RUKUNGIRI MOCK 2022
PROPOSED MARKING SCHEME
UACE CHEM P525/1 @TBN 077958561

SECTION A (46 MARKS)

1. (a) An element whose properties are progressive, between those of s-block and the p-block elements; ✓ — 1 mark

(b) • They have highly charged ions; high polarising powers; ✓
• They have vacant orbitals to accept lone pairs ✓ of electrons; — 2 marks

(c) (i) Hydroxypentaaqua iron(III) ion; ✓

(ii) Trichlorohexaaquachromium(III); ✓

(iii) ~~Hexacyano~~ Potassium hexacyanoferrate(II); ✓ — 01 mark

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2 (a) Original amount be x
New amount be $x/4$
$t = 40$ minutes

$t_{1/2} = \frac{0.693}{\lambda}$; λ = Constant;

From; $2.303 \log \frac{N_0}{N_t} = Kt$; $2.303 \log 4 = \lambda 40$

$\lambda = \frac{1.3865}{40} = 0.03466$ ✓

$t_{1/2} = \frac{0.693}{0.03466} = 19.99$ Minutes; ✓ — 02 marks

(b) (i) ${}^{1}_{1}H \longrightarrow {}^{0}_{1}e + {}^{1}_{0}n$; ${}_{+}e$ = Positron ✓

(ii) ${}^{7}_{3}Li + {}^{1}_{1}H \longrightarrow 2\alpha$; α = Alpha (${}^{4}_{2}He$) ✓

(c) • Determination of half life of compds/elements; ✓ — 02 marks

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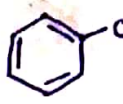
3. (a) $CH_2OHCHOHCH_2OH$; 1,2,3 trihydroxy propane/Propan-1,2,3 triol ✓

(b)  ✓ ; Chloromethylbenzene; /Accept = Chlorotoluene; ✓

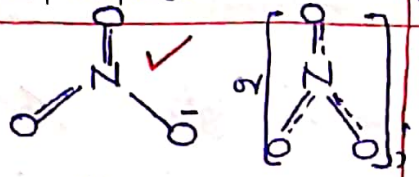
(c) $CH_3CH_2COOCH_2CH_3$ ✓; Ethyl propanoate; ✓ — 02½ mark

4. (a) Freshly prepared Iron(II) sulphate and concentrated sulphuric acid;

(b) With NO_3^- – A brown ring formed between the solution and reagent layer;

With NO_2^- – No observable change;

(c)

Ion	Structure	Shape
NO_3^-		Trigonal planar;
NO_2^-		Bent / V-shape;

6marks

5. (a) $_{26}Fe$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ 4s^2$;

1s
2s 2p
3s 3p 3d
4s 4p 4d 4f

(b) Blue litmus turned red;
Iron(III) ions are hydrated then hydrolyzed; Being highly charged, Iron easily attracts the hydroxyl ions in water leaving hydrogen ions free; making soln acidic;

$$Fe(H_2O)_{6(aq)}^{3+} + H_2O_{(l)} \rightleftharpoons [Fe(H_2O)_3(OH)_3]_{(aq)} + 3H^+_{(aq)}$$

4marks

6. (a) Reagents; Silver nitrate solution with hot concentrated Sodium hydroxide;

Observations;
with  – A white ppt;
 – No observable change;

(b) eg Aldehydes and Ketones;
Observation; with aldehydes a white ppt formed / or silver mirror
with Ketones no observable change;

Acc; Alkynes and alkenes etc

6marks

7. Let it be M

Molar mass of methane = $CH_4 = 12+4 = 16$

$t_1 = 10$ seconds

$t_2 = 12.5$ seconds

(a) $\frac{\text{Rate of Methane (1)}}{\text{Rate of other gas (2)}} = \sqrt{\frac{M}{16}}$; ; $\text{Rate} = \frac{\text{Volume}}{\text{Time}}$

let volume be x

$$\frac{x/10}{x/12.5} = \sqrt{\frac{M}{16}}$$

$$\left(\frac{12.5}{10}\right)^2 = \left(\sqrt{\frac{M_A}{16}}\right)^2 \qquad M_A = 25 \text{ ;}$$

2½

(b) $C_nH_{2n} = 25$

$12n + 2n = 25$

$14n = 25$

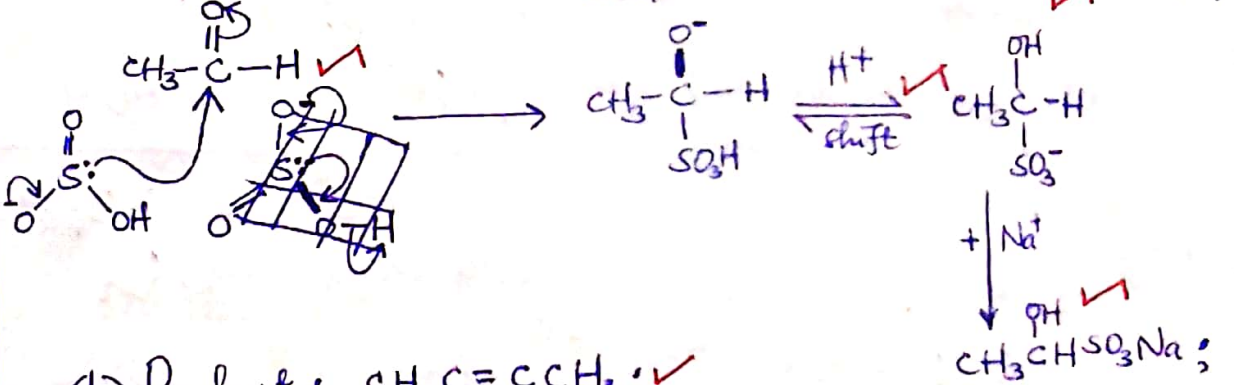
$n = 1.786 \simeq 2$

C_2H_4 Structure = CH_2CH_2 /or $CH_2=CH_2$;

1½ mark

8. (a) Product; $CH_3CH(OH)SO_3^-Na^+$

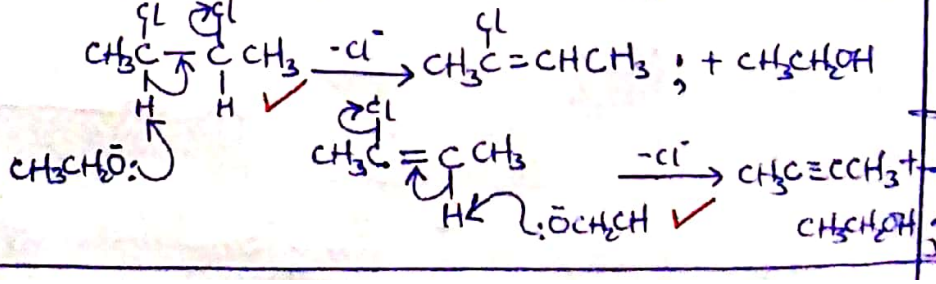
Mechanism; $NaHSO_3(aq) \longrightarrow Na^+(aq) + HSO_3^-(aq)$;



3 marks

(b) Product; $CH_3C\equiv CCH_3$;

Mechanism; $CH_3CH_2O^-Na^+(aq) \longrightarrow CH_3CH_2O^-(aq) + Na^+(aq)$



3 marks

9. (a) ~~$Pt, H_{2(g)}/H^+_{(aq)} // Cd_{(s)}$~~ $Pt, H_{2(g)}/H^+_{(aq)} // Cd^{2+}_{(aq)}/Cd_{(s)}$;
~~$H^+_{(aq)}/H_{2(g)} // Cd_{(s)}/Cd^{2+}_{(aq)}$~~ ; Pt = platinum

(b) (i) $Cd^{2+}_{(aq)} + 2e \longrightarrow Cd_{(s)}$;

(ii) $H_{2(g)} \longrightarrow 2H^+_{(aq)} + 2e$;

(iii) $Cd^{2+}_{(aq)} + H_{2(g)} \longrightarrow Cd_{(s)} + 2H^+_{(aq)}$;

(c) $Emf = E^{\theta}_{Right} - E^{\theta}_{Left}$

$= 0.40 - 0.00$

$= 0.4\ V$; ✓

4mrk

SECTION B (54 MARKS)

NB. Mark Only the first six attempted ;

10. (a) i) Plastics that can easily be moften on application of heat; can be molded into different shapes; ✓

ii) Polyethene ✓; Polyvinylchloride ✓ etc

(b) (i) Structural formula is; $CH_2=CClCH=CH_2$ ✓;

Name is; 2-chlorobuta-1,3-diene ; ✓

(ii) . Addition polymerisation ; ✓ Deny: Additional

(iii) . They are non-biodegradable ; ✓ Accept; Any other correct
They are expencive

(c) 20g Vegitable oil, Mr of oil = 566 + 282 = 848 g ;
~~salt~~ ester = $C_{16}H_{33}COOK$ Mr of soap = 1,725g ;

Equations;

oil; $CH_2OH(CHOH)CH_2OH + 3C_{16}H_{33}COOH \longrightarrow CH_2OOCC_{16}H_{33}(CHOOCC_{16}H_{33})CH_2OOCC_{16}H_{33}$ (20g)

Saponification; $CH_2OOCC_{16}H_{33}(CHOOCC_{16}H_{33})CH_2OOCC_{16}H_{33} + 3NaOH \longrightarrow CH_2CHCH_2(OH\ OH\ OH) + 3RCOO^-Na^+$

1 mole of oil reacts with 3 moles of hydroxide

3 moles of soap formed from One mole of oil ✓ 9 mark

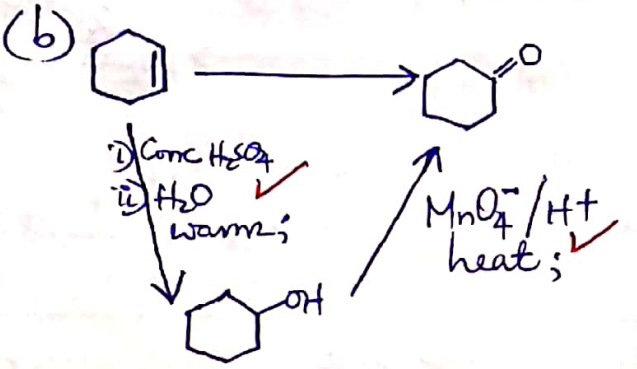
(3 × 1,725)g of soap formed from 848g of oil
x of soap formed from 20g of oil ; ✓ $x = \frac{20 \times 3 \times 1725}{848}$ ✓

$= 122g$ ✓

13. (a) $CH_3CH_2OH \longrightarrow CH_3CH_2CH_2NH_2$

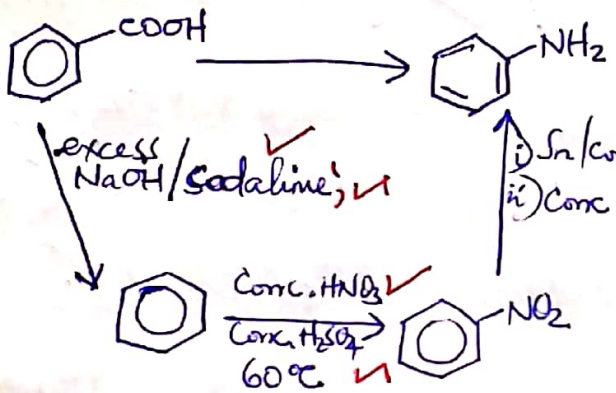
(03½ marks)

(b)



(02 marks)

(c)



(3½ marks)

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14. (a) A buffer solution is one that resists changes in pH when small quantities of base or acid are added; It may be prepared as acid buffer or basic buffer. It consists of a weak acid and its salt formed with a strong base or weak base and its salt from strong acid;

3 mar

(b) Only 0.05 M of HCOOH can produce the salt CH_3COONa.

$pH = pK_w - pOH$; $pK_w = 14$

$pKa = -\log Ka$

$= -\log 1.6\times10^{-4}$

$= 3.796$

$pH = pKa + \log\left(\frac{[salt]}{[acid]}\right)$

$= 3.796 + \log\left(\frac{0.05}{0.05}\right)$;

$= 4$;

4 mk

(c) The pH of the solution remained constant; ✓

Exp^n: The few H^+ ions added were removed ✓ by combining with CH_3COO^- ions from dissociation of CH_3COONa to form back ethanoic acid; ✓

$CH_3COO^-Na^+_{(aq)} \longrightarrow CH_3COO^-_{(aq)} + Na^+_{(aq)}$ ✓

$CH_3COO^-_{(aq)} + H^+_{(aq)} \rightleftharpoons CH_3COOH_{(aq)}$; ✓ 2mks

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15 (a) Ionization energy is the minimum amount of energy required to remove one mole of electrons from one mole of neutral gaseous atoms to form one mole of positively charged ions; ✓ 02 Deny; If misses any relevant; 2 marks

(b) (i) Elements; B and C; ✓

Group; II ✓

Reason; • The first two electrons ✓ are removed from same energy level ✓ or Very big difference btn 2nd and 3rd I.E; 2½ mks

(ii) Element A; ✓

Reason; The first electron is removed from its own energy level ✓ ~~hence group~~ or Very big diff btn 1st and 2nd I.E; 2 mks

(iii) $DCl_{3(s)} + 3H_2O_{(l)} \longrightarrow D(OH)_{3(aq)}/_s + 3HCl_{(g/aq)}$; ✓ ½ mks

(c) Atomic radius; ✓ Shielding/Screening effect; ✓

No. of energy levels etc;

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16. (a) The simplest ratio of the number of atoms present in a compound or molecule; ✓ 1 mk

(b) Composition of C $= \frac{12}{44} \times 5.28g = 1.44$; ✓

Composition of N; 22400 cm^3 contain 1 mole

224 cm^3 contain $\frac{224}{22400}$

$= 0.01$ moles;

Mass $= 28 \times 0.01$ ✓

$= 0.28g$ (N_2); $N = \frac{1}{2}(0.28)$

Mass of Hydrogen = 1.86 − (1.44 + 0.28)
= 0.14g

Elements;	C	H	N
Comp^n;	$\frac{1.44}{12}$	$\frac{0.14}{1}$	$\frac{0.28}{14}$; ✓
Moles;	0.12	0.14	0.01

Ratio; 6 : 7 : 1 ✓

Empirical formular = C_6H_7N ; ✓

3 mark

(ii) n (emp. f) = Molar mass (M);

from $PV = nRT$; $n = \frac{mass}{M}$

$M = \frac{mRT}{PV}$; $T = 273 + 184.1 = 457.1\ K$

$= \left(\frac{0.2 \times 8.31 \times 457.1}{101325 \times 81 \times 10^{-6}}\right)$ ✓

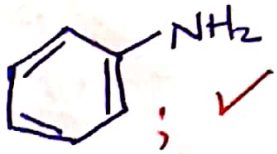
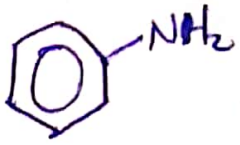
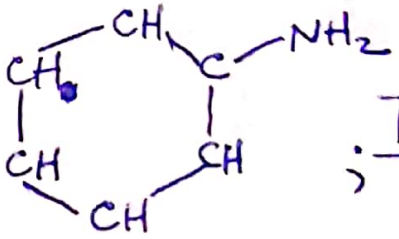
$= 92.56 \simeq 93\ g$

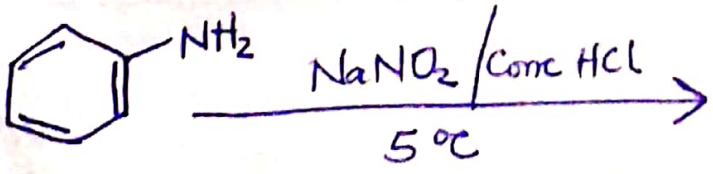
$n(C_6H_7N) = 93$; $n(93) = 93$; ✓

3 mark

$n = 1$

Hence, Molecular formula = C_6H_7N ; ✓

(c)  ; ✓ or  or  ; 1mark

(d)  ; 1mark

17 (a) • High pressure of about 200 atmospheres; ✓
• High temperature of about 450 °C; ✓
• Vanadium pentoxide (V_2O_5) catalyst ✓;

(b) $2SO_{2(g)} + O_{2(g)} \underset{450\,°C}{\overset{V_2O_5}{\rightleftharpoons}} 2SO_{3(g)}$ ✓

$SO_{3(g)} + H_2SO_{4(aq)} \longrightarrow H_2S_2O_{7(l)}$ ✓ — 3 marks
Oleum ;

$H_2S_2O_{7(l)} + H_2O_{(l)} \longrightarrow 2H_2SO_{4(l)}$ ✓;
97%

(c) • To prevent fumes which would injur the preparer; ✓
because the reaction is too exothermic; ✓ much heat evolves which causes flames; ✓ — 1½ marks

(d) $FeCl_{3(aq)} + SO_{2(g)} \longrightarrow SO_{3(g)} + FeCl_{2(aq)}$ — 1½ marks

or; $Fe^{3+}_{(aq)} + SO_{2(g)} \longrightarrow Fe^{2+}_{(aq)} + SO_{3(g)}$ Redox;

END

Tumwizere Brian CTBN