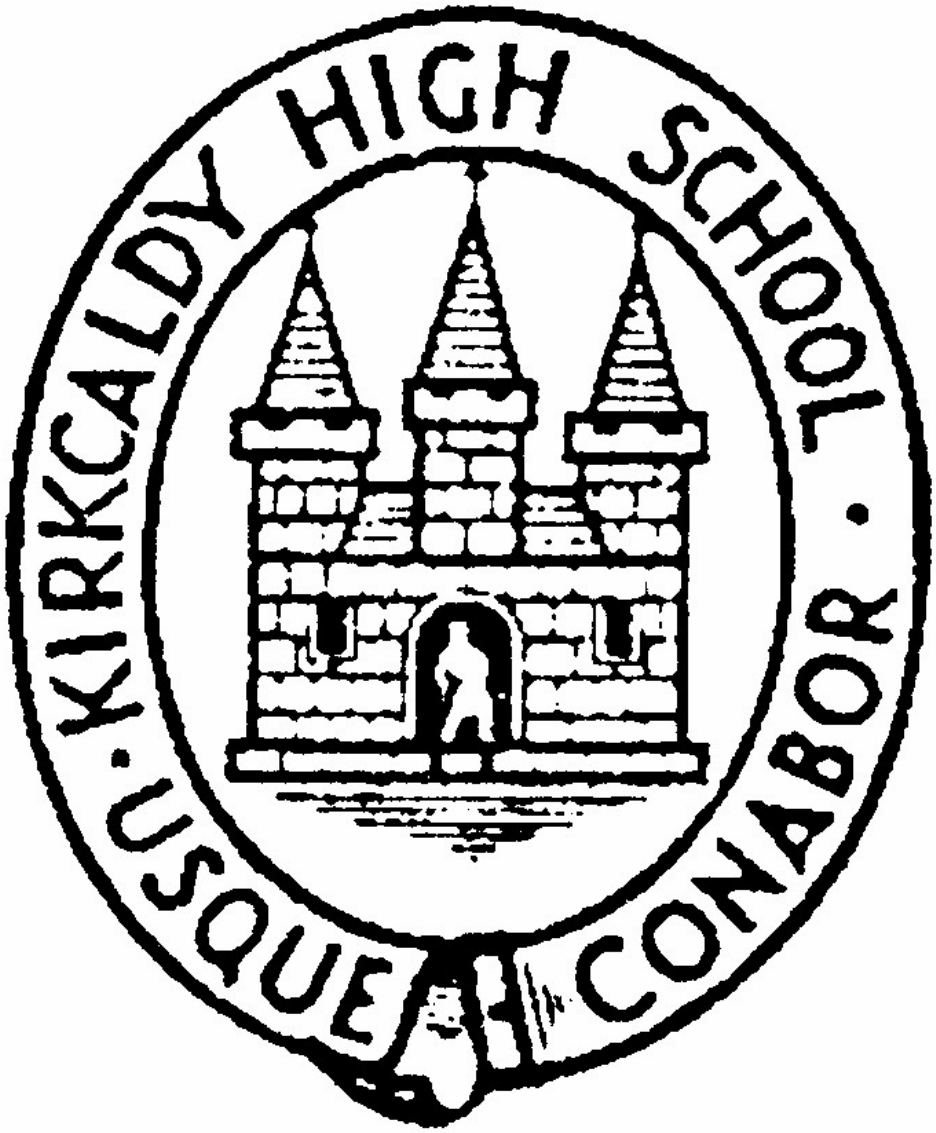
Higher Chemistry

Past Paper Answers – Book 3



Higher 2016

Higher 2017

2016

2016 Higher Marking Instructions

Multiple choice

V1 1.) D

A.) Na_2S - $Na^+ = 2,8$ $S^{2-} = 2,8,8$

B) $MgCl_2$ - $Mg^{2+} = 2,8$ $Cl^{2-} = 2,8,8$

C) KBr - $K^+ = 2,8,8$ $Br^- = 2,8,18,8$

D) $CaCl_2$ - $Ca^{2+} = 2,8,8$ $Cl^{2-} = 2,8,8$

V1 2.) A

[Chlorine is more electronegative than Hydrogen => electrons positioned nearer chlorine. Chlorine will have a partial negative charge, hydrogen will have a partial positive charge]

V1 3.) A

A) 4.0 - 0.8 = 3.2 => most ionic character - electronegativites on p11

B) 2.6 - 0.8 = 1.8

C) 4.0 - 0.9 = 3.1

D) 2.6 - 0.9 = 1.7

V1 4.) B

Enthalpy change = Energy products - energy reactants

= 50 - 100

= $-50 kJ\ mol^{-1}$ (exothermic)

V2 5) B

[Structure of isoprene: $H_2C=C(CH_3)-C(H)=CH_2$]

V2 6) A

A is the most non-polar molecule, as it is non-polar it will not dissolve in polar water ("like dissolves like") and therefore the flavor will be retained in the food.

B-D are polar molecules, these will dissolve in polar water and the water will take the flavor.

27) C [oil → fat = hydrogenation reaction]

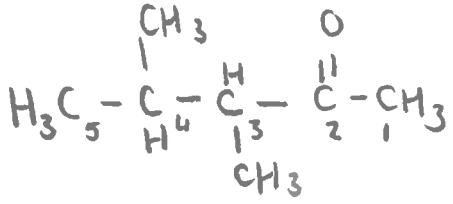
28) D 

Heating an enzyme causes it to denature

29) C Soaps are fatty acid salts formed from the alkaline
10) B hydrolysis of fats and oils

11) B $Ag^+(aq) + e^- \longrightarrow Ag(s)$

Colorless solution → silver mirror.

12) C 

Ketone on carbon number 2.

Methyl graps on carbon 3 + 4.

13) C

U3

$$\underset{gfm=100g}{CaCO_3(s)} + \underset{V=0.2L \quad C=0.1moll^{-1}}{2HNO_3(aq)} \rightarrow \underset{gfm=164g}{Ca(NO_3)_2(aq)} + CO_2(g) + H_2O(l)$$

$m = 2g$

$n = \frac{2}{100} = 0.02$ moles $\quad n = CV = 0.02$ moles

$CaCO_3 \rightarrow HNO_3$

1 mol $\rightarrow$ 2 mol

0.02 moles needs 0.04 moles

actual 0.02 moles $\Rightarrow HNO_3$ is limiting

$\Rightarrow$ not A

Base calculation on limiting $\Rightarrow 2HNO_3$

$HNO_3 \rightarrow Ca(NO_3)_2$

2 $\rightarrow$ 1 moles

0.02 $\longrightarrow$ 0.01 moles

mass of $Ca(NO_3)_2$ = n × gfm

= 0.01 × 164

= 1.64g $\Rightarrow$ answer is C

2016

V3 14) B

$\Delta H = \Sigma \Delta H$ bond breaking + $\Sigma \Delta H$ bond making

* All need to be in gas phase => cannot be D or A

For B:

Bond breaking

$4 \times C\text{-}F = 4 \times 484$

$= 1936$

Bond making

$C(g)$ - no bonds

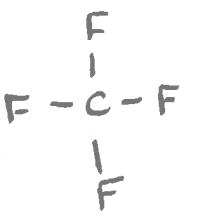
$4F(g)$ - no bons

=> $1936 + 0$

$= +1936\ kJ\ mol^{-1}$ ✓

Cannot be C as:

Bond breaking



$4 \times C\text{-}F = 4 \times 484$

$= 1936$

Bond making

$C(g)$ - no bonds

$2 \times F\text{-}F = 2 \times 159 = -318$

=> $\Delta H = 1936 + (-318)$

$= 1618$ x => answer is B

V3 15) C The concentration of reactants and products are constant but not equal.

V3 16) A Combustion reaction produces carbon dioxide and water.

V3 17) C

V3 18) D

$ClO_3^-(aq) \rightarrow Cl_2(g)$] equation

$2ClO_3^-(aq) \rightarrow Cl_2(g)$] Balance Cl

$2ClO_3^-(aq) \rightarrow Cl_2(g) + 6H_2O$] Balance oxygen by adding H_2O

$2ClO_3^-(aq) + 12H^+ \rightarrow Cl_2(g) + 6H_2O$] Balance hydrogen by adding H^+

U3 19) D

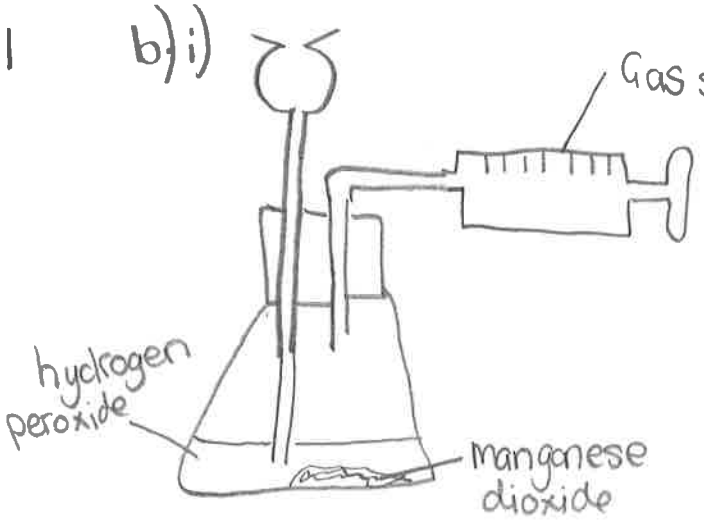
[Oxidising agents are found at the bottom left of the electrochemical series. An oxidising agent is reduced => also found below oxidation equation $2I^-(aq) \rightarrow I_2(s) + e^-$]

U3 20) A

Written Paper 2016

U1 1.) a.) The number of successful collisions will increase
or
More reactant particles will have energy equal to or greater than the activation energy.

U1 b.) i)



- Graduations on syringe must be shown
- Could also draw downward displacement of water from a measuring cylinder

PS ii) Volume of oxygen = volume strength × volume of hydrogen peroxide

$74cm^3 = x \times 20cm^3$

$x = \frac{74}{20} = 3.7$

U1 c.) $t = \frac{1}{s}$

$= \frac{1}{0.125} = 8s$

[equation is found on p4 of the data book.]

U1 2a.) The nuclear charge increases across a period which pulls electron shells closer to nucleus. Therefore covalent radius decreases.

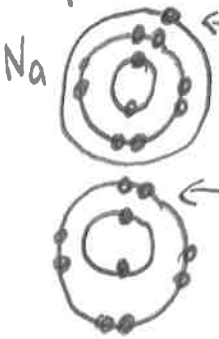
VI ii) Na: Sodium - 2,8,1

Na^+ = Sodium ion: 2,8

The sodium atom has three electron shells whereas the sodium ion only has two electron shells as it has lost an electron. Therefore, Sodium atom is larger than a Sodium ion.

VI b.) i) As you move down the group the outer electrons are less shielded from the nuclear pull.

VI ii) Group I elements e.g Sodium



Therefore, The first ionisation energy involves the removal of an electron which is more shielded from the nucleus => less energy to remove.

The Second ionisation energy involves the removal of an electron less shielded from the nucleus => more energy to remove.

or

Second ionisation energy involves removal of an electron from a full electron shell

PS 2c)i) Any value in range 720-770 $kJmol^{-1}$

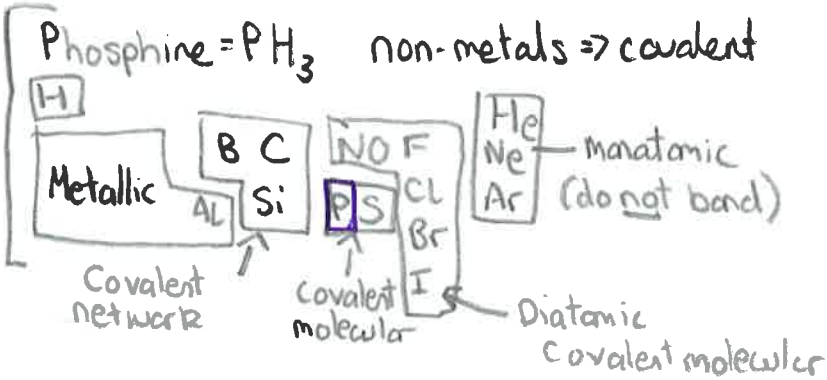
Ion	F^-	
Li^+	1030	] 120 difference
Na^+	910	] 102 difference
K^+	808	
Rb^+	?	] ~ 84 difference

PS ii) As the ionic radii increase, the lattice enthalpy decreases.

U1 3a.) Covalent molecular

[bonding] [structure]

Phosphine = PH_3 non-metals => covalent



U3 b.) $ALP_{(s)} + 3H_2O_{(l)} \longrightarrow PH_{3(g)} + Al(OH)_{3(aq)}$

m = 2.9kg

gfm: 58g

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

$= \frac{2900}{58} = 50 moles$

ALP $\longrightarrow$ PH_3

1mol $\longrightarrow$ 1mol

50mol $\longrightarrow$ 50mol

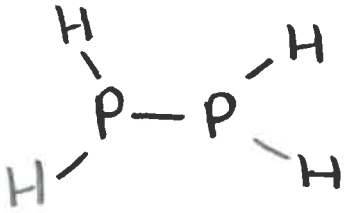
PH_3: 1 mol $\longrightarrow$ 24L

50 mol $\longrightarrow$ x

$x = 24 \times 50$

$= 1200L$

P5 c.) $P_2H_4(g)$



Phosphorus makes 3 bonds as it is in grap 5 of the periodic table.
Hydrogen makes 1 bond as it is in group 1 of the periodic table

L.) Open ended question

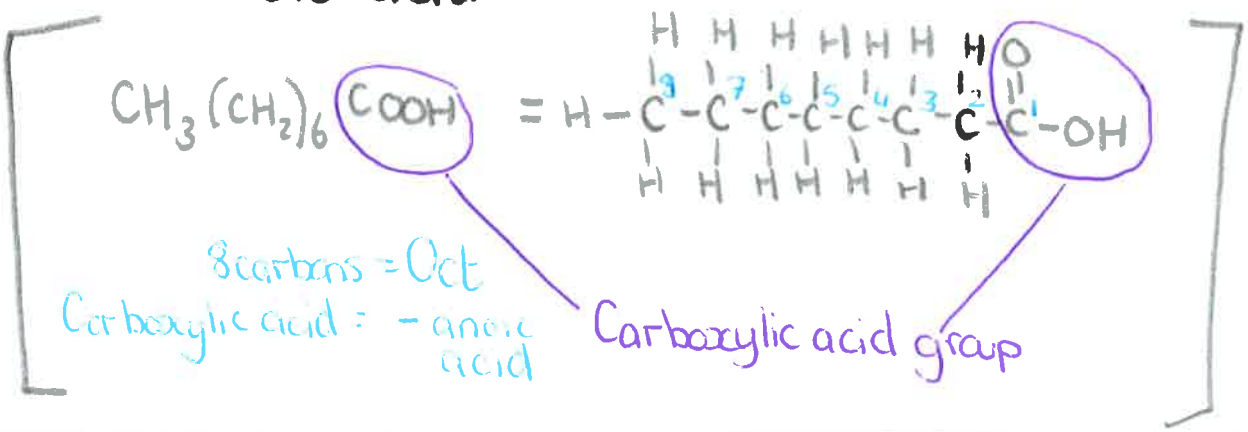
U2 5.) a.) Glycerol [or glycerine or propan-1,2,3-triol]

[Fats and oils are made from the reaction of glycerol and three fatty acid molecules]

U2 5) b) i) Polyunsaturated

[$C_{17}H_{31}COOH \Rightarrow$
unsaturated means it has at least 1 C to C double bond.
Single bond fits: $C_nH_{2n+1}COOH$
$C_{17}H_{31}COOH \Rightarrow n=17 = C_{17}H_{35}COOH \Rightarrow$
lost 4 H's $\Rightarrow$ 2 double bonds
mono unsaturated = 1 C to C double bond
Polyunsaturated = More than 1 C to C double bond.
Saturated = single bonds only]

U2 ii) Octanoic acid



U2 c.)i) Bromine water could be added to both olive oil and coconut oil until the bromine solution is no longer decolourised (or the red-braun colour remains)

More bromine would be needed for the more unsaturated oil (olive oil)

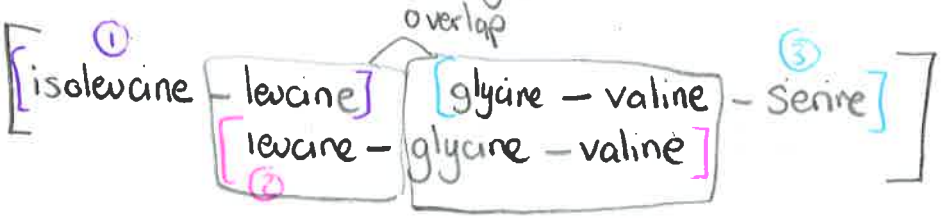
U1 ii) Hexane is non-polar, whereas water is polar. Oil is non-polar ⇒ will dissolve better in hexane. "Like dissolves like".

U2 iii) Coconut oil is less unsaturated than olive oil and will therefore be able to pack more closely together. This packing increases the number of van der Waals' forces in coconut oil in comparison to olive oil.
[The greater/stronger the forces the more difficult it is to break the attractions ⇒ higher melting point]

PS 6a.) Hexapeptide Hex = 6

① alanine - ② glycine - ③ valine - ④ proline - ⑤ tyrosine - ⑥ serine

PS b) Isoleucine - leucine - glycine - valine - serine



OR

serine - valine - glycine - leucine - isoleucine (above reversed)

U2 c) Essential

U3/PS d)i) Contained 4 different amino acids [represented by 4 spots]

or

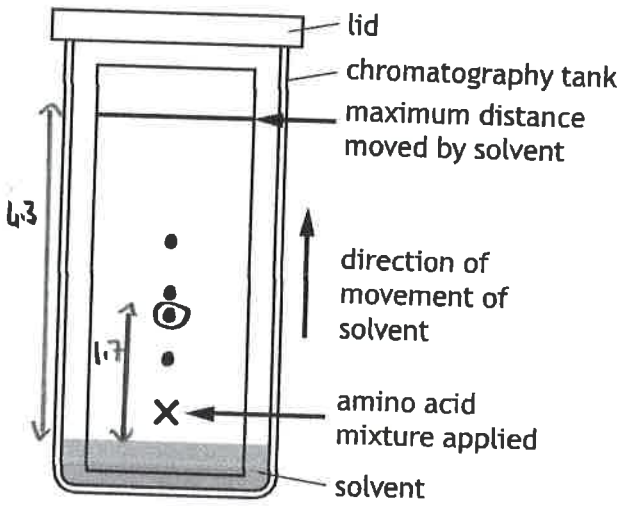
The peptide must have contained an amino acid repeated in the sequence [only 4 spots but it was a pentapeptide which is 5 amino acids]

or

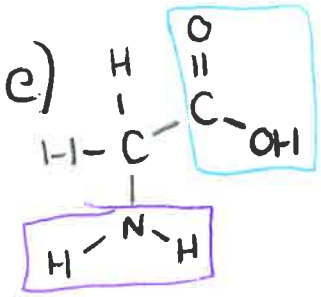
The peptide contained 2 amino acids with the same Rf value [4 spots for 5 amino acids]

U3 ii) $Rf = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$

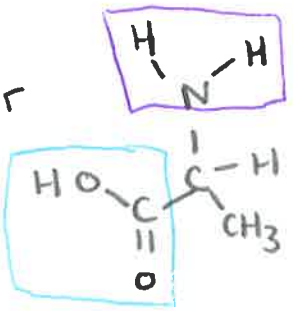
$= \frac{1.7}{4.3} = 0.40$

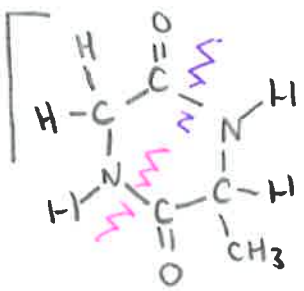


U2 c)

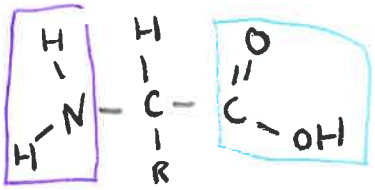


or





amino acid structure:



Protein breaks at:  bond to form amino acids

Numeracy ii) mass of alpha-amanitin → body mass [state relationship]

Link

100mg → 1kg

x → 75 kg

$x = \frac{75 \times 100}{1}$

x = 7500mg of alpha-amanitin for 75kg adult

mass of alpha-amanitin → mass of death cap [state relationship]

250mg → 1g

7500mg → x

$x = \frac{7500 \times 1}{250}$

= 30g

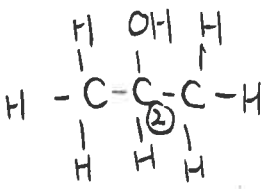
U2 7 a.) UV light is damaging to skin

U2 b.)i) Species (atoms/molecules etc) with unpaired electrons

U2 ii) Initiation [The C-C bond breaks to produce radicals]

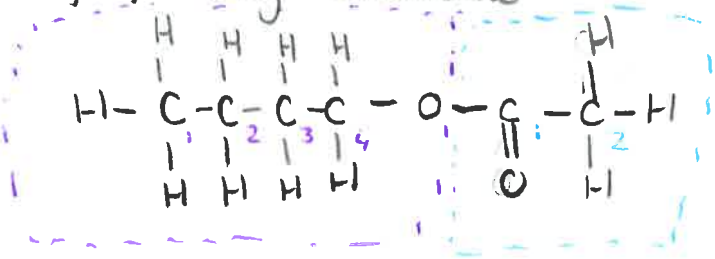
U2 iii) Carboxyl group [carboxylic acid]

iv) Propan-2-ol



The hydroxyl group is attached to a carbon that is attached to 2 other carbons.

U2 c) i) Butyl ethanoate



Name ending in "-yl" comes from alcohol

Name ending in "-oate" comes from carboxylic acid

First part of name comes from alcohol
But = 4 carbons

Second part of name comes from carboxylic acid. Eth = 2
Carboxylic acid part must contain $-\overset{\overset{O}{\|}}{C}-$

U2 ii) A wet paper towel acts as a condenser
or
To condense reactants/products which evaporate

U3 iii) ethanol + ethanoic acid $\rightleftharpoons$ ethyl ethanoate + water

gfm = 46g
m = 2.5g
$n = \frac{m}{gfm} = \frac{2.5}{46}$
= 0.0543478 moles

Must work out theoretical yield of ethyl ethanoate

ethanol $\rightleftharpoons$ ethyl ethanoate
1 mole → 1 mol
0.0543478 mol → 0.0543478 mol

gfm = 88g
n = 0.05437
m = n × gfm
= 0.05437 × 88
= 4.7826
= 4.78g

$\% \text{ yield} = \frac{\text{Actual}}{\text{Theoretical}} \times 100\%$

$= \frac{2.9}{4.78} \times 100$

= 60.7%

Actual is always given in question = 2.9
Theoretical must be worked out.

U2 iv.) Condensation or Esterification

[Forming an ester: Ethyl ethanoate is an ester.]

U3 8 a.)

	Temp (High/Low)	Pressure (High/Low)
Step 1	High	Low
Step 2	Low	High

Step 1: $CH_4(g) + H_2O(g) \rightleftharpoons 3H_2(g) + CO(g)$ $\Delta H = +210\ kJmol^{-1}$

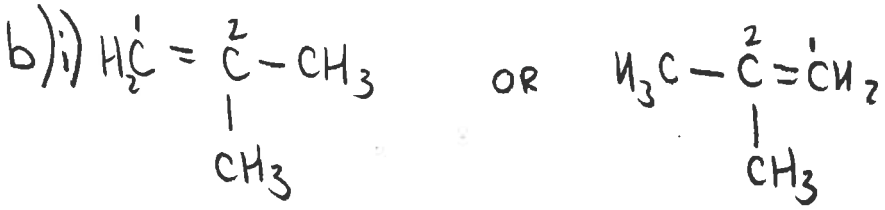
(2 mol gas) (4 mol gas)

- Low pressure favours side with higher no. moles gas
- Endothermic reaction ΔH = +ve ⇒ High temperature favours endothermic reaction.

Step 2: $2H_2(g) + CO(g) \rightleftharpoons CH_3OH(g)$ $\Delta H = -91\ kJmol^{-1}$

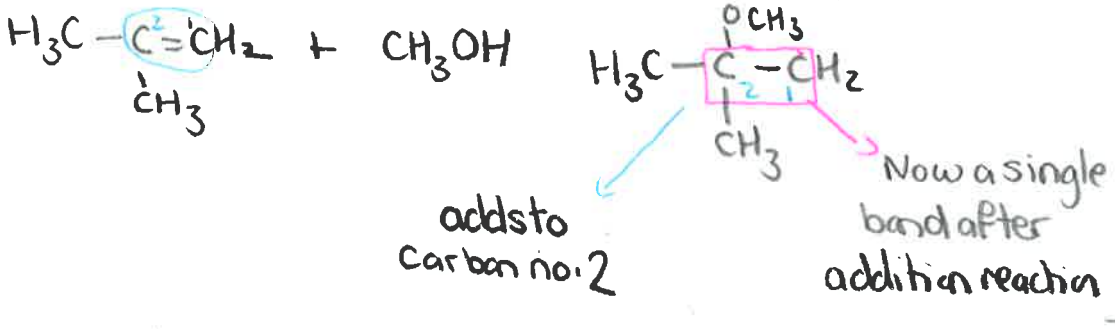
(3 mol gas) (1 mol gas)

- High pressure favours side with lower no. moles gas
- Exothermic reaction as ΔH = -ve ⇒ Low temperature favours exothermic reaction

U2 b)i) 

2-methyl propene

Double bond opens to add CH_3OH in addition reaction



U3 ii) Atom economy 100% =

All atoms in the reactants are converted into the desired product

OR

Mass of reactants are equal to mass of desired product

OR

No by-products / waste products formed

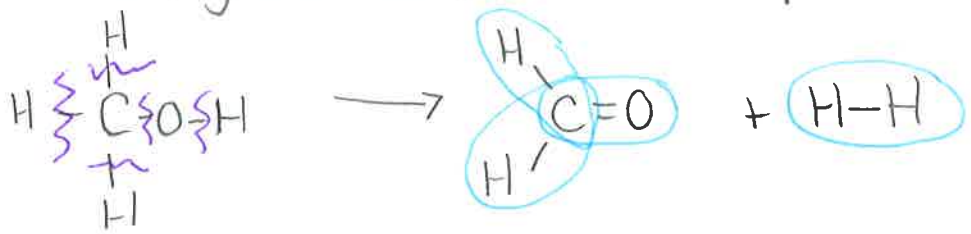
OR

only one product formed

OR

The proportion of the total mass of all stating materials successfully converted into the desired product is 100%.

U3 c)



Bond breaking:

3 x C-H = 3 x 412 = 1236
1 x C-O = 1 x 360 = 360
1 x O-H = 1 x 463 = 463 +
2059

= +2059 [endothermic reaction]

Bond making:

2 x C-H = 2 x 412 = 824
1 x C=O = 1 x 743 = 743
1 x H-H = 1 x 436 = 436 +
2003

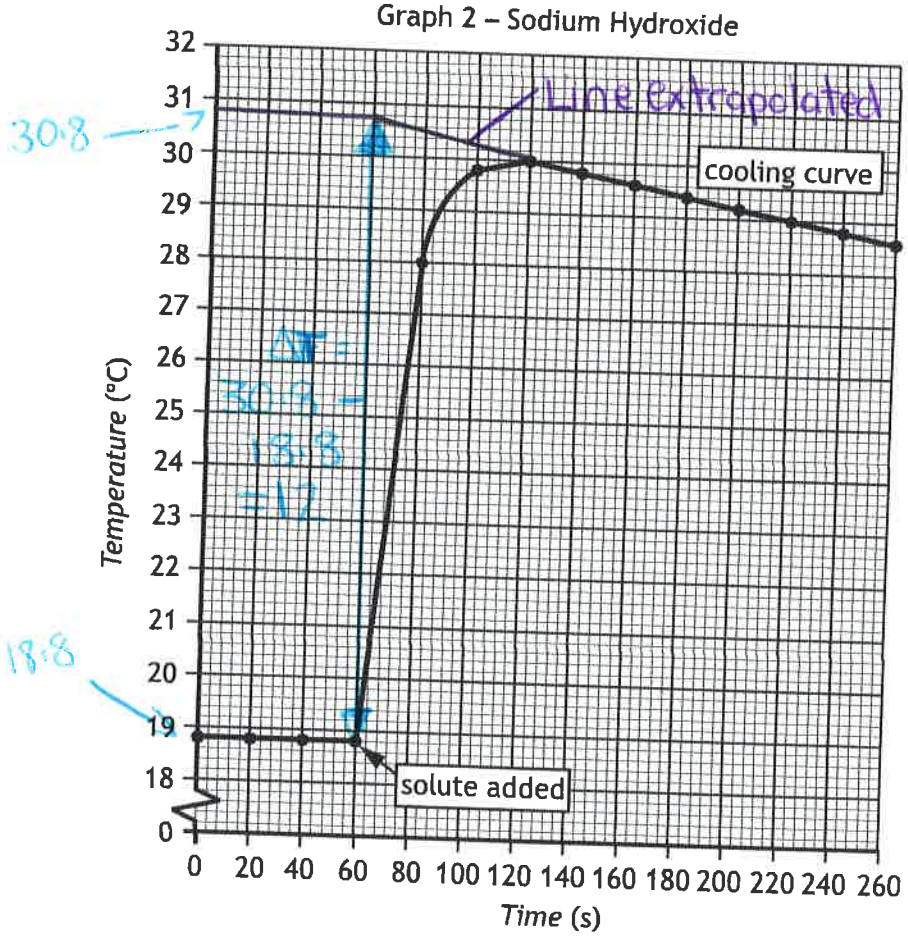
= -2003 [exothermic reaction]

Bond enthalpy = Bonds broken + bonds made

= 2059 + (-2003)

= +56 kJ mol^{-1}

U3/PS 9.)a.)i)



$E_h = cm\Delta T$

$E_h = 4.18 \times 0.1 \times 12$

$= 5.02\ kJ$

$c = 4.18$ [From question]

$m = 100\ cm^3 = 0.1\ kg$

$\Delta T = 30.8 - 18.8 = 12°C$ [From above]

[line in graph above was extrapolated using a ruler, the same as the example in graph 1. The temperature chang was then calculated]

U3 ii) Polystyrene cup is an insulator

or

polystyrene will minimis/prevent heat loss to surranding

U3 iii) 1 mole KOH = gfm

gfm of KOH = 56.1 g

mass		energy
5.61 g	→	5.25 kJ
56.1 g	→	x

$$x = \frac{5.25 \times 56.1}{5.61}$$

$$= 52.5 \text{ kJ mol}^{-1}$$

U3 b.) $Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(s) + H_2(g)$ T.E.

×2 [G $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ $\Delta H = -286 \text{ kJ mol}^{-1}$

$Ca(s) + O_2(g) + H_2(g) \rightarrow Ca(OH)_2(s)$ $\Delta H = -986 \text{ kJ mol}^{-1}$

[equation and ΔH multiplied by 2 and reversed]

$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$ $\Delta H = +572 \text{ kJ mol}^{-1}$

$Ca(s) + O_2(g) + H_2(g) \rightarrow Ca(OH)_2(s)$ $\Delta H = -986 \text{ kJ mol}^{-1}$

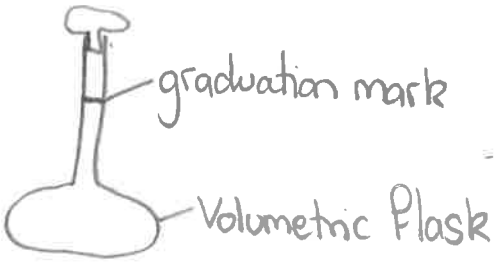
$2H_2O(l) + Ca(s) \rightarrow Ca(OH)_2(s) + H_2(g)$

$\Delta H = +572 + (-986)$

$= -414 \text{ kJ mol}^{-1}$

10.) Open ended question.

U3 11a.)i)



I3 ii) • Place a flask on a balance and tare it [mass of flask = 0g]
• use a 10cm³ pipette to add to accurately add the 10cm³ of sucrose solution to the flask.
• Note the mass on the balance when sucrose solution has been added to the flask

ii) - Points must be accurately plotted [½ a box tolerance]
- Line of best fit must be drawn

PS iv)A) Bubbles/dissolved gas would affect the density/mass/volume of solution

PS B.) Density = (0.0204 x % conc of sugar) + 1.00

1.07 = (0.0204 x % conc of sugar) + 1.00

1.07 − 1.00 = 0.0204 x % conc of sugar

$$\frac{0.07}{0.0204} = \%\ \text{conc of sugar}$$

% conc of sugar = 3.43%

Numeracy v) mass of sugar → volume [state relationship]

10.6g → 100cm³

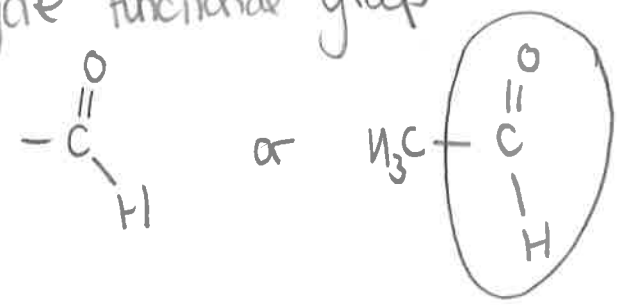
x → 330cm³

$$x = \frac{330 \times 10.6}{100}$$

$$= 34.98$$

$$= 35g$$

U2 b.)i) Aldehyde functional group



U3 ii) $C_6H_{12}O_6 \longrightarrow C_6H_{12}O_7$ [carbon already balanced]

$C_6H_{12}O_6 + H_2O \longrightarrow C_6H_{12}O_7$ [balance "O" by adding H_2O]

$C_6H_{12}O_6 + H_2O \longrightarrow C_6H_{12}O_7 + 2H^+$ [balance "H" by adding H^+]

$C_6H_{12}O_6 + H_2O \longrightarrow C_6H_{12}O_7 + 2H^+ + 2e^-$ [balance charge by adding e^-]

Charge = 0 Charg = +2-2 = 0

[Oxidation reaction uses reducing agent, question tells you $C_6H_{12}O_6$ is the reducing sugar]

U3 iii) Blue → orange/red/brown/yellow

U3 iv) $C_6H_{12}O_6 + 2Cu^{2+} + H_2O \rightarrow C_6H_{12}O_7 + 2Cu^{+} + 2H^{+}$

$V = 25\,cm^3 = 0.025L$ $V = 19.8\,cm^3 = 0.0198L$

$C = ?$ $C = 0.0250\,mol\,l^{-1}$

$n = 0.0002475$ $n = C \times V$

$C = \frac{n}{V} = \frac{0.0002475}{0.025}$ $= 0.0250 \times 0.0198$

$= 0.0099\,mol\,l^{-1}$ $= 0.000495$ moles

mole ratio: $Cu^{2+} : C_6H_{12}O_6$

2mol → 1mol

0.000495mol → x

x = 0.0002475 moles

Concentration = $0.0099\,mol\,l^{-1}$

U1 12a.)i) Hydrogen bonding [-OH groups]

PS ii). Branching lowers the boiling point

- The shorter the alcohol the lower the boiling point

OR

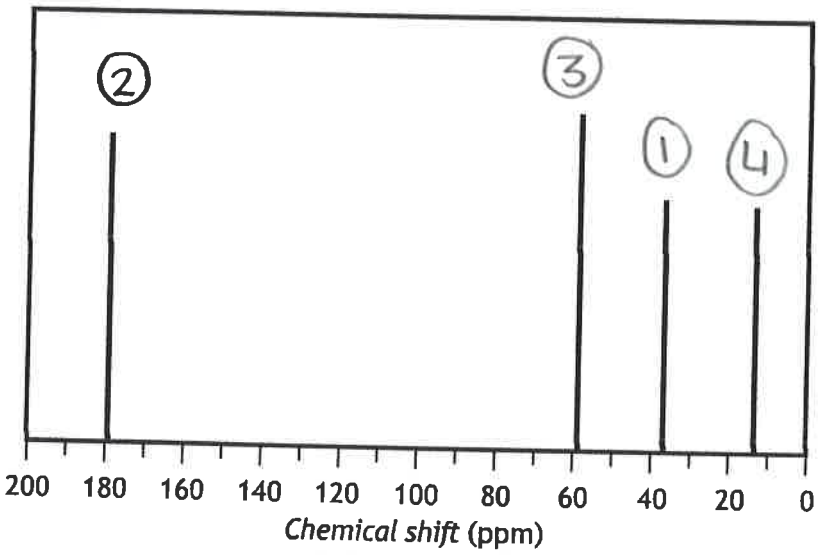
- The longer the carboxylic acid the lower the boiling point.

OR

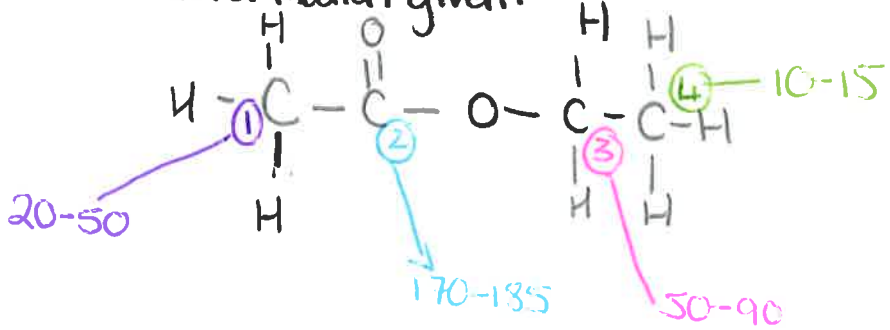
- The nearer the ester link is to the right hand side the higher the boiling point.

PS iii) Any temperature between 99-124 °C

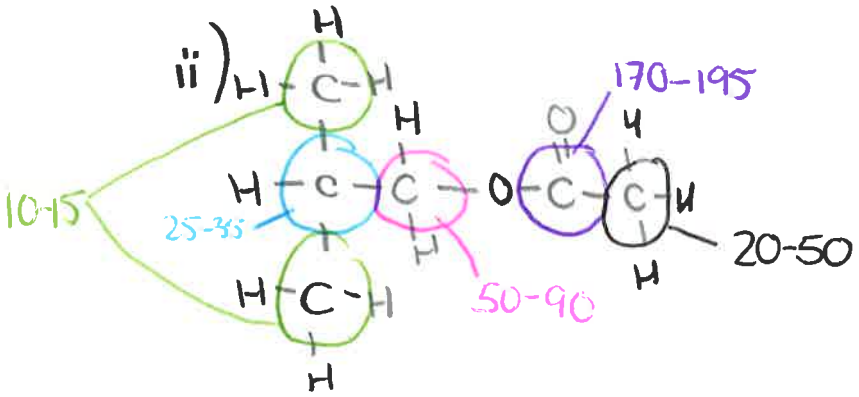
PS b i)



From table of information given:



PS ii)



5 different peaks.

2017

2017 Higher Marking Instructions

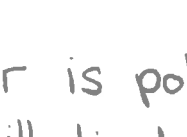
Multiple Choice

U1 1.) A

A) C-I = 2.6 - 2.5 = 0.1 ⇒ least polar
B) C-F = 4.0 - 2.5 = 1.5
C) C-Cl = 3.0 - 2.5 = 0.5
D) C-Br = 2.8 - 2.5 = 0.2

[Values are electronegativity values from p11 of the data book.]

U1 2.) D.

Water is polar  "Like dissolves like"
⇒ will dissolve a polar molecule. D is most polar and will hydrogen bond with water due to the 4-OH groups.

U1 3.) C

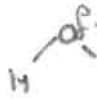
A) Sulfur = 2.5
B) Silicon = 1.9
C) Nitrogen = 3.0 ⇒ greatest attraction
D) Hydrogen = 2.2

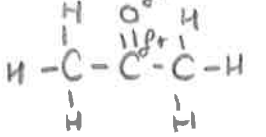
[Attraction of bonding electrons is electronegativity values - p11]

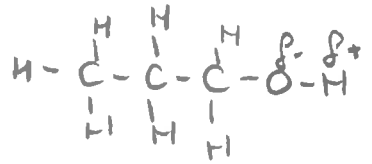
U1 4.) B

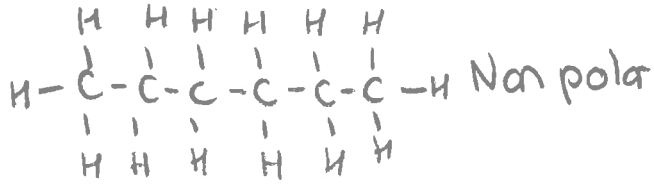
U1 5.) D

Polar liquids will attract the charged rod.

A) Water  Polar

B) Propanone  Polar

C) Propanol  Polar

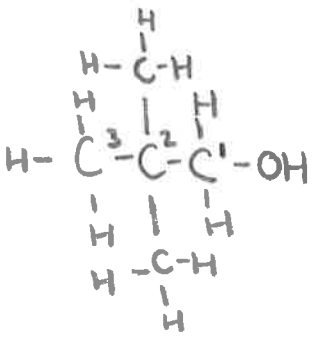
d.) Hexane  Non polar

V3 6.) C $2P_2H_4 + 7O_2 \rightarrow P_4O_{10} + 4H_2O$

P = 4
H = 8
O = 14

P = 4
H = 8
O = 14

V2 7.) B



[• alcohol group on carbon number 1
• 2 methyl groups on carbon number 2]

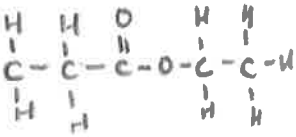
V2 8.) C

[unsaturated means it has at least 1 C=C double bond]
Single bonds fit: $C_nH_{2n+1}COOH$
A.) $C_{15}H_{29}COOH \Rightarrow n=15 = C_{15}H_{31}COOH$ - lost 2 H's $\Rightarrow$ 1 double bond
B.) $C_{15}H_{31}COOH \Rightarrow n=15 = C_{15}H_{31}COOH$ - same $\Rightarrow$ only single bonds
C) $C_{17}H_{31}COOH \Rightarrow n=17 = C_{17}H_{35}COOH$ - lost 4 H's $\Rightarrow$ 2 double bonds
D) $C_{17}H_{35}COOH \Rightarrow n=17 = C_{17}H_{35}COOH$ - same $\Rightarrow$ only single bonds

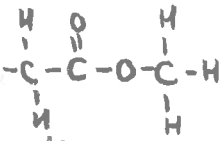
V2 9.) A

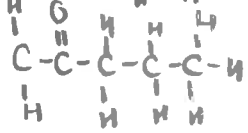
[steps: Initiation, Propagation and Termination]

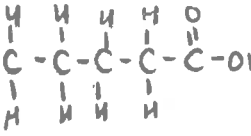
V2 10.) C

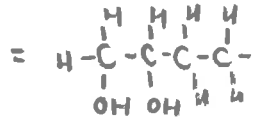
$CH_3CH_2COOCH_2CH_3 = C_5H_{10}O_2$ 

[Isomer = same molecular formula different structures]

A.) Methyl propanoate = Ester  $x = C_4H_8O_2$

B.) Pentan-2-one =  $x = C_5H_{10}O$

C.) Pentanoic acid =  ✓ $= C_5H_{10}O_2$ ✓

D.) Pentane-1,2,diol =  $x = C_5H_{12}O_2$

V2 11.) B

Essential oils are non-watersoluble and volatile.

12.) C Definition: Enthalpy of combustion

U313.) B (reducing agents at the top right of electrochemical series p 12)

U314.) B $TiCl_4 + 2Mg \longrightarrow 2MgCl_2 + Ti$

$$\text{Atom economy} = \frac{\text{Mass of desired product}}{\text{total mass of reactants}} \times 100$$

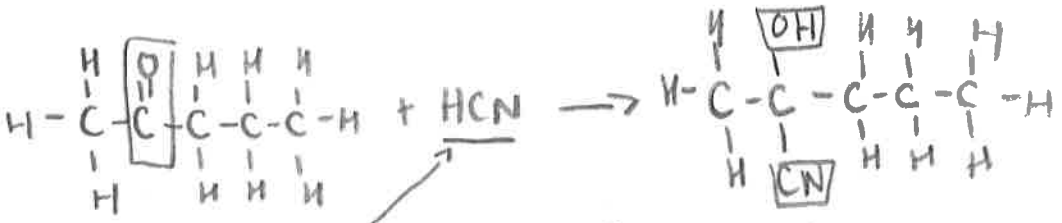
$TiCl_4$ + $2Mg$ $\longrightarrow$ $2MgCl_2$ + Ti

Mass = 189.9 g | Mass = 2 × 24.3 g = 48.6 g | Mass = 47.9 g

$$\text{Atom economy} = \frac{47.9}{189.9 + (2 \times 24.3)} \times 100$$

U315) C

U216) A



[H joins with O from compound. CN attaches to same carbon that the O is bonded to]

U317) D - The rate of the forward reactions equals the rate of the backwards reaction. The concentration of reactants and products are not equal.

U318.) A $\Sigma H = \Sigma\Delta H$ bonds broken + $\Sigma\Delta H$ bonds made

$= 630 + (-732)$

$= -102\ kJ\,mol^{-1}$

Bonds broken = 1 × H-H = 436 $kJ\,mol^{-1}$

1 × Br-Br = 194 $kJ\,mol^{-1}$

Total = 630 $kJ\,mol^{-1}$

Bonds made = 2 × H-Br = 2 × -366 = $-732\ kJ\,mol^{-1}$

(Bond making = exothermic)

V219.) D

Glycerol structure: CH_2OH / $CH\,OH$ / $CH_2\,OH$

V3 20) B [A catalyst does not effect the position of an equilibrium. A catalyst speeds up a chemical reaction => increases the rate of the forward reaction.]

2017

Written Paper

U1 1 a) Silicon

b)i) Across the period the first ionisation energy increases as there is an increased / greater / stronger / higher nuclear charge (holds electrons tightly)

OR

Increasing number of protons

ii) $Mg^{+}(g) \longrightarrow Mg^{2+}(g) + e^{-}$ (state symbols needed. See data booklet top of p11)

iii) Fourth ionisation energy involves removal of an electron from an electron shell which is full which requires more energy.

c) The Van der Waals forces present in Chlorine and argon are london dispersion forces. The LDF are stronger in chlorine than in argon. Chlorine (Cl_2) molecules have more electrons than argon atoms ⇒ higher boiling point.

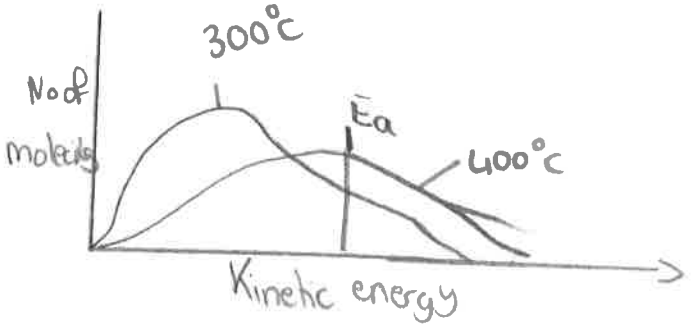
U3 2. a) i) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

H-H I-I

$\Delta H = 436\ kJmol^{-1}$ $\Delta H = 151\ kJmol^{-1}$ (p10)

Since Iodine has a smaller bond enthalpy this will break more easily.

U1 ii)



[Increase in temperature shifts curve to the right]

2a.) iii) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ - exothermic

U3 A) Increasing the temperature will favour the endothermic reaction and will => shift to the left

U3 B.) 2mols gas $\rightleftharpoons$ 2mols gas There are 2 moles of gas on each side of the equation => pressure will have no effect on equilibrium

U1 iv) A) Activated complex

U3 B) Enthalpy change = 173.2 - 182.8
= -9.6 kJ (exothermic => negative)

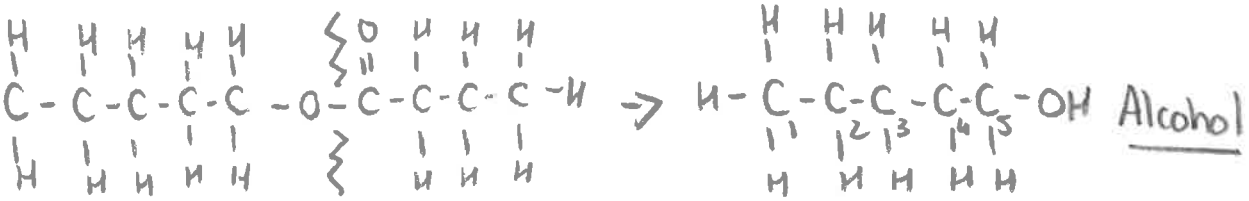
U1 C) Catalyst lowers activation energy

PS b) i) - To keep concentration of reactants constant
- Adding water will change/affect/decrease concentration

U1 ii) $T = \frac{1}{f} = \frac{1}{0.00819} = 122s / 122.1s$

U1 iii) Decreasing the concentration means less particles => the number of successful collisions will decrease

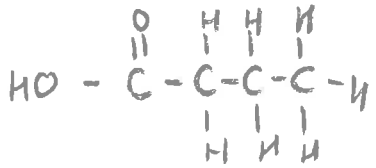
3.) Open ended question

U2 4.) i) 

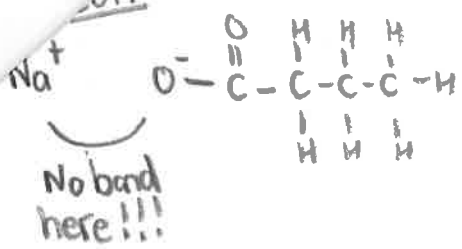
Alcohol

Alcohol name: Pentan-1-ol

and



Carboxylic acid



V2 b) i) pentyl butanoate is an ester.

ii) Soap / emulsifier / detergent

V3 iii) $C_{17}H_{35}COOH + 26O_2 \rightarrow 18CO_2 + 18H_2O$

mass of one mole = gfm = 284g

[$C_{17}H_{35}COOH \rightarrow CO_2$
1mol $\rightarrow$ 18mol]

mass		energy
284g	$\longrightarrow$	(623 kJ x 18)
10g	$\longrightarrow$	X

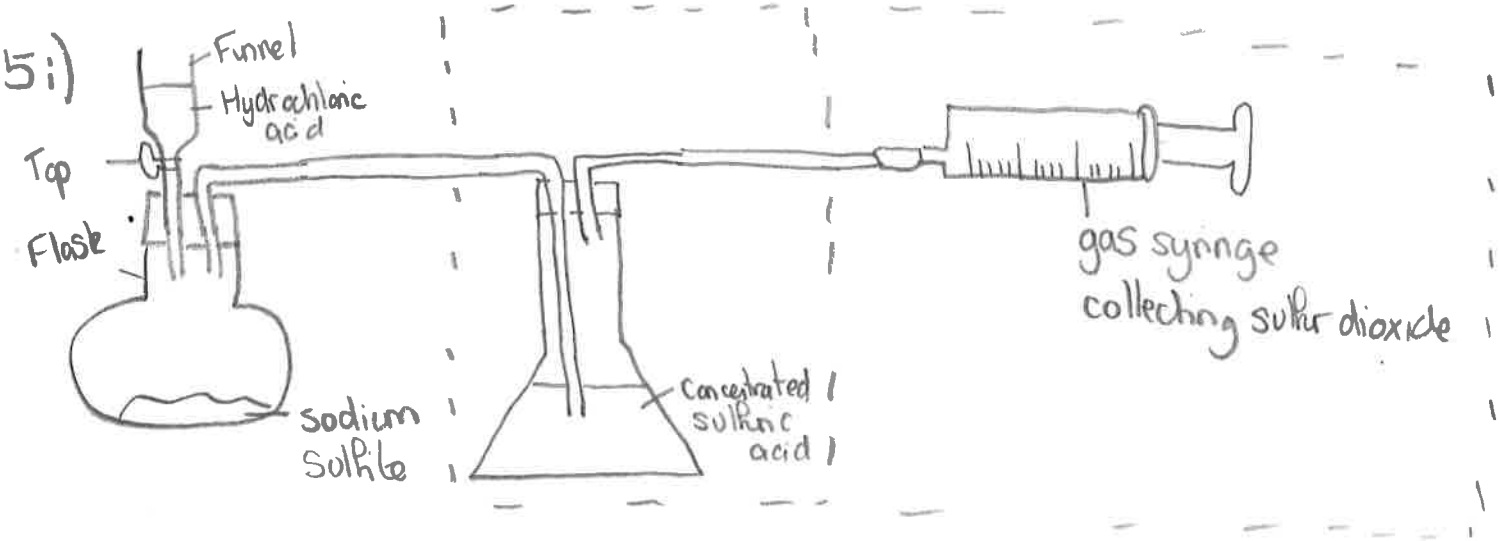
$X = \frac{11214 \times 10}{284}$

$= 394.9$ kJ

$= -395$ kJ (negative as combustion is exothermic)

[multiply by 18 as there are 18 moles of CO_2 and 623kJ of energy is produced per mole of CO_2 produced]

5i)



V3 ii) $Na_2SO_3(s) + 2HCl(aq) \rightarrow H_2O(l) + 2NaCl(aq) + SO_2$

Work out moles

$gfm = 126.1\,g$, $m = 0.4\,g$

$n = \frac{m}{gfm} = \frac{0.4}{126.1} = 0.00317208$ moles

$c = 1\,mol\,L^{-1}$, $V = 0.05\,L$

$n = cV = 1 \times 0.05 = 0.05$ moles

use mole ratios

$Na_2SO_3(g) \rightarrow HCl$

$1\,mol \rightarrow 2\,mol$

$0.00317208\,mol$ needs 0.006 moles

actual 0.05 moles $\Rightarrow$ HCl is in excess

$\Rightarrow Na_2SO_3$ is limiting

V3 b) TE: $CS_2(l) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$

✓ $C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -393.5\,kJ\,mol^{-1}$ [CO_2 both on right hand side, 1 mole $\Rightarrow$ matches TE]

x2 [$S(s) + O_2(g) \rightarrow SO_2(g)$ $\Delta H = -296.8\,kJ\,mol^{-1}$ [SO_2 both on right hand side. Need to multiply by 2 to match TE]

6. $C(s) + 2S(s) \rightarrow CS_2(l)$ $\Delta H = +87.9\,kJ\,mol^{-1}$ [CS_2 needs to be on left hand side to match TE]

$C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -393.5\,kJ\,mol^{-1}$

$2S(s) + 2O_2(g) \rightarrow 2SO_2(g)$ $\Delta H = -296.8 \times 2 = -593.6\,kJ\,mol^{-1}$

$CS_2(l) \rightarrow C(s) + 2S(s)$ $\Delta H = -87.9\,kJ\,mol^{-1}$

matches TE: $CS_2(l) + 3O_2 \rightarrow CO_2(g) + 2SO_2(g)$

$= -393.5 + (-593.6) + (-87.9)$

$= -1075\,kJ\,mol^{-1}$

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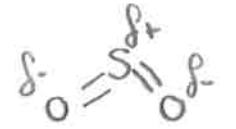
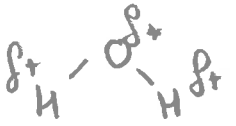
-)i) 163 - 167 gl^{-1} (draw a line to join the dots and read from the graph).

VI ii) $\delta-O=\overset{\delta+}{C}=O^{\delta-}$ Carbon dioxide is a non-polar molecule due to the linear shape ⇒ dipoles cancel out

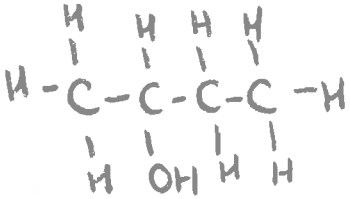


Sulfur dioxide is a polar molecule due to the bent shape.



Water is polar due to the bent shape. Like dissolves like therefore polar sulfur dioxide will be more soluble in polar water.

U2 6 a.)i)

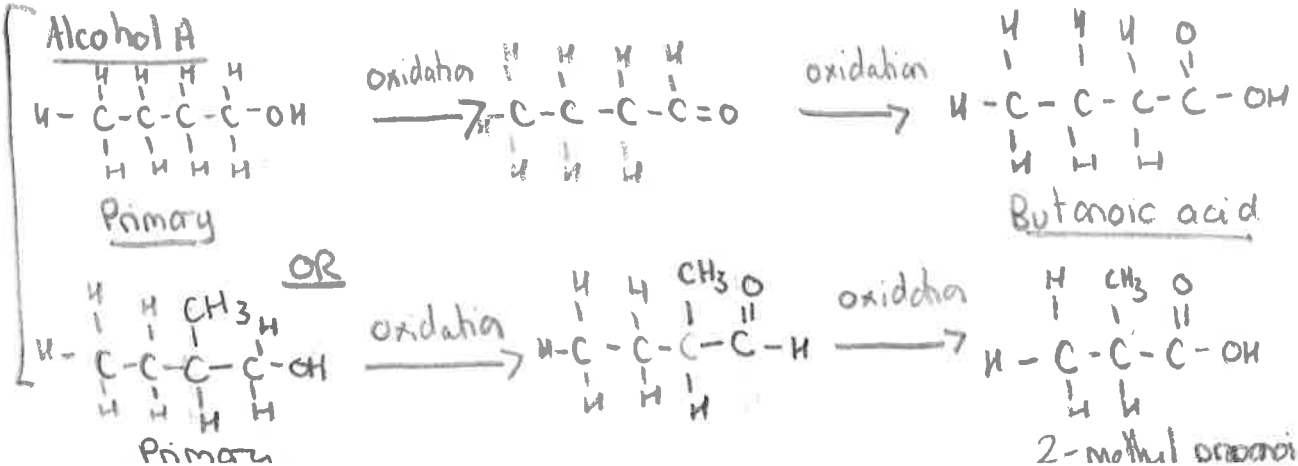


U2 ii)A) The reaction mixture is flammable ⇒ dangerous to use a Bunsen burner in case it catches fire.

U2 B) Orange ⟶ Blue-green / Blue/green

U2 C) Tertiary

U2 iii) A-) Butanoic acid or 2-methylpropanoic acid



U3 B.) $C_4H_9OH \longrightarrow C_4H_8O_2$ [Balance Carbons]

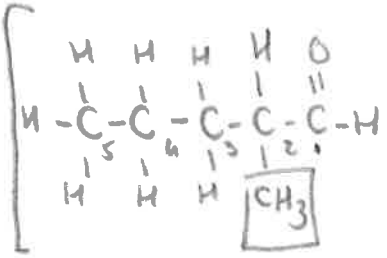
$C_4H_9OH + H_2O \longrightarrow C_4H_8O_2$ [Balance O by adding H_2O]

$C_4H_9OH + H_2O \longrightarrow C_4H_8O_2 + 4H^+$ [Balance H by adding H^+]

$C_4H_9OH + H_2O \longrightarrow C_4H_8O_2 + 4H^+ + 4e^-$ [Balance charge by adding e^-]

*U2

PS b.) i) 2-methyl pentanal



Aldehyde => name ending al

5 carbons => pent

1 methyl grap on carbon no 2. => 2-methyl

ii) Any temperature between 166 – 181°C

iii) More branching lowers the boiling point of isomeric aldehydes. [Compare 2 compounds with the same molecular formula e.g $C_5H_{10}O$]

U2 iv) Silver mirror

U1 c.)  POP-POP.

2017

7a.) Rinse beaker and transfer washings to the flask.

U3 b.)i) It is self-indicating

ii) To provide H^+ ions for the reaction.

iii) A)- You do not use the first titre as it is rough => not reliable.

B) $5Fe^{2+}_{(aq)} + 8H^+_{(aq)} + MnO_4^-{}_{(aq)} \rightarrow 5Fe^{3+}_{(aq)} + Mn^{2+}_{(aq)} + 4H_2O_{(l)}$

$c = ?$
$v = 0.025\,l$

$c = 0.02\,mol\,l^{-1}$
$v = 0.01455\,l$ (titre)
$n = c \times v$
$= 0.02 \times 0.01455$
$= 0.000291$ moles

mole ratio: $MnO_4^-{}_{(aq)} \rightarrow Fe^{2+}$
$1\,mol \rightarrow 5\,mol$
$0.000291\,mol \rightarrow x$
$x = 5 \times 0.000291$
$= 0.001455$ moles

U

$\cdot Fe^{2+} = c = \frac{n}{v}$
$= \frac{0.001455}{0.025}$
$= 0.0582\,mol\,l^{-1}$

C) A solution of accurately known concentration

D) Pipette [ ]

c.) 5 tablets → 0.00126 moles

1 tablet → x

$$x = \frac{0.00126}{5} = 0.000252 \text{ moles}$$

mass = gfm × moles

= 56 × 0.000252

= 0.0141g = 14.1mg

d.) 100g → 12mg iron

30g → x

$$x = \frac{30 \times 12}{100}$$

= 3.6mg iron in 30g serving

% of recommended daily amount = $\frac{3.6}{14.8} \times 100 = 24.3\%$

8.) Open ended question

9a.)

Tail is covalent and is therefore is soluble in fat

Ionic head is not soluble in fat

ii) hydrophobic (water hating)

b.) i) It can break down coloured compounds / kill bacteria / germs

2017

9 ii) $2H_2O_2(l) \longrightarrow 2H_2O(l) + O_2(g)$

$m = 0.051g$

$gfm = 34g$

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

$= \frac{0.051}{34}$

$= 0.0015 moles$

mole ratio: $H_2O_2 \longrightarrow O_2$

2 mole $\rightarrow$ 1 mole

0.0015 moles $\rightarrow x$

$x = \frac{0.0015}{2}$

$= 0.00075 moles$

mole	volume
1 mole	$\longrightarrow$ 24L
0.00075 moles	$\longrightarrow x$

$x = \frac{24 \times 0.00075}{1}$

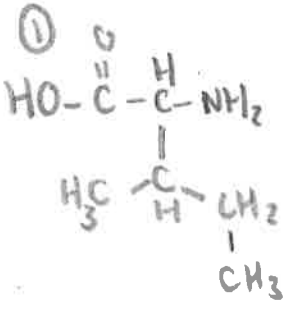
$= 0.018L$

U2 C i) amino acids

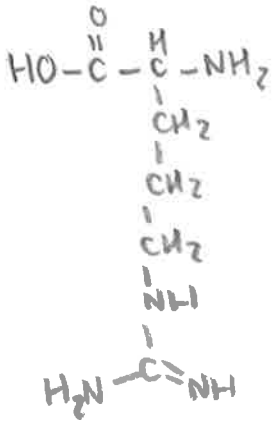
ii) A) amide / peptide link

ii) B) Any from:

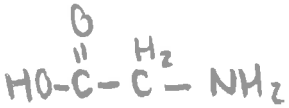
①



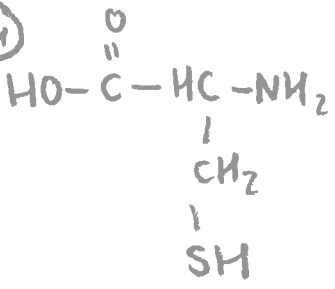
②

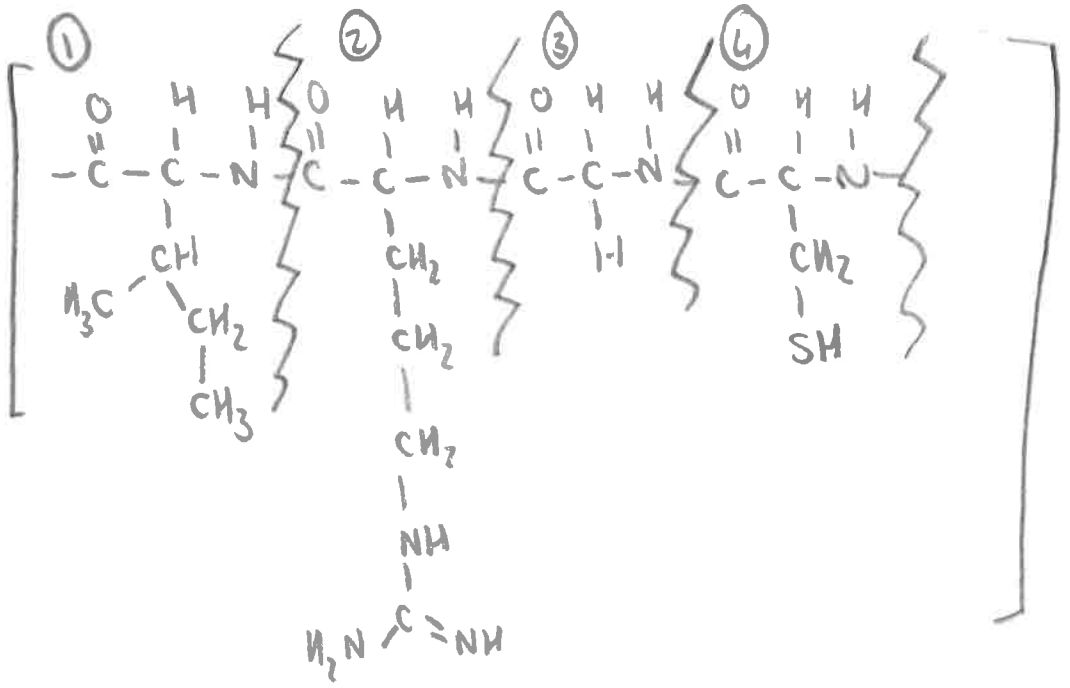


③



④



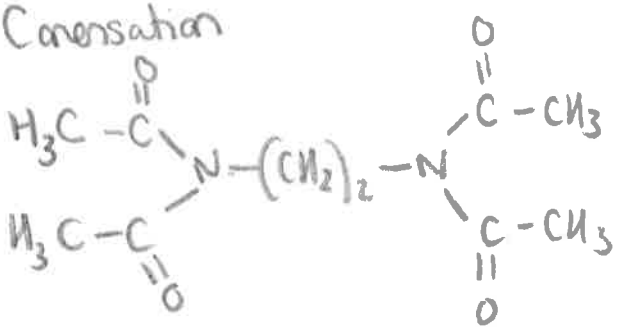


U2 iii) A) Denaturing

B) Temperature / pH increase

U2 d.) i) Condensation

ii)



U3 10 a.) i) 40.23/40.2/40 %.

$$\left[\frac{31909}{79310} \times 100\%\right]$$

ii) peak 5 geranyl acetate

b) 0.92mg → 1cm³

x → 500cm³

x = 500 × 0.92

= 460mg

460mg = 0.460g

= 0.000460kg

1 kg → £59.10

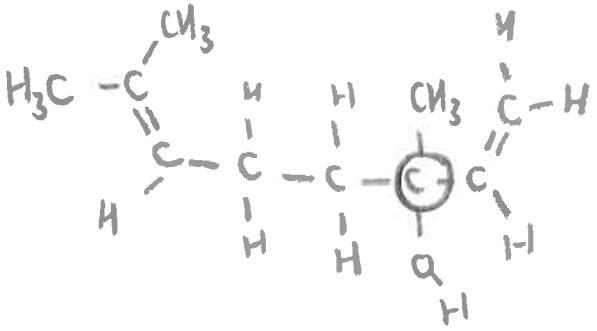
0.000460kg → x

x = £0.027

= 2.70/3p

2017

10 c)



ii) $C_{15}H_{24}$ or $(C_5H_8)_3$