G.C.E. A/L Examination June - 2017

Conducted by Field Work Centre, Thondaimanaru
In Collaboration with
Provincial Department of Education Northern Province

Grade:13(2017)	***Chemistry***	***Two hours***

1) There are only two electrons in the outermost sub energy level in the ground state of element A. Their quantum numbers are respectively

	n	l	m_ℓ	m_s
(i)	4	0	0	+1/2
(ii)	4	0	0	-1/2

Which could be the element A?

(i) Cu (ii) Ge (iii) Zn (iv) Cr (v) Sr

2) Which of the following is incorrect Lewis structure?

i) $:C = \ddot{O}:$ ii) $N \equiv \overset{(+)}{N} - \underset{..}{\overset{..}{O}}\overset{(-)}{:}$ iii) $:\underset{..}{\overset{(-)}{S}} - C \equiv N:$ iv) $:O - \overset{(-)}{C} \equiv \underset{..}{\overset{..}{N}}:$

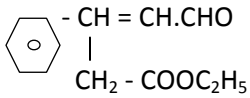
v) $\ddot{N} \equiv N - \underset{..}{\overset{..}{N}}:^{2-}$

3) Which pair has only London dispersive forces?

(i) NO_2, CO_2 (ii) BF_3, NH_3 (iii) SiF_4, O_3 (iv) $SiCl_4$, C_6H_6
(v) $BeCl_2$, SO_2

4) What is the minimum volume of 0.40mol dm^{-3} KI (aq) to convert 0.1 mol dm^{-3}, 20 cm^3 IO_3^- completely into I_3^- in acidic medium?

(i) 80 cm^3 (ii) 40 cm^3 (iii) 20 cm^3 (iv) 10 cm^3 (v) 160 cm^3

5) 

IUPAC name of the compound is

(i) 1 - ethyl - 5 - formyl - 3 - enpentoate

(ii) ethyl - 5 - formyl - 3 - phenyl - 3 - pentenote

(iii) ethyl 5 - formyl - 3 - phenyl - 3 - pentenoate

(iv) ethyl 5 - oxo - 3 - phenyl - 3 - pentenoate

(v) ethyl 3 - phenyl - formylpent -3 – enoate

6) The **incorrect** statement regarding the role of catalyst in the industrial manufacturing process.
   (i) Catalysts increase the efficiency of production
   (ii) Catalysts increase the percentage yield
   (iii) Catalysts decrease the manufacturing cost
   (iv) Catalysts decrease the activation energy
   (v) Catalysts decrease the time to attain equilibrium of reversible reactions

7) Correct structure regarding the emission spectrum of hydrogen is
   (i) Could calculate the energy of the 4th energy level using the fregquency of H_β in Balmer series.
   (ii) Could calculate the ionisation energy of hydrogen using the line with highest frequency in Lyman series.
   (iii) The lines converge in each series with the increase in wavelength.
   (iv) Resembles the emission spectrum of He^+ in all aspects.
   (v) All atoms having one electron in the outermost energy level have similar spectrum

8) The ion which gives a yellow precipitate with dil HNO_3, KI and clear colourless solution on heating is

   (i) Ag^+ (ii) Cu^{2+} (iii) Fe^{3+} (iv) Pb^{2+} (v) Hg^{2+}

9) The property of Li which is different from the property of Mg is
   (i) Solubility of hydroxide in water
   (ii) Reaction with atmospheric N_2
   (iii) Formation of insoluble carbonates in water
   (iv) Thermal decomposition of nitrates
   (v) Solubility of fluorides in water

10) $H_3O^+_{(aq)} + OH^-_{(aq)} \rightarrow 2H_2O_{(l)}$ $\Delta H^\ominus = -57.3\ kJmol^{-1}$

   But $HF_{(aq)} + NaOH_{(aq)} \rightarrow NaF_{(aq)} + H_2O_{(l)}$ $\Delta H^\ominus = -63.2\ kJmol^{-1}$

   The most appropriate reason is

   (i) HF is a weak acid

   (ii) $F^-_{(g)} + aq \rightarrow F^-_{(aq)}$ is highly exothermic process

   (iii) NaF releases large amount of heat on dissolving in water

   (iv) At standard state HF dissolves readily in water

   (v) Dissolution of NaOH in water is exothermic process

11) The **incorrect** statement regarding the chlorides of the elements,

(i) Aqueous solution of $FeCl_3$ is acidic in nature
(ii) The solution becomes turbid when $BiCl_3$ is dissolved in water
(iii) When we add NCl_3 into water, strong acidic solution is produced
(iv) $MgCl_2$ undergoes partial hydrolysis.
(v) The complete hydrolysis of PCl_5 yields H_3PO_4

12) The species having different electron pair geometry than the others
(i) NCl_3 (ii) BF_4^- (iii) MnO_4^- (iv) ClO_3^- (v) XeF_4

13) Which could not be used to distinguish between $Na_2SO_{3(aq)}$ and $Na_2S_2O_{3(aq)}$,
(i) dil H_2SO_4 (ii) Br_2 (aq) (iii) $AgNO_3$ (iv) $Pb(CH_3COO)_2$ (v) dil HNO_3

14) Correct statement regarding polymers
(i) PVC is a thermo setting plastic
(ii) Vulcanized rubber is a linear polymer
(iii) Simple unit of PTFE is $CF_2 = CF_2$
(iv) Bakelite could dissolve in organic solvents
(v) The repeat unit of polystyrene is $C_6H_5\ CH = CH_2$

15) The IUPAC name of $[Co(NH_3)_3(H_2O)_3][Fe(CN)_6]$ is
(i) triamminotriaquacobalt(iii) hexacyanidoferrate(iii)
(ii) triaquatriamminecobalt(iii) hexacyanidoferrate(iii)
(iii) triaminotriaquacobalt(iii) hexacyanidoiron(iii)
(iv) triamminetriaquacobalt(iii) hexacyanoferrate(iii)
(v) triamminotriaquacobalt(iii) hexacyanidoferrate(ii)

16) At what temperature the gas Ar could have the same root mean square speed of He at 27°C ? (assume ideal behaviour of He, Ar) (He = 4.0, Ar = 40)
(i) 1270°C (ii) 3727°C (iii) 27°C (iv) 4000°C (v) 3000K

17) Which could be used to distinguish between $CH_3C \equiv CH$ and $CH \equiv CH$?
(i) $CuCl/NH_{3(aq)}$ (ii) $Br_{2(aq)}$
(iii) Dilute cold alkaline MnO_4^- (iv) dil H_2SO_4, Hg^{2+} gpd; $AgNO_3/NH_3$
(v) $NaNH_2$ and then $CuCl/NH_3$

18) Which could produce yellow precipitate with H_2S in alkaline medium

(i) Zn^{2+} (ii) Cd^{2+} (iii) Sn^{2+} (iv) Cr^{3+} (v) Fe^{3+}

19) 0.5 $moldm^{-3}$ dil HCl is added dropwise into 1.0 dm^3 $AgNO_{3(aq)}$ until the reaction is completed The dry mass of the precipitate is 0.287 g. The concentration of $AgNO_{3(aq)}$ and volume of HCl are respectively

(i) 2×10^{-2} $moldm^{-3}$, 40 cm^3

(ii) 2×10^{-2} $moldm^{-3}$, 4.0 cm^3

(ii) 2 $moldm^{-3}$, 4.0 cm^3

(iv) 1×10^{-2} $moldm^{-3}$, 40cm^3

(v) 2×10^{-1} $moldm^{-3}$, 40 cm^3

20) 0.1 $moldm^{-3}$ 15.0 cm^3 NaOH is added to 0.1 $moldm^{-3}$, 20.0 cm^3 A which is an organic mono basic weak acid and could function as acid – base indicator. The pH of the resulting solution is 5.5 Which could be the pH range of this indicator?

($pH = pKa + \lg \frac{[salt]}{[acid]}$, log 30 = 1.5)

(i) 5 - 7 (ii) 4 - 6 (iii) 3 -5 (iv) 7 - 9 (v) 4.5 - 6.5

21) Which would give gaseous neutral compound on heating?

(i) $NaNO_3$ (ii) $(NH_4)_2Cr_2O_7$ (iii) NH_4NO_2 (iv) NH_4NO_3 (v) $KMnO_4$

22) The solubility of the sparingly soluble salt MCl_2 in 0.010 $moldm^{-3}$ $BaCl_2$ at 30^0C is 1×10^{-8} $moldm^{-3}$. The solubilitgy product of MCl_2 is

(i) 1×10^{-12} mol^2dm^{-6} (ii) 1×10^{-10} mol^3dm^{-9} (iii) 2×10^{-8} mol^3dm^{-9}

(ii) 1×10^{-12} mol^3dm^{-9} (v) 1×10^{-8} mol^3dm^{-9}

23) Which of the following statements is **incorrect**?

(i) Amides give NH_3 when heating with NaOH(aq)

(ii) Basic strength of trimethylammine is greater than ethylamine

(iii)Basic strength of CH_3OH is greater than H_2O

(iv)2 - aminopropanoic acid exhibits amphoteric character

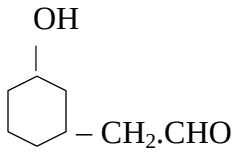
(v) C_6H_5OH is less acidic than 4 – nitrophenol

(vi)

24) Which of the following compound could show the diastereomerism?

(i) $CH_3CH(OH).CH_2CH_3$ (ii) $CH_3CH = C.(CH_3)_2$ (iii) $CH_3CH_2CH_2.\underset{\underset{OH}{|}}{CH}.C_2H_5$

(iv) $CH_3CH = CBr.CH_2CH_3$ (v) $CH3CH(OH).CH_2.C(CH_3)_3$

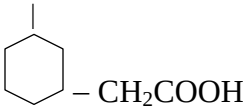
25) 

Incorrect statement regarding the reaction the above compound is

(i) Gives the blue – purple colour with neutral $FeCl_3$

(ii) Gives white fumes with PCl_3

(iii) Gives white precipitate with $AgNO_3/NH_3$

(iv) Gives  with MnO_4^-/H^+

(v) All the above are incorrect

26) Which of the following statement / s is / are correct regarding reaction mechanism of the reaction of OH^- with $C_6H_5CHBr.C_2H_5$

a) yields only $C_6H_5CHOH.C_2H_5$ as the product

b) $C_6H_5\overset{+}{C}H.C_2H_5$ is the reaction intermediate

c) A competing reaction occurs and two structural isomers are obtained.

d) Four isomeric products are obtained

(i) A, B only (ii) A, B, C only (iii) all A, B, C, D

(ii) C, D only (v) B, C, D only

27) The reaction of $CH_3CO\ddot{\underset{\cdot}{C}}l$ with $C_2H_5NH_2$

(i) Nucleophilic addition is followed by nucleophilic substitution

(ii) Nucleophilic substitution is followed by nucleophilic addition

(iii) Nucleophilic addition is followed by elimination and the overall reaction is nucleophilic substitution

(iv) An acid – base neutralisation reaction

(v) $C_2H_5NH_2$ acts as a Lewis acid

28) Consider the equilibrium $2NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$

At 77° the equilibrium pressure is 1000 kPa. The equilibrium mixture has 50% N_2O_4 Which of the following is not true at 77°C?

(i) K_P of the reaction is 2×10^{-3} kPa

(ii) The equilibrium mole fraction of $N_2O_{4(g)}$ is ½.

(iii) The percentage dissociation of $NO_{2(g)}$ is 50%

(iv) At equilibrium partial pressure of N_2O_4 is equal to that of $NO_{2(g)}$

(v) Pressure increase favoures the forward reaction

29) $C_2H_{4(g)} + H_{2(g)} \rightarrow C_2H_{6(g)}$ $R = k [C_2H_{4(g)}] [H_{2(g)}]$

At a particular temperature the above system is compressed and the pressure is trebled (three fold) of the initial pressure. The increase in rate of reaction is

(i) 3 fold (ii) 6 fold (iii) 9 fold (iv) 12 fold (v) 27 fold

30) Which of the following does not show any reaction with $H_2S_{(g)}$?

(i) $FeCl_{2(aq)}$ (ii) $FeCl_{3(aq)}$ (iii) $KMnO_4$/dil H_2SO_4 (iv) $CuSO_{4(aq)}$ (v) $AgNO_{3(aq)}$

Instructions for the questions from 31-40

1	2	3	4	5
a, b correct	**b, c correct**	**c, d correct**	**d, a correct**	**some other combination**

31) Which of the following exhibit different colours among the combination of three species

(a) ZnS, $Mg(OH)_2$, $Mn(OH)_2$ (b) CuS, MnS, CdS

(c) NiS, ZnS, SnS_2 (d) $[Cu(NH_3)_4]^{2+}$, $[Ni(NH_3)_6]^{2+}$, $[CoCl_4]^{2-}$

32) Equi molar benzene (B) tolune (T) are mixed in a closed system, and the resulting mixture shows ideal behaviour. $P_B^0 > P_T^0$. Which of the following statements is / are true?

(a) Equilibrium pressure is ½ P_B^0 + ½ P_T^0 (c) in vapour phase $X_B > X_T$

(b) in liquid phase $X_B < X_T$ (d) in vapour phase $X_B = X_T$

33) Which of the following statements is / are true?

(a) The important substance responsible for the hydroscopic nature of common salt is $MgCl_2$.

(b) KI is used to iodise the common salt.

(c) Ti is used as cathode in the manufacture of caustic soda in membrane cell process.

(d) Brine is a raw material in the manufacture of Na_2CO_3

34) $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ $\Delta H^{\ominus} = -92 kJmol^{-1}$.

The standard entropies of $N_{2(g)}$, $H_{2(g)}$ and $NH_{3(g)}$ are 192, 131, 193 ($Jmol^{-1}K^{-1}$) respectively. Which of the following statements is / are true?

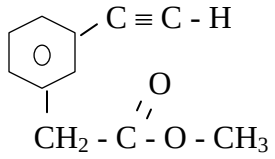
(a) $\Delta S^{\ominus}$ is negative

(b) at room temperature (27°C) the reaction is spontaneous

(c) at 900°C the reaction is nonspontaneous

(d) on the basis of thermodynamics, at low temperature $\Delta G^{\ominus} < 0$.

35)



The incorrect statement / s is / are regarding the products when the above compound is reacted with excess CH_3MgBr followed by hydrolysis

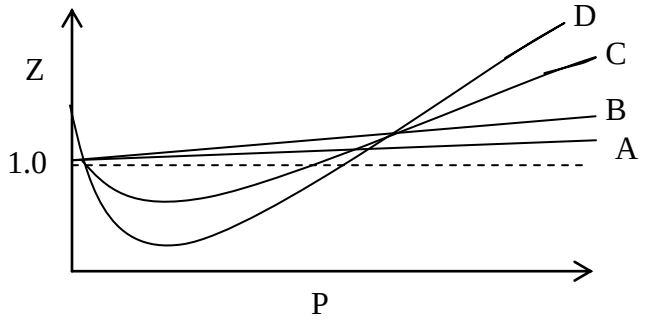
(a) One of the products gives turbidity immediately with anhydrous $ZnCl_2$ / Con HCl

(b) One of the products gives white precipitate with $AgNO_3$ / NH_3

(cOne of the products gives orange precipitate with 2, 4 - DNPH

(d) all the products give white fume with PCl_5

36)



The above graph shows the variation of compressibility factor of $CO_2(g)$ with pressure. From the above graph we could deduce,

(a) temperature deceasing order is A > B > C > D
(b) at temperature B or above the graph is linear
(c) Above the temperature B , $CO_{2(g)}$ could not be liquefied.
(d) At high pressure, intermolecular repulsions increase with increase in temperature

37) Which does not react with H_2O_2 ?
(a) MnO_2 (b) MnO_4^-/H^+ (c) PbS (d) $NaOH_{(aq)}$

38) In which of the following reactions, products have pH = 7 at 25°C?
(a) 0.1 $moldm^{-3}$ 25 cm^3 $NaOH_{(aq)}$ and 0.1 $moldm^{-3}$ 25 cm^3 $CH_3COOH_{(aq)}$
(b) 0.1 $moldm^{-3}$ 25 cm^3 $NaHCO_3$ and 0.1 $moldm^{-3}$ 25 cm^3 $HCl_{(aq)}$
(c) 0.1 $moldm^{-3}$ 25 cm^3 $NaOH_{(aq)}$ and 0.05 $moldm^{-3}$ 25 cm^3 H_2SO_4
(d) 0.1 $moldm^{-3}$ 25 cm^3 CH_3COOH (Ka = 1 x 10^{-5} $moldm^{-3}$) and 0.1 $moldm^{-3}$ 25 cm^3 $NH_{3(aq)}$ (Kb = 1 x 10^{-5} $moldm^{-3}$)

39) At room temperature X does not dissolve in water. But on addition of excess conc.HCl, evolution of gas and clear aqueous solution is / are observed. Which could be X?
(a) CuCl (b) $AgNO_2$ (c) $Pb(NO_2)_2$ (d) $Hg_2(NO_3)_2$

40) Which of the following statements is / are correct regarding
$H_2NOC - CH_2 - CH = CH - CHO$?
(a) Gives red precipitate with $CuCl/NH_3$
(b) NH_3 evolves when heated with $NaOH_{(aq)}$
(c) Gives gas bubbles with $NaNO_2$ / dil HCl
(d) The product obtained on reacting with HCN has four stereo isomers

Instructions from questions 41-50

Response	First statement	Second statement
1	true	true and correctly explains the first statement
2	true	true but does not explains the first statement correctly
3	true	false
4	false	true
5	false	false

41) H_2O and H_3O^+ are bas – conjugate acid pair;.	The following equilibrium $H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$ exists in pure water
42) A catalyst decreases the rates of forward and backward reactions by the same ratio in a reversible reaction system	Catalyst decreases the activation energy by the same amount due to change in reaction mechanism
43) Water could be used to distinguish between C_6H_5COCl and CH_3COCl	C_6H_5COOH is sparingly soluble in water.
44) O_2 gas contributes to acid rain	CO_2 is the important factor for acid rain.
45) $NaNO_2$/HCl is used to distinguish between $(C_6H_5)_2CH_2NH_2$ and $(C_6H_5)_2CHNH_2$	$NaNO_2$ / HCl could be used to distinguish between primary amine and secondary amine
46) To confirm the presence of SO_4^{2-} dil HNO_3/$BaCl_2$ could be used.	Among the salts of Ba^{2+} ,only $BaSO_4$ does not dissolve in dil HNO_3
47) If we consider only electron and proton, e/m ratio of proton is higher	Electron has one unit negative charge and proton has one unit positive charge
48) CH_3COCH_3 and $CHCl_3$ forms a solution with negative deviation	Hydrogen bonds are formed between CH_3COCH_3 ,and $CHCl_3$
49) $NO_2(g)$and $Br_{2(g)}$ form brown colour solution when added into water	At room temperature NO_2 and Br_2 undergo disproportination reaction
50) For all the neutralisations equivalence point and end point differ	Equivalent point is calculated theoretically. But end point is identified experimentally

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$NaNO_2$ / HCl could be used to distinguish between primary amine and secondary amine

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G.C.E. A/L Examination June - 2017

Conducted by Field Work Centre, Thondaimanaru
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FWC

Grade:13(2017)	*Chemistry*	*Three hours*

Part IIA - Structured Essay
Answer the four question in this question paper

(01)

A) Using the following set of elements given below answer the following.

H Na Ti Al Cr Mn C S Cl

1. Element / elements that can form compounds in highest number of oxidation States.

   .....

2. Element / elements that can form diatomic molecules.

   .....

3. Element / elements that occurs only in three allotropic forms.

   .....

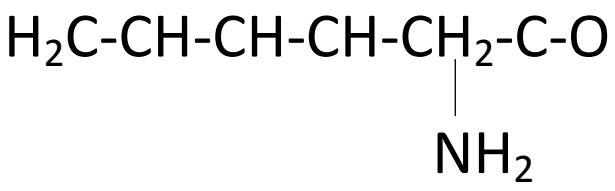
4. Element / elements that can form an oxide on reaction with concentrated HNO_3.

   .....

5. Element / elements that can form chlorides of a molecular weight 267.

   .....

B) The following questions are based on the following molecule ($CH_2CHCHCHCH_2CONH_2$). The Skeleton of the molecule is given.



1. Draw the most acceptable Lewis structure for the molecule.

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2. Draw 4 resonance structuresfor this moleculeother than you drawn in (1) above.

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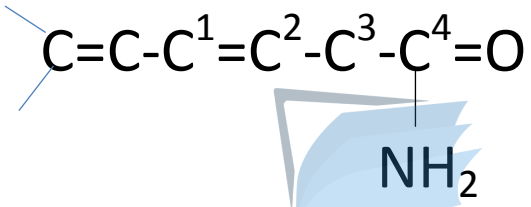
3. Based on the Lewis structure drawn in (1) above, state the following regarding the C, N and O atoms given in the table below.



	C^1	C^3	N	O
1. VSEPR Pairs				
2. Electron Pair geometry				
3. Shape				
4. Hybridization				

4. In the Lewis structure drawn in (1) above, indicate whether C^1 or C^4 is more electronegative. Give reason for your choice.

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5. Identify the atomic / hybrid orbitals involved in the formation of the following σ bonds in the Lewis structure drawn in part (1) above.

   i. C1-C2 : .....

   ii. C3-H : .....

   iii. C4-O : .....

   iv. C4-N : .....

C) State whether the following statements are true or false. Reasons are not required.

1. NCl_3 exist but NCl_5 doesn't. (.....)
2. ΔH^{θ}_{L} of MgF3 is nearly equal to ΔH^{θ}_{L} of AlF_3. (.....)
3. Solution enthalpy of solid NaCl is endohelmic at room temperature pressure. (.....)
4. Na_3AsO_4(aq) is a basic solution while $CH3COONH_4$(aq) is an acid. (.....)
5. Phenolphthalein is not used as the indicator for weak acid-strong base titrations as the observed end point is lower than the equivalence point. (.....)

(02)

A) A and B are 2 elements in the periodic table less than atomic number 40. A is a reactive metal. The compound obtained in the reaction of the metal with Sulphur is used as an electron detector in vacuum tubes. When this metal is heated in atmosphere produces a mixture of two compounds, pale yellow in colour. Normally the element B is a diatomic molecule. The product of the reaction between A and B is used in some dry cells as depolariser dry cells. commonly the salts of this element B are used in the flame test. B normallyreacts with ammonia to form N_2 and a compound C.

1. Identify elements A and B.

   .....

2. Write the electronic configuration of both A and B.

   .....

   .....

3. Write down the balanced chemical equation for obtaining the products, when A is heated in atmosphere.

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4. Write down the chemical symbol of all the compounds of A and B, mentioned in the paragraph above other than C.

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   .....

5. Indicate the relative magnitudes of the following in respect of A and B (Using <, >, = symbols)
   i. Atomic size: ……..
   ii. Density: …….
   iii. First ionization energy: ……..
   iv. Melting point: ……..
6. Identify C.

   ……

7. Write all the balance chemical equation for the reaction of B with ammonia and conditions, other than the reaction mentioned in above paragraph.

   ……..

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   ……

8. Indicate a chemical reaction to obtain B by electrolysis.

   ……

9. What are the electrodes and electrolyte used in this electrolysis? (in (8) above)

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10. Give the balanced equations for the electrode reactions.

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B) Test tubes labelled A-E contain the following chemical samples are in a rack.

PCl_3 $Na_2S_2O_3$ $KMnO_4$ $NaNO_3$ $H_2C_2O_4$ H_2CO_3 Na_2S, NCl_3

Sample	Description
A	Gives a turbidity on addition of dil. HCl.
B	Comparatively unstable weak acid used in laboratories at room temperature.
C	Gives a strongly acidic compound and a tetrahedral shape compound on hydrolysis.
D	Gives a green colour compound when heated.
E	Gives a basic gas on the reaction with NaOH in the presence of Al.

1. Identify the samples A-E.

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2. Write all the balanced chemical equations for all the descriptions mentioned in the table above.

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(03)

A) The Kinetics of the following reaction can be studied by measuring initial rates.

$$P(aq) + 5Q(aq) + 6R(aq) \longrightarrow 3S(aq) + 3T(aq)$$

The experiment carried out by changing initial concentration of P, Q, R at a constant temperature are given in the table. The change in the concentration of P $[\Delta P]_0$ with time[t/s] was measured.

Expt.	$[P]_0$/ $moldm^{-3}$	$[Q]_0$/ $moldm^{-3}$	$[R]_0$/ $moldm^{-3}$	$[\Delta P]_0$/ $moldm^{-3}$	t/s	Initial Rate(R) /$moldm^{-3}$
1	0.2	0.2	0.2	0.040	50	R1=.....
2	0.4	0.2	0.2	0.096	60	R2=.....
3	0.4	0.4	0.2	0.128	40	R3=.....
4	0.2	0.2	0.4	0.080	25	R4=.....

1. Calculate initial rates R1, R2, R3, R4 and complete the table above.
2. Deduce and write the rate orders corresponds to P, Q and R.

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3. Hence find the overall order of the reaction.

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4. Calculate the rate constant K of the reaction.

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B) A 0.10 $moldm^{-3}$ solution of aweak acid,$CH_3COOH_{(aq)}$ was prepared by diluting an appropriate amount of the pure weak acid to 25.00cm^3 with distilled water in a volumetric flask at 25^0C.The pH of this solution was 3.0.

1. Write the balanced chemical equation for the hydrolysis of the weak acid $CH_3COOH_{(aq)}$.

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2. Derive an equation for finding the Ka value of the weak acid $CH_3COOH_{(aq)}$.

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3. Calculate the value of Ka $CH_3COOH_{(aq)}$.

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4. State the assumptions you have taken for the above calculations.

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……

* Dilute solution of $CH_3COOH_{(aq)}$ was titrated with NaOH. It was found that the pH of the titration mixture after reaching the equivalence points was 9.0. ($Kw=1.0\times10^{-14}mol^2dm^{-6}$ at 25°C).

5. Derive an equation for Ka/Kw.

……

……

6. What is the important assumption have taken by you to derive above equation?

……

7. Hence calculate the concentration of salt CH_3COONa in the titration mixture, and indicate the assumption needed for the calculations.

……

……

……

……

……

……

8. What will happen if the above solution is diluted?

……

9. Find the pH of the above solution, when diluted hundred times.

……

……

……

……

……

(04)

A) Answer the following questions based on the following paragraph.

A is a non-cyclic organic compound, with the empirical formula C_3H_4O. Its exact relative molar mass is 112. A show both optical and geometrical isomerism. A reacts with 3 moles of sodium metal and doesn't react with NaOH(aq). B is a stereo isomer of A, but not the enantiomer. B react with 3 moles of H_2/Pd and gives the compound C. C reacts with H^+ / $KMnO_4$ and gives the compound D.Compound D gives orange colour precipitate with Brady's reagent and can react with $NaHCO_3$(aq). When compound D is treated with Zn/Hg/con. HCl gives a compound E.

When compound D is treated with PCL_5 the compound F is obtained.F, when reacted with excess CH_3MgBr, it gives compound G. Compound G is optically active. Compound G is treated with PCl_3

gives the compound H. H, when treated with alcoholic KOH gives a compound I as one of the minor products. I doesn't show any geometrical isomerism. I when treated with H^+ / $KMnO_4$gives J as the only one organic product and two other products K and L.

1. Draw the structures of A-M. (You don't have to show the exact shape of the bonds or molecules)

A B C

D E F

G H I

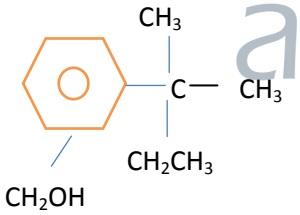
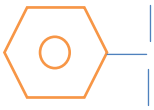
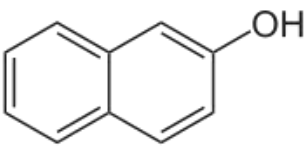
J K L

2. Give a method to separate A and B from the mixture.

.....

.....

B) The reactant and reagent in each of the reactions 1-5 are given in the table below. For each reaction complete the missing part of the table {Nucleophilic addition(A_N), Electrophilic addition(A_E), Nucleophilic substitution(S_N), Electrophilic substitution(S_E), Elimination(E), Others(Y)} and the missing compound in the chart.

	Reactant	Reagent	Reaction Type	Major Product
1	$CH_3CH_2C{\equiv}CCH_3$	Hg^{2+}/ dil. H_2SO_4		
2		Br_2/CCl_4		
3			Y (Strong Oxidation)	
4	 (An alkene)	H^+ / $KMnO_4$		$HOOCCH_2CH_2CH_2CH_2COOH$
5				

G.C.E. A/L Examination June - 2017

Conducted by Field Work Centre, Thondaimanaru
In Collaboration with
Provincial Department of Education Northern Province

FWC

Grade:13(2017)	*Chemistry*	*Three hours*

Part II B – Essay Questions
(Answer any two questions only, each questions carry 15marks.)

Q5)

(A)

The following procedures are done in order to determine the partition coefficient, K_D of butanedioic acid (BDA / $HOOCCH_2CH_2COOH$) in between benzene and water layers at 25^0C.

Initially, 25g of solid BDA is shaken well with the mixture of approximate volumes $100cm^3$of each benzene and water in a reagent bottle and allowed for some time for the layers to separate. At this stage a small amount of BDA is found in the bottom of the reagent bottle in undissolved state. Thereafter, a $50cm^3$of the benzene layer and $25cm^3$ of water layer are titrated with $0.05moldm^{-3}$ NaOH solution separately. For The titration of benzene and water layer $4.8cm^3$ and $16cm^3$ NaOH is required respectively.

1. Calculate the partition coefficient KD, of BDA in between benzene and water layers at 25^0C.
2. If the solubility of BDA in water is $8.0gdm^{-3}$, calculate the solubility of BDA in Benzene layer.

(B)

	$\Delta S/JK^{-1}mol^{-1}$
N_2	193
H_2	131
NH_3	191

($\Delta H_f(NH_3)$ =(-46kJmol^{-1})

Using the above thermochemical data, calculate the Gibbs free energy change(ΔG^{Θ}) for the '**Haberprocess'** at,

1. 27^0C
2. 450^0C, Temperatures.

at, which termprature will be NH3 form

Why in the heber process use in 450° C temperatures.

(C)

Excess amount of C(s) and 0.75mol of $CO_2(g)$ were placed in a rigid $1dm^3$container and the system was allowed to reach equilibrium at a temperature of 689^0C. Once the equilibrium was achieved, the pressure in the container was found to be 8.0×10^5Pa (Take RT = $8000Jmol^{-1}$ at 689^0C).

1. Write the expression for the equilibrium constant K_P for the following reaction.

$$C(s) + CO_2(g) \rightleftharpoons 2CO(g)$$

2. Calculate K_P and K_C at 689^0C.
3. In another experiment, the container described above contain and excess of C(s) together with CO(g) and $CO_2(g)$ at 689^0C.The initial partial pressure of which gas is 2×10^5Pa. Explain with the aid of a calculation, the change in partial pressure of $CO_2(g)$ when system reaches equilibrium.

Q6)

(A)

1. Using your knowledge in fractional distillation, explain what is fractional distillation.
2. What is the intention of using so many columns(chambers) or small tubes in fractional distillation process?
3. Explain, why non-ideal solutions can't be separated into pure forms using fractional distillation method.
4. Draw the 'boiling point Vs mole percentage graph' for an ideal solution and clearly indicates the important aspects of your graphs.

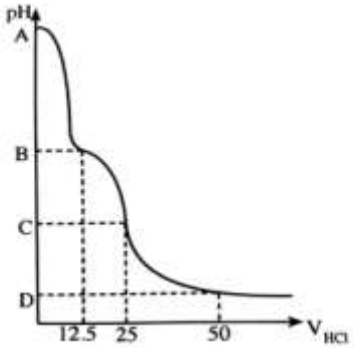
(B) AgI(s) is a yellow coloured salt sparingly soluble in water.

Its solubility product K_{SP} is $5 \times 10^{-18} mol^2 dm^{-6}$ at 25^0C.

1. Calculate the concentration of $Ag^+(aq)$ in a saturated solution of AgI in equilibrium with solid AgI at 25^0C.
2. Solid AgI together with $100.0cm^3$ of the solution described in part (1) above placed in a beaker. A volume of $100.0cm^3$ of distilled water was added to the beaker and the mixture was stirred well until the equilibrium is reached.At this stage, some solid AgI was still left at the bottom of the beaker.What could be the concentration of $Ag^+(aq)$ in this solution?Explain your answer.
3. Using a suitable calculation, predict the observation expected when $10cm^3$ of a $1.5 \times 10^{-4} moldm^{-3}$ silver nitrate solution and $5.0cm^3$ of a $6 \times 10^{-4} moldm^{-3}$ NaI solution are mixed at 25^0C.

(C)

1. Weak base B is given. Derive an expression for its dissociation constant K_b.
2. Calculate the pH of $0.1moldm^{-3}$ CH_3NH_2 solution at 25^0C. ($K_b(CH_3NH_2) = 6 \times 10^{-5} moldm^{-3}$).
3. $50cm^3$ of a 0.18 $moldm^{-3}$ HCl solution were gradually added to $25cm^3$ of a 0.18 $moldm^{-3}$ CH_3COONa



4. solution. The following graph sketches the variation of the pH of the medium during this addition. Calculate the pH values corresponding to the points A, B, C and D in the graph.

($K_a(CH_3COOH) = 1.8 \times 10^{-5} moldm^{-3}$

(K_w at $25^0C = 1.0 \times 10^{-14} mol^2dm^{-6}$)

Q7)

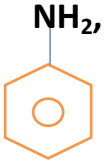
A)

(I) Tertiary alcohols can easily react with Lucas reagent but phenol can't react with Lucas reagent. Explain why,

1. Tertiary alcohols easily react with Lucas reagent?
2. Phenol can't react with Lucas reagent?

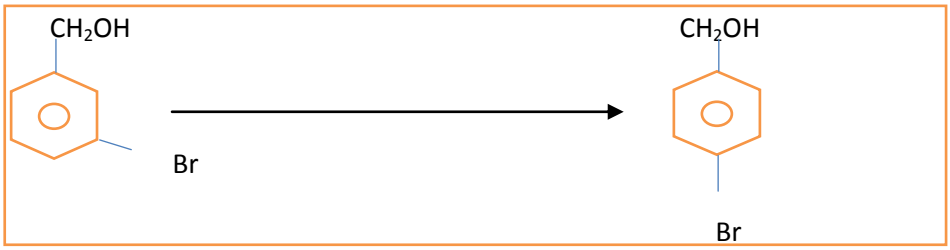
(II) Arrange the following in the increasing order of their basicity and explain the reason for your answer.

NH_3, NH_2, $CH_3CH_2NH_2$, $(CH_3CH_2)_2NH$



(B)

Using only the chemical compounds given below, carry out the following conversion.

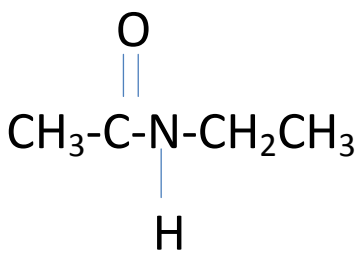


Chemical compounds

PBr_3, Mgpowder, dryether, $KMnO_4$, H_2SO_4, $LiAlH_4$, H_2O, Fe/Br_2

(C)

Show, how can you synthesize the following compound using $CH_2=CH_2$ as the only organic starting material.



(D)

Give the formula of all the compounds formed in the reaction between $CH_3CH_2CHClCH_3$ and CH_3CH_2ONa.

Part C

(Answer any two questions only, each questions carry 15 marks)

Q8)A)

The compound A (A = Mx, M = a transition Element that belongs to the 3d-block, X = a ligand). When treated with excess acidic $K_2S_2O_8$, gives the violet coloured compound B. When an aqueous solution of B is treated with conc.KOH, a green coloured compound C is produced. B, when reacted with NH_4Cl gives compound D as one of the products. Heating solid D gives a black coloured compound E (amphoteric oxide of M), water vapor and an inert diatomic gases F. (Thermal decomposition of D is same as that of $(NH_4)_2Cr_2O_7$). Sr metal when burnt in gas F gives a white solid G. The reaction of G with water liberates the gas H. This gas gives a brown colouration with Nessler's reagent.The metal Li react with liquid H to give a colorless diatomic gas I as one of the products. Anaqueous solution of A is treated with NH_4Cl/NH_4OH and then H_2S gas is bubbled through the resulting solution, a pink color precipitate is obtained the precipitate is filtered and filtrate is acidified with dilute HCl. Addition of $BaCl_2$(aq) to this solution gives white precipitate which is insoluble in dilute HCl.

1. Identify A, B, C, D, E, F, G, H, I and J.
2. Write down the equated half-ionic equations for the reaction takes place during the formation of C from B.

(B) (I) The following experiments were carried out to identify the cation and anion of a given salt "A".

Experiment	Observations
1. A portion of salt A was treated with $Ca(OH)_2$ solution and the evolving gas was treated with moist red litmus paper and HCl gas separately.	Litmus Paper was turned blue. White fumes were observed.
2. Another portion of salt A was dissolved in distilled water and it was heated with solution of Ammonium molybdate and conc. HNO_3.	A bright yellow precipitate was formed.

1. Identify the cation and anion present in the given salt A.
2. Write down the chemical formula of the saltA.

(II) An aqua solution T contains two metal ions.The following experiments were carried out to identify this metal ion.

Experiments	Observations
1. A portion of T was acidified with dilute HCl and H_2S was bubbled through the clear solution obtained.	A Yellow Precipitate Q was formed.
2. Q1 was removed by filtration the filtrate was boiled till all H_2S was removed.Then it was boring with concentrated HNO_3 and the solution was cooled.NH_4Cl andNH_4OH were added.	A green precipitate Q2 was formed.
3. Q2 was removed by filtration and a portion of Q2 was dissolved in excess concentrated NaOH.	Green colour solution was formed.
4. Another portion of Q2 was dissolved in dilute HCl and then it was shaken with excess liquid NH_3.	Yellow colour solution Q3 was formed.
5. Another portion of T was treated with iron dust for 30 minutes and then it was acidified with dilute HCl. H_2S gas was bubbled through it.	Brown colour precipitate Q4 was formed.

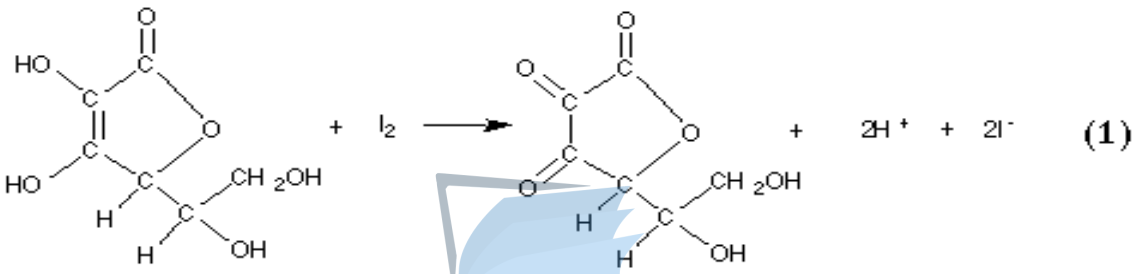
1. Identify the two metal ions in solution "T" (Reasons are not required).
2. Write the chemical formula of the compounds Q1, Q2, Q3 and Q4.

(C) The following procedures was used to measure the amount of Vitamin C (Ascorbic acid) in a fruit drink.

Procedure-1: 0.620g of $Na_2S_2O_3.5H_2O$ was dissolved in distilled water and made up to $250cm^3$ in avolumetric flask.

Procedure-2: A $10cm^3$ of $0.0024moldm^{-3}$ KIO_3 (aq), $10cm^3$ of $0.050moldm^{-3}$ KI (aq) and few drops of $1moldm^{-3}$ H_2SO_4 were added together into a titration flask. Then $10cm^3$ of the fruit drink was added and swirled gently.

Then the resulting solution was titrated with the $Na_2S_2O_3$ solution prepared in procedure-1 using starch as indicator, the volume of$Na_2S_2O_3$ required to reach the end point was $7.40cm^3$.



The reaction between I_2 and ascorbic acid($C_6H_8O_6$) is given below.

1. Calculate the concentration of $Na_2S_2O_3$ solution prepared in procedure-1. (Na=23,S=32, O=16, H=1).
2. Calculate the concentration of ascorbic acid in the given fruit drink in ppm. ($1ppm=1mgdm^{-3}$)

   (C=12, H=1, O=16).

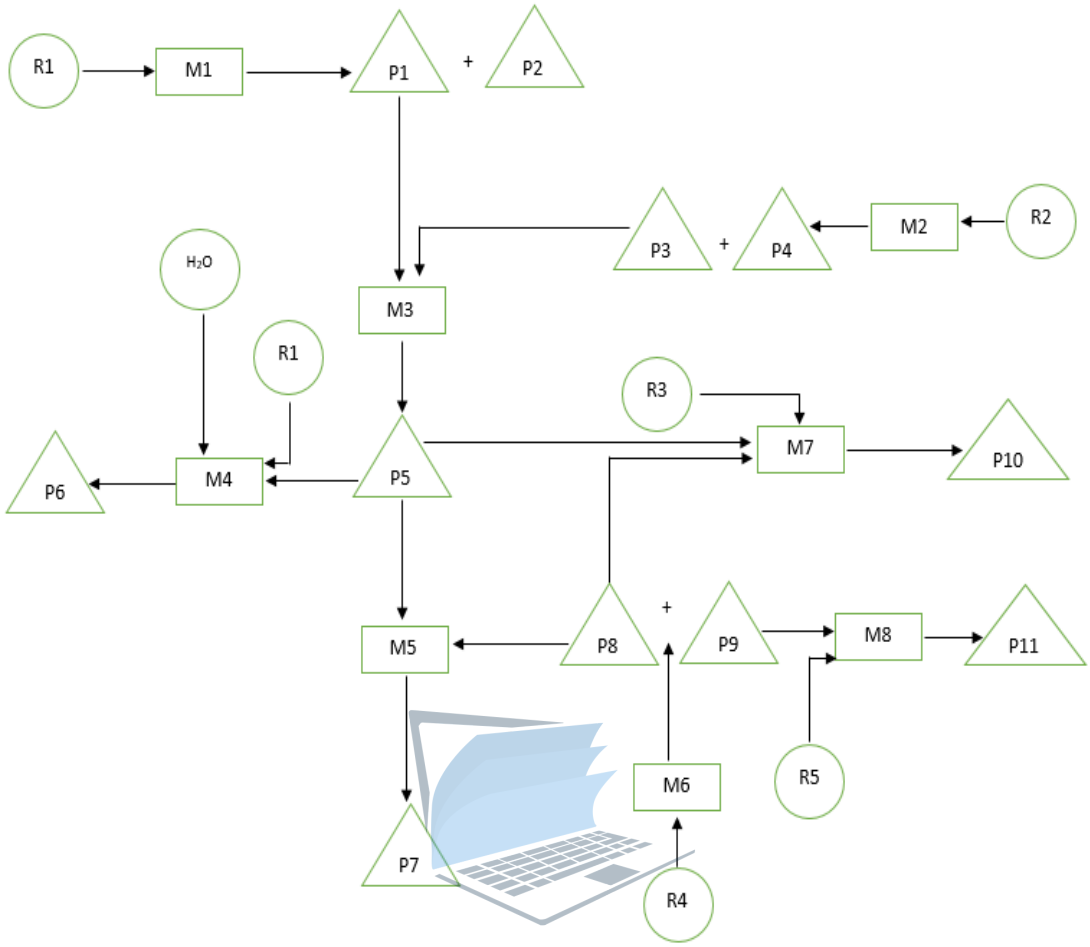
Q9) (A)

A flowchart drawn by a student to illustrate the manufacturing process in chemical industry. The following symbols are used to represent natural raw materials, manufacturing processes and products.

- R Natural raw materials

M - Manufacturing process products

P - Product



- R2 is a hydrocarbon in gaseous state.
- P5 is used in Rubber Industry for the stabilization of natural and synthetic latex to prevent premature coagulation.
- P7 is used in the manufacture of a thermos-setting polymer.
- P11 is used in the production of oxy-acetylene flame.
  1. Identify the natural raw materials R1, R2, R3, R4 and R5.
  2. Identify M1, M3, M4, M5 and M7.
  3. Identify all the products P1 to P11.
  4. Explain the manufacturing processes of M2, M6 and M8.
  5. State the catalyst, suitable temperature and pressure required to increase the efficiency of the manufacturing process M3 and M4.
  6. P5 is used as a starting material in one of these processes but it is not incorporated in any form in the final product. Name that process.
  7. Give one use for each of P6 and P10.
  8. Write two products formed when adding water to Product P11.
  9. How would you prepare $Ca(H_2PO_4)_2(s)$ from ZnS and $3Ca_3(PO_4)_2.CaCl_2$?

(B)

1. What is photochemical smog? List the factors that favour the formation of photochemical smog?
2. What are the primary and secondary pollutants of photochemical smog?
3. Identify the gas that is responsible for the brown colour of photochemical smog.

4. Suggest ways to minimize the formation of photochemical smog.
5. What is greenhouse effect? write 5 gases responsible for this phenomenon.
6. Describe the three human activities that generate carbon dioxide.
7. List two major mechanism for the uptake of carbon dioxide.
8. How does a catalytic converter change CO(g), NO(g) and C_7H_{16}(g)?Write down the reactions.
9. State inert metal / a transition metal / oxide contains in catalytic converter.
10. Ozone formed at ground level is harmful pollutant. Describe two effects that ground level Ozone can have on ecosystems and or on human health.

Q10) A)

1. The coordination compound of Cobalt(iii) contains four ammonia molecules, one sulphate ion, and one chlorine ion. Addition of aqueous $BaCl_2$ solution to an aqueous solution of this compound gives no precipitate. Addition of aqueous $AgNO_3$ to an aqueous solution of this compound produces a white precipitate. Propose a structure for this coordination compound.

2. Three coordination compounds have the same molecular formula of $CoH_{12}N_5O_2Cl_2$. They have an octahedral geometry.The oxidation state of the metal ion in all three compounds is the same. Write the structural formula and IUPAC name of each compounds.

3. Given below is the structure of diethylenetriamine (diene).

$$H_2\ddot{N}\text{-}(CH_2)_2\text{-}\ddot{N}H\text{-}(CH_2)_2\text{-}\ddot{N}H_2$$

Diethylenetriamine co-ordinates to the metal ion M^{3+} through the three nitrogen atoms to form the complex ion P (i.e. metal ion and ligands coordinated to it). P has in octahedral geometry.Write the structural formula of P and draw its structure.

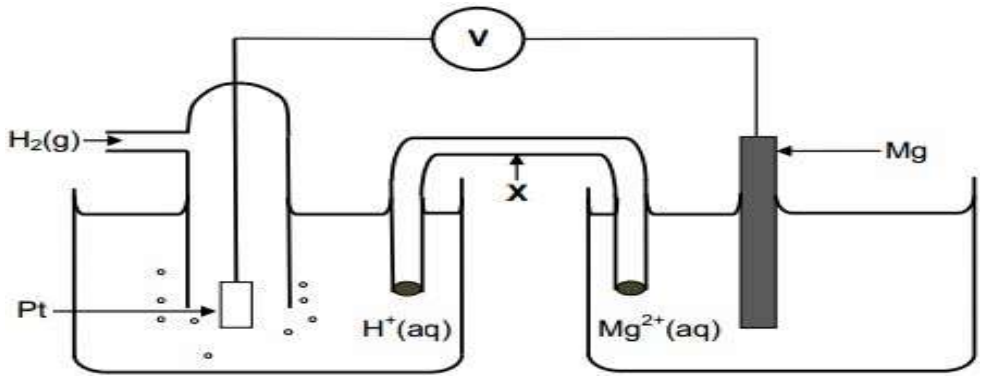
(Note: Consider that diethylenetriamine is coordinated to the metal ion.Use the abbreviation "dien" to denote diethylenetriamine in your structural formula.)

4. Given below is the structure of Ethylene diaminetetraacetate (EDTA).

It forms an octahedral Complex Q with Mn^{2+} ion in 1:1 molar ratio.It coordinates to the Mn^{2+} ion through 4 oxygen atoms and 2 nitrogen atoms to form the compound Q.Write the structural formula of Q.

B)

The Galvanic cell represented below consists of a hydrogen half-cell and magnesium half-cell at Standard conditions the reading on the voltmeter is 2.36V.



1. Apart from the concentration, write down two other conditions needed for hydrogen half-cell to function at Standard conditions.
2. Write down the name of the item of apparatus labelled as X.
3. Is magnesium the anode or cathode in the cell above?Refer to the relative strength of reducing agents to explain the answer.
4. Write down the cell notation for this cell.
5. Calculate the standard reduction potential of the magnesium half-cell.
6. Give balanced chemical equations with the physical States for the electrode reactions.
7. Write down the balanced overall cell reaction that takes place in this cell.

(C)

The notation of a standard voltaic cell containing an unknown metal X is shown below.

$X(s) / X^{3+}(aq, 1moldm^{-3}) // Pb^{2+}(aq, 1.00moldm^{-3}) / Pb(s)$

1. Identify the oxidizing agent in the above cell.
2. The initial reading on a voltmeter connected across the electrons of the above cell is 1.53V. Identify metal X by calculating the standard reduction potential of the unknown metal X.

   $E^{\ominus}Pb^{2+}/Pb = (-0.13V)$ **$E^{\ominus}Al^{3+}/Al = (-1.66V)$**

   $E^{\ominus}Fe^{2+}/Fe = (-0.44V)$ **$E^{\ominus}Cr^{3+}/Cr = (-0.74V)$**
3. How will the initial voltmeter reading be affected, if the concentration of electrolyte in the X(s)/X3+(aq), half-cell is increased.
4. Write down the balanced equation for the overall reaction taking place in this cell.

(D)

Chromium plating can be carried out on an object in an acidic solution of $2moldm^{-3}$ sodium dichromate (vi).The process is carried out on an object of surface area of $0.50m^2$.The current used in this process is 50A. Calculate the time needed to plate the object to a thickness of $1 \times 10^{-5}m$.

(Density of chromium is $7.28\ gcm^{-3}$)

(Charge of 1mol of electrons= 96500C)