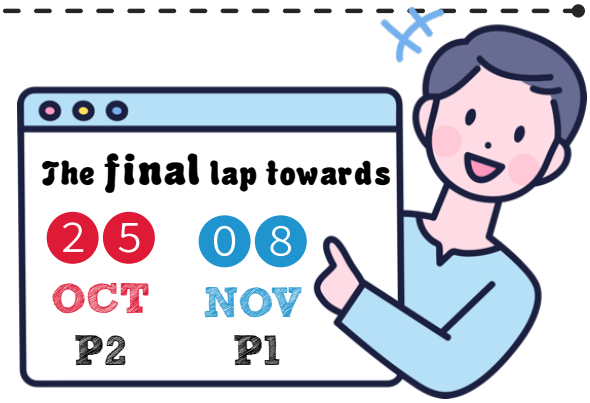
A – Z School's Preliminary Papers
4 Express
Chemistry

ANSWERS: Part 5 FINAL

U	yUying Secondary School
V	Victoria School
W	West Spring Secondary School
X	Xinmin Secondary School
Y	Yuhua Secondary School
Z	Zhenghua Secondary School



YUYING SECONDARY SCHOOL

Paper 1

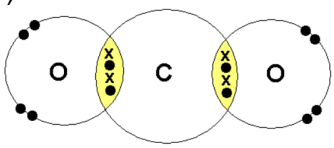
1	B	**11**	D	**21**	A	**31**	D
2	A	**12**	D	**22**	B	**32**	A
3	A	**13**	C	**23**	C	**33**	C
4	C	**14**	B	**24**	C	**34**	D
5	A	**15**	D	**25**	D	**35**	D
6	A	**16**	B	**26**	C	**36**	C
7	C	**17**	B	**27**	A	**37**	C
8	D	**18**	C	**28**	C	**38**	C
9	A	**19**	D	**29**	C	**39**	B
10	C	**20**	A	**30**	D	**40**	A

Paper 2

A1a) B
b) C
c) C
d) A
e) E

A2) before – solid structure of unshaded magnesium atoms, regularly arranged. [1]
After – alternating solid structure of unshaded magnesium atoms and shaded oxygen atoms in the 1:1 ratio, regularly arranged. [1]

A3a) X marked a the intersection of the two curves. [1]
b) Increase the pressure to 50 atm and above to obtain liquid carbon dioxide. [1]
c)



1 m double bond, 1 m all other electrons correct.
d) Acidic oxide [1]. It reacts with bases to form salts / dissolves in water to form acid. [1]

A4a) If only water is used, yellow dye is insoluble [1].
If only ethanol is used, red dye is insoluble [1]
b) At 80% ethanol, all the dyes have the same solubility, so there will be only one spot formed on the chromatogram.
c) blue: 0.5, red: 0.68, yellow: 0.16
2 marks for all 3 correct, 1 mark for 2 correct, ½ mark for 1 correct.

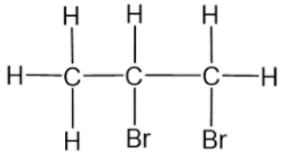
A5a) All the 3 valence electrons of boron are used in the forming of boron nitride.[1] It has no delocalized electrons to move about to conduct electricity. [1]
b) There are weak van der Waals forces [½] between the hexagonal rings [½] of boron nitride. These forces are easily overcome [½], hence boron nitride is soft and slippery [½].
It is suitable to be used for lipsticks.
c) Very high melting point

A6a) True, False, True (1m each)
b) Add excess water to the mixture. [½] Stir thoroughly to dissolve all the copper(II) halide. [½] Filter the mixture to remove the copper as residue. [½] Wash the copper with distilled water and dry between pieces of filter paper. [½]
c) Mole of cu = 96/64 = 1.5 mols [½]
mole of $CuCl_2$ = 1.5 mols [½]
mass of $CuCl_2$ = 1.5 x 135 [½] = 202.5 g [½]

A7a) Q, copper, P, S, R [1]
b) 1. The blue [½] solution decolourises. [½]
2. Pinkish brown deposits of copper formed [1]
c) The voltage difference between zinc and copper is more than the voltage difference between P and copper [½]. P is a more reactive metal than copper, but less reactive than zinc [½]. Hence, P is extracted from it's oxide by reduction with carbon. [1]
d) metals have a 'sea of delocalized electrons' which are free to move about to conduct electricity.

A8a) test: add aqueous silver nitrate. [1]
With NaCl: a white precipitate is seen. [½]
With Na_2SO_4 : no precipitate seen. [½]
Or: can use aqueous barium nitrate and answers given accordingly.
b) Add excess dilute nitric acid to dissolve both carbonates. [1]
Add aq. NaOH (or aq. ammonia) [1]
With Na_2CO_3 : no precipitate is seen. [½]
With $ZnCO_3$: a white precipitate is seen which dissolves in excess aq. NaOH (or aq ammonia). [½]

A9ai) A hydrocarbon is a compound containing hydrogen and carbon atoms only.
ii) C_2H_{2n+2}
bi) C_8H_{16}
ii) $C_{20}H_{24} \rightarrow C_{12}H_{24} + C_8H_{16} + H_2$
iii) temperature of 600°C [½], Al_2O_3 or SiO_2 catalyst [½]
iv) It helps to meet the demand for smaller, more useful fractions, produce H_2 etc.
ci) They have the same functional group / similar chemical properties etc
ii)



[1]

dibromopropane [1]

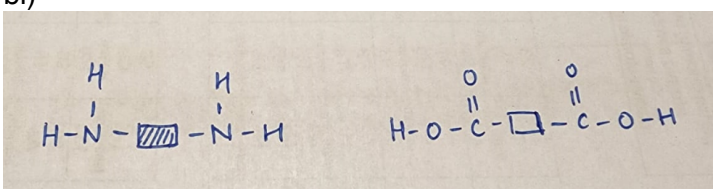
Section B
B10ai) The larger the atomic radius, the more reactive the metal. [1]
ii) With a larger atomic radius, the attraction of the nucleus to the valence electrons [½] decreases [1]. This makes it easier to lose the valence electrons [½], and hence the metal gets more reactive.

b) The last electron shell is removed/lost [½] when the valence electrons are given away [½], hence the atomic radius of the magnesium atom becomes smaller when it forms magnesium ion.
ci) Mg^{2+}
ii) The statement is false. [1]
Mg^{2+} has the highest polarizing power, followed by Ca^{2+} and Sr^{2+}. [1]. However, $Mg(OH)_2$ has the lowest decomposition temperature, followed by $Ca(OH)_2$ and $Sr(OH)_2$. [1] Hence, the relationship is not directly proportional, but inversely proportional. (accept this line as well, if evidence given is sufficient).
di) dilute hydrochloric acid
ii) $2\ HCl\ +\ Sr(OH)_2\ \rightarrow\ SrCl_2\ +\ 2\ H_2O$
[½] correct formulae, [½] balancing

B11ai) As it produces the least energy in KJ per 100g/ least energy in KJ per cent
Or: As it produces the pollutant sulfur dioxide as a product, while the rest do not.
ii) It provides the most energy in KJ per 100g
Or: It produces only harmless water vapor as a product.
bi) Exothermic [1]. The energy released in the forming of the bonds of $2H_2O$ [½] is more [½] than the energy taken in in the breaking of the bonds of $2H_2$ and O_2. [1]
ii) A suitable catalysed curve showing lower activation energy with labelling.
[½] mark only awarded if not labelled.
ci) From right to left.
ii) $H_2\ \rightarrow\ 2H^+\ +\ 2e^-$
[½] correct formulae, [½] balancing
iii) It has charged particles (ions) which can move about to conduct electricity to complete the circuit.
iv) Reduction has occurred. [1].
As electrons are accepted [1]
Or: As the oxidation state of oxygen decreases from 0 in O_2 to -2 in OH^-.

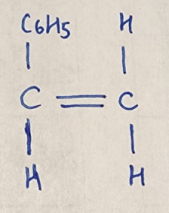
B12ai) Bi_2O_3
ii) Add excess [½] bismuth metal to hot dilute nitric acid. [½]
Filter the mixture to remove the excess bismuth metal. [½]
Heat the filtrate to make it saturated. [½]
Leave the filtrate to cool. [½] Crystals of bismuth nitrate are formed.
Dry the crystals between pieces of filter paper. [½]
iii) $Bi(NO_3)_3\ +\ 3\ NaOH\ \rightarrow\ 3\ NaNO_3\ +\ Bi(OH)_3$
[1] correct formulae, [1] balancing
iv) To make sure all the bismuth nitrate is fully reacted/used up.
v) The bismuth hydroxide decomposes to form bismuth oxide.
bi) Bismuth shares its valence electrons with oxygen, there are no delocalized electrons available to move about to conduct electricity. (or: Bi_2O_3 is a simple covalent molecule/substance, it does not have any mobile ions or electrons to move about to conduct electricity.)
iii) Amphoteric oxide [½]
As it reacts with both citric acid and potassium hydroxide. [½]

B13ai) addition polymer – polyethene etc [1]
condensation polymer – terylene [1]
ii) 1. In addition polymerization, only one single product is formed, while in condensation polymerization, more than one product is formed. [1]
2. Addition polymers are made up from one type of monomer, while condensation polymers are made up of two types of monomers. [1]
bi)



[1 mark each]
ii) Mr of one repeat unit = 182 + 30 + 56 = 268 [1]
Hence, Mr of 20000 repeat units = 20000 x 268 = 5360000 [1] (no units)

ci)



ii) packaging for food

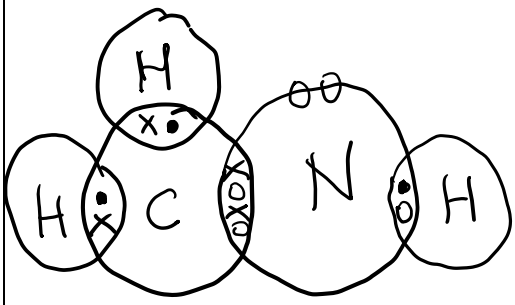
VICTORIA SCHOOL

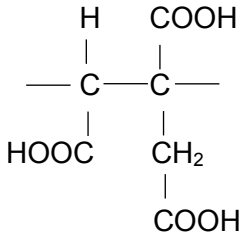
Paper 1

1	2	3	4	5	6	7	8	9	10
B	A	B	D	C	D	A	A	C	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
A	C	B	D	D	D	D	C	B	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
B	A	C	C	D	C	A	D	D	B
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
D	C	C	B	B	D	D	D	A	B

Paper 2

Qn	Suggested answers	Mark
A1a	SO_2	1
A1b	C	1
A1c	$CaCl_2$	1
A1d	$Cu(NO_3)_2$ / $ZnSO_4$	1
A1e	$Cu(NO_3)_2$	1
A2a	Isotope	1
A2bi	$2D_2 + O_2 \rightarrow 2D_2O$	1
A2bii	They have the **same number** of **valence electrons**.	1
A2biii	Number of moles of water = 7.2/18 = 0.400 mol Number of moles of sodium = 6.9/23 = 0.300 mol ; Since 0.300 mol of sodium will react with 0.300 mole of water, water is in excess and **sodium** is the **limiting** reagent. ; Number of moles of hydrogen = 0.300 ÷ 2 = 0.150 mol Volume of hydrogen gas = 0.15 x 24 = **3.60 dm^3** ;	 1 1 1
A3a	Methane has a **simple molecular structure** while lithium has **giant metallic structure**. ; **Less energy** is needed to overcome **weak intermolecular forces of attraction** in methane as it has a lower boiling point while a **larger amount of energy** is needed to overcome **strong metallic bonds between positive ions and electrons in lithium** as it has a higher boiling point. ;	1 1
A3b	Lead(II) bromide is **insoluble in water** and displacement reaction is unable to take place.	1

Qn	Suggested answers	Mark
A3ci	**Diamond**	1
A3cii	There are **no mobile electrons** as **all valence electrons** of the carbon atoms are involved in **bonding**.	1
A3d	 1m bonding electrons, 1m non-bonding electrons	2
A4a	Group 0/Noble gases.	1
A4b	**Transition elements** in the Mendeleev's Periodic Table are **arranged with the other elements in groups** while transition elements in the modern Periodic Table is placed in a **transition element block**. **Hydrogen** is placed **in Group I** together with other alkali metals in the Mendeleev's Periodic Table while **hydrogen is not placed in any Groups** in the modern Periodic Table. **Groups** are **horizontally arranged** and **Periods** are **vertically arranged** in the modern Periodic Table while **Groups** are **vertically arranged** and **Periods** are **horizontally arranged** in the modern Periodic Table. Any 2 of the points.	1 1
A4c	In Group IV and Period 4	1
A4di	**No**. Elements in the same Group should form **compounds** with **similar formulae**. Accept: oxidation states of oxygen in the metal oxides are different, different ratios of elements in the formulae	1
A4dii	**Yes**. Going down the group, the **number/proportion of oxygen** in the **formula increases**.	1
A4e	peroxide ion: O_2^{2-} superoxide ion: O_2^-	1 1
A5ai	Circle -OH and -COOH groups	1
A5aii	Acidified $KMnO_4$: purple to colourless Na_2CO_3: effervescence of colourless gas	1m each
A5bi	Steam, 300^oC, 60 atm, phosphoric(V) acid catalyst Accept: water	1

<table>
<tr><th>Qn</th><th>Suggested answers</th><th>Mark</th></tr>
<tr><td>A5bii</td><td>  </td><td>1</td></tr>
<tr><td>A5ci</td><td>
<table>
<tr><td></td><td>C</td><td>H</td><td>O</td></tr>
<tr><td>Mass in 100 g /g</td><td>35.8</td><td>4.5</td><td>59.7</td></tr>
<tr><td>No. of moles / mol</td><td>2.983</td><td>4.5</td><td>3.73125</td></tr>
<tr><td>Ratio</td><td>1</td><td>1.5</td><td>1.25</td></tr>
</table>
Formula: $C_4H_6O_5$</td><td>1

1</td></tr>
<tr><td>A5cii</td><td>No. of moles of NaOH = 0.0294 x 1
= 0.0294 mol

No. of moles of Y = (1.97 / 134) x 1
= 0.01470 mol

No. of carboxyl groups = 0.0294 / 0.01470
= 2</td><td>

1

1</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>A6a</td><td>1 (state no mark)

The reaction releases heat as the enthalpy change is the more negative/ The reaction releases more heat.</td><td>

1</td></tr>
<tr><td>A6b</td><td>$SiO_2 + CaO \longrightarrow CaSiO_3$

Calcium carbonate in limestone added is decomposed under high heat/ thermally decomposed to form calcium oxide and carbon dioxide.

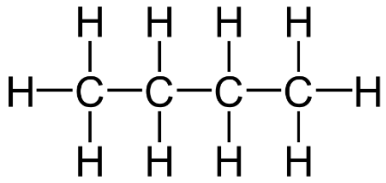
Calcium oxide is a basic oxide and it reacts with silica/silicon dioxide/SiO_2/acidic impurities, to form molten slag OR

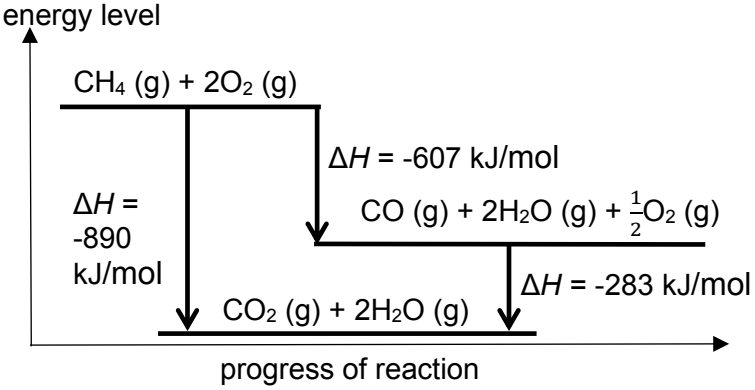
Calcium oxide reacts with silicon dioxide in a neutralization reaction to produce molten slag.</td><td>1

1

1</td></tr>
<tr><td>A6c</td><td>To produce steels with different / particular properties for different / particular uses.</td><td>1</td></tr>
<tr><td>A6d</td><td>Scrap steel has lower melting point than iron ore /
Less heat energy is required to melt the scrap steel.</td><td>1</td></tr>
<tr><td>A6ei</td><td>Calcium oxide / Calcium chloride

Accept: silica gel</td><td>1</td></tr>
</table>

Qn	Suggested answers	Mark
A6eii	**Gaseous** iron(III) chloride cools and is **deposited** / changes from **vapour to solid**.	1
A7a	**Petroleum gas.** It has a **short carbon chain length**/it is a **gas at room temperature.**	 1
A7b	**Bubble** gaseous sample of **butadiene** into **aqueous bromine**. ; **Reddish-brown/orange-brown liquid** turns **colourless rapidly/decolourise rapidly**. ; Max 1m if add aqueous bromine directly into butadiene.	1 1
A7c	The particles are **far apart** in a disorderly arrangement. ; The particles **move randomly** at **high speeds**. ;	1 1
A7di	Nickel catalyst, 200 °C	1
A7cii		1

Qn	Suggested answers	Mark
B8a	$\Delta H_3 = \Delta H_1 + \Delta H_2$ Enthalpy change of complete combustion = enthalpy change of incomplete combustion + ΔH_2 $-890 = -607 + \Delta H_2$; $\Delta H_2 = -890 + 607 = -283$ kJ/mol ;	 1 1
B8b	energy level  1m: all reactants and products at correct energy level 1m: correct ΔH and values for -607 kJ/mol and -890 kJ/mol 1m: correct ΔH and value -283 kJ/mol	3

Qn	Suggested answers	Mark
B8c	The total **bond energy of carbon dioxide** is **greater** than the combined bond energy of **carbon monoxide and oxygen**. ; This increases the total **energy released** from the **formation of the products of complete combustion,** which is **greater** than the total energy released from the formation of the products of incomplete combustion. ; Accept: energy released from forming more bonds in the products	1 1
B8d	The **oxidation state** of **carbon increases** from **-4 in CH_4** to **+4 in CO_2**. Hence, **oxidation** occurs. ; The **oxidation state** of **oxygen decreases** from **0 in O_2** to **-2 in CO_2/H_2O**. Hence, **reduction** occurs. ; Since oxidation and reduction occurs simultaneously, this is a redox reaction.	1 1
B8ei	$\Delta G = \Delta H - T\Delta S$ $\Delta G = -890 - (298)(-0.242)$ $= -818$ kJ / mol ; Hence, the **reaction will proceed naturally**. ; Accept: –817.884 kJ / mol	1 1
B8eii	Although the reaction proceeds naturally, the temperature is too low and the **speed of reaction is slow**.	1
B9a	$4Ag + O_2 + 4H^+ \longrightarrow 4Ag^+ + 2H_2O$	1
B9b	Silver to platinum	1
B9c	No of moles of silver = no. of moles of electrons No. of oxygen molecules $= \frac{(5.20 \times 10^{-4})}{4} \times 6 \times 10^{23}$ $= 7.89 \times 10^{19}$	 1 1
B9d	Insert a **glowing splint** into the tube. Gas **relights** the glowing splint.	1 1
B9e	Ensures **a constant rate of diffusion of oxygen** to the platinum electrode/ **constant supply of oxygen** to the electrode.	1
B9f	Silver chloride / AgCl	1
EITHER B10a	Reducing agent	1
B10b	Measure **volume of gas** produced using a **calibrated gas syringe** and measure the **time taken for reaction to reach completion** using a **stopwatch**.	2

Qn	Suggested answers	Mark
	1m: Volume vs time 1m: apparatus	
B10ci	**Twice the number of / More H_2O_2 molecules/ particles per unit volume**. **Higher frequency of effective collisions between reacting particles**, leading to **a faster reaction rate**.	1 1
B10cii	No. Silver oxide is a **limiting reactant.**	 1
B10d	Amount of Ag_2O = $\frac{1}{24}$ = 0.0417 mol Mass of Ag_2O = 0.0417 x 232 = 9.67 g	1 1
B10e	Add **excess aqueous sodium hydroxide** to the mixture to dissolve all lead(II) oxide. **Filter** the mixture to obtain **Ag_2O residue**. **Wash** it with distilled water and **dry** between sheets of filter paper.	1 1
OR B10ai	Hydrogen gas / H_2	1
B10aii	Neutralisation **reaction between Al_2O_3 and acid** which produces salt and water, **exposes the aluminium**. **Aluminium metal and acid** reaction results in the **H_2** gas produced after some time.	1 1
B10b	In dilute HCl, **OH^- ions are preferentially discharged/ oxidised more readily** at the anode to produce **O_2 gas**. The **gas reacts with Al metal to form Al_2O_3** layer. In concentrated HCl, **Cl^- ions are preferentially discharged to form Cl_2 gas** instead.	1 1
B10ci	**3**Al + **3**NH_4ClO_4 → Al_2O_3 + AlCl$_3$ + **3**NO + **6**H_2O	1
B10cii	Add aqueous NaOH / NH_3 to both samples. **White precipitate** formed which dissolves in excess to form a colourless solution indicates zinc perchlorate sample. No visible reaction for ammonium perchlorate. Or Add **aqueous NaOH** to both samples of ammonium perchlorate and zinc perchlorate and **heat**.	1 1 1 1

Qn	Suggested answers	Mark
	Gas evolved which turns moist red litmus paper blue is ammonium perchlorate while the other sample is zinc perchlorate.	
B10ciii	Disagree(no mark) Excess **ammonium carbonate cannot be filtered** as it is **soluble in water.**	1
B10civ	Aqueous ammonia	1

WEST SPRING SECONDARY SCHOOL

Paper 1

Q1	A		**Q11**	B		**Q21**	D		**Q31**	B
Q2	B		**Q12**	A		**Q22**	A		**Q32**	C
Q3	A		**Q13**	B		**Q23**	D		**Q33**	B
Q4	B		**Q14**	C		**Q24**	C		**Q34**	A
Q5	D		**Q15**	C		**Q25**	D		**Q35**	A
Q6	B		**Q16**	C		**Q26**	C		**Q36**	D
Q7	B		**Q17**	D		**Q27**	B		**Q37**	A
Q8	B		**Q18**	B		**Q28**	A		**Q38**	C
Q9	A		**Q19**	C		**Q29**	D		**Q39**	D
Q10	A		**Q20**	B		**Q30**	A		**Q40**	B

Paper 2

1	**(a)**	Neutralisation	**1**
	(b)	Oxidation	**1**
	(c)	Decomposition	**1**
	(d)	Reduction	**1**
	(e)	Combustion / Oxidation	**1**
			[5]
2	**(a)**	B	**1**
	(b)	It is a mixture that contains **A and E** [1] and an **unknown substance** [1].	**2**
	(c)	Distance travelled by dye C ÷ distance travelled by solvent = **1.85 ÷ 4.55 = 0.4066** = 0.4 [1] (students to measure using ruler) Food colour C is **Fast Red.** [1]	**2**
			[5]

3 **(a)**  CAO — **1**

(b)

Universal Indicator paper	colour	pH
1	**Blue /violet /purple**	**9-11**
2	**red**	**1**

2 correct [1] — **2**

(c) Gaseous ammonia **(Mr = 17) is lighter/lower molar mass** than gaseous hydrogen chloride **(Mr= 36.5)** [1].
Lighter ammonia molecules can **diffuse faster** [1] and hence, **travels further/longer distance** [1] towards the right / nearer to hydrogen chloride end, than the heavier hydrogen chloride molecules, within the same period of time. — **3**

[6]

4 **(a)** $(84 \times \frac{1}{100}) + (86 \times \frac{10}{100}) + (87 \times \frac{7}{100}) + (88 \times \frac{82}{100})$ — **1**

$= 87.7$ **(A: 87.69 or 88)** — **1**

(b)

Elements	Sr	O
Mass in grams	180	245 - 180 = 65
Molar mass	88	16
Number of moles	$\frac{180}{88}$ =2.045	$\frac{65}{16}$ = 4.062
Mole ratio	$\frac{2.045}{2.045}$ = 1	$\frac{4.0625}{2.045}$ = 1.99 ~ 2

Correct moles [1] ; correct ratio [1]
The Empirical formula is SrO_2 — **2**

(c) Oxygen **oxidised Sr**, **increasing oxidation state of Sr** from **0 in Sr to +4 in SrO_2.** Oxygen itself is **reduced** due to **decrease in oxidation state** from **0 in O_2 to -2 in SrO_2**.

or

Oxygen **oxidised Sr**, **increasing oxidation state of Sr** from **0 in Sr to +2 in SrO_2.** Oxygen itself is **reduced** due to **decrease in oxidation state** from **0 in O_2 to -1 in SrO_2**.

[1] correct definition of oxidation and reduction for Sr and O.
[1] correct values of oxidation states for Sr and O. — **2**

(d) O_2^- — **1**

5 **(a)**

symbol	number of protons	number of neutrons	number of electrons
$^{85}_{210}At$	85	125	85
$^{85}_{211}At$	85	126	85

Any 3 correct [1] **2**

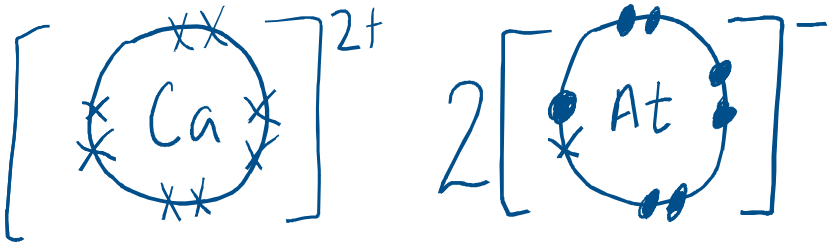
(b) Similarity : Both atoms have **85 protons** [1]
Difference : Astatine – **210** has **125 neutrons** whereas astatine-**211** has **126 neutrons.** [1] **2**

similarity: both atoms have the same number of protons.
difference: the two atoms have different number of neutrons. **[1]**

(c)

1

(d)



[1] [1] **2**

Chemical formula : $CaAt_2$ **1**
ECF for chemical formula based on diagram.

(e) Calcium astatide is an ionic compound, which consists of **strong electrostatic forces** of attraction and requires a **large amount of heat** to overcome.

Astatine is a simple covalent compound, which consists of **weak intermolecular forces** of attraction and **requires little heat** to overcome. **3**

Hence, calcium astatide has a **higher melting point** than astatine. [1]

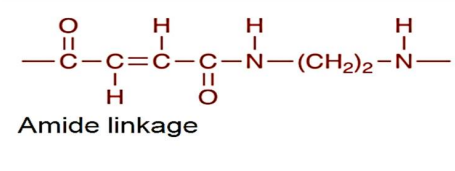
[1m - correct type of forces ; 1m - lesser/greater heat required for astatine/calcium astatide respectively]

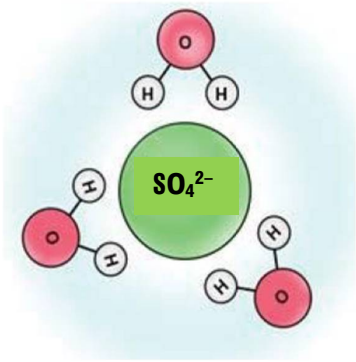
6 **(a)** In graphite, each carbon atom is **covalently bonded to three other carbon atoms**.[1]

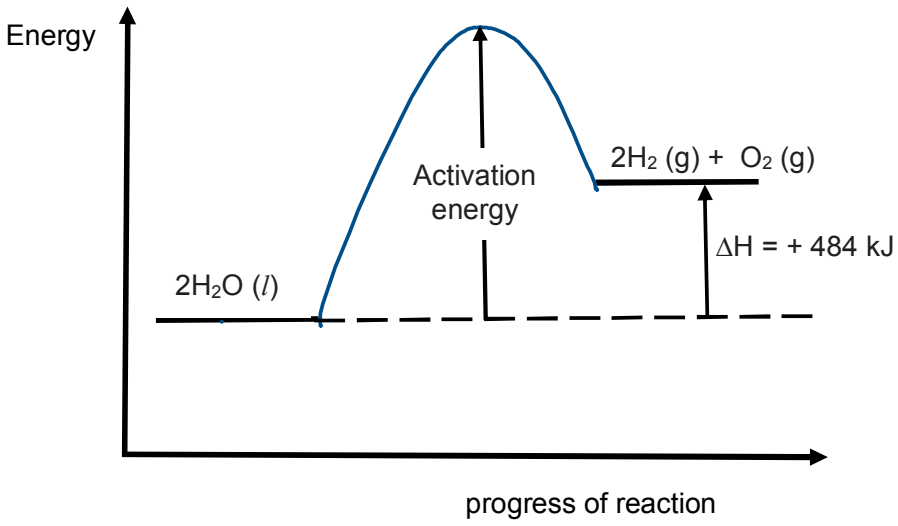
Hence, **one valence electron** that is **not used for bonding is free to move / mobile** and carry electrical charges. [1] **2**

(b) **Hydrogen** and **chloride ions** are **discharged**, whereas **sodium and hydroxide ions remain** in solution / **not discharged**. [1]

Hence, solution X is **sodium hydroxide.** [1] **2**

7	**(a)**	$3K + AlCl_3 \rightarrow 3KCl + Al$	**1**
	(b)	**Potassium / K** is **oxidized** due to **loss of (one) electron** to form potassium ion / K^+ / potassium chloride. [1] **Aluminium ion / Al^{3+}** is **reduced** due to **gain of (three) electrons** to form aluminium metal / Al. [1] Since **both reduction and oxidation take place simultaneously** [1], this is a redox reaction.	**3**
	(c)	Sodium **can** be used. It is **more reactive than aluminium,** and can displace aluminium from aluminium chloride.	**1**
			[5]
8	**(a)**	**(i)** - Each consecutive member **increases** by **one carbon** atom and **two hydrogen atoms**. - Name ends with -ol. - General formula is $C_nH_{2n+1}OH$ or $C_nH_{2n+2}O$ - Same functional group -OH - **A: Boiling point increases gradually from methanol to propanol. so keyword here is 'gradual increase'.** - **A: Enthalpy heat increases by 650 kJ/mol from one member to the next.**	**Any 2** **2**
		(ii) – 2650 kJ The difference between enthalpy changes is about 650 kJ. [Give credit for correct reason]	**1**
	(b)	**(i)** ethanol / fumaric acid add aqueous bromine: reddish brown bromine remains / no visible change / reddish brown bromine decolourises add acidified potassium manganate (VII) solution and warm: purple acidified potassium manganate(VII) decolourises / no visible change / purple acidified potassium manganate (VII) remains add named metal / carbonate: no visible change / effervescence **R: potassium manganate (different formula, K_2MnO_4)** **R: bromine (the word 'aqueous'/ 'solution' must be given)** **R: through bromination (without stating aqueous bromine as the reagent)**	Any 1 difference **2**
		(ii)  	**1** **1**

B9	**(a)**	**(i)** Water (solvent) will **boil** off / **turn to steam** Reject : evaporate	**1**
		(ii) $Ce_2(SO_4)_3$ or Cerium(III) sulfate / Cerium sulfate	**1**
		(iii) at 50 °C, **80 g** of potassium nitrate in 100 g of water. In 200 g : 80 x 2 = **160 g**	**1** **1**
	(b)	The forces of attraction between water and Na^+ and Cl^- are **stronger/greater** than the attractive forces between Na^+ and Cl^- in the solid. The forces of attraction between water and Ag^+ and Cl^- are **weaker** than the attractive forces between Ag^+ and Cl^- in the solid. Hence, sodium chloride is more soluble than silver chloride.	**1** **1**
	(c)	 Hydrogen atoms of the water molecules are attracted to the sulfate ions.	**1**
	(d)	As temperature increases, value of K_{sp} increases. **R : directly proportional (not constant)**	**1**
	(e)	**(i)** calcium sulfate	
		(ii) $Ca(NO_3)_2$ + Na_2SO_4 → $CaSO_4$ + $2NaNO_3$ 0.02M 0.005M $CaSO_4$ (aq) → Ca^{2+} (aq) + SO_4^{2-} (aq) Ionic product (IP) = $[Ca^{2+}]$ x $[SO_4^{2-}]$ = 0.02 mol x 0.005 mol = 0.0001 Since I.P (0.0001) > K_{SP} (0.00002), precipitation will occur. **ECF** based on named compound in (e)(i) or wrong Ksp answer.	 **1** **1**
	(f)	Cool the solution / lower the temperature of the solution	**1**

<table>
<tr>
<td>B10</td>
<td>(a)</td>
<td>


R: double arrow head for labeling of activation energy or enthalpy change.
R: missing state symbols / equation not balanced.
*Penalise 1m for shape if energy level diagram is given instead; no dashed line to indicate arrows for activation energy and enthalpy change.

BOD : label activation energy as ‘Ae’ or ‘Ea’ but notify that there should be no abbreviation if not given in question.
</td>
<td>1 – correct reactants & products

1 – activation energy

1 – enthalpy change

1 – correct shape</td>
</tr>
<tr>
<td></td>
<td>(b)</td>
<td>
<table>
<tr><th>Fuel</th><th>enthalpy change when 1 mol of H_2 is completely burned in kJ/mol</th><th>enthalpy change when 1 kg of H_2 is completely burned in kJ/kg</th></tr>
<tr><td>Hydrogen, H_2</td><td>(- 484) ÷ 2 = -242</td><td>1000 ÷ 2 = 500 mol

500 x (-242) = -121000 kJ</td></tr>
</table>
-1m overall for no/wrong sign.
</td>
<td>1 x 2</td>
</tr>
<tr>
<td></td>
<td>(c)</td>
<td>Yes. When hydrogen burns in oxygen, water, which is non-polluting, is formed.

Or

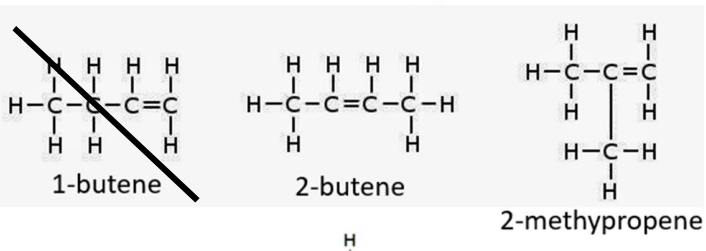
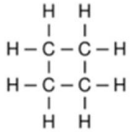
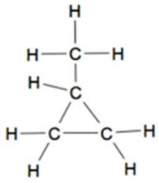
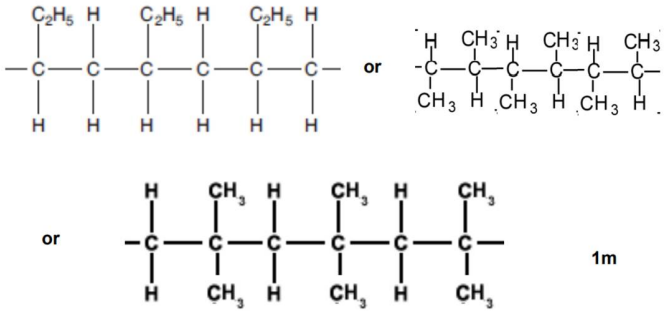
No. Source of hydrogen is cracking of petroleum, which occurs at high temperature, will result in combustion of sulfur / carbon-containing compounds to form pollutants such as sulfur dioxide / carbon monoxide.

Or

No. Hydrogen produced from electrolysis of water, requires electricity that is generated by burning fossil fuels. This can result in pollutants such as sulfur dioxide / carbon monoxide being produced.

[Credit is given for correct reason.]</td>
<td>2</td>
</tr>
</table>

Either			
B11	**(a)**	At the start of the reaction, <u>concentration of the reactants are at the highest</u>. Hence, the **reaction is** the **fastest** / **gradient** is **steep**. As the reaction progresses, **reactants are being used up**, **reaction slows down** /**gradient** becomes **less steep / gentle**. When the **reaction is complete** / **has stopped**, the **gradient is zero** / graph reaches a **plateau/horizontal**.	**1** **1** **1**
	(b)	When hammered, the **<u>exposed surface area</u>** per unit volume is **<u>increased</u>**. Reaction will be **<u>faster / rate of reaction increases.</u>**	**1** **1**
	(c)	As the concentration increases, the **number of reacting particles per unit volume increases**. There will be **more frequent /increased frequency/increased rate of effective collisions**, leading to **faster reaction/greater mass loss of iron**.	**1** **1**
	(d)	1 – 9 mg (must be less than 10mg) Iodine is **less reactive** than bromine so reaction will be **slower**. [Credit given to correct reason.]	**1**
	(e)	Moles of Br_2 = 12 ÷ 24 = 0.5 mol [1] Moles of Fe = 0.5 x $\frac{2}{3}$ = 0.3333 mol Mass of Fe = 0.3333 x 56 = 18.7 g [1] A : 18.6g [Allow ecf]	**2**
OR			
B11	**(a)**	Cracking	**1**
	(b)	Propane	**1**
	(c)	$C_{11}H_{24} \rightarrow 2C_4H_8 + C_3H_8$	**1**
	(d)	Moles of $C_{11}H_{24}$ = Mole of butene = 1 x 2 = 2 mol Mass of butene = 2 x (12 x 4 + 8) = 112 g % yield of butene = (50.4 ÷ 112) x 100% = 45% [Allow ecf]	**1** **1**

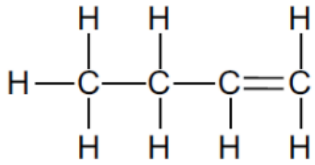
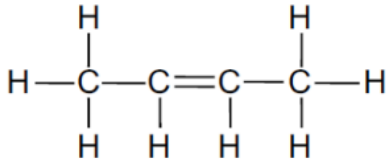
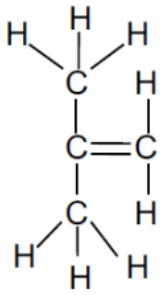
	(e)	Isomers of C_4H_8  1-butene 2-butene 2-methypropene  cyclobutane  methycyclopropane	Any 2 x [1]	**2**
	(f)	 or or 1m		**1**
	(g)	Method : **fractional distillation** [Reject : distillation] Reason : They have **different boiling points**.		**1** **1**

Paper 1

1	**C**	11	**C**	21	**A**	31	**A**
2	**C**	12	**D**	22	**B**	32	**A**
3	**B**	13	**C**	23	**B**	33	**C**
4	**C**	14	**C**	24	**C**	34	**B**
5	**B**	15	**B**	25	**A**	35	**A**
6	**A**	16	**B**	26	**A**	36	**A**
7	**A**	17	**A**	27	**A**	37	**C**
8	**D**	18	**B**	28	**B**	38	**B**
9	**B**	19	**C**	29	**C**	39	**C**
10	**A**	20	**D**	30	**D**	40	**B**

Paper 2

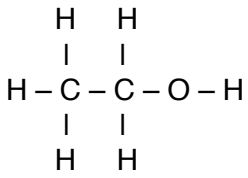
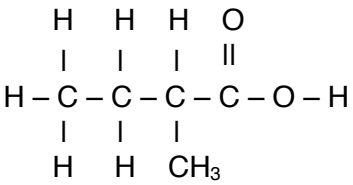
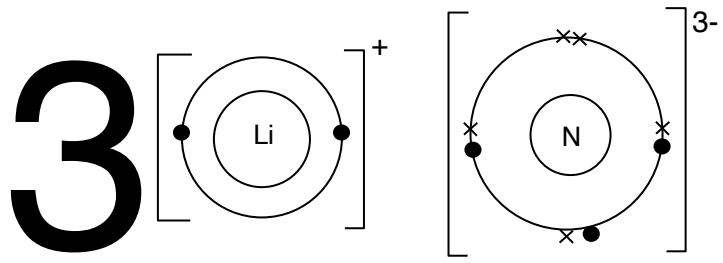
			SECTION A [50 marks]	
A1	**(a)**		iron	**1**
	(b)		iodine	**1**
	(c)		aluminium **and** lead (both correct to score)	**1**
	(d)		iron	**1**
	(e)		argon	**1**
	(f)		aluminium	**1**
			Total	**6**
A2	**(a)**		solid disappears / sample disappears / nothing remains in test tube / no more (pungent) smell of ammonia NOT ammonium iodide evaporated / vaporised	**1**
	(b)		moles of ammonium iodide = 2.9/145 = 0.02 (1) total moles of gas = 2 × 0.02 **=** 0.04 (1) total volume of gas = (0.04 × 24) = 0.96 dm^3 OR 960 cm^3 (1)	**3**
	(c)	**(i)**	$2NH_4I + X_2 \rightarrow 2NH_4X + I_2$	**1**
		(ii)	astatine is less reactive than iodine / astatine cannot displace iodine (ORA) NOT astatine is below iodine	**1**
	(d)		in solid ions cannot move / are held in fixed positions (1) in aqueous / solution ions can move / are mobile (1)	**2**
			Total	**8**
A3	**(a)**		incorrect (no mark) Idea that the shorter the time, the higher the diffusion rate (1) $1/t \propto 1/M_r$, so 1/t x M_r = constant (for inverse proportion) Mr of HCl = 36.5 & Mr of HBr = 81 (1) 1/4 x 36.5 (HCl) = 9.1 1/7 x 81 (HBr) = 11.6 Since 9.1 ≠ 11.6, the conclusion is not correct (1) Qualitative comparison of M_r to difference in diffusion rate – award max 1	**3**
	(b)	**(i)**	Initially the carbonate is cold/at room temperature, so a low speed of reaction / at the start, the carbonate is not hot enough to decompose ALLOW takes time to overcome the activation energy	**1**
		(ii)	At the time when the line is first horizontal / gradient of the line is zero ALLOW explanation written on the graph	**1**

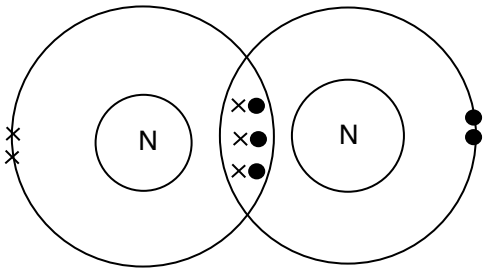
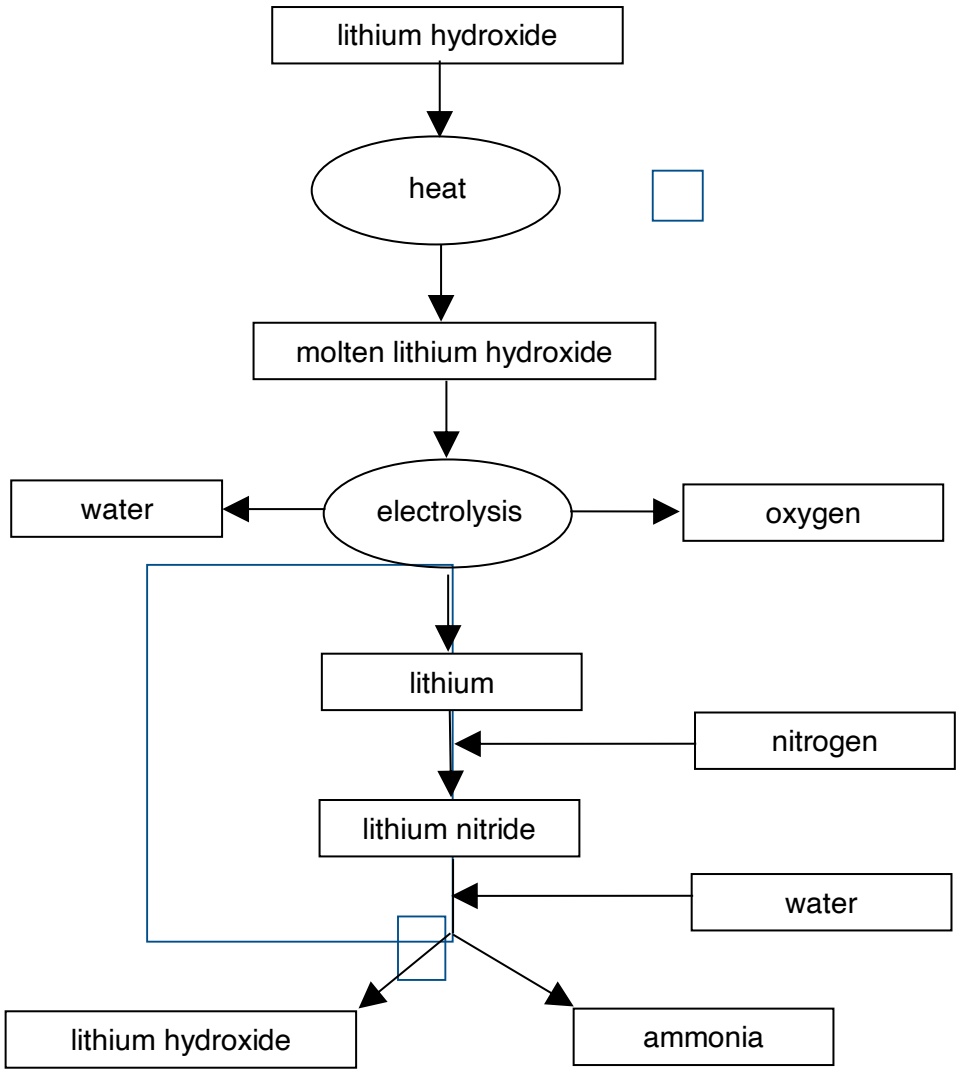
		(iii)	$MgCO_3$ any time greater than 70 and less than 360 (1) $PbCO_3$ any time less than 60 (1) Idea that the time is linked to position of metal in the reactivity series e.g. the more reactive the metal the longer the time (1)	**3**
			Total	**8**
A4	**(a)**	**(i)**	Moles of C_4H_8 =600 / 24 = 25 (1) Energy released = 25 x 2702 = 67 550 kJ (1)	**2**
		(ii)	Bond breaking absorbs energy / bond breaking is endothermic; Bond making releases energy / bond making is exothermic (1) More energy is released than absorbed (1)	**2**
		(iii)	any one of these alkene isomers:   	**1**
	(b)	**(i)**	Y is a reducing agent / Y is oxidised / Potassium manganate(VII) oxidises Y NOT: reference to colour changes NOT: potassium manganate(VII) is an oxidising agent (unqualified) Y is a weak acid / Y is only partially ionised to form H^+ ions ALLOW: Y is weak / Y is a weaker acid than hydrochloric acid/is not strong compared with hydrochloric acid NOT: Y is not a strong acid	**1** **1**

		(ii)	moles of C = 2.67/12 = 0.223 moles of H = 0.220/1 = 0.220 moles of O = 7.11/16 = 0.444 (1) simplest ratio: 1: 1: 2 empirical formula = CHO_2 (any order) (1) n = 90/45 = 2 molecular formula = $C_2H_2O_4$ (1)	**3**
			Total	**10**
A5	**(a)**	**(i)**	sodium is above hydrogen in reactivity series / sodium is more reactive than hydrogen / hydrogen is below sodium in reactivity series / hydrogen is less reactive than sodium	**1**
		(ii)	hydrogen and chlorine gases are formed in equal mole ratio or 1:1 mole ratio OR show half equations: $2H^+ + 2e^- \rightarrow H_2$ and $2Cl^- \rightarrow Cl_2 + 2e^-$	**1**
		(iii)	(1) for any of following sodium hydroxide is formed concentration of hydroxide ions is higher than hydrogen ions ALLOW OH^- ions are present	**1**
	(b)	**(i)**	Cu^{2+} / copper ions gain electrons accept $Cu^{2+} + 2e^- \rightarrow Cu$	**1**
		(ii)	change to copper electrodes / use copper as anode (1) (1) for explanation Cu^{2+} ions coming out of solution are replaced Cu atoms are oxidized to Cu^{2+} ions number of Cu^{2+} ions present (in solution) stays the same concentration of Cu^{2+} ions (in solution) stays the same	**2**
			Total	**6**
A6	**(a)**	**(i)**	respiration and combustion use oxygen and produce carbon dioxide whereas photosynthesis uses carbon dioxide and produces oxygen (1) burning more fossil fuels - increase in combustion / deforestation - decrease in photosynthesis (1) more heat energy trapped in the atmosphere results in global warming (1)	**3**
		(ii)	evidence is initially strong then not (1) increase in solar activity accompanied by increase in temperature / upward trend in both, followed by breakdown of trend from 1980 (1)	**2**
	(b)	**(i)**	X = activation energy; [1] ALLOW: Ea Z = enthalpy change (of reaction); [1] ALLOW: ΔH NOT: energy change/heat given out	**2**
		(ii)	energy change is positive/enthalpy change is positive/ energy of 2NO is above that of N2 and O2/ energy of N2 and O2 is below that of 2NO/ energy of product(s) is above that of reactants/ energy of reactants is below that of product(s) NOT: it (unspecified) gains energy NOT: the product is above the reactants	**1**
	(c)	**(i)**	activation energy lowered/provides surface for molecules to react/makes the reaction go by quicker alternative pathway NOT: allows more frequent collisions	**1**
		(ii)	2.4/2 = 1.2 dm^3	**1**

		(iii)	2.0/2.4 x 100 (1) = 83.3 or 83% (1) OR 1.0/1.2 x 100 (1) = 83.3 or 83% (1) OR 1.0/24 = 0.04166 (mol N_2) moles NO = 2 × 0.04166 = 0.0833 (moles) (1) theoretical moles of NO = 2.4/24 = 0.1 (moles) 0.0833/0.1 x 100 = 83.3 or 83% (1) ALLOW: ecf from part (ii)	**2**
			Total	**12**

SECTION B [30 marks]

B7	**(a)**		as a catalyst / speeds up the reaction	**1**
	(b)		4.485% / 4.49% / 4.5%	**1**
	(c)		carbon dioxide / CO_2	**1**
	(d)	**(i)**	0.25 (ignore any units)	**1**
		(ii)	Cider B / Sample 4 All of the malic acid has been converted to lactic acid / Only a single spot of lactic acid	**1** **1**
	(e)		□ Use 25.0 cm^3 or an equal volume of each cider solution □ Bromine solution is added to both until the bromine is no longer decolourised. (or reddish-brown colour remains) □ More bromine used means more procyanidin B2 present in cider / more bitter tasting (ORA) □ Assumption made: No other unsaturated compounds present in cider other than procyanidin B2	**4**
	(f)		Alcohol  Carboxylic acid 	**1** **1**
			Total	**12**
B8	**(a)**		oxygen nitrogen both correct to score	**1**
	(b)		$Li^+ + e^- \rightarrow Li$	**1**
	(c)		Correct outer shells (1) Correct ionic charges (1) 	**2**

			Correct outer shells (1) Correct shared electron pairs (1)  	2
(d)			$Li_3N + 3H_2O \rightarrow 3LiOH + NH_3$	1
(e)			Arrow from water at top to water at bottom / to the vertical line beneath the 'lithium nitride' box. **OR** Arrow from lithium hydroxide at bottom to lithium hydroxide OR heat at top OR to the vertical line between lithium hydroxide and heat.  	1
				Total 8

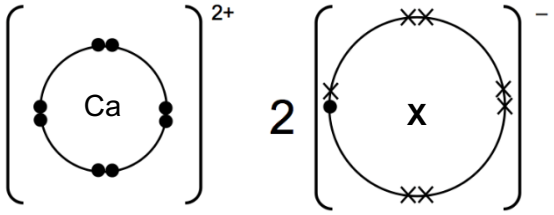
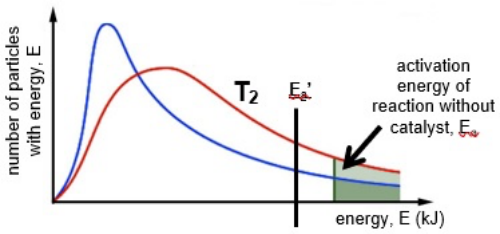
YUHUA SECONDARY SCHOOL

Paper 1

1. A	2. A	3. A	4. B	5. A	6. B	7. D	8. A	9. D	10. C
11. C	12. C	13. C	14. A	15. B	16. B	17. A	18. C	19. A	20. C
21. A	22. C	23. C	24. D	25. D	26. A	27. D	28. A	29. C	30. A
31. A	32. B	33. C	34. C	35. B	36. B	37. B	38. A	39. D	40. D

Paper 2

1	**a**	<table><tr><th>symbol</th><th>name</th><th>charge</th></tr><tr><td>●</td><td>neutron</td><td><u>0</u></td></tr><tr><td>⊕</td><td><u>proton</u></td><td>+1</td></tr><tr><td>⊖</td><td><u>electron</u></td><td>−1</td></tr></table> All correct to be awarded 1 mark.	1
	bi	**<u>D^-</u>**	1
	bii	**<u>NaD</u>** Note: Mark not awarded if student write DNa	1
	c	**<u>liquid</u>** **<u>Water, H_2O, is a liquid at room temperature.</u>** Note: First mark not awarded if the reason is incorrect	1 1
2	**a**	The use of the locating agent is to make the **<u>invisible/colourless markings</u>** **<u>visible</u>**. Note: Mark not awarded if student write to locate the colourless spots.	1
	b	**<u>No</u>**, the two rock samples are from different regions. The **<u>chromatogram</u>** of rock **A** and rock **B** had **<u>different number of spots</u>**.	1 1
	c	R_f value of Pb^{2+}ions = 2 / 16 = **<u>0.125</u>** Note: Mark not awarded if student write unit for answer.	1
	d	The spot should be **<u>drawn at mark 12</u>**.	1
3	**ai**	**<u>silver iodide</u>**	1
	aii	**<u>calcium hydroxide</u>**	1
	aiii	**<u>zinc hydroxide</u>**	1
	aiv	**<u>hydrogen gas</u>**	1
	b	**<u>zinc ion</u>** or **<u>Zn^{2+}</u>** Note: Mark not awarded when student did not write ion if they name as it could refer to zinc metal.	1
	c	**<u>$Zn (s) + 2HCl (aq) \rightarrow ZnCl_2 (aq) + H_2 (g)$</u>** Note: State symbols not required.	1
4	**a**	**<u>$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$</u>** Note: Mark not awarded if state symbols is not written or is incorrect.	1
	b	**<u>Nitrogen gas</u>**	1

		Note: Mark awarded even if student write the chemical formula, N_2.	
	c	volume of O_2 reacted = 90 – 72 = 18 cm^3 number of moles of O_2 reacted = (18/1000) / 24 = **0.00075 mol** From the balanced chemical equation, 2 mol of Mg reacts with 1 mol of O_2. **Hence, 0.0015 mol of Mg will react with 0.00075 mol of O_2.** Mass of Mg reacted = 0.0015 * 24 = **0.036 g**	1 1 1
5	**a**	The **oxidation state of X decreases from 0 to -1** in both reactions.	1
	bi	C**X**$_4$: **simple molecular structure** Ca**X**$_2$: **giant crystal lattice structure**	1 1
	bii		2
	c	Ca**X**$_2$ has a higher melting and boiling point. This is because **large amount of energy is required** to **overcome the strong electrostatic forces of attraction between the positive and negative ions**. Note: Mark not awarded for correct identification without reasons.	1 1
6	**a**	A reaction that **takes in heat/thermal energy** from the surroundings.	1
	b	The rate of the forward reaction increases. This is because the **kinetic energy of the particles increases** which leads to an **increase in the frequency of effective collisions**.	1 1
	c	An increase in pressure **will not have an effect on the equilibrium**. This is because there is an **equal number of moles of gaseous reactant is to product**.	1 1
	di	**T_2**	1
	dii		1
	e	Number of mol of Fe = 5.6 / 56 = **0.1 mol** From balanced chemical equation, 3 mol of Fe produce 1 mol of Fe_3O_4, Hence, **0.1 mol of Fe will produce 0.033333 mol of Fe_3O_4**.	1 1

<table>
<tr><td></td><td></td><td>Mass of Fe_3O_4 = 0.033333 x [3(56) +4(16)] = <u>7.73 g</u></td><td>1</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>a</td><td><u>$2H^+$ (aq) + 2e → H_2 (g)</u>

Note: Mark not awarded if state symbol is missing.</td><td>1</td></tr>
<tr><td></td><td>bi</td><td><u>Oxygen gas is formed at the anode when OH^- ions are discharged</u>.

<u>Oxygen gas formed then reacts with graphite electrodes</u> to <u>form CO_2 and CO</u></td><td>1

1</td></tr>
<tr><td></td><td>bii</td><td>$4OH^-$ (aq) → O_2 (g) + $2H_2O$ (l) + 4e OR
C(s) + O_2 (g) → CO_2 (g) OR
C(s) + O_2 (g) → CO (g) OR
CO_2 (g) + C(s) → 2CO (g)

Any one of the above equations</td><td>1</td></tr>
<tr><td></td><td>c</td><td><u>No, the products will remain the same</u>.

In the presence of K^+ and SO_4^{2-} ions, it is still <u>H^+ and OH^- ions being discharged due to their ease of discharge as compared to K^+ and SO_4^{2-} ions</u>.</td><td>1

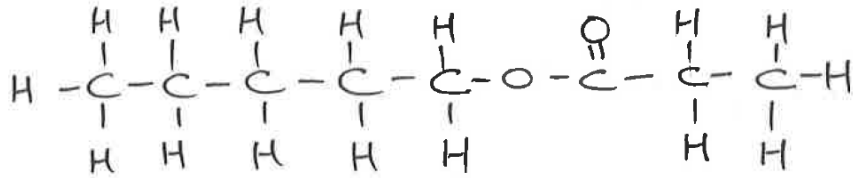
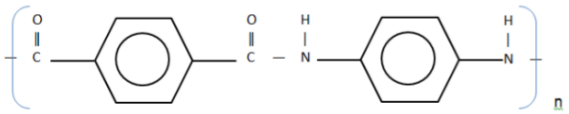
1</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>8</td><td>a</td><td><u>$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g)$</u>

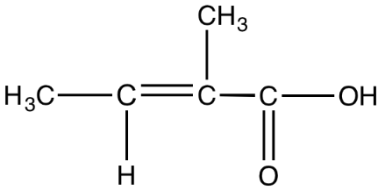
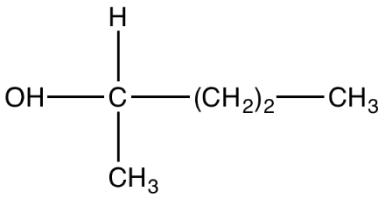
Note: Mark not awarded if state symbols is incorrect, especially for water vapour</td><td>1</td></tr>
<tr><td></td><td>b</td><td><u>$C_4H_{10} + Cl_2 \rightarrow C_4H_9Cl + HCl$</u></td><td>1</td></tr>
<tr><td></td><td>ci</td><td>Catalytic <u>cracking</u></td><td>1</td></tr>
<tr><td></td><td>cii</td><td><table><tr><td></td><td>carbon</td><td>hydrogen</td></tr><tr><td>% by mass</td><td>84.2</td><td>15.8</td></tr><tr><td>relative atomic mass</td><td>12</td><td>1</td></tr><tr><td>number of mol</td><td>84.2 / 12 = 7.017</td><td>15.8 / 1 = 15.8</td></tr><tr><td>Mol ratio</td><td>7.017 / 7.017 = 1</td><td>15.8 / 7.017 = 2.25</td></tr><tr><td></td><td>4</td><td>9</td></tr></table>
(C_4H_9) x n = 114
57n = 114
n = 2

Therefore, X is <u>C_8H_{18}</u></td><td>1

1</td></tr>
<tr><td></td><td>ciii</td><td><u>C_2H_4</u></td><td>1</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>9</td><td>ai</td><td><u>burning/combustion of fossil fuels/fuels</u>
OR
<u>Industrialisation / deforestation</u></td><td>1</td></tr>
<tr><td></td><td>aii</td><td><u>Increase in temperature of the Earth/global warming</u>
Reject “greenhouse gases”</td><td>1</td></tr>
<tr><td></td><td>aiii</td><td><u>0.038% to 0.076%</u>
Mark not deducted when units not written.</td><td>1</td></tr>
<tr><td></td><td>bi</td><td><u>the ocean</u> OR <u>plants</u> OR <u>forest/tress</u></td><td>1</td></tr>
<tr><td></td><td>bii</td><td><u>Carbon dioxide dissolves in water.</u></td><td>1</td></tr>
</table>

		The dissolved carbon dioxide can be **used by plants for photosynthesis** OR **used by marine animals** to make calcium carbonate shells or skeleton. OR **used by organisms in the sea.** Reject if there is no mention of how carbon dioxide is used by marine organisms. Reject if answer does not mention that carbon dioxide is dissolves in water.	
	ci	From the graph, **the mixing ratio of ClO and ozone is inversely related.** Since **ClO is a product of the reaction between ozone and CFCs**, **high levels of ClO coupled with low ozone levels is indicative of the presence of CFCs** in the atmosphere where ozone is depleted.	1 1 1
	cii	Ozone depletion leads **to increased exposure of UV radiation** and can **result in skin cancer/genetic mutations/eye damage.**	1 1
10	**ai**	Changes to metal strip: **Reddish-brown deposits coated on grey metal / reddish-brown deposits at the bottom of test-tube** Changes to solution: **pale blue solution turned green**	1 1
	aii	**Iron is more reactive than copper** hence iron will **displace** copper from copper(II) chloride solution.	1
	bi	**Effervescence observed**. **Green solution observed / Colourless solution turned green**.	1 1
	bii	The **volume of gas produced** for a fixed duration of time for chromium is the **second largest**. **Hydrogen gas has a molar mass of 2g/mol. The lost in mass will not be significant.**	1 1
	biii	**Volume of gas collected** for a given duration of time will be **lesser** with dilute ethanoic acid. **Ethanoic acid is a weak acid**, hence it **dissolves and ionized partially to produce a low concentration of hydrogen ions**. **Rate of reaction** will be **slower**. 1 pt [0], 2 - 3 pts [1], 4 pts [2]	2
	c	Recycling metals can ensure that metal ores which are **finite/ non-renewable resource**, can be **conserved** and prevent their depletion. **OR** Recycling **reduces the number of landfills needed for disposal of metal objects.** / Recycling reduces **damage to land created during mining for metals ores**. Land can be **used for housing or agriculture** **OR**	1

		Recycling **reduces production of pollutant gases like carbon monoxide formed during reduction of metals ores**. (any one)	
11 EITHER	**ai**	**X**: **Pentanol** **Y**: **Propanoic acid**	1 1
	aii	Add acidified potassium manganate (VII) solution separately to both samples. For **X**, **purple solution turns colourless.** For **Y**, **solution remains purple**. Note: Do not accept litmus test as it is not a chemical test.	 1 1
	aiii	 Note: Do not accept if all bonds are not shown as full structural formula is required.	1
	bi	**Condensation polymer**. It is formed when the condensation polymerization/reaction of **two organic compounds/molecules/monomers with two different functional groups and a small molecule is removed during the reaction**.	1 1
	bii	 Correct linkage drawn [1], indicated "n" with brackets [1]	2
	biii	They are **non-biodegradable/cannot be decomposed by bacteria** into simpler substances. OR Burning of Kevlar **releases CO_2 that leads to global warming in excessive amounts**.	1
11 OR	**a**	**C=C double bond** and **–OH group** Note: Do not accept alkene and alcohol.	1 1
	b	**Combustion** OR **addition** OR **oxidation** Any 2 award 1 mark each	2
	c	**Higher melting and boiling point** due to **stronger intermolecular forces of attraction** present between larger molecules of the pheromone of leaf miner moths. OR **Higher viscosity** due to **stronger intermolecular forces of attraction** present between larger molecules of the pheromone of leaf miner moths.	1 1

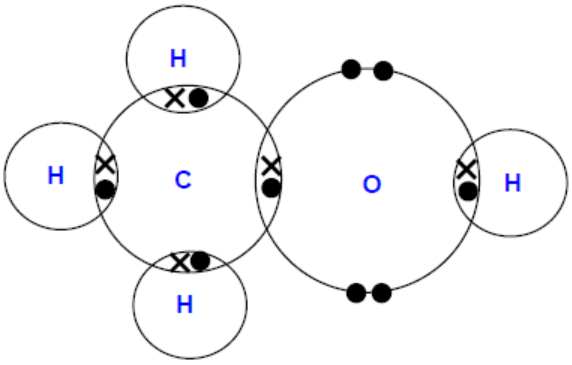
		OR **<u>Lower flammability</u>** due to the need for **<u>more oxygen for complete combustion</u>** of the larger hydrocarbon.	
	d	Add aqueous bromine separately to both pheromones. If the aqueous bromine turns **<u>from reddish-brown to colourless</u>**, it is the **<u>pheromone of the silkworm moth.</u>** If aqueous bromine **<u>remains reddish-brown, it is the pheromone of the leaf miner moth.</u>** OR Add acidified potassium manganate (VII) solution separately to both pheromones. If the acidified potassium manganate (VII) solution turns from **<u>purple to colourless</u>**, it is the **<u>pheromone of the silkworm moth</u>**. If acidified potassium manganate (VII) solution **<u>remains purple</u>**, it is the **<u>pheromone of the leaf miner moth</u>**.	1 1
	e	Compound **1**  Compound **2** 	1 1

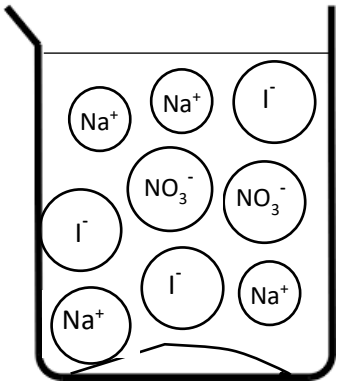
Paper 1

Qn	Answer	Qn	Answer
1	**D**	21	**A**
2	**A**	22	**B**
3	**A**	23	**D**
4	**A**	24	**B**
5	**A**	25	**C**
6	**B**	26	**B**
7	**C**	27	**D**
8	**D**	28	**C**
9	**D**	29	**D**
10	**C**	30	**A**
11	**D**	31	**D**
12	**D**	32	**B**
13	**D**	33	**D**
14	**D**	34	**C**
15	**B**	35	**B**
16	**B**	36	**B**
17	**D**	37	**A**
18	**A**	38	**B**
19	**A**	39	**A**
20	**B**	40	**C**

Paper 2

A1(a) **Full marks** **Daryl**	Diamond Must be an element (1 types of atom)	[1]
(b)	Iron (II) chloride	[1]
(c)	Carbon dioxide Not well-done. Many do not know the term 'discrete molecules'	[1]
(d)	Carbon dioxide Not well-done	[1]
(e)	Zinc oxide/sodium oxide	[1]
A2(a)	Filter the mixture and obtain the red residue of silver dichromate. [1] Wash with cold deionised water and dry between filter papers. [1]	[2]
(b)(i)	+6	[1]
(b)(ii)	$2Ag^{+}(aq) + Cr_2O_7^{2-}(aq) \rightarrow Ag_2Cr_2O_7(s)$ [1] balanced equation [1] state symbols Many students incorrectly split up the dichromate ions.	[2]
(c)(i)	The dichromate ion (Mr of 216) has a larger molecular mass than the sliver ion (Ar of 108).[1] Hence silver ion diffuses faster than dichromate ion and the red line is formed nearer to ammonium dichromate. [1] Many students never state the exact Mr in comparison.	[2]
(c)(ii)	Shorter time taken. The ions/particles gain heat energy and kinetic energy and diffuse faster. Many students never explain why rate will increase. Key terms like kinetic energy is missing.	[1]
A3(a)(i)	Purple Not well done.	[1]
(a)(ii)	0.50, 1.25	[1]
(b)(i)	NaOH / KOH/ $Ca(OH)_2$ [1] Alkali with pH 14 is a strong alkali.[1]	[2]

(b)(ii)	Blue Pink	[2]
A4(a)(i)	 [1] correct no. of sharing electrons [1] correct no. of non-sharing electrons If more than 3 symbols, pls indicate the legend clearly! Be careful of the sizes of the atoms	[2]
(a)(ii)	Methanol has covalent bonds between atoms and have a simple molecular structure/ exists as simple molecules. [1] Little energy is required to overcome the weak intermolecular forces of attraction between the molecules.[1] Thus, it exists in liquid state at room temperature and pressure. Many students left out the mention of the correct structure. Reject less/lower amount of energy needed to overcome force Not so good to write 'not as much'	[2]
(b)(i)	Labelled 'Y' graph with gentler gradient; higher than the current graph. Accept if graph end at the same point, assuming reaction has ended. Few incorrectly gave straight lines	[1]
(b)(ii)	From A to B, the concentration of HCl decreased from 1.8 mol/dm^3 to 1.2mol/dm^3 during the first 5 hours/ decreased by 0.5 mol/dm^3 during the first 5 hours.[1] From B to C, the concentration of HCl decreased from 1.2 mol/dm^3 to 0.74mol/dm^3 in the next 5 hours/ decreased by 0.56 mol/dm^3 in the next 5 hours.[1] From C to D, the concentration of HCl decreased from 0.74 mol/dm^3 to 0.58 mol/dm^3 in the next 5 hours/ decreased by 0.16 mol/dm^3 in the next 5 hours.[1] Not well-done Correct answer must come with the use of data!	[3]
(b)(iii)	When temperature decreases, the rate of reaction decreases.	[2]

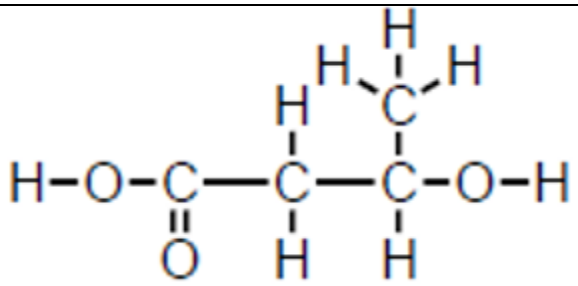
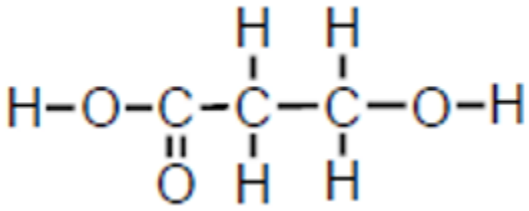
	When the temperature decreases, the particles have less energy and move slower/lesser particles have energy higher or equal to activation energy.[1] Decreases frequency of effective collision. [1]	
A5(a)	$Pb(NO_3)_2$ + 2NaI → PbI_2 + $2NaNO_3$	[1]
(b)	No of moles of $Pb(NO_3)_2$ = 1.50 ÷ (207 + 28 + 96) = 0.0045317 No of moles of NaI = (125 ÷ 1000) x 0.1 = 0.0125 [1] From equation, 2 moles NaI reacts with 1 mole of $Pb(NO_3)_2$. Therefore 0.0125 mol of NaI reacts with 0.00625 mol of $Pb(NO_3)_2$ but there are only 0.0045317 mol of $Pb(NO_3)_2$. Therefore $Pb(NO_3)_2$ is the limiting reactant. [1] Explanation is needed to derive limiting reactant from workings	[2]
(c)	No of moles of nitrate ions in 125 cm^3 = 2 x 0.0045317 = 0.0090634 [1] Therefore concentration of nitrate ions (no of moles in 1 dm^3) = 0.0090634 ÷ (125 ÷ 1000) = 0.0725072 = 0.0725 mol/dm^3 (3 sf) [1]	[2]
(d)		[1]
(e)	Excess lead(II) oxide is added to nitric acid. [1] Add excess insoluble materials and not excess acid Filter the mixture to obtain the filtrate. Heat filtrate to saturation and allow to cool. [1] Collect/filter to obtain crystals and wash with cold deionised water and dry crystals between filter paper. [1]	[3]
A6(a)		[2]

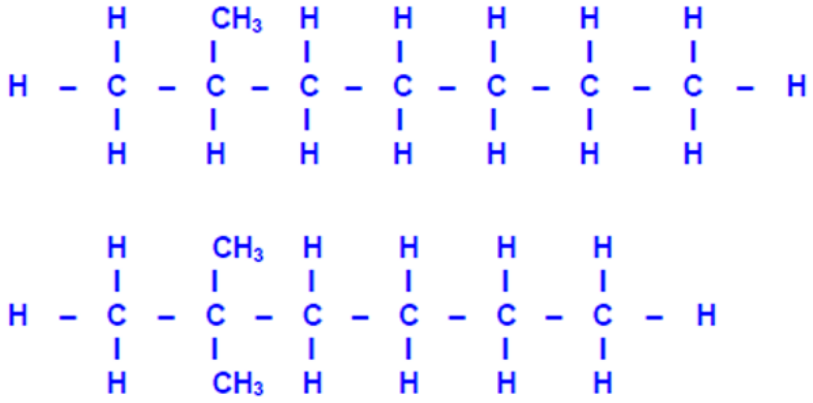
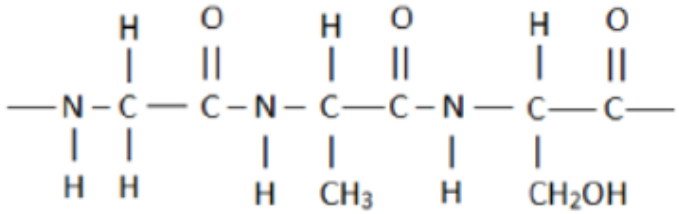
	C	H	N	O
mass in 100g/ g	63.6	5.9	9.3	21.2
Ar	12	1	14	16
no. of moles/ mol	63.6/12 =5.3	5.9/1 =5.9	9.3/14 =0.664	21.2/16 =1.325
Simplest mole ratio	8	9	1	2

	The empirical formula is $C_8H_9NO_2$	
(b)(i)	Two products (2-nitrophenol and 4-nitrophenol) are produced in step 1	[1]
(b)(ii)	4-nitrophenol ($C_6H_5NO_3$) is reduced as it loses oxygen /gains hydrogen to form 4-aminophenol (C_6H_7NO) Can also accept the change in oxidation state of N.	[1]
(b)(iii)	Mass of paracetamol in 8 tablets = 8 x 500 = 4000 mg = 4g [1] No. of moles of paracetamol = 4/ [8(12) + 9 + 14 + 2(16)] = 4/ 151 = 0.026490 mol [1] No. of moles of 4-aminophenol = 0.026490 mol Mass of 4-aminophenol = 0.026490 x [6(12) + 7 + 14 +16] = 0.026490 x 109 = 2.8874g = 2.89g [1]	[3]
(b)(iv)	Check that melting point is fixed/ check that paracetamol sample produces only one spot using paper chromatography.	[1]
(b)(v)	Paracetamol has a larger relative molecular mass (Mr) than ethanoic acid so the intermolecular forces of attraction between paracetamol molecules are stronger than that between ethanoic acid molecules. [1] Not the breaking of bonds for covalent molecules! Hence, more energy is required to overcome the intermolecular forces of attraction in paracetamol than ethanoic acid, hence paracetamol has a higher melting point than ethanoic acid. [1]	[2]
(c)	Maximum dose of Panadol syrup in a day = 600/ 120 x 5 = 25 ml [1] Maximum dose of Panadol syrup every 6 hours = 25/ (24/6) = 6.25ml [1]	[2]

B7(a)	Student 1 is correct. For experiment 1 and 2, when the concentration of I- is constant at 0.020 and when the concentration of $S_2O_8^{2-}$ doubles, the rate of reaction doubles from $1.22x10^{-3}$ to 2.44×10^{-3}. [1] For experiment 2 and 3, when the concentration of I- is constant at 0.020 and when the concentration of $S_2O_8^{2-}$ doubles, the rate of reaction doubles from $2.442x10^{-3}$ to 4.88×10^{-3}. [1] Student 2 is incorrect. For experiment 4 and 5, when the concentration of $S_2O_8^{2-}$ is constant at 0.008 and when the concentration of I- doubles, the rate of reaction doubles from $2.442x10^{-3}$ to 4.88×10^{-3}. [1]	[3]
(b)	zero-order reaction first-order reaction 	[1]
(c)	Experiment 6– 4.88×10^{-3} mol/dm^{3}s [1] Experiment 7 – 0.016 mol/dm^3 [1]	[2]
(d)	Fe^{2+} ions act as a catalyst.[1] In stage 1, iron(II) ions initially react with $S_2O_8^{2-}$ forming iron(III) ions. Iron(III) ions will inturn react with iodide ions in Stage 2 to form iron(II) ions again. Since, iron(II) ions remains chemically unchanged at the end of the reaction, it is a catalyst. [1]	[2]
(e)	Add excess sodium hydroxide solution. Green precipitate will be formed as iron(II) hydroxide. Filter away the green precipitate and obtain the filtrate. Many incorrectly mentioned sublimation.	[1] [1]
B8(a)(i)	As the current increases, the mass of copper formed also increases.	[1]
(a)(ii)	As more electron passes through more copper (II) ions will gain electrons/reduced and be deposited.	[1]
(a)(iii)	Since current are the variable in this experiment. Time is fixed as a constant.	[1]

	Not well done Reject: to ensure fair experiment	
(b)	In 10 mins, 1.2 g of copper is produced for current at 6A. In 5 mins, 12/2 =0.6 g of copper is produced.[1] With half the amount of time, half the number of electrons passes through, results in half the amount of copper deposited.[1] Accept: 0.58g / 0.63g / 0.605g	[2]
(c)	A blue precipitate is formed which dissolves in excess aqueous ammonia to form a dark blue solution. [1] Many gave incorrect phasing. There is copper(II) ions present in the solution.[1] Few students omitted the conclusion, thus losing one mark.	[2]
(d)(i)	$Ag^+(aq) + e^- \rightarrow Ag(s)$	[1]
(d)(ii)	No. of moles of copper = 0.81 / 64 = 0.0127 mol (3 s.f.) No. of moles of silver = 2.7 / 108 = 0.0250 mol [1] $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ $Ag^+(aq) + e \rightarrow Ag(s)$ From the calculation, no. of moles of copper is about half that of the no. of moles of silver. Each copper(II) ion needs two electrons to form a copper atom whereas each silver ion needs one electron to form a silver atom. [1]	[2]

Either B9(a)	Ester linkage	[1]
(b)	Poly(butene)	[1]
(c)	 [1]  [1]	[2]
(d)	Addition: polymer is the only product/ only one product Condensation: polymer and water formed/ small molecule formed Addition: monomer has carbon-carbon double bond Condensation: monomers have different types of fuctional group , -NH2, -COOH, -COH Addition: no loss in mass from monomer Condensation: loss in mass due to small molecules eliminated Addition: polymers are joined by carbon – carbon single bond Condensation: polymers are joined by ester or amide linkages One pair of answer [1]	[2]
(e)	Mr of repeating unit = 4x12 + 8x1 =56 No of monomers = 71400/56 = 1275 [1] No of carbon atoms = 1275 x 4 =5100 [1]	[2]
(f)	Ingestion can be fatal to animals/ combustion of plastics releases toxins/ land-fill uses natural resources and causes land pollution Any two [1] each	[2]

ORB9 (a)(i)	$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$	[1]
(a)(ii)	The total amount of energy taken/ absorbed to break the C-H, C-C and O=O bonds in isooctane and octane is the same. [1] The total amount of energy given out/released to form C=O and O-H bonds in carbon dioxide and water is the same [1] Thus the enthalpy change of combustion for isooctane and oactane are the same. Not well done.	[2]
(a)(iii)	 [1] each	[2]
(b)(i)	 [1]- 2 proper amide linkages [1]- consists of 1 glycine, 1 alanine, 1 serine Not well done.	[2]
(b)(ii)	Mr of repeating unit = 215 [1] No of repeating units = 600 000/215 [1] No of amino acids = 2790.7 x 3 OR 2791 x 3 = 8372.1	[3]