



G.C.E. A/L Examination June - 2018

Conducted by Field Work Centre, Thondaimanaru

In Collaboration with

Provincial Department of Education, Northern Province.

Chemistry I

Grade :- 13 (2018)

Time :- Two hours

Part - I

01. The scientist who is not related with either electrons or the arrangement of electrons in atoms is

01. Neil Bohr

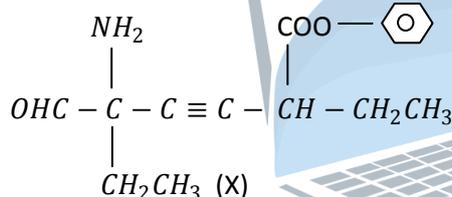
02. Hund

03. Thomson

04. Pauling

05. de Broglie

02. What is the IUPAC name of the compound X?



01. phenyl 5 -amino - 2 - ethyl - 5 - formyl - 3 - heptynoate

02. 5 - amino - 2 - ethyl - 5 - formyl - 3 - heptynoate

03. phenyl 2,5 - diethyl - 6 - oxo - 5 - amino - 3 - heptynoate

04. phenyl 5 amino - 2,5 diethyl - 6 - oxo - 3 - heptynoate

05. phenyl - 5 - amino - 2,5 - diethyl - 6 - oxo - 3 - heptynoate

03. Which of the following statements regarding the properties of atoms is true?

01. The nuclear charge felt by the valence electron of Mg atom is 12

02. The first electron affinity of Li atom has a more negative value than that of Na atom

03. Electro negativity is a measure of the electron attracting ability of an isolated atom.

04. According to Pauling scale, electro negativity of S is greater than the electro negativity of Br.

05. The first ionization energy of an element with higher atomic radius is always less than that with lower atomic radius in the same period.

04. A,B and C are three elements belonging to the fourth period of the periodic table. Each of them has one unpaired electron. If the azimuthal quantum numbers of these unpaired electrons are all different from each other, the elements which are possible to be

A,B and C are

01. K, Sc, Cr

02. Cr, Cu, Ga

03. K, Sc, Br

04. Cr, Cu, Ge

05. Sc, Cr, Cu

05. The statement which is false in regard of alkali metals and alkaline earth metals is

- 01. All alkali metals react with water
- 02. None of the bicarbonates of alkali metals exists in solid state
- 03. Except Li, any other alkali metals do not react directly with N_2 gas
- 04. Although the hydroxides of alkali metals are strong bases, only LiOH among them will undergo thermal decomposition
- 05. The melting point of alkali metals is less than the melting point of the corresponding alkali earth metal in the same period.

06. The element M forms the oxide M_2O_3 . If the mass of dry sulphate formed when 1.60g of M_2O_3 is dissolved in dilute H_2SO_4 is 4.00g, the relative atomic mass of M is (S= 32, O= 16)

- 01. 27
- 02. 56
- 03. 112
- 04. 160
- 05. 168

07. A buffer solution may be prepared by mixing a weak acid HA ($K_a = 4 \times 10^{-7} \text{ mol dm}^{-3}$) with a strong base. What is the volume ratio of the weak acid HA to the NaOH solution of the same concentration to be mixed to prepare a buffer solution of pH= 6?

- 01. 1:1
- 02. 1:2
- 03. 7:2
- 04. 5:2
- 05. 3:2

08. In which of the following reactions may Cl_2 gas be produced as a product?

- a) $OCl_{(aq)}^- + H^+_{(aq)} + Cl^-_{(aq)} \rightarrow$
- b) $H_2O_{2(aq)} + Cl^-_{(aq)} + H^+_{(aq)} \rightarrow$
- c) $MnO_{2(s)} + H^+_{(aq)} + Cl^-_{(aq)} \rightarrow$
- d) $Cl^-_{(aq)} + Conc. H_2SO_4 \rightarrow$

- 01. Only b and d
- 02. Only b, c and d
- 03. Only c and d
- 04. c only
- 05. Only a and c

09. A gas mixture of H_2 and CH_4 has a density of 0.6 kg m^{-3} at 300 K and under a pressure of $3 \times 10^5 \text{ Nm}^{-2}$. The mole fraction of CH_4 gas in the mixture (assume that the gases behave ideally)

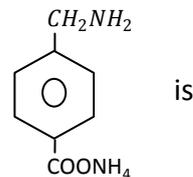
- 01. $\frac{2}{16}$
- 02. $\frac{3}{14}$
- 03. $\frac{11}{14}$
- 04. $\frac{2}{9}$
- 05. $\frac{8}{9}$

10. The correct statement regarding the changes in enthalpy and entropy of a system and its surrounding when a chemical reaction takes place is

- 01. In an exothermic reaction both the enthalpy of the particles in the system decreases while the entropy of the particles in the surrounding increases
- 02. In an exothermic reaction both the enthalpy of the particles in a system and the entropy of the particles in the surrounding will decrease
- 03. When heat is liberated to the surrounding the entropy of the particles in the surrounding will increase
- 04. Entropy change occurring in the molecules of a system is equal to the entropy change in the molecules of the surrounding
- 05. All the above statements are correct.

11. Which one of the following does not give any chemical change with H_2O_2 ?
01. $MnO_2(s)$ 02. $K_2Cr_2O_7/dilute\ H_2SO_4$ 03. $Cr(OH)_3/NaOH$
 04. $KI/dilute\ H_2SO_4$ 05. Ag_2O

12. The statement which is incorrect regarding the compound

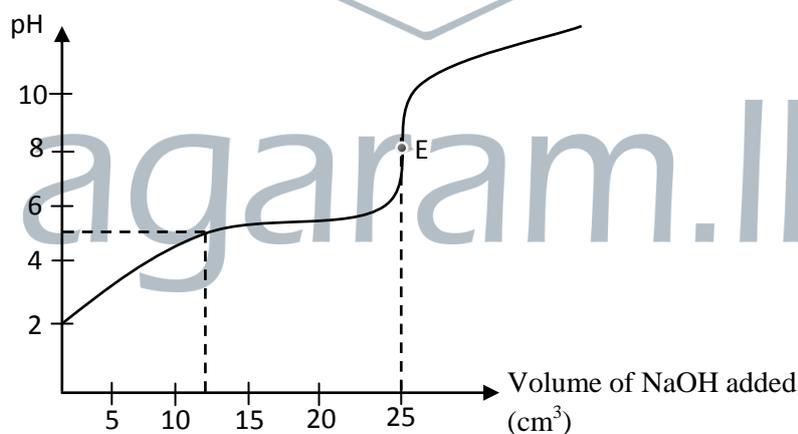


01. It dissolves in dilute HCl.
 02. It gives NH_3 gas with $NaOH_{(aq)}$.
 03. It is soluble in water.
 04. It produces diazonium salt with $NaNO_2/dil\ HCl$.
 05. When the compound is heated, a compound with an amide group is obtained.

13. Assuming that only metallic cations are reduced in their relevant aqueous solutions, what is the mole ratio of Cu, Ag and Cr which are deposited when the same current is passed for the same duration of time through the aqueous solutions of $CuSO_4$, $AgNO_3$ and $Cr_2(SO_4)_3$ of equal concentrations?

01. 2:3:3 02. 3:6:2 03. 3:2:6
 04. 2:1:3 05. 32:108:26

14. The following graph represents the pH change when $0.1\ mol\ dm^{-3}\ NaOH_{(aq)}$ is added from a burette into a weak acid HA of concentration $0.1\ mol\ dm^{-3}$ at $25^\circ C$



The correct statement is,

01. The ionization constant of the weak acid HA at $25^\circ C$ is $K_a = 1 \times 10^{-5}\ mol\ dm^{-3}$.
 02. In the above titration, E denotes the equivalence point.
 03. The indicator having a colour change pH range 8- 9.6 may be used for this titration.
 04. The resulting solution at the equivalence point is neutral.
 05. Statements 1,2 and 3 above are correct.
15. When $100\ cm^3$ of a weak acid HA of concentration $0.15\ mol\ dm^{-3}$ was shaken well with $100\ cm^3$ of CCl_4 and the layers were allowed to settle, the pH of the aqueous layer was found to be 3. The distribution co-efficient of HA between water and CCl_4 at the temperature concerned is ($K_a\ of\ HA = 1 \times 10^{-5}\ mol\ dm^{-3}$)
01. 2 02. 4 03. 0.5 04. 5 05. 8

16. The statement which is not true regarding the metals in 3d - series and their compounds

01. Cu and Mn have relatively low melting point

02. The cations of metals with d^7, d^8, d^9 and d^{10} electron configuration easily form ammine complexes with NH_3 .

03. Of the oxides formed by V, Cr and Mn, lower oxidation states are basic whereas higher oxidation states show acidic nature.

04. Oxyanions of them in their highest oxidation states are reducing agents.

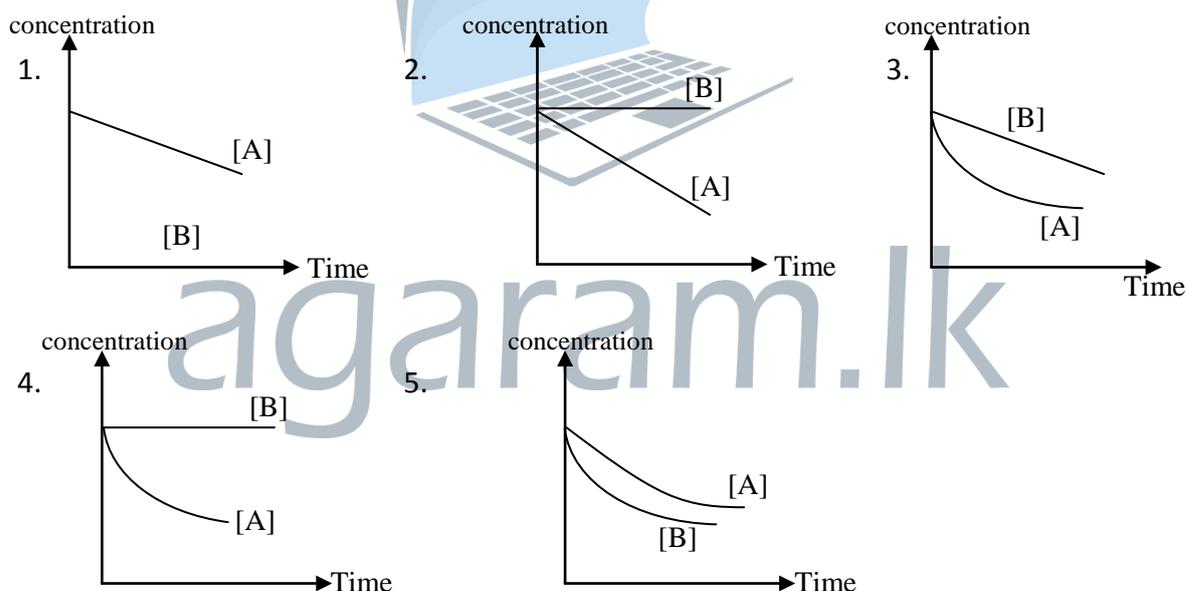
05. The highest oxidation state of the elements from Sc to Mn is the sum of the outermost electrons and the inner d electrons.

17. $2A + B \rightarrow C + 4D$.

Some information regarding the above reaction are given below.

- The concentration of B is not in the rate expression of the reaction.
- The time taken for the concentration of A to become half its initial value is independent of its initial concentration

If the above reaction is started with equal moles of A and B, which of the following graphs best represents the variation of concentration with time?



18. 0.04 moles of a sparingly soluble solid $M(OH)_2$ is dissolved well in $1 dm^3$ of $0.07 mol dm^{-3}$ HCl solution. The solubility product (K_{SP}) of $M(OH)_2$ at the given temperature is $3.5 \times 10^{-10} mol^3 dm^{-9}$ and the salt MCl_2 dissolves completely in water. The OH^- concentration in the solution is,

01. $1.0 \times 10^{-5} mol dm^{-3}$

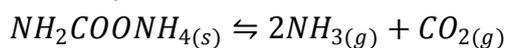
02. $1.0 \times 10^{-4} mol dm^{-3}$

03. $1.0 \times 10^{-2} mol dm^{-3}$

04. $8.0 \times 10^{-2} mol dm^{-3}$

05. $2.0 \times 10^{-5} mol dm^{-3}$

19. Consider the equilibrium reaction



If $K_p = 3.2 \times 10^{10} N^2 m^{-4}$ for the above equilibrium reaction at $27^\circ C$, the total pressure of the system is,

01. $2 \times 10^3 N m^{-2}$

02. $5.4 \times 10^5 N m^{-2}$

03. $4 \times 10^3 N m^{-2}$

04. $3 \times 10^3 N m^{-2}$

05. $6 \times 10^3 N m^{-2}$

20. An electro chemical cell is constructed by connecting a redox electrode $Pt_{(s)} / Fe_{(aq)}^{3+}, Fe_{(aq)}^{2+}$ and a metal - insoluble salt electrode $Ag_{(s)}, AgCl_{(s)} / Cl_{(aq)}^-$ with a salt bridge

Standard electrode potentials of these electrodes are given below

$$E_{AgCl_{(s)}, Ag_{(s)} / Cl_{(aq)}^-}^\theta = 0.22V, E_{Pt_{(s)} / Fe_{(aq)}^{3+}, Fe_{(aq)}^{2+}}^\theta = 0.77V$$

Which of the following statement regarding the above cell is correct?

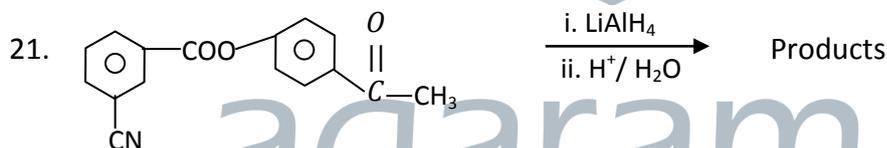
01. The emf of the cell is 0.99v.

02. Negative electrode of the cell is $Pt_{(s)} / Fe_{(aq)}^{3+}, Fe_{(aq)}^{2+}$

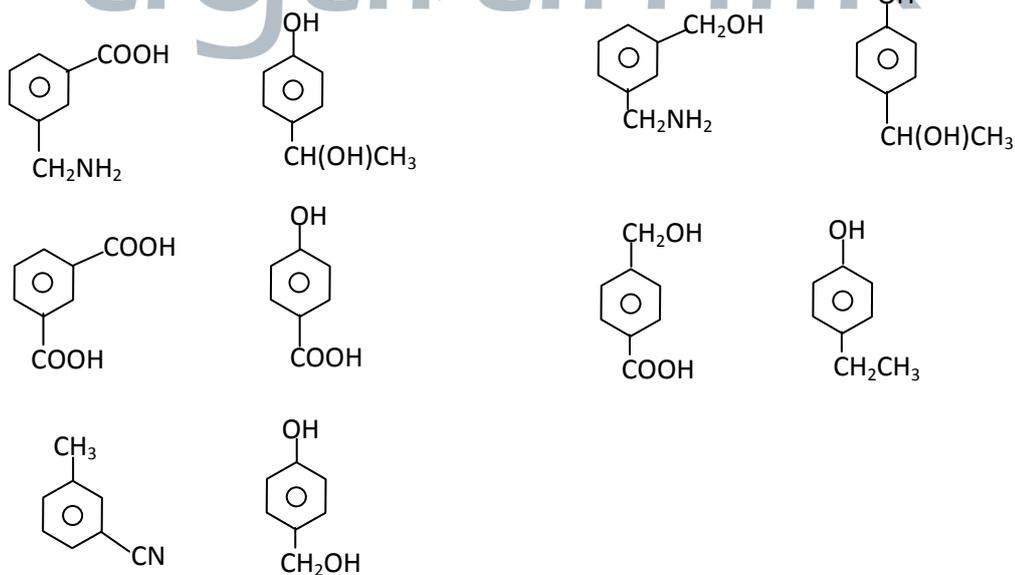
03. Reducing the concentration of $Fe_{(aq)}^{2+}$ makes the electrode potential of $Pt_{(s)} / Fe_{(aq)}^{3+}, Fe_{(aq)}^{2+}$ more positive

04. When the distance between the electrodes is reduced, the current that flows will not change.

05. When the cell operates, anions move towards cathodic compartment.



The products of the above reaction are,



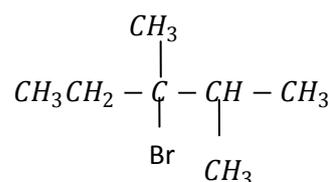
22. At a temperature T , the dissociation constant of monobasic weak acid is $2 \times 10^{-6} \text{ mol dm}^{-3}$. The pH value of a 0.5 mol dm^{-3} aqueous solution of it (At TK, K_w of water is $1 \times 10^{-16} \text{ mol}^2 \text{ dm}^{-6}$).

01. 2.6 02. 3.0 03. 11.0 04. 11.3 05. 13

23. Which one of the following statements regarding NH_3 is false?

01. When NH_3 acts as an oxidizing agent, H_2 will be a product.
 02. Concentrated H_2SO_4 cannot be used to dry $\text{NH}_3(g)$.
 03. NH_3 is formed in the reaction of NH_4NO_3 and NaNH_2 .
 04. NF_3 molecule has a dipole moment greater than that of NH_3 .
 05. NCl_3 may form in the reaction of NH_3 with excess Cl_2 .

24. The correct statement about the reaction of the compound with $\text{NaOH}_{(aq)}$ is



01. The reaction occurring is a single step reaction.
 02. The major product in this reaction shows diastereoisomerism.
 03. Mechanism of the reaction is nucleophilic addition.
 04. The product formed does not give immediate turbidity with Lucas reagent.
 05. The major products are optically active isomeric alcohols.

25. Which one of the following statements regarding H_2O_2 is not true?

01. Boiling point of H_2O_2 is greater than that of H_2O .
 02. The resultant dipole moment of H_2O_2 molecule is not zero.
 03. H_2O_2 reacts with HCl and liberates Cl_2 gas.
 04. H_2O_2 may be prepared by the reaction of BaO_2 with H_2SO_4 .
 05. O_2 gas is evolved in the reaction of Ag_2O with H_2O_2 .

26. When a mixture of FeO and Fe_3O_4 is heated in air to constant mass, an increase of 5% in mass is observed. The mass percentage of FeO in the mixture is

01. 20% 02. 10% 03. 67.5% 04. 25% 05. 30%

27. $\text{A}_{(g)} \xrightleftharpoons[K_2]{K_1} 2 \text{B}_{(g)} \Delta \quad H > 0$

Given above is a reversible, equilibrium reaction where K_1 and K_2 are rate constants of forward and reverse reactions respectively.

The correct statement about the above equilibrium system is

01. As the reaction is endothermic, with the increase in temperature rate of forward reaction will increase whereas the rate of reverse reaction will decrease
 02. When a catalyst is introduced into the system, rate constants of both the forward and reverse reactions increase by the same extent.
 03. When a catalyst is introduced into the system, the activation energies of both forward and reverse reactions decrease by the same percentage.
 04. At a given temperature, the average speed to B molecules is greater than that of A molecules
 05. When the system is in equilibrium, the percentage of reactant and product molecules having energy greater than a particular value is equal to each other.

28. A and B are two liquids which can form ideal solutions. At a given temperature, two ideal solutions comprising A and B were prepared and allowed to attain equilibrium with their vapours. When the mole fraction of A in these solutions are 0.6 and 0.2, the vapour pressures are P_1 and P_2 respectively ($P_1 > P_2$) If at the given temperature vapour pressures of pure A and B are P_A° and P_B° respectively, which of the following relationships is correct?

01. $2P_1 - P_2 = P_A^\circ$ 02. $P_B^\circ = \frac{1}{2}(3P_2 - P_1)$ 03. $P_A^\circ > P_B^\circ$
 04. $P_A^\circ = P_B^\circ$ 05. in the vapour phase always $Y_A > Y_B$

29. To determine the amount of sulphur in a sample of coal, the following procedure was followed. 1g sample of coal was burnt in excess O_2 and the SO_2 gas formed was passed into chlorine water which was sufficient for its complete reaction. When the resultant solution was titrated against a $0.1 \text{ mol dm}^{-3} NaOH_{(aq)}$ the end point was found to be 40 cm^3 . The mass percentage of sulphur in the coal sample (S= 32).

01. 3.2 02. 6.4 03. 1.6 04. 0.8 05. 8

30. When forming compounds with the following, with which does nitrogen exhibit its highest oxidation state?

01. F 02. O 03. Cl 04. Mg 05. B

❖ For each of the question 31 to 40 one or more response out of four responses (a), (b), (c) and (d) given is / are correct. Select the correct responses / responses. In accordance with the instruction given on your answer sheet mark.

1	2	3	4	5
only (a) and (b) are correct	only (b) and (c) are correct	only (c) and (d) are correct	only (a) and (d) are correct	any other number or combination is correct

31. The correct statement / statements pertaining to reaction kinetics is/are

- a) It is the slowest step which determines the unit of the rate of a reaction.
 b) Depending on the molecularity of the overall reaction, the unit of the rate constant is decided.
 c) The overall rate of a reaction depends on the slowest step in a multi - step reaction.
 d) If one of the reactants is not involved in the rate law of a reaction, the reaction cannot be a single step reaction.

32. The correct statement/ statements which is/ are true regarding the molecule of 4 - pentenal.

- a) It does not exhibit stereoisomerism.
 b) The compound produced when it reacts with HBr is not found in enantiomeric forms
 c) When it is reacted with CH_3MgBr followed by hydrolysis, a primary alcohol is obtained.
 d) When it is treated with $LiAlH_4$ and then water is added, a primary alcohol is obtained

33. Of the following statements about extraction of sodium by Down cell, the correct statement/ statements is are

- a) High current is used in this process.
- b) Titanium anode and nickel cathode are used.
- c) $CaCl_2$ solid is added to $NaCl$ solid and melted.
- d) A porous steel gauze diaphragm is used to protect the contact of Na with Cl_2 .

34. The solution/solutions that can be a buffer is/are

- a) $NaHSO_4(aq)$
- b) $NaHPO_3(aq)$
- c) $NaHCO_3(aq)$
- d) $NaHC_2O_4$

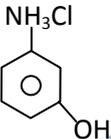
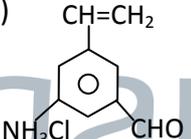
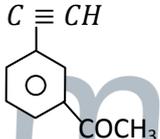
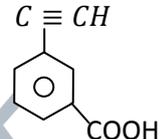
35. In which of the following electrolysis processes, the deposition of a metal at the cathode and the liberation of a gas at the anode would take place?

- a) Electrolysis of an aqueous $AgNO_3$ solution using Ag anode.
- b) Electrolysis of dilute H_2SO_4 solution using inert electrodes.
- c) Electrolysis of a mixture of molten $NaCl$ and $MgCl_2$ using inert electrodes.
- d) Electrolysis of an aqueous solution of $CuSO_4$ using Pt electrodes.

36. Some tests carried out with the organic compound X and the observations are given below.

- When $NaHCO_3(aq)$ is added, a colourless, odourless gas was evolved.
- When Br_2/H_2O is added, its orange colour was decolorized.
- Gave a white precipitate when Toller's reagent is added
- No observation with 2, 4 – DNPH.

The compound/ compounds that comply with the above observations is/are

- a)  b)  c)  d) 

37. The correct statement/ statements regarding nitric acid is/are

- a) Pure nitric acid is a pale yellow liquid.
- b) The N -O bond lengths in HNO_3 are not all equal.
- c) In its reaction with conc. H_2SO_4 , conc. HNO_3 acts as a base.
- d) Nitric acid can act as a reducing agent.

38. The incorrect statement/ statements related to polymers is/are

- a) Terelene is a thermoplastic condensation polymer.
- b) Bakelite, urea formaldehyde and Teflon are thermosetting polymers.
- c) Polythene, PVC and polystyrene are thermoplastic linear polymers.
- d) Although Teflon is a thermosetting polymer, it can withstand high temperature due to the presence of halogen.

39. Among the statements about gases which is/are true?

- a) At room temperature and atmospheric pressure, the compressibility factor (z) of H_2 gas is greater than unity.
- b) At Boyle's Temperature, real gases conform to ideal gas behaviour for a greater range of pressure
- c) Van - der - waal's equation cannot be used for ideal gases
- d) When $Z > 1$, the gas can be compressed more easily than an ideal gas.

40. Which of the following statement/statements regarding some chemical industrial processes carried out in Sri Lanka is/ are true?

- a) In the manufacture of bleaching powder, Cl_2 gas is allowed to react with solid quick lime
- b) In the extraction of sodium by Down cell method, the cathode and anodic compartments are separated so as to avoid the reaction of Na with Cl_2
- c) In the production of urea the starting materials are NH_3 and CO_2
- d) K_2CO_3 may be produced by Solvay process.

❖ Instructions for questions 41 to 50

Response	First statement	Second statement
(1)	True	True and correctly explains the first statement.
(2)	True	True, but does not explain the first statement correctly
(3)	True	False
(4)	False	True
(5)	False	False

Statement I	Statement II
41. When a non - volatile solute is dissolved in a volatile solvent, vapour pressure of the solvent decreases.	The molar mass of the non - volatile solute cannot be determined using the depression in vapour pressure.
42. A Grignard's reagent can be produced by the reaction of $\begin{array}{c} \text{CH}_2 - \text{CH}_2 - \text{CHO} \\ \\ \text{Cl} \end{array}$ with Mg in dry ether.	If an acidic hydrogen is present in the compound, it will react with Grignard's reagent.
43. Addition of $\text{He}_{(g)}$ into the equilibrium system $\text{A}_{2(g)} + 3\text{B}_{2(g)} \rightleftharpoons 2\text{AB}_{3(g)}$ will drive the equilibrium position to the right.	When $\text{He}_{(g)}$ is inserted in to the equilibrium system, partial pressures of $\text{A}_{2(g)}$ and $\text{B}_{2(g)}$ increases in a constant volume
44. When an aqueous solution containing Cu^{2+} and Ni^{2+} ions is treated with $\text{OH}^-/\text{H}_2\text{S}$, only NiS will get precipitated	As S^{2-} ion concentration in $\text{OH}^-/\text{H}_2\text{S}$ is high, CuS will not be precipitated.
45. Unlike alkyl halides, vinyl chloride and chlorobenzene do not easily undergo nucleophilic substitution reactions.	Due to resonance, the bond between carbon and chlorine in these compounds shows a partial double bond character.
46. Spontaneous reactions occurring in an isolated system always take place with an increase in entropy.	The overall effect of ΔH and ΔS is given by the Gibb's free energy change ΔG .
47. The temperature of He gas molecules having the same mean speed as that of O_2 gas molecules must be smaller.	The distribution of mean speed of gas molecules depends on their molar mass and the temperature.
48. In contact process for the manufacture of sulphuric acid, high pressure is employed to get higher yield.	The reaction $2\text{SO}_{2(g)} + \text{O}_{2(g)} \rightleftharpoons 2\text{SO}_{3(g)}$ occurs with a decrease in the number of moles
49. 2 - methylbut - 2 - ene does not exhibit diastereoisomerism.	All three dimensional structures which are not the mirror images of each others are called diastereoisomers.
50. The boiling point of an ideal solution shows a uniform linear variation with its composition.	In an ideal solution, the attractive forces between different species is equal to that between the species of individual components.



G.C.E. A/L Examination June - 2018

Conducted by Field Work Centre, Thondaimanaru

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Provincial Department of Education Northern Province.

Chemistry IIA

Grade :- 13 (2018)

Time :- Three hours

Part II A Structured Essay

Answer all questions.

01. (A) Arrange the following in the ascending order of the properties given in parentheses.

(i) H_2O_2, HF, NH_3, H_2O (boiling point)

.....

(ii) $OH^-, NH_2^-, CH_3O^-, HCO_3^-$ (basic nature)

.....

(iii) $Na_2CO_3, BeCO_3, (NH_4)_2CO_3, BaCO_3$ (thermal stability)

.....

(iv) $NH_2^-, NH_2^+, NO_3^-, NH_3$ (bond angle)

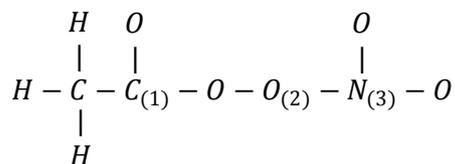
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(v) $CO, CO_2, CO_3^{2-}, C_2O_4^{2-}$ (C-O bond length)

.....

(B) Motor vehicle emissions contain NO_x and Unburnt hydrocarbons (C_xH_y). They are converted to ozone and peroxyacetyl nitrate in the presence of sunlight and temperatures above $15^\circ C$

The skeleton of the PAN molecule is given below



(i) Draw the most acceptable Lewis structure for PAN molecule

.....
.....
.....
.....

- (ii) Draw four resonance structures of PAN and comment on their relative stabilities

.....

.....

.....

.....

.....

.....

- (iii) Complete the following table with regard to the Carbon, Oxygen and nitrogen atoms indicated by $C_{(1)}$, $O_{(2)}$, and $N_{(3)}$, in the Lewis structure

Atom	Hybridization	Electron pair geometry around the atom	Shape
$C_{(1)}$			
$O_{(2)}$			
$N_{(3)}$			

- i. Identify the atomic / hybrid orbitals involved in the formation of sigma bond between the following atoms in the Lewis structure drawn in part (i) above

- i. Between $C_{(1)}$ and O atom joined with O

..... of $C_{(1)}$ and of O

- ii. Between $C_{(1)}$ and C

..... of $C_{(1)}$ and of C

- iii. Between $O_{(2)}$ and $N_{(3)}$

..... of $O_{(2)}$ and of $N_{(3)}$

- iv. Draw the shape of the PAN molecule indicating the approximate bond angles

.....

.....

.....

.....

(C) State whether the following statements are true or false giving reasons briefly for your choice (Although the)

(i) Although the reactivity of alkaline metals increases down the group, reactivity of halogens decreases down the group

.....
.....
.....
.....

(ii) The increasing order of the covalent character of the compounds $MgBr_2, CaCl_2, BaF_2$ and $BaCl_2$ is $MgBr_2 < CaCl_2 < BaCl_2 < BaF_2$

.....
.....
.....
.....

(iii) The first electron affinity of carbon is negative while that of N is Positive

.....
.....
.....
.....

(iv) The melting point of Zn is much higher than that of Co.

.....
.....

02. (A) Q,R and T are three consecutive, non transition elements in the periodic table. R forms more than one oxide. These oxides are either acidic or neutral. R never forms basic oxide. One of the above oxides undergoes disproportionation with water. One of the Hydrides of R which is basic is used in rubber industry.

(i) Identify the above mentioned elements Q, R and T

Q = R = T =

(ii) Write balanced equation for the disproportionation reaction of the oxide with water

.....
.....

(iii) Write balanced equation for the reaction of the oxide of R in its highest oxidation state with $NaOH_{(aq)}$

.....
.....

(iv) Another hydride of R, not mentioned in the question, may show acidic nature. Give the formula and the name of it.

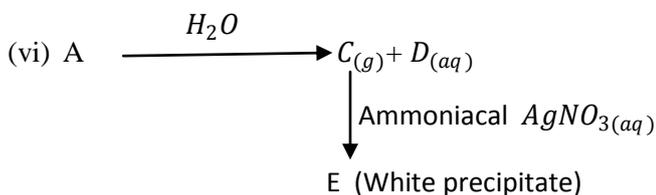
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- (v) The element Q reacts with quick lime under certain conditions and gives A and B as products. A is a solid and B is a gas. Give the chemical formula of A and B and the relevant condition of the reaction

A =

B =

Reaction conditions



Identify C,D and E

C =

D =

E =

- (B) You are required to identify the solutions NaOH, KI, Pb(NO₃)₂, Na₂S₂O₃ and CuCl₂ which are given in the test tubes labelled as A,B,C,D and E

The solutions are not in that order

The observations when the other solutions are added separately into solution A are given below.

- i. When solution B is added, a white precipitate formed which turned black after some time.
- ii. When solution D is added drop wise, initially a white precipitate was observed and it dissolved on addition of excess D.
- iii. When solution E is added, a white precipitate and a coloured solution were obtained. The precipitate dissolved on heating and re-deposited when allowed to cool.

I. Identify the solutions A to E

A =

B =

C =

D =

E =

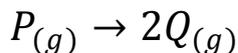
II. Mention an experiment to identify the anion in solution A

.....

III. Write balanced equation for the reaction when dilute HCl is added to solution B

.....

03. (A) When 0.020 moles of gas P was placed in an evacuated rigid vessel at 1.0 dm^3 volume at 127°C in the presence of a small amount of a solid catalyst, it decomposed according to the equation.



The concentration of $Q_{(g)}$ with time was measured and the results were tabulated.

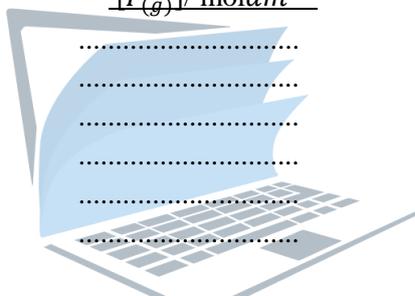
Time/s	$[Q] / \text{mol dm}^{-3}$
0.0	0.000
50.0	0.008
100.0	0.016
150.0	0.024
200.0	0.032
250.0	0.040

- i. Calculate the concentrations of P, $[P]$, corresponding to the times mentioned in the above table.

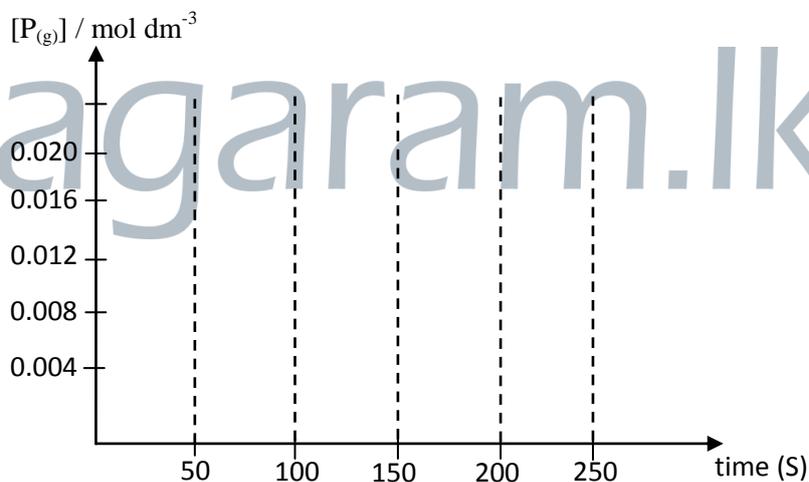
Time/s

0.0
50.0
100.0
150.0
200.0
250.0

$[P_{(g)}] / \text{mol dm}^{-3}$



- ii. Show the variation of $[P_{(g)}]$ with time in the following graph.



- iii. Taking the order and the rate constant of the reaction as n and k respectively, write the expression for the rate law of the reaction.

.....
.....

- iv. Deduce the value of n using the above graph. Give reasons briefly.

.....
.....
.....
.....

v. Find the value of the rate constant k at 127°C

.....
.....
.....
.....
.....

vi. Calculate the pressure inside the vessel at 127°C when 75 % of the initial amount of $P_{(g)}$ has dissociated. [Neglect the volume of the catalyst].

.....
.....
.....
.....

vii. Mention the temperature and pressure at which the three phases of water co- exist together in equilibrium.

Temperature :-

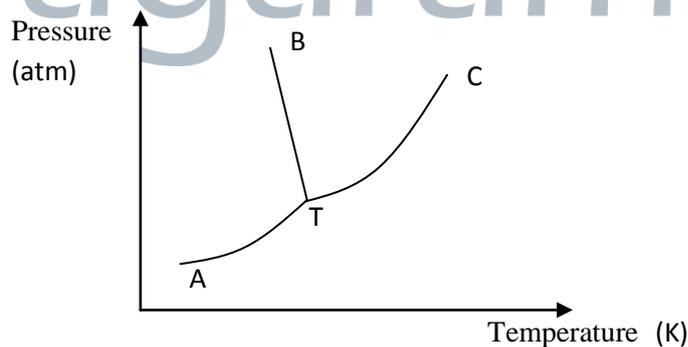
Pressure :-

viii. If the temperature of ice is increased under a pressure below that you mentioned above, state the physical change in it?

.....
.....
.....

(B) The diagrams indicating the phase changes of a particular substance with temperature and pressure are called phase diagrams .

The phase diagram of water is given below.



i. Indicate the regions of solid, liquid and gaseous phases of water with the letters X,Y and Z respectively in the above phase diagram.

ii. How is the point T called?
What is its significance ?

.....
.....
.....

iii. What is meant by the critical temperature of water?

.....
.....
.....

04. (A) D, E and F are three compounds with the molecular formula $C_5H_{10}O$, which give orange precipitate with Brady's reagent. All the three compounds D, E and F give the same product G with Zn/Hg, conc. HCl. Of the three compounds, only D exhibits optical activity while only D and E give silver mirror with Tollen's reagent.

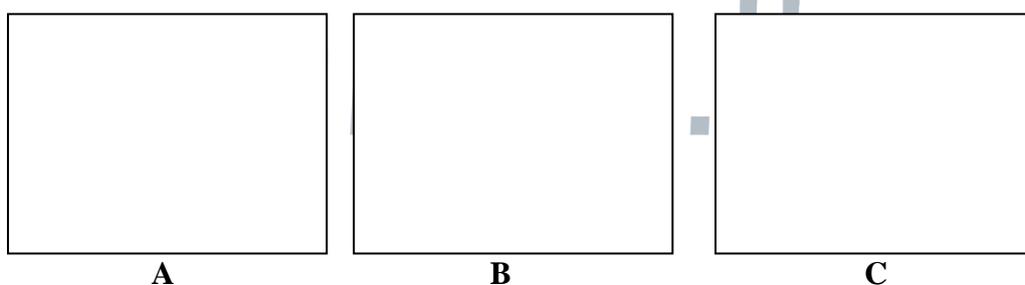
(i) Draw the structures of D, E, F and G in the boxes given below.



(ii) A, B and C are three structural isomers of D, E and F. Only A gives silver mirror with Tollen's reagent and forms aldol type compound with dilute NaOH

When B and C were treated with $NaBH_4$ separately, only B gave a product having optical activity. When the product obtained from C in the above reaction was treated with Lucas reagent, a turbid was formed after a short time.

Draw the structures of A, B and C in the relevant boxes given below.

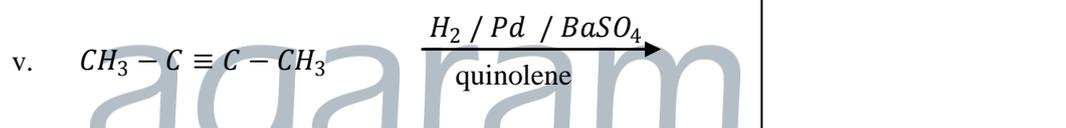
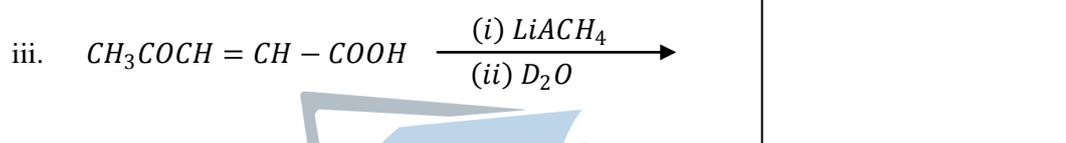
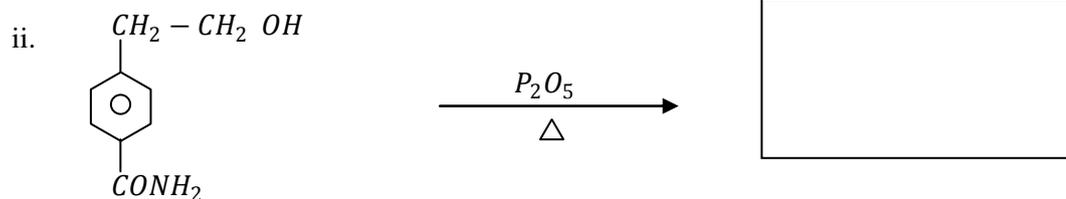
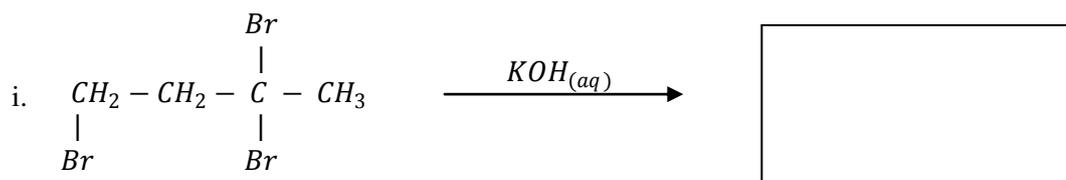


(iii) The above mentioned compounds A, D and E have another chain isomer H. Draw the structure of H.



H

(B) Write the products of the following reactions in the cages against them.



(C) Consider the reaction of $\text{C}_6\text{H}_5\text{CHO}$ with $\text{C}_2\text{H}_5\text{ONa}$.

(I) Mention the type of mechanism of the above reaction.

.....

(II) Write the mechanism for the above reaction.

.....



G.C.E. A/L Examination June - 2018

Conducted by Field Work Centre, Thondaimanaru

In Collaboration with

Provincial Department of Education, Northern Province.

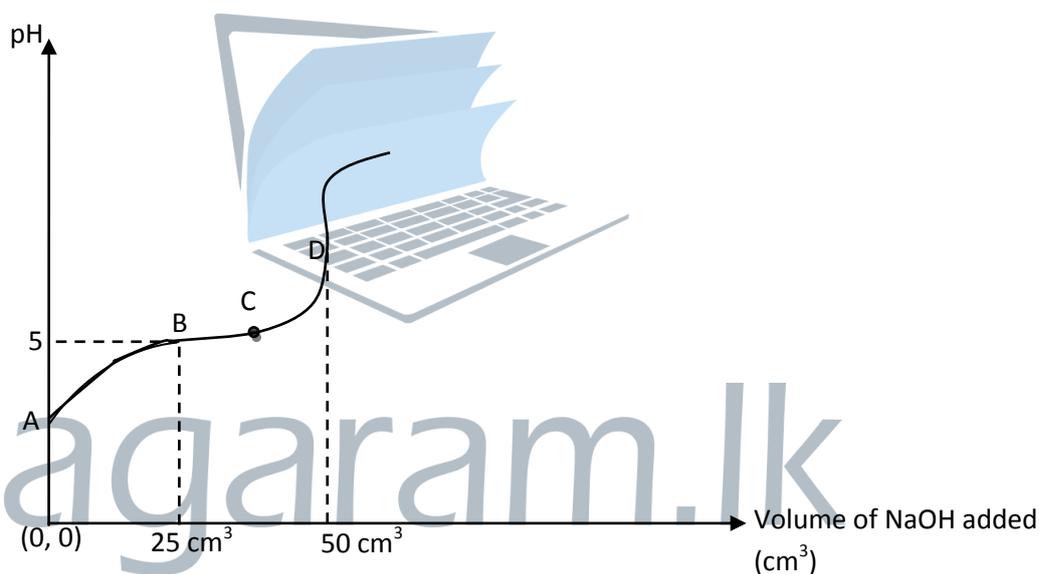
Chemistry IIB

Grade :- 13 (2018)

Part IIB - Essay Questions

Answer only two questions

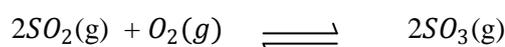
- 05) (a) The following graph shows the variation of pH when 25cm^3 of a weak acid HA is titrated against a 0.1mol dm^{-3} aqueous solution of NaOH.



- What is the concentration of the weak acid HA?
 - Find the ionization constant K_a of HA.
 - What is the pH value corresponding to the point A?
 - Find the pH at the equivalence point of the titration
 - If the colour change pH interval of two indicators X and Y are 3.1 – 4.4 and 8 – 9.6 respectively, which one may be used for the above titration?
- (b)
- A solution has 0.01 M Ag^+ and 0.01 M Ba^{2+} . Solid K_2CrO_4 is added slowly. Assuming no volume change,
 - Calculate the concentrations of CrO_4^{2-} ion when Ag_2CrO_4 and $BaCrO_4$ start precipitating
 - Which ion is precipitated first?
 - What is the concentration of first ion in the solution when the second ion starts precipitating?

- d) Would the addition of CrO_4^{2-} be a practical method of separating Ag^+ and Ba^{2+}
 Given :- $K_{sp}(Ag_2CrO_4) = 1.1 \times 10^{-12} mol^3 dm^{-9}$,
 $K_{sp}(BaCrO_4) = 2.2 \times 10^{-10} mol^2 dm^{-6}$,

- II. An aqueous solution of a metal bromide MBr_2 of concentration $0.05 mol dm^{-3}$ is saturated with H_2S . What is the minimum pH at which MS will precipitate? K_{sp} for $MS = 6.0 \times 10^{-21} mol^2 dm^{-6}$ concentration of saturated $H_2S = 0.1 mol dm^{-3}$, first and second ionization constant of H_2S are
 $K_1 = 1 \times 10^{-7} mol dm^{-3}$ and $K_2 = 1.3 \times 10^{-13} mol dm^{-3}$ respectively.
- (C) When SO_2 and O_2 gases were mixed in a closed vessel, the initial pressure was found to be 3×10^5 Pa. When the gases were allowed to react with each other by passing them over a catalyst at $500^\circ C$, the following reaction took place and the system attained equilibrium.



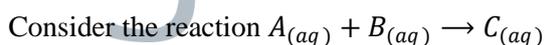
In the equilibrium system, the partial pressure of $SO_3(g)$ was $1.8 \times 10^5 pa$

- Find the partial pressures of SO_2 and $O_2(g)$ in the mixture at equilibrium
- Find the total pressure of the equilibrium system and the percentage of conversion of $SO_2(g)$ to $SO_3(g)$
- Calculate the K_p for the equilibrium reaction at $500^\circ C$



06. (a) i. Define the terms “initial rate” and “average rate” of a reaction.
 ii. Mention 4 factors that influence on the rate of a reaction.

Briefly explain how you would experimentally show that one of the above factors affects the rate



Result of four experiments to investigate the kinetics of the above reaction are given below:

Expt.No	Initial concentration		Initial rate/ $mol dm^{-3} s^{-1}$
	[A]/ $mol dm^{-3}$	[B] $mol dm^{-3}$	
1	1×10^{-3}	2×10^{-2}	3×10^{-5}
2	2×10^{-3}	2×10^{-2}	6×10^{-5}
3	2×10^{-3}	4×10^{-2}	6×10^{-5}
4	4×10^{-3}	3×10^{-2}	R

- What is the overall order of the reaction?
- Calculate the rate constant K?
- Find the value of R
- “When $[B_{(aq)}]$ remains a constant, the half life of the above reaction is independent of the initial concentration of $A_{(aq)}$ ”
 Justify the above statement with the help of a suitable graph

- (b) i. What is meant by a “buffer solution”?
- ii. Derive an expression for the pH of a buffer solution containing a weak acid HA and its strong base salt NaA.
(The ionization constant of the weak acid at the given temperature is K_a)
- iii. In the titration of a particular volume of a solution of a weak acid HA with NaOH, the pH is 5.8 after 10.0 cm^3 NaOH solution has been added and 6.402 after 20.0 cm^3 of the same NaOH has been added from the burette,
Calculate the ionization constant, K_a , of the weak acid HA.

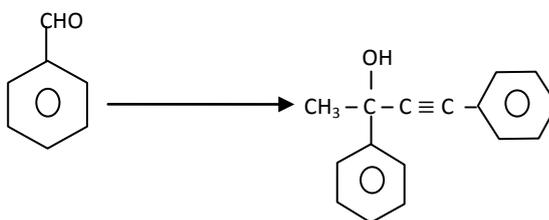
- (c) i. State Raoult’s law as applied to a system which consists of two completely miscible liquids.
- ii. Derive a mathematical expression for Raoult’s law considering the equilibrium that exists between two completely miscible liquids A and B and their water vapours.
[mole fractions of A and B at equilibrium are X_A and X_B , their partial pressures P_A, P_B and pure vapour pressures are P_A^0 and P_B^0 respectively]
- iii. Two completely miscible volatile liquids A and B form an ideal solution. When the mole fractions in the liquid phase are $X_A = 0.2$ and $X_B = 0.8$, the vapour pressure of the equilibrium system is P

When the mole fractions are changed to $X_A = 0.6$ and $X_B = 0.4$, the pressure of the vapour phase which is in equilibrium with liquid phase is Q.

During the process, the system was maintained at constant temperature.

If $\frac{P_A^0}{P_B^0} = 6$, find the ratio $\frac{P}{Q}$.

07. (a) Show how you would effect the following conversion using only the chemicals given in the list below.



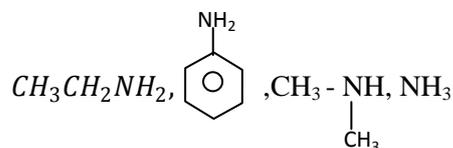
List of chemicals:-

$Br_2 / CCl_4, H_2O, alcoholic KOH, PCC,$
 $CH_3MgBr / dry ether Al_2O_3$

- (b) Indicate how the compound $C_6H_5 - CH = N - CH_2 - C_6H_5$ could be synthesised using benzene as the starting compound. Your reaction scheme should not exceed 7 steps.

(c) i. Phenol does not undergo nucleophilic substitution reactions easily
Explain the reason for it.

ii. Consider the following compounds



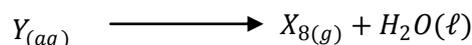
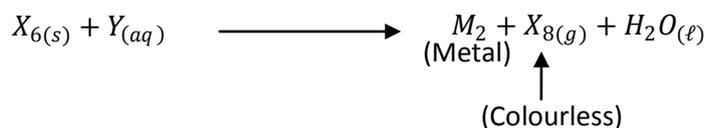
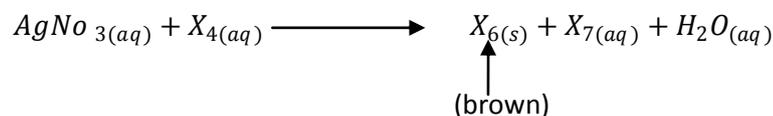
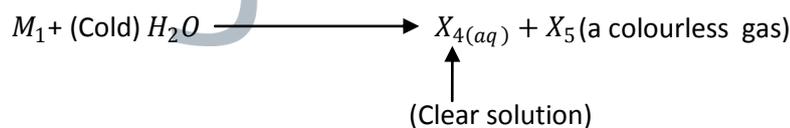
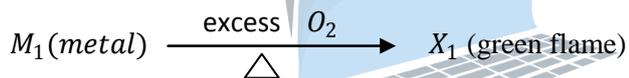
Arrange the above compounds in the order of the increasing basic strength and briefly explain your answer

Part II C

Answer any two questions in this part.

08. (a) When the ionic compound X_1 is treated with cold water, the aqueous solution of the inorganic compound $Y (M_r < 35)$ is formed. Y is a syrupy liquid at room temperature. The boiling point of Y is greater than that of water.

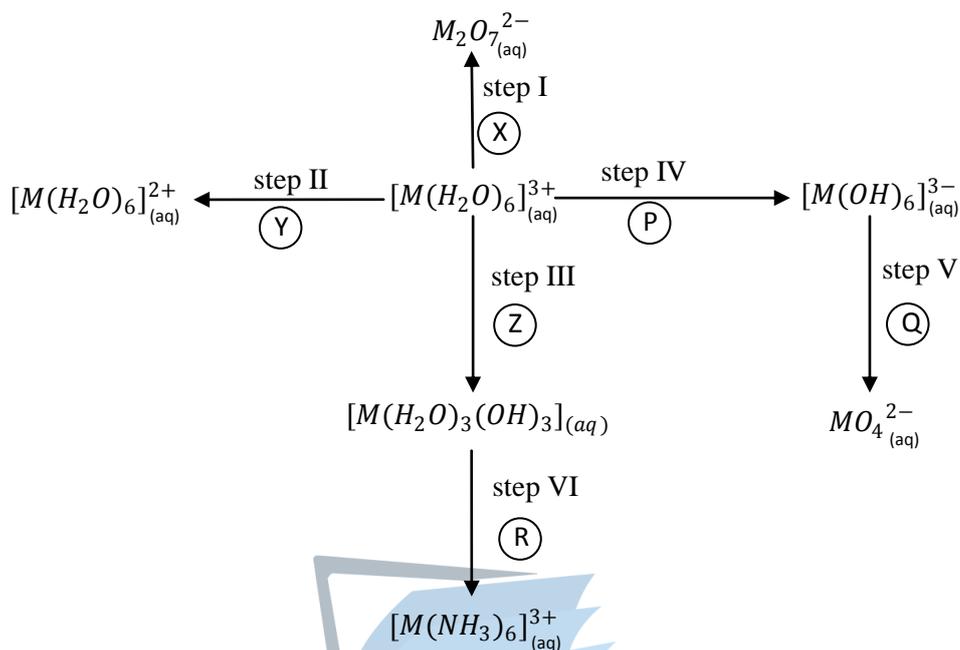
The following data is based on some S,P and d block elements in the periodic table



Based on the above information,

- identify the inorganic compound Y_1 , metals M_1 and M_2 , and the substances X_1 - X_8
- Write the balanced equation for the reaction of Cl_2 with Y
- Mention 2 uses of Y

- (b) M is a first row transition element which forms two oxy anions MO_4^{2-} and $M_2O_7^{2-}$. A reaction scheme involving some reactions of $M_{(aq)}^{3+}$ are given below



The reagents used for step I to VI are X, Y, Z, P, Q and R respectively.

- Identify the element M.
 - Identify the species X, Y, Z, P, Q and R.
 - What are the colours of $[M(H_2O)_6]^{3+}$ and $[M(NH_3)_6]^{3+}$?
 - Write the colour of the species obtained in steps I to V.
 - Indicate the colour change and the balanced equation for the relevant reaction when $OH_{(aq)}^-/H_2O_2$ is added to $[M(H_2O)_6]_{(aq)}^{3+}$.
- (c) A 8.0g sample contained Fe_3O_4 , Fe_2O_3 and an inert material. It was treated with an excess of aqueous KI solution in acidic medium which reduced all the iron to Fe^{2+} . The resulting solution was diluted to $50.0cm^3$ and a $10.0cm^3$ of it was taken. The liberated iodine in this solution required $7.2cm^3$ of $1.0mol\ dm^{-3} Na_2S_2O_3$ for reduction to iodide. The iodine from another $25.0cm^3$ sample was extracted after which the Fe^{2+} ion was titrated against $0.1mol\ dm^{-3} MnO_4^-(aq)$ in acidic medium. The volume of $KMnO_4$ solution used was found to be $4.2cm^3$. Calculate the mass percentages of Fe_3O_4 and Fe_2O_3 in the original mixture
(Given :- Molar mass of $Fe = 56gmol^{-1}$, $O = 16gmol^{-1}$)

10. (a) P, Q and R are coordination compounds. The coordination sphere in them are either positively charged or neutral and all of them have an octahedral geometry. If these compounds contain non-coordinated anions, they are of the same type, and also simple anions. The oxidation state of the central metal ion in all three compounds is the same in each compound.

The atomic composition of the species in the coordination sphere (metal ion and the ligands coordinated to it) in P, Q and R are $CoH_9N_3Cl_3$, $CoH_{12}N_4Cl_2$, $CoH_{15}N_5Cl$ but they are not in the given order.

- No precipitate was formed when $AgNO_3(aq)$ was added to an aqueous solution of Q
- Mass of the white precipitate obtained when $AgNO_3(aq)$ was added to a $100cm^3$ solution of P with concentration $0.1mol\ dm^{-3}$ was found to be 2.870g and this precipitate dissolved in dilute ammonia solution.

(The relative molar mass of the compound in white precipitate = 143.5)

- Identify the ligands coordinated to the metal ions in P, Q and R.
- Write the chemical formula of the white precipitate.
- Deduce the structural formula of P, Q and R and write their names according to the IUPAC nomenclature.

- (b) i. State Faraday's laws of electrolysis.

- ii. At $25^\circ C$, $500cm^3$ of $1\ mol\ dm^{-3}$ aqueous solution of Na_2SO_4 is electrolysed by using pure magnesium as the anode and an inert electrode X as the cathode by passing a current of 50mA. Assuming that the ions formed at the electrode spread throughout the entire solution to form a homogeneous solution at the moment they are formed, answer the following questions.

(Molar charge of electrons = $96,500\ C\ mol^{-1}$)

- Draw the labelled diagram of the electrolytic cell used.
- Write balanced half ionic equations for the reactions taking place at the electrodes.
- Calculate the time for which the electrolysis must be carried out to form a slight turbidity in the solution

(At $25^\circ C$, K_{SP} of $Mg(OH)_2(s) = 4 \times 10^{-12}\ mol^3\ dm^{-9}$)

- iv. In another experiment, electrolysis is carried out for 7.72 minutes using the same current. If the precipitate obtained is filtered and heated to constant mass, find the mass of residue. (Mg=24, O=16)