

R.2 Energy Changes & Rates of Reaction

Practice Worksheet — name: _____ date: _____

FORMULAS FOR THIS TOPIC

MEAN RATE OF REACTION $\text{rate} = \frac{\text{quantity of product formed}}{\text{time taken}}$

SECTION A — MULTIPLE CHOICE

A1. A reaction mixture in a beaker gets colder as the reaction proceeds. The reaction is:

- A Exothermic, because energy is released
- B Endothermic, because energy is absorbed from the surroundings
- C Catalytic, because no energy is involved
- D Reversible, because temperature changed

A2. Powdered marble reacts faster with acid than the same mass of marble chips because the powder has:

- A More mass
- B A larger surface area
- C A higher temperature
- D A higher concentration

A3. A catalyst speeds up a reaction by:

- A Increasing the temperature of the mixture
- B Increasing the energy of the collisions
- C Providing a pathway with lower activation energy
- D Being consumed to release extra energy

SECTION B — SHORT ANSWER

B1. Sketch an energy level diagram for an exothermic reaction, labelling reactants, products, activation energy and the overall energy change. [4 marks]

B2. In an investigation, hydrochloric acid reacts with magnesium ribbon. State three ways to increase the rate, and explain one of them using collision theory. [4 marks]

B3. The graph of gas volume against time for a reaction levels off after 90 s. Explain the shape of the graph. [3 marks]

ANSWER KEY

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Section A

A1: Endothermic, because energy is absorbed from the surroundings — The reacting chemicals take in thermal energy from the water and beaker around them, so the surroundings cool. Sports cold packs exploit exactly this (dissolving ammonium nitrate).

A2: A larger surface area — Grinding exposes far more particles at the surface where acid can collide with them. More collisions per second means a faster rate — the total amount of product is unchanged.

A3: Providing a pathway with lower activation energy — With a lower energy barrier, a much larger fraction of the existing collisions succeeds. The catalyst is chemically unchanged at the end — which is why a tiny amount works and can be reused.

Section B

B1: Products are drawn LOWER than reactants. The curve rises from reactants over a hump (peak height above reactants = activation energy) then falls below the starting level. The vertical drop from reactants to products is the energy released to the surroundings.

B2: Increase the acid concentration, raise the temperature, or use magnesium powder instead of ribbon (also: add a suitable catalyst). Explanation (concentration): more acid particles per unit volume means more frequent collisions with the magnesium surface each second, so the rate increases.

B3: The curve is steepest at the start when reactant concentrations — and therefore collision frequency — are highest. It becomes shallower as reactants are used up, and flattens when one reactant is completely consumed: the reaction has finished and no more gas forms.