1. In terms of entropy and energy, systems in nature tend to undergo changes toward

   A) lower entropy and lower energy
   B) lower entropy and higher energy
   C) higher entropy and lower energy
   D) higher entropy and higher energy

2. Systems in nature tend to undergo changes toward

   A) lower energy and higher entropy
   B) lower energy and lower entropy
   C) higher energy and higher entropy
   D) higher energy and lower entropy

3. Which equation represents a change that results in an increase in disorder?

   A) $I_2(s) \rightarrow I_2(g)$
   B) $CO_2(g) \rightarrow CO_2(s)$
   C) $2Na(s) + Cl_2(g) \rightarrow 2NaCl(s)$
   D) $2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$

4. The entropy of a sample of $CO_2$ increases as the $CO_2$ changes from

   A) gas to liquid  B) gas to solid
   C) liquid to solid  D) solid to gas

5. The entropy of a sample of $H_2O$ increases as the sample changes from a

   A) gas to a liquid  B) gas to a solid
   C) liquid to a gas  D) liquid to a solid

6. Systems in nature tend to undergo changes toward

   A) lower energy and lower entropy
   B) lower energy and higher entropy
   C) higher energy and lower entropy
   D) higher energy and higher entropy

7. Which 1-mole sample has the *least* entropy?

   A) $Br_2(s)$ at 266 K  B) $Br_2(\ell)$ at 266 K
   C) $Br_2(\ell)$ at 332 K  D) $Br_2(g)$ at 332 K

8. Systems in nature tend to undergo changes toward

   A) lower energy and less disorder
   B) lower energy and more disorder
   C) higher energy and less disorder
   D) higher energy and more disorder

9. Which of these changes produces the greatest increase in entropy?

   A) $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
   B) $2\ Mg(s) + O_2(g) \rightarrow 2\ MgO(s)$
   C) $H_2O(g) \rightarrow H_2O(\ell)$
   D) $CO_2(g) \rightarrow CO_2(s)$

10. Which reaction has the greatest increase in entropy?

    A) $2\ H_2O(\ell) \rightarrow 2\ H_2(g) + O_2(g)$
    B) $2\ H_2O(g) \rightarrow 2\ H_2(g) + O_2(g)$
    C) $H_2O(g) \rightarrow H_2O(\ell)$
    D) $H_2O(\ell) \rightarrow H_2O(s)$

11. Which equation shows an increase in entropy?

    A) $CO_2(g) \rightarrow CO_2(s)$
    B) $CO_2(\ell) \rightarrow CO_2(g)$
    C) $CH_3OH(\ell) \rightarrow CH_3OH(s)$
    D) $CH_3OH(g) \rightarrow CH_3OH(\ell)$

12. In terms of energy and entropy, systems in nature tend to undergo changes toward

    A) higher energy and higher entropy
    B) higher energy and lower entropy
    C) lower energy and higher entropy
    D) lower energy and lower entropy

13. Given the reaction:

    $2\ Na(s) + Cl_2(g) \rightarrow 2\ NaCl(s)$

    As the reactants form products, the entropy of the chemical system will

    A) decrease  B) increase
    C) remain the same

14. Which reaction results in an increase in entropy?

    A) $CO_2(g) \rightarrow CO_2(s)$
    B) $H_2O(\ell) \rightarrow H_2O(s)$
    C) $Ca(s) + 2\ H_2O(\ell) \rightarrow Ca(OH)_2(aq) + H_2(g)$
    D) $NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$

15. As products are formed in the reaction:

$$NH_4Cl(s) + 3.5\ Kcal \rightarrow NH^+(aq) + Cl^-(aq)$$

the entropy of the system

A) decreases and heat is absorbed
B) decreases and heat is released
C) increases and heat is absorbed
D) increases and heat is released

16. Given the change of phase:

$$CO_2(g) \rightarrow CO_2(s)$$

As $CO_2(g)$ changes to $CO_2(s)$, the entropy of the system

A) decreases B) increases
C) remains the same

17. Which phrase best describes the reaction below?

$$C(s) + \tfrac{1}{2}\,O_2(g) \rightarrow CO(g) + 26.4\,kcal$$

A) exothermic with an increase in entropy
B) exothermic with a decrease in entropy
C) endothermic with an increase in entropy
D) endothermic with a decrease in entropy

18. As the reactants are converted to product in the reaction

$$A(g) + B(g) \rightarrow C(s),$$

the entropy of the system

A) decreases B) increases
C) remains the same

19. Which type of reaction is the Haber process,

$$N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g) + heat?$$

A) exothermic, with an increase in entropy
B) exothermic, with a decrease in entropy
C) endothermic, with an increase in entropy
D) endothermic, with a decrease in entropy

20. As NaCl(s) dissolves according to the equation

$$NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq),$$

the entropy of the system

A) decreases B) increases
C) remains the same