Victoria School
2017 Chemistry O Levels / 5073
Suggested Answer Key

PAPER 1

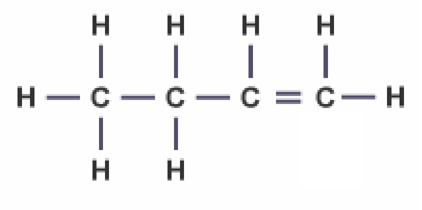
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
D	C	A	B	C	A	B	D	C	C	D	C	C	A	D	C	C	A	D	A
Q21	**Q22**	**Q23**	**Q24**	**Q25**	**Q26**	**Q27**	**Q28**	**Q29**	**Q30**	**Q31**	**Q32**	**Q33**	**Q34**	**Q35**	**Q36**	**Q37**	**Q38**	**Q39**	**Q40**
A	C	A	D	B	D	B	B	D	D	C	C	C	A	C	A	B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

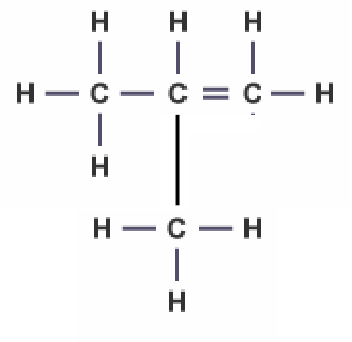
PAPER 2 (SECTION A)

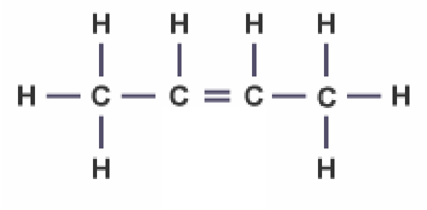
Question		Answer	Mark
A1	**ai**	Fe	1
	aii	H_2	1
	aiii	Cu	1
	aiv	O_2	1
	av	Zn	1
	bi	Cu, Fe, Zn	1
	bii	• High melting and boiling points • Transition metals and their compounds are good catalysts	2

		• Forms coloured compounds • Variable oxidation states in their compounds [any 3 points – 2 marks, 2 points – 1 mark, 1 point – 0 marks]	
A2	**ai**	(aq), (aq), (s), (aq) [any 2 correct – 1 mark]	2
	aii	For reaction 1: The oxidation states of all the elements remain unchanged, hence this is not a redox reaction. For reaction 2, The oxidation state of X increases from -1 in AgX to 0 in X_2. This is oxidation. The oxidation state of Ag decreases from +1 in AgX to 0 in Ag. This is reduction. Since oxidation and reduction occurs simultaneously, this is a redox reaction.	1 1
	bi	yellow	1
	bii	As the reactivity of the halogen increases, the rate of breakdown of the silver halide increases.	1
A3	**a**	Combustion	1
	bi	photosynthesis: $\mathbf{6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2}$ respiration: $\mathbf{C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O}$	1 1
	bii	During photosynthesis, plants take in carbon dioxide from the atmosphere and decreases the amount of carbon dioxide in the atmosphere. During respiration, carbon dioxide is given out by plants and animals into the atmosphere and increases the amount of carbon dioxide in the atmosphere.	1
	c	In the long term, trees will die and undergo bacterial decay. The bacteria will break down the carbon containing compounds in the trees and release carbon dioxide into the atmosphere, which will contribute to the increase in the amount of carbon dioxide.	1 1
A4	**ai**	Catalytic cracking	1

<table>
<tr><td></td><td>aii</td><td>The heavier and longer chain hydrocarbons such as diesel and lubricating oil are in low demand but in large supplies. The lighter and shorter chain hydrocarbons such as naphtha and petrol are in high demand but in low supplies.

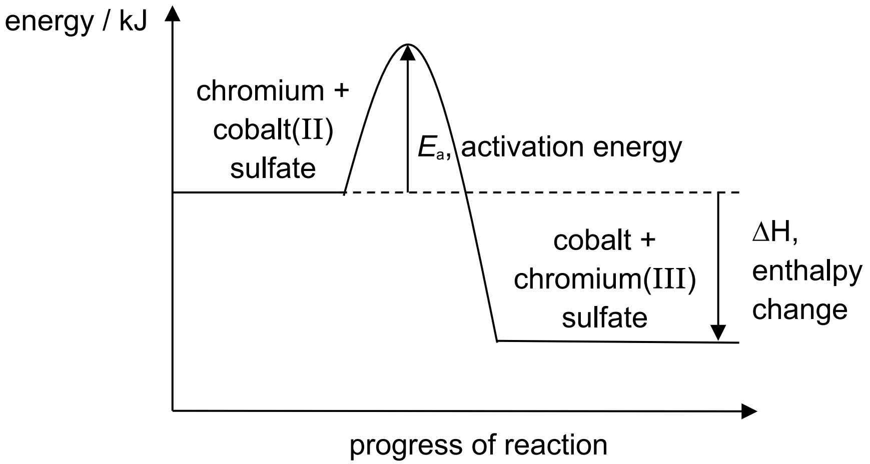
Cracking helps to break down the heavier and longer chain hydrocarbons into lighter and shorter chain hydrocarbons to meet the demand for lighter and shorter chain hydrocarbons.</td><td>1
1</td></tr>
<tr><td></td><td>b</td><td>



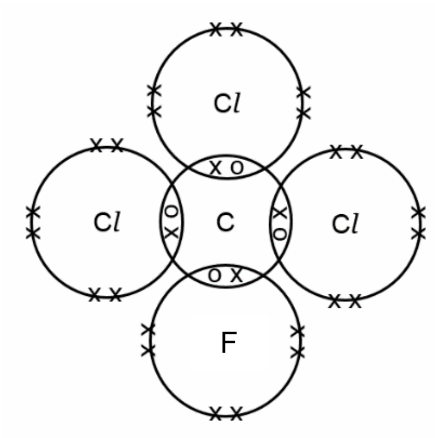
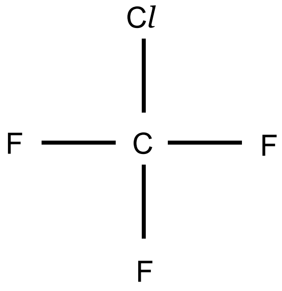


[Any 2 of the above. 1 mark each]</td><td>2</td></tr>
<tr><td></td><td>c</td><td><table>
<tr><th>reagent</th><th>observation for ethane</th><th>observation for propene</th></tr>
<tr><td>aqueous bromine</td><td>no visible reaction / solution remains reddish brown</td><td>reddish-brown solution turns colourless / decolourises rapidly</td></tr>
</table>
[3 correct – 2 marks, 2 correct – 1 mark, 1 correct – 0 marks]</td><td>2</td></tr>
<tr><td></td><td>di</td><td>Similarity: Both vegetable oils and alkenes contain carbon-carbon double bonds.

Difference: Alkenes contain one carbon-carbon double bond but vegetable oils can contain more than one carbon-carbon double bond.</td><td>1
1</td></tr>
</table>

<table>
<tr><td></td><td>dii</td><td>To produce margarine, hydrogen is added to vegetable oils at a temperature of 200 °C and a nickel catalyst.
[3 points – 2 marks, 2 points – 1 mark, 1 point – 0 marks]</td><td>2</td></tr>
<tr><td>A5</td><td>a</td><td>Most reactive: magnesium
chromium
cobalt
Least reactive: copper</td><td>1</td></tr>
<tr><td></td><td>b</td><td><table>
<tr><th>metal sulfate</th><th>colour of solution</th></tr>
<tr><td>copper(II) sulfate</td><td>blue</td></tr>
<tr><td>cobalt(II) sulfate</td><td>pink</td></tr>
<tr><td>chromium(III) sulfate</td><td>green</td></tr>
</table>
[3 correct – 2 marks, 2 correct – 1 mark, 1 correct – 0 marks]</td><td>2</td></tr>
<tr><td></td><td>ci</td><td>

1m – correct shape of energy profile and label names of products
1m – Indicate and label activation energy
1m – Indicate and label enthalpy change</td><td>3</td></tr>
</table>

	cii	$2Cr(s) + 3Co^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Co(s)$ 1m – balanced ionic equation 1m – state symbols	2
	d	Calcium is a very reactive metal and it reacts with water in the salt solutions to form calcium hydroxide and hydrogen gas, causing the fizzing.	1
A6	**ai**	 1m – bonding electrons 1m – non-bonding electrons	2
	aii		1
	aiii	Freon-14	1

	aiv	No. [must state but no marks] CFCs are compounds containing the elements carbon, chlorine and fluorine. However, Freon-14 does not have any chlorine atom in the molecule.	1
	b	The energy absorbed to break the C-F bond is 485 kJ/mol, which is higher than the energy of 327 kJ/mol absorbed to break the C-C*l* bond. Hence, more C-C*l* bonds are broken than C-F bonds, resulting in more chlorine atoms in the ozone layer.	1 1
	ci	$2O_3 \rightarrow 3O_2$	2
	cii	The chlorine atom is used up in the first equation when it reacts with O_3 to form C*l*O but it is regenerated in the second equation when C*l*O reacts with more O_3 to form O_2.	1

PAPER 2 (SECTION B)

Question		**Answer**	**Mark**
B7	**ai**	For iron: 1st experiment: (28.6 - 20.0) / 20.0 = 0.430 (to 3 s.f) 2nd experiment: (42.7 - 30.0) / 30.0 = 0.423 (to 3 s.f) For mercury: 1st experiment: (27.0 - 25.0) / 25.0 = 0.0800 (to 3 s.f) 2nd experiment: (41.6 - 40.0) / 40.0 = 0.0400 (to 3 s.f) Iron obey the Law of Constant Composition since the increase in mass was proportional to the mass of the metal used for both experiments. Mercury does not obey the Law of Constant Composition as the increase in mass was not proportional to the mass of the metal used for both experiments.	1 1 1
	aii	Pb O	

		Mass / g 25.0 1.9 A_r 207 16 No. of moles / mol 25.0 / 207 = 0.12077 1.9 / 16 = 0.11875 Simplest ratio 1 1 Empirical formula is PbO, hence lead(II) oxide was formed.	2 1
	bi	Dalton's formula for water shows one hydrogen atom and one oxygen atom, but the modern formula of water is H_2O, which contains two hydrogen atoms and one oxygen atom. Dalton's formula for hydrochloric acid shows one hydrogen atom and three oxygen atoms, but the modern formula of hydrochloric acid is HCl, which contains one hydrogen atom and one chlorine atom. Dalton's formula for nitrogen monoxide shows one nitrogen atom and one oxygen atom, which is the same as the modern formula of nitrogen monoxide, NO.	1 1 1 1
	bii	name: sodium chloride reason: Since Dalton's formula shows that the salt is formed from hydrochloric acid, and it contains the sodium ion, the anion inside the salt should be chloride, as the modern formula of the salt is $NaCl$.	1 1
B8	**a**	Molar mass of 1 mol of octane = 8(12) + 18(1) = 114 g/mol Volume of 1 mol of octane = 114 / 703 = 0.162 dm^3 (to 3 s.f.) Enthalpy change when 1 kg of octane is completely burnt = -5075 / 114 x 1000 = -44500 kJ/kg (to 3 s.f.) Enthalpy change when 1 kg of hydrogen is completely burnt = -286 / 2 x 1000 = -143000 kJ/kg (to 3 s.f.)	1 1 1 1 1
	b	The advantage is that when 1 kg of hydrogen and 1 kg of octane are burnt, more energy is given out for hydrogen. When 1 kg of hydrogen is burnt, it releases 143000 kJ of energy compared to octane which releases 44500 kJ of energy.	1

<table>
<tr><td></td><td></td><td>The disadvantage is that hydrogen requires more space for storage compared to octane. Hydrogen is a gas at room temperature and pressure but octane which is a liquid. 1 mole of hydrogen occupies a volume of 24 dm^3 compared to 1 mole of octane which occupies 0.162 dm^3.

[Use of data to support answer]</td><td>1

1</td></tr>
<tr><td>EITHER

B9</td><td>a</td><td>$Cu(NO_3)_2$</td><td>1</td></tr>
<tr><td></td><td>bi</td><td>Experiment 3. [must state but no marks]

Comparing experiments 1, 3 and 4, where the acids are of the same concentration (0.5 mol/dm^3), the time taken to collect 10 cm^3 of gas is the same for experiments 1 and 4 (15 s) but shorter for experiment 3 (7 s).

This is because the rate of reaction increases as temperature increases, hence the time taken is shorter for the acid at higher temperature.</td><td>1

1</td></tr>
<tr><td></td><td>bii</td><td>At a higher temperature, the particles have more kinetic energy and hence move faster.

There are more collisions between the hydrogen ions and copper(II) carbonate particles.

The frequency of effective collisions increases and hence rate of reaction increases.</td><td>1

1

1</td></tr>
<tr><td></td><td>c</td><td>
<table>
<tr><th>experiment</th><th>acid</th><th>concentration in mol/dm^3</th><th>time taken to collect 10 cm^3 of gas / s</th><th>total volume of gas / cm^3</th></tr>
<tr><td>5</td><td>ethanoic</td><td>0.5</td><td>any value above 30</td><td>150</td></tr>
<tr><td>6</td><td>sulfuric</td><td>0.5</td><td>7.5</td><td>300</td></tr>
</table>

For ethanoic acid:
Ethanoic acid is a weak acid hence it will dissolve and dissociate in water partially to give a low concentration of hydrogen ions. Hence, the time taken to collect 10 cm^3 of gas in experiment 5 is longer than in experiment 1 as the rate of reaction decreases with a lower concentration of hydrogen ions.</td><td>1

1</td></tr>
</table>

		The total volume of gas formed in experiment 5 is the same as experiment 1 (150 cm^3) as the concentration of ethanoic and hydrochloric acid are the same, thus the number of moles of both acids are the same. This results in the same number of moles of gas formed. For sulfuric acid: Sulfuric acid is a dibasic acid compared to hydrochloric acid which is a monobasic acid. It dissolves and dissociate in water to give twice the concentration of hydrogen ions. Hence, the time taken to collect 10 cm^3 of gas in experiment 6 is half of that in experiment 1 as the rate of reaction increases with a higher concentration of hydrogen ions. The total volume of gas formed for experiment 6 is twice (300 cm^3) compared to experiment 1. This is because the concentration and hence number of moles of sulfuric acid is twice of hydrochloric acid, thus the number of moles of gas formed will be the twice.	1 1
OR **B9**	**a**	poly(propene): **CH_2 [empirical formula]** propanol: **C_3H_8O [molecular formula]**	1 1
	b	Poly(propene) and silicon dioxide have giant molecular structures but propanol have a simple molecular structure. In poly(propene), the atoms are held together by strong covalent bonds to form a long chain polymer. Weak intermolecular forces of attraction exists between the polymer chains. In silicon dioxide, the atoms are held together in an extensive network by strong covalent bonds. In propanol, the atoms are held together by strong covalent bonds. Weak intermolecular forces of attraction exists between the molecules.	1 1 1 1
	c	Silicon dioxide has the highest melting point of 1600 °C as a lot of energy is required to overcome the extensive network of strong covalent bonds between the Si and O atoms. Poly(propene) and propanol have low melting points as little energy is required to overcome the weak intermolecular forces of attraction between the molecules. However, poly(propene) has a higher melting point than propanol as it has a larger relative molecular mass / larger molecular size than propanol. Hence, there are stronger intermolecular forces of attraction between the poly(propene) molecules and energy is required	1 1 1 1

		to overcome the intermolecular forces of attraction.	