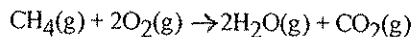


Name: _____

Kinetics and Equilibrium Unit Test

___ 1) Given the reaction:

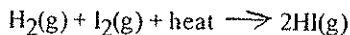


$$DH = \Delta H$$

What is the overall result when $\text{CH}_4(\text{g})$ burns according to this reaction?

- A) Energy is released and DH is positive. C) Energy is absorbed and DH is negative.
 B) Energy is absorbed and DH is positive. D) Energy is released and DH is negative.

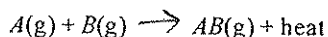
___ 2) Given the equilibrium reaction in a closed system:



What will be the result of an increase in temperature?

- A) The equilibrium will shift to the right and $[\text{HI}]$ will decrease.
 B) The equilibrium will shift to the left and $[\text{H}_2]$ will decrease.
 C) The equilibrium will shift to the right and $[\text{HI}]$ will increase.
 D) The equilibrium will shift to the left and $[\text{H}_2]$ will increase.

___ 3) Given the reaction at equilibrium:

The concentration of $A(\text{g})$ can be increased by

- A) lowering the temperature C) increasing the concentration of $B(\text{g})$
 B) increasing the concentration of $AB(\text{g})$ D) adding a catalyst

___ 4) Which statement correctly describes an endothermic chemical reaction?

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

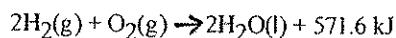
___ 5) Which balanced equation represents an endothermic reaction?

- A) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$ C) $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$
 B) $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}(\text{g})$ D) $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$

___ 6) A solution that is at equilibrium must be

- A) concentrated B) saturated C) unsaturated D) dilute

___ 7) Given the reaction:

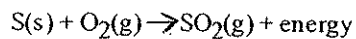
What is the approximate DH for the formation of 1 mole of $\text{H}_2\text{O}(\text{l})$?

- A) -571.6 kJ B) +571.6 kJ C) -285.8 kJ D) +285.8 kJ

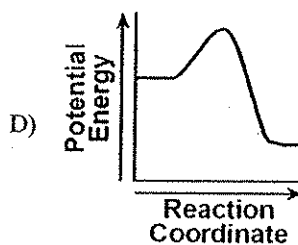
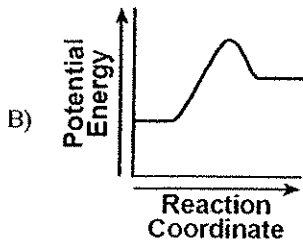
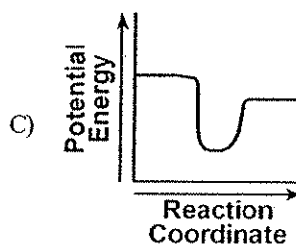
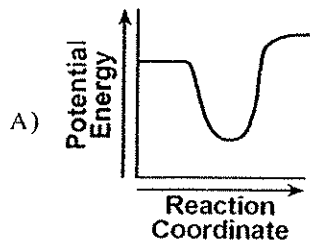
___ 8) Which statement about a system at equilibrium is true?

- A) The forward reaction rate stops and the reverse reaction rate continues.
 B) The forward reaction rate is greater than the reverse reaction rate.
 C) The forward reaction rate is less than the reverse reaction rate.
 D) The forward reaction rate is equal to the reverse reaction rate.

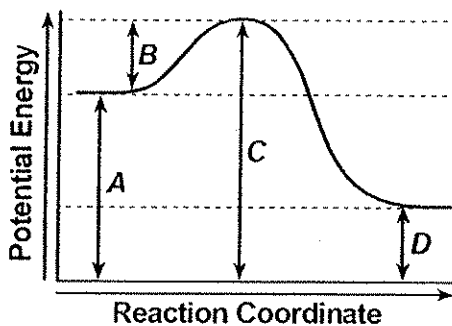
___ 9) Given the reaction:



Which diagram *best* represents the potential energy changes for this reaction?



___ 10) The potential energy diagram below represents a reaction.



Which arrow represents the activation energy of the forward reaction?

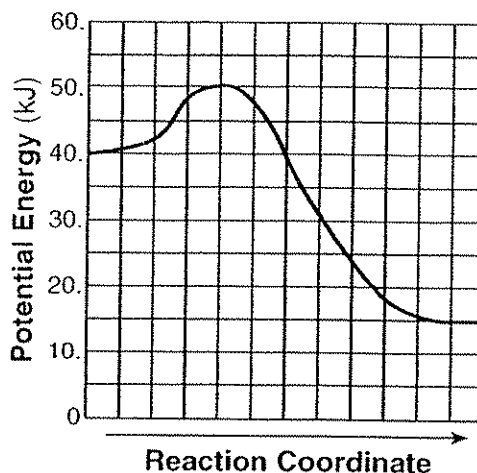
A) A

B) B

C) C

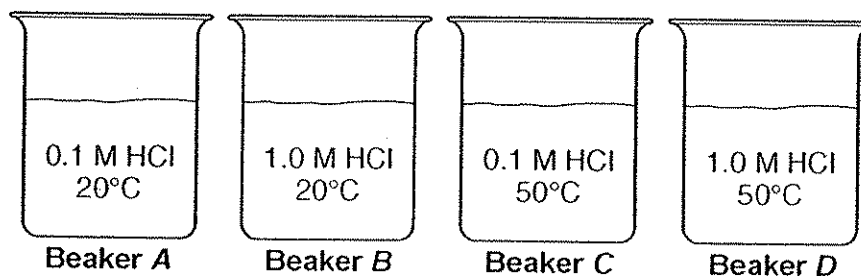
D) D

- 11) Given the potential energy diagram for a chemical reaction:



Which statement correctly describes the energy changes that occur in the forward reaction?

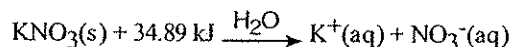
- A) The activation energy is 50. kJ and the reaction is exothermic.
 B) The activation energy is 50. kJ and the reaction is endothermic.
 C) The activation energy is 10. kJ and the reaction is endothermic.
 D) The activation energy is 10. kJ and the reaction is exothermic.
- 12) Increasing the temperature increases the rate of a reaction by
- A) lowering the activation energy
 B) increasing the frequency of effective collisions between reacting molecules
 C) lowering the frequency of effective collisions between reacting molecules
 D) increasing the activation energy
- 13) In each of the four beakers shown below, a 2.0-centimeter strip of magnesium ribbon reacts with 100 milliliters of HCl(aq) under the conditions shown.



In which beaker will the reaction occur at the *fastest* rate?

- A) A B) B C) C D) D
- 14) At STP, which 4.0-gram zinc sample will react *fastest* with dilute hydrochloric acid?
 A) sheet metal B) powdered C) bar D) lump
- 15) Which statement *best* explains the role of a catalyst in a chemical reaction?
 A) A catalyst changes the kinds of products produced.
 B) A catalyst provides an alternate reaction pathway that requires less activation energy.
 C) A catalyst limits the amount of reactants used.
 D) A catalyst is added as an additional reactant and is consumed but not regenerated.
- 16) Which phase change represents a decrease in entropy?
 A) solid to gas C) solid to liquid
 B) liquid to gas D) gas to liquid

- ___ 17) Which process is accompanied by a decrease in entropy?
- A) boiling of water
B) melting of ice
C) condensing of water vapor
D) subliming of iodine
- ___ 18) Which sample has the *lowest* entropy?
- A) 1 mole of $\text{KNO}_3(\text{l})$
B) 1 mole of $\text{KNO}_3(\text{s})$
C) 1 mole of $\text{H}_2\text{O}(\text{g})$
D) 1 mole of $\text{H}_2\text{O}(\text{l})$
- ___ 19) Given the balanced equation:

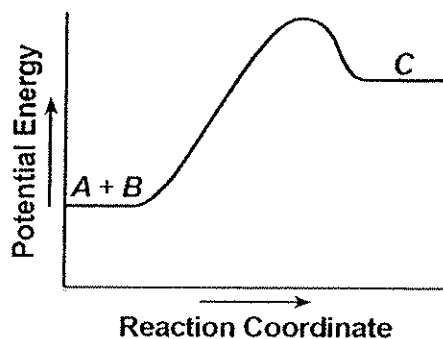


Which statement *best* describes this process?

- A) It is endothermic and entropy decreases.
B) It is endothermic and entropy increases.
C) It is exothermic and entropy decreases.
D) It is exothermic and entropy increases.
- ___ 20) Systems in nature tend to undergo changes toward
- A) lower energy and lower entropy
B) lower energy and higher entropy
C) higher energy and higher entropy
D) higher energy and lower entropy

Questions 21 and 22 refer to the following:

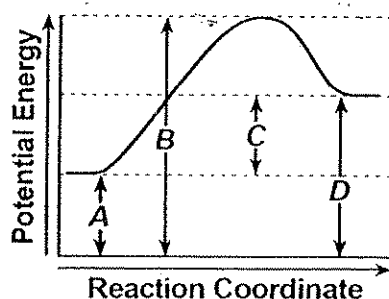
The diagram below represents the changes in potential energy that occur during the given reaction: $A + B \rightarrow C$.



- 21) Does the diagram illustrate an exothermic or an endothermic reaction? [State one reason, in terms of energy, to support your answer.]
- 22) On the given above, draw a dashed line to indicate a potential energy curve for the reaction if a catalyst is added.

Questions 23 through 25 refer to the following:

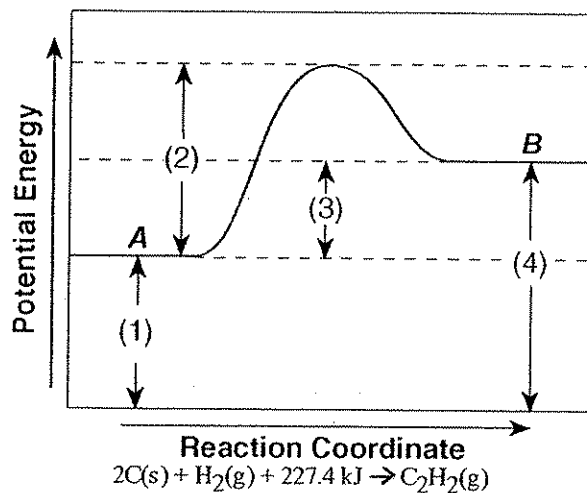
Chemical cold packs are often used to reduce swelling after an athletic injury. The diagram below represents the potential energy changes when a cold pack is activated.



- 23) Which lettered interval on the given diagram represents the potential energy of the products?
- 24) Which lettered interval on the given diagram represents the heat of reaction?
- 25) Identify a reactant listed in the *Heats of Reaction at 101.3 kPa and 298 K* chemistry reference table that could be mixed with water for use in a chemical cold pack.

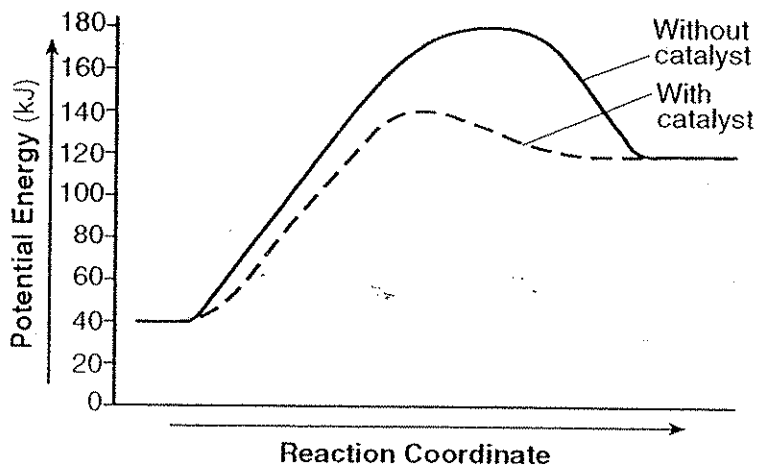
Questions 26 and 27 refer to the following:

Given the potential energy diagram and the equation below:



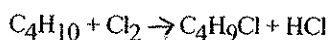
- 26) The letter *B* in the diagram represents which chemical formula or formulas in the equation?
- 27) Based on the given information, how many moles of $\text{C}_2\text{H}_2(\text{g})$ are produced if 682.2 kilojoules are absorbed?

Questions 28 and 29 refer to the following:



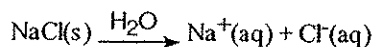
- 28) What is the heat of reaction for the forward reaction in the potential energy diagram shown?

- 29) What is the activation energy for the forward reaction with the catalyst in the potential energy diagram shown?
- 30) Given the balanced equation for an organic reaction between butane and chlorine that takes place at 300.DC and 101.3 kilopascals:



Explain, in terms of collision theory, why the rate of the reaction shown would *decrease* if the temperature of the reaction mixture was lowered to 200.DC with pressure remaining unchanged.

- 31) Given the equation for the dissolving of sodium chloride in water:



Describe what happens to entropy during the dissolving process shown.

Questions 32 and 33 refer to the following:

Given the equation for a reaction at equilibrium:



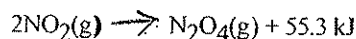
- 32) Explain, in terms of Le Chatelier's principle, why the concentration of $\text{SO}_2(\text{g})$ in the given equation increases when the temperature is increased.
- 33) Explain, in terms of collisions between molecules, why increasing the concentration of $\text{O}_2(\text{g})$ in the equation shown produces a *decrease* in the concentration of $\text{SO}_2(\text{g})$.

- 34) Given the reaction at equilibrium:



Explain, in terms of Le Chatelier's principle, why the concentration of $\text{NH}_3(\text{g})$ decreases when the temperature of the equilibrium system shown increases.

- 35) Given the reaction at equilibrium:



Explain, in terms of Le Chatelier's principle, why the equilibrium shifts to the right to relieve the stress when the pressure on the system shown is increased at constant temperature.