

Use of Amount of Sub; Masses

Pure Subs

Question Paper

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.3 Quantitative Chemistry
Sub-Topic	Use of Amount of Sub; Masses Pure Subs
Difficulty Level	Silver Level
Booklet	Question Paper

Time Allowed: 48 minutes

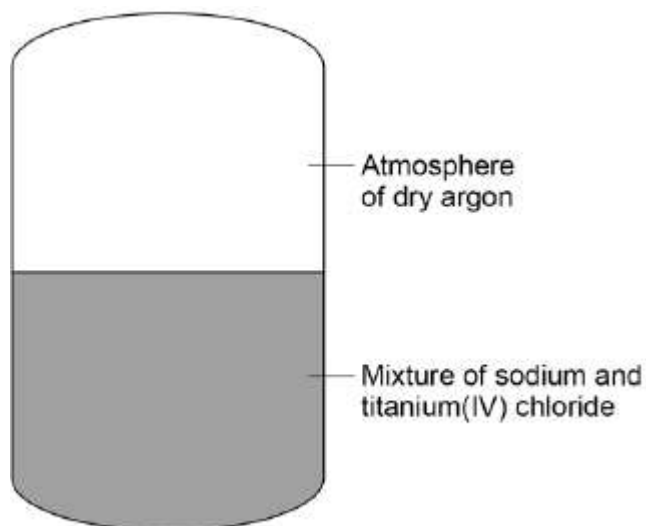
Score: /47

Percentage: /100

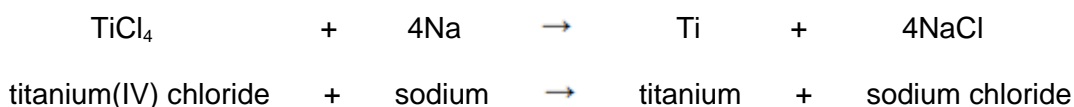
Grade Boundaries:

Q1.Figure 1 shows a reactor used to produce titanium from titanium(IV) chloride.

Figure 1



The chemical equation for the reaction of titanium(IV) chloride with sodium is:



(a) For one reaction:

- 1615 kg titanium(IV) chloride reacted completely with 782 kg sodium
- 1989 kg sodium chloride was produced.

Calculate the mass of titanium produced from this reaction.

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Mass of titanium = kg

(1)

(b) The table below shows the solubility of sodium chloride in 100 cm³ of aqueous solution at different temperatures.

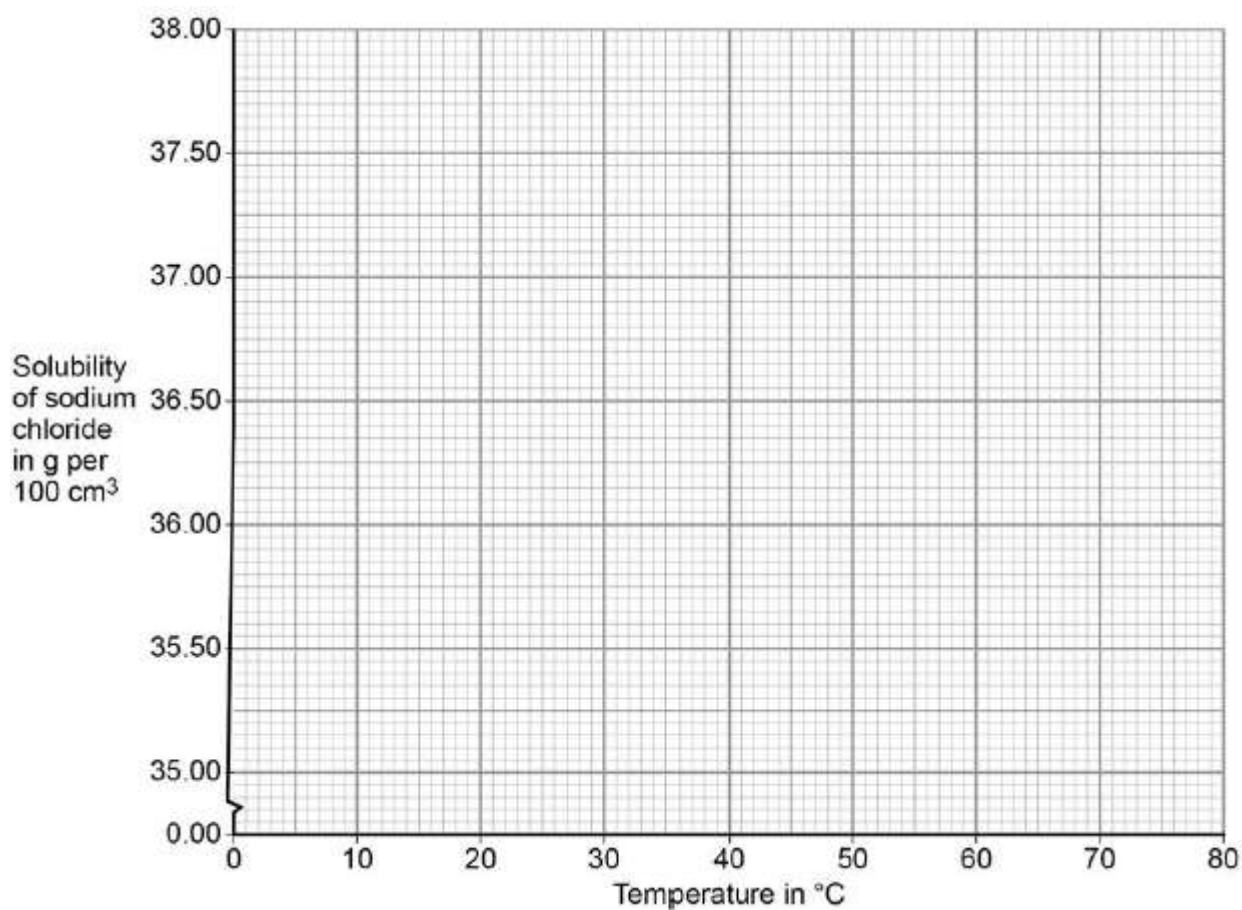
Solubility of sodium chloride in g per 100cm ³	Temperature in °C
35.72	10

35.89	20
36.09	30
37.37	40
36.69	50
37.04	60

On **Figure 2**:

- plot this data on the grid
- draw a line of best fit.

Figure 2



(3)

(c) The product sodium chloride is dissolved in water to separate it from titanium.

At 30 °C the solubility of sodium chloride is 36 kg per 100 dm³.

Calculate the minimum volume of water in dm^3 , at $30\text{ }^\circ\text{C}$, needed to dissolve 1989 kg sodium chloride.

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Volume of water = dm^3

(2)

- (d) Calculate the percentage by mass of titanium in titanium(IV) chloride (TiCl_4).

Give your answer to 3 significant figures.

Relative atomic masses (A_r): Cl = 35.5; Ti = 48

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Percentage of titanium by mass = %

(3)

- (e) Suggest why the reaction is done in an atmosphere of dry argon instead of air containing water vapour.

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(3)

- (f) Explain why titanium conducts electricity.

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(3)
(Total 15 marks)

Q2. This question is about atoms and isotopes.

- (a) Atoms contain protons, neutrons and electrons.

A lithium atom has the symbol ${}^7_3\text{Li}$

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

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(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

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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 $^{18}_{8}\text{O}$ and $^{16}_{8}\text{O}$

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

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

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(3)

(Total 8 marks)

Q3. Scientists found that a compound contained:

22.8% sodium; 21.8% boron; and 55.4% oxygen.

Use the percentages to calculate the empirical formula of the compound.

Relative atomic masses (A_r): B = 11; O = 16; Na = 23

To gain full marks you **must** show all your working.

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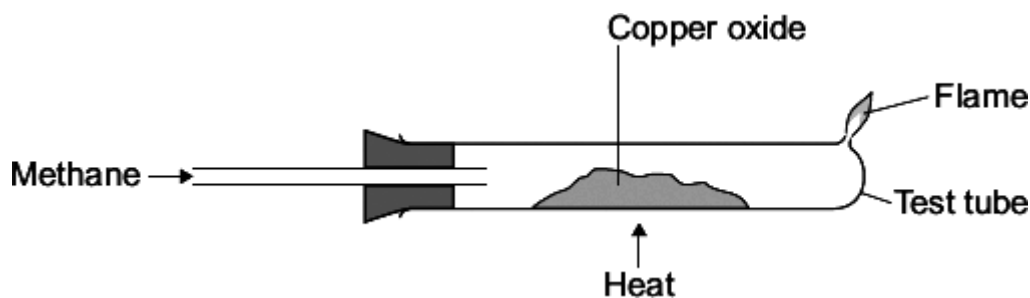
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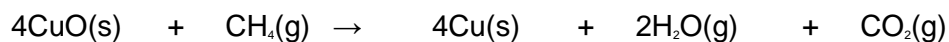
Empirical formula =

(Total 5 marks)

Q4. An experiment was done on the reaction of copper oxide (CuO) with methane (CH₄).



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



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

Use information from the equation to explain why.

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(1)

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

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

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Relative formula mass (M_r) =

(2)

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

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Percentage of copper = %

(2)

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

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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.

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Mean mass of copper made = g

(1)

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

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(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.

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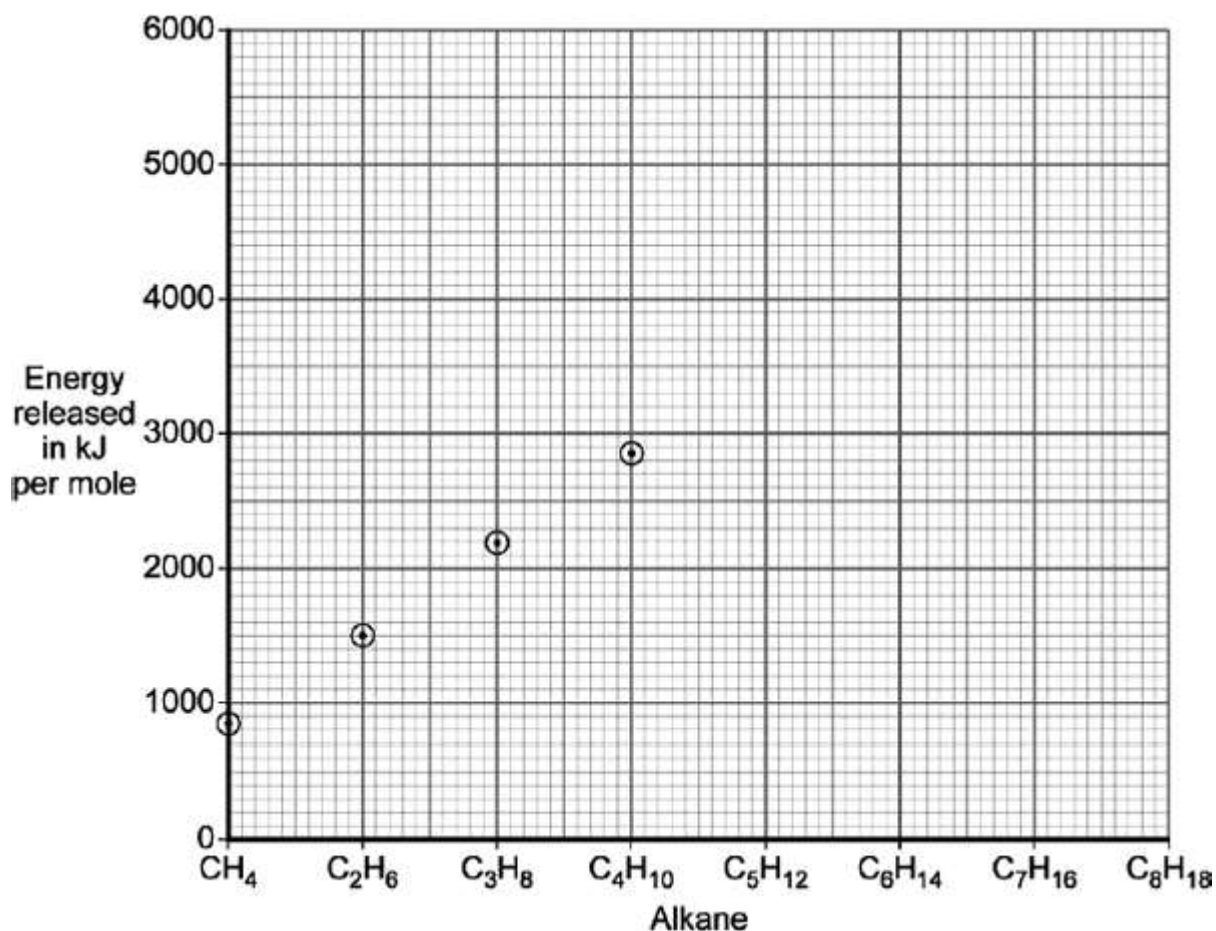
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(2)

(Total 10 marks)

- Q5.** (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 (C₈H₁₈) is burned.

Energy released = kJ

(1)

- (iii) Suggest why we can make a good estimate for the energy released by 1 mole of pentane (C₅H₁₂).

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(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.

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(2)

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

Fuel	Type	Heat released in kJ per g	Combustion products			Type of flame
			CO ₂	SO ₂	H ₂ O	
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.”

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(2)

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

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(2)
(Total 9 marks)