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TRINITYHOUSE
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TRINITYHOUSE HIGH SCHOOL
PHYSICAL SCIENCES GRADE 12 PRELIM EXAMINATION MEMO
PAPER 2 CHEMISTRY

QUESTION 1 – MULTIPLE CHOICE

1.1	A	B	C	D
1.2	A	B	C	D
1.3	A	B	C	D
1.4	A	B	C	D
1.5	A	B	C	D
1.6	A	B	C	D
1.7	A	B	C	D
1.8	A	B	C	D
1.9	A	B	C	D
1.10	A	B	C	D

QUESTION 2 - STOICHIOMETRY

2.1.1 KAuCl_4 $n = m/M$ ✓

$$= 120,96/378 \text{ ✓}$$

$$= 0,32 \text{ mol}$$

$$M_r = 39 + 197 + 4 \times 35,5$$

$$M_r = 378 \text{ g.mol}^{-1}$$

Na_2CO_3 $n = m/M$

$$= 153,7 / 106$$

$$= 1,45 \text{ mol } \checkmark$$

The ratio is 2 : 3 ✓

$$0,32 : x$$

$$2x = 3(0,32)$$

$$x = 0,48 \text{ mol needed of } \text{Na}_2\text{CO}_3 \text{ ✓}$$

Limiting reagent is KAuCl_4 ✓ (6)

$$M_r = (2 \times 23) + 12 + (3 \times 16)$$

$$M_r = 106 \text{ g. mol}^{-1}$$

2.1.2 Ratio KAuCl_4 (coe) : $\text{Au}(\text{OH})_3 = 2 : 2$ ✓

$$m = n \times M$$

$$m = 0,32 \times 248 \text{ ✓}$$

$$m = 79,36 \text{ g } \checkmark$$

$$M_r = 197 + 17 \times 3$$

$$M_r = 248 \text{ g. mol}^{-1}$$

(3)

2.1.3 Ratio KAuCl_4 (coe) : $\text{Na}_2\text{CO}_3 = 2 : 3$ ✓

$$0,32 : 0,48 \text{ (is used)}$$

$$1,45 - 0,48$$

$$0,97 \text{ mol is left over } \checkmark$$

$$m = n \times M$$

$$= 0,97 \times 106 \text{ ✓}$$

$$= 102,82 \text{ g remains unreacted } \checkmark \quad (4)$$

2.1.4 % yield = actual / theoretical $\times 100 / 1$ ✓

$$= 67,93 / 79,36 \text{ (coe 2.1.2)} \times 100 \text{ ✓}$$

$$= 85,60 \% \text{ ✓} \quad (85,59727) \quad (3)$$

2.1.5 Ratio KAuCl_4 (coe) : $\text{CO}_2 = 2 : 3$ ✓

$$0,32 : 0,48$$

$$n = V / V_m$$

$$V = n \times V_m$$

$$= 0,48 \times 22,4$$
 ✓

$$= 10,75 \text{ dm}^3$$
 ✓ (3)

2.2.1 the amount of solute per unit volume of solution ✓✓ (2)

2.2.2 $c = n / V$ ✓

$$n = c \times V$$

$$= 0,8 \times 0,04$$
 ✓

$$= 0,032 \text{ mol}$$
 ✓

$$c = 0,032 / 0,25$$
 ✓

$$c = 0,128 \text{ mol.dm}^3$$
 (0,13 mol.dm³) ✓ (5)

2.2.3 $N = \text{particles} / N_A$ ✓

$$\text{Particles} = n \times N_A$$

$$2 \times 0,032 \times 6,02 \times 10^{23}$$
 ✓

$$= 3,85 \times 10^{22} \text{ Na particles}$$
 ✓ (3) [29]

QUESTION 3 - BONDING AND FORCES3.1.1 NH_3 ✓✓3.1.2 SiO_2 ✓✓3.1.3 CBr_4 ✓✓3.1.4 Pb ✓✓3.1.5 I_2 ✓✓3.1.6 H_2O ✓✓ (12)

3.2.1 There are strong H – bonds in water ✓ than the van der Waals forces ✓ in the other hydrides more energy is required to overcome the forces when melting occurs ✓ (3)

3.2.2 Increase in relative molar mass causes an increase in the electron density ✓ and therefore the van der Waals forces increase ✓ more energy is required to overcome the forces during a change in phase when boiling takes place. ✓ (3) [18]

QUESTION 4 - RATES AND ENERGY

4.1.1 Reaction rate will increase by using powdered zinc ✓✓ (2)

4.1.2 Add the same volume of acid to the pieces of zinc in a conical flask and then to the powder in another flask ✓✓

Connect a syringe and record the volume of gas that evolves in each case. ✓
(3)

4.2.1 A ✓ (1)

4.2.2 A ✓ 0-20 seconds ✓ (2)

4.2.3 All the zinc has been used up (reacted) ✓ and no more hydrogen is being produced ✓ (2)

4.2.4 For A = $30 - 0 / 30 - 0$ ✓ (leeway 1,0 – 1,4)

$$A = 1,0 \text{ cm}^3 \text{ H}_2 \text{ s}^{-1} \quad \checkmark$$

For B = $20 - 0 / 40 - 0$

$$B = 0,5 \text{ cm}^3 \text{ H}_2 \text{ s}^{-1} \quad \checkmark \quad (\text{leeway } 0,2 - 0,6) \quad (3)$$

4.3.1 *a substance that increases the rate of the reaction but remains unchanged at the end of the reaction* ✓✓ (2)

4.3.2 Gradient will be steeper due to the rate increasing ✓ (1)

4.3.3 a) No effect ✓

b) No effect ✓ (2)

[18]

QUESTION 5 – CHEMICAL EQUILIBRIUM5.1.1 $\text{COF}_2 \checkmark = 0,5 \text{ mol.dm}^{-3} \checkmark$ $\text{F}_2 \checkmark = 0,2 \text{ mol.dm}^{-3} \checkmark$ (4)5.1.2 7,5 minutes $\checkmark \checkmark$ (5- 10 min) $\checkmark$ (2)5.1.3 'When an external stress (change in pressure, temperature or concentration) is applied to a system in dynamic chemical equilibrium, the equilibrium point will change in such a way as to counteract the stress' $\checkmark \checkmark$ (2/0)5.1.4 F_2 was removed. $\checkmark \checkmark$ (2)

- 5.1.5 • When the temp decreased the equilibrium shifted to the left/ favoured the forward reaction. $\checkmark$
 • Le Chateliers principle states that to accommodate the stress of decreased temp, $\checkmark$
 • the exothermic will be favoured. $\checkmark$ In this case the forward reaction,
 • so the reverse reaction was endothermic $\checkmark$ (4)

5.2.1 $K_c = \frac{[\text{COCl}_2]}{[\text{CO}][\text{Cl}_2]}$, $\checkmark$ (1)5.2.2 $c(\text{CO}) = \frac{n}{V} = \frac{0,15}{0,5} = 0,3$ Correct method $\checkmark$ (coe from 5.2.1)

$$c(\text{Cl}_2) = \frac{n}{V} = \frac{1}{0,5} = 2$$

$$c(\text{COCl}_2) = \frac{n}{V} = \frac{1,5}{0,5} = 3$$

$$K_c = \frac{[\text{COCl}_2]}{[\text{CO}][\text{Cl}_2]} = \frac{[3]}{[0,3][2]} = 5 \checkmark$$
 (4)

5.2.3 Same temp therefore the same K_c value. $\checkmark$

$$K_c = \frac{[\text{COCl}_2]}{[\text{CO}][\text{Cl}_2]}$$

$$5 = \frac{[\text{COCl}_2]}{[0,1][0,2]} \text{ SUB}$$

 $\text{COCl}_2 = 0,1 \text{ M} \checkmark \checkmark$ present. (coe from 5,2,1)

(3) [22]

QUESTION 6 – ACIDS AND BASES

6.1.1 an acid that only ionises partially in an aqueous solution ✓✓ (2)

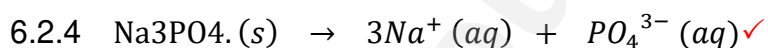
6.1.2 it can donate more than one proton ✓✓ or it has three protons to donate. (2)

$$\begin{aligned}
 6.2.1 \quad c &= \frac{m}{MV} \checkmark \\
 \therefore m &= cMV \\
 &= 0,2 \times 40 \checkmark \times 0,5 \checkmark \\
 &= 4,4 \text{ g} \checkmark \quad (4)
 \end{aligned}$$

6.2.2

$c = n/v$	mol ratio	$c = n/v$
$n = c \times v$	3 : 1 H_3PO_4	$= 1,1 \times 10^{-3} / 0,02$
$= 0,22 \times 0,015 \checkmark$	$3,3 \times 10^{-3} : 1,1 \times 10^{-3} \checkmark$	$= 5,5 \times 10^{-2} \text{ mol.dm}^{-3} \checkmark$
$= 3,3 \times 10^{-3} \text{ mol} \checkmark$		(4)

6.2.3 a reaction of an ion (from a salt) with water ✓✓ (2)



PO_4^{3-} ion will react with water molecules



$[\text{OH}^-]$ increases ✓, pH increases ✓ (4)

6.3.1 A ✓ (1)

6.3.2 A ✓ (1)

6.3.3 C ✓ (1)

[21]

QUESTION 7 – GALVANIC CELL

7.1 concentration of $1 \text{ mol} \cdot \text{dm}^{-3}$ ✓ and Temperature (at 25°C) ✓ (2)

7.2 **Cr to Ag** ✓ (1)

7.3 $\text{Cr} \rightarrow \text{Cr}^{3+} + 3\text{e}^-$ ✓✓ (2)

$$\begin{aligned} 7.4 E^\theta_{\text{cell}} &= E^\theta_{\text{cat}} - E^\theta_{\text{an}} \quad \checkmark \\ &= (+0,80) - (-0,74) \quad \checkmark \\ &= +1,54 \text{ V} \quad \checkmark \quad (3) \end{aligned}$$

7.5 $\text{Cr(s)} / \text{Cr}^{3+}(\text{aq}, 1 \text{ mol} \cdot \text{dm}^{-3}) \quad \checkmark // \text{Ag}^+(\text{aq}, 1 \text{ mol} \cdot \text{dm}^{-3}) / \text{Ag(s)} \quad \checkmark$ at 25°C ✓ -1 for each mistake (3)

7.6

- In the chromium half-cell cations (Cr^{3+}) are produced (OR concentration of Cr^{3+} increases OR there are excess cations) ✓
- (in order to prevent the build-up of positive charge) anions from the salt bridge enter the half cell ✓
- and cations from the half-cell (Cr^{3+}) enter the salt bridge ✓ (3)

7.7 **INCREASES** ✓ (1)

7.8 **INCREASE** ✓, if you increase the concentration of Ag^+ ions, the forward reaction will be favoured which will counteract the stress of the increased positive charges at the cathode, thus the emf of the cell will increase. ✓ (2)

$$\begin{aligned} 7.9 \quad 63,2 - 7,3 &= 55,9 \text{ g} \quad \checkmark \\ n &= m/M \\ &= 55,9/108 \\ &= 0,5175... \text{ mol Ag} \quad \checkmark \\ \text{Ag} : \text{e}^- & \\ 1 : 1 &\text{ so } 0,5175... \text{ mol e}^- \text{ transferred} \quad \checkmark \\ Q &= n \times F \quad \checkmark \\ &= 0,5175 \times 96\,500 \\ &= 4\,9947,69 \text{ C} \quad \checkmark \\ t &= Q/I \\ &= 4\,9947,69/10,5 \\ &= 4\,756,92 \text{ s} \quad \checkmark \quad (6) \end{aligned}$$

[23]

QUESTION 8 – ELECTROLYTIC CELL

8.1 concentrated ✓ Sodium chloride solution ✓ (2)

8.2 $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$ ✓✓ (2)

8.3.1 The second reaction or $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$ ✓ (1)

8.3.2 **Na⁺** (and not Na) is a weak oxidising agent and will not be reduce to Na. ✓✓ (2)

8.4 $2\text{NaCl} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2 + \text{Cl}_2$. ✓✓ (2)

8.5 mercury cell ✓ uses mercury which is toxic ✓

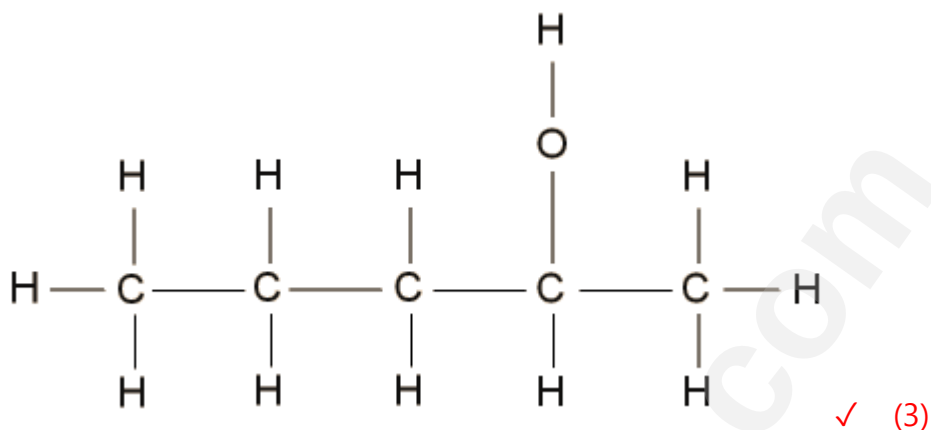
the diaphragm cell ✓ uses asbestos which is carcinogenic ✓ (4)

[13]

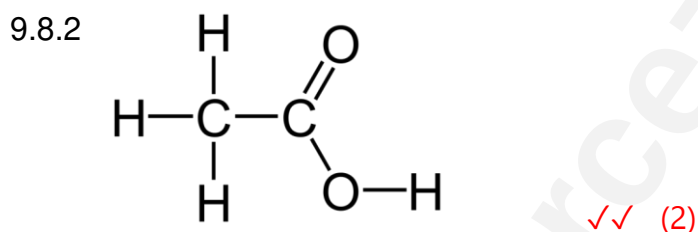
QUESTION 9 – ORGANIC CHEMISTRY

- 9.1.1 a compound only containing hydrogen and carbon and in which all of the bonds between carbon atoms are single bonds ✓✓ (2)
- 9.1.2 An atom or a group of atoms that form the centre of chemical activity in the molecule. ✓✓ (2)
- 9.1.3 Compounds having the same molecular formula ✓ but different types of chain structure i.e. branching ✓ (2)
- 9.2.1 carboxyl group ✓✓ (2)
- 9.2.2 halogen ✓✓ (2)
- 9.3 $2 \text{C}_5\text{H}_{10} + 15 \text{O}_2 \rightarrow 10 \text{CO}_2 + 10 \text{H}_2\text{O}$ ✓✓✓✓ (4)
- 9.4 1-bromo-4,4-dimethylpentane
✓✓✓ (3)
- 9.5 Compound D has the higher boiling point. ✓
D is propanoic acid, which has two sites at which hydrogen bonding can occur ✓
whereas ethyl methanoate has dipole – dipole forces between molecules. ✓
More energy is required to overcome the stronger intermolecular forces in propanoic acid ✓ therefore it has a higher boiling point (4)
- 9.6.1 2-bromopentane OR 1-bromopentane ✓✓ NO other products ✓ (3)
- 9.6.2 hydrohalogenation ✓ (1)
- 9.7.1 Steam ✓ and a suitable catalyst (H_3PO_4) ✓ (2)

- 9.7.2 Pentan-2-ol/ pentan-3-ol is a positional isomer of pentan-1-ol because they both have the same functional group, the same chain length, but the functional group is placed at a different position in the chain. ✓✓



- 9.8.1 Esters ✓ (1)



- 9.8.3 heptanoic acid ✓✓ (2)

- 9.8.4 making perfumes / deodorants / fragrances / making polymers (polyesters) ✓
(1)