

1. The energy needed to initiate a chemical reaction by pushing two molecules together and breaking their intramolecular bonds is called the _____.

- (A) equilibration energy
- (B) kinetic energy
- (C) elevation energy
- (D) activation energy**

Hint: Molecules are stable and surrounded by an electron cloud, so it will take considerable energy to get them close to each other and remain there long enough while their intramolecular bonds are broken and new bonds form.

The energy to do this is called “activation energy.”

2. Catalysts _____.

- (A) raise the kinetic energy
- (B) lower the potential energy
- (C) raise the activation energy
- (D) lower the activation energy**

Hint: Catalysts make chemical reactions more likely to happen by lowering the activation energy.

3. Which chemical equation is correct?

- (A) $C_3H_8 + 3O_2 \rightarrow 5CO_2 + 4H_2O$
- (B) $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 2H_2O$
- (C) $C_3H_8 + 3O_2 \rightarrow 5CO_2 + 2H_2O$
- (D) $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$**

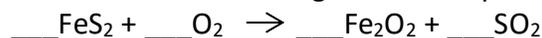
Hint: The small subscript number after an element refers to how many atoms of that element are in the molecule.

The number preceding a group of letter elements is the number of molecules.

The same number of atoms reacting in a chemical reaction must be present in the products of that chemical reaction.

10 oxygen atoms and 3 carbon atoms react so 10 oxygen atoms and 3 carbon atoms must be present in the products.

4. Balance the following chemical equation.



- (A) $4FeS_2 + 10O_2 \rightarrow 2Fe_2O_2 + 8SO_2$**
- (B) $2FeS_2 + 8O_2 \rightarrow 2Fe_2O_2 + 8SO_2$
- (C) $4FeS_2 + 4O_2 \rightarrow 4Fe_2O_2 + 8SO_2$
- (D) $2FeS_2 + 10O_2 \rightarrow Fe_2O_2 + 8SO_2$

Hint: Only one reaction has the same number of reacting atoms as product atoms: 4 iron, 8 sulfur, and 20 oxygen atoms.

5. In the reaction $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$, how many moles of H_2 result when 1 mole of water reacts with calcium?

- (A) $\frac{1}{2}$**
- (B) 1
- (C) 2
- (D) 4

Hint: In the reaction as written, 2 moles of water result in 1 mole of hydrogen molecules, meaning that half as many moles of hydrogen gas result from the moles of water.

6. 250 mL of a 2 M solution contains _____.

- (A) 0.125 moles
- (B) 0.25 moles
- (C) 0.5 moles**
- (D) 1.0 mole

Hint: A 2 molar solution contains 2 moles per liter.

250ml, or one-fourth of a liter, contains one-fourth of 2 moles, or half a mole.

7. When a chemical reaction is at equilibrium, _____.

- (A) the rate of formation of products equals the rate of formation of reactants**
- (B) the concentration of products equals the concentration of reactants
- (C) the rate of formation of products equals the equilibrium constant
- (D) the equilibrium constant has reached 1.0

Hint: Most chemical reactions are able to proceed in both directions but it may take a period of time before this happens at the same rate.

In order to identify a state of equilibrium, though, you must be able to measure the rate of formation of products and rate of formation of reactants.

8. Which of the following is an exothermic process?

- (A) condensation of water**
- (B) melting of ice
- (C) evaporation of water
- (D) evaporation of ice

Hint: An exothermic reaction gives off heat.

It takes heat to evaporate water and ice, and melt ice.

Conversely, heat must be removed from water vapor to get the molecules to slow down and stick to each other to form water droplets.

9. An endothermic reaction can still take place spontaneously if _____.

- (A) the products do not produce too much disorder (entropy)
- (B) the products produce enough enthalpy (heat)
- (C) the products produce enough disorder**
- (D) the reactants become more disordered

Hint: Endothermic reactions absorb heat. In general, heat must be added for endothermic reactions to occur spontaneously.

However, what also helps drive chemical reactions is entropy, because increasing entropy (making things more disordered) lowers their energy state to a more stable level.

If the amount of energy lost to entropy is greater than the energy needed to make the reactants react with each other, the reaction can still occur spontaneously.

10. According to LeChatelier's principle, adding heat to a chemical reaction causes an exothermic reaction _____.

- (A) to shift to the right
- (B) to shift to the left
- (C) to shift in neither direction
- (D) to reach equilibrium faster

Hint: Chemical reactions react in both directions, and eventually equilibrate.

We can disrupt the equilibrium by changing the pressure, temperature, or availability of reactant or product.

Le Chatelier's principle says that the equilibrium adjusts by shifting to the right or left, as if it were trying to resist or counteract the change.

To us, it looks the change is driving or pushing the reaction in the one direction.

11. Water's phase diagram indicates that increasing the atmospheric pressure without changing the temperature makes it _____ for ice to form.

- (A) more difficult
- (B) less difficult
- (C) neither more nor less difficult

Hint: When water freezes, the resulting ice has greater volume.

The formation of ice reacts to increased pressure by lowering the pressure, which it does by not forming ice as readily.

12. In the following chemical reaction, what does the equilibrium constant equal?
 $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$

- (A) $K = [\text{H}_2] [\text{O}_2]/[\text{H}_2\text{O}]$
- (B) $K = [\text{H}_2\text{O}]/[\text{H}_2] [\text{O}_2]$
- (C) $K = [\text{H}_2]^2 [\text{O}_2]/[\text{H}_2\text{O}]^2$
- (D) $K = [\text{H}_2\text{O}]^2/[\text{H}_2] [\text{O}_2]$

Hint: Equilibrium constants are calculated by multiplying the concentration of each product and dividing by the concentration of each reactant.

When multiples of a product or reactant are present, the product or reactant is multiplied multiple times, which is expressed with exponents.