

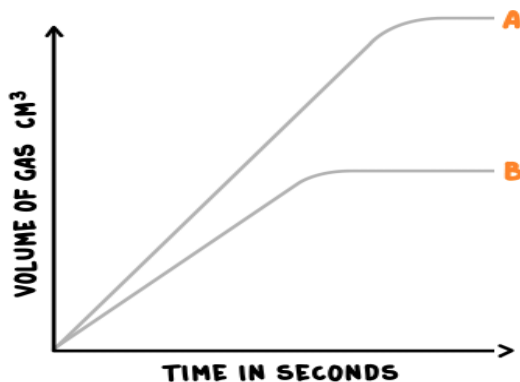
A. Rate of Reaction – part 1 – calculating rate of reaction

1. State two ways of finding the rate of reaction.
2. State two units of rate of reaction.
3. State two ways of measuring the quantity of reactant or product.
4. A student carries out an experiment reacting hydrochloric acid (HCl) with calcium carbonate (CaCO_3) to give calcium chloride (CaCl_2), carbon dioxide and water. Write the balanced symbol equation for this reaction.
5. The student collects 50cm^3 of carbon dioxide in 10 seconds. What is the rate of reaction, including units?
6. **HT ONLY** – The student repeats the experiment again, this time they find the mass of the carbon dioxide collected. They collect 11g of carbon dioxide in 10 seconds. Calculate the rate of reaction in mol/s.
7. **HT ONLY** - What mass of carbon dioxide are they collecting per second if the rate of reaction is 0.075 mol/s?

B. Rate of Reaction – part 2 – Factors affecting rate, collision theory, catalysts

1. What is meant by the term 'collision theory'?
2. What is meant by the term 'activation energy'?
3. What happens to the gradient of a line if the rate of reaction is increased?
4. What is a catalyst?
5. According to collision theory, chemical reactions can only occur when...
6. Other than concentration, give three factors that affect the rate of reaction.
7. Draw a labelled graph to show how changing any one of these factors may affect the rate of reaction. Include the line before and after the change.

8. The graph below shows how the reaction is affected when the concentration of hydrochloric acid is doubled when reacting with excess magnesium. Explain why the amount of hydrogen gas doubles and why the rate of reaction doubles; use collision theory in your response.



C. Rate of reaction – part 3 - catalysts

1. What is a catalyst?
2. The symbol equation for photosynthesis is:



The catalyst for this reaction is chlorophyll, this does not appear in the equation. Why is this?

3. A student carries out three reactions to investigate how quickly oxygen gas was given off by decomposing hydrogen peroxide. Each time she changed the chemical she was adding to see if it was a catalyst. Here are her results.

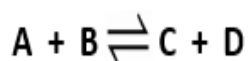
Chemical	Time taken to collect 50 cm ³ in seconds
Without chemical	33
A	33
B	No oxygen given off
C	15

Which chemical was a catalyst? How do you know?

4. Draw the reaction profile for $2\text{H}_2\text{O} \longrightarrow \text{O}_2 + 2\text{H}_2\text{O}$ with and without a catalyst and label the activation energies.

D. Reversible Reactions and Dynamic Equilibrium – part 1 – Reversible reactions, Energy Changes and Reversible Reactions, Equilibrium

1. What is meant by a reversible reaction?
2. Draw the symbol for a reversible reaction.
3. If a reaction is endothermic in one direction, what is it in the other direction?
4. What is meant by the term equilibrium?
5. What needs to happen for equilibrium to be reached?
6. What can be said about the amount of energy being transferred in a reversible reaction?
7. The following reversible reaction occurs:

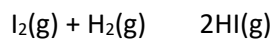


The reaction that make C and D is exothermic. What happens if we heat up A and B?

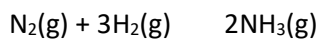
E. Reversible Reactions and Dynamic Equilibrium – part 2 – The Effects of Changing Conditions on Equilibrium (HIGHER Tier ONLY)

1. What is Le Chatelier's Principle?
2. What three factors can be changed in a system at equilibrium?
3. If the concentration of a reactant is increased what will happen to the products of the reaction?
4. What will happen to the amount of product in an endothermic reaction at equilibrium if the temperature is increased?
5. What will happen to the amount of product in an exothermic reaction at equilibrium if the temperature is increased?
6. What will happen to the amount of product in an endothermic reaction at equilibrium if the temperature is decreased?
7. What is meant by the term 'gaseous reaction'?

8. What would happen to the position of equilibrium in a gaseous reaction if the pressure is increased?
9. Using Le Chatelier's Principle, explain what will happen in the following reaction if we increase the concentration of the hydrogen and iodine.



10. What will happen if we increase the temperature of the reaction below? Explain why you think this.



11. Explain what will happen if we decrease the pressure in the reaction above.

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