Regents Exam Questions for Chemical Reactions

1. Given the equation representing a reaction: $3Mg_{(S)} + N_{2(G)} \rightarrow Mg_3N_{2(S)}$
   What is the mass of Mg_3N_2 that is produced when 14.58 grams of magnesium completely reacts with 5.60 grams of nitrogen? (from Aug 2023)
   (1) 8.98 g (2) 10.46 g (3) 20.18 g (4) 49.34 g

2. Which solutions react to produce an insoluble compound?
   (1) $KCl_{(AQ)} + LiCl_{(AQ)} \rightarrow$ (2) $LiCl_{(AQ)} + NaNO_{3(AQ)} \rightarrow$
   (3) $NaCl_{(AQ)} + AgClO_{3(AQ)} \rightarrow$ (4) $KNO_{3(AQ)} + AgClO_{3(AQ)} \rightarrow$

3. Given the equation representing a reaction: $F_{2(G)} + 2KCl_{(AQ)} \rightarrow 2KF_{(AQ)} + Cl_{2(G)}$
   Which type of chemical reaction is represented by the equation? (from June 2023)
   (1) synthesis (2) decomposition (3) single replacement (4) double replacement

4. Which statement describes what occurs when two iodine atoms react to produce an iodine molecule?
   (1) A bond forms and energy is absorbed. (2) A bond forms and energy is released.
   (3) A bond breaks and energy is absorbed. (4) A bond breaks and energy is released.

5. Based on Table I, which equation represents conservation of mass and energy?
   (1) $CH_{4(G)} + O_{2(G)} + \text{energy} \rightarrow CO_{2(G)} + H_2O_{(G)}$
   (2) $CH_{4(G)} + O_{2(G)} \rightarrow CO_{2(G)} + H_2O_{(G)} + \text{energy}$
   (3) $CH_{4(G)} + 2O_{2(G)} + \text{energy} \rightarrow CO_{2(G)} + 2H_2O_{(G)}$
   (4) $CH_{4(G)} + 2O_{2(G)} \rightarrow CO_{2(G)} + 2H_2O_{(G)} + \text{energy}$

6. Which formula represents chromium (III) oxide?
   (1) CrO_3 (2) Cr_3O (3) Cr_2O_3 (4) Cr_3O_2

7. Which equation represents conservation of atoms?
   (1) $TiO_2 + 2Al \rightarrow 2Al_2O_3 + Ti$ (2) $TiO_2 + 4Al \rightarrow 2Al_2O_3 + Ti$
   (3) $3TiO_2 + 2Al \rightarrow 2Al_2O_3 + 3Ti$ (4) $3TiO_2 + 4Al \rightarrow 2Al_2O_3 + 3Ti$

8. Given the balanced equation representing a reaction: $2KClO_3 + \text{energy} \rightarrow 2KCl + 3O_2$
   What's the mass of KCl produced when 24.51 grams of $KClO_3$ reacts to produce 9.60 grams of O_2?
   (1) 5.31 g (2) 14.91 g (3) 34.11 g (4) 43.71 g

9. Which type of reaction does this equation represent: $2NaCl \rightarrow 2Na + Cl_2$
   (1) double replacement (2) decomposition (3) synthesis (4) single replacement

10. Given the equation representing a reaction: $2H_2(G) + 2NO_{(G)} \rightarrow N_{2(G)} + 2H_2O_{(G)}$
    What is the mass of $N_{2)G)}$ produced when 1.0 gram of $H_{2(G)}$ completely reacts with 15.0 grams of $NO_{(G)}$ to produce 9.0 grams of $H_2O_{(G)}$?
    (1) 7.0 g (2) 14.0 g (3) 25.0 g (4) 28.0 g

PART 2 Problems – not multiple choice

Boric acid, H_3BO_3, is heated to produce tetraboric acid, $H_2B_4O_7$, and water.
The equation below represents the reaction to form tetraboric acid.

$$\underset{\text{boric acid}}{4H_3BO_{3(S)}} \xrightarrow{\text{heat}} \underset{\text{tetraboric acid + water}}{H_2B_4O_{7(S)} + 5H_2O_{(G)}}$$

The tetraboric acid is then used to make borax, which is used as a cleaning agent. Borax, $Na_2B_4O_7 \cdot 10H_2O$, is a hydrate with a gram-formula mass of 381 grams per mole. A hydrate is a compound with water within its crystal structure. Borax has ten moles of water for every mole of $Na_2B_4O_7$.

11. Explain why the formula for tetraboric acid is an empirical formula.

Phosphorus combines with oxygen to form an oxide that reacts with water to produce phosphoric acid, which is an important industrial compound used to produce fertilizers. An unbalanced equation for the production of phosphoric acid is shown here: $P_4O_{10(S)} + H_2O_{(G)} \rightarrow H_3PO_{4(AQ)} +$ energy

12. Balance this equation using the smallest whole-number coefficients.

$$\_\_\_P_4O_{10(S)} + \_\_\_H_2O_{(G)} \rightarrow \_\_\_H_3PO_{4(AQ)} + \text{energy}$$

14. Write the empirical formula of the solid reactant in the equation.

15. Calculating the percent composition by mass of phosphorus in P_4O_{10} (gram-formula mass 284 u).

Calcium oxide, CaO, also known as lime, is an important industrial chemical. Lime can be obtained by the heating of limestone, which is mainly calcium carbonate, $CaCO_3$. An equation representing the reaction for the production of lime is shown here.

$$CaCO_{3(S)} \rightarrow CaO_{(S)} + CO_{2(G)}$$

16. State the solubility of limestone in water.

17. State evidence from the equation that the reaction to form lime is endothermic.