TESO COLLEGE ALOET

EXAMINATION ANSWER BOOKLET TERM I 2023

TESSMEA 2023 10 Copies

Candidate's Name..... Class.....

Paper Code/Name P525/1 CHEMISTRY Signature.....

Draft Working Guide

1(a) $^{232}_{90}Th \xrightarrow{\alpha} {}^{228}_{88}Ra \xrightarrow{\beta} {}^{228}_{89}Ac \xrightarrow{\beta} {}^{228}_{90}Th$ ✓ ✓ ✓

X is Ra Y is Ac Z is Th 3

(b) $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$ ✓ $\therefore \lambda = \frac{0.693}{1.4\times10^{10}} = 4.95\times10^{-11}\ year^{-1}$

$N = N_0 e^{\frac{-\lambda t}{2.303}}$ ✓ $2.303\log\frac{N_0}{N_t} = \lambda t$

$= 5.0\, e^{-\left(\frac{4.95\times10^{-11}\times2.5\times10^{10}}{2.303}\right)}$ ✓ 2

$= 2.99g$ ✗ $1.45g$ 05

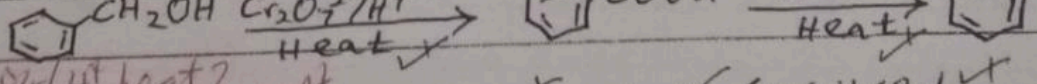
2(a) Both beryllium and aluminium ✓

- are rendered apassive by concentrated nitric acid
- reacts with sodium hydroxide solution ✓
- forms carbides that reacts with water forming methane ✓ 3
- oxides, hydroxides are amphoteric / chlorides dimerize
- ~~metals are amphoteric~~

(b) Diagonal relationship ✓ $\frac{1}{2}$

(c) Lithium and magnesium ✓ $\frac{1}{2}$

Boron and Silicon 04

3(a)  ✓ $NaOH/Ca(OH)_2$

Excess ✓ Soda lime

$CH_2OH \xrightarrow[\text{Heat}\ \checkmark]{Cr_2O_7^{2-}/H^+} COOH \xrightarrow[\text{Heat}\ \checkmark]{\text{Soda lime}}$ $2\frac{1}{2}$

$KMnO_4/H^+$, heat? CrO_3/H^+, heat? except

(b) $CH_3CH_2CH_2OH \xrightarrow[170°C]{Conc.\ H_2SO_4} CH_3\overset{H}{C}=CH_2 \xrightarrow[\text{Warm}]{H_2O} CH_3\overset{OH}{C}HCH_3$ ✓ ✓ ✓ ✓ 3 $5\frac{1}{2}$

dilute

4(a) (i) $\frac{r_R}{r_{H_2}} = \sqrt{\frac{M_{H_2}}{M_R}}$ ✓ Rmm of $H_2 = 1\times2 = 2$

H_2

$\left(\frac{50/126}{50/26.5}\right)^2 = \left(\sqrt{\frac{2}{M_r}}\right)^2$ ✓

$M_R = 45$ ✓

(ii) $C_nH_{2n+1}NH_2 = 45$ ✓

$12n + 2n + 1 + 14 + 2 = 45$

$14n = 28$ (45 − 17) ✓

$n = 2$ ✓ 1½

Molecular formula of R is $C_2H_5NH_2$ ✓

(b) (i) $CH_3CH_2NH_2$ ✓ ethylamine ✓ aminoethane

$CH_3\underset{H}{N}CH_3$ ✓ N-dimethylamine ✓ N-methylmethylamine / N-methylaminomethane 2

(ii) $CH_3CH_2NH_2$ ✓ (or name) 1

06

5(a) Partial Pressure is the pressure a gas exerts when it occupies a container initially occupied by a mixture of gases in which it was a component ✓ ✗ 1½

(b) (i) Total moles = 0.96 + 0.96 = 1.92 ✓

Partial Pressure = mole fraction × Pure Pressure

$P_{CHCl_3} = \frac{0.96}{1.92} \times 199.1$ ✓

$= 99.55 mmHg$ ✓

$P_{CCl_4} = \frac{0.96}{1.92} \times 114.5$ ✓ 2½

$= 57.25 mmHg$ ✓

(ii) Total Pressure = (99.55 + 57.25) mmHg

$= 156.8 mmHg$ ✓ ½

(iii) %age of $CHCl_3 = \frac{99.55 \times 100}{156.8}$ ✓ 1

$= 63.49\%$ ✓ 05½

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Paper Code/Name..... Signature.....

6(a)(i) $CH_3CH_2NH_2(aq) + H_2O(l) \rightleftharpoons CH_3CH_2\overset{+}{N}H_3(aq) + OH^-(aq)$ ✓ ½

(ii) $K_b = \dfrac{[CH_3CH_2\overset{+}{N}H_3][OH^-]}{[CH_3CH_2NH_2]}$ (or 4) ✓ 1

(b) $K_b = \alpha^2 C$ ✓ $\alpha = \frac{1.34}{100} = 0.0134$

$= \left(\frac{1.34}{100}\right)^2 \times 1$ ✓

$= 0.00017956\ mol\,dm^{-3}$ ✓ ½ (1.7956×10^{-4}) 04

7(a) $H_2C{=}CH_2(g) + Br_2(l) \xrightarrow{CCl_4} H_2C(Br)CH_2Br(l)$ ✓ 1

(b) (i) Rmm of $H_2C(Br)CH_2Br = 1\times4 + 12\times2 + 79.9\times2 = 187.8$ ✓

Rmm of $Br_2 = 79.9 \times 2 = 159.8$ ✓ or (160)

187.89 of $H_2C(Br)CH_2Br$ produced by 159.89 of Br_2

∴ 10g of $H_2C(Br)CH_2Br$ produced by $\left(\frac{159.8\times10}{187.8}\right)$ g of Br_2 ✓ 2

$8.509 = 0.85$ g ✓

(ii) 187.89 of $H_2C(Br)CH_2Br$ produced by 22.4 litres of Ethene

∴ 10g of $H_2C(Br)CH_2Br$ produced by $\left(\frac{22.4\times10}{187.8}\right)$ litres of Ethene ✓

$1.19\ dm^3 = (0.053$ litres$)$ of Ethene ✓ 1

04

8. (a) Copper
forms many complexes ✓
forms coloured compounds and ions ✓
has variable oxidation state ✓ 1½
shows catalytic activity

(b) (i) $_{29}Cu$ $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$ ✓ ½
or $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$

(ii) +1, ✓ +2. ✓

(c) (i) Reddish-brown precipitate ✓
$2Cu^{2+}_{(aq)} + Fe(CN)_6^{4-}_{(aq)} \longrightarrow Cu_2Fe(CN)_{6(s)}$ ✓✓ 2

(ii) White precipitate (white solid) ✓ and
brown solution ✓ (or brown ppt)
$2Cu^{2+}_{(aq)} + 4I^-_{(aq)} \longrightarrow Cu_2I_{2(s)} + I_{2(aq)}$ ✓✓ 2½
or $2CuI_{(s)}$

07½

9. (a) $CH_3CH(OH)CH_2CH_3 \xrightarrow[\text{Heat}]{\text{Conc. } H_2SO_4} CH_3CH=CHCH_3$ ✓1
accept butan-2-ol

(b) $CH_3CH=CHCH_3$ + H–Br → $CH_3\overset{+}{C}HCH_2CH_3 + Br^-$ ✓✓
$CH_3\overset{+}{C}HCH_2CH_3 + Cl^-$ ✓
$CH_3CH(Cl)CH_2CH_3$ 3½

$CH_3CH=CHCH_3$ → $CH_3\overset{+}{C}HCH_2CH_3 + Br^-$ ✓
H–Br

$CH_3CH_2CH(Br)CH_3$ 04½

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10. (a)

Elements	C	H	O	Pb	
%age mass	14.77	1.85	19.69	63.69	100-(14.77+1.85+19.69)
	14.77	1.85	19.69	63.69	
moles	$\frac{14.77}{12}$	$\frac{1.85}{1}$	$\frac{19.69}{16}$	$\frac{63.69}{207}$	
	1.23	1.85	1.23	0.31	
mole ratio	$\frac{1.23}{0.31}$	$\frac{1.85}{0.31}$	$\frac{1.23}{0.31}$	$\frac{0.31}{0.31}$	
	4	6	4	1	

Empirical formula of Q is $C_4H_6O_4Pb$ 2½

(b) Freezing Point depression = $0-(-0.14) = +0.14^{\circ}C$

a 2% aqueous solution of Q means

100g of water dissolves 2g of Q

∴ 1000g of water dissolve $\left(\frac{2\times1000}{100}\right)$g of Q

= 20g of Q

$0.14^{\circ}C$ is the depression in f.pt by 20g of Q

$1.86^{\circ}C$ is the depression in f.pt by $\left(\frac{20}{0.14}\times1.86\right)$g of Q

= 265.7 ≈ 266g of Q

$(C_4H_6O_4Pb)_n = 266$

$(12\times4+1\times6+16\times4+207)n = 266$

$325n = 266$

$n = 0.8 \simeq 1.0 = 1$

Molecular formula of Q is $C_4H_6O_4Pb$ 4½

(c) (i) $(CH_3COO)_2Pb$ ✓½

or lead(II) ethanoate

$3(CH_3COO)_2Pb(aq) + 2FeCl_3(aq) \rightarrow 3PbCl_2(s) + 2(CH_3COO)_3$ ✓✓ 1½

ionic $Pb^{2+}(aq) + 2Cl^-(aq) \rightarrow PbCl_2(s)$

09

11. (a) (i) Thermoplastic is a polymer that when heated melts (softens) ✓ and can be reshaped or remoulded. ✓ hardens on cooling 1½

(ii) Polythene ✓

Polystyrene ✓ polyphenylethene

polychloroethene (P.V.C) 1

(b) Monomers of Polyester $+OCH_2CH_2OOC-C_6H_4-COO+_n$

$HOCH_2CH_2OH$ ✓✓ Ethane-1,2-diol ✓

HO-C(=O)-C$_6$H$_4$-C(=O)-OH ✓✓ Benzene-1,4-dioic acid ✓ dicarboxylic 3

(c) (i) Condensation ✓ polymerisation 1

(ii) To make fabrics ✓, bottles, boats 1

aircraft parts, fishing rods, laminate sheets

(d) Thermosetting Plastic is a polymer ✓ which on forming cross-linked ✓ cannot melt or hardens on heating but decomposes cannot be remoulded

whereas thermosoftening Plastic is a polymer 1½

that melts softens on heating and can be remoulded. ✓ hardens on cooling ✓

09

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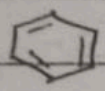
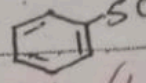
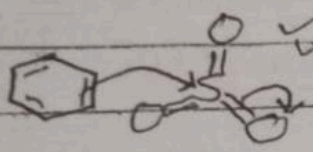
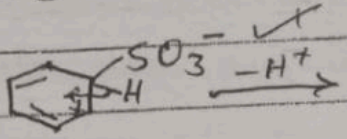
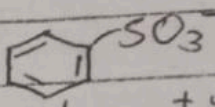
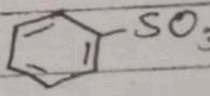
12(a)  Fuming H_2SO_4 $40^{\circ}C$  $+ H_2O$

conc H_2SO_4/heat

$2H_2SO_4 \rightleftharpoons SO_3 + HSO_4^- + H_3O^+$

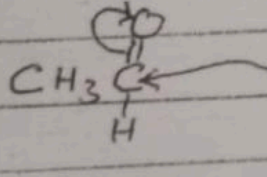
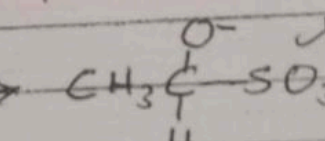
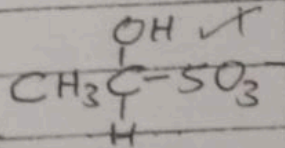
  

H_3O^+ or H^+ 3½

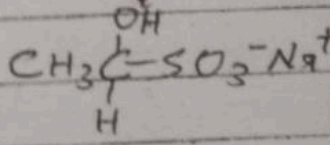
 $+ H_2O$

(b) $CH_3CHO(l) + NaHSO_3(aq) \longrightarrow CH_3CH(OH)SO_3^-Na^+$

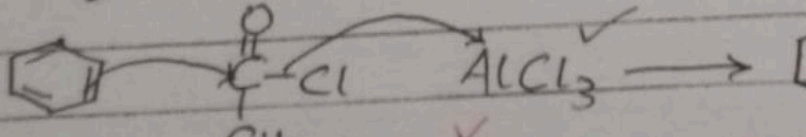
conc saturated

  shift 

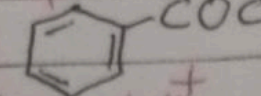
Na^+ 3½

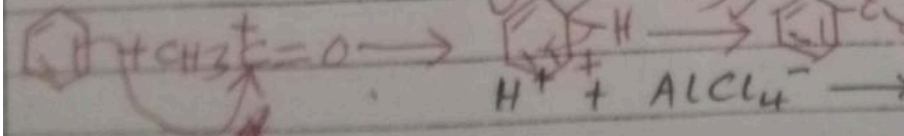


(c)  $+ CH_3COCl \xrightarrow{AlCl_3}$  $+ HCl$



$CH_3COCl + AlCl_3 \rightleftharpoons CH_3C^+=O\ AlCl_4^-$





$H^+ + AlCl_4^- \longrightarrow AlCl_3 + HCl$

2

09

13(a)(i) $Fe^{2+}(aq) \rightarrow Fe^{3+}(aq) + e$ ✓

$Zn(s) + 4OH^-(aq) \rightarrow Zn(OH)_4^{2-}(aq) + 2e$ 2½

(ii) $2H^+(aq) + 2e \rightarrow H_2(g)$ ✓

$BrO_3^-(aq) + 3H_2O(aq) + 6e \rightarrow Br^-(aq) + 6OH^-(aq)$ 2½

(b)(i) $Pt(s)/Fe^{2+}(aq), Fe^{3+}(aq) // H^+(aq)/H_2(g)/Pt(s)$ ✓

$Zn(s)/OH^-(aq), Zn(OH)_4^{2-}(aq) // BrO_3^-(aq), H_2O(l), Br^-(aq)/Pt(s)$ 2

(ii) Pt Platinum

/ seperating species in different phases

// seperating species in the same phase

// salt bridge for connecting the two half cells 2

09

14(a)(i) ns^2np^2 1

(ii) +2, +4 1

(b)(i) CCl_4 No observable change 1

(ii) $SiCl_4$ misty fumes and white solid 3

$SiCl_4(l) + 4H_2O(l) \rightarrow SiO_2 \cdot 2H_2O(s) + 4HCl(g)$

(iii) $SnCl_4$ misty fumes and white solid

$SnCl_4(l) + 2H_2O(l) \rightarrow SnO_2(s) + 4HCl(g)$ or (aq) 3

09

15(a) Molecularity is the total number of molecules or ions that participate in the rate determining step (slowest step) ✓

Order of reaction is the sum of the powers to which the concentration terms of the reactants are raised in an experimentally determined rate equation ✓ 2

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(To be fastened together with other answers to paper)

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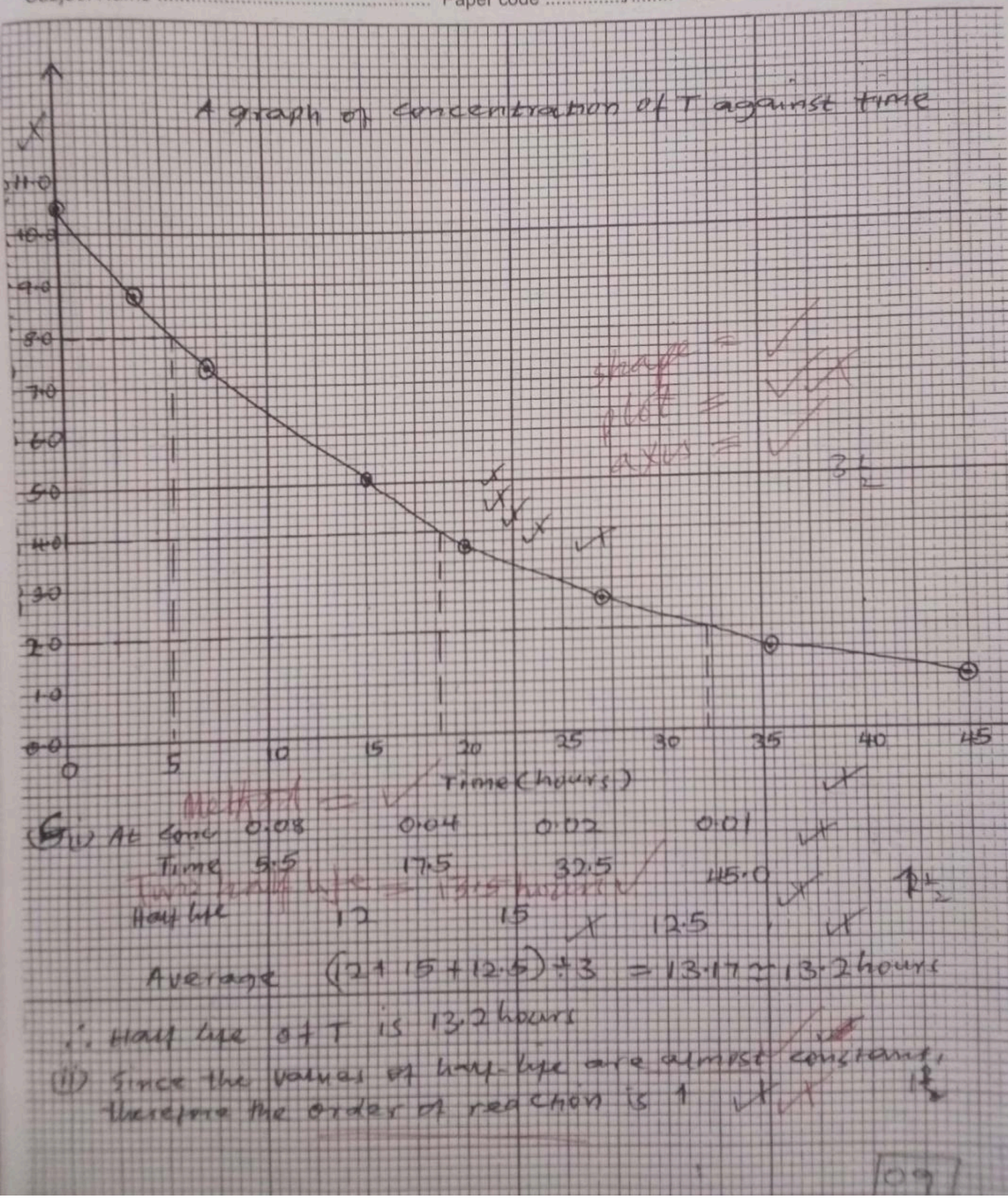

(b) (i) At conc 0.08 0.04 0.02 0.01

Time 5·5 17·5 32·5 45·0

Half life 12 15 12·5

Average (12 + 15 + 12·5) ÷ 3 = 13·17 ≈ 13·2 hours

∴ Half life of T is 13·2 hours

(ii) Since the values of half-life are almost constant, therefore the order of reaction is 1

16 (a) CH_3CHO and CH_3CH_2CHO

Reagent: Iodine solution followed by sodium hydroxide solution ✓

CH_3CHO Yellow Precipitate ✓

CH_3CH_2CHO No observable change ✓

Equation: ✓

$CH_3CHO(l) + 3I_2(aq) + 4NaOH(aq) \rightarrow CHI_3(s) + HCOONa(aq) + 3NaI(aq) + 3H_2O(l)$

(ignore states)

3

(b) $CH_3CH_2NH_2$ and CH_3NHCH_3

Reagent: Sodium nitrite followed by dilute hydrochloric acid ✓

(nitrous acid)

Observation: $CH_3CH_2NH_2$ Bubbles of colourless gas ✓

CH_3NHCH_3 Yellow oil (liquid) ✓

Equation

$CH_3CH_2NH_2 \xrightarrow[HCl]{NaNO_2} CH_3CH_2OH + H_2O + N_2$ ✓

$(CH_3)_2NH \xrightarrow[HCl]{NaNO_2} (CH_3)_2N-N=O$ ✓

3

(c) $CH_3COO^-Na^+$, and $\begin{matrix} COO^-Na^+ \\ | \\ COO^-Na^+ \end{matrix}$

Reagent: Acidified Potassium manganate(VII) solution ✓

or $K_2Cr_2O_7/H^+$

Observation:

$CH_3COO^-Na^+$ No observable change ✓

$\begin{matrix} COO^-Na^+ \\ | \\ COO^-Na^+ \end{matrix}$ Purple solution turns colourless ✓

Equation: ✓

$2MnO_4^-(aq) + 5C_2O_4^{2-}(aq) + 16H^+(aq) \rightarrow 2Mn^{2+}(aq) + 8H_2O(l) + 10CO_2(g)$

or $Cr_2O_7^{2-}(aq) + 3C_2O_4^{2-}(aq) + 14H^+(aq) \rightarrow 2Cr^{3+}(aq) + 6CO_2(g) + 7H_2O(l)$

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17(a) Fluorine reacts with water producing hydrofluoric acid and oxygen ✓

$2F_2(g) + 2H_2O(l) \rightarrow 4HF(aq) + O_2(g)$ ✓✓

Chlorine reacts with water to produce hydrochloric acid and chloric(I) acid ✓

$Cl_2(g) + H_2O(l) \rightarrow HCl(aq) + HOCl(aq)$ ✓✓ 3

(b) Fluorine reacts with cold dilute sodium hydroxide solution to produce sodium fluoride, oxygen difluoride gas and water ✓

$2F_2(g) + 2NaOH(aq) \rightarrow 2NaF(aq) + H_2O(l) + OF_2(g)$ ✓

ionic $2F_2(g) + 2OH^-(aq) \rightarrow 2F^-(aq) + H_2O(l) + OF_2(g)$

Chlorine reacts with cold dilute sodium hydroxide solution to produce sodium chloride, sodium chlorate(I) and water. ✓

$Cl_2(g) + 2NaOH(aq) \rightarrow NaCl(aq) + NaOCl(aq) + H_2O(l)$ ✓

ionic $Cl_2(g) + 2OH^-(aq) \rightarrow Cl^-(aq) + ClO^-(aq) + H_2O(l)$

Fluorine reacts with hot concentrated sodium hydroxide solution to form sodium fluoride, water and oxygen ✓

$2F_2(g) + 4NaOH(aq) \rightarrow 4NaF(aq) + 2H_2O(l) + O_2(g)$ ✓

ionic $2F_2(g) + 4OH^-(aq) \rightarrow 4F^-(aq) + 2H_2O(l) + O_2(g)$

Chlorine reacts with hot concentrated sodium hydroxide solution to produce sodium chloride, Sodium chlorate(V) and water ✓

$3Cl_2(g) + 6NaOH(aq) \rightarrow 5NaCl(aq) + NaClO_3(aq) + 3H_2O(l)$ ✓

ionic $3Cl_2(g) + 6OH^-(aq) \rightarrow 5Cl^-(aq) + ClO_3^-(aq) + 3H_2O(l)$ 6

09