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OCTOBER - NOVEMBER, 2023

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MARKING GUIDE:
P525/1
CHEMISTRY PAPER 1.

ASSHU - ANKOLE:

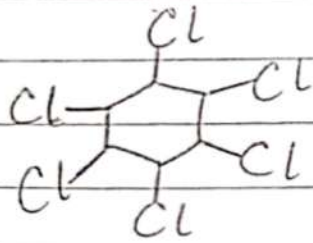
1 (a) $3^{0}_{-1}e$ ✓ (01)

(b) $^{233}_{92}U$ ✓ (01)

(c) $^{1}_{0}n$ ✓ (01)

(d) $^{28}_{14}Si$ ✓ (01) [04]

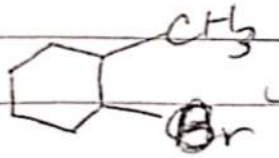
2 (a)



✓ (01½)

1,2,3,4,5,6-hexachlorocyclohexane. ✓
(No gap).

b)



✓ (01½)

1-bromo-2-methylcyclohexane. ✓

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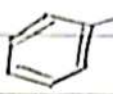
(c)  ✓ OH ✓ (01½)

Phenol ✗ or hydroxybenzene.

(d)  ✓ CH_3 ✓ (01½)

Methylbenzene ✗. Reject, Methyl benzene.

06

3(a). Both are rendered passive by Concentrated nitric acid.

• Both react with hot concentrated Sodium hydroxide (alkalis) to form a Complex and hydrogen gas. (03)

• Their oxides and hydroxides are amphoteric. Three Any Correct

• Their Carbides react with Raw water to form methane gas.

• Their Chlorides are Covalent, polymeric and readily hydrolysed in water.

b) i) $Be_2C_{(s)} + 4HCl_{(aq)} \longrightarrow 2BeCl_{2(aq)} + CH_{4(g)}$ ✓ ✓ (03)

ii) $CaC_{2(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + C_2H_{2(g)}$. ✓ ✓

- Deduct ½ mk if states are missing or are wrong
- ~~Deny marks if eqn is not balanced~~ 06

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4) a) (01)

i) $C_xH_{y(g)} + \left(x + \frac{y}{4}\right)O_{2(g)} \longrightarrow xCO_{2(g)} + \frac{y}{2}H_2O_{(l)}$

(ii) Volume of CO_2 produced $= 70 - 30 = 40cm^3$ ✓

Volume of O_2 used $= 95 - 30 = 65cm^3$ ✓

1 vol. of C_xH_y produces x vol. of CO_2

$10cm^3$ of C_xH_y produce $40cm^3$ of CO_2

$\therefore 10x = 40$

$x = 4.$ ✓

1 vol. of C_xH_y reacts with $\left(x + \frac{y}{4}\right)$ Vol. of O_2

$10cm^3$ of C_xH_y react with $65cm^3$ of O_2.

$\therefore 10\left(x + \frac{y}{4}\right) = 65$ (02½)

$4 + \frac{y}{4} = 6.5$

$y = 10.$ ✓ ✓

$\therefore$ Molecular formula of R is C_4H_{10}.

b) $CH_3\underset{\underset{OH}{|}}{C}HCH_2CH_3 \xrightarrow[\text{heat}]{\text{Conc. } H_2SO_4}$ ✓ $CH_3CH=CHCH_3$

$\xrightarrow{H_2/Ni/150^\circ C}$ ✓ (02)

$CH_3CH_2CH_2CH_3$

05½

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5 a) i) $NH_4^+(aq) + H_2O(l) \rightleftharpoons NH_3(aq) + H_3O^+(aq)$ (01½)

(ii) $K_h = \frac{[NH_3][H_3O^+]}{[NH_4^+]}$ (02½)

b) i) $PH = -\log[H_3O^+]$

$5.13 = -\log[H_3O^+]$

$[H_3O^+] = 10^{-5.13} = 7.413 \times 10^{-6}\ Moldm^{-3}$

$K_h = \frac{[H_3O^+]^2}{[NH_4^+]}$ (02)

$= \frac{(7.413 \times 10^{-6})^2}{0.1} = 5.495 \times 10^{-11}\ Moldm^{-3}$

ii) At equilibrium;

$[NH_3] = [H_3O^+]$ (01)

$[NH_4^+] = [Salt] = 0.1\ M$

05

6 a) $Cu^{2+}(aq)$ or hydrated Copper(II) ion. (02½)

Reject; Cu^{2+} alone or Copper(II) ion

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b) i) Hexaaquacopper(II) ion ✓ (01)

ii) Tetrachlorocuprate(II) ion ✓ (01)

c) i) A blue solution turns to brown and a white precipitate is formed. (03)

(ii) $2Cu^{2+}_{(aq)} + 4I^-_{(aq)} \longrightarrow Cu_2I_{2(s)} + I_{2(aq)}$ (01)

0.5⅓

7 a) $Pt_{(s)} | SO_3^{2-}{}_{(aq)}, H^+_{(aq)}, SO_4^{2-}{}_{(aq)} \| MnO_4^-{}_{(aq)}, H^+_{(aq)}, Mn^{2+}_{(aq)} | Pt_{(s)}$ (01)

b)

$2MnO_4^-{}_{(aq)} + 6H^+_{(aq)} + 5SO_3^{2-}{}_{(aq)} \longrightarrow 2Mn^{2+}_{(aq)} + 5SO_4^{2-}{}_{(aq)} + 3H_2O_{(l)}$ (01)

c i) $E^\ominus_{cell} = E^\ominus_{right} - E^\ominus_{left}$ ✓

$= 1.51 - 0.20$ ✓

$= +1.31V$ ✓

0½

Free energy $= -nFE^\ominus$ ✓ (02)

$= -10 \times 96500 \times 1.31$

$= -1,264,150$ ✓ Joules.

or, $-1264.15\ KJMol^{-1}$

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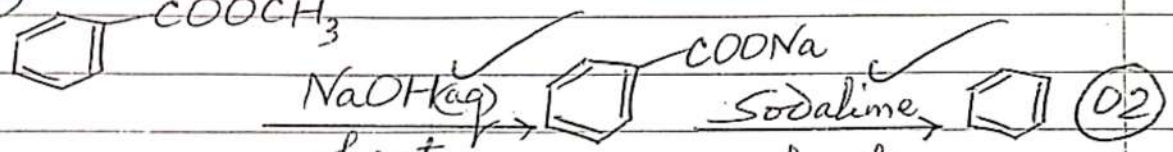
(ii) Feasible because the free energy is negative or emf of the cell is positive. (01)

05

8 a)



(02)

or ,, $LiAlH_4$ / dry ether → CH_2OH .....

b) $CH_3CHO \xrightarrow[heat]{Cr_2O_7^{2-}/H^+} CH_3COOH \xrightarrow{PCl_5} CH_3COCl$

$CH_3COOH \xrightarrow[2.\ heat]{1.\ (NH_4)_2CO_3(s)} CH_3CONH_2$

$CH_3COCl \xrightarrow{Conc.\ NH_3} CH_3CONH_2$

$CH_3NH_2 \xleftarrow[warm]{Br_2/Conc.\ NaOH} CH_3CONH_2$ (03)

05

9(a) Enthalpy of formation is the enthalpy change that occurs when one mole of a substance is formed from its constituents in normal physical states. (01)

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(b) (i) $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ $\Delta H_1 = -393.5$

(ii) $H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow H_2O_{(l)}$ $\Delta H_2 = -285.8$

(iii) $C_6H_5OH_{(s)} + 7O_{2(g)} \longrightarrow 6CO_{2(g)} + 3H_2O_{(l)}$ $\Delta H_3 = -2009.7$

Required equation,

$6C_{(s)} + 3H_{2(g)} + \frac{1}{2}O_{2(g)} \longrightarrow C_6H_5OH_{(s)}$, $\Delta H_f^\circ = ?$ (02)

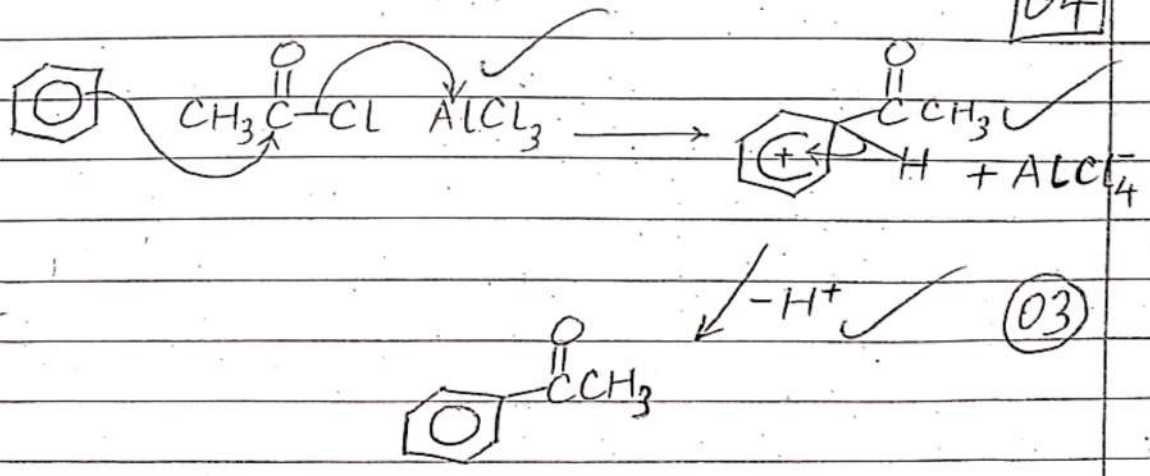
ΔH_f° = eqn(i) × 6 + eqn(ii) × 3 − eqn(iii)

= 6(−393.5) + 3(−285.8) − (−2009.7)

= −1208.7 KJ Mol^{-1}

(ii) Phenol is stable because its enthalpy of formation is negative for exothermic. (01)

(10) (a) (04)



(03)

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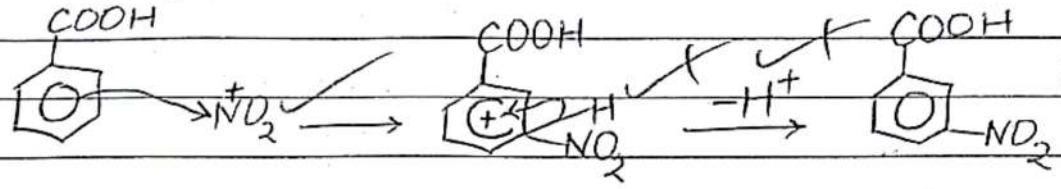
b) $HNO_3 + 2H_2SO_4 \longrightarrow \overset{+}{N}O_2 + 2HSO_4^- + H_3O^+$



03

c) $NaOH_{(aq)} \longrightarrow Na^+_{(aq)} + \bar{O}H_{(aq)}$

$(CH_3)_3C-\overset{+}{I} \rightleftharpoons (CH_3)_3\overset{+}{C} + I^-$

03

$(CH_3)_3\overset{+}{C} \longrightarrow (CH_3)_3C-OH$

$\bar{O}H$

09

11 a) $(NH_4)_2Cr_2O_{7(s)} \longrightarrow Cr_2O_{3(s)} + N_{2(g)} + 4H_2O_{(l)}$ 03

b) Orange solution turns to intense blue. 02

$Cr_2O_7^{2-}{}_{(aq)} + 2H^+_{(aq)} + 4H_2O_{2(aq)} \longrightarrow 2CrO_{5(aq)} + 5H_2O_{(l)}$

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ii) Orange solution turns to yellow. ✓ (02)

$Cr_2O_7^{2-}(aq) + 2OH^-(aq) \longrightarrow 2CrO_4^{2-}(aq) + H_2O(l)$ ✓✓

iii) Orange solution turns to green. ✓

$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6Fe^{2+}(aq) \longrightarrow 2Cr^{3+}(aq) + 6Fe^{3+}(aq) + 7H_2O(l)$ ✓✓ (02)

c i) Red precipitate ✓ (01 1/3)

$2Ag^+(aq) + CrO_4^{2-}(aq) \longrightarrow Ag_2CrO_4(s)$ ✓

09

(12) a) Direct titration ✓
Conductivity measurements ✓ (01)

b i) $Cu(IO_3)_2(s) \rightleftharpoons Cu^{2+}(aq) + 2IO_3^-(aq)$ ✓ (01 1/3)

ii) $K_{sp} = [Cu^{2+}][IO_3^-]^2$ ✓ (01 1/2)

c) Let the solubility of $Cu(IO_3)_2$ be x

$[Cu^{2+}] = x$; $[IO_3^-] = 2x$ ✓

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$1.4 \times 10^{-7} = x(2x)^2$ ✓

$4x^3 = 1.4 \times 10^{-7}$

$x = \sqrt[3]{\frac{1.4 \times 10^{-7}}{4}}$ ✓

$= 3.27 \times 10^{-3}$ Moldm^{-3}.

RFM of $Cu(IO_3)_2 = 64 \times (2 \times 127) + (6 \times 16) = 414$ ✓ (02½)

Solubility $= 414 \times 3.27 \times 10^{-3} = 1.35$ g dm^{-3}. ✓

(ii) Let the solubility of $Cu(IO_3)_2$ in 0.1M Potassium iodate be y.

$[Cu^{2+}] = y$, $[IO_3^-] = 2y + 0.1 \simeq 0.1$M ✓

since 2y is very small.

(02)

$y(0.1)^2 = 1.4 \times 10^{-7}$ ✓

$y = \frac{1.4 \times 10^{-7}}{0.01} = 1.4 \times 10^{-5}$ Moldm^{-3} ✓

Solubility in 0.1M KIO_3 solution $= 414 \times 1.4 \times 10^{-5}$ ✓

$= 5.8 \times 10^{-3}$ g dm^{-3} ✓

d) Solubility is lower in potassium iodate than in water. This is because potassium iodate increases the concentration of ✓

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iodate ions which react with Copper(II) ions to precipitate Copper(II) iodate. ✓

(01½)

09

(13)

a) Ammoniacal Silver nitrate solution ✓

With $HCOOCH_2CH_2CH_3$; Silver mirror ✓ (03)

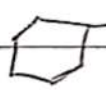
With $CH_3COOCH_2CH_3$; No observable change.

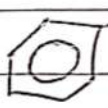
OR: Fehling's Solution and heat.

With $HCOOCH_2CH_2CH_3$; red/reddish brown ppt.

With $CH_3COOCH_2CH_3$; No observable change.

(b) Neutral Iron(III) chloride solution ✓

With 
; No observable change. ✓ (03)

With 
; purple/violet colouration. ✓

c) Iodine solution and Sodium hydroxide solution. ✓

(03)

With CH_3CHO; yellow precipitate. ✓

With CH_3CH_2CHO; No observable change. ✓

09

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14 a)

i) $Cl_{2(g)} + 2I^-_{(aq)} \longrightarrow 2Cl^-_{(aq)} + I_{2(aq)}$ ✓✓ (03)

(ii) $I_{2(s)} + I^-_{(aq)} \longrightarrow I_3^-{}_{(aq)}$ ✓✗

b) i) $4Cl_{2(g)} + S_2O_3^{2-}{}_{(aq)} + 5H_2O_{(l)} \longrightarrow 2SO_4^{2-}{}_{(aq)} + 10H^+_{(aq)} + 8Cl^-_{(aq)}$ ✓✓

or $Cl_{2(g)} + S_2O_3^{2-}{}_{(aq)} + H_2O_{(l)} \longrightarrow SO_4^{2-}{}_{(aq)} + S_{(s)} + 2H^+_{(aq)} + 2Cl^-_{(aq)}$ ✓✓

(ii) $2S_2O_3^{2-}{}_{(aq)} + I_{2(aq)} \longrightarrow S_4O_6^{2-}{}_{(aq)} + 2I^-_{(aq)}$ ✓✓ (03)

c i) $3Cl_{2(g)} + 6OH^-_{(aq)} \longrightarrow 5Cl^-_{(aq)} + ClO_3^-{}_{(aq)} + 3H_2O_{(l)}$ ✓✓

(ii) $3I_{2(s)} + 6OH^-_{(aq)} \longrightarrow 5I^-_{(aq)} + IO_3^-{}_{(aq)} + 3H_2O_{(l)}$ ✓✓ (03)

[09]

- Deduct ½ mk for wrong or missing physical states
- Deny marks if equation is not balanced.
- Accept balanced molecular equations.

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15 a) Initially at X, the Conductivity is low because ethanoic acid is a weak acid that partially ionises producing few Conducting hydrogen ions. ✓
Along XY, Conductivity slightly decreases because ammonia reacts with ethanoic acid producing ammonium ethanoate which in presence of the ~~excess~~ excess acid forms a buffer solution that suppresses further ionisation of the acid; ✓
Conductivity along YZ increases due to increase in the number Conducting ions from Complete ionisation of ammonium ethanoate. ✓ (04)
Along ZW, Conductivity remains Constant because the ionisation of ammonia is suppressed by ammonium ethanoate. ✓

b) (i) $\Lambda_o BrCH_2COOH = \Lambda_o BrCH_2COONa + \Lambda_o HNO_3 - \Lambda_o NaNO_3$ ✓

$= 89.3 + 421 - 121.3$ ✓ (01½)

$= 389\ \Omega^{-1}Cm^2Mol^{-1}$ ✓

(ii) $\alpha = \frac{\Lambda_c}{\Lambda_o}$ ✓

$\Lambda_c = \frac{K}{C}$ ✓

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$\Lambda_c = \frac{4.38 \times 10^{-3} \times 1000}{0.1} = 43.8\ \Omega^{-1} Cm^2 Mol^{-1}$ ✓

$\alpha = \frac{\Lambda_c}{\Lambda_o} = \frac{43.8}{389} = 0.1125964$ ✓

03½

$K_a = \frac{C\alpha^2}{1-\alpha}$ ✓

$= \frac{0.1(0.1125964)^2}{1-0.1125964} = 1.43 \times 10^{-3}\ Mold m^{-3}$ ✓ ✓

09

16 a) i) % age of Oxygen = $100-(60+13.3) = 26.7$ ✓

	C	H	O
No of moles	$\frac{60}{12}$	$\frac{13.3}{1}$	$\frac{26.7}{16}$
	5	13.3	1.669 ✓
Mole ratio	$\frac{5}{1.669}$	$\frac{13.3}{1.669}$	$\frac{1.669}{1.669}$
	3	8	1 ✓

02

Empirical formula of W is C_3H_8O ✓

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ii) 100g of water dissolved 0.698g of W
1000g of water dissolve $\left(\frac{0.698 \times 1000}{100}\right)$ g
$= 6.98$ g ✓

0.19°C is the freezing depression caused by 6.98g of W
1.63°C is the fpt depression caused by $\left(\frac{6.98 \times 1.63}{0.19}\right)$ g ✓

~~$= 59.88$~~ ✓ 02
$= 59.88 \simeq 60$

$(C_3H_8O)_n = 60$

$36n + 8n + 16n = 60$
$60n = 60$
$n = 1$ ✓ ✓

∴ Molecular formula of W is C_3H_8O.

b) i) $CH_3CH(OH)CH_3$ ✓ Propan-2-ol ✓ (01)

(ii) $CH_3CH(OH)CH_3 \xrightarrow{I_2(aq)/NaOH(aq)} CHI_{3(s)} + CH_3COO^-Na^+_{(aq)}$ ✓ (01)

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c) CH_3CHCH_3 (OH) $\longrightarrow$ $CH_3\overset{+}{C}HCH_3$ + $\bar{O}PO_3H_2$

CH_3CHCH_3 ($\overset{+}{O}H_2$) ✓

$H-\overset{+}{O}PO_3H_2$ ✓

OR; H^+

$-H_2O$ ✓ (02½)

$CH_3\overset{+}{C}H-CH_2$ (H)

$-H^+$ ✓

$CH_3CH=CH_2$

09

17 a) i) $CH_2=C(CH_3)-CH=CH_2$ ✓ (01)

ii) $-\left(CH_2-C(CH_3)=CH-CH_2\right)_n-$ ✓ (01)

b) Addition ✓ Reject; additional (01½)

ci) Heating the raw rubber in Sulphur. ✓ (01)

ii) Introduces Cross-links which increases the tensile strength (makes rubber strong), more elastic and more durable. (02½)

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d) i) $M_r = \frac{mRT}{\pi V}$ ✓

$= \frac{5.5 \times 8.31 \times 293}{106.39 \times 10^{-3}}$ ✓ (02)

$= 125872.4$ ✓

(ii) RFM of monomer $= (12 \times 8) + (1 \times 8) = 104$ ✓

No of monomers $(n) = \frac{125872.4}{104}$ (01)

$= 1211.$ ✓

09