Chapter 12 Review

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What two conditions must be met for two molecules to react?
2. Consider a thought experiment in which nitrogen and oxygen gases are mixed, as in air. No spontaneous reaction occurs under normal conditions or even by supplying high temperature and pressure. Then consider a lightning strike, which provides evidence for the production of nitrogen oxides. The evidence for this reaction is so strong that scientists list this reaction as part of the nitrogen cycle.
	1. Write a balanced chemical equation for the reaction of nitrogen and oxygen to produce nitrogen dioxide, including the enthalpy change.
	2. Draw and label a chemical potential energy diagram to express the enthalpy change for this reaction.
	3. Create a hypothesis to explain why lightning is necessary to initiate this reaction.
3. Enthalpy change and activation energy are two important concepts used when describing a chemical reaction. How are these two terms similar, and how are they different?
4. Draw a chemical potential energy diagram (similar to Figure 3 on page 533) for the decomposition of liquid water into hydrogen and oxygen gases. Illustrate the energy change for the breaking of water molecules into atoms and then for the subsequent formation of hydrogen and oxygen molecules.
5. In the Exploration activity (page 523) you looked at the reactions of metals with hydrochloric acid, and in Investigation 11.3 (pages 507 and 517) you determined the enthalpy change for the reaction of magnesium with hydrochloric acid.
	1. Draw a chemical potential energy diagram, including the enthalpy change, for the reaction of magnesium metal with hydrochloric acid.
	2. Using the net ionic equation for this reaction, list the bonds that must be broken in the reactants and the bonds that must be formed in the products.
	3. Suggest a possible theoretical hypothesis to explain the empirical differences in the rates of reaction of zinc, magnesium, and iron with hydrochloric acid. Identify any assumptions you are making.
6. Enzymes in your body are generally present in extremely small quantities, but any substances that affect your enzymes are almost always very toxic and dangerous. Explain why this should be so, referring to reaction rates in your explanation.
7. How do catalysts provide solutions to technological problems? Give at least four examples.

Answers:

1. Two conditions that must be met for two molecules to react are: the molecules must have sufficient energy, and they must have the correct orientation at the moment of collision.
2. .
3. Enthalpy change and activation energy are similar in that they both measure the difference in chemical potential energies between molecules at different stages in a reaction. They are different in that activation energy measures the chemical potential energy difference between the reactants and the activated complex, while enthalpy change measures the chemical potential energy difference between the reactants and final products. [For the reverse reaction, the activation energy changes but only the sign of the enthalpy change changes.]
4. 
5. 
6. Your physical health is dependent on precisely controlled reaction rates. Very small changes in enzyme (catalyst) amounts can cause very large changes in the reactions they control. Consequently, some necessary reactions in your body would probably occur much too slowly if the relevant enzyme were to be damaged—affecting your health and, perhaps, endangering your life
7. There are many ways in which catalysts provide solutions to technological problems. Catalysts allow chemical reactions to proceed at a faster rate, and allow for reactions to occur appreciably at lower temperatures. For both of those reasons, catalyzed reactions can save money for industries and consumers. Examples of catalysts providing solutions to technological problems include:
	1. Ɣ detergents with enzymes to remove various stains (amylases, cellulases, lipases, and proteases)
	2. Ɣ brewing or fermentation to produce alcoholic beverages (zymase or yeast catalyst)
	3. Ɣ ammonia production to meet the needs for fertilizers (Fe(s) with KOH(s) additive as catalyst)
	4. Ɣ automobile catalytic converters to reduce pollution (Pt(s), Rh(s), and Pd(s) catalysts)