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Provincial Department of Education - NWP

02	E	I

Third Term Test - Grade 12 - 2018

Index No : ....

Chemistry I

Two Hours

- *Periodic Table is provided.*
- *This paper consists of 08 pages.*
- *Answer **all** the questions.*
- ***Use of calculators is not allowed.***
- ***Write your Index Number** in the space provided in the answer sheet.*
- *Follow the instructions given on the back of the answer sheet carefully.*
- *In each of the questions **1** to **50**, pick one of the alternatives from (1), (2), (3), (4), (5) which is correct or most appropriate and mark your response on the answer sheet with a cross (×) in accordance with the instructions given on the back of the answer sheet.*

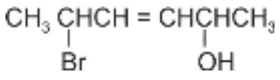
Universal gas constant $R = 8.314\ \mathrm{J\ K^{-1}\ mol^{-1}}$
Avogadro constant $N_A = 6.022 \times 10^{23}\ \mathrm{mol^{-1}}$
Planck's constant $h = 6.626 \times 10^{-34}\ \mathrm{J\ s}$
Velocity of light $c = 3 \times 10^{8}\ \mathrm{m\ s^{-1}}$

---

1. The Scientist who has the close relationship regarding Rutherford's planetary model of the atom.
   1. Dalton 2. Milikan 3 Marsdon 4. Chadwick 5. De-Brogli

2. The correct increasing order of the radius of N^{3-} , O^{2-} , F^{-} ,Na^{+} and Mg^{2+} is,
   1. $N^{3-} < O^{2-} < F^{-} < Na^{+} < Mg^{2+}$
   2. $F^{-} < O^{2-} < N^{3-} < Mg^{2+} < Na^{+}$
   3. $N^{3-} < O^{2-} < F^{-} < Mg^{2+} < Na^{+}$
   4. $F^{-} < O^{2-} < N^{3-} < Na^{+} < Mg^{2+}$
   5. $Mg^{2+} < Na^{+} < F^{-} < O^{2-} < N^{3-}$

3. What is the IUPAC name of the following compound ?



$$CH_3\underset{Br}{\underset{|}{C}}HCH = CH\underset{OH}{\underset{|}{C}}HCH_3$$

   1. 5-bromohex-3-ene-2-ol
   2. 5-bromohex-3-en-2-ol
   3. 5-bromohex-3-ene 2-ol
   4. 2-bromo-5-hydroxyhex – 3- ene
   5. 5-bromo-2-hydroxyhex-3-ene

4. The number of electrons neutrons and protons in the ion ${}^{18}_{8}O_2^{2-}$ respectively are ?
   1. 20, 16, 20
   2. 20, 20, 16
   3 18, 20, 16
   4. 10, 10, 8
   5. 20, 36, 16

5. Which of the following statement is false regarding quantum numbers of an atom.

1. The number of orbitals possible for which the quantum numbers n = 3 and $m_l = +1$ is 2.
2. $2l + 1$ number of orbitals possible [for the sub energy level which the azimuthal quantum number is l.
3. Whole numbers from $-l$ to $+l$ including zero can exist for m_l
4. The number of values which can exist for m_l directly proportional to the value of l
5. The number of the orbitals possible for which the quantum numbers $n = 4$ and $m_l = -2$ is 4.

6. The molecule without a dative covalent bond among following molecules is?

1. NO_2F 2. NO_2 3. N_2O_4 4. NO_3^- 5. NO_2^-

7. What is the mass of Ethanol should be mixed with 1kg of water where the mole fraction of ethonal is 0.2 in a mixture of ethanol and water is ? (H = 1, C = 12, O = 16) (density of water $1 g/cm^3$)

1. $92\ g$ 2. $638.8 g$ 3. $833.25 g$ 4. $200 g$ 5. $13.89\ g$

8. V_2 Volume of a hydrogen peroxide solution was required to react completely with V_1 volume of $C\ mol\ dm^{-3}$ acidified $KMnO_4$ Solution. The concentration of hydrogen peroxide solution is?

1. $2CV_1\ /\ 5\ V_2$ 2. $5\ CV_1\ /\ 2\ V_2$ 3. $2CV_1\ /\ 3\ V_2$
4. $CV_1 / (\ V_1 + V_2\ )$ 5. Data given was not enough for the calculator.

9. Which of the following statement is true regarding an elements of S – block ?

1. Carbonates of group one are stable for heat.
2. Aqueous solution of MgH_2 is neutral.
3. Oxygen gas is obtained by the dissociation of $LiNO_3$
4. All the carbonates are insoluble in water.
5. All the hydroxides of group II are insoluble in water.

10. How many resonance structures can be drawn for the ion OCN^- (Skelton O – C - N)

1. 1 2. 2 3. 3 4. 4 5. 5

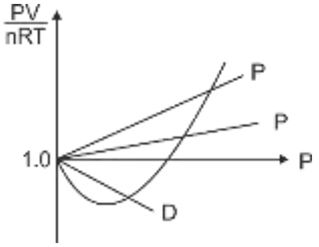
11. Which of the following statement is true regarding secondary interactions ?

1. Dispersion forces exist among some molecules could be stronger than dipole attractions.
2. $NaCl$ dissolve in water due to the formation of H bonds with water.
3. London dispersion forces exist only among non polar molecules.
4. I_2 slightly dissolves in water due to ion – induce dipole interactions.
5. Vander Waals attractions among ions become stronger, when the molecular mass of an ionic compound increases.

12. True regarding following enthalpy relationships ?

1. ΔH_f^θ (CO(g)) = $\frac{1}{2}\Delta H_f^\theta$ (CO_2 (g))
2. ΔH_f^θ (CO(g)) = ΔH_c^θ (C , graphite) - ΔH_c^θ (CO(g))
3. ΔH_f^θ (CO(g)) = ΔH_f^θ (C , graphite) + $\frac{1}{2}\ \Delta H_f^\theta$ (O_2 (g))
4. ΔH_f^θ (CO(g))= ΔH_f^θ ($CO_{2_{(g)}}$) - $\frac{1}{2}\ \Delta H_f^\theta$ (O_2 (g))
5. All above are false.

13. The gases A,B, C and D respectively in the following graph are.



1. CH_4 , H_2 , He , NH_3
2. CH_4 , He , NH_3 , H_2
3. H_2 , CH_4 , NH_3 , He
4. CH_4 , He , H_2 , NH_3
5. CH_4 , H_2 , NH_3 , He

14. Pressure of the gasses NH_3 and N_2H_4 in a rigid closed vessel is $0.6\,atm$ at 300K. NH_3 and N_2H_4 dissociate completely according to following reactions when the temperature increases up to $1000K$

$2\,NH_3(g) \rightarrow N_{2(g)} + 3\,H_2\,(g)$
$N_2H_4\,(g) \rightarrow N_{2(g)} + 2\,H_{2\,(g)}$

Then the total pressure increases up to $4.8\,atm$ calculate the mole percentage of NH_3 in the initial mixture.

1. 40% 2. 50% 3. 60% 4. 70% 5. 80%

15. Example for an intensive property ?

1. Mass 2. Density 3. Volume 4. Heat capacity 5. Charge

16. Values of a, b, c and d in the following reaction respectively are ?

$aH^+ + b\ Cr_2O_7^{2-} + c\,SO_2 \rightarrow$ Products.

1. 10,2,3 2. 26,6,2 3. 2,1,3 4. 13,3,1 5. 5,1,3

17. Standard formation enthalpy of water is $-249\,kJ\,mol^{-1}$. Standard bond dissociation enthalpies of $H-H$ and $O=O$ are $433\,kJ\,mol^{-1}$ and $492\,kJ\,mol^{-1}$ respectively. Standard mean bond dissociation enthalpy of $O-H$ is ?

1. $676\ kJ\,mol^{-1}$ 2. $464\ kJ\,mol^{-1}$ 3. $-464\ kJ\,mol^{-1}$
4. $232\,kJ\,mol^{-1}$ 5. $-232\ kJ\,mol^{-1}$

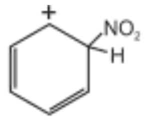
18. When $25\,cm^3$ of $1\,mol\,dm^{-3}$ KOH and $25\,cm^3$ of $1\,mol\,dm^{-3}\,HNO_3$ is mixed in a calorimeter, temperature increases by 5 ^0C . What is the enthalpy Change? (Density of water $1g/cm^3$ standard heat capacity of water 4.2 $J\ g^{-1}\ \ ^0C^{-1}$)

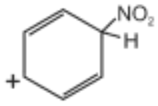
1. $+42\ kJ\,mol^{-1}$ 2. $-42\ kJ\,mol^{-1}$ 3. $+1.05\ kJ\,mol^{-1}$
4. $-1.05\ kJ\,mol^{-1}$ 5. $-26.25\ kJ\,mol^{-1}$

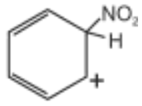
19. True among following statements ?

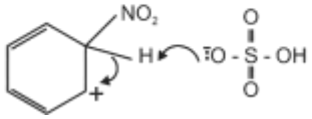
1. Ability to subject in nucleophilic substitution reactions in alkyl halides do not depend on the polarity of C – X bond.
2. Nucleophiles can act as bases.
3. Aryl halides are inert to nucleophiles but react readily with Vinyl Chlorides.
4. The main reaction shown by alkyl halides is elimination as competitive reaction.
5. Reactivity of halogens joined to SP^2 carbon atoms is higher than the halogens joined to SP^3 carbon atoms.

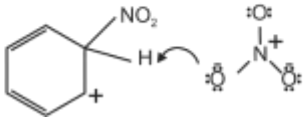
20. Not a structure relevant to the nitration of benzene.

(1)


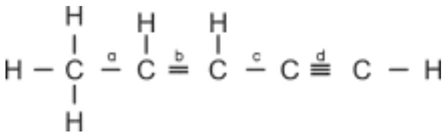
(2)


(3)


(4)


(5)


21. Consider the following compound.



$$H-\underset{H}{\overset{H}{C}}\overset{a}{-}\overset{H}{C}\overset{b}{=}\overset{H}{C}\overset{c}{-}C\overset{d}{\equiv}C-H$$

Here,

1. All carbon atoms are not lie on the same plane.
2. Bond length is d < b < c < a.
3. All hydrogen atoms lie on the same plane.
4. Bond strength is in the order of d < b < c < a
5. There are three sp hybridized carbon atoms.

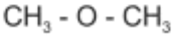
22. Which of the following reacts with both bromine water and ammonical cuprous chloride is?

1. $CH_3\,CH = \;CH_2$
2. $CH_3CH_2C\;\equiv\;CH$
3. $CH_3C\;\equiv CCH_3$
4. $CH_3\;\underset{H}{\underset{|}{C}}\;=\;\underset{H}{\underset{|}{C}}\,CH_3$
5. $CH_3CH = \;CHBr$

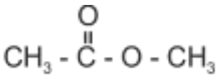
23. $C_5H_{10}O$ is an aldehyde or ketone The number of isomers can exist is?

1. 4
2. 5
3. 6
4. 7
5. 8

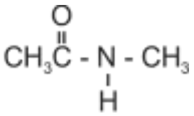
24. Which of the following is an ether?

1. 

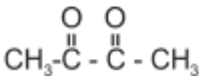
CH_3-O-CH_3

2. 

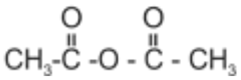
$CH_3-\overset{O}{\overset{\|}{C}}-O-CH_3$

3. 

$CH_3\overset{O}{\overset{\|}{C}}-\underset{H}{\underset{|}{N}}-CH_3$

4. 

$CH_3-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-CH_3$

4. 

$CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3$

25. Incorrect regarding the chemistry of Al is?

1. The main oxidation number of Al is +3 in Al containing compounds.
2. Al reacts with acids.
3. Al reacts only with bases.
4. Al is an amphoteric element.
5. Due to the electron deficiency of $AlCl_3$ it tends arrange as Al_2Cl_6

26. $25\,cm^3$ of $0.4\,moldm^{-3}\,HCl$ is mixed with $25\,cm^3$ $0.1\,moldm^{-3}$ of $Ba(OH)_2$. Concentration of this H^+ in the solution is ?

1. $0.2\ M$ 2. $0.1\ M$ 3. $0.3\,M$ 4. $0.05\,M$ 5. 0.15 M

27. Products obtained when Cl_2 reacts with excess NH_3

1. $N_2(g) + HCl\ (g)$
2. $N_2\ (g) + NH_4Cl$ (s)
3. $NCl_3\ (g) + HCl\ (g)$
4. $NCl_3(g) + NH_4Cl(g)$
5. $N_2(g) + H_2\ (g) + HCl\ (g)$

28. Light green coloured flame was obtained when chloride of S-block heated in the bunsun flame. Metal ion contained in that chloride would be?

1. Na^+ 2. K^+ 3. Ca^{2+} 4. Sr^{2+} 5. Ba^{2+}

29. Standard combustion enthalpy of methanol is $-715\ kJmol^{-1}$. Mass of methanol should be burnt to produce $71.5\ kJ$ energy is ?

1. $3.2\ g$ 2. $32\ g$ 3. $71.5\ g$ 4. 715 g 5. $1.6\ g$

30. 30.4% of N and 69.6% of Oxygen contained in a gaseous compound by mass. Volume of 5.52 g of this gas at 27^0C and $1\ x\ 10^5\ Pa$ Pressure is $1.00\ dm^3$. Molecular formula of the compound is?

1. NO 2. NO_2 3. N_2O_4 4. N_3O_6 5. N_2O_5

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

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

  Summary of above Instructions,

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 of responses is correct**

31. Which of the following statements is / are true ?

a) Only the atom Pd shows deviation from the Aufbau principle.
b) Electrons filled in to orbitals according to the ascending order of their energy.
c) Orbitals of same energy are filled by electrons that their spins are parallel.
d) Both incomplete s orbitals and d orbitals can exist in an atom.

32. Species with identical geometry is / are ?

a) IOF_2^+ b) NH_3 c) $XeOF_2$ d) $H_2PO_2^-$

33. Which of the following is / are true regarding root mean square velocity ?

(a) $\overline{C^2}$ twices when doubles the temperature.

(b) $\sqrt{\overline{C^2}}$ twices when doubles the pressure.

(c) $\overline{C^2}$ becomes half when twices the volume of gas.

(d) At given temperature value of $\overline{C^2}$ is a constant for any gas.

34. Which of the following is / are true regarding NH_3 ?

(a) Act as an acid.

(b) Does not react with metals since it is weak base.

(c) Is a reducing agent.

(d) Is an oxidizing agent.

35. Colour of the aqueous solution is / are purple in?

(a) $Ti^{4+}\ (aq)$ (b) $Ti^{3+}\ (aq)$ (c) $V^{3+}\ (aq)$ (d) $Cr^{3+}\ (aq)$

36. Which of the following statement is / are true ?

(a) Standard combustion enthalpy of many compounds is a negative value.

(b) Entropy of any compound under standard conditions is a positive value.

(c) Atomization enthalpy of carbon equals to sublimation enthalpy.

(d) Vaporization enthalpy of Br_2 is not equal to atomization enthalpy.

37. Consider the system formed by adding $10\ cm^3$ of $2\ mol\ dm^{-3}$ H_2SO_4 , $10\ cm^3$ of $2\ mol\ dm^{-3}$ $BaCl_2$ and $10\ cm^3$ of $2\ mol\ dm^{-3}$ NaOH,

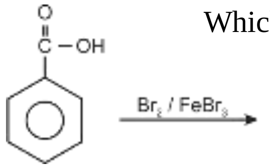
(a) Concentrations of Na^+ and Cl^- equal. (b) There are Ba^{2+} ions in the solution

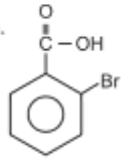
(c) Precipitate formed is soluble. (d) There are two enthalpy changes.

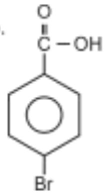
38. Which of the following is / are reach with ethanol?

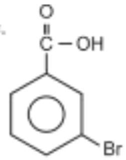
(a) Na (b) $NaOH$ (c) Na_2CO_3 (d) $NaHCO_3$

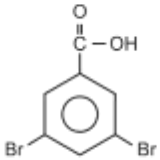
39. Which of the following has / have least ability to be a product of following reaction?



a.


b.


c.


d.


40. Which of the following is / are true regarding a real gas ?

(a) Reach to ideal behaviour at high temperature.

(b) Reach to ideal behavioour at high pressure.

(c) Reach to ideal behaviour when possess higher molecular mass.

(d) Reach to ideal behaviour at lower pressure.

- **In question numbers 41 to 50, two statements are given in respect of each question. From the table given below, select the response out of the responses (1), (2), (3), (4) and (5) that best fits the two statements and mark appropriately on your answer sheet.**

1st Statement	2nd Statement	Response
True	True and explains the 1st statement correctly	1
True	True but does not explain the first statement correctly	2
True	False	3
False	True	4
False	False	5

	First Statement	Second Statement
41.	De-Brogli equation can be used to explain the wave and particle duel nature of electrons.	Observations of cathode ray diffraction and interference can be used to study dual nature and properties of electrons.
42.	Green coloured solution of the ion $[Ni(H_2O)_6]^{2+}$ gives a green precipitate in presence of a strong base.	Colour of solid $Ni(OH)_2$ is green.
43.	$\Delta G = \Delta H - T\Delta S$ equation can be used to calculate gibbs energy change of a reaction.	The reaction is spontaneous, only at lower temperatures where $\Delta H > 0$ and $\Delta S < 0$
44.	Acidity of Mn_2O_7 is higher respect to Mn_2O_3	Acidic properties increases when electronegativity difference between Mn and O increases due to increasing oxidation number of Mn.
45.	$HOCH_2CH\,(CH_3)OMgBr$ can be obtained by the reaction between $HOCH_2CHO$ and (CH_3MgBr) grignard reagent.	Carbon attached to Mg in grigard reagent can act as nucleophile.
46.	σ bonds are formed only by linear overlapping of $S - S$ and $S - P$ orbitals.	π bonds are formed by parallel overlapping of two P orbitals.
47.	A gas cannot be converted to a liquid by exerting any high pressure, at temperatures higher than the critical temperature.	Critical temperature of any gas at constant pressure and constant volume is identical.
48.	$Cr_2O_7^{2-}$ ions oxides to CrO_4^{2-} ion in acidic medium.	Oxidation number of Cr in $Cr_2O_7^{2-}$ and CrO_4^{2-} ion is +6 .
49.	Reaction between CH_3CH_2Br and $NaOH$ takes place in two steps.	Neucliophilic substitution reactions of alkyl halides as two step reaction, when formation of a new bond takes place, after breaking bonds.
50.	PCC can be used to oxidize both primary alcohols and secondary alcohols.	Alcohol oxidize only, when H lie on the C where, OH group is attached.

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ஆவர்த்தன அட்டவணை
Periodic Table

1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	La- Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	Ac- Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub	113 Uut					

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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Provincial Department of Education - NWP

02 | E | II

Third Term Test - Grade 12 - 2018

Index No : ....

Chemistry II

Three Hours

- *A Periodic Table is provided*
- ***Use of calculators is not allowed.***
- *Universal gas constant,* $R = 8.314\ \mathrm{J\,K^{-1}\,mol^{-1}}$
- *Avogadro constant,* $N_A = 6.022 \times 10^{23}\ \mathrm{mol^{-1}}$

❑ **PART A — Structured Essay**

- *Answer **all** the questions on the question paper itself.*
- *Write your answer in the space provided for each question. Please note that the space provided is sufficient for the answer and that extensive answers are not expected.*

❑ **PART B and PART C — Essay**

- *Answer **four** questions selecting **two** questions from each part. Use the papers supplied for this purpose.*
- *At the end of the time allotted for this paper, tie the answers to the three Parts* **A, B** *and* **C** *together so that Part* **A** *is on top and hand them over to the Supervisor.*
- *You are permitted to remove* **only** *Parts* **B** *and* **C** *of the question paper from the Examination Hall.*

For Examiner's Use Only

Part	Question No.	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
C	8	
	9	
	10	
Total		
Percentage		

Final Mark

In Numbers	
In Letters	

Code Numbers

Examiner	
Checked by	1
	2
Supervised by	

Part - A – Structured Essay

- *Answer all* ***four questions*** *on this paper itself. (Each questions carries 10 marks)*

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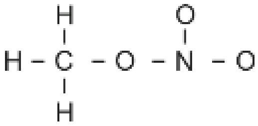
(01) a. I. Methyl nitrate is methyl ester of nitric acid and has the chemical formula CH_3NO_3. It is a colourless volatile liquid and it is explosive. Its Skelton given below.



$H-\overset{H}{\underset{H}{C}}-O-\overset{O}{N}-O$

i. Draw the most acceptable Lewis structure for methyl nitrate.

ii. Draw resonance structures for above molecule. Giving reasons comment on their stabilities.

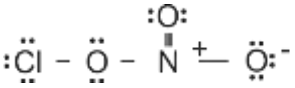
iii. Draw a sketch of the structure of above molecule giving approximate bond angles.

II. State the following considering hypothetical Lewis structure given below,

i. Electron pair geometry around the atom.

ii. Shape around the atom.

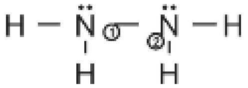
iii. Hybridization of the atom given in the table.



$:\ddot{\underset{..}{Cl}}-\ddot{\underset{..}{O}}-\overset{:O:}{\overset{\|}{N}}{}^{+}-\ddot{\underset{..}{O}}:^{-}$

		The N atom	The O atom attached to N and Cl atoms
i	Electron pair geometry		
ii	Shape		
iii	Hybridization		

(b) Identify atomic / hybrid orbitals involved in the formation of the folowing bonds in the lewis structure given below.



i. N① − N② ; N① .... N② ....

ii. N① − H ; N① .... H ....

(c) Xe , I_3^- , CH_4 , aqueous $NaCl$, HF

of the substances given above, which one/ones will have the forces given below.

i. Ion – Induce dipole interaction ....

ii. Ion – dipole interactions - ....

iii. London dispersion forces - ....

iv. Hydrogen bonds - ....

(02) (a) Test tubes labelled A to E contain following solids (not in order)

KNO_3, $(NH_4)_2CO_3$, $LiNO_3$, $(NH_4)_2Cr_2O_7$, NH_4NO_2

Description of the products formed when each of these solids is heated is given below.

Solid	Description
A	• A green coloured powder. • A colourless diatomic gas at room temperature. • Water vapour
B	• A white oxide reacts with water to farm a basic solution. • Colourless diatomic gas at room temperature. • A reddish brown gas.
C	• Three products which are in the gaseous state.
D	• White Powder • Colourless di atomic gas at room temperature.
E	• Two products which are in the gaseous state.

(i) Identify solids A to E.

A .... B ....
C .... D ....
E ....

(ii) Write the balanced chemical equations for the reactions take place on heating each of solid A to E. (Mention physical states of reactants and products.)

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(II) Write one simple experiment each to identify gaseous products obtained when heating solid C.

Gaseous Product	Experiment

(b)(I) Successive ionization energies of an element A is given below.

	IE_1	IE_2	IE_3	IE_4	IE_5
Ionization energy / $kJmol^{-1}$	578	1811	2745	11540	14842

(i) Identify the group of element A giving reasons.

....

....

(ii) The element A react with HCl and $NaOH.$ Chloride of element A exist as a dimer. Identify the element A.

....

(iii) Draw the structure of the chloride A.

(iv) Explain why it exist as dimer.

....

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(v) Write balanced chemical equations for the reactions of A.

With HCl ....

With NaOH ....

(II) (i) Complete the following nuclear reaction.

$$^{56}_{26}Fe \; + \; ^{1}_{2}H \; \rightarrow \; ^{4}_{2}\alpha \; + \; ^{\dots\dots}_{\dots\dots} X$$

(ii) Write a method to distinguish H_2S and D_2S (D – Duclerium)

(iii) Aqueous $NaOH$ and Al dust is added to an aqueous solution of nitrate ions and heated. It was observed the evolution of $NH_3(g)$ and formation of AlO_2^- ions.

i. Write the balanced oxidation half reaction.

....

ii. Write the balanced reduction half reaction.

....

iii. Write the balanced ionic equation.

....

(03) (a) Standard hydration enthalpies of some species given below.

	ΔH^{θ}_{hyd} / $kJmol^{-1}$
$K^+ \, (aq)$	-305
$Br^- \, (aq)$	-351
$Li^+ \, (aq)$	-499
$F^- \, (aq)$	-457

Standard lattice enthalpies of $KBr(s)$ and $LiF(s)$ are $668 \, kJmol^{-1}$ and $1008 \; kJmol^{-1}$ respectively.

i. Write the definition for the standard enthalpy of dissolution.

ii. Write balanced chemical equations for the standard dissolution enthalpy of

$KBr(s)$ ....

$LiF(s)$ ....

iii. Develop a thermochemical cycle to determine $\Delta H^{\theta}_{dissolution}$ of $KBr(s)$ using given data.

iv. calculate $\Delta H^{\theta}_{dissolution}$ of $KBr(s)$ using given data.

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v. Develop a thermochemical cycle to determine $\Delta H^{\theta}_{dissolution}$ of $LiF\ (s)$ using given data.

vi. Calculate $\Delta H^{\theta}_{dissolution}$ of $LiF(s)$ using data given.

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....

(b) I. Standard molar entropy values of some species are given below.

	$S^{\theta}_{m}\ /\ kJmol^{-1}$
$KBr\ (s)$	+95.9
$LiF\ (s)$	+35.9
$K^{+}\ (aq)$	+102.5
$Br^{-}\ (aq)$	+82.4
$Li^{+}\ (aq)$	+13.4
$F^{-}\ (aq)$	-13.8

i. Calculate the entropy change of the dissolution of $KBr(s)$

ii. Calculate the entropy change of the dissolution of $LiF(s)$

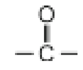
II i. Write the equation which represent the relationship between ΔG , ΔH and ΔS .

ii. Calculate the ΔG^{θ} for the dissolution of $KBr(s)$ at $298\ K$.

iii. Calculate the ΔG^{θ} for the dissolution of $LiF\ (s)$ at $298\ K$.

iv. Compare the solubility of $KBr(s)$ and $LiF\ (s)$ giving reasons.
(Use the calculate data obtained in ii and iii above.)

(04) (a) I. 15.4 g of $CO_2(g)$ and 5.4g of $H_2O\ (g)$ was given by the complete combustion of 0.05 mol of a hydrocarbon A, in the presence of Oxygen. Find the molecular formula of the Hydrocarbon A. $(C = 12,\ H = 1,\ O = 16)$

II. X, Y and Z are three optically active isomers of A.
Only Y and Z evolve H_2 gas with Na. X, Y and Z react with $HgSO_4(aq)/$ dil H_2SO_4 to give carbonyl compounds.
There are four α hydrogens in Y. (α Hydrogens are H atoms attached to C atom adjencent to carbonyl carbon  $-\overset{O}{\overset{\|}{C}}-$).
When X,Y and Z react with H_2/Ni produce the same optically active compound D.

i. Identify X, Y, Z and D Draw the structures of X, Y,Z and D in the boxes given below.

X	Y	Z	D

ii. Write the structures of products when X, Y and Z react with $HgSO_4(aq)/$ dil H_2SO_4

$$X \xrightarrow[60^{\circ}C]{HgSO_4/\text{ dil. }H_2SO_4} \boxed{}$$

$$Y \xrightarrow[60^{\circ}C]{HgSO_4/\text{ dil. }H_2SO_4} \boxed{}$$

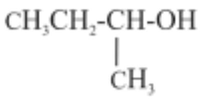
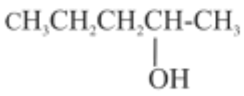
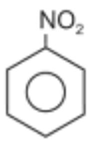
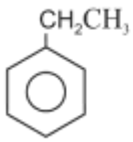
$$Z \xrightarrow[60^{\circ}C]{HgSO_4/\text{ dil. }H_2SO_4} \boxed{}$$

iii. Complete the following reaction sequence starting from Z in above (i).

$$Z \xrightarrow[\text{Quinoline}]{H_2/Pd/BaSO_4} \boxed{} \xrightarrow{HBr/\text{Peroxide}} \boxed{}$$

b. Draw the structures of the major products of the reactions given in the table below. Classify each reaction as,

A_N - Neucleophilic addition
A_E - Electrophilic addition
S_N - Neucleophilic substitution
S_E - Electrophilic substitution
E - Elemination
O - Oxidation, by writing A_N, A_E, S_N, S_E, E and O in appropriate cage.

Reactant	Reagent	Major Product	Type of Reaction
$C_2H_5CH{=}CHCH_3$	Br_2/CCl_4		
 $CH_3CH_2\text{-}CH(CH_3)\text{-}OH$	PCl_5		
 $CH_3CH_2CH_2CH(OH)\text{-}CH_3$	Anhy. Al_2O_3/Δ		
	CH_3Cl / Anhy $AlCl_3$		
	$H^+/KMnO_4$		

Third Term Test - 2018
Chemisty 2018 - Grade 12

Universal gas constant $R = 8.314\ \text{J K}^{-1}\ \text{mol}^{-1}$
Avogadro constant $N_A = 6.022 \times 10^{23}\ \text{mol}^{-1}$

PART B — ESSAY

Answer ***two*** *questions only.* (*Each question carries* **15 marks.**)

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(05) (a) I i.) Write the charles law.

ii) Derive the charles law using ideal gas equation.

(b) $CH_4\ (g)$ contains in a rigid vessel A of $4{\cdot}157\ dm^3$ at 227^0C and 1.5 x 10^5 Pa pressure. 1.0 mol of $O_2(g)$ contains in another rigid vessel B at 27^0C and 2.0 x 10^5 Pa
Both vessels were joined using thin tube of neligible volume. The tap was closed initially.

I Calculate

i) Number of moles of $CH_4(g)$ in vessel A.
ii) Volume of Vessel B.

II Temperature of the whole system was taken to 27^0C after open the tap. There is no reaction between $CH_4(g)$ and $O_2(g)$. Calculate following.

i) Total pressure of the system.
ii) Mole fractions of $CH_4(g)$ and $O_2(g)$
iii) Partial pressures of $CH_4(g)$ and $O_2(g)$
iv) Total number of moles in Vessel A

III Temperature of the above system was taken to 127^0C after open the tap. $CH_4(g)$ subject to combustion with $O_2(g)$ and from $CO_2(g)$ and $H_2O(g)$
Consider this system and calculate following.

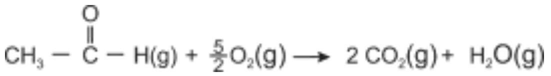
i) Calculate number of moles of each gas in the system.
ii) Calculate total number of moles in the system.
iii) Calculate the total pressure of the system
iv) Calculate mole fractions of each gas in the system.
v) Calculate partial pressures of each gas in the system.

IV After completing the reaction in above (iii) temperature of the whole system was taken to 27^0C calculate the total pressure of this system.

(c) i.) Write the Venda Waals equation and identify each term in it.
ii) What are the conditions that real gases reach to the ideal behaviour? Explain reasons.
iii) Draw Maxwell Baltzmann distribution curves for gases He, Ne, Ar under constant temperature in one diagram.

(06)(a) (i) Define standard enthalpy of combustion.
(ii) Define standard enthalpy of formation.

(b) Consider the reaction.

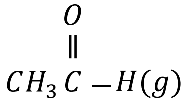


$$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-H(g)+\tfrac{5}{2}O_2(g)\longrightarrow 2\,CO_2(g)+\ H_2O(g)$$

i) Calculate the standard enthalpy change of above reaction using the thermochemical data given below at 298 K.

Bond	Standard enthalpy of bond dissociation / $kJ\ mol^{-1}$
$C - C$	348
$C - H$	412
$C = O$	743
$O = O$	496
$O - H$	463

ii) Calculate the standard enthalpy change of above reaction using thermochemical data given below at 298 K.

Species	Standard enthalpy of formation / $kJ\ mol^{-1}$
 $CH_3\overset{\overset{O}{\parallel}}{C}-H(g)$	-166
$CO_2(g)$	-394
$H_2O\ (g)$	-242

iii) Explain reason for the difference in enthalpy values obtained the reaction in part (i) and (ii) above briefly.

(b) 722 kJ amount of heat is released when burning 14.5g of butane $(C_4H_{10}(g))$ gas and 102.9 kJ amount of heat is released when burning 2.1g of gas propene $(C_3H_6\,(g))$ under standard conditions. $(C = 12, H = 1, O = 16)$

(i) Calculate the standard enthalpy of combustion for butane and propene.

(ii) Represent above enthalpies using equations.

(iii) Calculate heat released when burning 1kg each of propene and butane,

(iv) Calculate the mass of $CO_2(g)$ released when burning 1kg each of butane and propene.

(v) Explain what is the most efficient fuel according to the answer obtained above giving reasons.

(07) (a) $250.0\ cm^3$ solution was prepared by dissolving 1.07 g of pure dry KIO_3 which was measured accurately. $20.0\ cm^3$ of $Na_2S_2O_3$ solution of unknown concentration was required to react with I_2 released when excess KI solution and $5cm^3$ of dil H_2SO_4 is added to $25.0\ cm^3$ of this solution.

(i) Write the balanced ionic equation for the reaction between I^- and IO_3^- in acidic medium.

(ii) Write the balanced ionic equation for the reaction between I_2 and $S_3O_3^{2-}$

(iii) Calculate the concentration of $Na_2S_2O_3$ solution.

(K = 39, I = 127, O = 16)

(b) (i) Explain the amphoteric nature of water using reactions of NH_3 and HCl with water.

(ii) Write balanced chemical equations for following.

1. NH_3 as oxidizing agent.
2. NH_3 as reducing agent.
3. H_2O_2 as oxidizing agent.
4. H_2O_2 as reducing agent.
5. H_2S as oxidizing agent.
6. H_2S as reducing agent.

(iii) Write balanced chemical equations for the heat dissociation of following compounds.

1. $Mg(NO_3)_2\ (s)\ \underset{\Delta}{\rightarrow}$
2. $Li_2CO_3\ (s)\ \underset{\Delta}{\rightarrow}$
3. $KHCO_3(s)\ \underset{\Delta}{\rightarrow}$
4. $NaNO_2\ (s) + NH_4Cl_{(s)}\ \rightarrow$
5. $NH_4NO_3(s)\ \underset{\Delta}{\rightarrow}$
6. $(NH_4)_2\ SO_4\ (s)\ \underset{\Delta}{\rightarrow}$

(c) Explain simple experiment to show the existence of $N_2(g)$ in air.

PART C — ESSAY

Answer two questions only. (*Each question carries* **15** *marks.*)

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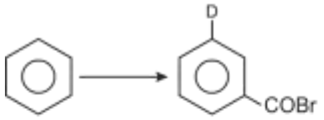
(08) (a) i) Show how you would carry out the followings conversation not more than 6 steps.

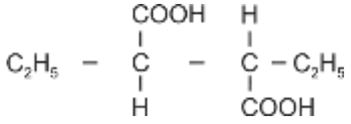
$$CH_2 = CH_2 \longrightarrow CH_3\ \underset{OH}{CH} - \underset{OH}{CH_2}$$

ii) Using suitable chemicals given in the list show how would you carry out the following conversation.



PBr_3	Mg	CH_3Cl	CH_3OCH_3
$AlCl_3$	Zn(Hg)	CH_3COCl	
HCl	Cl_2	H_2SO_4	
$KMnO_4$	D_2O	PCC	

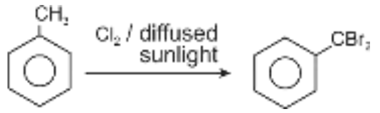
(b) Show how you would synthesize.



$$C_2H_5 - \overset{COOH}{\underset{H}{C}} - \overset{H}{\underset{COOH}{C}} - C_2H_5$$

Using CH_3CH_2Br as the only organic starting material.

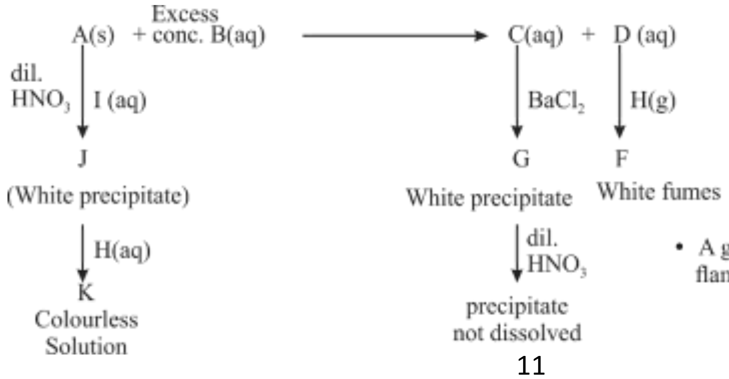
(c) i) propose a mechanism for the conversion of



ii) Mention the major product and minor product obtained in the presence of HBr and $CH_3CH = CH_2$.
Write the mechanism relevant to the formation of major product.

(09) Use following flow chart to answer questions given below.

(a) Identify A, B, C, D, E, F,G, H, I, J, K



- A gives blue colour for the flame test.

(i) Identify $A\ B\ C\ D\ F\ G\ H\ I\ J\ K$

(ii) Write the balanced chemical equation for the reaction between concentrated solution of D and $KMnO_4(aq)$

(iii) What is the standard experiment to identify gas H

(iv) Distinguish following using the given method.

(b) (a) $BaSO_3(s)$, $BaS_2O_3(s)$, $BaCO_3(s)$ } adding dil. HNO_3

(b) $Mg(NO_3)_2$, $MgCO_3(s)$, $(NH_4)_2CO_3(s)$ } heating

(c) i) Draw the structures of Oxyacids of chlorine exist in different oxidation states.

ii) Arrange them in the increasing order of,

a) Acidic property b) Oxidizing ability.

(10) (a) i) X, Y, Z are three $3d$ elements. Aqueous solutions of the ions formed by them in the form of M^{3+} are purple in colour. Increasing order of the maximum oxidation state obtained by them in compounds are $y < x < z$

(i) Identify elements X, Y, Z

(ii) Write structural formulas of complex ions formed by X with NH_3 Y with H_2O and Z with Cl^-

(iii) Mention oxidation numbers of oxides formed by X and their acidic, basic and amphoteric properties.

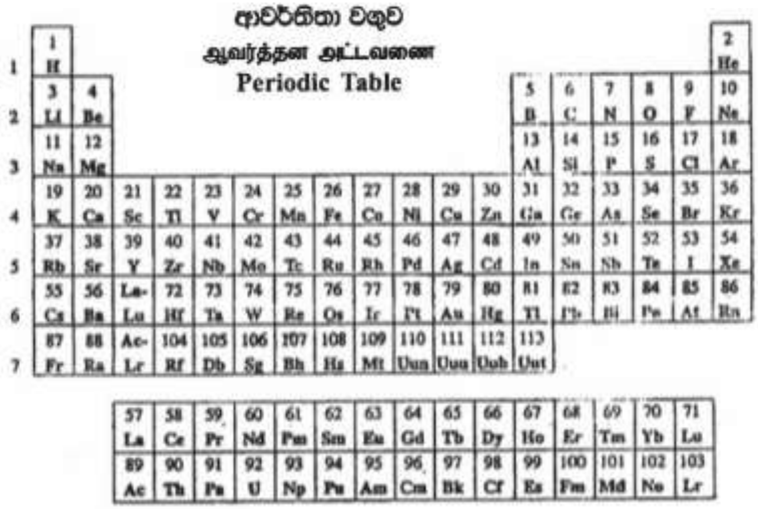
(iv) What are the oxidation states of Y obtained in compounds.

(v) Mention a use of a chloride of Y as a catalyst and use of Y as alloy.

(vi) What is the oxianion formed with the maximum oxidation state of Z. Write the balanced chemical equation for the reaction with this anion and concentrated base.

(b) 10g of a mixture of iron ore contaminated with FeO and Fe_2O_3 was dissolved in dil. H_2SO_4 and excess KI solution was added. 200ml solution where all atoms of iron converted to Fe^{2+} was named as A. 20ml of $0.25M\ Na_2S_2O_3$ was required to titrate 25ml of solution A. $25cm^3$ of $0.05\ moldm^{-3}$ $K_2Cr_2O_7$ acidic solution was required to titrate another 25cm^3 volume of solution A.

1. Write the balanced chemical equation relevant to the reaction of H_2SO_4 with iron ore.
2. Write the balanced ionic equation relevant to the reaction when KI added to the solution.
3. Write the balanced ionic equation for the reaction of titration with $Na_2S_2O_3$.
4. Write the balanced ionic equation for the reaction of A with $H^+/\ K_2Cr_2O_7$
5 Calculate mass percentages of FeO and Fe_2O_3 in the mixture.



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ஆவர்த்தன அட்டவணை

Periodic Table

1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	La-Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	Ac-Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub	113 Uut					

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Third Term Test Grade 12 - 2018
Chemistry Answer - Script Part A - Structured Essay

Part I

(1) 3
(2) 5
(3) 2
(4) 3
(5) 5
(6) 5
(7) 2
(8) 2
(9) 3
(10)3
(11)1
(12)2
(13)4
(14)3
(15)2
(16)3
(17)2
(18)2
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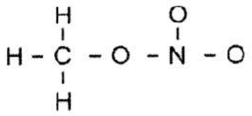
(36)5
(37)5
(38)5
(39)1
(40)4
(41)2
(42)1
(43)3
(44)1
(45)4
(46)4
(47)3
(48)4
(49)4
(50)1

Part II

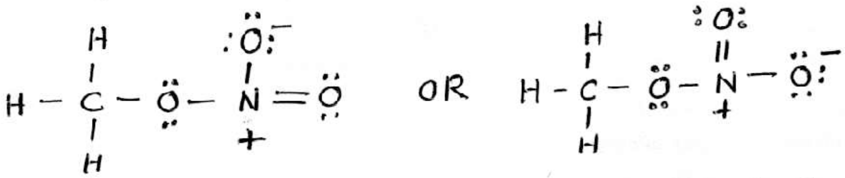
Part - A – Structured Essay

- *Answer all* ***four questions*** *on this paper itself. (Each questions carries 10 marks)*

(01) a. I. Methyl nitrate is methyl ester of nitric acid and has the chemical formula CH_3NO_3. It is a colourless volatile liquid and it is explosive. Its Skelton given below.

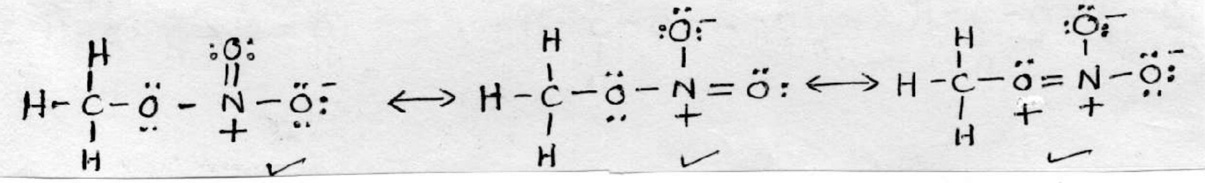


i. Draw the most acceptable lewis structure for methyl nitrate.



(20 marks)

ii. Draw resonance structures for above molecule. Giving reasons comment on their stabilities.



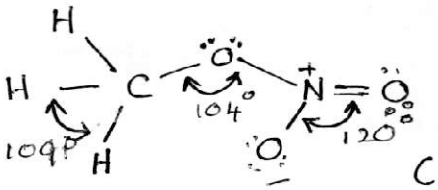
Stable
- -ve charge on electronegative oxygen

Stable
- -ve charge on electronegative oxygen.

Unstable
- -ve charge on electronegative O
- Charge distribution is high

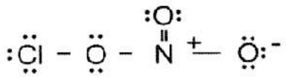
(2 marks x 10 = 20 marks)

iii. Draw a sketch of the structure of above molecule giving approximate bond angles.



(10 marks)

II. State the following considering hypothetical Lewis structure given below.
  i. Electron pair geometry around the atom.
  ii. Shape around the atom.
  iii. Hybridization of the atom given in the table.

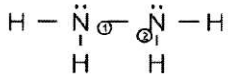


$:\ddot{Cl}-\ddot{O}-\overset{:O:}{\overset{\|}{N}}\overset{+}{-}\ddot{O}:^-$

		The *N* atom	The *O* atom attached to *N* and *Cl* atoms
i	Electron pair geometry	Triangular planer ✓	Tetrahedral ✓
ii	Shape	Triangular planer ✓	Angular ✓
iii	Hybridization	sp^2 ✓	sp^3 ✓

(3 marks x 6 = 18 marks)

(b) Identify atomic / hybrid orbitals involved in the formation of the folowing bonds in the lewis structure given below.



$H-\underset{H}{\underset{|}{\ddot{N}}}-\underset{H}{\underset{|}{\ddot{N}}}-H$

i. $N_①-N_②$; $N_①$ sp^3 hybrid orbital ✓ $N_②$ sp^3 hybrid orbital ✓

ii. $N_①-H$; $N_①$ sp^3 hybrid orbital ✓ H unhybrid 1s orbital ✓

(3 marks x 4 = 12 marks)

(c) *Xe* , I_3^- , CH_4 , aqueous *NaCl* , *HF*

of the substances given above, which one/ones will have the forces given below.

i. Ion – Induce dipole interaction I_3^- ✓

ii. Ion – dipole interactions - aqueous NaCl ✓

iii. London dispersion forces - CH_4 , Xe ✓ ✓

iv. Hydrogen bonds - HF ✓

(2 marks x 5 = 10 marks)

(02) (a) Test tubes labelled A to E contain following solids (not in order)

KNO_3, $(NH_4)_2CO_3$, $LiNO_3$, $(NH_4)_2Cr_2O_7$, NH_4NO_2

Description of the products formed when each of these solids is heated is given below.

Solid	Description
A	• A green coloured powder. • A colourless diatomic gas at room temperature. • Water vapour
B	• A white oxide reacts with water to farm a basic solution. • Colourless diatomic gas at room temperature. • A reddish brown gas.
C	• Three products which are in the gaseous state.
D	• White Powder • Colourless di atomic gas at room temperature.
E	• Two products which are in the gaseous state.

(i) Identify solids A to E.

A $(NH_4)_2Cr_2O_7$ ✓ B $LiNO_3$ ✓
C $(NH_4)_2CO_3$ ✓ D KNO_3 ✓
E NH_4NO_2 ✓

(3 marks x 5 = 15 marks)

(ii) Write the balanced chemical equations for the reactions take place on heating each of solid A to E. (Mention physical states of reactants and products.)

$(NH_4)_2Cr_2O_7(s) \xrightarrow[\Delta]{} N_2(g) + Cr_2O_3(s) + 4H_2O(g)$ ✓

$4LiNO_3(s) \xrightarrow[\Delta]{} 2Li_2O(s) + 4NO_2(g) + O_2(g)$ ✓

$(NH_4)_2CO_3(s) \xrightarrow[\Delta]{} 2NH_3(g) + CO_2(g) + H_2O(g)$ ✓

$2KNO_3(s) \xrightarrow[\Delta]{} 2KNO_2(s) + O_2(g)$ ✓

$NH_4NO_2(s) \xrightarrow[\Delta]{} N_2(g) + 2H_2O(g)$ ✓

(2marks x 5 = 15 marks)

(II) Write one simple experiment each to identify gaseous products obtained when heating solid C.

Gaseous Product	Experiment
$NH_3(g)$	Turn Nestler reagent brown. ✓
$CO_2(g)$	Turn lime water milky ✓
$H_2O(g)$	Turn anhydrous $CuSO_4(s)$ blue ✓

(2marks x 3 = 6 marks)

(b)(I) Successive ionization energies of an element A is given below.

	IE_1	IE_2	IE_3	IE_4	IE_5
Ionization energy / $kJmol^{-1}$	578	1811	2745	11540	14842

(i) Identify the group of element A giving reasons.

Group 13. ✓ (4marks) (2marks x3 = 6marks)

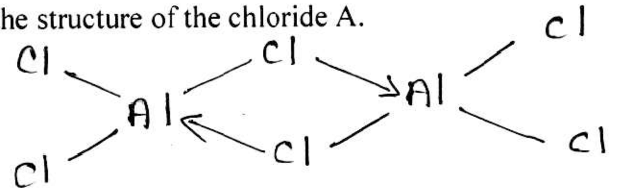
After removing 3 electrons in valence shell ✓ (ns^2np^1) it has nobel gas configuration. ✓ So it needs lot of energy to loose another electron from next energy level. ✓

(ii) The element A react with HCl and $NaOH$. Chloride of element A exist as a dimer.

Identify the element A.

Al (4 marks)

(iii) Draw the structure of the chloride A.



(4 marks)

(iv) Explain why it exist as dimer.

$AlCl_3$ is an electron deficient ✓ compound and exist as a dimer, thus attaining an octet of electrons. ✓

(2marks x 2 = 4 marks)

(v) Write balanced chemical equations for the reactions of A.

With HCl $2Al(s) + 6HCl(aq) \rightarrow 2AlCl_3(aq) + 3H_2(g)$ OR $2Al(s) + 6HCl(aq) \rightarrow Al_2Cl_6(s) + 3H_2(g)$ ✓

With NaOH $2Al(s) + 2H_2O(l) + 2NaOH(aq) \rightarrow 2NaAlO_2(aq) + 3H_2(g)$ OR $2Al(s) + 6H_2O(l) + 2NaOH(aq) \rightarrow 2NaAl(OH)_4(aq) + 3H_2(g)$

(4 marks × 2 = 8 marks) ✓

(II) (i) Complete the following nuclear reaction.

$${}^{56}_{26}Fe + {}^{1}_{2}H \rightarrow {}^{4}_{2}\alpha + {}^{53}_{26}X$$

(4 marks)

(ii) Write a method to distinguish H_2S and D_2S (D – Duclerium)

D and H are isotopes, ${}^{2}_{1}D$ & ${}^{1}_{1}H$. ✓ Since same no of electrons chemical properties are identical. ✓ If above two gases were collected in equal volumes ✓ at same temperature ✓ and ✓ pressure, D_2S has higher mass than H_2S. ✓ (6 marks)

(iii) Aqueous $NaOH$ and Al dust is added to an aqueous solution of nitrate ions and heated. It was observed the evolution of $NH_3(g)$ and formation of AlO_2^- ions.

i. Write the balanced oxidation half reaction.

$Al(s) + 4OH^-(aq) \rightarrow AlO_2^-(aq) + 2H_2O(l) + 3e$ ✓

ii. Write the balanced reduction half reaction.

$NO_3^-(aq) + 6H_2O(l) + 8e \rightarrow NH_3(g) + 9OH^-(aq)$ ✓

iii. Write the balanced ionic equation.

$8Al(s) + 5OH^-(aq) + 3NO_3^-(aq) + 2H_2O(l) \rightarrow 8AlO_2^-(aq) + 3NH_3(g)$

(8 marks × 3 = 24 marks) ✓

(03) (a) Standard hydration enthalpies of some species given below.

	ΔH^{θ}_{hyd} / $kJmol^{-1}$
$K^+(aq)$	-305
$Br^-(aq)$	-351
$Li^+(aq)$	-499
$F^-(aq)$	-457

Standard lattice enthalpies of $KBr(s)$ and $LiF(s)$ are 668 $kJmol^{-1}$ and 1008 $kJmol^{-1}$ respectively.

i. Write the definition for the standard enthalpy of dissolution.

It is the enthalpy change that occurs when a mole of a substance under the standard state is dissolved in an excess of solvent to form a solution (06 marks)

ii. Write balanced chemical equations for the standard dissolution enthalpy of

$KBr(s)$ $KBr(s) + aq \rightarrow KBr(aq)$ ✓ OR $KBr(s) + aq \rightarrow K^+(aq) + Br^-(aq)$

$LiF(s)$ $LiF(s) + aq \rightarrow LiF(aq)$ ✓ OR $LiF(s) + aq \rightarrow Li^+(aq) + F^-(aq)$

(4 marks × 2 = 8 marks)

iii. Develop a thermochemical cycle to determine $\Delta H^{\theta}_{dissolution}$ of $KBr(s)$ using given data.

$$\begin{tikzcd}
KBr(s) + (aq) \arrow[rr, "\Delta H^{\theta}dissolution"] \arrow[dr, swap, "\Delta H^{\theta}_{L}(KBr(s))"] & & K^+(aq) + Br^-(aq) \\
& K^+(g) + Br^-(g) \arrow[ur, swap, "\Delta H^{\theta}_{hyd}(K^+(g)) + \Delta H^{\theta}_{hyd}(Br^-(g))"] &
\end{tikzcd}$$

(3 marks × 4 = 12 marks)

iv. calculate $\Delta H^{\theta}_{dissolution}$ of $KBr(s)$ using given data.

$\Delta H^{\ominus}dissolution = \Delta H_L^{\ominus}(KBr) + \Delta H^{\ominus}_{hyd}(K^+(g)) + \Delta H^{\ominus}_{hyd}(Br^-(g))$ ✓

$= 1 \times 668\ kJ\,mol^{-1} + 1 \times -305\ kJ\,mol^{-1} + 1 \times -351\ kJ\,mol^{-1}$

$= (668 - 305 - 351)\ kJ\,mol^{-1}$ ✓

$= \underline{\underline{12\ kJ\,mol^{-1}}}$ ✓ (2 marks x 3 = **6** marks)

v. Develop a thermochemical cycle to determine $\Delta H^{\theta}_{dissolution}$ of $LiF\ (s)$ using given data.

$$\begin{tikzcd}
LiF(s) \arrow[rr, "\Delta H^{\ominus}dissolution"] \arrow[dr, "\Delta H_L^{\ominus}(LiF(s))"'] & & Li^+(aq) + F^-(aq) \\
& Li^+(g) + F^-(g) \arrow[ur, "\Delta H^{\ominus}_{hyd}(Li^+(g)) + \Delta H^{\ominus}_{hyd}(F^-(g))"'] &
\end{tikzcd}$$

✓ ✓ ✓ ✓

(3 marks x 4 = **12** marks)

vi. Calculate $\Delta H^{\theta}_{dissolution}$ of $LiF(s)$ using data given.

$\Delta H^{\ominus}dissolution = 1 \times 1008\ kJ\,mol^{-1} + 1 \times -499\ kJ\,mol^{-1} + 1 \times -457\ kJ\,mol^{-1}$ ✓

$= \underline{\underline{52\ kJ\,mol^{-1}}}$ ✓ (3 marks x 2 = **6** marks)

(b) I. Standard molar entropy values of some species are given below.

	S^{θ}_m / $kJmol^{-1}$
$KBr\ (s)$	+95.9
$LiF\ (s)$	+35.9
$K^+\ (aq)$	+102.5
$Br^-\ (aq)$	+82.4
$Li^+\ (aq)$	+13.4
$F^-\ (aq)$	-13.8

i. Calculate the entropy change of the dissolution of $KBr(s)$

$KBr(s) \longrightarrow K^+(aq) + Br^-(aq)$ ✓

$\Delta S^{\ominus} = S^{\ominus}(K^+(aq)) + S^{\ominus}(Br^-(aq)) - S^{\ominus}(KBr(s))$ ✓

$= 102.5\ JK^{-1}mol^{-1} + 82.4\ JK^{-1}mol^{-1} - 95.9\ JK^{-1}mol^{-1}$ ✓

$= \underline{89.0\ JK^{-1}mol^{-1}}$ ✓ (2 marks x 4 = **8** marks)

ii. Calculate the entropy change of the dissolution of $LiF(s)$

$LiF(s) \longrightarrow Li^+(aq) + F^-(aq)$ ✓

$\Delta S^{\ominus} = S^{\ominus}(Li^+(aq)) + S^{\ominus}(F^-(aq)) - S^{\ominus}(LiF(s))$ ✓

$= 13.4\ JK^{-1}mol^{-1} - 13.8\ JK^{-1}mol^{-1} - 35.9\ JK^{-1}mol^{-1}$

$= \underline{-36.3\ JK^{-1}mol^{-1}}$ ✓ ✓ (2 marks x 4 = **8** marks)

II i. Write the equation which represent the relationship between ΔG, ΔH and ΔS.

$\Delta G = \Delta H - T\Delta S$ (**6** marks)

ii. Calculate the ΔG^{θ} for the dissolution of $KBr(s)$ at 298 K.

$$\Delta G^{\theta} = 12\ kJ\ mol^{-1} - 298\ K \times 89 \times 10^{-3}\ kJ\ K^{-1} mol^{-1}$$
$$= -14.522\ kJ\ mol^{-1}$$

2marks x 5 (10 marks)

iii. Calculate the ΔG^{θ} for the dissolution of $LiF\ (s)$ at 298 K.

$$\Delta G^{\theta} = 52\ kJ\ mol^{-1} - 298\ K \times -36.3 \times 10^{-3}\ kJ\ mol^{-1} K^{-1}$$
$$= +62.62\ kJ\ mol^{-1}$$

(2 marks x 5 = **10** marks)

iv. Compare the solubility of $KBr(s)$ and $LiF\ (s)$ giving reasons.
(Use the calculate data obtained in ii and iii above.)

ΔG^{θ} of KBr is (-)ve value and ΔG^{θ} of LiF is a positive value. (02x2) Therefore solubility of ∴ LiF is lower than KBr (OH) 02x2.

(+4 = **8** marks)

(04) (a) I. 15.4 g of $CO_2(g)$ and 5.4g of $H_2O\ (g)$ was given by the complete combustion of 0.05 mol of a hydrocarbon A, in the presence of Oxygen. Find the molecular formula of the Hydrocarbon A.
$(C = 12,\ H = 1,\ O = 16)$

$$C_xH_y + (x + y/4)O_{2(g)} \longrightarrow xCO_{2(g)} + y/2\ H_2O_{(g)}$$

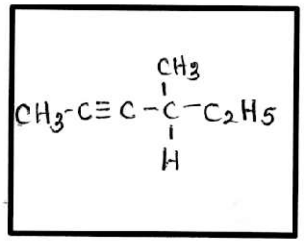
$$n_{CO_2(g)} = \frac{15.4g}{44\ gmol^{-1}} = 0.35mol \qquad n_{H_2O} = \frac{5.4g}{18gmol^{-1}} = 0.3\ mol$$

$$\text{for 1 mol} \quad \frac{0.35mol}{0.05} = x = 7 \qquad \text{for 1 mol} = \frac{0.3\ mol}{0.05\ mol} = y/2 \quad y = \underline{12}$$

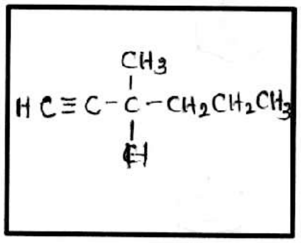
Hydrocarbon A $\underline{\underline{C_7H_{12}}}$ (2marksx**10** = **20** marks)

II. X, Y and Z are three optically active isomers of A.
Only Y and Z evolve H_2 gas with Na. X, Y and Z react with $HgSO_4(aq)/$ dil H_2SO_4 to give carbonyl compounds.
There are four α hydrogens in Y. (α Hydrogens are H atoms attached to C atom adjencent to carbonyl carbon $-\overset{O}{\overset{\|}{C}}-$).
When X,Y and Z react with H_2/Ni produce the same optically active compound D.

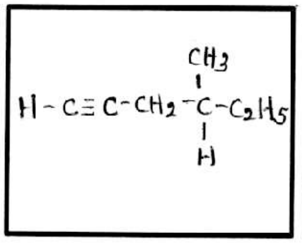
i. Identify X, Y, Z and D Draw the structures of X, Y,Z and D in the boxes given below.


$CH_3-C\equiv C-\overset{CH_3}{\underset{H}{C}}-C_2H_5$

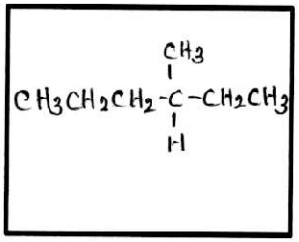
X


$HC\equiv C-\overset{CH_3}{\underset{H}{C}}-CH_2CH_2CH_3$

Y


$H-C\equiv C-CH_2-\overset{CH_3}{\underset{H}{C}}-C_2H_5$

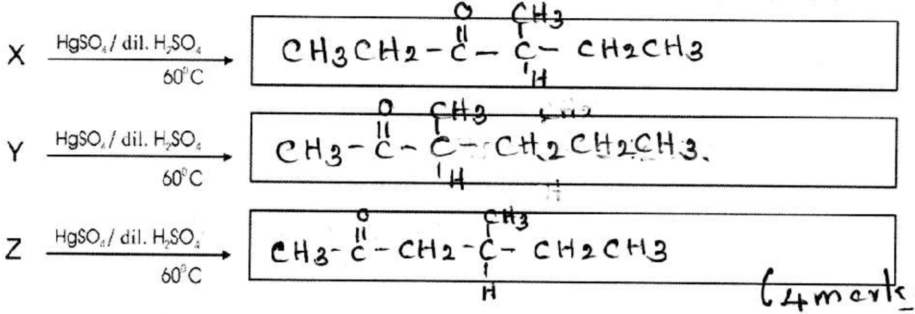
Z


$CH_3CH_2CH_2-\overset{CH_3}{\underset{H}{C}}-CH_2CH_3$

D

(5marks x 4 = 20marks)

ii. Write the structures of products when X, Y and Z react with $HgSO_4(aq)/$ dil H_2SO_4



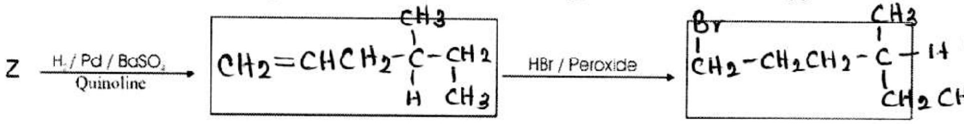
$$X \xrightarrow[60^\circ C]{HgSO_4 / \text{dil. } H_2SO_4} \boxed{CH_3CH_2-\overset{\overset{O}{\|}}{C}-\underset{H}{\overset{CH_3}{C}}-CH_2CH_3}$$

$$Y \xrightarrow[60^\circ C]{HgSO_4 / \text{dil. } H_2SO_4} \boxed{CH_3-\overset{\overset{O}{\|}}{C}-\underset{H}{\overset{CH_3}{C}}-CH_2CH_2CH_3.}$$

$$Z \xrightarrow[60^\circ C]{HgSO_4 / \text{dil. } H_2SO_4} \boxed{CH_3-\overset{\overset{O}{\|}}{C}-CH_2-\underset{H}{\overset{CH_3}{C}}-CH_2CH_3}$$

(4marks x 3 = 12 marks)

iii. Complete the following reaction sequence starting from Z in above (i).

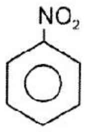
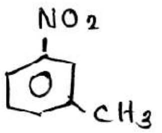
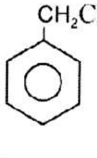


$$Z \xrightarrow[\text{Quinoline}]{H_2 / Pd / BaSO_4} \boxed{CH_2=CHCH_2-\underset{H}{\overset{CH_3}{C}}-\underset{CH_3}{CH_2}} \xrightarrow{HBr / \text{Peroxide}} \boxed{\overset{Br}{CH_2}-CH_2CH_2-\underset{CH_2CH_3}{\overset{CH_3}{C}}-H}$$

(4marks x 2 = 8marks)

b. Draw the structures of the major products of the reactions given in the table below. Classify each reaction as,

A_N - Neucleophilic addition
A_E - Electrophilic addition
S_N - Neucleophilic substitution
S_E - Electrophilic substitution
E - Elemination
O - Oxidation, by writing A_N, A_E, S_N, S_E , E and O in appropriate cage.

Reactant	Reagent	Major Product	Type of Reaction
$C_2H_5CH=CHCH_3$	Br_2/CCl_4	$C_2H_5\underset{Cl}{CH}\underset{Cl}{CH}-CH_3$	A_E
$CH_3CH_2-\underset{CH_3}{CH}-OH$	PCl_5	$CH_3CH_2\underset{CH_3}{CH}-Cl$	S_N
$CH_3CH_2CH_2\underset{OH}{CH}-CH_3$	Anhy. Al_2O_3/Δ	$CH_3CH_2CH=CHCH_3$	E
	CH_3Cl / Anhy $AlCl_3$		S_E
	$H^+/KMnO_4$		O

(4marks x 10 = 40marks)

Part - B ~~Essay~~

05\. (a) I (i) The volume of a fixed mass of gas under constant pressure is diretly proportional to the absolute temperature of the gas. (05)

(ii) $PV = nRT$ ✓

$V = \frac{nRT}{P}$ ✓

When the pressure of a fixed mass of a gas is constant ✓ $\frac{nR}{P}$ is constant.

$\frac{V}{T} = k$ ✓

$V = kT$ ✓ (02 ×5)

$V \propto T$

$\boxed{10}$

(b) I (i) $PV = nRT$ (02)

$1.5 \times 10^5 \text{ Pa} \times 4.157 \times 10^{-3} \text{ m}^3 = n \times 8.314 \text{ J mol}^{-1} \text{K}^{-1} \times 500 \text{ K}$ (02+01)

$n = 0.15 \text{ mol}$ (02+01)

$\boxed{08}$

(II) $PV = nRT$

$2.0 \times 10^5 \text{ Pa} \times V = 1.0 \text{ mol} \times 8.314 \text{ J mol}^{-1} \text{K}^{-1} \times 300 \text{K}$ (02+01)

$V = 0.012471 \text{ m}^3$

$= 12.471 \text{ dm}^3$ (02+01)

$\boxed{06}$

II (1) $PV = nRT$

$P \times (4.157 + 12.471) \times 10^{-3} \text{ m}^3 = (0.15 + 1.0) \text{ mol} \times 8.314 \text{ J mol}^{-1} \text{K}^{-1} \times 300 \text{K}$ (02+01)

$P = \frac{1:15 \times 8.314 \times 300}{16.628 \times 10^{-3}}$

$= 1.725 \times 10^5 \text{ Pa}$ (02+01)

3 $\boxed{06}$

(ii) $X_{CH_4(g)} = \frac{n_{CH_4}}{n_T}$ ✓ $= \frac{0.15 \text{ mol}}{(1 + 0.15) \text{ mol}} = \frac{0.15}{1.15} = \frac{\cancel{15}}{\cancel{115}_{23}} = \frac{3}{23}$ (02)

(01+01)

$= 0.13$

$X_{O_2(g)} = \frac{n_{O_2}}{n_T} = \frac{1.0 \text{ mol}}{1.15 \text{ mol}} = \frac{20}{23} = 0.8695$

≈ 0.87

(01+01) (02)

$\boxed{08}$

(iii) $P_{CH_4(g)} = X_{CH_4(g)} \times P_T$ (02)

$= \frac{3}{23} \times 1.725 \times 10^5$ Pa (01+01)

$= 2.25 \times 10^4$ Pa (01+01)

$P_{O_2(g)} = X_{O_2(g)} \times P_T$

$= \frac{20}{23} \times 1.725 \times 10^5$ Pa (01+01)

$= 1.5 \times 10^5$ Pa (01+01) $\boxed{10}$

(iv) If no of moles in vessel A is x, no of moles in vessel B is $(1.15 - x)$ mol.

Pressure in vessel A = Pressure in vessel B (02)

$P = \frac{nRT}{V}$

$$\frac{x \text{ mol} \times \cancel{R} \times \cancel{300K}}{\cancel{4.157} \times \cancel{10^{-3}} \text{ m}^3} = \frac{(1.15 - x) \text{ mol} \times \cancel{R} \times \cancel{300 K}}{\cancel{12.471} \times \cancel{10^{-3}} \text{ m}^3}$$ (02+01)

$3x = 1.15 - x$

$4x = 1.15$

$x = 0.2875$ (02+01)

Moles in vessel A = 0.2875 mol $\boxed{08}$

III (i) $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(g)$ (04)

0.15 mol 1.0 mol

Amount of O_2 react with 0.15 mol of CH_4 } = 0.15 mol × 2 = 0.30 mol (02)

Remaining amount of O_2 = (1 − 0.30) mol = 0.70 mol (02)

Amount of $CO_2(g)$ formed = 0.15 mol (02)

Amount of $H_2O(g)$ = 2 × 0.15 mol = 0.30 mol (02) $\boxed{12}$

(ii) Total number of gaseous moles = Remaining O_2 + $n_{CO_2} + n_{H_2O(g)}$

= (0.70 + 0.15 + 0.30) mol (02)

= 1.15 mol (02) $\boxed{04}$

(III) $PV = nRT$

$P \times 16.628 \times 10^{-3} m^3 = 1.15 \text{ mol} \times 8.314 \text{ J mol}^{-1} K^{-1} \times 400 K$. (02+01)

$= 2.3 \times 10^5$ Pa (01+01)

$\boxed{05}$

(IV) $X_{O_2(g)} = \frac{0.70 \text{ mol}}{1.15 \text{ mol}} = \frac{14}{23}$ (02)
(01+01)

$X_{CO_2(g)} = \frac{0.15 \text{ mol}}{1.15 \text{ mol}} = \frac{3}{23}$ (02)
(01+01)

$X_{H_2O(g)} = \frac{0.30 \text{ mol}}{1.15 \text{ mol}} = \frac{6}{23}$ (02)
(01+01)

$\boxed{12}$

(IV) $P_{O_2(g)} = \frac{14}{23} \times 2.3 \times 10^5$ Pa (01+01)

$= 1.4 \times 10^5$ Pa (01+01)

(01+01)

$P_{CO_2(g)} = \frac{3}{23} \times 2.3 \times 10^5$ Pa (01+01)

$= 3 \times 10^4$ Pa (01+01)

$P_{H_2O(g)} = \frac{6}{23} \times 2.3 \times 10^5$ Pa (01+01) $\boxed{12}$

$= 6 \times 10^4$ Pa

IV Total no of gaseous moles at 27 °C = Remaining O_2 + CO_2 formed.

$= 0.7$ mol + 0.15 mol (02+01)

$= 0.85$ mol. (02+01)

$PV = nRT$

$P \times 16.628 \times 10^{-3} m^3 = 0.85 \text{ mol} \times 8.314 \text{ J mol}^{-1} K^{-1} \times 300 K$ (02+01)

$P = 1.275 \times 10^5$ Pa. (02+01)

$\boxed{12}$

(C) (i) $\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$ (05)

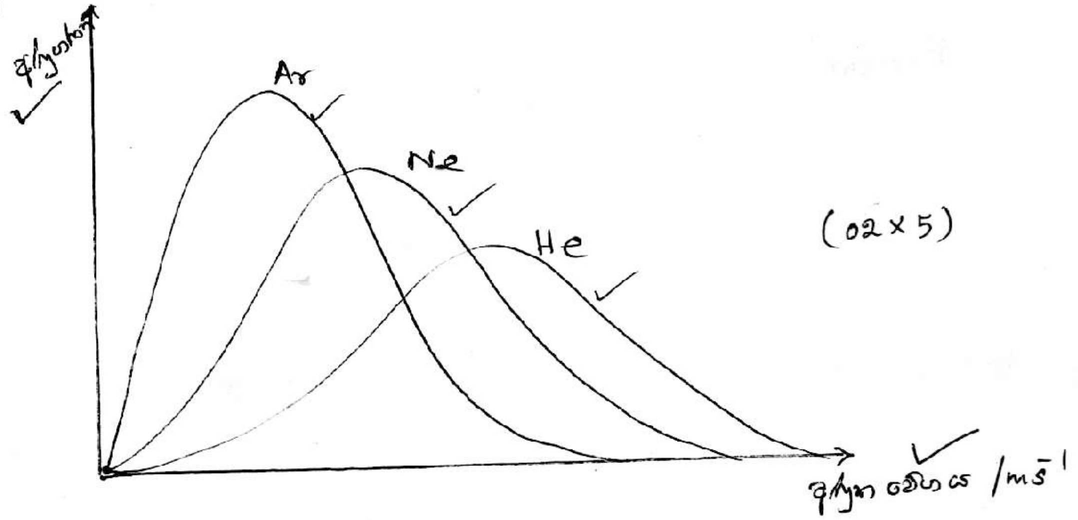
P = Pressure.
V = Volume.
n = Amount of substance.
R = Universal gas constant
T = Absolute temperature. (01×6)

a and b are Van der Waals constants for real gases.

(II) Real gases reach to ideal behaviour at high temperatures and low pressures.

Reason :- When pressure decreases volume occupies by the gas increases . ∴ distence between molecules increases while, strength of intermolecular attractions decreases .
When compared with total volume of the gas, volume of molecules is very small .
When temperature increases volume increases, Kinetic energy of molecules increases . Intermoleculer attractions among molecules become weak . When compered with total volume , volume of molecules is very small . (02 x 5)

iii



(02 x 5)

06. (a) (i) It is the enthalpy change that occurs when one mole of an element or a compound in the standard state undergoes complete combustion in an excess amount of oxygen . $\boxed{10}$

(ii) It is the enthalpy change that occurs when one mole of the compound is formed in the standard state from the constituent elements in the standard state. $\boxed{10}$

(b) (i) 

$$CH_3-\overset{O}{\overset{\|}{C}}-H(g) + \frac{5}{2}O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(g)$$

ΔH_r^θ = Standard bond dissociation enthalpy of bonds broken $-\sum$ Standard bond dissociation enthalpy of bonds formed. (05)

$$= \left\{\left(4\times 412 + 348 + 743 + \frac{5}{2}\times 496\right) - \left(4\times 743 + 4\times 463\right)\right\} \text{ kJ mol}^{-1}$$

(12+02)

$= -845$ kJ mol^{-1} (05+01)

$\boxed{25}$

(ii) $\Delta H_r^\theta = \sum \Delta H_f^\theta$([illegible]) $- \sum \Delta H_f^\theta$([illegible]) (05)

$$= \left\{\left(2\times(-394) + 2\times(-242)\right) - (-166)\right\} \text{ kJ mol}^{-1}$$

(12+02)

$= -1106$ kJ mol^{-1} (05+01)

$\boxed{25}$

(iii) Bond dissociation enthalpies given in (i) above are not bond dissociation enthalpy of relevant compound. (10)

(b) (i) $n_{butane} = \frac{14.5\text{ g}}{58\text{ g mol}^{-1}}$ ✓ $= 0.25$ mol ✓

Heat released when burning 1 mol of butane $= \frac{722\text{ kJ}}{0.25\text{ mol}}$ ✓

$= 2888$ kJ mol^{-1} ✓

Standard combustion enthalpy of butane $= -2888$ kJ mol^{-1} ✓

$n_{propene} = \frac{2.1\text{ g}}{42\text{ g mol}^{-1}}$ ✓ $= 0.05$ mol ✓

Heat released when burning 1 mol of propene $= \frac{102.9\text{ kJ}}{0.05\text{ mol}}$ ✓

$= 2058$ kJ mol^{-1} ✓

Standard combustion enthalpy of propene $= -2058$ kJ mol^{-1} ✓

(03×10)

(ii) $C_4H_{10}(g) + \frac{13}{2}O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l)$; $\Delta H_c^\theta = -2888$ kJ mol^{-1}

(05)

$C_3H_6(g) + O_2(g) \longrightarrow 3CO_2(g) + 3H_2O(l)$; $\Delta H_c^\theta = -2058$ kJ mol^{-1}

(05)

(iii) Heat released when burning 1kg of butane. $= \frac{2888 \text{ kJ}}{58 \text{ g}} \times 1000 \text{ g}$ ✓

$= 49793.10$ kJ ✓

Heat released when burning 1kg of propene $= \frac{2058 \text{ kJ}}{42 \text{ g}} \times 1000 \text{ g}$ ✓

$= 49000$ kJ ✓

(iv) Mass of CO_2 released when burning 1kg of butane $= \frac{4 \times 44 \text{ g}}{58 \text{ g}} \times 1000 \text{ g}$ ✓

3034.48 g

3.03 kg ✓

Mass of CO_2 released when burning 1kg of propene. $= \frac{3 \times 44 \text{ g}}{42 \text{ g}} \times 1000 \text{ g}$ ✓

3142.86 g

= 3.14 kg ✓

(v) Butane ✓

Reason:- Minimum pollution in environment due to minimum evolution of CO_2 ✓

(03 x 10)

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07. (a) (i) $2IO_3^-(aq) + 12H^+(aq) + 10e \longrightarrow I_2(aq) + 6H_2O(l)$ — ① (04)

$2I^-(aq) \longrightarrow I_2(aq) + 2e$ — ② (04)

① + ② × 5 $2IO_3^- + 12H^+ + 10I^- \longrightarrow 6I_2 + 6H_2O$

$IO_3^-(aq) + 6H^+(aq) + 5I^-(aq) \longrightarrow 3I_2(aq) + 3H_2O(l)$ (06)

[illegible]: 1 : 6 : 5 : 3

(ii) $I_2(aq) + 2S_2O_3^{2-}(aq) \longrightarrow S_4O_6^{2-}(aq) + 2I^-(aq)$ (06)

[illegible]: 1 : 2

$n_{KIO_3} = \frac{1.07\ g}{214\ g\ mol^{-1}} = 0.005\ mol$ ✓ ✓

No of moles of IO_3^- in $25\ cm^3 = \frac{0.005\ mol}{250\ cm^3} \times 25\ cm^3$ ✓

$0.0005\ mol$ ✓

Amount of I_2 released $= \frac{3}{1} \times 0.0005\ mol$ ✓

$0.0015\ mol$ ✓

Amount of $S_2O_3^{2-}$ consumed $= \frac{2}{1} \times 0.0015\ mol$ ✓

$0.003\ mol$ ✓

Concentration of $S_2O_3^{2-} = \frac{0.003\ mol}{20 \times 10^{-3}\ dm^3}$ ✓

$= 0.15\ mol\ dm^{-3}$ ✓ (03 x10)

$\boxed{50}$

(b) (i) $NH_3(aq) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$ ✓(05)

Here proton is donated by water. (03)

Therefore behave as an acid. (02)

$HCl(aq) + H_2O(l) \longrightarrow H_3O^+(aq) + Cl^-(aq)$ (05)

Here proton is accepted by water (03)

Therefore behave as base.

∴ Water can act as an acid as well as base. (05)

$\boxed{25}$

(ii) 1. $2Na(s) + 2NH_3(l) \longrightarrow 2NaNH_2(s) + H_2(g)$

හෝ $3Mg(s) + 2NH_3(l) \longrightarrow Mg_3N_2(s) + 3H_2(g)$

2. $3Cl_2(g) + 2NH_3(g) \longrightarrow 2N_2(g) + 6HCl(g)$

හෝ $3CuO(s) + 2NH_3(g) \longrightarrow N_2(g) + 3Cu(s) + 3H_2O(g)$

3. $2H^+(aq) + H_2O_2(aq) + 2KI(aq) \longrightarrow I_2(aq) + 2H_2O(l) + 2K^+(aq)$

හෝ! $2FeSO_4(aq) + H_2O_2(aq) + H_2SO_4(aq) \longrightarrow Fe_2(SO_4)_3(aq) + 2H_2O(l)$.

(7)

4. $2KMnO_4(aq) + 5H_2O_2(aq) + 3H_2SO_4(aq) \longrightarrow 2MnSO_4 + 8H_2O(l) + 5O_2(g) + K_2SO_4$

හෝ $K_2Cr_2O_7(aq) + 4H_2SO_4(aq) + 3H_2O_2(aq) \longrightarrow Cr_2(SO_4)_3(aq) + 3O_2(g) + K_2SO_4(aq) + 7H_2O(l)$

5. $2Na(s) + \overset{\text{වැඩිපුර}}{2H_2S}(g) \longrightarrow 2NaHS(s) + H_2(g)$

හෝ $2Na(s) + H_2S(g) \longrightarrow Na_2S(s) + H_2(g)$

හෝ $Mg(s) + H_2S(g) \longrightarrow MgS(s) + H_2(g)$

6. $SO_2(g) + 2H_2S(g) \longrightarrow 3S(s) + 2H_2O(l)$

හෝ $2KMnO_4(aq) + 3H_2SO_4(aq) + 5H_2S(g) \longrightarrow K_2SO_4(aq) + 5S(s) + 2MnSO_4(aq) + 8H_2O(l)$

හෝ $K_2Cr_2O_7(aq) + 4H_2SO_4(aq) + 3H_2S(g) \longrightarrow K_2SO_4(aq) + Cr_2(SO_4)_3(aq) + 3S(s) + 7H_2O(l)$

(05 × 6)

(iii)(1) $2Mg(NO_3)_2(s) \xrightarrow[\Delta]{} 2MgO(s) + 4NO_2(g) + O_2(g)$

(2) $Li_2CO_3(s) \xrightarrow[\Delta]{} Li_2O(s) + CO_2(g)$

(3) $2KHCO_3(s) \xrightarrow[\Delta]{} K_2CO_3(s) + CO_2(g) + H_2O(g)$

(4) $NaNO_2(s) + NH_4Cl(s) \longrightarrow NaCl(s) + 2H_2O(g) + N_2(g)$

(5) $NH_4NO_3(s) \xrightarrow[\Delta]{} N_2O(g) + 2H_2O(g)$

(6) $(NH_4)_2SO_4(s) \longrightarrow 2NH_3(g) + H_2SO_4(g)$ (05×6)

(c). Gas obtained by adding the product obtained by burning a strip of Mg into water, turns Nestler reagent brown ∴ $NH_3(g)$ evolved.
∴ N_2 exist in air.

$3Mg(s) + N_2(g) \longrightarrow Mg_3N_2(s)$, $Mg_3N_2(s) + 6H_2O(l) \longrightarrow 3Mg(OH)_2 + 2NH_3(g)$

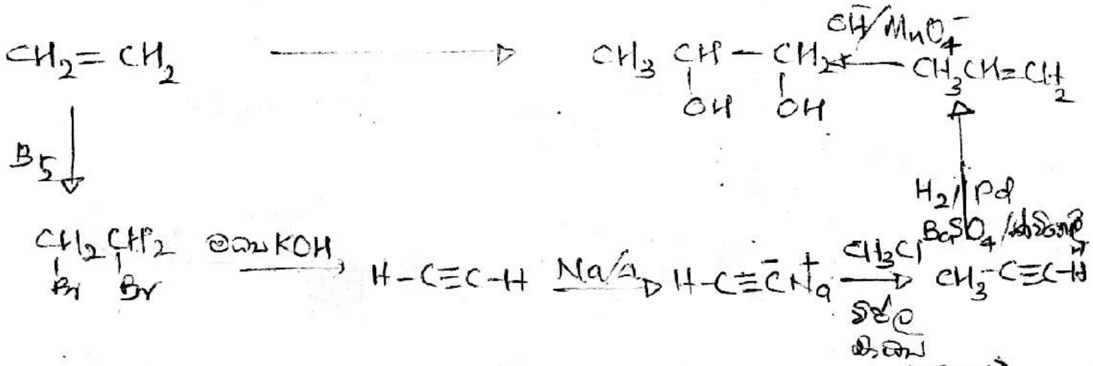
8 ·

$\boxed{15}$

⑧

(a)

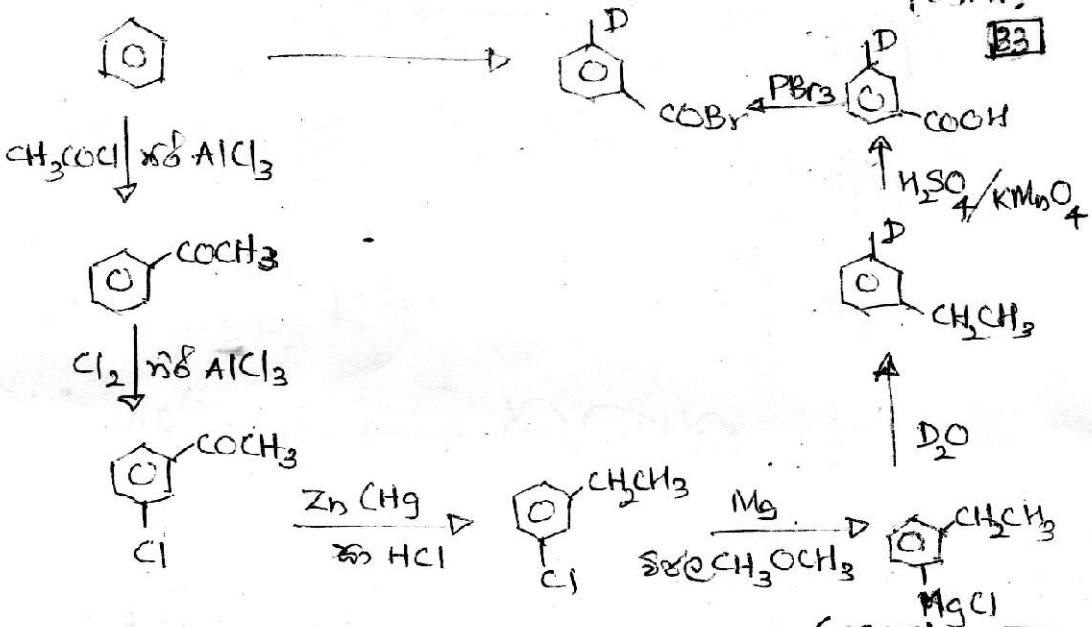
(i)



(03×11)

$\boxed{33}$

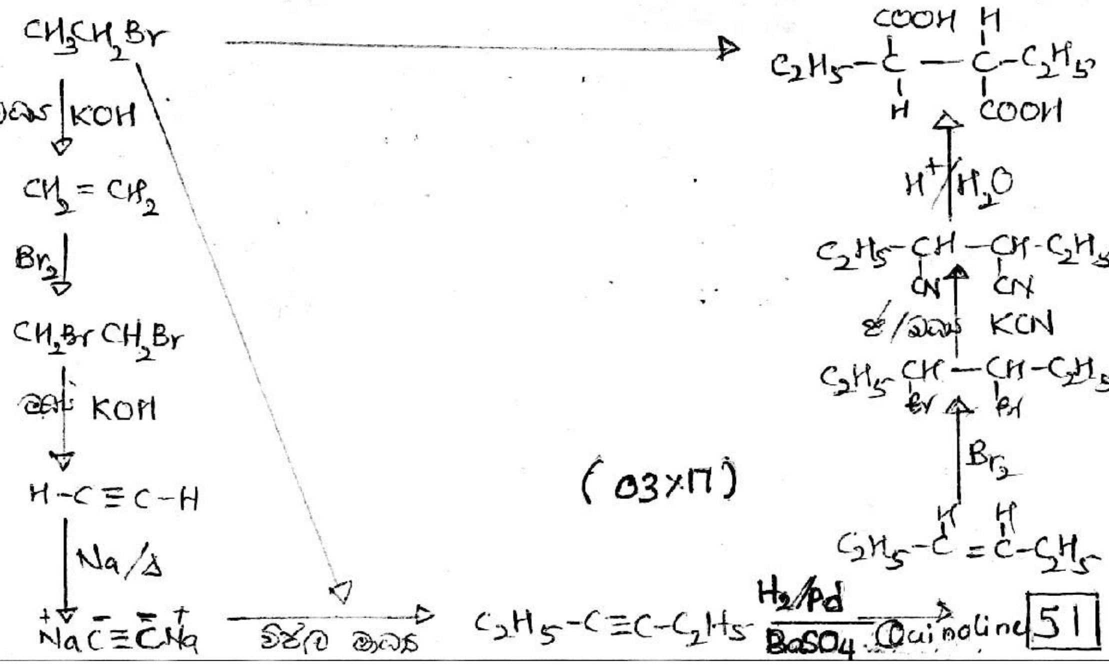
(ii)



(03×13)

$\boxed{39}$

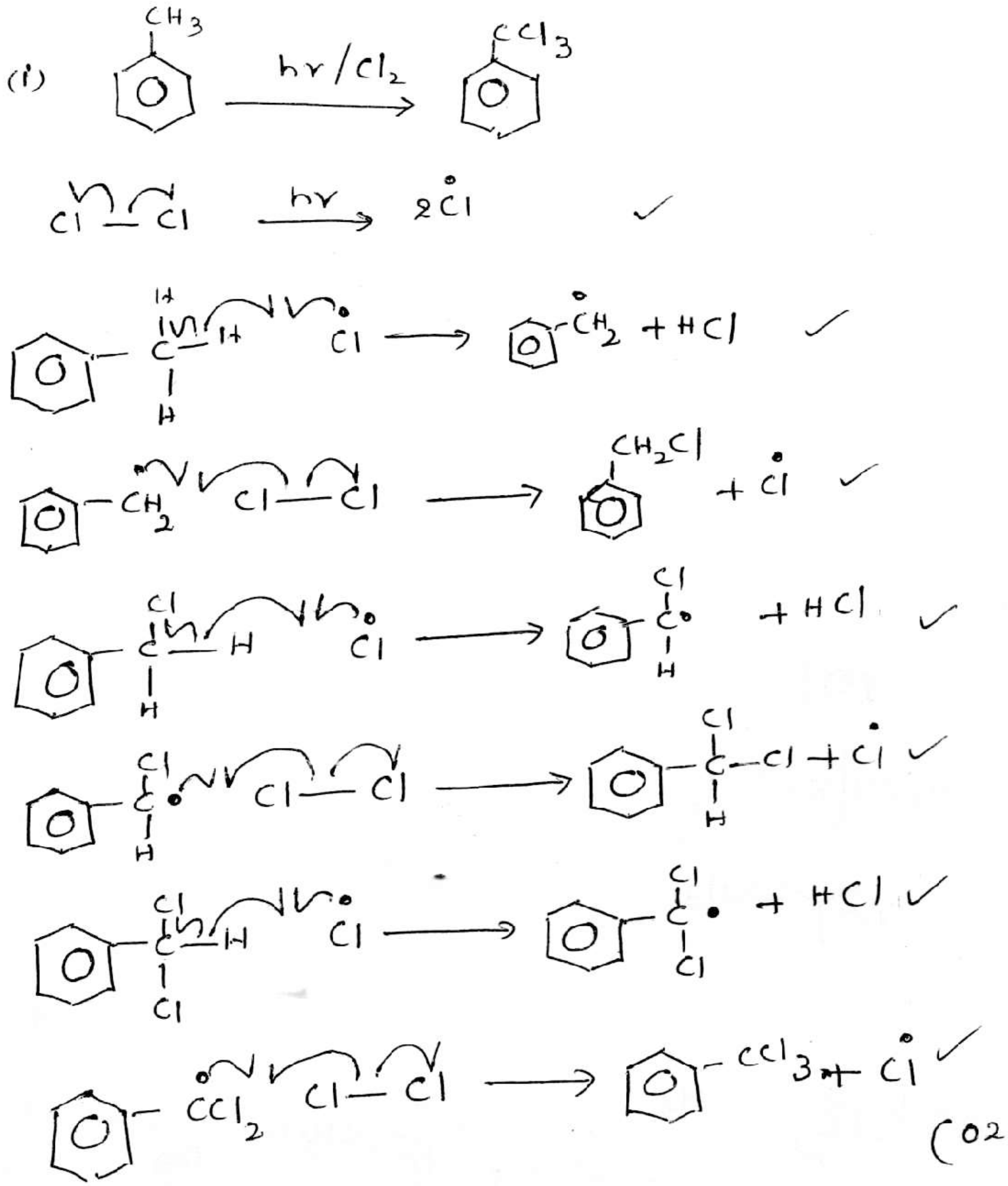
(b)



(03×17)

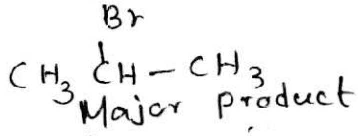
$\boxed{51}$

(C) (i)



(02×7)

(ii)

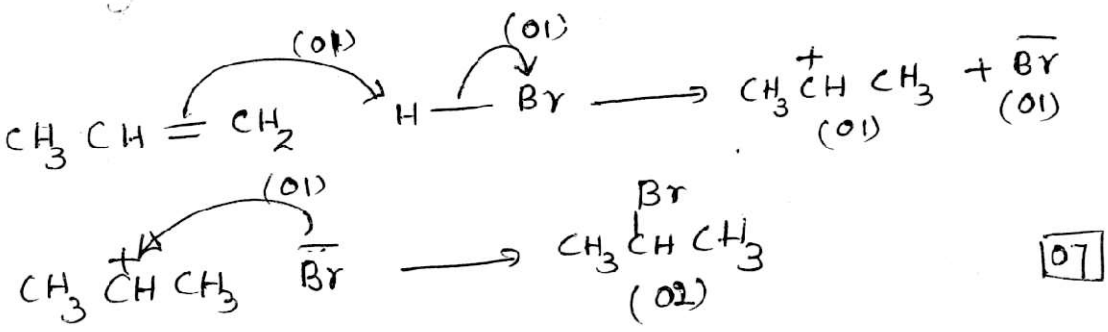


$CH_3CH(Br)-CH_3$

Major product

$CH_3CH_2CH_2Br$ minor product.

(02×2)



$\boxed{07}$

⑨ (a) (i)

A - $CsCl$	F - NH_4Cl	J - $AgCl$
B - H_2SO_4	G - $BaSO_4$	K - $[Ag(NH_3)_2]^+Cl^-$
C - Cs_2SO_4	H - NH_3	
D - $HCl(g)$	I - $AgNO_3$	

(05×10)

(ii) $2KMnO_4 + 16HCl \longrightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2(g)$ (08)

(iii) When filter paper dipped in Nestler reagent is held to gas H (NH_3), turns it brown. (05)

$\boxed{63}$

(b) (a) $Ba_2S_2O_3$ gives pungent smell with precipitate (light yellow) when adding dil. HNO_3.
$BaSO_3$ gives colourless solution with a gas having a pungent smell.
Remaining is $BaCO_3$. (05×3)

(b) $2Mg(NO_3)_2(s) \xrightarrow{\Delta} 2MgO(s) + 4NO_2(g) + O_2(g)$
brown.

$MgCO_3(s) \xrightarrow{\Delta} MgO(s) + CO_2(g)$

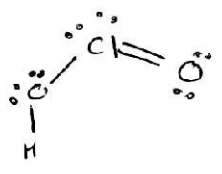
$(NH_4)_2CO_3(s) \xrightarrow{\Delta} 2NH_3(g) + CO_2(g) + H_2O(g)$ (04×3)

If there is no residue when heating, it is $(NH_4)_2CO_3$.
Brown gas is given by $Mg(NO_3)_2$
There is a residue with colourless gas, It is $MgCO_3$.
(04×3) $\boxed{39}$

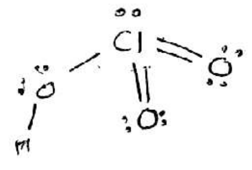
(c) (i)

HOCl

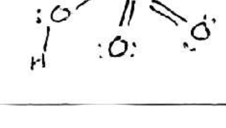
$HClO_2$



$HClO_3$



$HClO_4$



(04×8)

(ii) a) $HOCl < HClO_2 < HClO_3 < HClO_4$ (08)

(b) $HOCl < HClO_2 < HClO_3 < HClO_4$ (08)

$\boxed{48}$

(10) (a) I (i) $X \equiv Cr$ $Y \equiv Ti$ $Z \equiv Mn$ (10×3)

(ii) $[Cr(NH_3)_6]^{3+}$

$[Ti(H_2O)_6]^{3+}$

$[MnCl_4]^{2-}$

(05×3)

(iii)

	ඔ.ක.අ.	Nature of oxide.
CrO ✓	+2 ✓	Weakly basic. ✓
Cr_2O_3 ✓	+3 ✓	Amphoteric. ✓
CrO_2 ✓	+4 ✓	Weekly acidic. ✓
CrO_3 ✓	+6 ✓	Acidic ✓

(03×12)

(iv) +2, +3, +4 (02×3)

(v) As catalyst – Polymerization of ethene. $TiCl_3 / Al_2(C_2H_5)_6$. (04)

As alloy – Produce different types of corrosion resistance steel. (04)

(vi) $MnO_4^- + 4\overline{OH} \longrightarrow 4MnO_4^{2-} + 2H_2O + O_2$ (05)

$\boxed{100}$

(b) 1) $FeO + H_2SO_4 \longrightarrow FeSO_4 + H_2O$ ✓ (02)

$Fe_2O_3 + 3H_2SO_4 \longrightarrow Fe_2(SO_4)_3 + 3H_2O$ ✓ (02)

2) $2Fe^{3+} + 2I^- \longrightarrow 2Fe^{2+} + I_2$ ✓ (04)

4) $14H^+ + Cr_2O_7^{2-} + 6Fe^{2+} \longrightarrow 6Fe^{3+} + 2Cr^{3+} + 7H_2O$ ✓ (04)

3) $2S_2O_3^{2-} + 2I_2 \longrightarrow 2I^- + S_4O_6^{2-}$ ✓ (04)

5)

$n_{S_2O_3^{2-}} = 0.25 \times 20 \times 10^{-3} = 5.0 \times 10^{-3}$ mol ✓

$\therefore n_{I_2} = 2.5 \times 10^{-3}$ mol ✓

$n_{Fe^{3+}} = 5 \times 10^{-3}$ mol ✓

$n\ Fe_2O_3$ (In 200 cm³) $= 2.5 \times 8 \times 10^{-3}$ mol $= 0.02$ mol ✓

Mass of Fe_2O_3. $= 2.5 \times 8 \times 10^{-3}$ mol $\times 160$ g mol^{-1} ✓

$= 3.2$ g ✓

Percentage of Fe_2O_3. $= \frac{3.2g}{10g} \times 100$ ✓ $= 32\%$ ✓

Since Fe^{2+} in solution A, $K_2Cr_2O_7$ required for all Fe^{2+}

No of moles of $Cr_2O_7^{2-}$ required. $= 0.05 \times 25 \times 10^{-3}$ ✓

$n_{Fe^{2+}}$ in 25 cm³. $= 6 \times 0.05 \times 25 \times 10^{-3}$ ✓

$n_{Fe^{2+}}$ in 200 cm³. $= 6 \times 0.05 \times 25 \times 10^{-3} \times 8$ ✓

$= 0.06$ mol ✓

Fe^{2+} from Fe_2O_3. $= 0.02$ mol ✓

Fe^{2+} from FeO $= 0.04$ mol ✓

mass of FeO. $= 0.04$ mol $\times$ 72 g mol ✓

$= 2.96$ g ✓

Percentage of FeO $= 29\%$ ✓ (02×17)

$\boxed{50}$