**BC SCIENCE 10 - Chapter 6 Practice Booklet**

**Short Answer**

 **1)** List the six types of chemical reactions discussed in this chapter.

 **2)** Assume that the formula for candle wax is C26H54. Write a balanced formula equation for the combustion reaction that occurs when a candle burns.

 **3)** When an iron nail is placed in a flask containing an aqueous solution of copper(II) sulfate, a reaction occurs according to the following balanced equation:

Fe(s) + CuSO4(aq)  FeSO4(aq) + Cu(s)

(Cu2+ ions in water are blue in colour, and Fe2+ ions are colourless in water.) Classify this reaction, and describe two changes evident in the flask as the reaction proceeds.

 **4)** Complete and balance the following equation for the reaction occurring when these two solutions are mixed, and state the observation that you would expect as the reaction proceeds.

Na3PO4(aq) + AlCl3(aq)  ?

 **5)** When a piece of aluminum foil is placed in a solution of aqueous copper(II) chloride, a single replacement reaction occurs according to the following balanced equation:

2 Al(s) + 3 CuCl2(aq)  2 AlCl3(aq) + 3 Cu(s)

Describe the changes occurring in the aluminum atoms and the copper(II) ions as this reaction proceeds.

 **6)** All alkali metals react violently with water in a single replacement reaction releasing a gas and forming a basic solution. Choose any alkali metal, and write the balanced formula equation representing its reaction with water. How will a pH meter help monitor the progress of the reaction?

 **7)** A neutralization reaction normally involves an ionic acidic solution mixing with an ionic basic solution. Explain how these ionic reactants are able to produce the covalent product water.

 **8)** Describe two ways that double replacement and neutralization reactions are similar and two ways they are different.

 **9)** List four methods of increasing reaction rates, and indicate how each is thought to work.

 **10)** Consider the following situation: A dilute aqueous solution of hydrogen peroxide is commonly used as a disinfectant for small cuts or scrapes. Hydrogen peroxide decomposes into water and oxygen gas according to the following balanced equation:

2 H2O2(aq)  2 H2O(l) + O2(g)

When a few drops of 3 percent hydrogen peroxide at room temperature are placed in a petri dish, little or no evidence of gas production in the form of oxygen gas from the decomposition is seen. Upon warming the solution, the formation of gas bubbles begins, but only slowly. When the same amount of the same solution at room temperature is placed on a small cut on a student’s finger, however, rapid bubbling of the hydrogen peroxide begins almost immediately. Suggest a likely explanation for this great increase in reaction rate.

**Problem**

 **11)** Complete the following word equations by writing the names of the products on the right side of each of the arrows.

a) aluminum metal + fluorine gas  ?

b) magnesium metal + hydrochloric acid  ?

c) sodium sulfate + lead(II) nitrate  ?

d) acetic acid + potassium hydroxide  ?

e) ethane (C2H6) + oxygen gas 

 **12)** Convert the following word equations into balanced formula equations. You need not indicate the states of the reactants or products.

a) aluminum metal + fluorine gas  aluminum fluoride

b) magnesium metal + hydrochloric acid  magnesium chloride + hydrogen gas

c) sodium sulfate + lead(II) nitrate  sodium nitrate + lead(II) sulfate

d) acetic acid + potassium hydroxide  potassium acetate + water

e) ethane (C2H6) + oxygen gas  carbon dioxide + water

 **13)** Write the names of the products expected in each of the following reactions, and classify each reaction into one of the six types discussed in the chapter.

a) the reaction between magnesium and oxygen

b) the conversion of calcium nitride into its elements

c) the reaction between sodium and water

d) the reaction between nitric acid and magnesium hydroxide

e) the reaction between potassium chromate and silver nitrate

 **14)** Write the names of the reactants that could have reacted to produce the following:

a) ? + ?  silver chloride + sodium nitrate

b) ? + ?  strontium sulfate + water

c) ? + ?  bromine + sodium chloride

d) ? + ?  sodium hydroxide + hydrogen gas

e) ? + ?  magnesium chloride + hydrogen gas

 **15)** Write the formulas of the reactants that could have reacted to produce the following (you need not balance the equations):

a) ?  Al + O2

b) ? + ?  K3PO4 + H2O

c) ? + ?  Ag2CrO4 + LiNO3

 **16)** Both hydrochloric acid and sodium hydroxide solutions are clear and colourless and look exactly like water. When equal volumes of equally concentrated solutions of hydrochloric acid and sodium hydroxide are mixed together, a reaction occurs, but the appearance of the reaction vessel does not change at all; it still looks exactly like pure water. Write the complete and balanced equation for this reaction below, and explain what method you could employ to show that a chemical reaction has actually occurred.

 **17)** Complete the following table:

|  |  |  |
| --- | --- | --- |
| Reactant Names | Product Name(s) | Reaction Type |
| sodium + oxygen  |  |  |
| ? + ?  | magnesium bromide + water |  |
| zinc + silver nitrate  |  |  |
| sodium sulfide + copper(II) chloride  |  |  |

 **18)** Complete the following table (you need not balance the equations):

|  |  |  |
| --- | --- | --- |
| Reactant Formulas | Product Formula(s) | Reaction Type |
| C6H14 + O2  |  |  |
| Al + CuCl2  |  |  |
| MgSO4 + Na3PO4  |  |  |
| HClO3 + Sr(OH)2  |  |  |

 **19)** When you fill a car with gasoline, the gasoline enters the fuel tank as a liquid; however, in the cylinder where the combustion actually takes place, a *very fine mist* of gasoline is sprayed and mixed with air. This mixture of gasoline mist and oxygen is then compressed, and at the point where the volume is the smallest, a spark ignites the mixture. This causes an explosion that eventually causes the car’s wheels to turn and the car to move. Explain at least two reasons why the conditions in the cylinder increase the rate of the combustion of the gasoline.

 **20)** A solid cube of zinc metal will react slowly with a dilute solution of hydrochloric acid to produce (a solution of) zinc chloride and hydrogen gas according to the following balanced equation:

Zn(s) + 2 HCl(aq)  ZnCl2(aq) + H2(g)

State three ways that the rate of this reaction could be increased, and explain why each method works.

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**Answer Section**

**SHORT ANSWER**

 **1)** i) synthesis

ii) decomposition

iii) single replacement

iv) double replacement

v) neutralization

vi) combustion

 **2)** 2 C26H54 + 79 O2  52 CO2 + 54 H2O

 **3)** This is a single replacement reaction. As it proceeds, the blue colour of the solution will fade and the solid copper will form on the surface of the nail.

 **4)** Na3PO4(aq) + AlCl3(aq)  AlPO4(s)+ 3 NaCl(aq) A solid should form upon mixing that can be identified as aluminum phosphate. (Students should know that sodium chloride dissolves in water.)

 **5)** Each aluminum atom loses 3 electrons to become a 3+ cation, and each copper(II) cation gains 2 electrons to become a neutral copper atom.

 **6)** 2 Na + 2 H2O  2 NaOH + H2 As the reaction proceeds and more and more NaOH is formed, the solution will become more basic, and the pH will increase above the original value of 7 and continue to increase as the NaOH forms.

 **7)** The H+ cation in the acid solution combines with the OH- anion present in the base to form HOH, which is water. (Note: The product salt is formed from the anion of the acid and the cation from the original base.)

 **8)** Similarities: Both reactions occur in aqueous solutions, and both involve ions being exchanged between reactants.

Differences: Double replacement reactions will produce two ionic products, while neutralization will produce one ionic product and one covalent product. Double replacement reactions will produce at least one solid product, while neutralization reactions may not. The pH of the product solution in a neutralization reaction will always be different than the pH of each initial reactant solution, but the pH may not necessarily change during a double replacement reaction.

 **9)** i) Increase reactant concentration(s): this increases the number of reactant collisions.

ii) Increase reactant surface area(s): this increases the number of reactant collisions.

iii) Increase reactant temperature: this increases the number and intensity of reactant collisions.

iv) Add a catalyst: this causes the reactants to align better with one another prior to collision.

 **10)** As surface area, concentration, and temperature increase are not likely explanations, the most probable explanation would be that a catalyst that decomposes hydrogen peroxide exists in the student’s tissue or bloodstream that speeds up the decomposition. (This catalyst does exist and is an enzyme called catalase.)

**PROBLEM**

 **11)** a) aluminum metal + fluorine gas  aluminum fluoride

b) magnesium metal + hydrochloric acid  magnesium chloride + hydrogen gas

c) sodium sulfate + lead(II) nitrate  sodium nitrate + lead(II) sulfate

d) acetic acid + potassium hydroxide  potassium acetate + water

e) ethane (C2H6) + oxygen gas  carbon dioxide + water

 **12)** a) 2Al + 3 F2  2 AlF3

b) Mg + 2 HCl  MgCl2 + H2

c) Na2SO4 + Pb(NO3)2  2 NaNO3 + PbSO4

d) CH3COOH + KOH  KCH3COO + H2O

e) 2 C2H6 + 7 O2  4 CO2 + 6 H2O

 **13)** a) magnesium oxide (synthesis)

b) calcium + nitrogen (decomposition)

c) sodium hydroxide + hydrogen (single replacement)

d) magnesium nitrate + water (neutralization)

e) silver chromate + potassium nitrate (double replacement)

 **14)** a) silver nitrate + sodium chloride  silver chloride + sodium nitrate

b) sulfuric acid (hydrogen sulfate) + strontium hydroxide  strontium sulfate + water

c) chlorine + sodium bromide  bromine + sodium chloride

d) sodium + water  sodium hydroxide + hydrogen gas

e) magnesium + hydrochloric acid (hydrogen chloride)  magnesium chloride + hydrogen gas

 **15)** a) (Al2O3)  Al + O2

b) (H3PO4 + KOH)  K3PO4 + H2O

c) (Li2CrO4 + AgNO3)  Ag2CrO4 + LiNO3

 **16)** HCl + NaOH  NaCl + H2O Chemical indicators would show that the original HCl solution was acidic (methyl orange would be red) and that the original NaOH solution was basic (phenolphthalein would be pink). The final solution, however, should be close to neutral (methyl red will be yellow, and phenolphthalein would be colourless). Also, a pH meter measuring the before and after pH values would give the same information. The original acid solution would have a pH well below 7, and the original basic solution would have a pH well above 7. The final solution, however, should have a pH close to 7.

 **17)**

|  |  |  |
| --- | --- | --- |
| Reactant Names | Product Name(s) | Reaction Type |
| sodium + oxygen  | sodium oxide  | synthesis |
| hydrogen bromide + magnesium hydroxide  | magnesium bromide + water | neutralization |
| zinc + silver nitrate  | zinc nitrate + silver | single replacement |
| sodium sulfide + copper(II) chloride  | sodium chloride + copper(II) sulfide  | double replacement |

 **18)**

|  |  |  |
| --- | --- | --- |
| Reactant Formulas | Product Formula(s) | Reaction Type |
| C6H14 + O2  | CO2 + H2O | hydrocarbon combustion |
| Al + CuCl2  | AlCl3 + Cu | single replacement |
| MgSO4 + Na3PO4  | Mg3(PO4)2 + Na2SO4 | double replacement |
| HClO3 + Sr(OH)2  | Sr(ClO3)2 + H2O | neutralization |

 **19)** Students can respond with any two of the following:

i) By converting the liquid gasoline into a fine mist, the surface of the gasoline is greatly increased, which increases the number of collisions with oxygen molecules and, therefore, increases the reaction (combustion) rate.

ii) By compressing the gas/air mixture before ignition, the concentration of each reactant is increased, which increases the number of collisions between the reactant molecules and, therefore, increases the reaction rate.

iii) The spark generates heat, which increases the number and intensity of collisions between some reactant molecules, thereby speeding up (and starting) the reaction.

 **20)** i) Increase the concentration of the hydrochloric acid. This increases the number of collisions between the reactant particles and, therefore, increases the reaction rate.

ii) Increase the temperature of the acid. This increases the number and the intensity of the reactant collisions and, therefore, increases the reaction rate.

iii) Crush the zinc into a powder before placing it in the acid solution. This increase in surface area increases the number of collisions between the reactant particles and, therefore, increases the reaction rate.