Chemical Reactions Practice

Use this key to check answers and read the explanations.

1. In the symbolic equation PQ(aq) + R(aq) → PR(s) + Q(aq), which formula represents a solid product?

A. PR
B. PQ
C. R
D. Q

Correct answer: A. PR
Products appear to the right of the arrow. PR is a product and carries the state label (s), which means solid.

2. In the model equation 3 AB_2 → A_3B_4 + B_2, how many atoms of A and B are on the product side, respectively?

A. 3 A and 2 B
B. 3 A and 4 B
C. 3 A and 6 B
D. 1 A and 6 B

Correct answer: C. 3 A and 6 B
A_3B_4 contains 3 A and 4 B. The separate B_2 product adds 2 more B atoms, giving 6 B altogether.

3. Which label describes the pattern in 2 C_2D → 4 C + D_2, where C and D stand for model elements?

A. Combination
B. Decomposition
C. Precipitation
D. Acid–base neutralization

Correct answer: B. Decomposition
C_2D is the only reactant substance. It breaks down into two product substances, C and D_2, which is the decomposition pattern.

4. The model equation 4 LM + 2 M_2 → 4 LM_2 is balanced. What are its coefficients in the smallest whole-number ratio, from left to right?

A. 1, 1, 1
B. 4, 2, 4
C. 2, 2, 2
D. 2, 1, 2

Correct answer: D. 2, 1, 2
Divide each coefficient by 2. The balanced ratio is 2 LM to 1 M_2 to 2 LM_2.

5. A textbook represents baking soda decomposition with $2\ NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$. What is the mole ratio of $NaHCO_3$ consumed to CO_2 formed?

A. 1 to 2
B. 2 to 1
C. 1 to 1
D. 3 to 1

Correct answer: B. 2 to 1
There is a coefficient of 2 for $NaHCO_3$ and an implied coefficient of 1 for CO_2. The ratio is 2 moles to 1 mole.

6. What are the smallest whole-number coefficients, from left to right, that balance $M_3N_2 + N_2 \rightarrow MN$ in a model?

A. 2, 1, 6
B. 1, 1, 3
C. 1, 2, 3
D. 2, 2, 6

Correct answer: A. 2, 1, 6
Two M_3N_2 units contribute 6 M and 4 N. One N_2 adds 2 N. Six MN units account for all 6 atoms of each kind.

7. For the model $2\ EF \rightarrow E_2 + F_2$, a table lists the change in each particle count. Which row fits the reaction as written, in the order EF, E_2, F_2?

A. −4, +4, +4
B. −8, +4, +8
C. −4, +2, +1
D. −8, +4, +4

Correct answer: D. −8, +4, +4
Every two EF particles consumed form one E_2 and one F_2. Losing eight EF therefore adds four particles of each product.

8. A complete ionic equation reads $Ca^{2+}(aq) + 2\ Cl^-(aq) + 2\ Na^+(aq) + CO_3^{2-}(aq) \rightarrow CaCO_3(s) + 2\ Na^+(aq) + 2\ Cl^-(aq)$. Which ions are spectators?

A. Ca^{2+} and Cl^-
B. Ca^{2+} and CO_3^{2-}
C. Na^+ and Cl^-
D. Na^+ and CO_3^{2-}

Correct answer: C. Na^+ and Cl^-
Dissolved sodium and chloride ions appear unchanged on both sides. The calcium and carbonate ions are incorporated into the solid.

9. A student reads $G + 2\ T \rightarrow GT_2$, a balanced symbolic reaction. Which claim requires evidence beyond the equation and its coefficients?

A. The reaction reaches completion in ten seconds.
B. Each product unit has twice as many T atoms as G atoms.
C. Two moles of T are consumed per mole of G that reacts.
D. The model describes one product species.

Correct answer: A. The reaction reaches completion in ten seconds.
Formulas and coefficients give composition and amount ratios. The time to completion requires separate information about how fast the reaction proceeds.

10. A closed model starts with 16 g of X and 14 g of Y. The final inventory lists 3 g of X, 4 g of Y, 16 g of product P, and product Q. What mass of Q completes the inventory?

A. 23 g
B. 14 g
C. 16 g
D. 7 g

Correct answer: D. 7 g
The initial inventory totals 30 g. The final masses already listed total 3 + 4 + 16 = 23 g. Product Q accounts for the remaining 7 g.

11. A net ionic equation has $Ca^{2+}(aq)$ and $PO_4^{3-}(aq)$ as the only reactants and $Ca_3(PO_4)_2(s)$ as the only product. Which equation balances the atoms and charge?

A. $3\ Ca^{2+}(aq) + PO_4^{3-}(aq) \rightarrow Ca_3(PO_4)_2(s)$
B. $2\ Ca^{2+}(aq) + 3\ PO_4^{3-}(aq) \rightarrow Ca_3(PO_4)_2(s)$
C. $3\ Ca^{2+}(aq) + 2\ PO_4^{3-}(aq) \rightarrow Ca_3(PO_4)_2(s)$
D. $Ca^{2+}(aq) + 2\ PO_4^{3-}(aq) \rightarrow Ca_3(PO_4)_2(s)$

Correct answer: C. $3\ Ca^{2+}(aq) + 2\ PO_4^{3-}(aq) \rightarrow Ca_3(PO_4)_2(s)$
The product formula contains three calcium atoms and two phosphate groups. The reactants' charges add to $3(+2) + 2(-3) = 0$, matching the neutral solid.

12. In a symbolic model, one half-reaction is $M \rightarrow M^{3+} + 3\ e^-$ and the other is $Z^{2+} + 2\ e^- \rightarrow Z$. After the electrons cancel, what is the smallest whole-number ratio of M to Z^{2+} consumed?

A. 3 to 2
B. 2 to 3
C. 1 to 1
D. 3 to 4

Correct answer: B. 2 to 3
Two M units release six electrons. Three Z^{2+} units take up six electrons. This matches the electron counts and gives a 2 to 3 ratio.

13. In the model 2 $GQ_3 \rightarrow G_2Q_4 + Q_2$, an inventory shows that 0.540 mol of GQ_3 reacted. The molar mass of G_2Q_4 is 120.0 g/mol. What mass of G_2Q_4 formed?

A. 2.25 g
B. 64.8 g
C. 16.2 g
D. 32.4 g

Correct answer: D. 32.4 g
The equation gives one G_2Q_4 per two GQ_3, so 0.540 mol of GQ_3 forms 0.270 mol of G_2Q_4. Multiply 0.270 mol by 120.0 g/mol to get 32.4 g.

14. A model uses 3 U + $V_2 \rightarrow U_3V_2$. It starts with 1.80 mol of U and excess V_2. The recorded yield is 0.45 mol of U_3V_2. What is the percent yield?

A. 75%
B. 25%
C. 50%
D. About 133%

Correct answer: A. 75%
The theoretical yield is 1.80 ÷ 3 = 0.60 mol of U_3V_2. The percent yield is 0.45 ÷ 0.60 × 100% = 75%.

15. A model starts with ten J_3 and twelve W_2 particles. First, 2 $J_3 \rightarrow 3\ J_2$ goes to completion. Then $J_2 + W_2 \rightarrow J_2W_2$ proceeds as far as possible. How many J_2W_2 form and how many J_2 remain?

A. 10 form and 5 remain
B. 15 form and 0 remain
C. 12 form and 3 remain
D. 12 form and 0 remain

Correct answer: C. 12 form and 3 remain
The first step converts ten J_3 into fifteen J_2. The twelve W_2 allow twelve particles of J_2W_2 to form. That uses twelve J_2 and leaves three.