

Chemical Reactions Review

1. Even though coal-burning power plants have survived through the years with many objections, the environmental problems that they are responsible for are real. Coal contains sulfur compounds, meaning the combustion of coal produces sulfur dioxide, $\text{SO}_{2(g)}$.
 - a. Sulfur dioxide released to the atmosphere reacts further with oxygen to form sulfur trioxide gas. Give the balanced equation for this reaction. Indicate the type of chemical reaction.
 - b. Sulfur trioxide gas reacts with water vapour producing sulfuric acid. Give the balanced equation for this reaction. Indicate the type of chemical reaction.
 - c. Explain why the burning of coal has been an environmental concern in the context of this question.

2. Two inert electrodes have been immersed into an aqueous solution containing copper(II) chloride. The electrodes are then connected to a power supply and the apparatus is moved into a fume hood. As the power supply is steadily increased, bubbles begin to form at one of the electrodes creating an unpleasant odour. The other electrode has a brownish-pink solid forming on it, and over time the blue colour of the solution fades.
 - a. Write a word equation representing the reaction that is taking place.
 - b. Give the balanced chemical equation for the reaction. Indicate the type of chemical reaction.
 - c. Which of the substances in the reaction is a compound? What type of compound?
 - d. List **three** physical properties of the compound in this reaction involved in the question.
 - e. Explain why this reaction is performed in a fume hood?

3. A clear, colourless solution was left in an unlabeled beaker on the chemistry bench from the previous day's experiment. The classes had used two solutions yesterday: aqueous hydrochloric acid and aqueous silver nitrate. The identity of the solution would be determined through simple diagnostic tests.

The solution turned blue litmus paper red and when a piece of zinc was placed in a test tube with the solution, bubbles began to form on the surface of the metal. The gas that formed was then exposed to a lit splint and created a small 'pop' noise.

- a. List **one** physical property of the solution and **one** chemical property of the solution.
 - b. Write a word equation representing the reaction of the solution with zinc.
 - c. Give the balanced chemical equation for the reaction. Indicate the type of chemical reaction.
 - d. What results would have been expected from the diagnostic tests if the identity of the solution was actually aqueous silver nitrate?
4. Silicon can be obtained from silica, $\text{SiO}_{2(s)}$, found in ordinary beach sand. Liquefied silica is reacted with solid carbon in a furnace (**Eq. 1**).



- a. Explain what this process indicates about the relative reactivity of carbon and silicon.

When the liquid silicon is cooled, it still requires further purification. The solid silicon is reacted with chlorine gas to produce liquid silicon tetrachloride.

- b. Write the balanced chemical equation for this step.
- c. What type of chemical reaction is this?
- d. If we considered silicon as a metal (even though it is a metalloid) in silicon tetrachloride, suggest a final step for producing silicon from the product of the previous step. Be specific and provide a chemical reaction.
- e. Considering the products of each of the previous three reactions, what step in the production of silicon would be considered the most environmentally hazardous?

5. When a small piece of barium metal is held briefly over a flame, it heats up enough and creates a greenish-grey flame indicative of its rapid reaction with air. The resulting white powder can be collected for further testing.

a. Write the balanced chemical equation for this reaction. Indicate the reaction type.

The white powder is added to distilled water where it experiences low solubility. However, the new solution becomes blue-purple when universal indicator is added to it.

b. Write a balanced chemical equation to account for this observation. Indicate the reaction type.

A dilute solution of aqueous sulfuric acid, $\text{H}_2\text{SO}_{4(\text{aq})}$, is then slowly added to this solution.

c. What type of reaction is most likely to occur? Write the balanced chemical equation.

d. Indicate the empirical observations that will be made to indicate such a reaction does occur.

6. Most internal combustion engines are powered with gasoline, a mixture of hydrocarbons. For the purpose of this problem, assume gasoline is octane, $\text{C}_8\text{H}_{18(\text{l})}$.

a. If complete combustion is assumed, write the balanced chemical equation for the combustion of gasoline. Note the ratio of O_2 : C_8H_{18} .

b. Since incomplete combustion typically occurs in internal combustion engines, write the balanced chemical equation for the incomplete combustion where the ratio of CO_2 : CO is one.

c. Explain what happens to the ratio of O_2 : C_8H_{18} in the incomplete combustion compared to complete combustion. Theoretically, why does incomplete combustion occur?

d. Why is it cautioned that machines powered by internal combustion engines are only operated in well-ventilated areas?