Q1. This question is about atoms and isotopes.

(a) Atoms contain protons, neutrons and electrons.

A lithium atom has the symbol $^{7}_{3}Li$

Explain, in terms of sub-atomic particles, why the mass number of this lithium atom is 7.

.....

.....

.....

.....

.....

.....

(3)

(b) Amounts of substances can be described in different ways.

Complete the sentences.

One mole of a substance is the relative formula mass in

.....

The relative atomic mass of an element compares the mass of an atom of an element with the mass of an atom of

.....

(2)

(c) Two isotopes of oxygen are $^{18}_{8}O$ and $^{16}_{8}O$

Describe the similarities and differences between the isotopes $^{18}_{8}O$ and $^{16}_{8}O$

You should refer to the numbers of sub-atomic particles in each isotope.

.....

.....

.....

.....

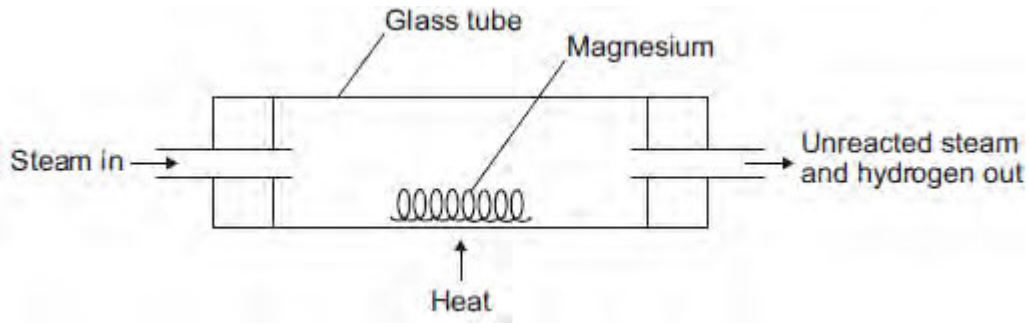
.....

.....

(3)
(Total 8 marks)

Q2. Magnesium reacts with steam to produce hydrogen gas and magnesium oxide.

A teacher demonstrated the reaction to a class. The figure below shows the apparatus the teacher used.



(a) (i) The hydrogen produced was collected.

Describe how to test the gas to show that it is hydrogen.

Test .....

.....

Result .....

.....

(2)

(ii) Explain why the magnesium has to be heated to start the reaction.

.....

.....

.....

.....

(2)

(b) The equation for the reaction is:

$$Mg(s) + H_2O(g) \longrightarrow MgO(s) + H_2(g)$$

(i) The teacher used 1.00 g of magnesium.

Use the equation to calculate the maximum mass of magnesium oxide produced.

Give your answer to three significant figures.

Relative atomic masses (A_r): O = 16; Mg = 24

.....

.....

.....

.....

Maximum mass = ... g

(3)

(ii) The teacher's demonstration produced 1.50 g of magnesium oxide.

Use your answer from part (b)(i) to calculate the percentage yield.

If you could not answer part (b)(i), use 1.82 g as the maximum mass of magnesium oxide. This is **not** the answer to part (b)(i).

.....

Percentage yield = ... %

(2)

(iii) Give **one** reason why the percentage yield is less than 100%.

.....

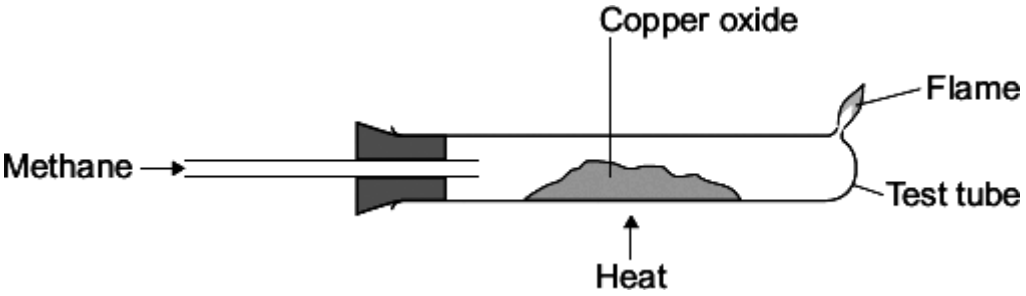
.....

.....

(1)

(Total 10 marks)

Q3. An experiment was done on the reaction of copper oxide (CuO) with methane (CH_4).



(a) The equation for this reaction is shown below.

$4CuO(s) + CH_4(g) \rightarrow 4Cu(s) + 2H_2O(g) + CO_2(g)$

The water and carbon dioxide produced escapes from the test tube.

Use information from the equation to explain why.

.....

(1)

(b) (i) Calculate the relative formula mass (M_r) of copper oxide (CuO).

Relative atomic masses (A_r): O = 16; Cu = 64.

.....

.....

.....

Relative formula mass (M_r) = ...

(2)

(ii) Calculate the percentage of copper in copper oxide.

.....

.....

.....

Percentage of copper = ... %

(2)

(iii) Calculate the mass of copper that could be made from 4.0 g of copper oxide.

.....

.....

Mass of copper = ... g

(1)

(c) The experiment was done three times.
The mass of copper oxide used and the mass of copper made was measured each time.
The results are shown in the table.

	Experiment		
	1	**2**	**3**
Mass of copper oxide used in g	4.0	4.0	4.0
Mass of copper made in g	3.3	3.5	3.2

(i) Calculate the mean mass of copper made in these experiments.

.....

.....

Mean mass of copper made = ... g

(1)

(ii) Suggest how the results of these experiments could be made more precise.

.....

.....

(1)

(iii) The three experiments gave slightly different results for the mass of copper made. This was caused by experimental error.

Suggest **two** causes of experimental error in these experiments.

1 .....

.....

2 .....

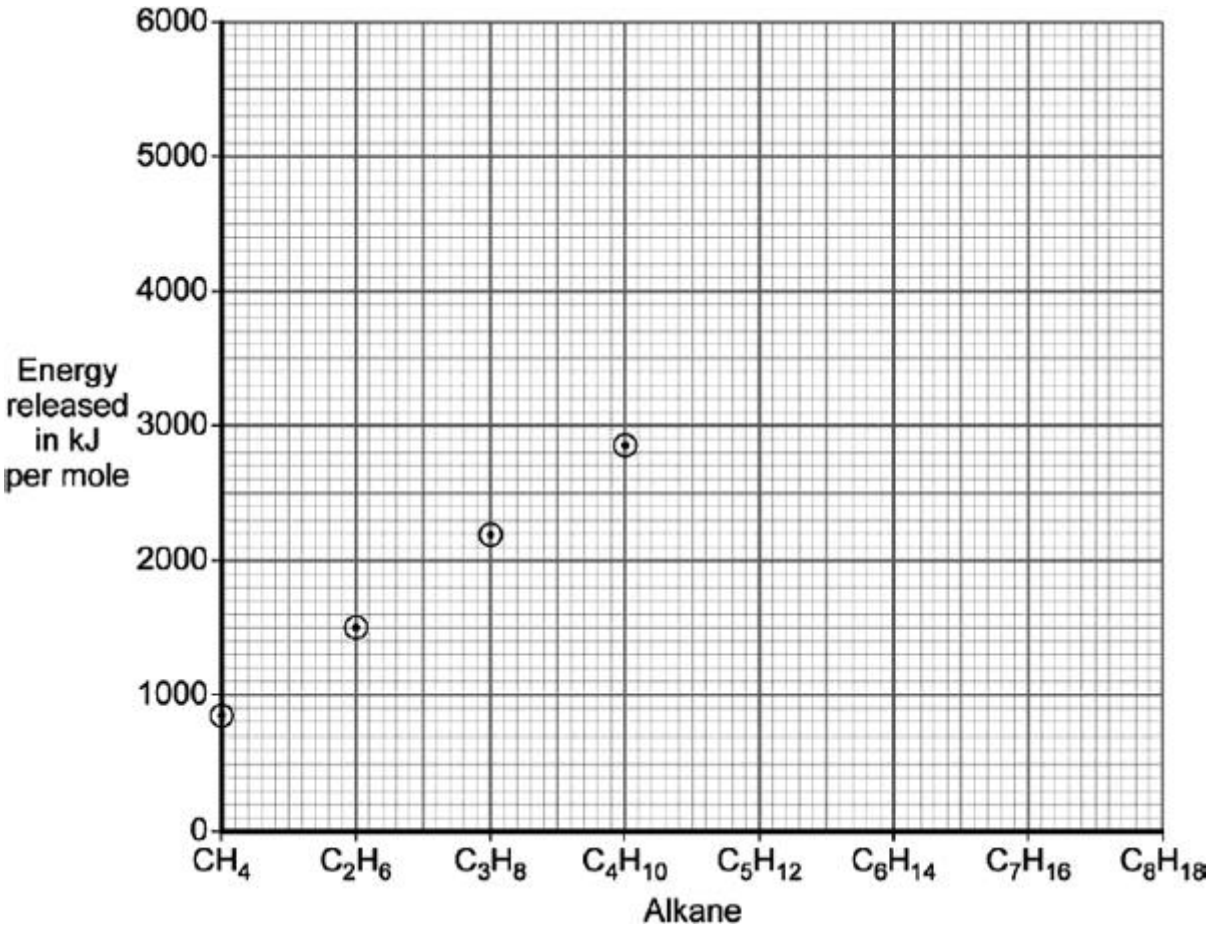
.....

(2)

(Total 10 marks)

Q4. (a) Alkanes are important hydrocarbon fuels. They have the general formula C_nH_{2n+2}

The points on the graph show the amount of energy released when 1 mole of methane (CH_4), ethane (C_2H_6), propane (C_3H_8) and butane (C_4H_{10}) are burned separately.



(i) Draw a line through the points and extend your line to the right-hand edge of the graph.

(1)

(ii) Use the graph to estimate the amount of energy released when 1 mole of octane (C_8H_{18}) is burned.

Energy released = ... kJ

(1)

(iii) Suggest why we can make a good estimate for the energy released by 1 mole of pentane (C_5H_{12}).

.....

.....

(1)

(iv) A student noticed that octane (C_8H_{18}) has twice as many carbon atoms as butane (C_4H_{10}), and made the following prediction:

"When burned, 1 mole of octane releases twice as much energy as 1 mole of butane."

Use the graph to decide if the student's prediction is correct. You **must** show your working to gain credit.

.....

.....

.....

.....

(2)

(b) Some information about four fuels is given in the table.

			Combustion products			
Fuel	**Type**	**Heat released in kJ per g**	**CO_2**	**SO_2**	**H_2O**	**Type of flame**
Bio-ethanol	Renewable	29	✓		✓	Not smoky
Coal	Non-renewable	31	✓	✓	✓	Smoky
Hydrogen	Renewable	142			✓	Not smoky
Natural gas	Non-renewable	56	✓		✓	Not smoky

From this information a student made two conclusions.

For each conclusion, state if it is correct **and** explain your answer.

(i) "Renewable fuels release more heat per gram than non-renewable fuels."

.....

.....

.....

.....

(2)

(ii) "Non-renewable fuels are better for the environment than renewable fuels."

.....

.....

.....

.....

.....

.....

.....

(2)
(Total 9 marks)