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Multiple choice Practice: Thermodynamics

Multiple Choice
Identify the letter of the choice that best completes the statement or answers the question.

$N_{2(g)} + 3H_{2(g)} <=> 2NH_{3(g)}$ H = -92kJ
The Haber process is commercial method for the manufacture of ammonia. It is based upon the equilibrium shown in the equation above. The absolute entopies of the components of this system are given below. S_N = 192 j/kmol
S_{H2} = 131 j/k mol
S_{NH3} = 193 j/k mol

NH_3 N_2 $3H_2$
$2(193) - (192 + 131(3)$
$386 - 585 = -199$ J/K

1. (#9-5) The value of S in J/K for the reaction above is closest to
   a. +200 d. -100
   b. +100 e. -200
   c. 0

2. (#9-6) Which describes the change in G and the change in spontaneity of the reaction as temperature increases?
   a. G decreases to values less than zero and the reaction achieves equilibrium.
   b. G decreases to values less than zero and the reaction becomes spontaneous.
   c. G decreases to values less than zero and the reaction becomes non-spontaneous
   d. G increases to values greater than zero and the reaction becomes spontaneous.
   e. G increases to values greater than zero and the reaction becomes non-spontaneous.

$\Delta G = \Delta H - T\Delta S$ (− ↑ +)

3. (#9-2) The molar heat of fusion, H_{fus}, for water is 6.01kJ/mol. The heat capacity for water, C_p, is 75 J/mol C. Which expression gives the quantity of energy needed to change 1.0 mol ice at 0 C to liquid water at 25 C?
   a. 6010/(75 x 25) d. 6010/298 + (75 x 25)
   b. 6.01 + 75 e. 6010 + (75 x 25)/298
   c. 6010 + (75 x 25)

6010 J $q = m \cdot \Delta t \cdot C$ $(25 \cdot 75)$ +

4. (#9-3) The heat of neutralization for a strong acid in dilute water solution is about 60 kJ/mol H^+. What quantity of heat in kJ is produced when 100 mL of 3.0 M HCl is mixed with 100 mL of 1.0 KOH?
   a. 0.10 d. 6.0
   b. 0.30 e. 18
   c. .0.40

Limiting Reactant
$HCl + KOH \rightarrow KCl + H_2O$ $\Delta H = -60$ kJ
$1 \cdot \frac{x}{.1L} = .1$ mol

5. (#9-5) All of the following reactions illustrate an increase in entropy EXCEPT:
   a. $N_2O_{4(g)} => 2NO_{2(g)}$
   b. $C_6H_{6(l)} => C_6H_{6(g)}$
   c. $2KClO_{3(s)} => 3O_2 + 2KCl$
   d. $3Fe_{(s)} + 2O_{2(g)} => Fe_3O_{4(s)}$ ← decrease movement
   e. $C_2H_5OH_{(l)} + 3O_{2(g)} => 3CO_{2(g)} + 3H_2O_{(g)}$

____ 6. (#9-6) For the burning of propane
$C_3H_{8(g)} + 5O_{2(g)} \Rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$
Which of the following is true at any temperature?
I. delta G < 0
II. delta S > 0
III. delta H < 0

$\Delta G = \Delta H - T\Delta S$

a. I only
b. III only
c. I and II only
d. II and III only
e. I, II, and III

____ 7. (#9-6) Which equation represents the standard formation reaction for $BaSO_{4(s)}$ at 298K ?
a. $BaS_{(s)} + 2O_{2(g)} \Rightarrow BaSO_{4(s)}$
b. $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \Rightarrow BaSO_{4(s)}$
c. $Ba_{(s)} + S_{(s)} + O_{2(g)} \Rightarrow BaSO_{4(s)}$
d. $Ba^{2+}_{(aq)} + S^{6+}_{(aq)} + 4O^{-2}_{(aq)} \Rightarrow BaSO_{4(s)}$
e. $Ba(OH)_{2(aq)} + H_2SO_{4(aq)} \Rightarrow BaSO_{4(s)} + 2H_2O$

____ 8. (#9-6) Which gives the thermodynamic parameters for the system
$H_2O_{(s)} <= => H_2O_{(l)}$ at 298K? (cold)

	G −	H +	S +
a.	0	>0	>0
b.	0	>0	<0
c.	<0	>0	<0
d.	<0	<0	>0
e.	<0	>0	>0

____ 9. (#9-5) A cube of ice is added to some hot water in a rigid, insulated container, which is then sealed. There is no heat exchange from the surroundings. What happened to the total energy of the system and the total entropy of the system.

	Energy	Entropy
a.	remains constant	remains constant
b.	remains constant	Decreases
c.	remains constant	Increases
d.	Decreases	Increases
e.	Increases	Decreases

____ 10. (#9-4) Its value is negative for any exothermic reaction.
a. K_c
b. Delta G
c. Delta H
d. Delta S
e. E_a (energy of activation)

____ 11. (#7-2b) An 11g sample of CaF_2 (Molar mass 110.8g/mol) compound is dissolved in the 100mL of water dropping the temperature 10 degrees.
Which of the following represents the net ionic equation of the process discribed
a. $CaF_2 \rightarrow Ca + F_2$
b. $CaF_2 \rightarrow Ca^{2+} + 2F^-$
c. $CaF_2 + H_2O \rightarrow CaF_2(aq)$
d. $F^- + H_2O \rightarrow HF + H_3O^+$

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C 12. (#9-3) An 11g sample of CaF_2 (Molar mass 110.8g/mol) compound is dissolved in the 100mL of water dropping the temperature 10 degrees.
How much energy is transfered in the process?
a. 100 calories
c. 1000 calories
b. 10 calories
d. 1000 joules

$q = m \cdot \Delta t \cdot c$
$100 \cdot 10 \cdot 1 = 1000$ c

d 13. (#9-4) An 11g sample of CaF_2 (Molar mass 110.8g/mol) compound is dissolved in the 100mL of water dropping the temperature 10 degrees.
Which of the following shows the calculation of Enthlapy for the reaction above?
a. 100/.1 = 1000 cal/rxn
c. 1000/110 = 9 cal/rxn
b. 10/110 = .09 cal/rxn
d. 4180/.1 = 418J/rxn ←

d 14. (#9-1) An 11g sample of CaF_2 (Molar mass 110.8g/mol) compound is dissolved in the 100mL of water dropping the temperature 10 degrees.
What types of bonds are broken and formed in this process and are they endothermic or exothermic

	Broken only endothermic	Formed only exothermic
a.	ionic/ exothermic	ion-dipole/endothermic
b.	Ion-dipole/ exothermic	ionic/exothermic
c.	covalent/endothermic	ionic/exothermic
d.	ionic/endothermic ←	ion-dipole/exothermic ←

C 15. $3C_{(s)} + 4H_{2(g)} \Rightarrow C_3H_{8(g)}$ Delta $H_f = -104$kJ flip
$C_{(s)} + O_{2(g)} \Rightarrow CO_{2(g)}$ Delta $H_{comb} = -394$ kJ x3
$H_{2(g)} + 1/2O_{2(g)} \Rightarrow H_2O_{(l)}$ Delta $_{comb} = -286$ kJ x4

(#9-6) Using the values above, which expression gives the heat of combustion, delta H_{comb}, for propane, C_3H_8 in kJ/mol.

$C_3H_8 + 5O_2 \Rightarrow 3CO_2 + 4H_2O_{(l)}$ delta H = ?

a. (-104) - (394 +(-286))
c. (-104) - (-3 * 394 + (-4 * 286)) ← Best
b. (-394 +(-286)) - (-104)
d. (-3 * 394 + (-4 x 286))- (-104)

B 16.

$X(aq) + Y(s) \Leftrightarrow Z(aq)$ $-\Delta H$ $-\Delta G$

(#9-7) A reaction is set up using 1 molar concentrations of all substances in a chemical reaction. The reaction is both exothermic and exergonic. Which of the following is true?
I. The reaction Quotent = 0.5 at the start of the reaction. NO Q = 1
II. The reaction quotient Q will increase to become K, K > 1 so yes
III. The driving force of this reaction is enthalpy only (not entropy) NO, Both

$-\Delta G$ R → P, $\frac{P}{R}$

a. I only
c. I and II only
b. II only
d. II and III only

A 17. (#9-1) Which of the following relationships represents the first law of thermodynamics where the system is exothermic.

	System	Surroundings
A.	-	+
B	+	+
C	-	-
D	+	-

a. A
c. C
b. B
d. D

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total entropy increases

____ 18. (#9-1)One version of the Second Law of Thermodynamics for any spontaneous process includes the statement.

$$\text{Delta } S_{total} = (\text{delta } S_{system} + \text{delta } S_{surroundings}) > 0$$

a. For any spontaneous process, the total entropy increases.

b. For any spontaneous process, the free energy change is negative

c. For any spontaneous process, the entropy change for the system is less than the entropy change for the surroundings.

d. For any spontaneous process the entropy change for the system is less than the entropy change for the surroundings.

e. For any spontaneous process, he entropy change for the system is greater than the entropy change for the surroundings.

____ 19.

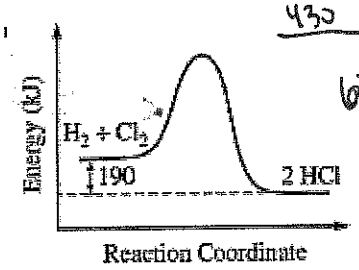
Bond	Bond Energy (kJ/mol)
H–H	430
Cl–Cl	240
H–Cl	430

(#8-4) Based upon the table of bond energies provided, which is the best model of the energy of the following chemical reaction. $H_2 + Cl_2 \Rightarrow 2HCl$

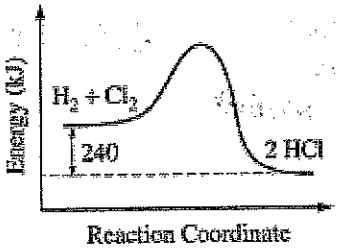
430 240 860

670 - 860 = -190

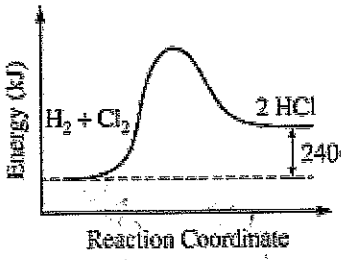
a.



b.



c.



d.