AQA

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Chemistry Paper 2H

Wednesday 10 June 2020   Morning   Time allowed: 1 hour 15 minutes

Materials
For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

8464/C/2H

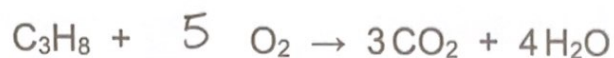**0 1** This question is about the Earth's resources.

When most fuels burn carbon dioxide is produced.

Propane (C_3H_8) is a fuel.

0 1 . 1 Balance the equation for the combustion of propane.

[1 mark]

$$C_3H_8 + \underline{5} \; O_2 \rightarrow 3CO_2 + 4H_2O$$

0 1 . 2 Describe the test for carbon dioxide.
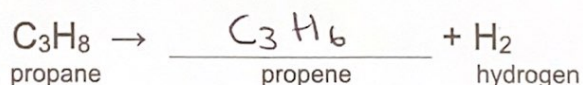
Give the result of the test.

[2 marks]

Test ___Bubble the gas through limewater___

Result ___will turn a milky white colour in the___

___prescence of carbon dioxide___

0 1 . 3 Propane can be cracked to produce propene and hydrogen.

Complete the symbol equation for the reaction.

[1 mark]

$$C_3H_8 \rightarrow \underline{\quad C_3H_6 \quad} + H_2$$

propane   propene   hydrogen

0 1 . 4 Describe the test for hydrogen.

Give the result of the test.

[2 marks]

Test _Hold a lit splint to the test tube_

Result _Burns with a squeaky pop sound_

0 1 . 5 Propene is an alkene.

Describe the test for alkenes.

Give the colour change in the test.

[3 marks]

Test _Add to bromine water_

Colour change _orange_ to _colourless_

9

Turn over for the next question

0 2 Some students investigated the effect of temperature on the rate of reaction.

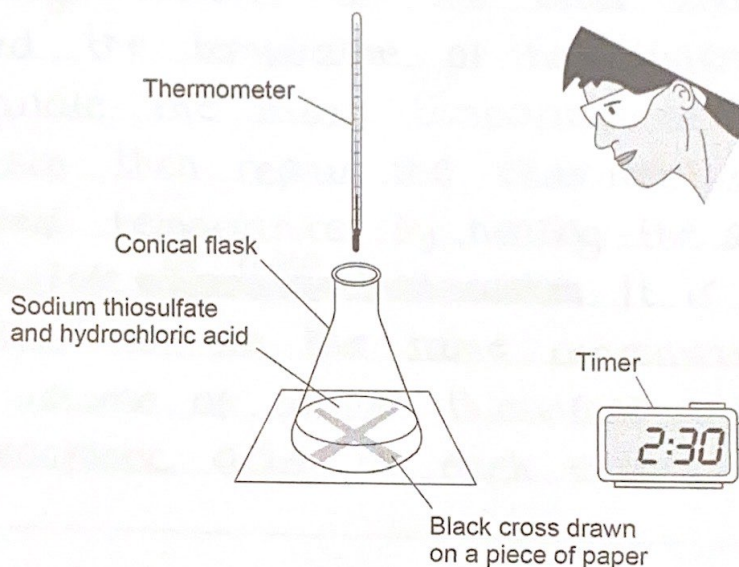**0 2 . 1** The students reacted sodium thiosulfate solution with hydrochloric acid.

This is the method used.

1. Use a beaker to measure 50 cm³ of heated sodium thiosulfate solution into a conical flask.

2. Measure the temperature of the room.

3. Put the conical flask on a black cross drawn on a piece of paper.

4. Start a timer.

5. Use the same beaker to measure 10 cm³ of hydrochloric acid into the conical flask.

6. Stop the timer when the cross is no longer visible.

The students repeated the experiment at a different room temperature.

Figure 1 shows the apparatus.

Figure 1

Thermometer

Conical flask

Sodium thiosulfate
and hydrochloric acid

Timer

2:30

Black cross drawn
on a piece of paper

The method contains errors and does **not** produce accurate results.

Describe a method the students should use to produce accurate results.

You do **not** need to write about safety precautions.

[6 marks]

Use a measuring cylinder to measure $50\,cm^3$ of the sodium thiosulfate then measure $10\,cm^3$ of hydrochloric acid using a different measuring cylinder. Add the two together in a conical flask and start the timer/stop watch. Record the temperate of the solution as soon as the acid is added to the solution and place conical flask onto the piece of paper with the x on it. When the x is no longer visible, stop the timer and record the temperature of the solution again. Calculate the mean temperature of the reaction then repeat the experiment at different temperatures by heating the sodium thiosulfate or acid. ~~important to measure the reaction~~. It is important to use the same concentration and volume of sodium thiosulfate and hydrochloric acid in each experiment.

Question 2 continues on the next page
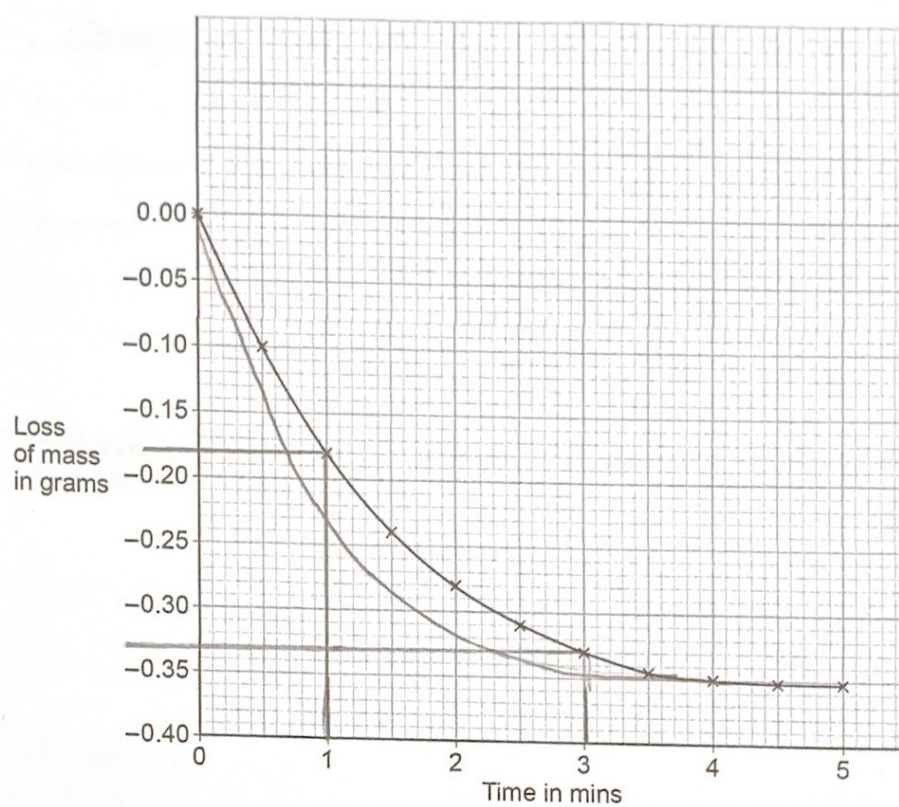
Turn over ▶

Some students investigated the effect of temperature on the rate of a different reaction.

They recorded the loss of mass from their apparatus at 40 °C

Figure 2 shows the results.

Figure 2

0 2 . 2 Calculate the mean rate of reaction between 1 minute and 3 minutes at 40 °C

Use **Figure 2** and the equation:

$$\text{Mean rate of reaction} = \frac{\text{change in mass of gas in g}}{\text{time in mins}}$$

[3 marks]

Change in mass of gas = 0.33 - 0.18 = 0.15

time = 2

rate of reaction = $\frac{0.15}{2}$ = 0.075

Mean rate of reaction = **0.075** g/min

0 2 . 3 Draw a curve on **Figure 2** for the results you would expect at a temperature of 50 °C instead of 40 °C

[2 marks]

11

Turn over for the next question

0 3 This question is about pollutants.

0 3 . 1 Waste water has harmful substances removed before being released into the environment.

Complete the sentences. **[2 marks]**

Agricultural waste water requires the removal of harmful

microbes .

Industrial waste water may require the removal of harmful

Chemicals .

0 3 . 2 How is sewage sludge treated before being released into the environment?

[1 mark]

Tick (✓) **one** box.

Aerobic biological treatment ☐

Anaerobic digestion ✓

Grit removal ☐

Screening ☐

0 3 . 3 Hydrocarbons are used to make polymers. Polymers are used to make plastic bags.

In one year 8.0 billion plastic bags were used.

The next year there was a charge for plastic bags and only 1.3 billion plastic bags were used.

Calculate the percentage decrease in the number of plastic bags used.

[3 marks]

$8.0 - 1.3 = 6.7$ (billion)

$\frac{6.7}{8} \times 100 = 84\%$

Percentage decrease = ___84___ %

Question 3 continues on the next page

Turn over ▶

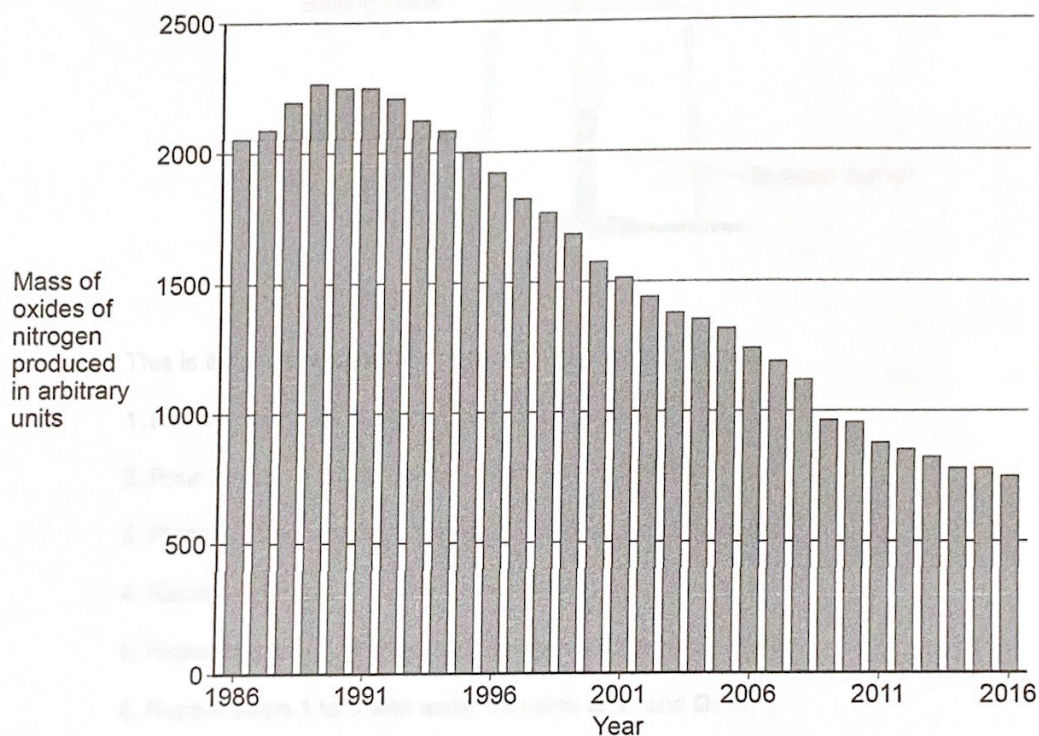Oxides of nitrogen are pollutants formed in car engines.

0 3 . 4   Give **one** problem oxides of nitrogen cause.

[1 mark]

Respiratory problems

0 3 . 5   **Figure 3** shows the mass of oxides of nitrogen produced from car engines from 1986 to 2016.

Figure 3

Mass of oxides of nitrogen produced in arbitrary units

Suggest why the mass of oxides of nitrogen produced from car engines increased and then decreased.

[2 marks]

Increased   more traffic

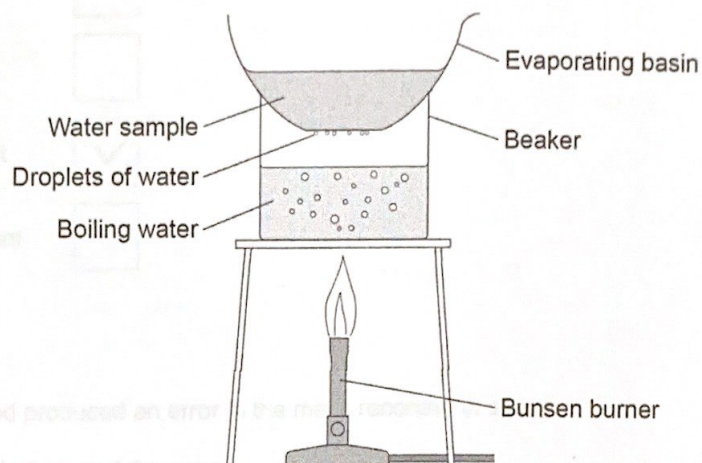Decreased   improved efficiency of car engines

9

0 4 A student investigated the mass of dissolved solids in four water samples **A**, **B**, **C** and **D**.

Figure 4 shows the apparatus used.

Figure 4

This is the method used.

1. Record the mass of a dry evaporating basin.

2. Pour 25 cm³ of water sample **A** into the evaporating basin.

3. Place the evaporating basin on the beaker for 10 minutes.

4. Record the mass of the evaporating basin and contents.

5. Repeat steps 1 to 4 with water sample **A** three more times.

6. Repeat steps 1 to 5 with water samples **B**, **C** and **D**.

0 4 . 1 What type of variable is the mass of dissolved solids?

[1 mark]

Tick (✓) **one** box.

Categoric ☐

Control ☐

Dependent ✓

Independent ☐

0 4 . 2 The method produced an error in the mass recorded in step 4.

Suggest what caused the error.

How could the error be avoided?

[2 marks]

Error ___Not all water had been removed from the sample after the 10 mins of heat.___

Avoided by ___heat until a constant mass is achieved.___

Question 4 continues on the next page

Turn over ▶

Another student carried out the investigation correctly.

Table 1 shows the results.

Table 1

Water sample	Mass of dissolved solids in g				
	Test 1	Test 2	Test 3	Test 4	Mean
A	0.22	0.23	0.20	X	0.21
B	0.03	0.08	0.02	0.03	0.04
C	0.45	0.60	0.49	0.58	0.53
D	0.80	0.91	0.79	0.86	0.84

| 0 | 4 | . | 3 | Calculate value **X** in **Table 1**.

[2 marks]

$$0.21 = \frac{0.22 + 0.23 + 0.2 + X}{4}$$

$$X = \left(\frac{0.21}{4}\right) - 0.22 - 0.23 - 0.2$$

X = _____0.19_____ g

| 0 | 4 | . | 4 | Which water sample has the greatest range of masses of dissolved solids?

Give the reason for your answer.

[2 marks]

Water sample _____C_____

Reason ____Biggest difference between the____
____maximum and minimum values____

0 4 . 5 Water companies measure the volume of water used by households in cubic metres (m^3).

25 cm^3 of a different water sample contained 0.016 g of dissolved solids.

Calculate the mass of dissolved solid in 1 m^3 of this water sample.

1 m^3 = 1000 dm^3

Give your answer in standard form.

[4 marks]

$1m^3 = 1 \times 10^6 \ cm^3$

$mass = 1 \times 10^6 \times \dfrac{0.016}{25}$

$= 640 \ g = 6.4 \times 10^2 \ g$

Mass (in standard form) = $\underline{\qquad 6.4 \times 10^2 \qquad}$ g

11

Turn over for the next question

Turn over ▶

0 5 This question is about crude oil and alkanes.

0 5 . 1 Describe how crude oil is formed.

[3 marks]

Crude oil is formed when plankton die and get ~~burried~~ buried in mud. Under high temperatures and pressure and over many years the remains turn ~~into~~ into crude oil.

0 5 . 2 Describe how crude oil is separated into fractions by fractional distillation.

[4 marks]

The crude oil is heated and the different hydrocarbons that it is made up ~~up~~ of ~~are~~ evaporate and enter the fractioning column. The fractioning column is hot at the bottom and gets cooler as you go up. Due to the varying hydrocarbon chain lengths they all have different boiling points and therefore condense and drain out of the column at different points up the column, the longer chains drain first at the bottom where it is hotter.
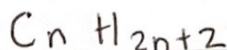
Table 2 shows the boiling points of three alkanes.

Table 2

Alkanes	Boiling point in °C
C_5H_{12}	36
$C_{10}H_{22}$	174
$C_{15}H_{32}$	271

| 0 | 5 | . | 3 | What is the general formula for alkanes?

[1 mark]

$C_n H_{2n+2}$

| 0 | 5 | . | 4 | Explain the trend in the boiling points of the alkanes.

[3 marks]

The boiling point increases as the number of carbon atoms increases because the forces between the molecules increase as the size of the molecules increases

Question 5 continues on the next page

Turn over ▶

0 5 . 5 A student investigated one property of the alkanes C_5H_{12}, $C_{10}H_{22}$ and $C_{15}H_{32}$

This is the method used.

1. Pour 20 cm³ of C_5H_{12} into a separating funnel.

2. Open the tap of the separating funnel and start a timer.

3. Stop the timer when the level of C_5H_{12} reaches line **X**.

4. Repeat steps 1 to 3 with $C_{10}H_{22}$ and $C_{15}H_{32}$

Figure 5 shows the apparatus used.

Figure 5

Separating funnel

20 cm³ C_5H_{12}

Line **X**

Tap
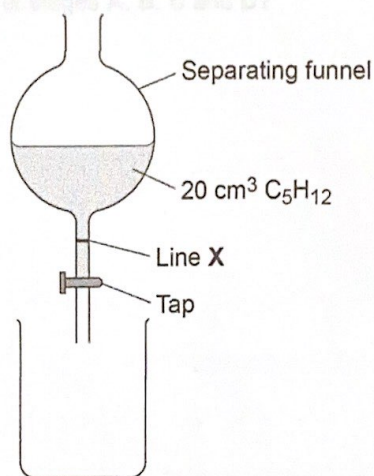
The level of C_5H_{12} takes 6.4 seconds to reach line **X**.

Predict the trend in times for the other two alkanes.

Give **one** reason for your answer.

[2 marks]

Trend ___As the number of carbons in the chain increase the time increases___

Reason ___The viscosity increases with chain length___

13

0 6 This question is about the Earth's atmosphere.

0 6 . 1 Carbon dioxide is a greenhouse gas.

The greenhouse effect happens in four stages.

The four stages are:

Stage **A**   Carbon dioxide stops longer wavelength radiation escaping

Stage **B**   Radiation is absorbed by the Earth

Stage **C**   Longer wavelength radiation is emitted

Stage **D**   Shorter wavelength radiation enters the atmosphere

What is the correct order of stages **A**, **B**, **C** and **D**?

[1 mark]

Tick (✓) **one** box.

C, A, B, D   ☐

C, D, B, A   ☐

D, B, C, A   ☑
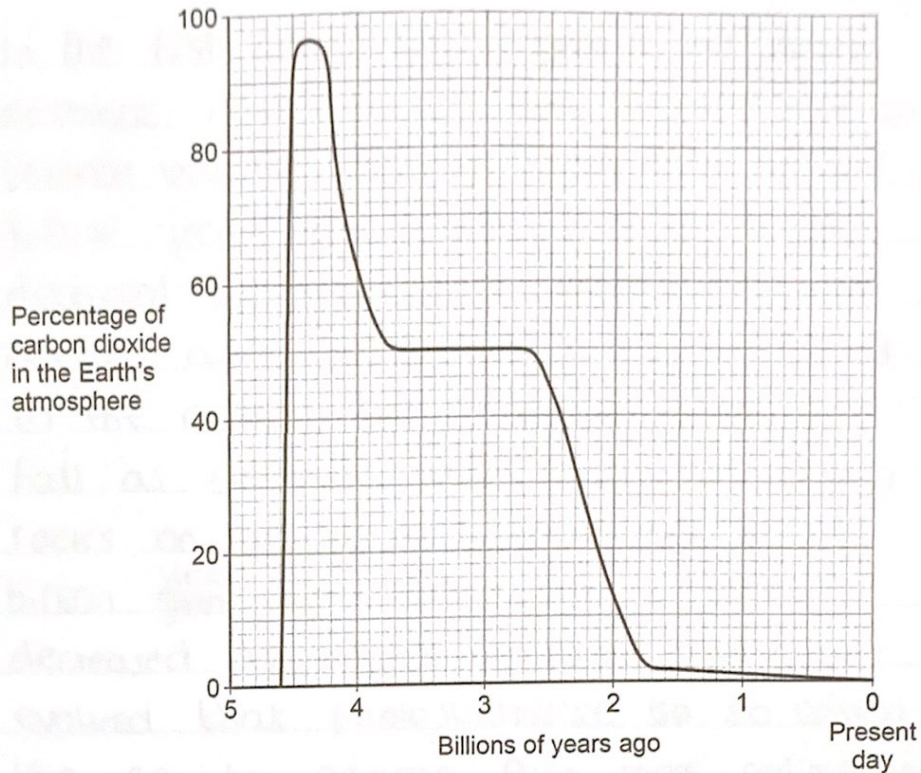
D, C, B, A   ☐

Question 6 continues on the next page

Turn over ▶

Figure 6 shows how the percentage of carbon dioxide in the Earth's atmosphere has changed over 4.6 billion years.

Figure 6

Billions of years ago

Present day

0 6 . 2 The mass of gas in Earth's atmosphere remains constant at 5.15×10^{18} kg

Determine the maximum mass of carbon dioxide that was in the Earth's atmosphere.

Use **Figure 6**.

[3 marks]

maximum percentage = 96%

maximum mass = $\frac{96}{100} \times 5.15 \times 10^{18}$

= 4.94 $\times 10^{18}$

Mass of carbon dioxide = 4.94 $\times 10^{18}$ kg

0 6 . 3 Describe the processes that have caused the main **changes** in the percentage of carbon dioxide in the Earth's atmosphere over the last 4.6 billion years.

Use **Figure 6**.

[6 marks]

In the first billion years ~~year~~ of the earth's existence carbon dioxide levels increased due to intense volcanic activity. From 4.4 to 2.7 billion years ago carbon dioxide levels decreased as water vapor ~~formed~~ condensed to form oceans and the carbon dioxide dissolved in the oceans. ~~The~~ The carbonates form and fall as sediment and form sedimentary rocks on the sea bed. From 2.7 to 1.7 billion ~~years~~ years ago carbon dioxide levels decreased as algae appeared and plants evolved that photosynthesise ~~so~~ so convert the CO_2 to oxygen. Also more sedimentary rock and fossil fuels are formed. Over the past 100-200 years carbon dioxide levels increased due to the industrial revolution as more fossil fuels are burnt so more CO_2 is produced.

10

Turn over for the next question

0 7 This question is about equilibrium.

**0 7 . 1** Describe how a reaction reaches equilibrium.

[2 marks]

In a reversible reaction that takes place in a system which prevents the escape of reactants and products when the forward and backward reactions occur at exactly the same rate it is said to be in equilibrium.

Nitrogen dioxide gas reacts to form dinitrogen tetraoxide gas.

The reaction is reversible.

The equation for the reaction is:

$$2 NO_2(g) \rightleftharpoons N_2O_4(g)$$
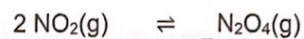
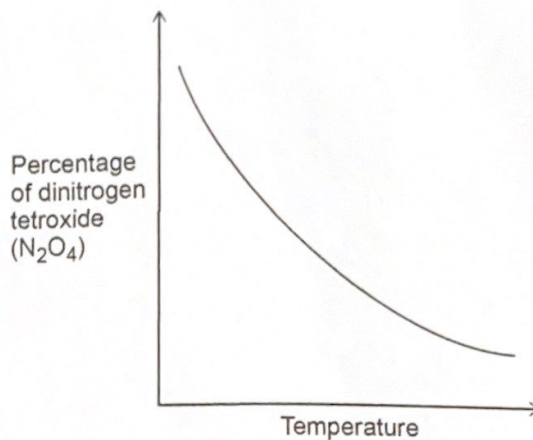**0 7 . 2** Explain the effect on the equilibrium position of increasing the pressure.

[2 marks]

When pressure increases the equilibrium position will shift to the right hand side because there are less molecules on the right.

| 0 | 7 | . | 3 |

Figure 7 shows the change in the percentage of dinitrogen tetroxide (N_2O_4) in the equilibrium mixture as the temperature of the equilibrium mixture is changed.

Figure 7

Percentage
of dinitrogen
tetroxide
(N_2O_4)

Temperature

Explain the effect on the equilibrium position of increasing the temperature.

Use **Figure 7**.

[3 marks]

As the temperature increases the equilibrium
position shifts to the left hand side because
the forward reaction is exothermic and
backward reaction is endothermic. This means
the percentage of product (N_2O_4)
decreases

7

END OF QUESTIONS