1. Which compound is formed from its elements by an exothermic reaction at 298 K and 101.3 kPa?

   A) $C_2H_4(g)$ B) $HI(g)$

   C) $H_2O(g)$ D) $NO_2(g)$

2. For which compound is the process of dissolving in water exothermic?

   A) $NaCl$ B) $NaOH$

   C) NH_4Cl D) NH_4NO_3

3. Given the balanced equation representing a reaction:
   $Cu + S \rightarrow CuS + energy$

   Which statement explains why the energy term is written to the right of the arrow?

   A) The compound CuS is composed of two metals.
   B) The compound CuS is composed of two nonmetals.
   C) Energy is absorbed as the bonds in CuS form.
   D) Energy is released as the bonds in CuS form.

4. A thermometer is in a beaker of water. Which statement best explains why the thermometer reading initially increases when LiBr(s) is dissolved in the water?

   A) The entropy of the LiBr(aq) is greater than the entropy of the water.
   B) The entropy of the LiBr(aq) is less than the entropy of the water.
   C) The dissolving of the LiBr(s) in water is an endothermic process.
   D) The dissolving of the LiBr(s) in water is an exothermic process.

5. Given the balanced equation representing a reaction:

   $CH_4(g) + 2O_2(g) \rightarrow 2H_2O(g) + CO_2(g) + heat$
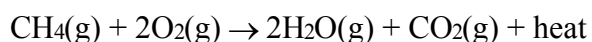
   Which statement is true about energy in this reaction?

   A) The reaction is exothermic because it releases heat.
   B) The reaction is exothermic because it absorbs heat.
   C) The reaction is endothermic because it releases heat.
   D) The reaction is endothermic because it absorbs heat.

6. Which balanced equation represents an endothermic reaction?

   A) $C(s) + O_2(g) \rightarrow CO_2(g)$
   B) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell)$
   C) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
   D) $N_2(g) + O_2(g) \rightarrow 2NO(g)$

7. Which change is exothermic?

   A) freezing of water
   B) melting of iron
   C) vaporization of ethanol
   D) sublimation of iodine

8. A student observed that the temperature of water increased when a salt was dissolved in it. The student should conclude that dissolving the salt was

   A) involved in the formation of an acidic solution
   B) involved in the formation of a basic solution
   C) an exothermic reaction
   D) an endothermic reaction

9. Salt A and salt B were each dissolved in separate beakers of water at 21°C. The temperature of the salt A solution decreased, and the temperature of the salt B solution increased.

   Based on these results, which conclusion is correct?

   A) The water gained energy from both salt A and salt B.
   B) The water lost energy to both salt A and salt B.
   C) The water gained energy from salt A and lost energy to salt B.
   D) The water lost energy to salt A and gained energy from salt B.

10. When ammonium chloride crystals are dissolved in water, the temperature of the water decreases. What does this temperature change indicate about the dissolving of ammonium chloride in water?

    A) It is an endothermic reaction because it absorbs heat.
    B) It is an endothermic reaction because it releases heat.
    C) It is an exothermic reaction because it absorbs heat.
    D) It is an exothermic reaction because it releases heat.

11. A student observed that when sodium hydroxide was dissolved in water, the temperature of the water increased. The student should conclude that the dissolving of sodium hydroxide

    A) is endothermic
    B) is exothermic
    C) produces an acid solution
    D) produces a salt solution

12. Which reaction releases the greatest amount of energy per 2 moles of product?

    A) $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$
    B) $4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$
    C) $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$
    D) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

13. Given the balanced equation representing a reaction at 101.3 kPa and 298 K:

    $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) + 91.8$ kJ
    Which statement is true about this reaction?

    A) It is exothermic and ΔH equals –91.8 kJ.
    B) It is exothermic and ΔH equals +91.8 kJ.
    C) It is endothermic and ΔH equals –91.8 kJ.
    D) It is endothermic and ΔH equals +91.8 kJ.

14. Given the balanced equation:

    $4Fe(s) + 3O_2(g) \rightarrow 2Fe2O_3(s) + 1640$ kJ
    Which phrase best describes this reaction?

    A) endothermic with $\Delta H = +1640$ kJ
    B) endothermic with $\Delta H = -1640$ kJ
    C) exothermic with $\Delta H = +1640$ kJ
    D) exothermic with $\Delta H = -1640$ kJ

15. Which statement correctly describes an endothermic chemical reaction?

    A) The products have higher potential energy than the reactants, and the ΔH is negative.
    B) The products have higher potential energy than the reactants, and the ΔH is positive.
    C) The products have lower potential energy than the reactants, and the ΔH is negative.
    D) The products have lower potential energy than the reactants, and the ΔH is positive.