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BEAULIEU COLLEGE

GRADE 12 PAPER II: CHEMISTRY

MEMORANDUM

JULY 2018

EXAMINER: M Naidoo

MODERATOR: K van Schoor

QUESTION 1: MULTIPLE CHOICE QUESTIONS

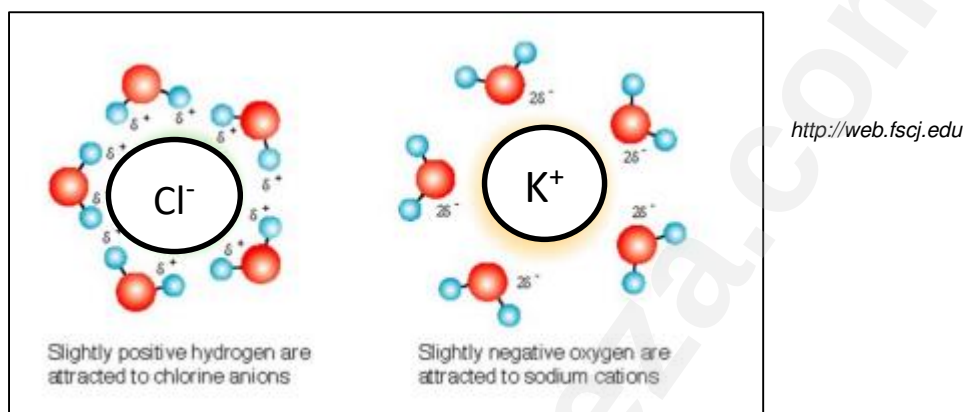
- 1.1 D✓✓
1.2 C✓✓
1.3 B✓✓
1.4 A✓✓
1.5 D✓✓
1.6 B✓✓
1.7 C✓✓
1.8 D✓✓
1.9 A✓✓
1.9.1 D✓✓

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QUESTION 2

- 2.1 Pure Covalent bonds.✓ (strictly marked Pure or non-polar) (1)
- 2.2
- Halogens have weak London forces. ✓
 - As the number of electrons increases the number of temporary dipoles increases. ✓
 - Greater cumulative attractive force (IMF). ✓
 - More energy required and hence a higher boiling point✓ (4)
- 2.3 Ionic bond: Transfer of electrons resulting in an electrostatic attraction. ✓✓ (2)
- 2.4 $\text{HCl}_{(g)} + \text{H}_2\text{O}_{(l)} \rightarrow \text{H}_3\text{O}^+_{(aq)} + \text{Cl}^-_{(aq)}$ ✓ (2)
- 2.5 Electronegativity: Measure of tendency of an atom to attract ✓ a bonding pair of electrons.✓ (2)

- 2.6 HCl- covalent✓ KCl- ionic✓ (not strictly marked for pure or polar) (2)
- 2.7 Dipoles form as a result of unequal ✓ distribution of charge/electrons ✓ (due to electronegativity of the atoms) (2)
- 2.8 Ionic Lattice. ✓ (1)
- 2.9 Dipole✓ H₂O molecules arrange with opposite ✓ poles attracted to ions. ✓✓ Diagram (4)



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QUESTION 3

- 3.1 Catalyst A/B will increase✓ the reaction rate more than✓ catalyst A/B. (2)
- 3.2 O₂ (g) released✓ against time indicates the rate✓ of the reaction. (2)
- 3.3 Graph
- Scale✓ (no odd values and must cover more than half the grid in both directions)
 - Unit and label on y axes (volume in dm³)✓
 - Plotting of points✓✓ (-1 for large blobs)
 - Line of Best Fit✓✓ (-1 if both are straight lines)
 - Heading (graph showing volume of oxygen formed vs time)✓ (7)
- 3.4 $V \approx 3,10 \text{ to } 3,20 \text{ dm}^3$ ✓ (coe from graph) (1)
- 3.5 Rate of Reaction: $\frac{\Delta y}{\Delta x} = \frac{1.3-0}{1.5-0} \checkmark = \underline{0.86 \checkmark \text{ dm}^3 \cdot \text{min}^{-1} \checkmark}$
- (Range (0,8 -0,9 dm³·min⁻¹) (coe from graph) (3)
- 3.6 4,2dm³✓
- Catalyst does not affect product yield- same reactant concentration✓, therefore same yield. (2)

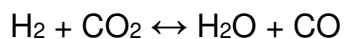
- 3.7 Gradient $\checkmark$ (Rate) of graph B will increase $\checkmark$. More $O_2(g)$ will be formed, therefore graph ends at higher $\checkmark$ volume $O_2(g)$. Concentration affects Rate of Reaction. $\checkmark$ (4)
- 3.8.1 Show activation energy at a lower energy when a catalyst is used $\checkmark\checkmark$ (2)
- 3.8.2 a) Show lower peak $\checkmark$ Shifted to the right $\checkmark$ (2)
- 3.8.2 b)
- High Temperatures will result in an increase in kinetic energy of particles. $\checkmark$
 - Greater number of collisions with adequate kinetic energy. $\checkmark$
 - More successful collisions **per unit time** resulting in an increase in the rate of reaction $\checkmark$. (3)

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QUESTION 4

- 4.1.1 When an external stress is imposed to an equilibrium system, the equilibrium point will change to counter the stress. $\checkmark\checkmark$ (2)
- 4.1.2
- a) Decrease $\checkmark$ (1)
- b) Higher Pressure will cause system to favour reaction with lower pressure $\checkmark$ therefore forming fewer particles $\checkmark$.
Reverse reaction is favoured $\checkmark$ and less $H_{2(g)}$. (3)
- 4.1.3 Endothermic Reaction. $\checkmark$
- High Temperatures will favour an endothermic reaction $\rightarrow$ forward reaction $\rightarrow$ higher yield. $\checkmark$
 - High temperatures increase kinetic energy of molecules, more successful collisions per unit time and hence an **increase in the rate of reaction**. $\checkmark$ (3)
- 4.2.1 $K_c = [H_2O][CO] / [H_2][CO_2]$ $\checkmark$ (1)

4.2.2



	H₂	CO₂	H₂O	CO
Initial moles	x	0,3	0	0
Reacting moles	-0,2	-0,2✓	+0,2	+0,2
n at equilibrium	x- 0,2	0,1✓	0,2✓	0,2
[] at equilibrium	(x-0,2/10) ✓	0,01	0,02	0,02✓

$$K_c = [\text{H}_2\text{O}][\text{CO}] / [\text{H}_2][\text{CO}_2]$$

$$4\sqrt{ = \frac{(0,02)(0,02)}{\left(\frac{x-0,2}{10}\right)(0,01)} \quad (\text{H}_2) \times = \underline{0,3 \text{ mol}}\sqrt{ \quad (7)}$$

4.2.3

a) Exothermic✓ (1)

b) High Temperatures favours an endothermic reaction✓. K_c decreases, therefore less product✓ because reverse reaction is favoured✓. (3)

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

4.3.2 Broken line. ✓ (1)

4.3.3 Both lines move up to a higher rate ✓ and then stay horizontal at this rate ✓ (2)

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QUESTION 5

5.1.1 HNO_3 ionises✓ almost completely.✓ (1)

5.1.2 NO_3^- ✓ (1)

5.1.3.1 H_2SO_4 ✓ (low pH) will have more $[\text{H}_3\text{O}^+]$ ✓ because it is a strong acid and ionises completely✓. H_2SO_4 is also diprotic, therefore $2 \times [\text{H}_3\text{O}^+]$ than HNO_3 ✓ (4)

5.1.3.2 CH_3COOH ✓ is a weak acid, therefore does not ionise completely.✓. Less ions.✓, therefore does not conduct well. (3)

$$\begin{aligned}
 5.2.1 \quad n(\text{HCl}) &= c \times V \\
 &= 2 \times 0,1 \\
 &= \underline{0,2 \text{ mol}}
 \end{aligned}
 \tag{3}$$

$$5.2.2 \quad \text{Burette.} \tag{1}$$

$$\begin{aligned}
 5.2.3 \quad &\text{Strong acid and Strong base.} \\
 &\text{No hydrolysis, therefore neutral end point.}
 \end{aligned}
 \tag{3}$$

$$5.2.4 \quad \text{End point where acid and base has reacted completely so neither is in excess} \tag{2}$$



$$\begin{aligned}
 n(\text{NaOH}) &= c \times V \\
 &= 0,2 \times 0,021 \text{ dm}^3 \\
 &= \underline{4,2 \times 10^{-3} \text{ mol}}
 \end{aligned}
 \tag{3}$$

Ratio: NaOH: HCl

1 : 1

$$n(\text{HCl}) = \underline{4,2 \times 10^{-3} \text{ mol}} \text{ in excess}$$

$$5.2.6 \quad n(\text{HCl}) \text{ reacted} = 0,2 - (4,2 \times 10^{-3} \text{ mol}) = 0,196 \text{ mol} \tag{1}$$

$$5.2.7 \quad \text{HCl} : \text{MgO}$$

$$2 : 1$$

$$\text{Therefore } n(\text{MgO}) = 0,0979 \text{ (} 9,8 \times 10^{-2} \text{) mol (coe)}$$

$$m(\text{MgO}) = 0,0979 \times (24,3 + 16)$$

$$= 3,95 \text{ g (} 3,92 \text{ g)}$$

$$\% \text{ purity} = (3,95 / 4,5) \times 100$$

$$= \underline{87,78\%} \tag{5}$$

$$5.3.1 \quad \text{Hydrolysis} \tag{1}$$

$$\begin{aligned}
 5.3.2 \quad &\text{Salt forms 2 ions in H}_2\text{O, react with water (1 + 2)} \\
 &\text{NaOH forms a strong base: dissociate fully to increase OH}^- \\
 &\text{CH}_3\text{COOH forms a weak acid: ionises poorly therefore less [H}_3\text{O}^+] \\
 &\text{Excess OH}^-, \text{ therefore basic.}
 \end{aligned}
 \tag{4}$$

QUESTION 6

6.1 Temperature = 298K or 25°C✓

Pressure = 1 atm✓

$[H^+] = 1 \text{ mol.dm}^{-3}$ ✓ (3)

6.2.1 A substance that conducts electricity✓ due to the presence of ions✓. (2)

6.2.2 Metals provide a surface for electron exchange. ✓✓
(or conductor in gas) (2)

6.2.3 Cathode✓.
 H^+ ions are stronger Oxidising agents✓, therefore undergoes reduction✓. (3)

6.3 $Fe_{(s)} + 2H^+_{(aq)} \rightarrow Fe^{2+}_{(aq)} + H_{2(g)}$ ✓✓✓. (3)

6.4 $Pt_{(s)} / H_{2(g)} / H^+_{(aq)} // Fe_{(s)} / Fe^{2+}_{(aq)}$ ✓✓✓✓ (phases not required) (4)

6.5 $E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}}$ ✓.
= 0 - (-0,44) ✓
= 0,44V✓ (3)

6.6.1 Decreases✓✓ (2)

6.6.2 Decreases✓ (1)

6.7.1 No Effect✓✓ (2)

6.7.2 Decreases✓✓ (2)

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QUESTION 7

7.1 Brine✓. (1)

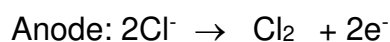
7.2 Electrical energy✓ → Chemical energy✓. (2)

7.3 H₂O is a stronger oxidising agent✓. (large positive electrode potential).
Therefore H₂O is reduced✓ before Na⁺ ions. (2)

7.4 The membrane cell is more cost effective✓.
It uses less energy and water✓. It produces a higher % purity of NaOH✓ (3)

$$7.5 \quad n = \frac{V}{V_m}$$

$$= \frac{11000}{22,4} = 491,07 \text{ mol}$$



Ratio: Cl₂ : e⁻

$$1 : 2 \checkmark$$

$$n\text{e}^- = 491.07 \times 2 = 982,14 \text{ mol e}^-$$

$$Q = 982,14 \text{ mol e}^- \times 96\,500 \text{ C.mol}^{-1}$$

$$= 9476785,71 \text{ C } (9,46 \times 10^7 \text{ C})$$

$$Q = It \checkmark$$

$$I = (9,46 \times 10^7 \text{ C}) / 63\,000 \text{ s}$$

$$= \underline{1504,39 \text{ A}} \text{ (or } 1501,58 \text{ A depending on rounding)} \quad (6)$$

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QUESTION 8

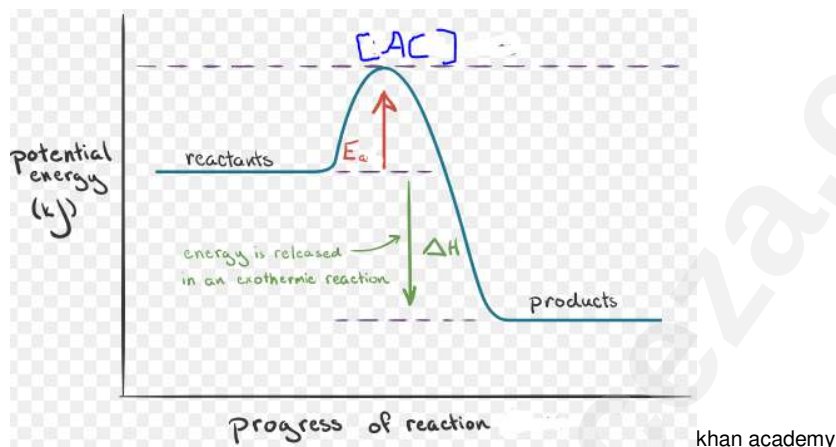
8.1.1 High Temperatures✓ (or High Pressure) (1)

8.1.2 $x = C_6H_{12}$ ✓ (1)

8.1.3 C_nH_{2n} ✓ (1)

8.1.4 $2 C_4H_{10} + 13 O_2 \rightarrow 8 CO_2 + 10 H_2O$ - balancing✓. (4)

8.1.5 [AC] ✓ E_a ✓ ΔH ✓ Shape exothermic ✓ (4)



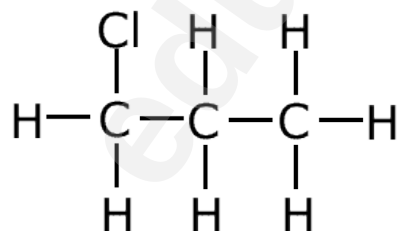
8.2 X ✓. – alkene, therefore unsaturated✓. Reaction is spontaneous✓.. Butane is saturated, needs UV/ non spontaneous✓ (4)

8.3.1 P- addition (Hydrogenation) ✓ (1)

8.3.2 Q- substitution✓ (1)

8.3.3 R- substitution✓ (1)

8.4

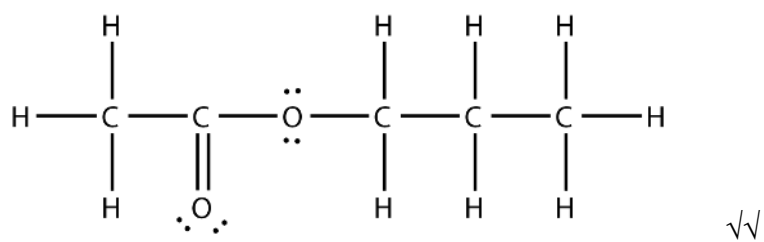


✓✓ . (2)

8.5.1 Esterification ✓. (1)

8.5.2 Sulphuric acid ✓. (1)

8.5.3



8.6 Methyl methanoate √√ (2)

8.7 X – (weak) London Intermolecular Forces (IMF) √

Y – dipole- dipole √

Z – Hydrogen bonding √

Hydrogen bond forces > √ dipole-dipole > London IMF √.

More energy needed to overcome stronger IMF √

Hence higher boiling point of Z. (6)

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