric acid to each of them :	If the whole alloy dissolves in the acid, so the alloy is (Fe + Zn) alloy	If the red metal (Cu) precipitates, so the alloy is (Cu + Zn) alloy
Chemical equations :	$Fe_{(s)} + Zn_{(s)}\ 4HCl_{(aq)} \xrightarrow{dil} FeCl_{2(aq)} + ZnCl_{2(aq)} + 2H_{2(g)}$	$Cu_{(s)} + Zn_{(s)} + 2HCl_{(aq)} \xrightarrow{dil} ZnCl_{2(aq)} + H_{2(g)} + Cu_{(s)}$
② Experiment	$FeCl_2$ solution	$FeCl_3$ solution
By adding sodium hydroxide solution to each of them :	Greenish white ppt	Reddish brown ppt
Chemical equations :	$FeCl_{2(aq)} + 2NaOH_{(aq)} \longrightarrow 2NaCl_{(aq)} + Fe(OH)_{2(s)}$	$FeCl_{3(aq)} + 3NaCl \longrightarrow 3NaCl_{(aq)} + Fe(OH)_{3(s)}$
③ Experiment	Dilute H_2SO_4	Concentrated H_2SO_4
By adding Iron fillings to each of them :	If it gives hydrogen gas which is burnt by pop sound so it is dilute H_2SO_4	If it gives sulphur dioxide gas which turns a paper wetted with acidified $K_2Cr_2O_7$ from orange to green so it is conc. H_2SO_4
Chemical equations :	$Fe_{(s)} + H_2SO_{4(aq)} \xrightarrow{dil} FeSO_{4(aq)} + H_{2(g)}$	$3Fe + 8H_2SO_4 \xrightarrow[heat]{Conc.} FeSO_4 + Fe_2(SO_4)_3 + 8H_2O + 4SO_2$
④ Experiment	$Al_2(SO_4)_3$ solution	$CuSO_4$ solution
By adding sodium hydroxide solution to the solution of each of them :	White gelatinous ppt soluble in excess sodium hydroxide forming sodium metal aluminate	Blue ppt which turns to black by heat forming black copper oxide .
Chemical equations :	$Al_2(SO_4)_{3(aq)} + 6NaOH_{(aq)} \xrightarrow{drop\ wise} 3Na_2SO_{4(aq)} + 2Al(OH)_{3(s)}$ $Al(OH)_{3(s)} + NaOH_{(aq)} \xrightarrow{excess} NaAlO_{2(aq)} + 2H_2O_{(\ell)}$	$CuSO_{4(aq)} + 2NaOH_{(aq)} \longrightarrow Na_2SO_{4(aq)} + Cu(OH)_{2(s)}$ $Cu(OH)_{2(s)} \xrightarrow[heat]{by} CuO_{(s)} + H_2O_{(\ell)}$
⑤ Experiment	Na_2CO_3 solution	$NaHCO_3$ solution
By adding magnesium sulphate solution to the solution of each of them.	A white ppt is formed on cold	A white ppt is formed after heat .
Chemical equations :	$Na_2CO_{3(aq)} + MgSO_{4(aq)} \longrightarrow Na_2SO_{4(aq)} + MgCO_{3(s)}$	$2NaHCO_{3(aq)} + MgSO_{4(aq)} \longrightarrow Na_2SO_{4(aq)} + Mg(HCO_3)_{2(aq)}$ $Mg(HCO_3)_{2(aq)} \xrightarrow{heat} MgCO_{3(s)} + H_2O_{(\ell)} + CO_{2(g)}$
⑥ Experiment	Methan	Ethene
(a) By adding bromine dissolved in (CCl_4) to each of them	No effect	The red colour of bromine disappears
Chemical equations :	-	$C_2H_4 + Br_2 \xrightarrow{CCl_4} C_2H_4Br_2$

(b) By adding $KMnO_4$ in an alkaline medium to each of them.	No effect	The violet colour of $KMnO_4$ disappears
Chemical equations :	-	$C_2H_{4(g)} + H_2O_{(\ell)} + (O)_{(g)} \xrightarrow[\text{alkaline medium}]{KMnO4} C_2H_4(OH)_2$
⑦ Experiment	Ethyl alcohol	Dimethyl ether
By adding sodium metal to each of them	Gives hydrogen gas which is burnt by pop sound	No effect
Chemical equations :	$C_2H_5OH_{(\ell)} + Na_{(s)} \longrightarrow C_2H_5ONa_{(\ell)} + H_{2(g)}$	-

(C) 1- Mention :

(1)	C_nH_{2n+2} : alkane $n + 2n + 2 = 17$ $3n = 15$ $n = 5$ $\therefore C_5H_{12}$	(2)	C_nH_{2n} : alkene $n + 2n = 18$ $3n = 18$ $n = 6$ $\therefore C_6H_{12}$
(3)	C_nH_{2n-2} : alkyne $n + 2n-2 = 13$ $3n = 15$ $n = 5$ $\therefore C_5H_8$	(4)	 (16 sigma bond)

2- Preparation of acetylene gas : By dropping water on to calcium carbide



Preparation of ethyne(acetylene) gas in laboratory

$$CaC_2 + 2H_2O \xrightarrow{\text{drop wise}} C_2H_2 + Ca(OH)_2$$

(D) From : $Zn + 2H^+ \longrightarrow Zn^{+2} + H_2$

Anode (Reducing agent) is Zinc

Cathode (Oxidizing agent) is Hydrogen ions

The expression for Galvanic cell is $Zn / Zn^{+2} // 2H^+ / H_2$

e.m.f of cell = oxidation potential of anode – oxidation potential of cathode

= + 0.76 – (– Zero)

= ⊕ 0.76 volt

(E) Compare between :

①	I.P.O.C	Anodic cover	Cathodic cover
	Definition	Covering the protective metal (e.g. iron) by another more active metal (e.g. zinc).	Covering the protective metal (e.g. iron) by another less active metal (e.g. tin).
	Its effect	If the anodic cover (e.g. zinc) is scratched the protective metal (e.g. iron) starts its corrosion after the anodic cover is corroded completely.	If the cathodic cover (e.g. tin) is scratched the protective metal (e.g. iron) is corroded faster .
	Example	Covering iron with zinc.	Covering iron with tin.

②	Primary cell	Secondary cell
	1. The (oxidation-reduction) reaction is irreversible.	1. The (oxidation-reduction) reaction is reversible.
	2. Cannot be recharged .	2. Can be recharged .
	3. Example: - Fuel cell. - Mercury cell.	3. Example : - Lead acid battery. - Lithium ion battery.

③	Hydration	Hydrogenation
	Addition of water to unsaturated Hydrocarbons in the presence of catalyst.	Addition of Hydrogen to unsaturated Hydrocarbons in the presence of Nickel as catalyst.
	Ex.	Ex.
	$C_2H_2 + H_2O \xrightarrow{Cat.} CH_3CHO$ Ethyne — Ethanal	$C_2H_4 + H_2 \xrightarrow{Ni} C_2H_6$ Ethene — Ethane

Property	Organic Compounds	Inorganic Compounds
1. Chemical structure	Mainly contain carbon and hydrogen atoms.	May contain carbon atoms in addition to other elements.
2. Solubility	Most are insoluble in water but soluble in organic solvent e.g. benzene.	Most are soluble in water.
3. Melting point	Low	High
4. Boiling point	Low	High
5. The odour	Most have characteristic odour	Most are odourless
6. Inflammability	Inflammable and produce CO_2, H_2O	Not inflammable, if it is inflammable it produces other gases
7. Kinds of bonds in the molecule	Covalent bonds	Ionic bonds
8. Conductivity	Do not conduct electricity	Usually electrolytic compounds conduct electricity
9. Rate of chemical reaction	Slow, because it takes place between the molecules	Fast, because it take splace between the ions.
10. Polymerization	Can be polymerized	Can't be polymerized
11. Isomerism	It is found among many compounds	It is not found among their compounds.

(F) **1- Law of mass action : At constant temperature, the rate of a chemical reaction is directly proportional to the product of multiplication of the reactant concentration; each is raised to the power of the number of molecules or ions in the balanced equation .**

$$K_c = \frac{[Fe(SCN)_3][NH_4Cl]^3}{[FeCl_3][NH_4SCN]^3}$$

On adding an excess of ammonium thiocyanate to the reaction the reaction moves towards the forward direction and a bloody red colour of iron (III) thiocyanate appears .

2- (a) Because when it is connected to an outside source of direct electric current whose potential is slighty higher than the potential produced from the battery, the oxidation reactions are converted into reduction reactions and vise versa .

(b) Because the German scientists Wohler destroyed the vital force theory, when he prepared urea by heating an aqueous solution of two inorganic compounds, ammonium chloride and silver cyanate.

$$NH_4Cl + AgCNO \longrightarrow NH_4CNO + AgCl$$
(Silver Cyanate) — (Ammonium cyanate)

$$NH_4CNO \xrightarrow{\Delta} H_2N - CO - NH_2$$
(Ammonium cyanate) — (Urea)

Finished answer