இலங்கையின் உயர்தர கணித விஞ்ஞான
பிரிவிற்கான இணையதளம்

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Part – 1

1) 3	6) 4	11) 3	16) 5	21) 2
2) 5	7) 5	12) 5	17) 4	22) 4
3) 1	8) 1	13) 4	18) 3	23) 3
4) 3	9) 4	14) 2	19) 2	24) 5
5) 2	10) 2	15) 3	20) 4	25) 4

Structure

I (a) (i) Cl_2 (ii) XeF_2 (iii) P (iv) $SrCO_3$ (v) $HClO_4$
(vi) SF_6
6 × 6 = 36

(b) (i) $CH_3-\overset{\overset{O}{\|}}{C}-\ddot{N}=\overset{+}{N}=\overset{-}{\underset{\cdot\cdot}{N}}:$ 08

(ii) $CH_3-\overset{\overset{O}{\|}}{C}-\overset{\cdot\cdot}{\underset{\cdot\cdot}{N}}-\overset{+}{N}\equiv N:$
2 ஒரு

$CH_3-\overset{\overset{:O:}{\|}}{C}=\underset{\cdot\cdot}{N}-\overset{+}{N}\equiv N:$
2 ஒரு.

$CH_3-\overset{\overset{O}{\|}}{C}-N\equiv N-\underset{\cdot\cdot}{N}:^{2-}$
2 ஒரு வலை

OR $CH_3-\overset{\overset{:O:}{\|}}{C}=\overset{+}{N}=\overset{+}{N}=\underset{\cdot\cdot}{N}:^{-}$
2 ஒரு வலை

(3+1) × 3 = 12

(iii)

	O^1	N^2	C^3	C^5
VSEPR Pair	4	4	3	4
Electron Pair geometry	Tetrahedral	Tetra hedral	Trigonal Planer	Tetra hedral
molecular shape	angular	Trigonal pyramidal	Trigonal Planer	Tetra hedral
hybridization	sp^3	sp^3	sp^2	sp^3

4 × 4 = 16

(iv) O^1 sp^3 N^2 sp^3
N^4 sp^3 C^3 sp^2
C^3 sp^2 C^5 sp^3
C^5 sp^3 Cl^6 sp^3 /3P

8 × 1 = 8

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(v) C^{3} 2P C^{4} 2P [02]

(C) (i)

	Species	Primary interaction (Bond TYPE)	secondary interaction.
(1)	$CH_4(g)$	Covalent bond	London force dispersion force
(2)	$NaCl(s)$	ion / Electrostatic force	—
(3)	Mg	Metalic bond	—
(4)	C (Diamond)	Covalent	—
(5)	$CH_3OH(aq)$	Covalent	Hydrogen bond

[12×1 = 12]

(iii) (i) XeF_4 90° (ii) 120, 90 (iii) 119 / 118

[3×2 = 06]

[27] (i)

	Cr	S	O	
mass	26.52	24.52	48.96	
mole	$\frac{26.52}{52}$	$\frac{24.52}{32}$	$\frac{48.96}{16}$	(5)
	0.51	0.766	3.06	(5)
	1	1.5	6	(5)
	2	3	12	(5)

(i) $Cr_2S_3O_{12}$ (5)

(ii) $Cr_2(SO_4)_3$ (5)

(ii) dihydrogen sulfide
hydrogen perchlorate / Perchloric acid
Potassium dihydrogen phosphate
Ferric sulfide or Iron(III) sulfide

[4×4 = 16]

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(i) $Fe^{2+}_{(aq)} \longrightarrow Fe^{3+}_{(aq)} + e$ (5)

$3e + NO_3^- + 2H_2O_{(l)} \longrightarrow NO_{(g)} + 4OH^-_{(aq)}$ (5)

$3Fe^{2+}_{(aq)} + NO_3^-{}_{(aq)} + 2H_2O_{(l)} \longrightarrow 3Fe^{3+}_{(aq)} + NO_{(g)} + 4OH^-_{(aq)}$ (5) (1)

(ii) $\overset{0}{S}_{(s)} + \overset{+5}{H}NO_{3(aq)} \longrightarrow \overset{+6}{H_2SO_4}_{(aq)} + \overset{+4}{N}O_{2(g)} + H_2O_{(l)}$ (5)

$S \xrightarrow{-6e} S^{+6}$ (oxidation)

$N^{+5} \xrightarrow{+e} N^{+4}$ (reduction) $\times 6$

$S_{(s)} + 6HNO_3 \longrightarrow H_2SO_4 + 6NO_2 + 2H_2O$ (5)

(iii) $C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(g)}$ (5) (4)

(c) (i) $MnO_4^-{}_{(aq)} + 8H^+_{(aq)} + 5e \longrightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$

$H_2O_2{}_{(aq)} \longrightarrow O_{2(g)} + 2H^+_{(aq)} + 2e$ $\times 2$ $\times 5$

$2MnO_4^-{}_{(aq)} + 5H_2O_2{}_{(aq)} + 6H^+_{(aq)} \longrightarrow 2Mn^{2+}_{(aq)} + 5O_{2(g)} + 8H_2O_{(l)}$

$SO_3^{2-}{}_{(aq)} + H_2O_{(l)} \longrightarrow SO_4^{2-}{}_{(aq)} + 2H^+_{(aq)} + 2e$

$2MnO_4^-{}_{(aq)} + 5SO_3^{2-}{}_{(aq)} + 6H^+_{(aq)} \longrightarrow 2Mn^{2+}_{(aq)} + 5SO_4^{2-}{}_{(aq)} + 3H_2O_{(l)}$

$5 \times 0.2 = 10$

(ii) $n_{H_2O_2} = 0.1\,mol\,dm^{-3} \times 50 \times 10^{-3}\,dm^3$

$= 5 \times 10^{-3}\,mol$ (2+1)

n_{KMnO_4} reacted with $H_2O_2 = \frac{2}{5} \times 5 \times 10^{-3}\,mol$

$= 2 \times 10^{-3}\,mol$ //

(2+1)

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$n_{SO_3^{2-}} = 0.1\ mol\,dm^{-3} \times 50 \times 10^{-3}\ dm^3$

$= 5 \times 10^{-3}\ mol$ (2+1)

$\therefore n_{KMnO_4\ (remaining)} = \frac{2}{5} \times 5 \times 10^{-3}\ mol$

$= 2 \times 10^{-3}\ mol$ (2+1)

$n_{Total\ (KMnO_4)} = 4 \times 10^{-3}\ mol$

$[KMnO_4] = \frac{4 \times 10^{-3}\ mol}{100 \times 10^{-3}\ dm^3} = 0.04\ mol\,dm^{-3}$

(2+1)

Q3 (i) A - Sodium (B) magnesium (C) Aluminium

5×3 = 15

(ii) A < C < B

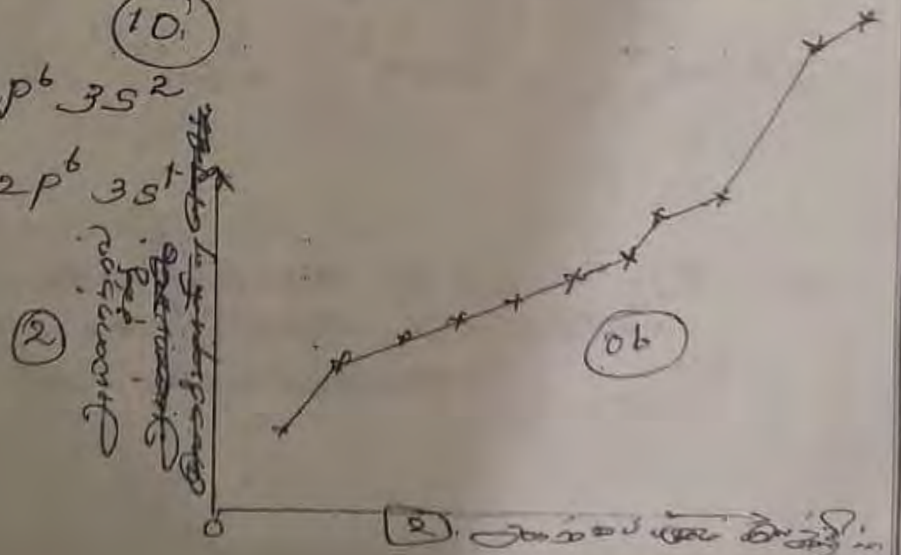
atomic radius A > B > C

Electronic configuration of B or Mg is in full fill arrangement in S Orbit. Therefore more energy is needed to remove Valance electron of Mg.

Mg or give marks for suitable - resonance. (10)

(iii) $1s^2\ 2s^2\ 2p^6\ 3s^2$

(iv) A $1s^2\ 2s^2\ 2p^6\ 3s^1$



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(v) Suitable uses (10)

(B) (i) ClF_3

~~Number of Valance Electron pair = 5~~

number of VSEPR pair = 5 (2)

" " " σ pairs = 3 (2)

" " Lone pairs = 2 (2)

Shape T-shape. (4)

(ii) SF_4 Number of VSEPR pair = 5. (2)

" " σ pair = 4 (2)

" " Lone pair = 1 (2)

Shape - sea-saw (4)

(C)

I SiO_2

II Mg

III NaCl

IV CO_2

V Al_2O_3. $6 \times 5 = 30$

(4) (i) $[HCl_{(aq)}] = \frac{36.5}{100} \times \frac{1.17 \times 10^3 \text{ g dm}^{-3}}{36.5 \text{ g mol}^{-1}}$

$= 11.7 \text{ mol dm}^{-3}$ // (15)

(ii) hydrochloric acid (05)

(iii) $11.7 \text{ mol dm}^{-3} \times V \text{ cm}^3 = 5 \text{ mol dm}^{-3} \times 250 \text{ cm}^3$

$V = 106.84$ // (15)

Initially small amount of distilled water was taken into a 250 cm^3 volumetric flask. Then 106.84 cm^3

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11.7 mol dm^{-3} conc. HCl was added slowly then ✓ water was added until the bottle mark of the volumetric flask. (5)

(iv) $HCl_{(aq)} + NaOH_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$

$n_{HCl} = 2 mol dm^{-3} \times 100 \times 10^{-3} dm^3$
$= 0.2 mol$

$n_{NaOH} = 1 mol dm^{-3} \times 100 \times 10^{-3} dm^3$
$= 0.1 mol$

∴ remaining mole of H^+ is $= 0.1 mol$ (5)

(I) ~~Base~~ (5)

II $[H^+_{aq}] = \frac{0.1 mol}{200 \times 10^{-3} dm^3} = 0.5 mol dm^{-3}$ // (10)

(v) $2KMnO_4 + 16HCl \longrightarrow 2MnCl_2 + 5Cl_2 + 2KCl + 8H_2O_{(l)}$ (15)

(B) (i) $A^{n+}_{(aq)} + 3H_2O \longrightarrow AO_3^-{}_{(aq)} + 6H^+_{(3)} + (5-n)$

$MnO_4^- + 8H^+ + 5e \longrightarrow Mn^{2+}_{(3)} + 4H_2O_{(l)}$ (15)

$5A^{n+} + 15H_2O + (5-n)MnO_4^- + (5-n)8H^+ \longrightarrow 5AO_3^- + 30H^+_{(3)} + (5-n)Mn^{2+} + 4(5-n)H_2O$ (10)

$\frac{n A^{n+}}{n MnO_4^-} = \frac{2.68 \times 10^{-3} mol}{1.61 \times 10^{-3} mol} = 1.66$ (5)

$1.66 = \frac{5}{(5-n)}$

$8.3 - 1.66n = 5$
$1.66n = 3.3$
$n = 2$ // (5)

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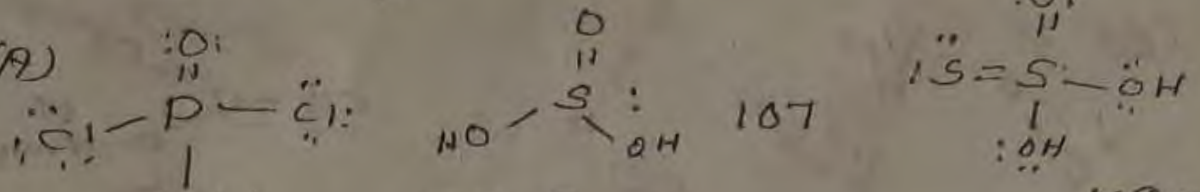
(5) (A)

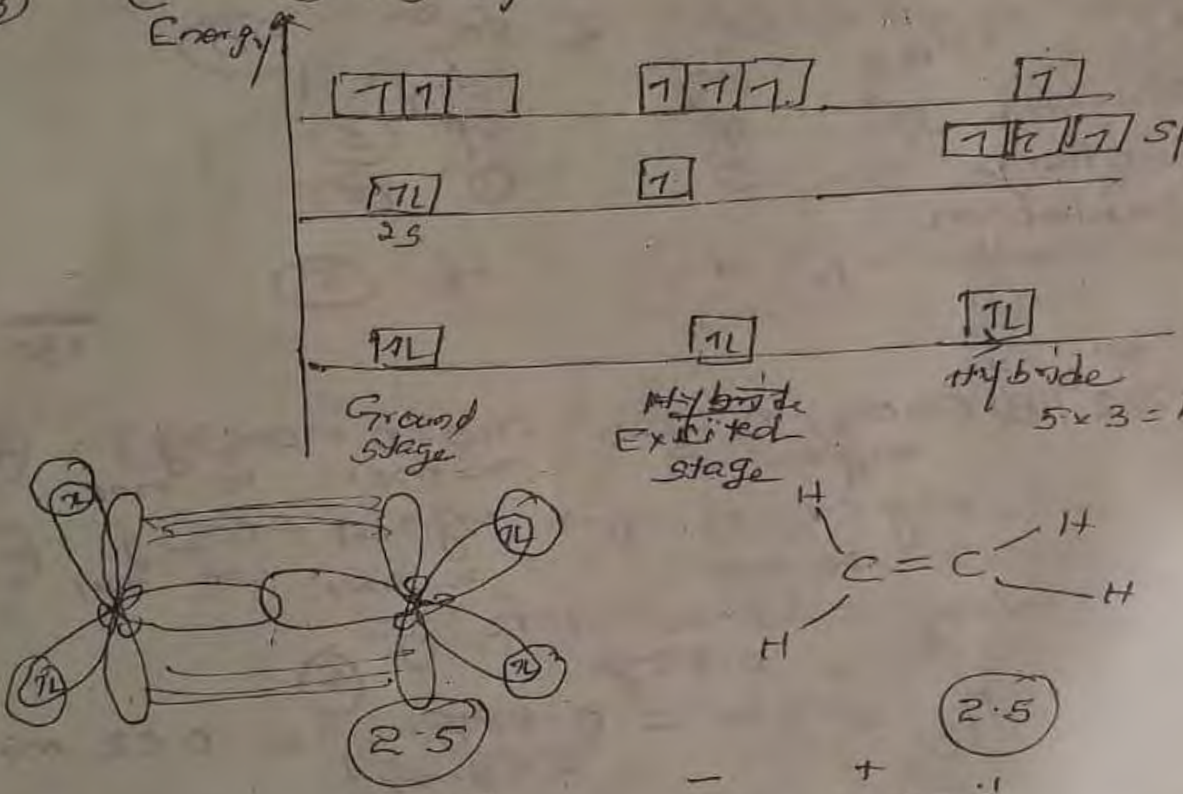


or/ other suitable angle.

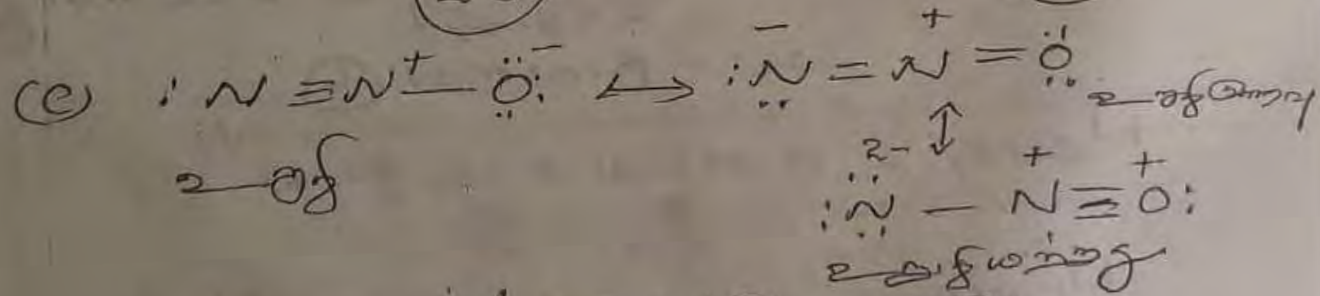
structure $10 \times 3 = 30$

each angles $01 \times 11 = 11$

(B) C $1s^2 2s^2 2p^2$



2·5

(C) 

structure $06 \times 3 = 18$

stability $02 \times 3 = 6$] (24)

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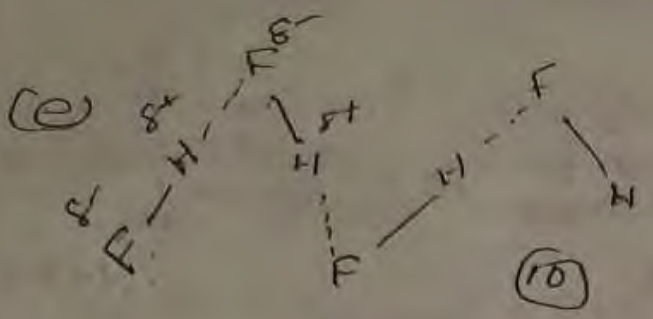
(e)



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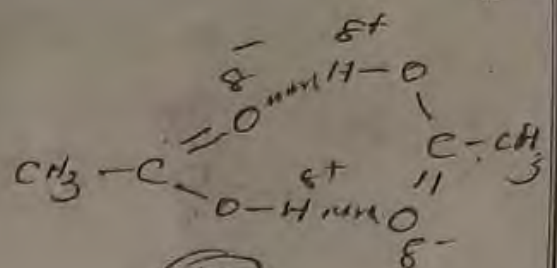

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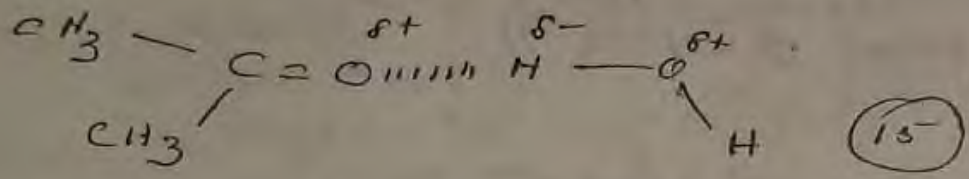

(15)

(d) (i) $H_2S < SO_3^{2-} < SO_4^{2-}$ (10)

(ii)

	H_2S	SO_3^{2-}	SO_4^{2-}	
Hybride	sp^3	sp^3	sp^3	(5)
charge	(1)	(1)	(1)	(5)
Oxidation number	-2	+4	+6	(5)

150

(ii)

[Q2] (a) $CaCO_3(s) \xrightarrow{\Delta} CaO(s) + CO_2(g)$ (4)

100 g, x mol; x mol, x mol

$MgCO_3(s) \xrightarrow{\Delta} MgO(s) + CO_2(g)$ (4)

x mol; x mol, x mol

$W_{CO_2} = (2.00 - 1.12)\,g$

$= 0.88\,g$ (4)

$n_{CO_2} = 2x = \frac{0.88\,g}{44\,g\,mol^{-1}} = 0.02\,mol$ (4)

$x = 0.01\,mol$ (4)

$W_{CaCO_3} = 0.01\,mol \times 100\,g\,mol^{-1}$

$= 1\,g$ // (4)

$W_{MgCO_3} = 0.01\,mol \times 84\,g\,mol^{-1}$

$= 0.84\,g$ // (4)

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$W\%\ CaCO_3 = \frac{1\,g}{2\,g} \times 100\ \%$ (03)

$= 50\ \%$ (03)

$W\%\ MgCO_3 = \frac{0.84\,g}{2\,g} \times 100\ \%$ (3)

$= 42\ \%$ (3)

40

(B) $M_2SO_4 \cdot x H_2O \xrightarrow{\Delta} M_2SO_{4(s)} + x H_2O_{(g)}$

8 g 3.75 g

$n_{M_2SO_4 \cdot xH_2O} = n_{M_2SO_4} = n\,x\,n_{H_2O}$

$n_{H_2O} = \frac{3.75\,g}{18\,g\,mol^{-1}} = 0.21\ mol$ (10)

$W_{M_2SO_4} = (80 - 3.75)\,g$

$= 76.25\,g.$ (10)

$n_{M_2SO_4} = \frac{76.25\,g}{120\,g\,mol^{-1}} = 0.635\ mol$ (10)

$0.635\ mol = 0.21x$

$x = 3$ (10)

(C) Or Relative atomic mass $A_r = \frac{12 \times 98.89 + 13 \times 1.11}{100}$

$A_r = \frac{12u \times 98.89 + 13u \times 1.11}{100}$ (10)

$= 12.01\ u$ (10)

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(D) $n_{Na_2CO_3} = 2 mol\,dm^{-3} \times 250 \times 10^{-3}\,dm^3$ (8)

$n_{Na_2CO_3} = 0.5 mol$

$W_{Na_2CO_3} = 0.5 mol \times 106\,g\,mol^{-1}$

$W_{Na_2CO_3} = 53g$ (8)

A 50g Na_2CO_3 (s) was measured accurately Then it was transferd into the 250 cm^3 volumetric flask with the help of funnel. The distile water was added and shaked then contineously distile water was added unitile the marked level (06)

(E) $^{226}_{88}Ra \longrightarrow \boxed{2}^{4}He + \boxed{86}^{222}Rn$

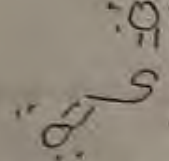
$^{7}_{4}Be + \boxed{-1}^{0}\beta \longrightarrow \boxed{3}^{7}Li$ $\quad 4 \times 7 = 28$

150

(3) SO_3.

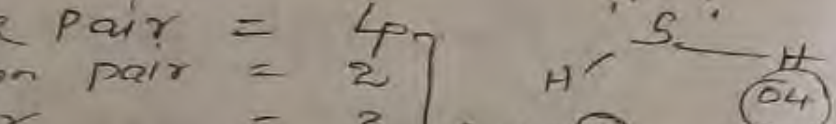
VSEPR Pair = 3.
σ electron pair = 3.] $3 \times 1 = 03$.
Lone Pair = 0

Shape trigonal Planar (03)



(4)

H_2S VSEPR Pair = 4
σ Electron pair = 2
Lone Pair = 2] $3 \times 1 = (3)$



(04)

Shape - angular

(03)

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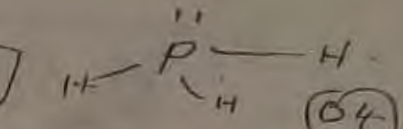
PH_3.

VSEPR Pair = 4
σ Pair = 3
Lone Pair = 1

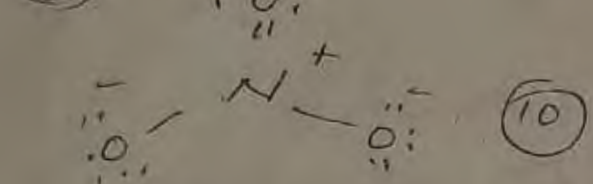
$3 \times 1 = 3$



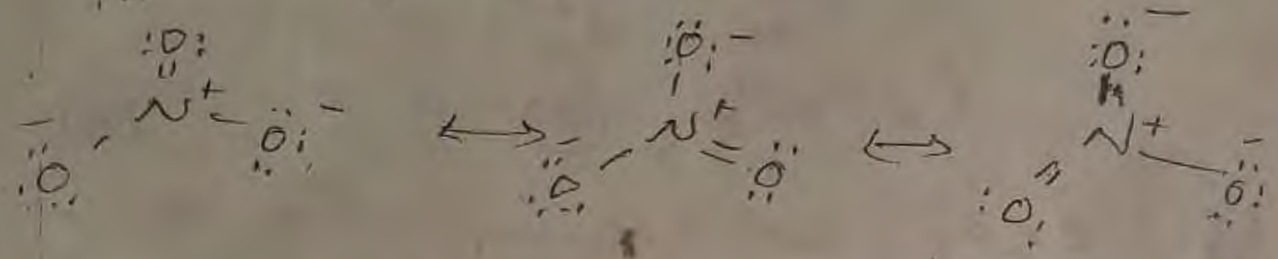
(04)

Shape Trigonal Planar. (03)

(B)



(10)



$3 \times 5 = 15^-$

(C) $E = h\nu = \frac{hc}{\lambda}$

$E = \frac{6.626 \times 10^{-34}\ Js \times 3 \times 10^{8}\ ms^{-1}}{589 \times 10^{-9}\ m}$ (10) (10)

for 1 mol $E = \frac{6.626 \times 10^{-34} \times 3 \times 10^{8} \times 6.022 \times 10^{23}}{589 \times 10^{-9}}$ (10) (10) $J\,mol^{-1}$

$= 203.23 \times 10^{3}\ J\,mol^{-1}$

$= 203.23\ kJ\,mol^{-1}$ // (10)

(D)

CO_2	:	H_2O	
2	:	1	
C	:	H	
1	:	1	molecular (5)

~~Empirical~~ formula $(CH)_x O_y$. (5)

$13x + 16y = 152$ (5)

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approximated maximum mass of O
$= \frac{40}{100} \times 152 = 60.8\,g$ (5)

η_O (approximate) $= \frac{60.8\,g}{16} = 3.8$ (5)

∴ accurate mole of 'O' = 3 (5)

i $13x + 16 \times 3 = 152$
$13x = 104$
$x = 8$ (5)
$C_8H_8O_3$ (5) [40]

(E) (i) $Cr_2O_7^{2-} + 14H^+ + 6e \longrightarrow 2Cr^{3+} + 7H_2O$
$H_2S \longrightarrow S + 2H^+ + 2e$.
$Cr_2O_7^{2-} + 8H^+ + 3H_2S \longrightarrow 2Cr^{3+} + 3S + 7H_2O$
$3 \times 5 = 15$
$K_2Cr_2O_7$

(ii) $MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O$ —(1)
$Fe^{2+} \longrightarrow Fe^{3+} + e$.
$C_2O_4^{2-} \longrightarrow 2CO_2 + 2e$
$FeC_2O_4 \longrightarrow Fe^{3+} + 2CO_2 + 3e$ —(2)

$3MnO_4^- + 24H^+ + 5FeC_2O_4 \longrightarrow$
$3Mn^{2+} + 5Fe^{3+} + 10CO_2 + 12H_2O$
$3 \times 5 = 15$

150

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அனைய்புக்குரிய வினா (2) b(i)
$Fe^{2+} + NO_3^- + H_2O \longrightarrow Fe^{3+} + NO + OH^-$

குறிவினா (2) (a) $MSO_4 \cdot xH_2O$
$M = 24$
$MSO_4 \cdot xH_2O$ (i) 80g

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