

CIE A-Level Chemistry 9701 Paper 5 Practice Paper (Planning, Analysis and Evaluation)

Total: 30 marks · 1 h 15 min · 2 questions · 11 parts

Data and formulae

Quantity	Value
Gas constant R	8.31 J K ⁻¹ mol ⁻¹
Avogadro constant L	6.02 x 10 ²³ mol ⁻¹
Planck constant h	6.63 x 10 ⁻³⁴ J s
Speed of light c	3.00 x 10 ⁸ m s ⁻¹
Elementary charge e	1.60 x 10 ⁻¹⁹ C
Relative atomic masses H, C, O, Na, S	1.0, 12.0, 16.0, 23.0, 32.1

Q 1 · Planning: effect of temperature on the rate of the sodium thiosulfate / acid reaction [15]

(a) A student investigates how the rate of the reaction between sodium thiosulfate solution and dilute hydrochloric acid changes with temperature. State the independent variable, the dependent variable and three variables that must be kept constant. [2]

(b) Describe how the reaction mixture is held steadily between 20.0 C and 60.0 C, in steps of 10 C, and how the temperature is read accurately. [3]

(c) Give the full procedure for timing the disappearance of the cross, including the volumes used, how the cross is observed, and how many repeats are taken. [4]

(d) Draw a table for the results, with every column heading and unit. [2]

(e) Explain how the activation energy E_a is found from these results: state what is plotted against what, and how the gradient gives E_a . [3]

(f) State two safety precautions for this experiment. [1]

Q 2 · Analysis and evaluation: activation energy from rate data [15]

- (a) A student timed the disappearance of a black cross in the same reaction at five temperatures; the results are in the table above. Complete the $10^3/T$ and $\ln(1/t)$ columns (three significant figures). [4]
- (b) Plot a suitable graph of the data and explain how you judge whether the points lie on a straight line. [4]
- (c) Find the gradient of the line, with its unit. [2]
- (d) Hence calculate the activation energy E_a in kJ mol^{-1} ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$). [2]
- (e) Give two sources of error in the experiment, each with an improvement. [3]