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## Question 1

1.1 A ✓✓

1.2 C ✓✓

1.3 B ✓✓

1.4 D ✓✓

1.5 D ✓✓

1.6 D ✓✓

1.7 C ✓✓

1.8 A ✓✓

1.9 A ✓✓

1.10 B ✓✓

[20]

working out:

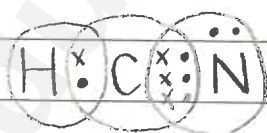
$$\begin{aligned}
 1.2 \quad n &= V/V_m \\
 &= 0.460/22.4 \\
 &= 2.05 \times 10^{-2} \text{ mol}
 \end{aligned}$$

$$\begin{aligned}
 m &= n \times M_r \\
 &= (2.05 \times 10^{-2}) \times 106 \\
 &= 2.17 \text{ g}
 \end{aligned}$$

## Question 2

2.1 a measure of the tendency of an atom to attract a bonding pair of electrons ✓ (1)

2.2 NaCN ✓ (1)



✓✓ (2) octet rule for who?!  
-1 per mistake

4 a force of attraction between molecules, ions, or atoms of noble gases ✓ (1)

5.1 London forces ✓

5.2 dipole-dipole IMF ✓ (2)

2.6 hydrogen bonding

2.7 - small atom ✓

- high electronegativity ✓ (2)

2.8  $\text{CCl}_4$  ✓ (1)

2.9 breaks apart into ions ✓ (1)

- there are not  $e^-$  because of the metal!

2.10 (answer sheet) (7)

2.11 - as molecular mass increases,  $e^-$  density increases ✓-  $\therefore$  greater IMF  $\therefore$  more energy required to overcome ✓ (2)

[21]

## Question 3

3.1  $\text{CuSO}_4 + \text{Ba}(\text{NO}_3)_2 \rightarrow \text{Cu}(\text{NO}_3)_2 + \text{BaSO}_4$  ✓ (3)

3.2 the substance in which another substance is dissolved forming a solution ✓ (1)

3.3  $\text{CuSO}_4$  ✓ (1)3.4  $n = m / M_r$  ✓

$$= (1,136 - 0,164) \quad \checkmark$$

$$(137,3 + 32 + 64)$$

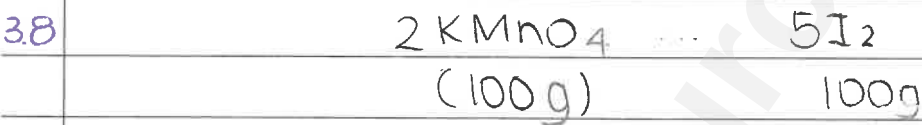
$$= 1,61 \times 10^{-3} \text{ mol} \quad \checkmark \quad (3)$$

3.5 % yield =  $\frac{\text{actual}}{\text{theoretical}} \times 100$  ✓  
 $80 = \frac{0,372}{\text{theoretical}} \times 100$   
 $\therefore \text{theoretical} = 0,47 \text{ g}$  ✓ (2)

3.6  $n = \frac{0,47}{233,3}$   
 $= 2,01 \times 10^{-3} \text{ mol}$  ✓

$\therefore c = \frac{n}{V}$  ✓  
 $= \frac{2,01 \times 10^{-3}}{50 \times 10^{-3}}$  ✓  
 $= 4,02 \times 10^{-2} \text{ mol} \cdot \text{dm}^{-3}$  ✓ (4)

3.7  $n = \frac{m}{M_r}$  ✓  
 $= \frac{3}{(37,3 + 124)}$  ✓  
 $= 1,15 \times 10^{-2} \text{ mol}$  ✓ (3)  
 $\therefore 1,15 \times 10^{-2} - 2,01 \times 10^{-3}$   
 $= 9,49 \times 10^{-3} \text{ mol}$  ✓



$n = \frac{m}{M_r}$   $n = \frac{m}{M_r}$   
 $= \frac{100}{158}$   $= \frac{100}{254}$   
 $= 0,63 \text{ mol}$  ✓  $= 0,39 \text{ mol}$  ✓

used % yield formula instead of % purity →  $2 : 5$   
 $0,16 : 0,39$  ✓  
 $\therefore \text{purity} = \frac{\text{pure}}{\text{impure}} \times 100$  ✓  
 $= \frac{0,16}{0,39} \times 100$   
 $= 25,40\%$  ✓ (5)  
 - using masses would also work

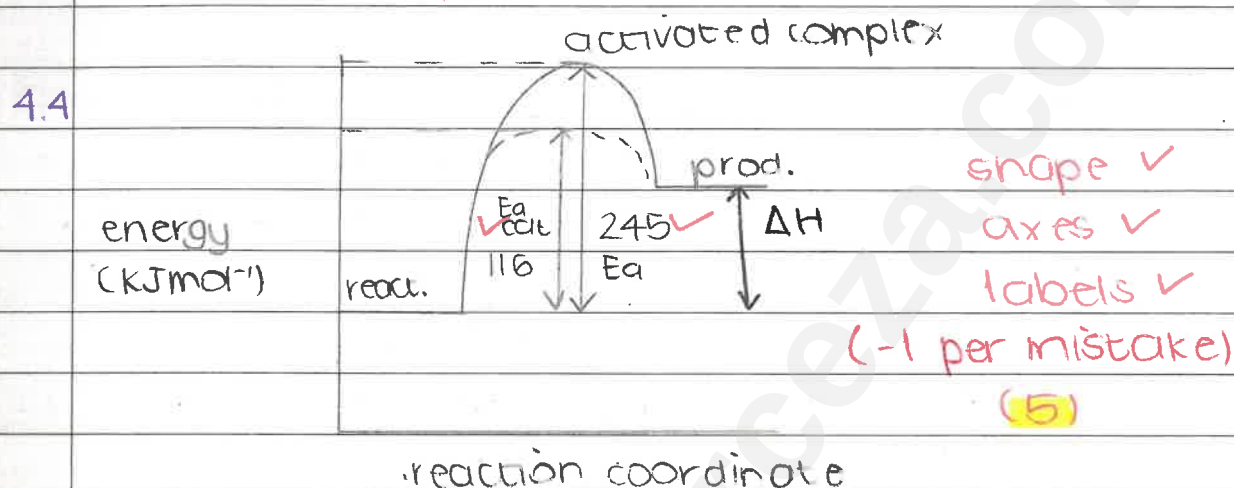
[22]

## Question 4 Downloaded from eduresourceza.com

4.1 a substance that increases the rate of the reaction but remains unchanged at the end of the reaction ✓ (1)

4.2 it has remained unchanged ✓ (1)

4.3 increase ✓ (1)



4.5 - swapped concentration and time as axes labels ✓  
- swapped labels for O<sub>2</sub> and NO<sub>2</sub> ✓ (2)

4.6 rate = gradient =  $\Delta y / \Delta x$  ✓  
 $= 0.0035 / 100$  ✓  
 $= 3.5 \times 10^{-5} \text{ mol} \cdot \text{dm}^{-3} \cdot \text{s}^{-1}$  ✓ (3)

4.7 in order for a reaction to proceed the reactant particles collide effectively with the correct orientation ✓ and sufficient energy ✓ (2)

4.8 - pressure decrease favours the reaction which produces more moles of gas ✓  
- fwd reaction favoured ∴ yield of O<sub>2</sub> increases ✓ (2)

4.9 - not correct ✓

- grinding up increases surface area : quicker rate ✓
- adding more solid does not change the concentration  
∴ won't increase rate ✓ (3)

[20]

## Question 5

5.1 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. ✓ (1)

5.2 - an increase in the concentration of nitrogen ✓  
 - fwd reaction is favoured to decrease concentration ✓  
 - conc of products increase and conc of reactants decreases ✓ (3)  
 - left off 3rd mark by not saying what happens to other species

5.3 - yes ✓  
 - mol of  $N_2$  would increase but not others  
 and fwd reaction would still be favoured ✓ (2)

5.4 - graph shows a pressure increase ✓ NEVER say 'favours the side'.  
 - fwd reaction is favoured ✓ (2) there are no sides.  
 stresses favour 4 REACTION!

5.5 (answer sheet) ✓ (4)

5.6  $K_c = \frac{[Cl_2]^2}{[HCl]^4 [O_2]}$  ✓ (2)

$[H_2O]$  is a) a liquid  
 b) how do you get the concentration of water?!

$$V = 0,4 \text{ dm}^3$$

5.1



|       |     |      |     |   |
|-------|-----|------|-----|---|
| start | 5   | 3    | 0   | ✓ |
| rxn   | 2   | 0,5  | 1   | ✓ |
| end   | 3   | 2,5  | 1   | ✓ |
| [ ]   | 7,5 | 6,25 | 2,5 | ✓ |

$$c = n/v$$

$$= 3/0,4$$

$$= 7,5 \text{ mol dm}^{-3}$$

- ai ai ai ...  
random mol  
calcs without  
taking changes  
into account

$$K_c = \frac{[O_2]^2}{[HCl]^4 [O_2]}$$

$$= \frac{(2,5)^2}{(7,5)^4 (6,25)}$$

sub

$$= 3,16 \times 10^{-4}$$

(6)

**NB!!** you MUST  
write out  
concentration  
and increase,  
decrease etc

[ ] ↑ ↓  
WILL NOT BE  
MARKED!!

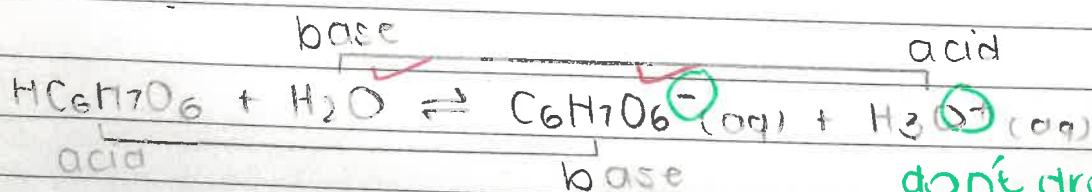
- 58 - increase temperature ✓  
- decrease [HCl] or [O<sub>2</sub>] ✓ (2) any 2  
- decrease pressure increase  
do not do this ..  
I am a bad person!

[22]

## Question 6

6.1 does not ionize completely in aqueous solution ✓ (1)

6.2



don't drop  
(3) charges

6.3 the point where an acid and base have reacted so neither is in excess ✓ (1)

6.4 - Fred ✓

- strong base + weak acid ∴ basic pH ✓ (2)

6.5 - starting pH should be basic as they are adding the acid to the base ✓ (1)

- didn't look carefully at how pH was changing

6.6 solution of known concentration ✓ (1)

$$n = m/M_r$$

$$= 40/56$$

$$= 0,71 \text{ mol} \quad \checkmark$$

$$c = n/v$$

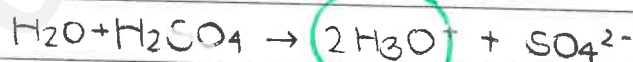
$$= 0,71/0,5$$

$$= 1,42 \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark \quad (4)$$

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

$$1 \times 10^{-14} = (4)[\text{OH}^-] \quad \checkmark$$

$$[\text{OH}^-] = 2,5 \times 10^{-15} \text{ mol} \cdot \text{dm}^{-3} \quad \checkmark \quad (3)$$



- forgot to double the concentration



$$c = 2 \text{ mol} \cdot \text{dm}^{-3} \quad c = 1,42 \text{ mol} \cdot \text{dm}^{-3}$$

$$v = 15 \text{ cm}^3$$

$$n = cv$$

$$= (1,42)(15 \times 10^{-3})$$

$$= 2,13 \times 10^{-2} \quad \checkmark$$

forgot to use mol ratio

$$c = n/v$$

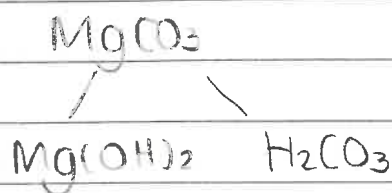
$$2 = (2,13 \times 10^{-2} \div 2) / v \quad \checkmark$$

$$v = 5,33 \times 10^{-3} \text{ dm}^3 \quad \checkmark$$

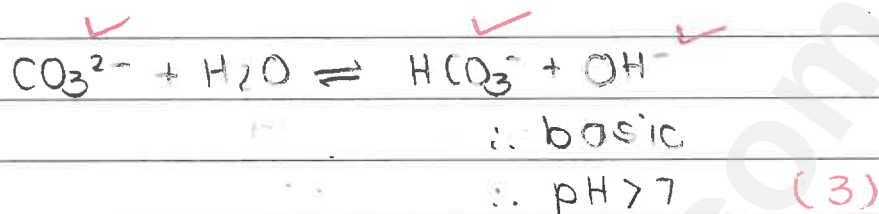
$$(5,33 \text{ cm}^3) \quad (5)$$

6.11 carbon dioxide ✓ (1)

6.12



this is your thinking when you are asked for a hydrolysis EQUATION



6.13 - adding strong acid increases concentration of  $\text{H}_3\text{O}^+$  ions ✓

- rev reaction favoured ∴ slight decrease in  $[\text{H}_3\text{O}^+]$  ✓ (2)

- this was a thinking extension one.. well done to those who got it totally right [30]

### Question 7

7.1 electrode at which oxidation takes place ✓ (1)

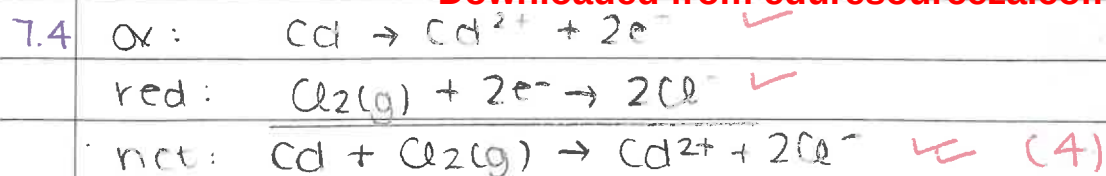
7.2 platinum (Pt) ✓ (1) - too many of you said  $\text{Cl}_2$ ... it needs to be a solid

7.3  $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$  ✓

$+1,76 = +1,36 - E^\circ_{\text{anode}}$  ✓

$E^\circ_{\text{anode}} = -0,40\text{V}$  ✓

∴ Cd ✓ (4)



7.5  $\text{Cd}(\text{s}) / \text{Cd}^{2+}(\text{aq}, 1\text{mol dm}^{-3}) // \text{Pt} / \text{Cl}_2(\text{g}, 1\text{atm}) / \text{Cl}^-(\text{aq}, 1\text{mol dm}^{-3}) @ 25^\circ\text{C}$   
 -1 per mistake ✓ -for unknown reasons (3) ✓  
 (you swapped the red rxn around)

7.6 a substance that can conduct electricity by forming free ions when molten or dissolved ✓ (1)

7.7 potassium nitrate ✓ (1) name!

7.8  $\text{HCl}$  (any chloride) ✓ (1)

7.9  
 $\text{Cd} - -0,40\text{V}$  no effect as  $\text{e}^-$  still flow  
 $\text{Ag} - +0,80\text{V}$  towards platinum electrode  
 $\text{Cl}_2 - +1,36\text{V}$  ✓ (2)

7.10 -  $\text{Al}$  ✓  
 - greater reducing ability than  $\text{Fe}$  : will be oxidized instead of  $\text{Fe}$  ✓ (3)

[21]

## Question 8

8.1 electrical → chemical ✓ (1)

8.2 -  $\text{Hg}$  amalgam ✓  
 - Na metal transported to cathode via mercury conveyor ✓ (2)



8.4 textiles, paper, soap ✓ (1)

8.5 membrane cell ✓ (1)

8.6 only allows  $\text{Na}^+$  ions through ✓ (1)

8.7 saturated salt solution ✓ (1)

8.8  $Q = It$   
 $= 10(15 \times 60)$

$= 9000 \text{ C}$  ✓

$\#e^- = Q/q_e = 9000 / 1,6 \times 10^{-19}$   
 $= 5,63 \times 10^{22}$  ✓

$n_{e^-} = \#e^- / N_A = 5,63 \times 10^{22} / 6,02 \times 10^{23}$   
 $= 9,34 \times 10^{-2} \text{ mol}$  ✓  
 (0,09)



$9,34 \times 10^{-2} : 4,67 \times 10^{-2}$  ✓  
 (0,09) (0,045)

forgot mol  
ratio step

$\therefore V = n \times V_m$

$= (0,045 \times 22,4)$  ✓

$= 1,01 \text{ dm}^3$  ✓ (6)

8.9 diaphragm is made from asbestos which can cause lung disease ✓ (1)

8.10 - no; this cell isn't aqueous  $\therefore$  water not reduced  
 -  $\text{Mg}^{2+}$  ions reduced ✓ (2)

- completely missed the difference that the water makes

## Question 9

- 9.1 A - 2-fluoropropane ✓  
 B - propan-2-ol ✓  
 D - prop-1-ene ✓ (6)

9.2 an atom or group of atoms that form the centre of chemical in the molecule ✓ (1)

9.3 hydroxyl ✓ (1)

- 9.4 (i) substitution ✓ /hydrolysis  
 (ii) dehydrohalogenation ✓  
 (iii) halogenation ✓ (3) } forgot to be specific

9.5 KF ✓ (1)

9.6 E - KF ✓ can be swapped  
 F - H<sub>2</sub>O ✓ (2)

9.7 Propane has extra hydrogen atoms ∴ greater e<sup>-</sup> density ∴ greater London forces ✓ (2)

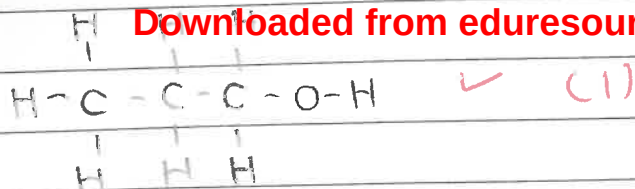
- not about double bond strength

9.8 propa-1,2-diene ✓ (1)

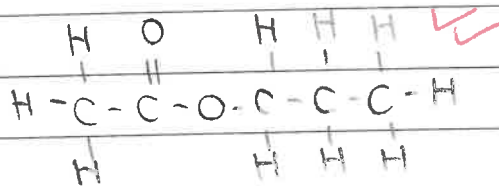
9.9 
$$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & & \\ & | & | & | & & & \\ \text{H} & -\text{C} & -\text{C} & -\text{C} & -\text{H} & & \\ & | & | & | & & & \\ & \text{H} & \text{I} & \text{I} & & & \end{array}$$
 ✓ 1,2-diiodopropane ✓ (2)

9.10 compounds having the same molecular formula but different structural formulae ✓ (1)

9.11



9.12



- read carefully... asked  
only for product not rxn

propyl ethanoate

(3)

9.13 concentrated  $\text{H}_2\text{SO}_4$  ✓ (1)

9.14

- incorrect ✓

- unsaturated because there is a double bond  
between carbon atoms ✓ (2)

9.15

- does not contain hydrogen bonds ✓

don't agree ✓

(2)

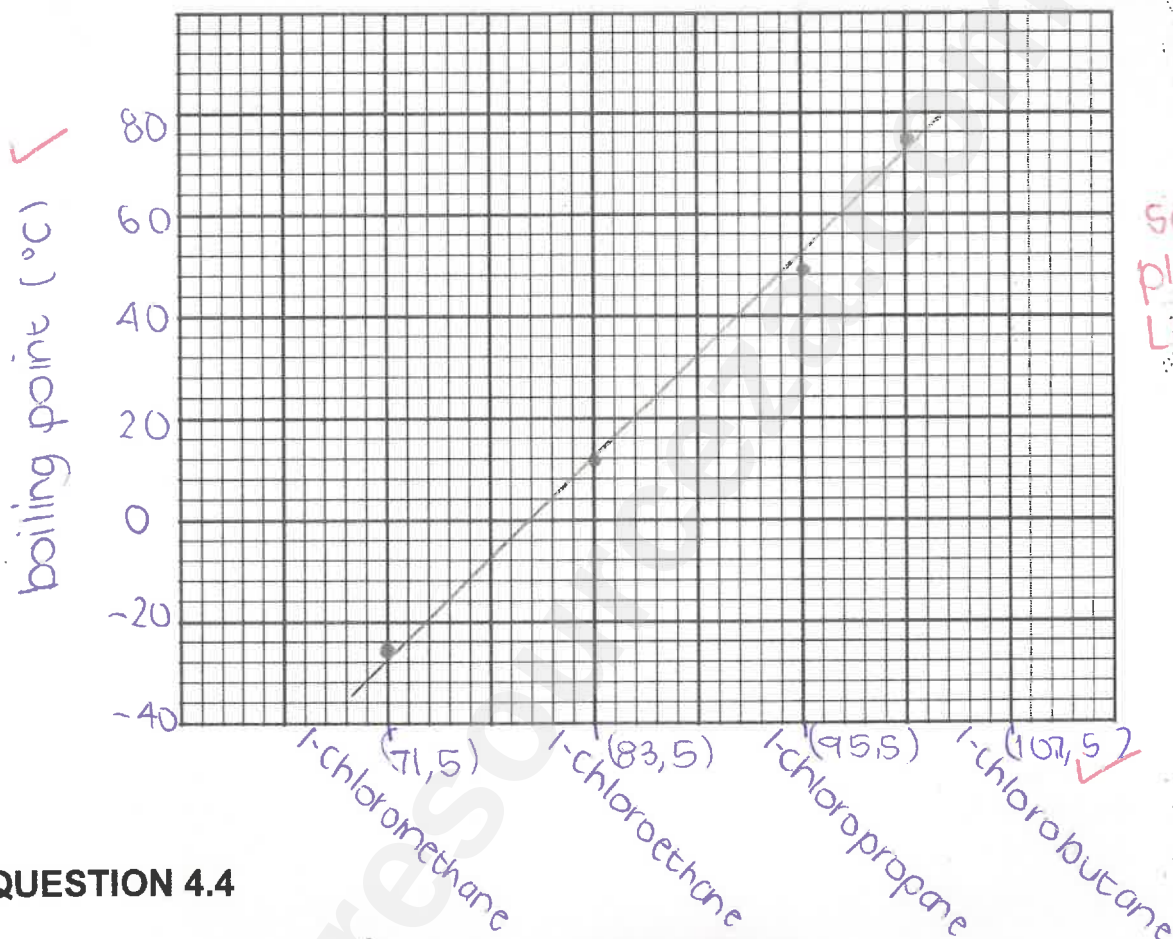
- soluble in water because it is a polar  
molecule

- missed that there were no hydrogen  
bonds present [29]

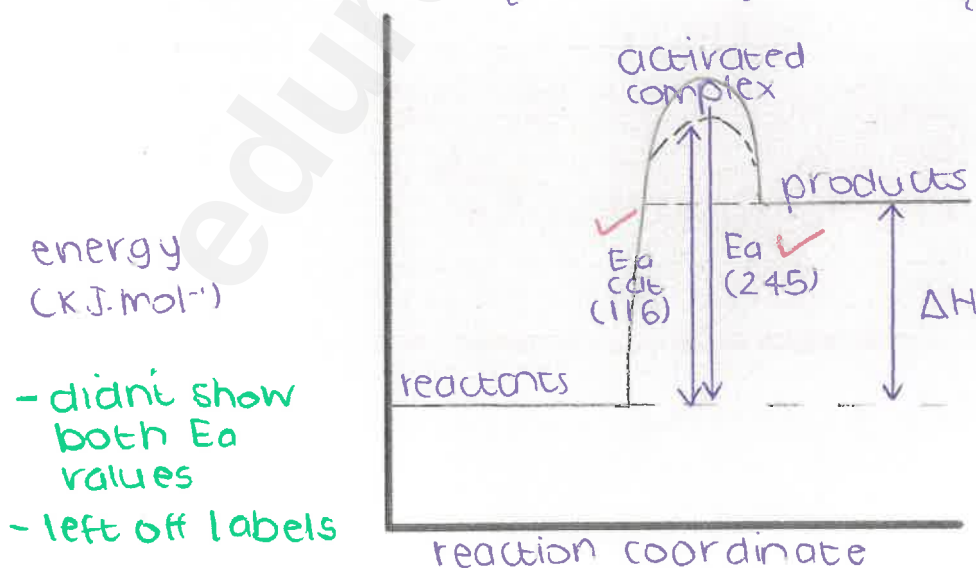
## CHEM PRELIM ANSWER SHEET 2021

NAME: Orch memo

## QUESTION 2.10

boiling point vs molecular mass  
of chloroalkanes ✓

## QUESTION 4.4

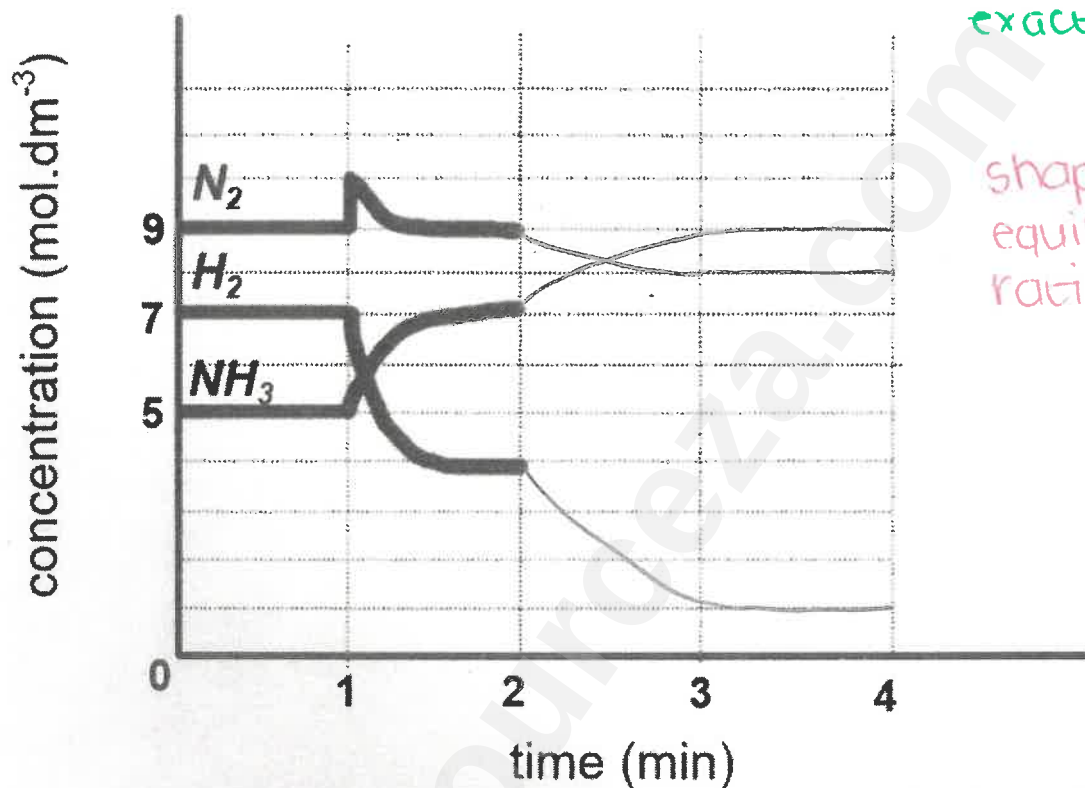


- didn't show both  $E_a$  values
- left off labels

shape ✓  
labels ✓

(5)

## QUESTION 5.5



- didn't show the flat lines  
- mol ratio needed to be exact

shapes ✓  
equilib ✓  
ratio ✓

(4)

- 11 A
- 12 C
- 13 B
- 14 D
- 15 D
- 16 D
- 17 C
- 18 A
- 19 A
- 20 B