

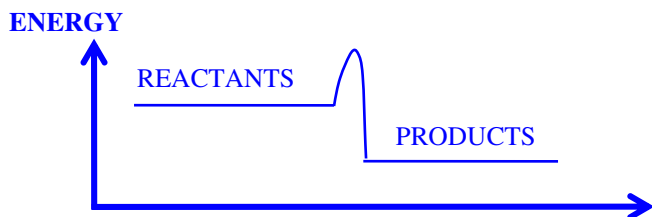
A) What factors determine the rate of a chemical reaction?

Ans. 1) Contact (access)
2) Temperature (energy)
3) Concentration (quantity)

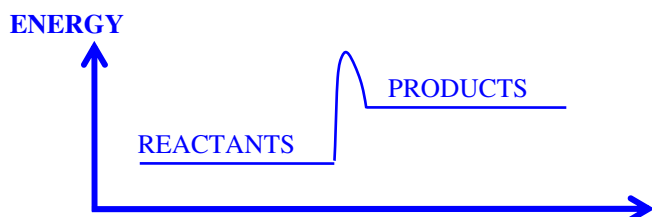
B) What is the role of a catalyst in a chemical reaction?

Ans. Catalysts lower the activation energy of a chemical reaction.

C) Sketch a simple energy diagram for an exothermic reaction?



D) Sketch a simple energy diagram for an endothermic reaction?



1. When sodium hydrogen carbonate (sodium bicarbonate) NaHCO_3 is heated strongly in a test tube, carbon dioxide gas, CO_2 , water vapor, H_2O , are evolved from the test tube, leaving a residue of sodium carbonate, Na_2CO_3 .

a) Write the unbalanced chemical equation for this process.

Ans. $\text{NaHCO}_3 (\text{s}) \rightarrow \text{CO}_2 (\text{g}) + \text{H}_2\text{O} (\text{g}) + \text{Na}_2\text{CO}_3 (\text{s})$

b) Write the balanced chemical equation for this process.

Ans. $2 \text{NaHCO}_3 (\text{s}) \rightarrow \text{CO}_2 (\text{g}) + \text{H}_2\text{O} (\text{g}) + \text{Na}_2\text{CO}_3 (\text{s})$

2. Boric acid, H_3BO_3 , is produced by treating borax ($\text{Na}_2\text{B}_4\text{O}_7$) with aqueous sulfuric acid and water. Sodium sulfate is a by-product of this process.

a) Write the unbalanced chemical equation for this process.

Ans. $\text{Na}_2\text{B}_4\text{O}_7 (\text{aq}) + \text{H}_2\text{SO}_4 (\text{aq}) + \text{H}_2\text{O} (\text{l}) \rightarrow \text{H}_3\text{BO}_3 (\text{s}) + \text{Na}_2\text{SO}_4 (\text{aq})$

b) Write the balanced chemical equation for this process.

Ans. $\text{Na}_2\text{B}_4\text{O}_7 (\text{aq}) + \text{H}_2\text{SO}_4 (\text{aq}) + 5 \text{H}_2\text{O} (\text{l}) \rightarrow 4 \text{H}_3\text{BO}_3 (\text{s}) + \text{Na}_2\text{SO}_4 (\text{aq})$

3. When sulfuric acid is added to ordinary table sugar (sucrose), $\text{C}_{12}\text{H}_{22}\text{O}_{11}$, a long black snake of elemental carbon forms, with the release of a cloud of steam (water vapor).

a) Write the unbalanced chemical equation for this process.

Ans. $\text{C}_{12}\text{H}_{22}\text{O}_{11} (\text{s}) \xrightarrow{\text{H}_2\text{SO}_4} \text{C} (\text{s}) + \text{H}_2\text{O} (\text{g})$

b) Write the balanced chemical equation for this process.

Ans. $\text{C}_{12}\text{H}_{22}\text{O}_{11} (\text{s}) \xrightarrow{\text{H}_2\text{SO}_4} 12 \text{C} (\text{s}) + 11 \text{H}_2\text{O} (\text{g})$

Balance each of the following chemical equations.

