

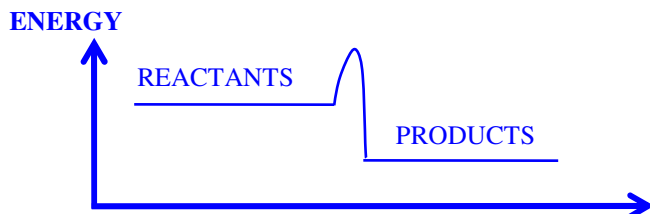
1. What factors determine the rate of a chemical reaction?

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

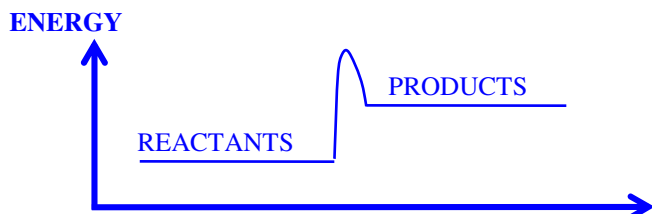
2. What is the role of a catalyst in a chemical reaction?

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

3. Sketch a simple energy diagram for an exothermic reaction?



4. Sketch a simple energy diagram for an endothermic reaction?



5. When sodium hydrogen carbonate (sodium bicarbonate)  $\text{NaHCO}_3$  is heated strongly in a test tube, carbon dioxide gas,  $\text{CO}_2$ , water vapor,  $\text{H}_2\text{O}$ , are evolved from the test tube, leaving a residue of sodium carbonate,  $\text{Na}_2\text{CO}_3$ .

a) The reactant(s) for this reaction are:

Ans.  $\text{NaHCO}_3$

b) The product(s) for this reaction are:

Ans.  $\text{Na}_2\text{CO}_3$ ,  $\text{H}_2\text{O}$  and  $\text{CO}_2$

c) Write the balanced chemical equation for this process.

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

6. Boric acid,  $\text{H}_3\text{BO}_3$ , 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) The reactant(s) for this reaction are:

Ans.  $\text{Na}_2\text{B}_4\text{O}_7$ ,  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{O}$

b) The product(s) for this reaction are:

Ans.  $\text{H}_3\text{BO}_3$  and  $\text{Na}_2\text{SO}_4$

c) Write the balanced chemical equation for this process.

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

7. 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) The reactant(s) for this reaction are:

Ans.  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$

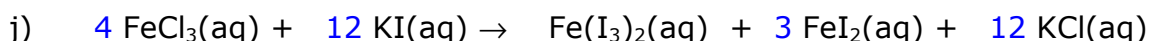
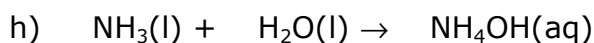
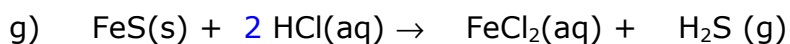
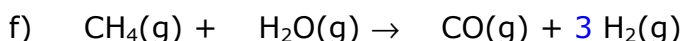
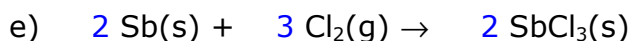
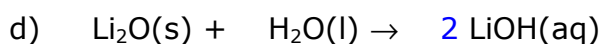
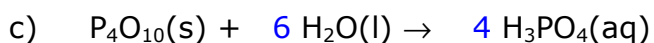
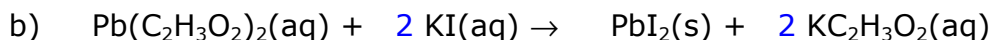
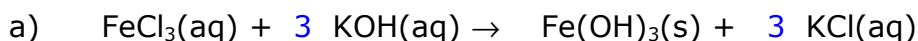
b) The product(s) for this reaction are:

Ans. C and H<sub>2</sub>O

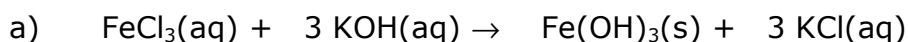
c) Write the balanced chemical equation for this process.

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

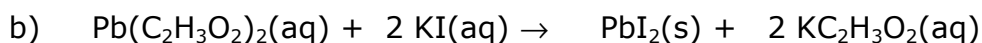
8. Balance each of the following chemical equations.



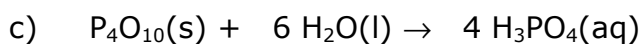
9. Classify the following chemical reactions in as many ways as possible.



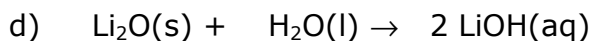
Ans. Double displacement, precipitation



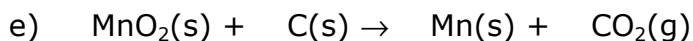
Ans. Double displacement, precipitation



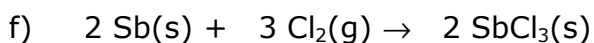
Ans. Combination, oxidation-reduction



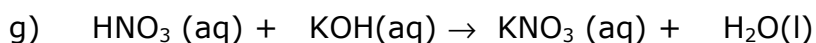
Ans. Combination, oxidation-reduction



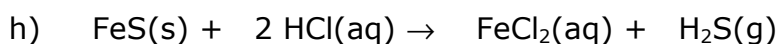
Ans. Single displacement, oxidation-reduction, gas formation



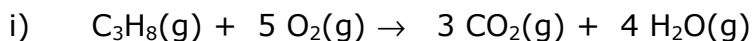
Ans. Combination, oxidation-reduction



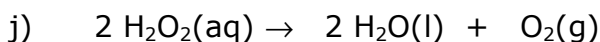
Ans. Double displacement (acid-base neutralization)



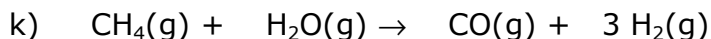
Ans. Double displacement (gas formation)



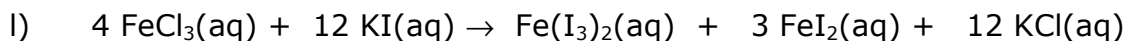
Ans. Oxidation-reduction



Ans. Decomposition, oxidation-reduction, gas formation



Ans. Oxidation-reduction, double displacement



Ans. Oxidation-reduction

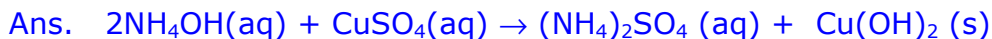
10. Evaluate the following aqueous double displacement reactions:

a) Aqueous solutions of ammonium hydroxide and copper (II) sulfate

i. Predict the products and their physical state (using a table of solubility)

Ans. aqueous  $(\text{NH}_4)_2\text{SO}_4$  and solid  $\text{Cu}(\text{OH})_2$

ii. Write down the balanced chemical equation for the reaction



b) Aqueous solutions of barium chloride and copper(II) sulfate

i. Predict the products and their physical state (using a table of solubility)

Ans. aqueous  $\text{CuCl}_2$  and solid  $\text{BaSO}_4$

ii. Write down the balanced chemical equation for the reaction

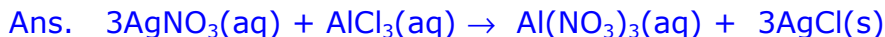


c) Aqueous solutions of silver nitrate and aluminum chloride

i. Predict the products and their physical state (using a table of solubility)

Ans. aqueous  $\text{Al}(\text{NO}_3)_3$  and solid  $\text{AgCl}$

ii. Write down the balanced chemical equation for the reaction



d) Aqueous solutions of sodium hydroxide and hydrochloric acid are combined in a test tube.

i. Predict the products and their physical state (using a table of solubility)

Ans. Liquid  $\text{H}_2\text{O}$  and aqueous  $\text{NaCl}$

ii. Write down the balanced chemical equation for the reaction.

