Higher Chemistry

Past Paper Answers – Book 2

Specimen Paper

Higher 2015

Specimen

Specimen Higher Chemistry

Multiple Choice

1. C Must have two different atoms for polarity: $\overset{\delta+}{X}-\overset{\delta-}{Y}$

2. C F more electronegative (electron withdrawing) than Cl.

3. A Covalent = "proper" bond.

4. D Y = group 5: N_2, P_4 etc. These are molecules.

5. A Lower E_a = faster reaction, more collisions

6. A Catalyst only changes E_a.

7. D. $0.5\,mol\,l^{-1}$, $0.2\,s^{-1}$

$$rate = \frac{1}{t}$$

$$t = \frac{1}{rate}$$

$$t = \frac{1}{0.2}$$

$$t = 5s$$

8. D — only correct answer.

9. B

Z - X - W - V - Y

A × W-Y not possible
B ✓ all possible
C × X-V not possible
D × Z-W not possible.

10. C

$C_4H_{10}O$

A: C_4H_8O ×
B: C_4H_8O ×
C: $C_4H_{10}O$ ✓
D: $C_4H_8O_2$ ×

11. C — Only one with possible H-bond

12. A — smaller: more volatile.
longer CH chain: less soluble in H_2O.

13. C — Hydro lysis
Hydro → water,
lysis → split

14. D — $12H^+ + 2IO_3^-(aq) \longrightarrow I_2(aq) + 6H_2O + e^-$

15. D — The mixture is already at equilibrium

16.

16. B

$5N_2O_4 (l) + 4CH_3NHNH_2 (l) \rightarrow 4CO_2 (g) + 12H_2O (l) + 9N_2 (g)$

given: 2 → 2

required: 2.5 → 1.6

L. E

So 2 moles reacts with 1.6 moles.

$5 \longrightarrow 2$

$-5116 \longrightarrow ?$

$? = \frac{-5116 \times 2}{5}$

$= -2046 \text{ kJ}$

17. B

$2Al(s) + 1\frac{1}{2}O_2 (g) \rightarrow Al_2O_3 (s)$.

$E_c = \frac{E}{n}$

$= \frac{-1670}{2}$

-ve as energy released.

$= -835 \text{ kJ mol}^{-1}$

18. A

Least electronegative.

19. B

A Not accurate

B

C Only measures 50 cm³.

D Not accurate.

20. D

A Gas lost

B Gas lost

C Gas dissolved.

D

Written

1a i. $Na_{(g)} \rightarrow Na^+_{(g)} + e^-$ • one electron
• gas state.

ii. Sodium Na electron arrangement. 2, 8, 1
Sodium ion Na^+ " " 2, 8

⇒ 2nd electron comes from a shell that is less shielded by inner electrons. 2nd electron shell is also full (8 electrons).
⇒ more energy required.

b. 100g → 0.7g.
10g → 0.07g.

$n = \frac{m}{GFM}$
$= \frac{0.07}{23}$
$= 3.04 \times 10^{-3}$

$m = n \times GFM$
$= 3.04 \times 10^{-3} \times 58.5$
$= 0.18g$

2a. • Energy > activation energy
• Correct geometry.

bi. $2HCl(aq) \rightarrow H_2(g) + Cl_2(g)$.

n			
V	$10cm^3$	$5cm^3$	$5cm^3$
MV	24L	24L	24L.

$n = \frac{V}{MV}$.

$= \frac{0.010}{24}$

$= 4.2 \times 10^{-4}$ mol //

ii. Initiation (radicals created from stable species)

Propagation

$2Cl^\bullet \rightarrow Cl_2$ Termination

or

$2H^\bullet \rightarrow H_2$

or

$H^\bullet + Cl^\bullet \rightarrow HCl$.

iii $\Delta H = \Sigma$ bonds broken $- \Sigma$ bonds formed

$= \Delta H(H-H) + \Delta H(Cl-Cl) - 2\Delta H(H-Cl)$

$= 436 + 243 - 2(432)$

$= -185$ kJ

- New/old data book values may be different.

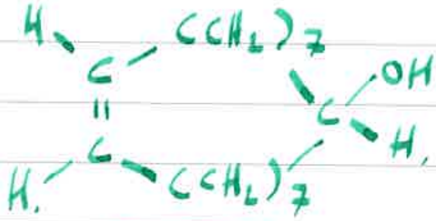
3 a i. Acid part: 3 carbons ⇒ "propanoate."
Alcohol part: 4 carbons ⇒ "butyl"

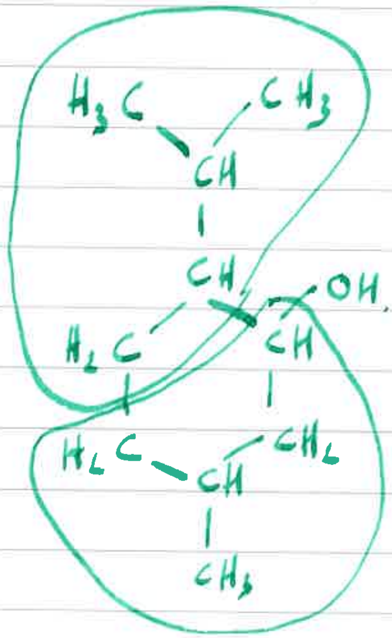
butyl propanoate.

ii. From the table

- Branching on alcohol side ⇒ lowers
- " " acid " ⇒ "
- Increasing/decreasing chain length ⇒ little effect

B > A > C.

b. 

c. 

- Look for a "Y".
- Count 5 × C.

4. Open question. Could mention...

- Oxidation
  - alcohols → aldehydes → carboxylic acids
    → ketones
  - 1°, 2°, 3° alcohols.
- Radicals + mechanisms
- Esters
  - formation
  - hydrolysis.

c. $C_4H_{10}O(l) \longrightarrow C_4H_8(g) + H_2O(g)$.

eq 1 × -1 (reverse to get $C_4H_{10}O$ on LHS)
eq 2 leave.
eq 3 leave.

$\Delta H = 335 - 17 - 242$

$= 76 \text{ kJ mol}^{-1}$

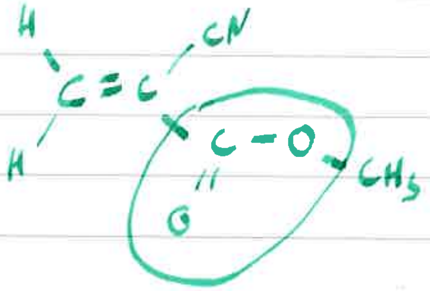
4 C(s)
$5H_2(g)$
$\frac{1}{2} O_2(g)$
) cancel!

d. • Allow liquids to run through a burette.
• Time taken to run through (same volume, same burette each time).

or.

• "Bubble tubes".
• Time taken for a bubble to travel the same distance through the liquid.

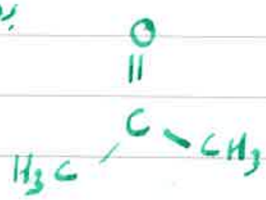
6 a,



bi, "...monomers that rapidly polymerise in the presence of water..."

- moisture is present on the skin.

ii, polar-polar attractions



c i, Methanal

- one carbon
- aldehyde.

ii, Condensation. (2x larg molecules combine, Small molecule produced.)

iii, $\% AE = \frac{\text{products}}{\text{reactants}} \times 100$

$= \frac{125}{113 + 30} \times 100$

$= 87\%$

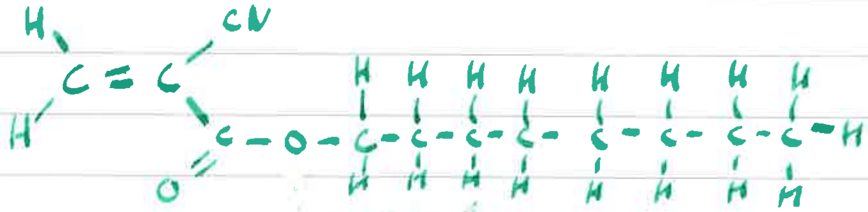
d.

- Multiple bonds + 300 or so.
- Branching lowers ([illegible]).

$$930 \xrightarrow{-510} 420$$

$$1240 \xrightarrow{-510} 730$$

e i. "octyl" = 8 carbons.



ii. The reaction is not exothermic.

7 a i. A solution of accurately known concentration.

ii.
- Sample weighed
- Dissolved in minimum vol. water in beaker
- Transferred to standard flask.
- Beaker washed + washings transferred.
- Made up to mark.

iii. Tap water contains other ions which may react, and alter the concentration.

iv. $2 mg L^{-1}$ ("best fit" line).

b i. $2MnO_4^- + 5NO_2^- + 6H^+ \rightarrow 2Mn^{2+} + 5NO_3^- + 3H_2O$.

$\div 2$ $\times 5$

	MnO_4^-	NO_2^-
n	3.24×10^{-4}	8.1×10^{-4}
C	0.015	
V	0.0216	0.025

$n = CV$
$= 0.015 \times 0.0216$
$= 3.24 \times 10^{-4}$

$C = \frac{n}{V}$
$= \frac{8.1 \times 10^{-4}}{0.025}$
$= 0.0324 \text{ mol L}^{-1}$

ii. $H_2O + NO_2^-(aq) \rightarrow NO_3^-(aq) + 2H^+ + 2e^-$

8a. Carboxyl.

bi. • It contains few sites for hydrogen bonding.
• It contains a long carbon chain.

ii. $CH_2 - O - \overset{O}{\overset{\|}{C}} - (CH_2)_6 - CH = CH - (CH_2)_7 - CH_3$

|

iii. 2g → 100 cm³

×

0.050g → ? cm³

? × 2 = 100 × 0.05

$? = \frac{100 \times 0.05}{2}$

? = 2.5 cm³ //

ci. Amide link.

ii. $0.04\,gl^{-1} \rightarrow 1.6\,A$

×

? → 0.9 A

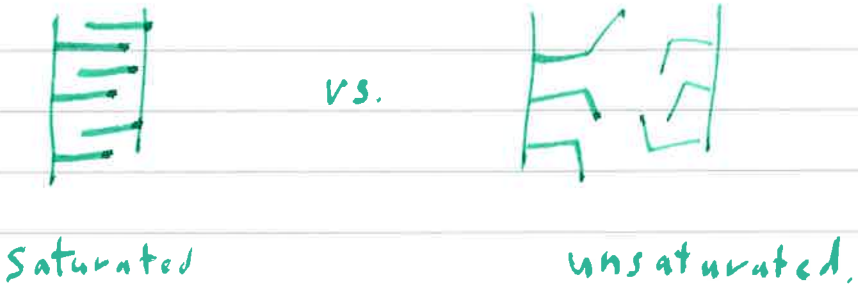
0.9 × 0.04 = 1.6 × ?

$? = \frac{0.9 \times 0.04}{1.6}$

$= 0.0225\,gl^{-1}$ //

9 a i. • It is saturated (little double bonding) so the molecules "pack" well and Van Der Waals attractions (London forces) are important.

i.e.



ii.

$-C_{17}H_{33}$	1x double bond
$-C_{17}H_{35}$	no double bond
$-C_{17}H_{31}$	2x double bond
$-C_{17}H_{29}$	3x double bonds.

Olive oil 3x double bonds.
Shea butter. 2x double bonds.
linseed oil 6x double bonds.
Sunflower oil 5x double bonds.

reduction of double bonds by 1: 84 → 43.

So sunflower oil: 172 − 41 = 131

iii. Oxygen.

b i. Glycerol.

ii. Water bath or heating mantle.

iii. Triolean $\longrightarrow$ Sodium oleate

n	5.7×10^{-3}	5.7×10^{-3}
m	5	
GFM	884	304.

$n = \frac{m}{GFM}$ $\qquad$ $m = n \times GFM$

$= \frac{5}{884}$ $\qquad$ $= 5.7\times10^{-3} \times 304$

$= 5.7\times10^{-3}$ $\qquad$ $= 1.72g.$

$\% = \frac{Actual}{Theoretical} \times 100 = \frac{1.28}{1.72} \times 100$

$= 71.9\%.$

10ai $2NH_3 + CO_2 \rightleftharpoons H_2NCOONH_3$.

m

n $8{\cdot}8 \times 10^6 \times 2$ $8{\cdot}8 \times 10^6$

GFM 17.

$H_2NCOONH_4 \rightleftharpoons (NH_2)_2CO + H_2O$.

m 530×10^6

n $8{\cdot}8 \times 10^6$ $8{\cdot}8 \times 10^6$

GFM 60.

$m = n \times GFM$ $n = \frac{m}{GFM}$

$= 17 \times 8{\cdot}8 \times 10^6 \times 2$ $= \frac{530 \times 10^6}{60}$

$= 150 \times 10^6 \times 2$.

300 tonnes.

ii.
- Excess of ammonia => equilibrium tries to rectify
- Equilibrium pushed to the left.

iii. LHS 0 moles of gas
RHS 3 moles of gas.

=> low pressure favoures LHS.

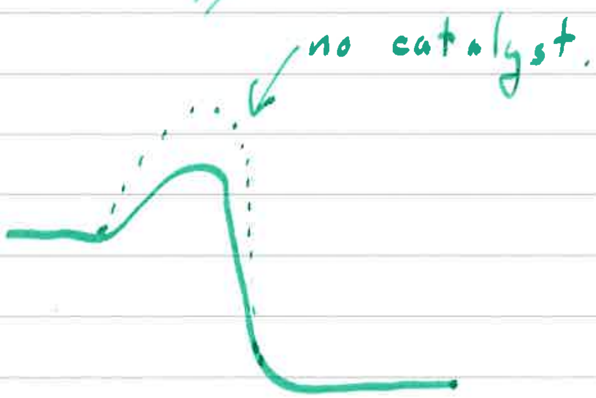
iv. Recycle loop from ammonia + CO_2 to feed back in at the top.

b i. $\Delta H = E_{prod} - E_{react}$

$= 32 - 120$

$= -88 \text{ kJ mol}^{-1}$

ii.



11. Open question. Could mention:

- Oxidation
- Radical Mechanisms,
- Alcohols, esters, carbonyls etc.
- Oils / hydrolysis.

12a. Amino acids that can't be made by the human body.

b. 100g → 755 mg. 15 mg → 1 kg.

? → 900mg 900mg → 60 kg.

$? \times 755 = 900 \times 100$.

$? = \frac{900 \times 100}{755}$

$= 119g$

c i. $R_f = \frac{\text{spot distance}}{\text{solvent distance}}$

$R_{f\,spot\,1} = 0.65$ → tyrosine.

ii. • In chromatogram 1, alanine and threonine have the same R_f value so the spots are on top of each other.
• They are spread in chromatogram 2 where the R_f values are different.

2015

2015 Higher Chemistry Marking Instructions (NH)

Multiple choice

1) D

A.) Neon does not form negative ions - it is a noble gas
B) Neon is not diatomic it is monotomic
c) Neon makes no bonds - it is monotomic
D) All have low boiling points ⇒ all gases.

2.) C

First ionisiation energy is the energy to remove 1 mole of electron in the gaseous state. P11 of the data booklet provides an equation

3.) D

A) Carbon - 2·5
B) Nitrogen - 3·0
C) Phosphorus - 2·2
D) Silicon - 1·9

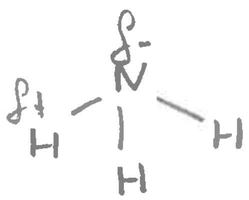
Least attraction for bonding electrons relates to electronegativity - p11 of data book.

4.) A

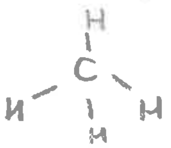
A.) Covalent bond is a intermolecular bond
B) Hydrogen bond is intramolecular
c) LDF is intramolecular
D) PDP - PDP is intramolecular

] Van der Waals'

5) C.



due to the nitrogen bonding to the hydrogen this will have hydrogen bonding. Since the nitrogen is more electronegative than the hydrogen it will also have PDP–PDP and LDF

A) Br-Br only has LDF as non-polar
B) O=C=O only has LDF as non-polar
D)  only has LDF as non-polar

6.) B [Basic knowledge question]

7) A [The alkali (NaOH) will react with the carboxylic acid to form the salt of the carboxylic acid - sodium ethanoate]

8) B [Increased iodine number, the greater the number of double bonds as the iodine reacts with C=C. Linseed will be more unsaturated and will not have efficient packing of chains due to distorted structure ⇒ weaker Van der Waals' attractions ⇒ lower melting point.]

9) B When oil is hydrolysed, glycerol and 3 fatty acids are produced. The structure of glycerol:

H_2C-OH
$HC-OH$
H_2C-OH

10) A

11) D [A. They are formed from the oxidation of <u>secondary</u> alcohols.
B. They contain the $R_2-C(=O)-R_1$ group
C. They contain a <u>carbonyl</u> group]

12) D Will decolourise bromine solution due to C=C double bond (it is unsaturated)

Will not react with acidified potassium dichromate solution as this only reacts with aldehydes ($H-C(=O)-R$) this structure is a ketone ($R-C(=O)-R_1$)

2015

13.) B

[Basic knowledge]

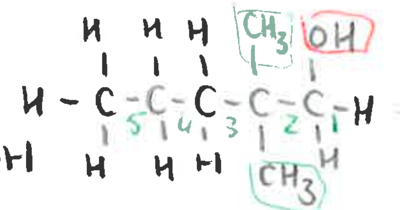
14.) C

Producing an ester. From the structure of erythromycin give it is an alcohol (-OH). Carboxylic acids $-\overset{O}{\overset{\|}{C}}-OH$ react with alcohols (-OH) to form esters
$(-\overset{O}{\overset{\|}{C}}-O-)$

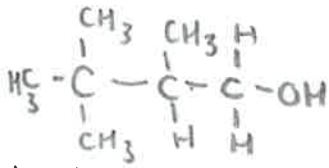
15.) B

2,2-dimethylpentan-1-ol = $C_7H_{15}OH$

↓ 5 carbons

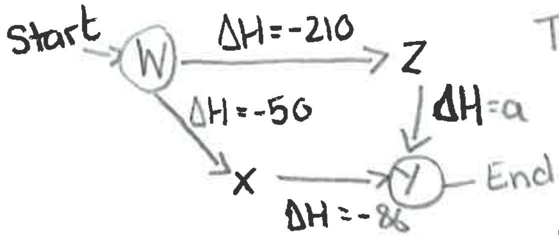


$(CH_3)_3CCH(CH_3)CH_2OH$ = $C_7H_{15}OH$



Isomers: Same molecular formula, different structural formula

16.) A



The enthalpy change should be the same regardless of the route taken ⇒

$-50+(-86) = -210+a$
$-136 = -210+a$
$a = -136+210$
$= +74$

17.) D.

TE: $I_2(s) + 2e^- \rightarrow 2I^-(g)$

$I_2(s) \rightarrow I_2(g)$ $\Delta H = +60\ kJ\ mol^{-1}$
$I_2(g) \rightarrow 2I(g)$ $\Delta H = +243\ kJ\ mol^{-1}$
x2 [$I(g) + e^- \rightarrow I^-(g)$ $\Delta H = -349\ kJ\ mol^{-1}$

$I_2(s) \rightarrow$ ~~$I_2(g)$~~ $\Delta H = +60\ kJ\ mol^{-1}$
~~$I_2(g)$~~ $\rightarrow$ ~~$2I(g)$~~ $\Delta H = +243\ kJ\ mol^{-1}$
~~$2I(g)$~~ $+ 2e^- \rightarrow 2I^-(g)$ $\Delta H = -698\ kJ\ mol^{-1}$

$I_2(s) + 2e^- \rightarrow 2I^-(g)$

18) A

At equilibrium the rate of the forward and reverse reaction are equal the concentration of reactants and products are not.

19) A

Activation energy = Activated complex − reactants
= X − Y

20) C

A.* OH^- is above both I_2 and Br_2 in the electrochemical series. Br_2 and I_2 will be oxidising agent and OH^- will be a reducing agent.

B.* SO_3^{2-} is above both I_2 and Br_2 in the electrochemical series. Br_2 and I_2 will be oxidising agents and SO_3^{2-} will be a reducing agent.

C.* Fe^{2+} is above Br_2 in the electrochemical series. Br_2 will be the oxidising agent and Fe^{2+} will be the reducing agent. Since I_2 is above Fe^{2+} it will not react.

D. Mn^{2+} is below both Br_2 and I_2 and therefore will react with neither.

p12 of the data book

	$Sn^{2+}(aq) + 2e^-$	⇌	$Sn(s)$	−0·14
	$Pb^{2+}(aq) + 2e^-$	⇌	$Pb(s)$	−0·13
	$Fe^{3+}(aq) + 3e^-$	⇌	$Fe(s)$	−0·04
	$2H^+(aq) + 2e^-$	⇌	$H_2(g)$	0·00
	$Sn^{4+}(aq) + 2e^-$	⇌	$Sn^{2+}(aq)$	0·15
	$Cu^{2+}(aq) + e^-$	⇌	$Cu^+(aq)$	0·15
	$SO_4^{2-}(aq) + 2H^+(aq) + 2e^-$	⇌	$SO_3^{2-}(aq) + H_2O(l)$ *	0·17
	$Cu^{2+}(aq) + 2e^-$	⇌	$Cu(s)$	0·34
	$O_2(g) + 2H_2O(l) + 4e^-$	⇌	$4OH^-(aq)$ *	0·40
*	$I_2(s) + 2e^-$	⇌	$2I^-(aq)$	0·54
	$Fe^{3+}(aq) + e^-$	⇌	$Fe^{2+}(aq)$ *	0·77
	$Ag^+(aq) + e^-$	⇌	$Ag(s)$	0·80
	$Hg^{2+}(aq) + 2e^-$	⇌	$Hg(l)$	0·85
*	$Br_2(l) + 2e^-$	⇌	$2Br^-(aq)$	1·07
	$O_2(g) + 4H^+(aq) + 4e^-$	⇌	$2H_2O(l)$	1·23
	$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^-$	⇌	$2Cr^{3+}(aq) + 7H_2O(l)$	1·36
	$Cl_2(g) + 2e^-$	⇌	$2Cl^-(aq)$	1·36
	$MnO_4^-(aq) + 8H^+(aq) + 5e^-$	⇌	$Mn^{2+}(aq) + 4H_2O(l)$ *	1·51
	$F_2(g) + 2e^-$	⇌	$2F^-(aq)$	2·87

Top right – reducing agents oxidation reaction

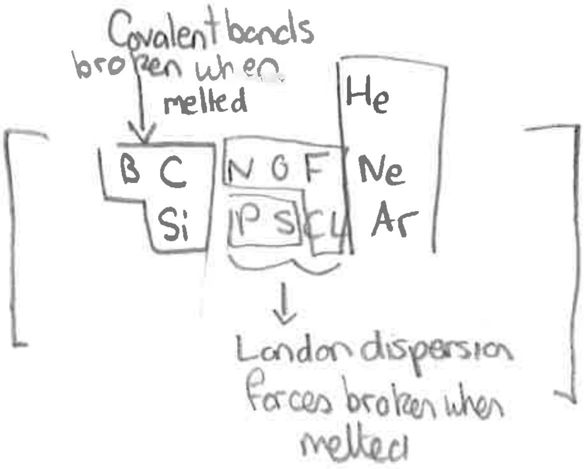
Bottom left – oxidising agents – reduction reaction

2015

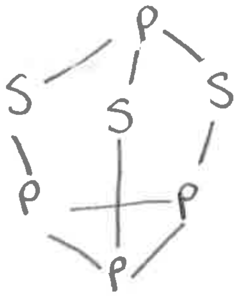
Written Paper

U1 1a) Sulfur : London dispersion forces

Silicon dioxide: Covalent bond



U1 b) i)



[Phosphorus in group 5 => makes 3 bonds
Sulfur in group 6 => makes 2 bonds
Any structure that obeys these rules]

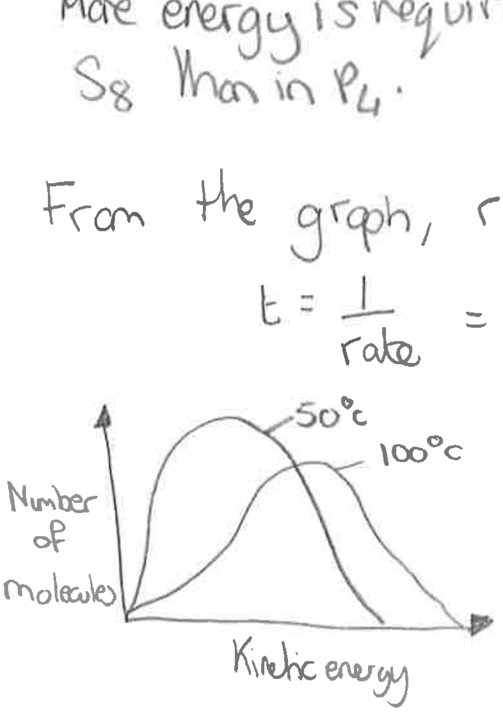
U1 ii) As you go along a period in the periodic table the covalent radius decreases due to increased nuclear charge [this attracts electrons]

U1 iii) Sulfur exists as S_8 whereas phosphorus exists as P_4. The London dispersion forces in sulfur is therefore stronger than the london dispersion forces in phosphorus. More energy is required to break stronger forces in S_8 than in P_4.

U1 2a) From the graph, rate = 0.022

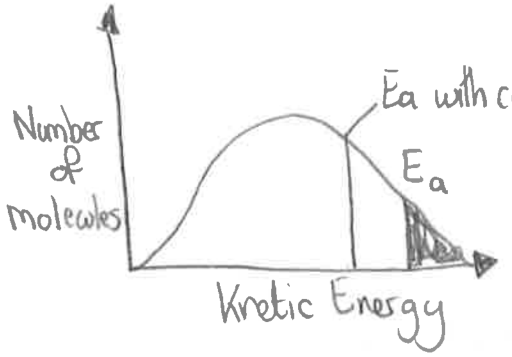
$$t = \frac{1}{rate} = \underline{45s}$$

U1 b)i)



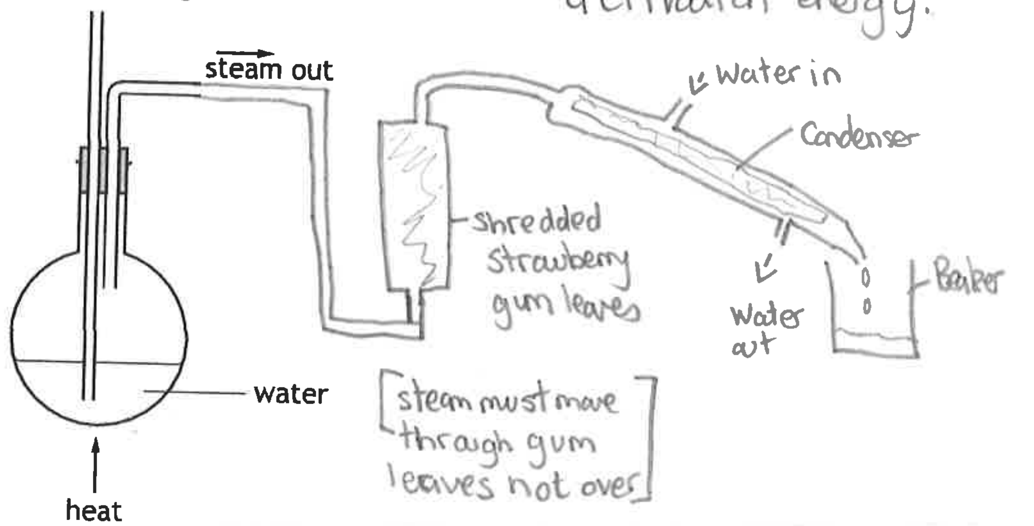
At a lower temperature the line will be shifted to the left as there will be less molecules with kinetic energy greater than or equal to the activation energy.

U1 ii)



The activation energy will be lowered with a catalyst which means that there are more molecules with energy equal to or greater than the activation energy.

U2 3a.) i)



U2 ii) Chromatography or (Fractional) distillation

U3 b.) i) cinnamic acid + methanol → methyl cinnamate + water

cinnamic acid: gfm = 148g, m = 6.5g

$n = \frac{m}{gfm} = \frac{6.5}{148}$ = 0.0439 moles

methanol: gfm = 32g, m = 2g

$n = \frac{m}{gfm} = \frac{2}{32}$ = 0.0625 moles

Mole ratio: cinnamic acid : methanol

1 mol : 1 mol

0.0439 mol needs 0.0439 mol

actual 0.0625 mol

Methanol is therefore in excess and cinnamic acid is limiting.

V3 ii) A) cinnamic acid + methanol → methyl cinnamate + water

[Actual mass of methyl cinnamate is 3.7g. Need to work out theoretical]

cinnamic acid:
m = 6.5g
gfm = 148g
$n = \frac{6.5}{148}$
= 0.0439

methyl cinnamate:
gfm = 162g
n = 0.0439
m = n × gfm
= 0.0439 × 162
= 7.1118g

mole ratio: cinnamic acid → methyl cinnamate
1mol → 1mol
0.0439mol → 0.0439mol

$\% \text{ Yield} = \frac{\text{Actual}}{\text{Theoretical}} \times 100$
$= \frac{3.7}{7.11} \times 100$
= 52%

[Actual mass of methyl cinnamate is always given in question. Theoretical mass of methyl cinnamate is what you need to work out.]

V3-numeracy B.)

cinnamic acid → methyl cinnamate
6.5g → 3.7g
x → 100g

$x = \frac{100 \times 6.5g}{3.7}$
= 175.68g of cinnamic acid is needed to produce 100g of methyl cinnamate.

Cinnamic acid: mass → cost
250g → £35
175.68g → x

$x = \frac{35 \times 175.68}{250}$
= £24.59

U3 4.) a.) citronellol or geraniol or anisyl alcohol

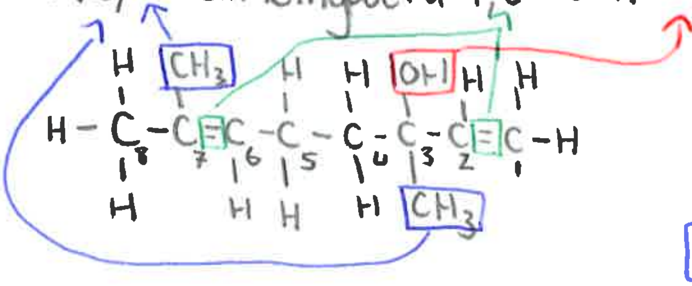
U3 b.) The concentration/volume of the compounds are lower in the counterfeit.

U3 c.) i.) Helium is an unreactive/inert gas.

U3 ii) size (mass) of molecules / temperature of column.

U2 d.) i.) Terpenes

PS ii) A) 3,7-dimethylocta-1,6-dien-3-ol



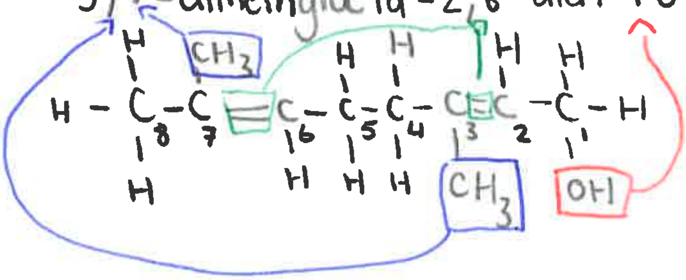
[alcohol group on carbon no. 3]

[C=C double bonds on carbon no. 1 and 6]

[methyl group on carbon no. 3 and 7]

[Example given that you can use to get this name:

3,7-dimethylocta-2,6-dien-1-ol



[alcohol group on carbon no. 1]

[C=C double bonds on carbon 2 and 6]

[methyl group on carbon no. 3 and 7]]

U2 B.) Hydroxyl [-OH] group is attached to a carbon which is attached to 3 other C atoms.

U3 - numeracy 4 e.)

intake of coumarin (mg) → body weight (kg)

0.1mg → 1kg

x → 75kg

$x = \frac{0.1 \times 75}{1} = 7.5$mg of coumarin for a 75kg adult

[1kg cinnamon = 1000g]

[7.5mg = 0.0075g]

mass of cinnamon powder (g) → mass of coumarin (g)

1000g → 4.4g

x → 0.0075g

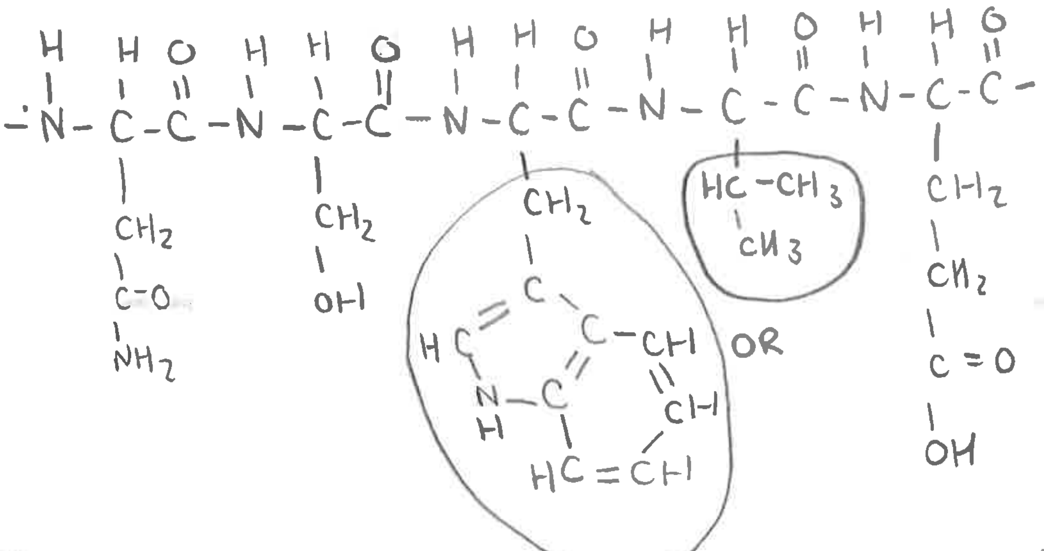
$x = \frac{0.0075 \times 1000}{4.4}$

$= 1.7$g

5) Open ended question

U2 6a.) Heat will break the hydrogen bonds.

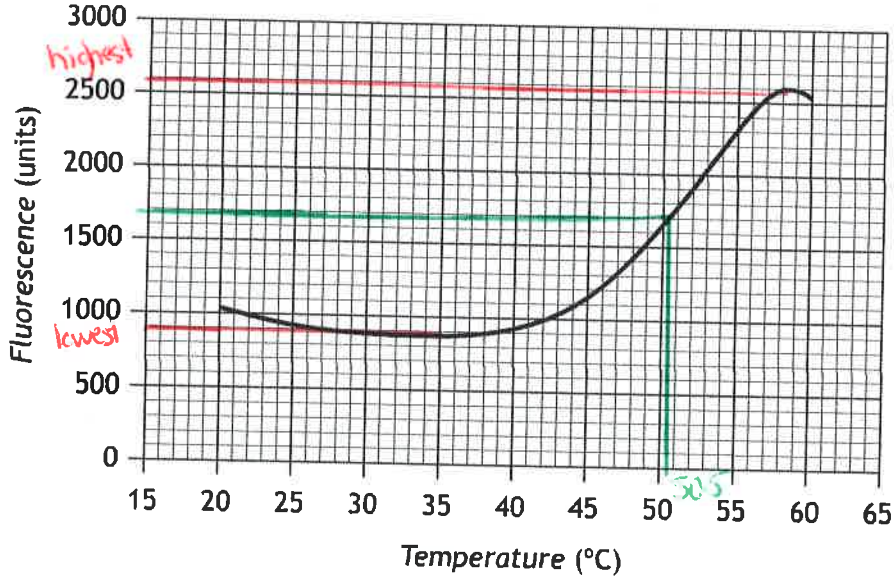
U2 + U1 b.) Hydrophobic = water hater, therefore hydrophobic parts will be nonpolar. [Remember water is polar and "like dissolves like", hydrophillic = water loving and will be polar]



[Non polar compounds consist of carbons and hydrogens
Polar compounds contain electronegative elements]

U2 6b)ii) Highest Fluorescence - lowest Fluorescence value

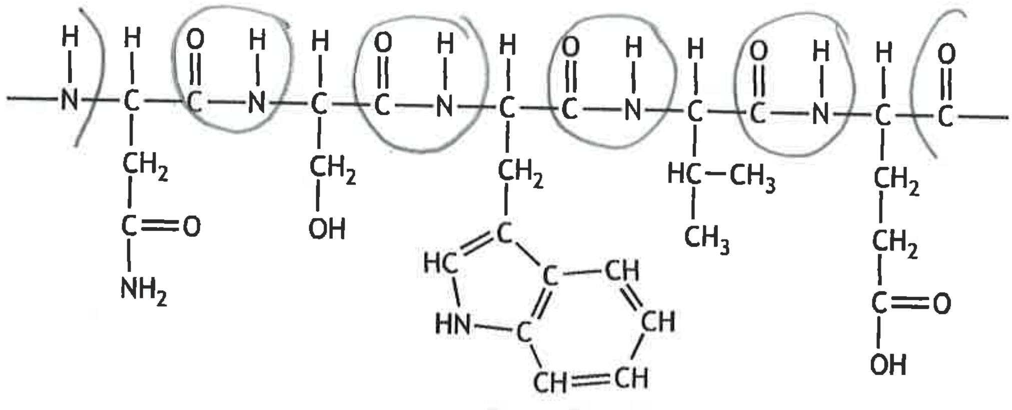
2600 - 900 = 1700



50.5°C ± 1°C

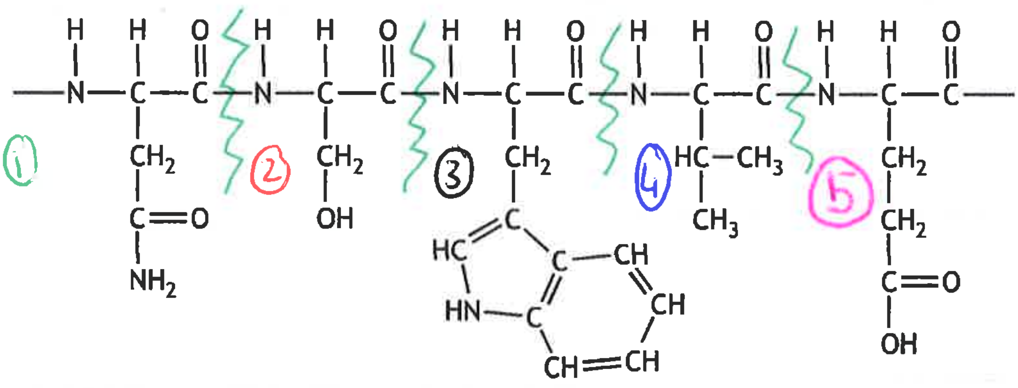
U2 c)i) Hydrolysis

U2 ii) 5

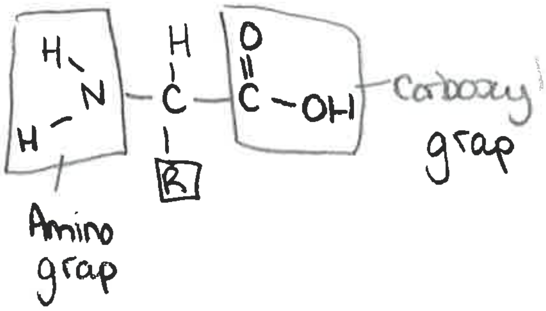


[Carboxyl group of 1 amino acid (C=O, -C-OH) joins with the amino group of another amino acid (H-N-H) to form peptide bonds]

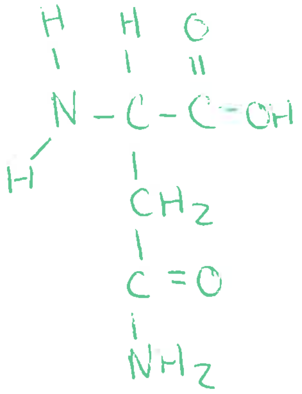
U2 (B)



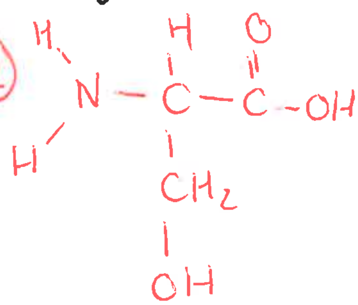
Remember amino acid structure!



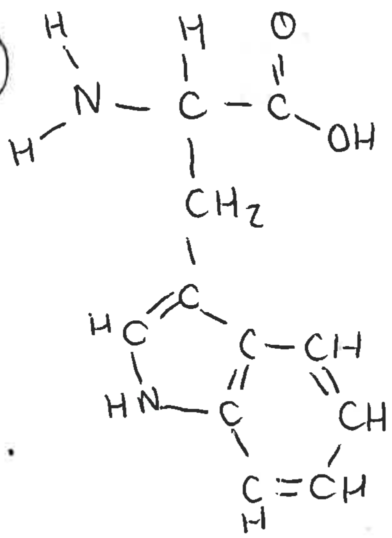
(1)



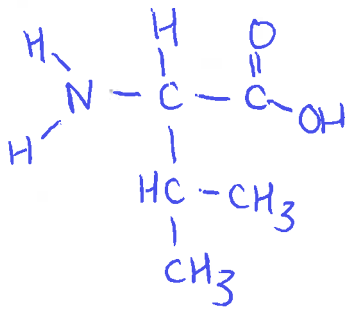
(2)



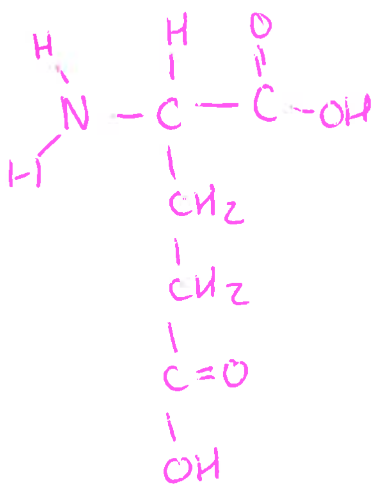
(3)



(4)



(5)



U3

7a.) $2CH_3OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 4H_2O(l)$

gfm = 32g	Volume: ?

m = 118g

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

$= \frac{118}{32}$

= 3.687 moles

mole ratio: $CH_3OH \rightarrow CO_2$

2 mol → 2 mol

3.687 mol → 3.687 mol

CO_2	moles → volume

1 mol → 24L

3.687 mol → x

$x = \frac{24 \times 3.687}{1}$

= 88.5L

U3

b.) i) A) Thermometer touching the bottom or thermometer is directly above flame or temperature would be greater than expected.

B) Distance between flame and beaker

or

Height of wick in burner

or

Same type of beaker

or

Same draught proofing

U3 c.) $E_h = cm\Delta T$
$= 4.18 \times 0.1 \times 23$
$= 9.614 kJ$

$c = 4.18$
$m = 100cm^3 = 0.1kg$ [mass of water]
$\Delta T = 23°C$

Enthalpy of combustion = energy required to burn 1mole of methanol

1mole of methanol = gfm = CH_3OH = 32g

[You are trying to calculate how much energy is released when 32g of methanol is burned]

mass	Energy
1.07g →	9.614 kJ
32g →	x

$$x = \frac{9.614 \times 32}{1.07}$$

$= 288 kJ mol^{-1}$

$= -288 kJ mol^{-1}$ [burning is exothermic]

PS ii) $\text{Density} = \frac{\text{mass (g)}}{\text{volume } (cm^3)}$

$= \frac{19.98}{25}$

$= 0.8$ or $0.799 gcm^{-3}$

[Ethanol density given: $0.802 gcm^{-3}$
$\frac{20.05}{25} = 0.802 gcm^{-3}$]

U3 7 (c) If reactions are exothermic heat will need to be removed

or

If reactions are endothermic heat will need to be supplied

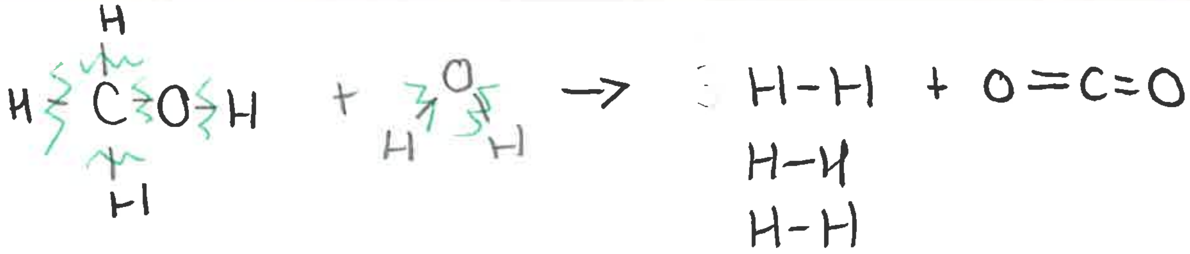
or

Chemists can create conditions to maximise yield

[Statement about safety not accepted]

U3

ii)



Bond breaking

$3 \times C-H = 3 \times 412 = 1236$
$1 \times C-O = 1 \times 360 = 360$
$3 \times O-H = 3 \times 463 = 1389$

$+2985$

Bond breaking is endothermic

Bond making

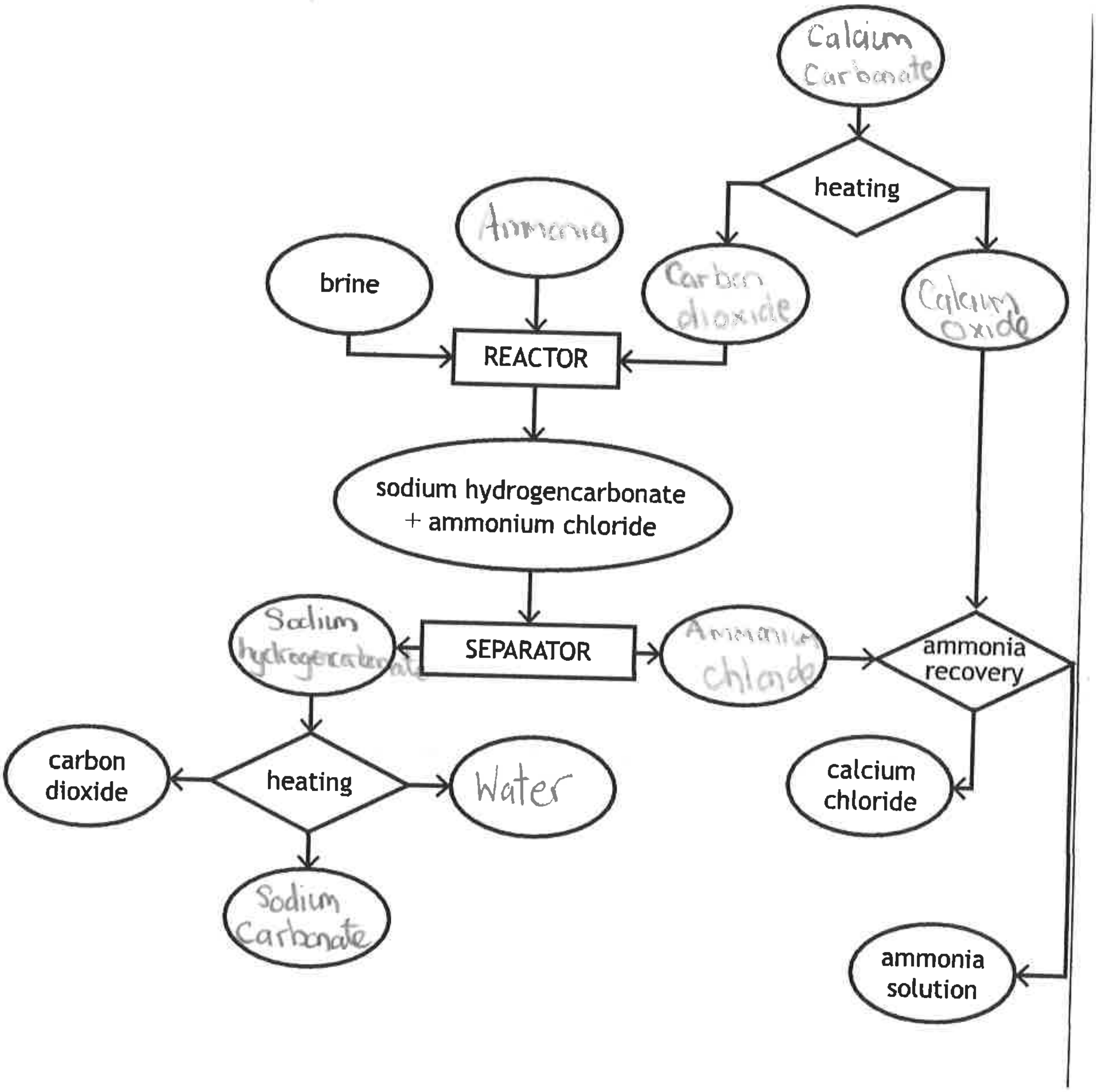
$3 \times H-H = 3 \times 436 = 1308$
$2 \times C=O = 2 \times 743 = 1486$

-2794

Bond making is exothermic

Bond enthalpy = Σ bond breaking + Σ bond making
= 2985 − 2794
= **+191 kJ mol^{-1}**

PS 8 a)



Calcium Carbonate
heating
Ammonia
brine
Carbon dioxide
Calcium Oxide
REACTOR
sodium hydrogencarbonate + ammonium chloride
Sodium hydrogencarbonate
SEPARATOR
Ammonium chloride
ammonia recovery
carbon dioxide
heating
Water
calcium chloride
Sodium Carbonate
ammonia solution

U3 8b.) $HCO_3^-(aq) + Na^+(aq) \rightleftharpoons NaHCO_3(s)$

Adding sodium chloride solution ($Na^+ Cl^-$) increases the concentration of $Na^+(aq)$ ions this then shifts the equilibrium to the right. By adding the salt solution the rate of the forward reaction is increased encouraging the production of $NaHCO_3(s)$

9.) Using your knowledge of Chemistry - Open question

V1 10 a) i) 24 hours allows time for all the zinc to react and no stopper allows the hydrogen gas to escape from the flask.

U3 ii) Impurities/metal ions/salts may be present in the tap water.

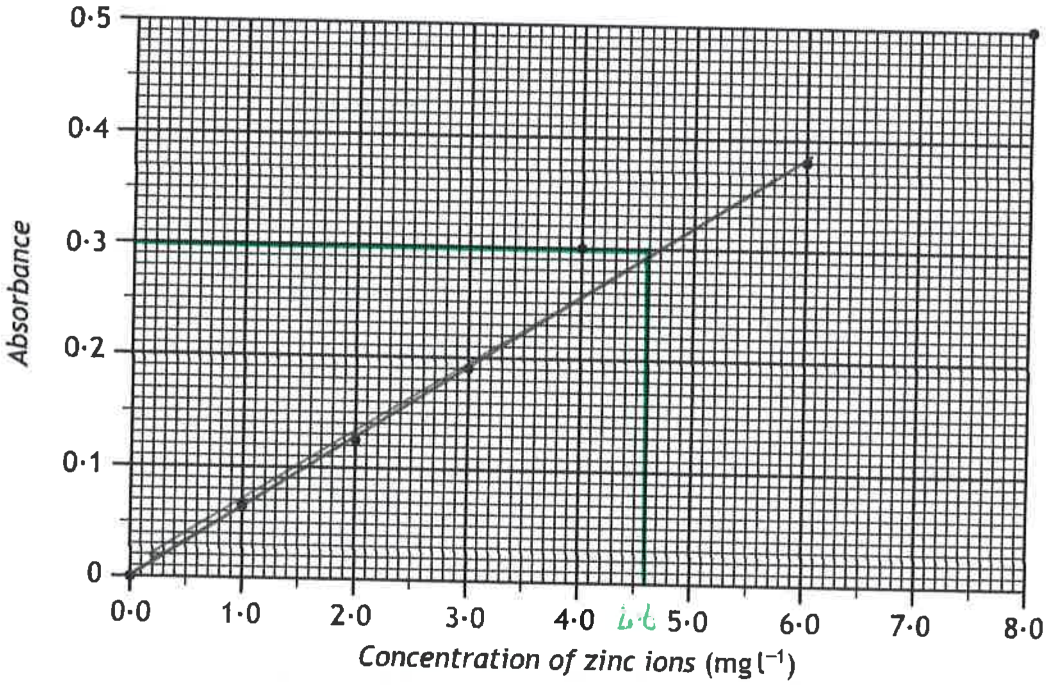
U3 b i) pipette

Numeracy ii) $10cm^3 \longrightarrow 1000cm^3$ ×100 dilution

$1gL^{-1} \longrightarrow 0.01gL^{-1}$ after 100 fold dilution

$0.01gL^{-1} = 10mgL^{-1}$

PS 10c.)

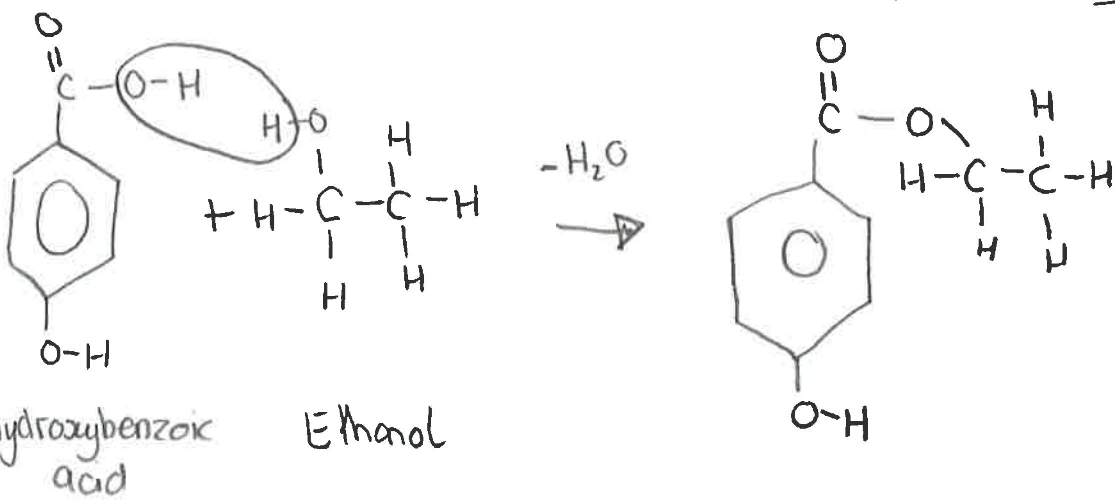


4.6-4.8 $mg\ L^{-1}$ [draw a line of best fit and read value from the graph]

U2 11a.) Carboxyl / Carboxylic acid group

U2 b) Esterification / condensation [alcohol + carboxylic acid → ester]

U2 c.)



PS d) As no. of carbon atoms (molecular size) increases, the absorption decreases.

U3 12 a.) i) - Rinse the burette with the thiosulfate solution/solution to be put in it
- Fill the burette above the scale with the thiosulfate solution
- Filter funnel used should be removed and tap opened to ensure no air bubbles.
- Solution run to a scale. Reading made from the bottom of meniscus.

U3 ii) $2I^-(aq) \longrightarrow I_{2(aq)} + 2e^-$

[Oxidation is loss of electrons. Will be equation on p12 flipped. Electrons on the right hand side for oxidation reactions]

U3 iii) $I_2(aq) + 2Na_2S_2O_3(aq) \longrightarrow 2NaI(aq) + Na_2S_4O_6(aq)$

$C = 0.001 \text{ mol } l^{-1}$
$V = 12.4 cm^3 = 0.0124 L$
$n = C \times V$
$= 0.0000124$ moles

mole ratio: $Na_2S_2O_3 : I_2(aq)$
2mol → 1mole
0.0000124 → x
= 0.0000062 moles

Link to first equation:

$NaOCl(aq) + 2I^-(aq) + 2H^+(aq) \rightarrow I_2(aq) + NaCl(aq) + H_2O(l)$

$V = 100 cm^3 = 0.1 L$
$n = 0.0000062$
$C ? \frac{n}{V}$
$= \frac{0.0000062}{0.1}$
$= 0.000062 \text{ mol} L^{-1}$

mole ratio: $NaOCl(aq) \rightarrow I_2(aq)$
1mol → 1mol
x → 0.0000062 moles
x = 0.0000062 moles

Numeracy b.) hypochlorite solution → volume of water

400 cm^3 → 45 000 L

x → 25 00 000 L

$$x = \frac{2500000 \times 400}{45000}$$

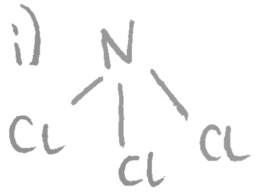
$= 22222\ cm^3$ for 1ppm to 2ppm

×2

$= 44444\ cm^3$ for 1ppm to 3ppm

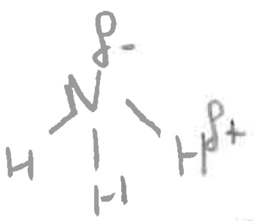
= **44L**

U1 c.) i)



Nitrogen electronegativity = 3.0
Chlorine electronegativity = 3.0 [p11 databook]

As they have the same electronegativities the molecule is non-polar



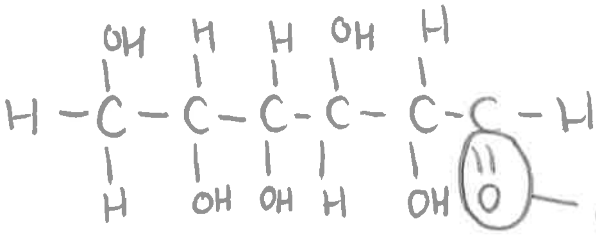
Nitrogen electronegativity = 3.0
Hydrogen electronegativity = 2.2

Nitrogen carries a partial negative charge and Hydrogen carries a partial positive charge. The molecule is polar

U2 ii) Substances that have unpaired electrons

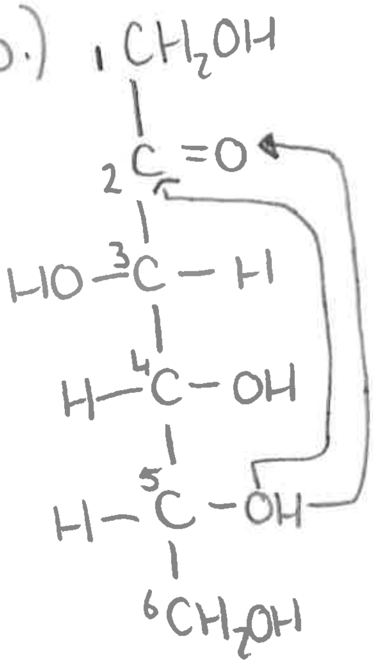
U2 . iii) Propagation

U2 13 a.)

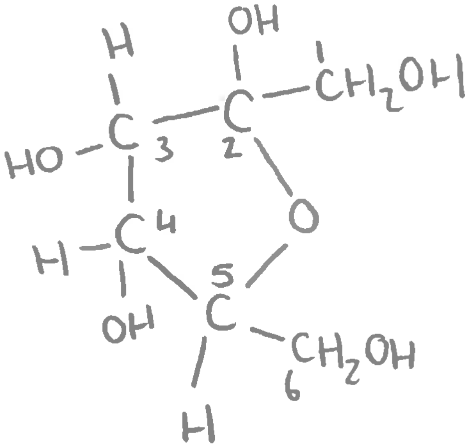


aldehyde group

PS b.)



1 CH2OH
2 C =O
HO-3C-H
H-4C-OH
H-5C-OH
6CH2OH



H
OH
CH2OH
HO-C 3
C 2
O
H-C4
OH
5
C
CH2OH
6
H