Chemistry unit 3 homework – Quantitative chemistry

For each of the questions below: -

Highlight the command word if there is one & annotate what the command word means. - Answer the question!

Q1. (a) The percentage by mass of oxygen in carbon dioxide (CO_2) is calculated by the equation:

$$\text{percentage by mass} = \frac{\text{number of atoms of O} \times \text{Relative atomic mass of oxygen (O)}}{\text{relative molecular mass of carbon dioxide } (CO_2)} \times 100$$

Relative atomic masses (A_r): C = 12 O = 16

Calculate the percentage by mass of oxygen in carbon dioxide (CO_2).

_____

_____

_____

_____

_____

_____

_____

Percentage by mass of oxygen = _____ %

(3)

Hydrogen peroxide decomposes to produce water and oxygen.

(b) Balance the chemical equation.

$$\_\_\_\_\ H_2O_2 \rightarrow \_\_\_\_ H_2O + O_2$$

(1)

(c) 6.8 g of hydrogen peroxide decomposes to produce 3.6 g of water.

Calculate the mass of oxygen produced when 68 g of hydrogen peroxide decomposes.

_____

_____

_____

Mass of oxygen = _____ g

(2)

Q2 Formulae and equations are used to describe chemical reactions.

(a) Aluminium reacts with sulfuric acid (H_2SO_4) to produce aluminium sulfate, $Al_2(SO_4)_3$ and hydrogen (H_2).

Complete and balance the equation for this reaction.

____Al + _____ ⟶ _____ + _____

(2)

(b) Calcium carbonate reacts with nitric acid to produce calcium nitrate.

Calculate the relative formula mass (M_r) of calcium nitrate, $Ca(NO_3)_2$

Relative atomic masses (A_r): N = 14; O = 16; Ca = 40

_____

_____

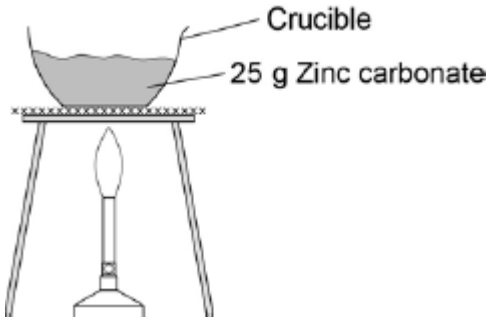
Relative formula mass (M_r) = _____

(2)

(c) Zinc carbonate decomposes when heated.

A student heated 25 g zinc carbonate ($ZnCO_3$).

The figure below shows how he set up the apparatus.



The balanced chemical equation for the decomposition reaction is:

$ZnCO_3$ (s) ⟶ ZnO (s) + CO_2 (g)

The student measured the mass of solid product after heating until there was no further change in mass.

The student did the experiment four times. The table below shows the results.

Experiment	1	2	3	4
Mass of solid product in g	17.4	19.7	17.6	16.9

Calculate the mean mass of the solid product.

Do **not** use any anomalous results in your calculation.

_____

_____

Mean mass = _____ g

(2)

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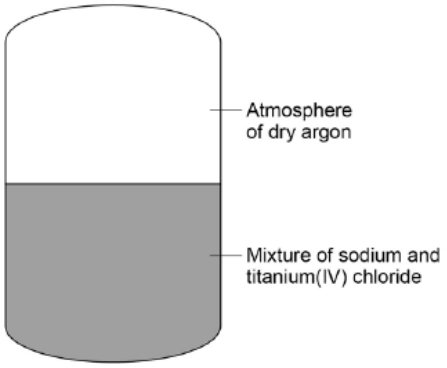
Q3 Figure 1 shows a reactor used to produce titanium from titanium(IV) chloride.

Figure 1



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

$$TiCl_4 + 4Na \rightarrow Ti + 4NaCl$$

titanium(IV) chloride + sodium → titanium + sodium chloride

(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.

_____

_____

Mass of titanium = _____ kg

(1)

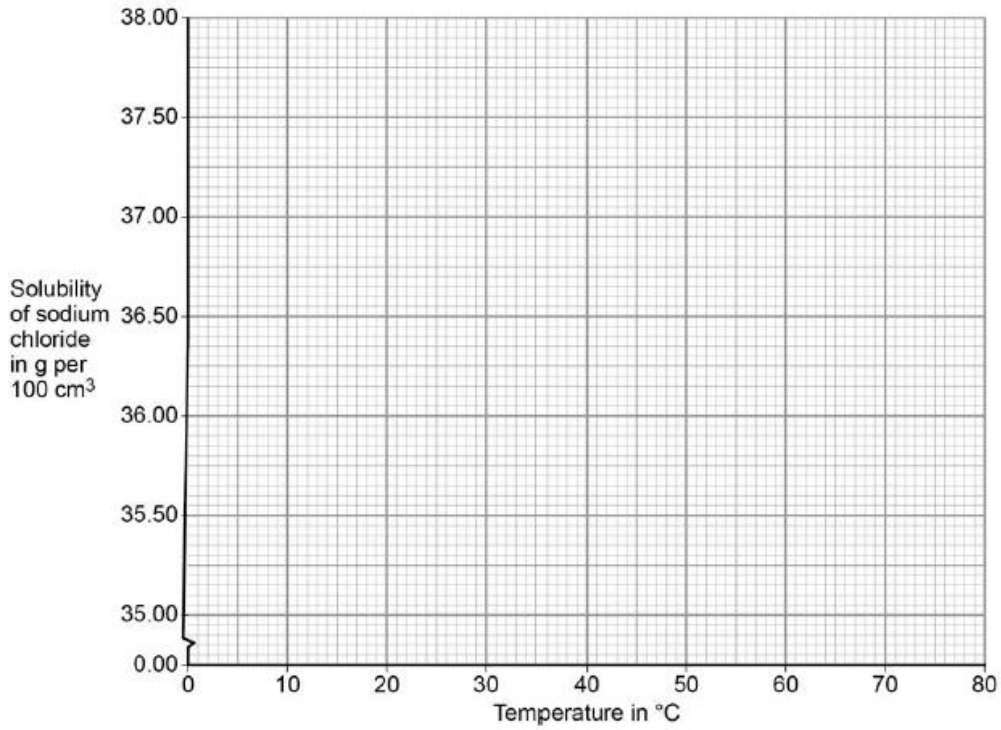
(b) The table below shows the solubility of sodium chloride in 100 cm^3 of aqueous solution at different temperatures.

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 dm^3.

Calculate the minimum volume of water in dm^3, at 30 °C, needed to dissolve 1989 kg sodium chloride.

_____

_____

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

_____

_____

Percentage of titanium by mass = _____ %

(3)