17 Rate of Reactions

Set B **Answer key**

A Multiple choice

3 MARKS

1 **D** test-tube [1]

The mixture is weighed in a conical flask on a balance, with readings taken against a stopwatch. No test-tube is needed.

2 **B** At higher pressure, the yield increases and the rate of production of ammonia is faster. [1]

A higher pressure increases both the yield and the rate. A higher temperature lowers the yield, and a catalyst does not change the yield.

3 **B** Experiments 1 and 2 produced the same volume of gas. [1]

Methanoic acid and hydrochloric acid each give one hydrogen ion per molecule, and the same amount of each acid is used, so they give the same volume of hydrogen. Methanoic acid is weak, so it reacts more slowly.

B Structured questions

12 MARKS

4 **(a)** Experiments 1 and 3: doubling the concentration of Br^- (1.00 to 2.00 mol/dm^3) makes the initial rate four times as fast (0.008 to 0.032). [1]

Experiments 2 and 4: doubling the concentration of H^+ makes the initial rate twice as fast (0.016 to 0.032). [1]

(b) As the concentration increases, there are more particles per unit volume. [1]

This increases the frequency of effective collisions between reacting particles, so the initial rate increases. [1]

5 **(a)** The final volume of gas is lower. [1]

The initial gradient is steeper. [1]

(b)(i) $3CaCO_3 + 2H_3PO_4 \rightarrow Ca_3(PO_4)_2 + 3H_2O + 3CO_2$ [1]

(ii)

Moles of $CaCO_3 = \frac{6}{100} = 0.06$ mol and moles of $H_3PO_4 = \frac{40}{1000} \times 2 = 0.08$ mol [1]

$CaCO_3 : H_3PO_4 = 3 : 2$, so 0.08 mol of H_3PO_4 needs 0.12 mol of $CaCO_3$, but only 0.06 mol is present. Calcium carbonate is the limiting reactant. [1]

(c)

A weak acid only partially ionises, so the concentration of H^+ ions is lower. [1]

There are fewer H^+ ions per unit volume. [1]

So the frequency of effective collisions decreases and the rate of reaction is lower. [1]