MARK SCHEME

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

MARK SCHEME

Section A

A1 (a) magnesium nitrate (b) hydrogen chloride [2]

(c) carbon tetrachloride (d) ammonium sulfate [2]

(e) magnesium nitrate / ammonium sulfate / calcium sulfate [1]

(f) calcium sulfate (g) ammonium sulfate [2]

A2 **P** = silver nitrate **R** = potassium carbonate [2]

Q = copper(II) nitrate **S** = hydrochloric acid [2]

A3 (a) (i) **U** = copper-silver alloy **V** = pure copper [2]

(ii) **U** = Cu (s) → Cu^{2+} (aq) + $2e^-$ **V** = Cu^{2+} (aq) + $2e^-$ → Cu (s) [2]

(b) mass loss at anode = 150 -136.5 = 13.5 g

mass copper deposited at cathode = 12.6 g

mass of silver at anode = 13.5 -12.6 = 0.9 g

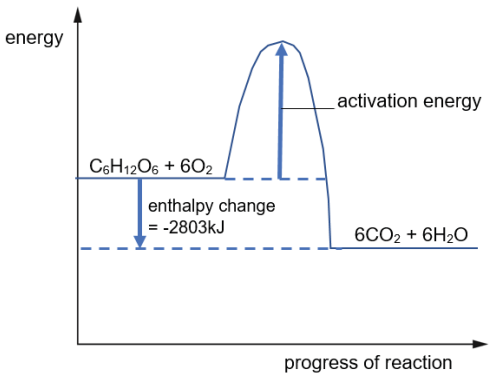
% impurities = 0.9 / 13.5 x 100 = 6.6667 % = 6.67% (to 3 s.f.) [1]

(c) As $CuCO_3$ is insoluble, there are no mobile **ions** present to carry the electric current. [1]

A4 (a) 1m – correct reaction pathway, showing the reactants and products [3]

1m – correct labelling of the enthalpy change with a single-sided arrow

1m – correct labelling of the activation energy with a single-sided arrow



(b) (i) The enzyme catalyst provides an alternative pathway with a lower activation energy, thus increasing the rate of respiration. [1] [1]

(ii) An increase in temperature increases the kinetic energy of the reactant particles. The particles move faster, resulting in more effective collisions, hence leading to an increase in the rate of respiration. [1]

(c) The energy released from bond-forming (i.e. C=O and O-H bonds) is more than the energy absorbed from bond-breaking (i.e. C-C, C-H, C-O, O-H and O=O bonds). [3]

(d) Let the bond energy of the O-H bond be x.

Energy absorbed = 5 C-C + 7 C-H + 7 C-O + 5 O-H + 6 O=O

= 5(347) + 7(413) + 7(358) + 5x + 6(495)

= 10102 + 5x kJ/mol [1]

Energy released = 12 C=O + 12 O-H

= 12(799) + 12x

= 9588 + 12x kJ/mol [1]

10102 + 5x – 9588 – 12x = -2803

x = 474 kJ/mol [1]

A5 (a) Monatomic means that the element exists as one / a single atom. [1]

(b) Helium has an electronic structure of 2, while neon has an electronic structure of 2,8. Since both have a stable electronic configuration, they do not lose, gain or share electrons (i.e. unreactive). [1] [1]

(c)(i)

	xenon	oxygen	fluorine
Mass	0.549 g	0.134 g	0.317 g
A_r	131	16	19
mass ÷ A_r	0.0041908	0.008375	0.016684
÷ 0041908	1	2	4

∴ empirical formula = XeO_2F_4 [1] [1]

(ii) relative molecular mass [1]

A6 (a)

	true	false
It has a low melting point.		✓
It forms coloured compounds.	✓	
It can form oxides with these formulae WO_2, WO_3, W_2O_3.	✓	
It contains positive ions in a sea of delocalised negative ions.		✓

[1] [1]

(b) (i) isotope [1]

(ii) All the four particles of tungsten have 74 protons and 74 electrons in each of their atom. [1]

The atoms of tungsten-182 has 108 neutrons, tungsten-183 has 109 neutrons, tungsten-184 has 110 neutrons and tungsten-186 has 112 neutrons. [1]

(c) (i) $WO_3 + 3H_2 \rightarrow W + 3H_2O$ [1]

(ii) WO_3 is reduced to W, as the oxidation state of tungsten decreases from +6 in WO_3 to 0 in W. [1] H_2 is oxidised to H_2O, as the oxidation state of hydrogen increases from 0 in H_2 to +1 in H_2O. [1]

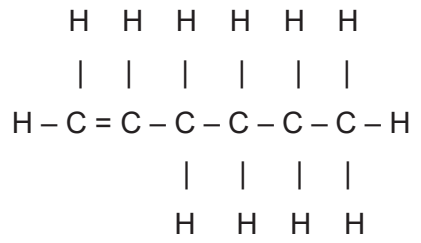
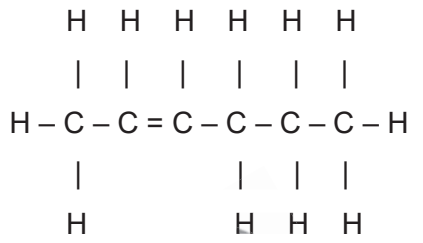
(iii) It is lower than hydrogen. [1]

(d) Choose any two: 1m for naming the two air pollutants; 1m for each effect [3]

air pollutant	harmful effect
Carbon monoxide	When inhaled, carbon monoxide combines with haemoglobin, causing the body to be starved of oxygen, leading to death.
Nitrogen dioxide / Sulfur dioxide	When inhaled, nitrogen dioxide / sulfur dioxide corrodes the body's internal organs. OR They form acid rain, which corrodes limestone buildings.

A7 (a) Cracking takes place in the presence of high temperature, high pressure, usually in the presence of a catalyst (e.g. aluminium oxide, silicon dioxide, broken porous pot, broken glass). [1]

(b)

isomer 1	isomer 2
	

[2]

Section B

B8 (a) (i) order: **5**, **6**, **2**, **3**, **1**, **4** [1]

explanation: The metal carbonate with no mass loss after heating is the most stable (i.e. metal carbonate **5**). The metal carbonate with the smallest mass loss is the second most stable (i.e. metal carbonate **6**) while the metal carbonate with the largest mass loss is the least stable (i.e. metal carbonate **4**). [1]

(ii)

metal carbonate	name of metal carbonate
5	potassium / sodium carbonate
4	copper(II) carbonate

[1]
[1]

(b) (i) 'Dot-and-cross' diagram for calcium oxide – ionic $[Ca]^{2+}$ $[O]^{2-}$ [1]

'Dot-and-cross' diagram for carbon dioxide – covalent O=C=O [1]

(ii) $CaCO_3$ (s) → CaO (s) + CO_2 (g)

Fr. Eqn.: 1 1 1

Given : 200 000 g

M_r : 100 56

2000 mol 2000 mol [1]

Mass of CaO formed = 2000 mol x 56 x 90%

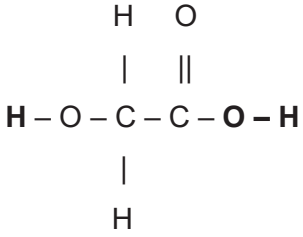
= 100 800 g / 100.8 kg [1]

(iii) chemical test : Deliver the gas into a test-tube of limewater. [1]
result : Gas evolved gives a white precipitate with limewater,

(iv) On the surface of the beam, acidic carbon dioxide neutralises the alkaline calcium hydroxide, causing the pH to be 7. [1]
Inside the beam, the crack allows little or no carbon dioxide to enter.
Hence, calcium hydroxide, being alkaline, causes the pH to be 13.

B9 (a) (i) Condensation polymerisation [1]

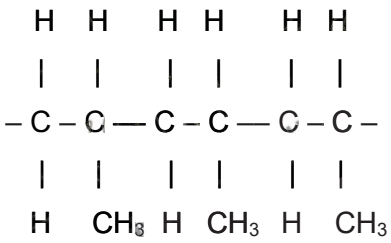
(ii) [1]



(iii) advantage: As it takes only 0.5 years to break down, it will not cause landfill problems. [1]

disadvantage: As it has a low tensile strength of 36 MPa, it breaks easily. [1]

(b) (i) [1]



(ii) chemical test : Pass both substances into aqueous bromine. [1]

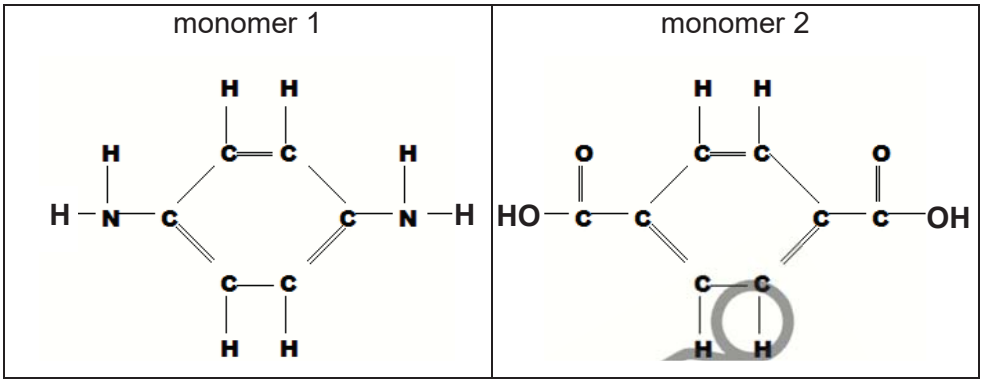
result with poly (propene) : No visible reaction. [1]

result with monomer : The red-brown aqueous bromine turns colourless **immediately**.

(iii) When burnt, poly (propene) undergoes incomplete combustion to produce a toxic gas, carbon monoxide. When inhaled, carbon monoxide combines with haemoglobin, causing the body to be starved of oxygen, leading to death. OR [1]

When burnt, poly (propene) produces a greenhouse gas, carbon dioxide. The trapping of heat on Earth's surface results in the melting of ice caps causing flooding in some areas.

(c)



[2]

B10 Either

(a) Choose any two: [2]

- Alkynes have the same general formula, C_nH_{2n-2}.
- Alkynes have the same functional group, C≡C triple bond.
- Alkynes have names ending with ~yne.

(b) C_4H_6, 8.08°C [2]

(c) Propyne (M_r = 40), having a higher relative molecular mass than ethyne (M_r = 26), diffuses at a slower rate. [2]

(d) (i) chemical test : Insert a piece of damp red litmus paper into the test-tube of gas. [1]

result : Gas evolved turns the damp litmus paper blue.

(ii) $C_2H_2 + NaNH_2 \rightarrow C_2HNa + NH_3$ [1]

(iii) Ammonia can be produced from the Haber process at 450°C, 200 atm, using finely divided iron as catalyst. [1]

$N_2\ (g) + 3H_2\ (g) \leftrightarrow 2NH_3\ (g)$ [1]

B10 Or

(a) (i) Steel is harder and stronger than iron. [1]

Steel contains different-sized atoms (i.e. bigger iron atoms and smaller carbon atoms), which disrupt the orderly arrangement of atoms, making it difficult for the layers to slide over each other. [1]

(ii) On diagram (70% iron : 30% carbon) [1]

(iii) The coke burns in air to produce carbon dioxide and a large amount of heat. $C\ (s) + O_2\ (g) \rightarrow CO_2\ (g)$ [1]

The carbon dioxide reacts with more coke to produce carbon monoxide. $CO_2\ (g) + C\ (s) \rightarrow 2CO\ (g)$ [1]

The carbon monoxide reacts with the iron(III) oxide to produce molten iron. $Fe_2O_3\ (s) + 3CO\ (g) \rightarrow 2Fe\ (s) + 3CO_2\ (g)$ [1]

(b) methane / CH_4 [1]

(c) Petrol can be obtained from petroleum (crude oil) by fractional distillation. [1]

Petrol, with the second lowest boiling point, will be collected second from the top, of the fractionating column. [1]

(d) Choose any one: [1]

The scrap metals need to be recycled:

- to conserve Earth's limited resource
- to save costs from extracting the metal from its ore
- to prevent pollution caused by the extraction of metal from its ore