Name: ( )	Class: 21S0____

RAFFLES INSTITUTION
2020 Year 5 Promotional Examination

HIGHER 2

CHEMISTRY 9729

30 September 2020

2 hours 30 minutes

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

DO NOT open this booklet until you are told to do so.

Write your name and civics tutorial group in the spaces provided on the OMR sheet, cover sheets on pages **1** and **17**.

This paper consists of three sections **A**, **B** and **C**.

Section A (15 marks) consists of 15 multiple-choice questions.
Answer this section first. The OMR sheet will be collected after the **first 35 minutes.**
Record your answers to this section in soft pencil on the separate OMR Answer Sheet.

Section B (35 marks) consists of 3 structured questions.

Section C (40 marks) consists of 3 free-response questions.
Answers to Sections B and C are to be written in the spaces provided in the question paper.

You are reminded of the need for good English and clear presentation in your answers.

The number of marks is given in brackets [ ] at the end of each question or part question.

Write in dark blue or black pen. You may be subjected to penalty for writing answers in pencil.

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C1	**/ 16**
C2	**/ 12**
C3	**/ 12**

This document consists of **26** printed pages

Section A (15 marks)

For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

1 What is the order of the following compounds in increasing melting point?

MgO $MgCl_2$ $AlCl_3$

A $AlCl_3 < MgCl_2 < MgO$

B $AlCl_3 < MgO < MgCl_2$

C $MgO < MgCl_2 < AlCl_3$

D $MgCl_2 < MgO < AlCl_3$

2 Water has a much higher boiling point than methane but a lower boiling point than silicon tetrabromide.

compound	H_2O	CH_4	$SiBr_4$
boiling point / °C	100	–162	153

Which statements correctly explain the observed trend?

1 The O–H bonds in water are stronger than the C–H bonds in methane but weaker than the Si–Br bonds in silicon tetrabromide.

2 Hydrogen bonds between water molecules are stronger than the instantaneous dipole-induced dipole interactions in methane but weaker than the instantaneous dipole-induced dipole interactions in silicon tetrabromide.

3 Water is a simple molecule while silicon tetrabromide is a giant molecule.

A 1 and 3 only **B** 2 only **C** 2 and 3 only **D** 1, 2 and 3

3 When lanthanum iodate(V), $La(IO_3)_3$, is heated to 560 °C, it decomposes as shown below.

lanthanum iodate(V) $\longrightarrow$ lanthanum periodate(VII) + iodine + oxygen

In this reaction, lanthanum does not change oxidation state.

If the IO_3^-:I_2 molar ratio in this reaction is 5:2, what is the formula of the periodate(VII) ion?

A IO_4^- **B** IO_5^{3-} **C** IO_6^{5-} **D** IO_7^{7-}

[Turn Over

4 *Use of the Data Booklet is relevant to this question.*

The second, third and fourth ionisation energies, IE, of four different elements are shown in the table.

The elements are antimony, arsenic, selenium and tellurium (though not necessarily in that order) from Groups 15 and 16.

Which element is antimony?

	second IE / kJ mol^{-1}	third IE / kJ mol^{-1}	fourth IE / kJ mol^{-1}
A	1590	2440	4270
B	1800	3010	3680
C	1950	2730	4850
D	2080	3090	4140

5 W, X, Y and Z are four elements with **consecutive** atomic numbers in Period 4. The table shows the number of unpaired electrons in each atom in its ground state.

element	W	X	Y	Z
number of unpaired electrons	0	1	2	3

Which statement is **not** correct?

A W can be zinc.

B X can be scandium.

C Y can be germanium.

D Z can be cobalt.

6 An equimolar mixture of H_2 and O_2 was placed in a sealed, rigid container at room temperature. The total pressure inside the container is *P* Pa.

The mixture was sparked, and H_2 and O_2 reacted until H_2 was completely consumed.

What is the partial pressure, in Pa, of O_2 in the container after the reaction at room temperature?

A 2*P** **B** *P*

C 0.5*P** **D** 0.25*P*

7 Which reaction represents the standard enthalpy change of atomisation of the reactant?

A $O_2(g) \rightarrow 2O(g)$

B $Hg(l) \rightarrow Hg(g)$

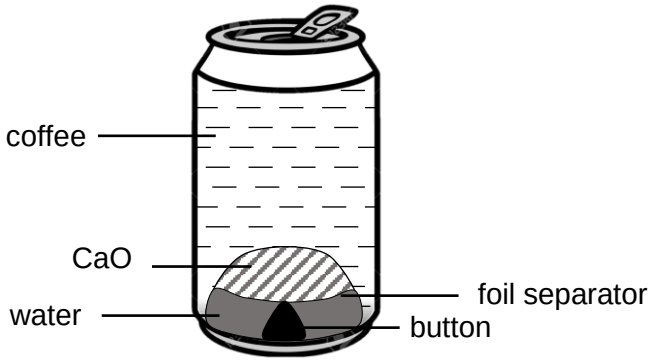
C $CO_2(g) \rightarrow C(g) + O_2(g)$

D $C_2H_4(g) \rightarrow 2C(s) + 4H(g)$

8 *Use of the Data Booklet is relevant to this question.*

A self-heating coffee can uses the reaction between calcium oxide and water to heat up the coffee in the can with the press of a button.

$$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq) \qquad \Delta H = -64.5 \text{ kJ mol}^{-1}$$



When the button is pressed, water reacts with CaO and the heat released from the reaction is transferred to the coffee in the can.

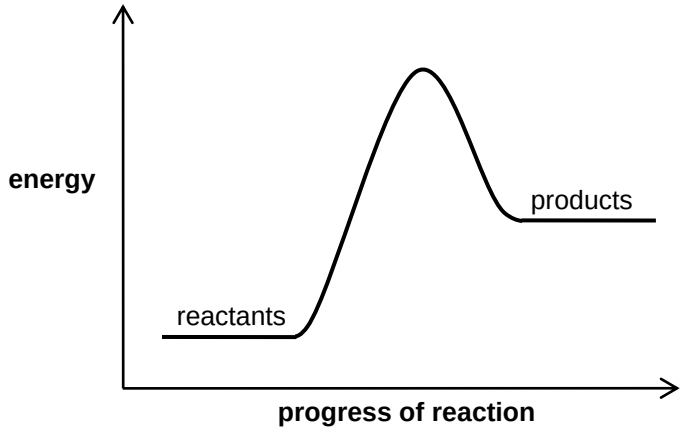
The volume of coffee in the can is 205 cm^3. Assuming that the reaction is 80% efficient in transferring the heat to the coffee, what is the mass of CaO required to increase the temperature of the coffee by 42 °C?

You may assume that the specific heat capacity of coffee is the same as that of water.

A 25.0 g **B** 31.3 g

C 33.1 g **D** 39.1 g

9 The diagram represents the energy profile of a chemical reaction.



Which statements about the chemical reaction are correct?

1 During the reaction, the change in temperature is positive.

2 The products are energetically less stable than the reactants.

3 For the reaction to be spontaneous, ΔS must be positive.

A 1 and 3 **B** 1 only

C 2 only **D** 2 and 3

10 During the titration of ethanedioic acid against potassium manganate(VII), the following reaction takes place.

$$5H_2C_2O_4 + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{2+} + 2CO_2 + 8H_2O$$

Early in the titration, it takes a while for the purple colour to be decolourised. Later in the titration, it was found that decolourisation took place more quickly.

What is the correct reason for the observations?

A With more MnO_4^- titrated, the MnO_4^- concentration increases, increasing the rate of reaction.

B With more MnO_4^- titrated, the MnO_4^- concentration increases, shifting the position of equilibrium more to the right.

C With more MnO_4^- titrated, the Mn^{2+} concentration increases, increasing the rate of reaction.

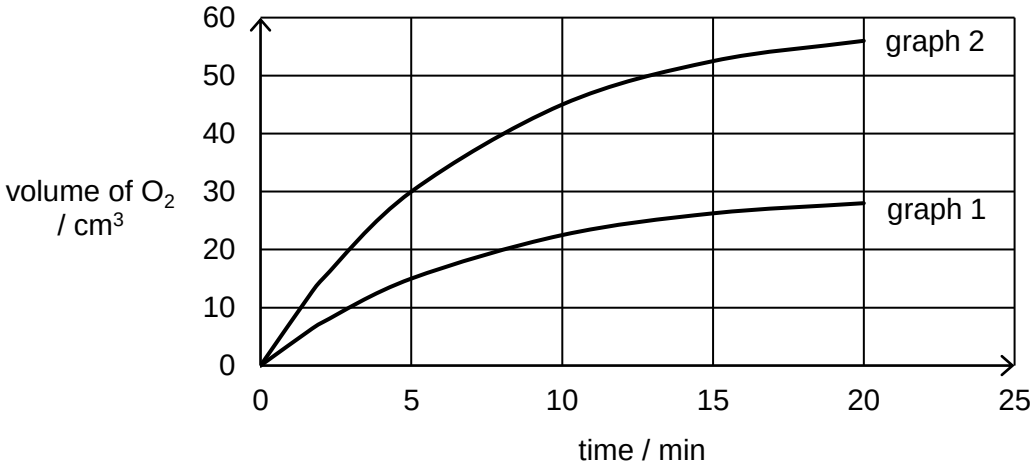
D With more MnO_4^- titrated, the CO_2 gas escapes, shifting the position of equilibrium more to the right.

11 H_2O_2 decomposes in the presence of $Mn^{2+}(aq)$ catalyst with the following equation:

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

The reaction is first order with respect to H_2O_2 and Mn^{2+}.

In experiment 1, 1 cm^3 of 0.1 mol dm^{-3} $Mn^{2+}(aq)$ solution was placed in a flask containing 25 cm^3 of 0.1 mol dm^{-3} $H_2O_2(aq)$. The flask was immediately stoppered with a delivery tube leading to a measuring cylinder, and a stopwatch was started at the same time. The volume of O_2 gas collected was recorded at regular time intervals, and graph 1 was plotted.



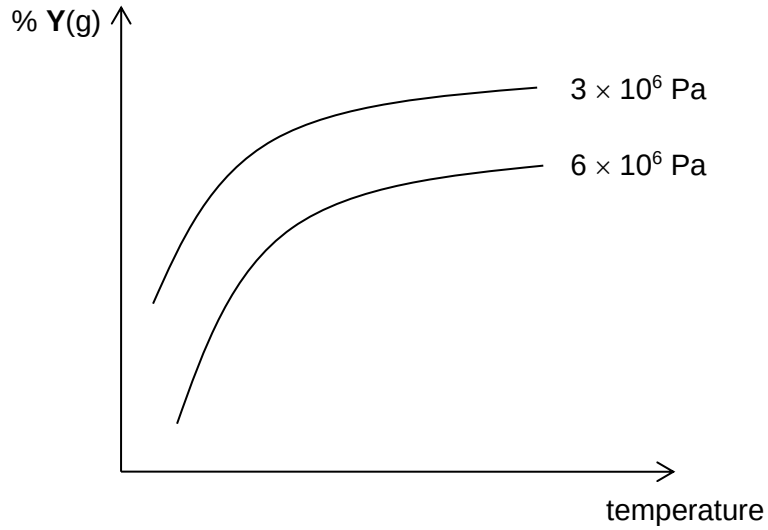
Which of the following sets of experimental conditions will result in graph 2?

	volume of $Mn^{2+}(aq)$ / cm^3	volume of $H_2O_2(aq)$ / cm^3	$[H_2O_2]$ / mol dm^{-3}
W	1	25	0.2
X	1	50	0.1
Y	2	25	0.2
Z	2	50	0.1

A W and X **B** X and Y

C W and Z **D** Y and Z

12 The graphs below show how the percentage of a gaseous product **Y** present at equilibrium varies with temperature at pressures of 3×10^6 Pa and 6×10^6 Pa respectively, for a reaction.



Which reaction could the graphs represent?

A	$N_2O_4(g) \rightleftharpoons 2NO_2(g)$	$\Delta H = +57$ kJ mol^{-1}
B	$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$	$\Delta H = +90$ kJ mol^{-1}
C	$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$	$\Delta H = -92$ kJ mol^{-1}
D	$2C(s) + O_2(g) \rightleftharpoons 2CO(g)$	$\Delta H = -222$ kJ mol^{-1}

13 A mixture of 0.1 mol of H_2 and 0.2 mol of I_2 was kept at 700 K in a 1 dm^3 vessel until the following equilibrium was reached.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

The mixture was cooled to room temperature, dissolved in water and titrated with aqueous sodium hydroxide. It is determined that x mol of HI has been formed at equilibrium.

Which of the following statements are correct?

1 $K_c = \dfrac{x^2}{(0.1-x)(0.2-x)}$

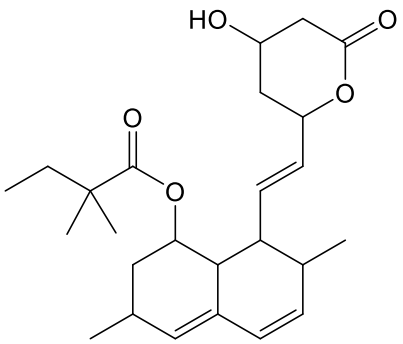
2 $K_p = K_c$

3 The cooling and dissolving of the equilibrium mixture should be carried out quickly to avoid changes to the composition of the mixture.

4 The addition of a catalyst will increase the amount of HI formed at equilibrium.

A	2 and 3 only	**B**	1 and 4 only
C	2, 3 and 4	**D**	1, 2 and 3

14 How many stereoisomers does the molecule below have?



A 2^7 **B** 2^8 **C** 2^9 **D** 2^{10}

15 Methane reacts with chlorine in the presence of sunlight to form chloromethane.

Which statement about the reaction intermediates is correct?

A They combine to form HC*l*.

B They each carry a positive charge.

C They each contain an unpaired electron.

D They are lower in energy than the products.

- END OF SECTION A -

Section C (40 marks)

This section consists of **three** questions.
Answer **all** the questions in this section in the spaces provided.

C1 Disulfur dichloride, S_2Cl_2, a yellow liquid, is one of the key reactants used to produce the chemical weapon known as mustard gas during the first world war. Mustard gas acts by causing the formation of large blisters on exposed skin and in the lungs.

(a) Disulfur dichloride can be made by direct combination of sulfur, S_8, and chlorine gas, Cl_2.

(i) Write the equation that represents the standard enthalpy change of formation of S_2Cl_2.

.....[1]

(ii) Both sulfur and chlorine are Period 3 elements. Describe and briefly explain the **general** trend in ionisation energy across Period 3.

.....

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.....

.....[2]

(b) Disulfur dichloride, S_2Cl_2, can also be formed when sulfur dichloride, SCl_2, decomposes.

$$2SCl_2(l) \rightarrow S_2Cl_2(l) + Cl_2(g) \qquad \Delta H_r^{\ominus} = +40.2 \text{ kJ mol}^{-1}$$

(i) Given that $\Delta H_f^{\ominus}(SCl_2)$ is -49.8 kJ mol^{-1}, calculate the standard enthalpy change of formation of S_2Cl_2 with the use of an energy cycle.

[3]

(ii) Predict the sign of $\Delta S^{\ominus}$ of the decomposition of SCl_2 and explain your answer.

.....

.....[1]

(iii) Using the information provided and your answer to **(b)(ii)**, predict, with reasons, conditions of temperature in which the decomposition of SCl_2 would be spontaneous.

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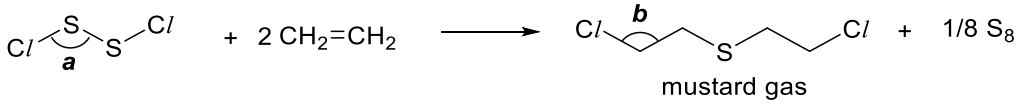
.....[2]

(c) The chemical weapon mustard gas is produced by reacting S_2Cl_2 with ethene in the reaction shown.



(i) State the bond angles labelled ***a*** and ***b*** in S_2Cl_2 and mustard gas, respectively.

a ..... ***b*** ..... [2]

(ii) Explain the bond angle ***a*** in S_2Cl_2 using the Valence Shell Electron Pair Repulsion Theory.

.....

.....

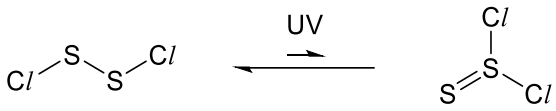
.....

.....[2]

(iii) State the hybridisation of carbon in ethene and draw the hybrid orbitals for one of the carbons.

[2]

(d) S_2Cl_2, when exposed to UV light, transiently forms a rare isomer, $S{=}SCl_2$, which quickly isomerises back to the more stable S_2Cl_2.



The structure of $S{=}SCl_2$ is unstable because the formation of the S=S π bond in $S{=}SCl_2$ is not favourable.

Explain why the π bond in S=S is weak.

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.....[1]

[Total: 16]

C2 "Clock reactions" involving iodine are useful in studying kinetics, as the presence of iodine, I_2, is easily observed with starch, giving a blue-black complex. Typically, thiosulfate, $S_2O_3^{2-}$, is used to delay the observation of I_2. It reacts with I_2 according to the following equation.

$$I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$$

Experiments involving the reaction between iodide, I^-, and peroxodisulfate, $S_2O_8^{2-}$, producing iodine, I_2, and sulfate, SO_4^{2-}, were conducted by mixing the following aqueous solutions according to the volumes indicated in Table 1.1.

0.2 mol dm^{-3} $K_2S_2O_8$
0.4 mol dm^{-3} KI
0.1 mol dm^{-3} $Na_2S_2O_3$
dilute starch solution

A stopwatch was started on addition of the $K_2S_2O_8$ solution and stopped on the first appearance of a blue-black complex. The time for each experiment was recorded accordingly.

experiment no.	volume of $K_2S_2O_8$ / cm^3	volume of KI / cm^3	volume of $Na_2S_2O_3$ / cm^3	volume of starch(aq) / cm^3	volume of deionised H_2O /cm^3	time / s
1	12.50	12.50	10.0	5.0	10.00	139
2	6.25	12.50	10.0	5.0	16.25	288
3	12.50	6.25	10.0	5.0	16.25	270

Table 1.1

(a) Write the balanced ionic equation for the reaction between I^- and $S_2O_8^{2-}$.

.....[1]

(b) Deduce, with reasons, the orders of reaction with respect to I^- and $S_2O_8^{2-}$.

[2]

(c) Write the rate equation for the reaction between I^- and $S_2O_8^{2-}$.

.....[1]

(d) Calculate the amount of I_2 formed in each experiment when the blue-black complex first appears.

Hence, calculate the values of the rate of experiment 1 and the rate constant, *k*, for the reaction. Include the units for *k* in your answer.

[3]

In experiment 4, a small amount of aqueous Fe^{2+} ions was added to a reaction mixture with the same volumes of reagents as experiment 1. Only 13 s was required for the blue-black colour to appear.

Further investigation showed that the rate was directly proportional to the concentrations of aqueous Fe^{2+} and $S_2O_8^{2-}$ and independent of the concentration of aqueous I^-.

(e) By considering the species involved in the rate determining step, explain why the reaction takes a much shorter time in the presence of aqueous Fe^{2+}.

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.....[4]

(f) A proposed mechanism for the reaction in experiment 4 is shown below.

$2Fe^{2+} + S_2O_8^{2-} \rightarrow 2SO_4^{2-} + 2Fe^{3+}$ slow
$2Fe^{3+} + 2I^- \rightarrow I_2 + 2Fe^{2+}$ fast

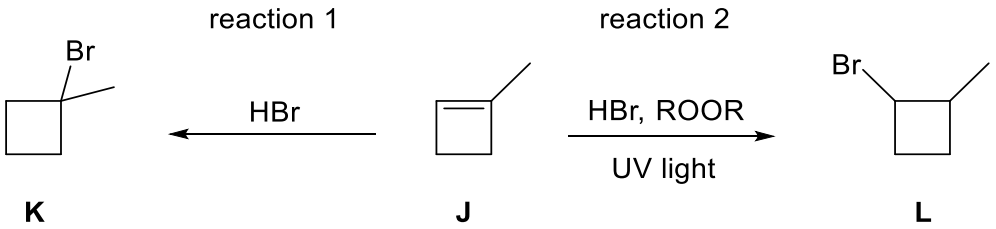
Explain whether the proposed mechanism is consistent with the observed kinetic data.

.....

.....[1]

[Total: 12]

C3 Alkenes undergo addition reactions readily with suitable reagents. The following reaction scheme shows two possible products formed between alkene **J** and HBr under different conditions.



(a) **(i)** State the isomeric relationship between compounds **K** and **L**.

.....[1]

(ii) By considering the relevant interactions involved, explain why compound **J** is insoluble in water.

.....

.....

.....

.....

.....[2]

(iii) Compound **L** exists as a mixture of four stereoisomers. Draw the structures of two of these compounds and state the type of isomerism present.

[2]

(b) Reaction 2 proceeds via a radical chain mechanism. The reaction begins via a two-step initiation stage and the steps are described below.

- In the presence of UV light, the dialkyl peroxide RO–OR undergoes homolytic fission to form two alkoxy radicals, RO•.
- Each alkoxy radical then abstracts a hydrogen atom from HBr to produce an alcohol and a bromine radical.

(i) With the aid of curly arrows, draw the mechanism for the two-step initiation stage in reaction 2.

[2]

(ii) *Use of the Data Booklet is relevant to this question.*

In the absence of dialkyl peroxide, bromine radicals are not generated, despite the presence of UV light during the initiation stage.

By considering the bonds in dialkyl peroxide and hydrogen bromide, explain why dialkyl peroxide is required for the generation of bromine radicals.

.....

.....

.....

.....[2]

The reaction then progresses to the propagation stage. The two steps in the propagation stage are described below.

- The bromine radical adds to alkene **J** to form a bromine-containing alkyl radical.
- The alkyl radical abstracts a hydrogen atom from HBr to form the final addition product **L** and regenerate a bromine radical.

(iii) Write balanced equations to show the formation of the addition product **L** from alkene **J** and a bromine radical. Curly arrows need not be shown.

[2]

As the reactants deplete, termination reactions dominate, in which two free radical species associate to form a molecule.

(iv) Among the termination products, a dibromoalkane with the formula $C_{10}H_{16}Br_2$ is formed. Draw the structure of this alkane product, ignoring its stereochemistry.

[1]
[Total: 12]

– END OF SECTION C –

RAFFLES INSTITUTION

2020 Year 5 Promotional Examination
H2 Chemistry

COVER SHEET

Name: ( )	**Class: 21S0____**

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Section		**Marks**
A		**/ 15**
B	**B1**	**/ 8**
	B2	**/ 13**
	B3	**/ 14**
C	**C1**	**/ 16**
	C2	**/ 12**
	C3	**/ 12**
Promotional Examination	**Total**	**/ 90**
	Percentage	**/ 100**
	Grade	

Section B (35 marks)

This section consists of **three** questions.
Answer **all** the questions in this section in the spaces provided.

B1 Compound **G** is an alcohol with the formula, C_xH_yOH. Two experiments were performed to determine its relative molecular mass, M_r.

(a) The method for experiment 1 uses the vapour density of the alcohol.

The procedure for the experiment is as follows:

1 Prepare a clean and dry test-tube with a piece of aluminium foil and record its mass.

2 Pour about 0.5 cm^3 of compound **G** into the test-tube, and immediately seal the test-tube with the aluminium foil.

3 Pierce a small hole through the aluminium foil using a pin.

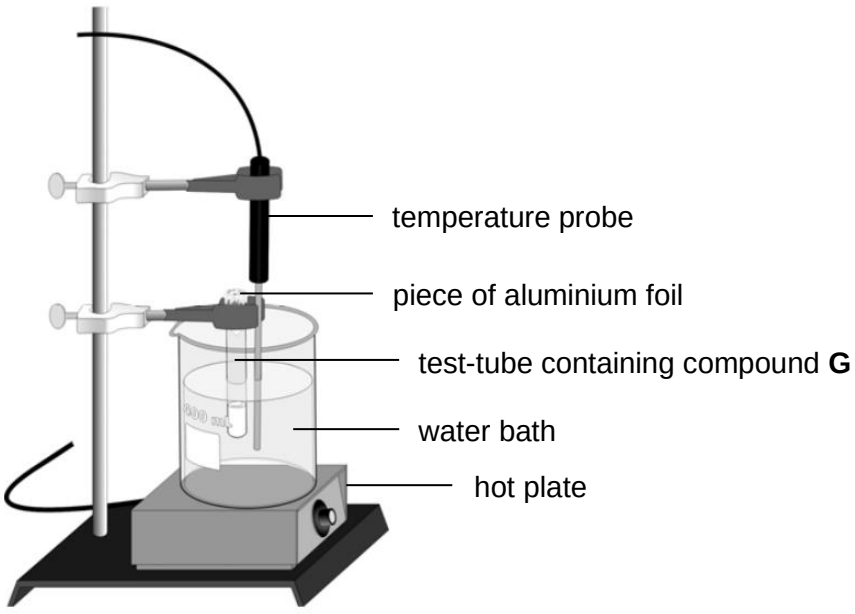
4 Place the test-tube into a hot water bath.

5 Heat the water bath to boiling and maintain the boiling until all of the compound **G** has vapourised. At this point, the test-tube will be completely filled with the vapour of compound **G** only.

6 Keep the test-tube in the boiling water bath for another three minutes. Record the temperature of the water bath.

7 Transfer the test-tube into an ice water bath. Cool the test-tube for one minute. Then, remove and dry it completely. Record the mass of test-tube, the piece of aluminium foil top and the condensed compound **G**.

The setup for the experiment is shown below.



The following data was obtained for experiment 1.

mass of test-tube and foil / g	7.5228
mass of test-tube and foil and condensed **G** / g	7.5387
mass of condensed **G** / g	
temperature of hot water bath / °C	99.0
atmospheric pressure in room / kPa	100

The volume of the test-tube was separately determined to be 8.6 cm^3.

(i) Determine the mass of the condensed **G** in the data table. [1]

(ii) Using the ideal gas law, derive an expression for the molar mass, *M,* of compound **G**. Hence, calculate the M_r for compound G.

[2]

(iii) If experiment 1 was carried out using an oil bath heated to 160 °C, explain how this may affect the mass of the condensed **G** measured in the experiment.

.....

.....

..... [1]

(b) Experiment 2 uses a redox back titration. Compound **G** is easily oxidised by a strong oxidising agent, such as potassium dichromate(VI), $K_2Cr_2O_7$. However, the oxidation reaction is slow and cannot be used for direct titration.

In the experiment, **FA2** was prepared by adding 1.500 g of compound **G** to 50.00 cm^3 of 0.400 mol dm^{-3} potassium dichromate(VI) which was in excess. The reaction was allowed to proceed to completion and the resulting mixture diluted to 250 cm^3 in a volumetric flask using deionised water.

The concentration of potassium dichromate(VI), $K_2Cr_2O_7$, in **FA2** was determined by titration to be 0.0169 mol dm^{-3}.

Given that compound **G** reacts with $K_2Cr_2O_7$ with a mole ratio of 3:2, calculate the M_r of compound **G**.

[2]

(c) The M_r value determined from experiment 2 was larger than that determined from experiment 1. Suggest one reason for the result and explain why.

.....

.....

..... [2]

[Total: 8]

B2 α-Farnesene and β-farnesene are isomeric hydrocarbons and their structural formulae are given below.

hydrocarbon	structural formula
α-farnesene	CH_3-C(CH_3)=CH-CH_2-CH_2-C(CH_3)=CH-CH_2-CH=C(CH_3)-CH=CH_2
β-farnesene	CH_3-C(CH_3)=CH-CH_2-CH_2-C(CH_3)=CH-CH_2-CH_2-C(CH_2)-CH=CH_2

(a) Both α-farnesene and β-farnesene display *cis-trans* isomerism.

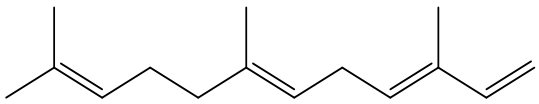
Explain how *cis-trans* isomerism arises in α-farnesene and β-farnesene.

.....

.....

..... [2]

(b) α-Farnesene can exist as four cis-trans isomers. One of the cis-trans isomers is found in the coating of green apples and has the skeletal formula as shown below.



Draw the skeletal formula of another cis-trans isomer of α-farnesene.

[1]

(c) Both α-farnesene and β-farnesene can undergo oxidation.

(i) Under suitable conditions, α-farnesene is oxidised into a compound **V** containing multiple alcohol groups per molecule.

Identify **V** by drawing its structural formula in the box provided below. [1]

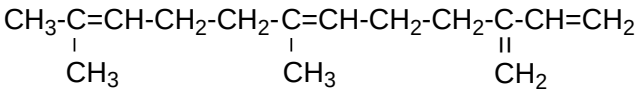
α-farnesene
$C_{15}H_{24}$ ⟶

V
$C_{15}H_{32}O_8$

(ii) Suggest reagents and conditions for the conversion in **(c)(i)**.

..... [1]

(iii) β-Farnesene, shown below, undergoes oxidation when it is heated with acidified potassium manganate(VII).



Draw the structures of the organic products of this reaction.

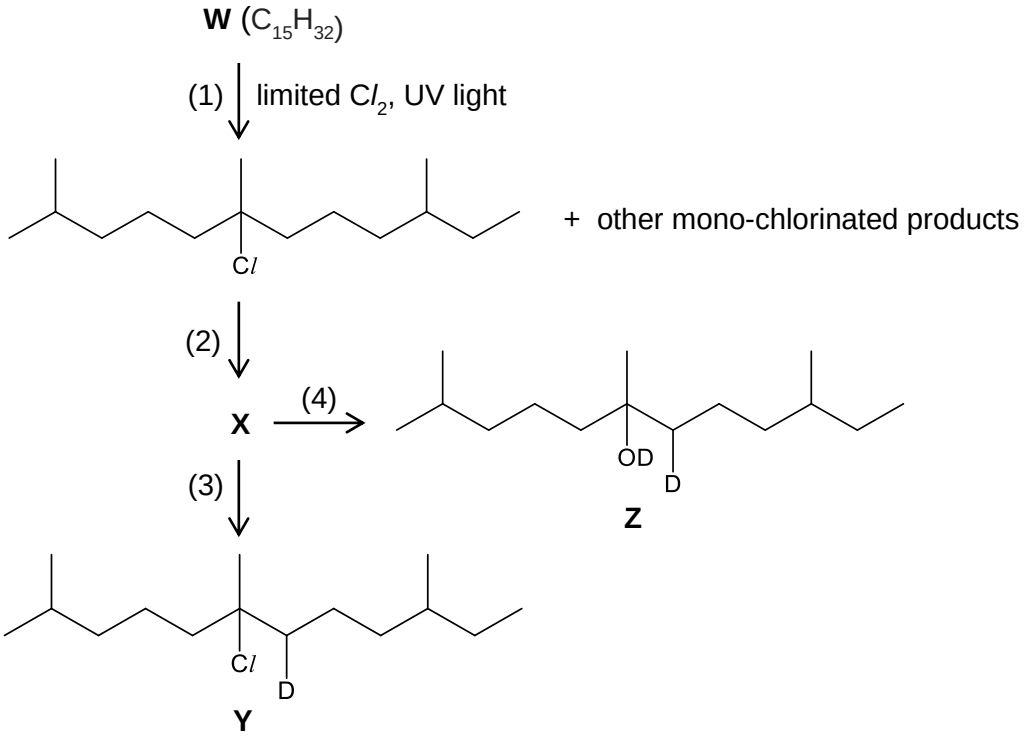
[3]

(d) When reacted with excess hydrogen in the presence of nickel catalyst, both α-farnesene and β-farnesene yield the same product **W**, $C_{15}H_{32}$.

(i) Complete the IUPAC name of **W**.

.....dodecane [1]

W can be converted to deuterium-containing compounds **Y** and **Z** as shown in the reaction scheme below. Deuterium is heavy hydrogen i.e. D or ^2H.



(ii) State the type of reaction in reaction (1).

..... [1]

(iii) Identify **X** and suggest reagents and condition for reaction (2).

X

reaction (2): ..... [1]

(iv) Suggest reagents and conditions for reactions (3) and (4).

reaction (3): ..... [1]

reaction (4): ..... [1]

[Total: 13]

B3 Nitrogen oxides like nitric oxide (NO) and nitrogen dioxide (NO_2) are formed from reactions between nitrogen and oxygen during the combustion of fuels, such as in car engines. In large cities, nitrogen oxides emissions are a significant source of air pollution.

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$$

(a) The equilibrium constant, K_p, for the formation of NO at 800 K is 4.5×10^{-11}.

(i) Write the expression for the equilibrium constant, K_p, for the above reaction.

[1]

(ii) In an experiment, an equimolar mixture of N_2 and O_2, at a total initial pressure of 3.0 atm, was allowed to reach equilibrium at 800 K in a container with fixed volume.

Calculate the equilibrium partial pressure of NO under these conditions.

[2]

(iii) In a separate experiment, a mixture of N_2, O_2 and NO was allowed to reach equilibrium in a sealed container with a movable piston.

Suggest, with an explanation, how the position of equilibrium might change if the volume of the container is increased at constant temperature.

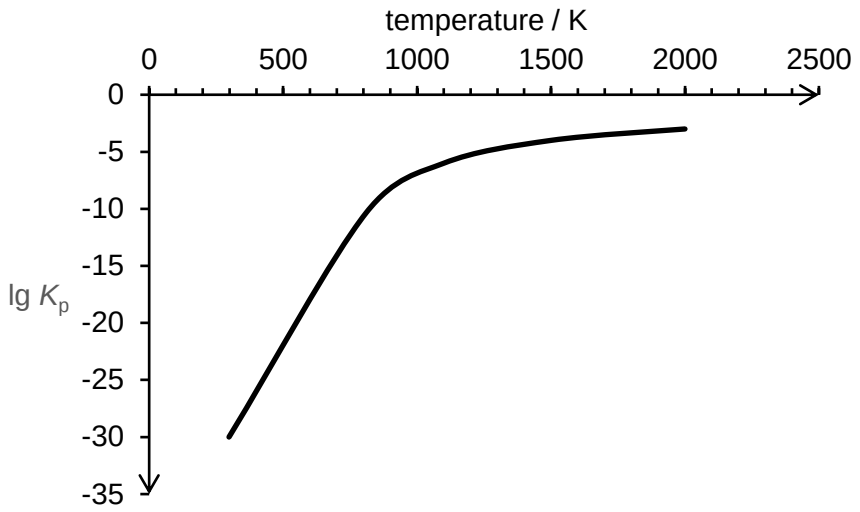
.....

.....

..... [2]

(b) The graph of lg K_p for the formation of NO at various temperatures at constant volume, is given below. A log scale is used for K_p since the values vary over a large range.

For example, when lg $K_p = -5$, $K_p = 10^{-5}$.



(i) Deduce, from the graph, if the formation of NO is an endothermic or exothermic process.

.....

.....

.....

..... [2]

(ii) Besides temperature, state another factor that could favour the formation of NO.

..... [1]

(iii) Using the graph, suggest how the sign and magnitude of $\Delta G^{\ominus}$ for the formation of NO will change from 500 K to 2000 K.

.....

..... [1]

(c) NO is an undesired by-product in the fuel-burning part of the car engine. Modern cars are fitted with a catalytic converter to convert pollutant gases in the exhaust into non-pollutant gases.

(i) The rhodium catalyst in the catalytic converter is used to remove NO and CO. Write a chemical equation for this reaction.

..... [1]

(ii) Briefly explain how the rhodium heterogeneous catalyst speeds up the above reaction.

.....

.....

.....

..... [2]

(d) When NO is emitted from the car exhaust, it combines with O_2 in the air to form nitrogen dioxide, NO_2, which is an air pollutant.

$$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$$

(i) Draw a dot-and-cross diagram of the NO molecule.

[1]

(ii) The first step in a possible mechanism for this reaction is shown below.

$$2NO(g) \rightleftharpoons N_2O_2(g)$$

By using your answer to **(i)**, explain if this step is likely to be endothermic or exothermic.

.....

..... [1]

[Total: 14]

– END OF SECTION B –