AQA Chemistry GCSE Teacher calculation sheet

C8.1

Calculating rates

Specification references

- C6.1.1 Calculating rates of reactions
- MS 1a, 1c, 1d, 4a, 4b, 4c, 4d, 4e

Aims

This worksheet gives the students practice at calculating the rate of a reaction from data showing the quantity of product formed or the quantity of reactant used up against time. Both calculations of mean rate and actual rate at a specific time are included in the examples provided.

Learning outcomes

After completing this worksheet, students should be able to:

- recall a definition for rate of reaction
- state the units for, and explain how there can be different units for measuring rate of reaction
- calculate the mean rate of reaction from given information about the quantity of reactant used or the quantity of product formed in a given time
- draw and interpret graphs showing the quantity of product formed or quantity of reactant used up against time
- draw tangents to curves and use the slope of the tangent as a measure of the rate of the reaction
- calculate the gradient of a tangent to a curve as a measure of the rate of a reaction at a specific time. (H)

Teacher notes

The key thing when teaching rate of reaction calculations is to emphasise the difference between calculating the mean rate of the reaction after a certain time and using the gradient of the curve to determine the rate of the reaction at a specific time. Initially the students can be introduced to the shape of the curve produced and asked to identify where the reaction is fast, slow and finished. This will introduce them to the idea that it is the gradient of the slope that indicates how fast the reaction is occurring. You can then go on to introduce them to calculating the gradient of the curve by drawing a tangent to the curve. This is an excellent opportunity to liaise with the mathematics department and ensure that the same language and method is taught for calculating the gradient of a slope in both subjects.

Lower ability students will struggle with choosing appropriate scales for axes when plotting graphs. Depending on the ability of the group it may be worth initially pre-drawing axes for graph plotting or alternatively talking through together the most appropriate scales for the graph paper provided. The concept of a smooth curve of best fit will also most likely be new to the students and will require demonstrating in the first instance.

AQA Chemistry GCSE Teacher calculation sheet

C8.1

Maths skills links

Students will also need to be able to translate information between graphical and numerical form when drawing reaction profiles and when looking at life cycle assessments.

Answers

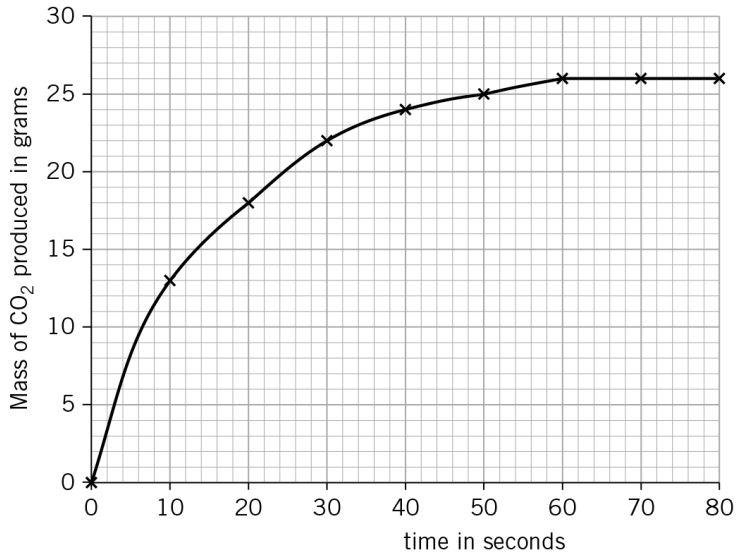
1 a $\frac{15\ \text{cm}^3}{6\ \text{min}} = 2.5\ \text{cm}^3/\text{min}$ (*1 mark answer, 1 mark units*)

b $\frac{6\ \text{g}}{24\ \text{s}} = 0.25\ \text{g/s}$ (*1 mark answer, 1 mark units*)

c $\frac{0.6\ \text{g}}{2.5\ \text{min}} = 0.24\ \text{g/min}$ (*1 mark answer, 1 mark units*)

d $\frac{2.5 \times 10^{-3}\ \text{mol}}{10\ \text{s}} = 2.5 \times 10^{-4}\ \text{mol/s}$ (*1 mark answer, 1 mark units*)

2 a



(*1 mark axes correct and labelled*)
(*2 marks points plotted correctly*)
(*1 mark smooth curve of best fit*)

b Mass of CO_2 produced after 15 s = 16 g (1)

Mean rate = $\frac{16\ \text{g}}{15\ \text{s}} = 1.1\ \text{g/s}$ (1) (*2 marks*)

c 60 seconds (*1 mark*)

3 a i 0.44 cm^3/s (there will be slight variation depending on students' tangents)
(*1 mark appropriate tangent drawn on graph*)
(*1 mark gradient calculated from graph*)

ii 0.23 cm^3/s (there will be slight variation depending on students' tangents)
(*1 mark appropriate tangent drawn on graph*)
(*1 mark gradient calculated from graph*)

b Mean rate between 40 and 60 seconds = $\frac{(30 - 26.5)\ cm^3}{(60 - 40)\ s} = 0.175\ cm^3/s$ (1)

Mean rate between 0 and 20 seconds = $\frac{(20 - 0)\ cm^3}{(20 - 0)\ s} = 1\ cm^3/s$ (1) (*2 marks*)

Student follow up answers

1 a zinc sulfate (*1 mark*)

b 25 cm^3 of gas is produced after 6 min when the reaction is complete (*1 mark*)

Mean rate = $\frac{25\ cm^3}{6\ min} = 4.2\ cm^3/min$ (*1 mark answer, 1 mark units*)

c 3.6 cm^3/min (there will be slight variation depending on students' tangents)
(*1 mark appropriate tangent drawn on graph*)
(*1 mark gradient calculated from graph*)

d i Steeper curve (1)
Finishes at same volume of hydrogen produced (1) (*2 marks*)

ii The curve will be steeper as powdered zinc has a bigger surface area (1) so the reaction will go faster. (1)
The same volume of hydrogen will be given off as the quantities of zinc and sulfuric acid haven't changed. (1) (*3 marks*)