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ST MARY'S DSG PHYSICAL SCIENCE TRIALS 2021 PAPER 2 MEMO

QUESTION 1 MC

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

[2x10-20]

QUESTION 2

- 2.1 A bond which occurs between atoms✓ within molecules✓ (2)
- 2.2 polar ✓covalent ✓ (2)
- 2.3.1 A measure of the tendency of an atom to attract ✓a bonding pair of electrons✓ (2)
- 2.3.2 Boiling point is not influenced by electronegativity/polarity/intramolecular bonds. HCl has dipole-dipole vd Waals forces between its molecules, ✓which are weak and easily overcome. NH₃ has hydrogen bonds✓ between its molecules which are much stronger✓ than dipole-dipole and a lot more energy✓ is required to overcome them, hence the huge discrepancy in boiling point. (4)
- 2.4 NH₄Cl ✓✓ (2)
- 2.5 It has ionic bonds between positive and negative ions✓ in the crystal lattice.✓ These are extremely strong.✓ (and therefore much E required to overcome✓, and high BP) (4)
- 2.6 In molten state✓/aqueous solution. ✓ Ions would be freed from the crystal lattice to be able to carry a current.✓ (3)

[19]

QUESTION 3

3.1.1 A change in concentration/volume per unit time✓ of the reactant HCl /product CO₂ ✓ (2)

3.1.2 Concentration of HCl✓ (1)

3.1.3 To ensure a fair test✓, OR only one variable must change (i.e. concentration), OR all other variables must stay the same (1)

3.2.1 Exp 2 has more moles per unit volume✓ therefore more collisions per unit time✓ more effective collisions per unit time✓ therefore higher reaction rate (3)

3.2.2 $n(\text{CaCO}_3) = \frac{m}{Mr}$ $Mr(\text{CaCO}_3) = 40 + 12 + 3(16) = 100 \text{ g.mol}^{-1}$
 $= \frac{4}{100} \checkmark$
 $= 0,04 \text{ mol} \checkmark$

CaCO₃ : HCl
 1 : 2

0,04 : x

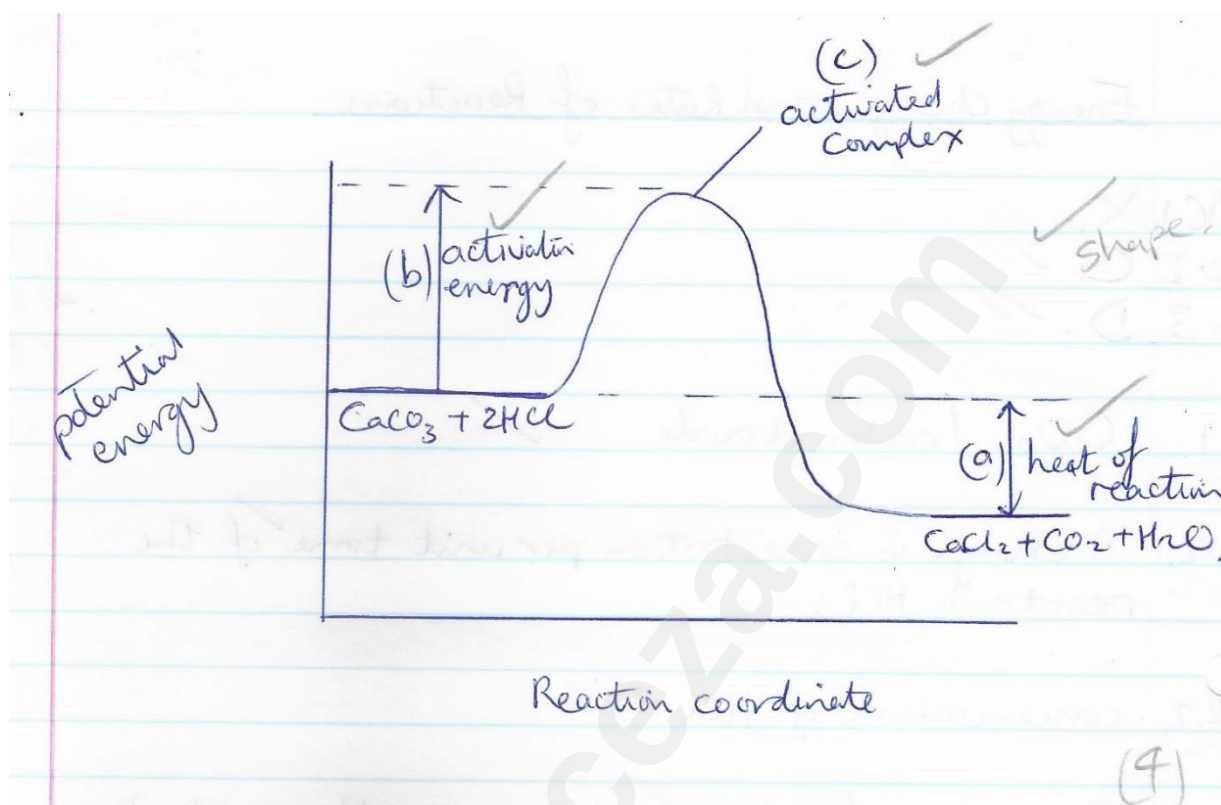
X = 0,08 ✓

$$V(\text{HCl}) = \frac{n}{C}$$

$$\frac{0,08}{0,4} = 0,2 \text{ dm}^3 \checkmark \times 1000 = 200 \text{ cm}^3 \checkmark \quad (5)$$

3.3

(4)



[16]

QUESTION 4

4.1 Standard solution✓ (1)

4.2 $\text{NaOH(s)} \rightarrow \text{Na}^+(\text{aq}) + \text{OH}^-(\text{aq})$ ✓ single arrow and subscripts (3)4.3 $\text{Mr}(\text{NaOH}) = 23 + 16 + 1 = 40 \text{ g.mol}^{-1}$ ✓

$$n = \frac{m}{Mr}$$

$$= \frac{2}{40}$$

$$= 0,05 \text{ mol} \checkmark$$

$$V = 250/1000 = 0,25 \text{ dm}^3 \checkmark$$

$$C = \frac{n}{V}$$

$$= \frac{0,05}{0,25}$$

$$= 0,2 \text{ mol.dm}^{-3} \checkmark$$

(4)

4.4 $[\text{OH}^-] = [\text{NaOH}] = 0,2 \text{ mol.dm}^{-3}$ c.o.e Q4.3

$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] \checkmark$$

$$1 \times 10^{-14} = [\text{H}_3\text{O}^+](0,2) \checkmark$$

$$[\text{H}_3\text{O}^+] = 5 \times 10^{-14} \checkmark \quad (3)$$

4.5 Dilute – little solute ✓ to a lot of solvent ✓ i.e. a lot of water to a little acid
Strong- ionises almost completely ✓ (3)

4.6 Bromothymol blue ✓ (1)

4.7 neutralisation (or the equivalence point) as the point where an acid and base
have reacted so neither is in excess ✓✓ (2)

$$4.8 \quad n(\text{NaOH}) = CV$$

$$= (0,2) \left(\frac{25}{1000} \right) \checkmark$$

$$= 0,005 \text{ mol} \checkmark$$

$$\text{NaCl} : \text{HCl}$$

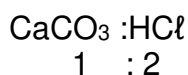
$$1 : 1 \checkmark$$

$$\text{Therefore } n \text{ HCl} = 0,005 \text{ mol.} \checkmark \quad (4)$$

$$4.9 \quad n(\text{CaCO}_3) = \frac{m}{Mr} \quad Mr(\text{CaCO}_3) = 40 + 12 + 3(16) = 100 \text{ g.mol}^{-1}$$

$$= \frac{1,5}{100} \checkmark$$

$$= 0,015 \text{ mol} \checkmark$$



$$0,015 : x$$

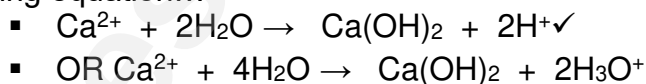
$$x = 0,03 \checkmark$$

$$n \text{ HCl total} = 0,03 + 0,005 = 0,035 \text{ mol} \checkmark$$

$$C(\text{HCl}) = \frac{0,035}{0,05} \checkmark = 0,7 \text{ mol.dm}^{-3} \checkmark \quad (6)$$

4.10.1 a reaction of an ion (from a salt) with water $\checkmark \checkmark \quad (2)$

4.10.2 The calcium ions from the salt is a strong conjugate ACID $\checkmark$ of the weak BASE, Ca(OH)_2 , and will thus ACCEPT hydroxide ions $\checkmark$ from water according to the following equation...



- Thus the concentration of H^+ ions in solution increases $\checkmark$ causing the solution at the end point to be slightly acidic $\checkmark$ (having a pH less than 7).
- The Cl^- ion from the salt does not hydrolyse water to go back to HCl (HCl is a strong acid and therefore we can consider the HCl always to be completely ionised).

(5)

[34]

QUESTION 5

5.1 Dynamic chemical equilibrium refers to a reversible reaction in which the forward and the reverse reactions are taking place at the same rate, and hence the concentrations of reactants and products are constant ✓✓ (2)

5.2.1 X ✓ – the products concentration is increasing as only reactants added initially ✓ (2)

5.2.2 HIGHER THAN ✓ (1)

5.3.1 There are more reactants at equilibrium than products ✓✓/lower yield (2)

5.3.2 No effect/remains the same ✓ as the number of moles are equal ✓ on both sides of equation so neither is favoured. (2)

5.3.3 $K_c = \frac{[H_2][I_2]}{[HI]^2}$ ✓✓ (2)

5.3.4

Ratio	2		1	1
Initial Concentration	1 ✓		0	0
Change in Concentration	-2x		+x	+x
Equilibrium concentration	1-2x		x	x ✓

$$\sqrt{0,04} = \frac{[x][x]}{[1-2x]^2} \quad \text{square root both sides}$$

$$0,2 (1-2x) = x$$

$$0,02 = 1,4x$$

$$X = 0,14 \text{ mol.dm}^{-3} \quad \checkmark$$

(6)

5.4.1 Forward reaction rate is greater than the reverse reaction rate. ✓ ✓ (2)

5.4.2 Both rates increase. ✓ An increase in temperature will favour the reaction that absorbs heat ✓ to counteract stress/decrease temperature. ✓ The forward reaction is favoured and is therefore ENDOTHERMIC. ✓ (4)

5.4.3 On answer sheet. (4)

[27]

QUESTION 6

- 6.1 Chemical ✓ → electrical ✓ (2)
- 6.2 Sn ✓ it gains mass therefore ions must be getting reduced ✓ to atoms (2)
- 6.3 Electrode where oxidation occurs ✓ (2)
- 6.4 X to Sn ✓ (1)
- 6.5 $E^{\circ}_{\text{cell}} = E^{\circ}_{\text{cat}} - E^{\circ}_{\text{an}}$
 $+0,6 \text{ ✓} = -0,14 \text{ ✓} - (x)$
 $+0,74 = -x$
 $X = -0,74 \text{ V ✓}$ (3)
- 6.6 Chromium/Cr ✓ (1)
- 6.7 $X(s)/X^{+3}(aq)(1 \text{ mol. dm}^{-3})//Sn^{2+}(aq)(1 \text{ mol. dm}^{-3})/Sn(s) \text{ ✓✓@ } 25^{\circ}\text{C} \text{ ✓✓}$ (4)
- 6.8 $X \rightarrow X^{3+} + 3e^{-} \text{ (x2) ✓}$
 $Sn^{2+} + 2e^{-} \rightarrow Sn \text{ (x3) ✓}$
 $2X + 3Sn^{2+} \rightarrow 2X^{3+} + 3Sn \text{ ✓}$ (3)
- 6.9 Sodium nitrate/ potassium nitrate ✓/KNO₃ etc (1)
- 6.10 At the cathode, the electrolyte loses positive ions and becomes negative ✓. The positive ions in the salt bridge move into the electrolyte ✓ to prevent the build-up of negative charge and negative ions move into salt bridge from cathode half cell ✓ (3)
- 6.11.1 Remains the same (1)
- 6.11.2 Increases (1)
- 6.11.3 Decreases (1)
- [25]**

QUESTION 7

7.1.1 Brine ✓ (1)

7.1.2 ONLY Allows only positive ions ✓ to pass through to make sure no Cl⁻ ions enter the NaOH solution. (2)

7.1.3 $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-$ ✓ (2)

7.1.4 Sodium ions (Na⁺) are weaker oxidising agent ✓ than water (Na has a more negative E° value ✓) therefore water molecules are reduced ✓ at the cathode.
OR Water is a stronger oxidising agent than Sodium ions (Na⁺) (Na has a more negative E° value) therefore water molecules are reduced at the cathode. (3)

7.2.1 $I = 2,5\text{ A}$

$t = 1,28\text{ h}$

$$\begin{aligned} Q &= It \quad \checkmark \\ &= 2,5 \times (1,28 \times 60 \times 60) \quad \checkmark \\ &= 2,5 \times 4608 \\ &= 11\,520\text{ C} \quad \checkmark \end{aligned} \quad (3)$$

7.2.2 $N_e = \frac{Q}{F}$

$$= \frac{11520}{96\,200}$$

= 0,12 mol ✓ Group 2 metal therefore 2 e gained

Mole ratio M:e
1:2

Moles M = 0,5 x 0,12

= 0,0597 mol ✓

$\Delta m = 30,949 - 25,72$

= 5,229 g ✓

$$M_r = \frac{m}{n} = \frac{5,229}{0,0597} = 87,59\text{ g.mol}^{-1} \quad \checkmark$$

Metal is Sr (Strontium) ✓ (5)

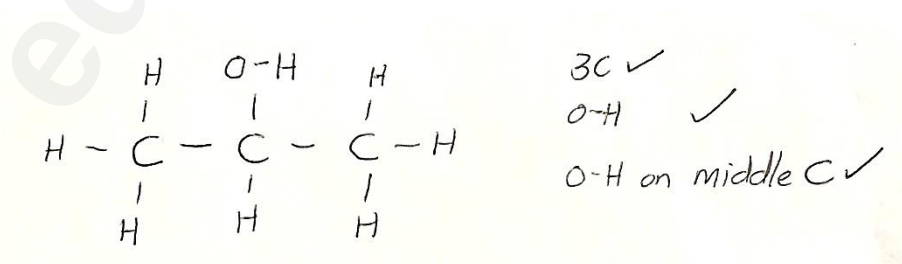
[16]

QUESTION 8

- 8.1 Esters ✓ (1)
- 8.2 propyl ✓ ethanoate ✓ (2)
- 8.3.1 Compounds having the same molecular formula ✓ but different structural formulae ✓ (2)
- 8.3.2 pentanoic ✓ acid ✓ (2)
- 8.4.1 A functional group as an atom or a group of atoms ✓ that form the centre of chemical activity in the molecule ✓ (2)
- 8.4.2 Carboxyl group ✓ ✓ (2)
- 8.5 Heat indirectly using a water bath ✓ Because reactants and products are highly flammable/ prevent alcohol evaporating (2)
- 8.6. Concentrated ✓ H_2SO_4 ✓ catalyst. Removes water/dehydrating agent ✓ (3)
- [16]**

QUESTION 9

- 9.1.1 General: Elimination ✓ 9.1.2 Specific: (thermal) cracking ✓ (2)
- 9.2 $2 \text{C}_6\text{H}_{14} + 19 \text{O}_2 \rightarrow 12 \text{CO}_2 + 14 \text{H}_2\text{O}$ ✓ r ✓ p ✓ b (3)
- 9.3.1 2-methylpentane / 3-methylpentane / 2,3-dimethylbutane number ✓ and side chain ✓ main name ✓ (3)
- 9.3.2 Chain ✓ isomerism (1)
- 9.4 propene ✓ (1)
- 9.5.1 hydrohalogenation ✓ (1)
- 9.5.2 absence of water ✓ (1)
- 9.6.1 Substitution ✓ (1)
- 9.6.2



- 9.6.3 (iv) NaOH ✓ or KOH (or names) (v) NaCl ✓ or KCl (or names) (2)

9.6.4 dilute ✓ NaOH (alkali) solution and heat ✓ (under reflux) (2)

9.7.1 ✓✓ L: London forces ✓ M: dipole-dipole forces ✓ N: hydrogen bonds ✓ (3)

9.7.2 L → M → N (2)

9.7.3 N has the strongest ✓ of the intermolecular forces thus more energy is required to overcome the forces ✓ of attraction for boiling to occur. (2)
[27]



GRADE 12 PHYSICAL SCIENCE ANSWER SHEET

Examination number:

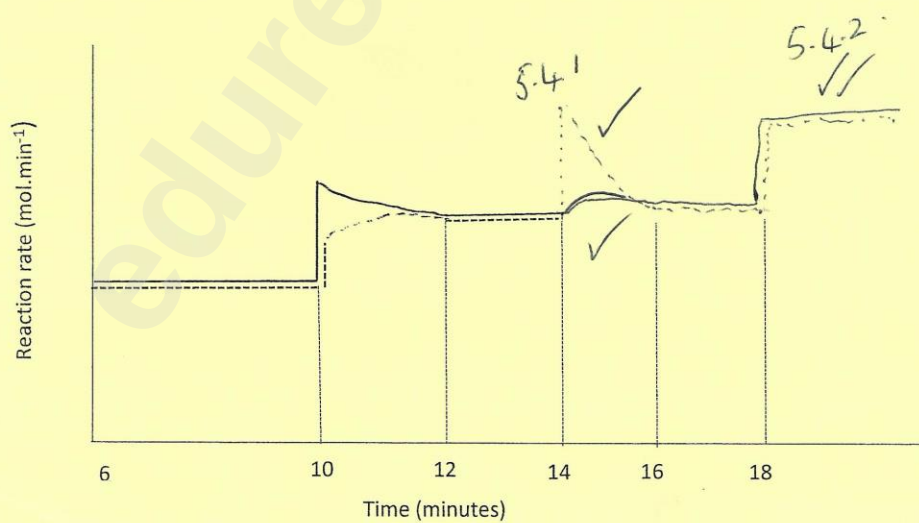
M	E	M	0								
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QUESTION 1 MULTIPLE CHOICE

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

[20]

QUESTION 5.4



(4)