Quiz 1: Thermochemistry

SCH4UE 2002-2003 Name: _____

Total Score: /20)

Matching (6)

Find the most appropriate match between the item in Column A and the description of that item in Column B.

Column A	Column B
1. $\Delta H = + 25$ kJ	_____a. standard conditions for reporting ΔH^0
2. $Na_{(s)} + 1/2\ Cl_{2(g)} \rightarrow NaCl_{(s)}$	_____b. standard enthalpy of formation for an element in its most stable state at 100 kPa and 25 ^{O}C
3. $q_p = \Delta H$	_____c. standard enthalpy of formation of a compound
4. $q = mc\Delta T$	_____d. heat calculated at constant pressure
5. 100 kPa and 25^{O}C	_____e. endothermic process
6. $\Delta H_f^0 = 0.00$ kJ	_____f. formula for calculating the amount of heat transferred.

Multiple Choice (10)

7. The specific heat of silver is 0.226 J $g^{-1O}C^{-1}$. Calculate the heat required to raise the temperature of 30.0 g of silver metal from 18.2 ^{O}C to 35.6 ^{O}C.
   a. 118 J b. 123 J c. 241 J d. 1.08 kJ

8. Given the following thermochemical equation:
   $H_{2(g)} + 1/2\ O_{2(g)} \longrightarrow H_2O_{(l)} \qquad \Delta H^0 = - 285.8$ kJ
   How much heat is evolved when 100.0 g of $H_2O_{(l)}$ are formed from the combustion of hydrogen gas and oxygen gas?
   a. - 51.44 b. - 285 kJ c. - 1587 kJ d. - 2297 kJ

9. $H_{2(g)}$ and $Cl_{2(g)}$ react according to the following equation, forming $HCl_{(g)}$:
   $H_{2(g)} + Cl_{2(g)} \longrightarrow 2\ HCl_{(g)} \qquad \Delta H^0 = - 92.0$ kJ
   If $H_{2(g)}$ and $Cl_{2(g)}$ are mixed in a thermally insulated vessel, the reaction that occurred would be:
   a. endothermic, and the temperature of the reaction system would rise.
   b. endothermic, and the temperature of the reaction system would fall.
   c. exothermic, and the temperature of the reaction system would rise.
   d. exothermic, and the temperature of the reaction system would fall.

10. Given the following thermochemical equation:
    $2\ Al_{(s)} + 3/2\ O_{2(g)} \longrightarrow Al_2O_{3(s)} \qquad \Delta H^0 = - 400$ kJ
    Determine ΔH^0 for: $2\ Al_2O_{3(s)} \longrightarrow 4\ Al_{(s)} + 3\ O_{2(g)}$
    a. + 200 kJ b. + 400 kJ c. - 400 kJ d. + 800 kJ
11. Which one of the following equation represents the standard enthalpy of formation of

nickel (II) carbonate, $NiCO_3$:

a. $Ni_{(s)} + C_{(g)} + 3/2\ O_{2(g)} \longrightarrow NiCO_{3(s)}$
b. $Ni_{(s)} + C_{(s)} + 3/2\ O_{2(g)} \longrightarrow NiCO_{3(s)}$
c. $2\ Ni_{(s)} + 2C_{(s)} + 3O_{2(g)} \longrightarrow 2\ NiCO_{3(s)}$
d. $Ni_{(s)} + CO_3^{-2}{}_{(aq)} \longrightarrow NiCO_{3(s)}$

12. What is the specific heat capacity for metal X from the following information. 95 g of metal at 75 ^{O}C are placed in 50 g of water, (specific heat capacity of water, c = 4.184 J g^{-1} $^{O}C^{-1}$). The final temperature of the water is 23 ^{O}C.

a. 23 b. 0.21 c. 0.76 d. 3.6

13. The average fuel value, (i.e. the energy released upon ingestion), of sugar is 17 kJ g^{-1}. A 2.0 L jug of sweetened Kool-Aid contains 400 g of sugar. What is the fuel value (in kJ) of a 500 cm^3 serving of Kool-Aid? (Assume the sugar is the only fuel source.)

a. 4.2×10^4 b. 1.7×10^3 c. 1.7×10^6 d. 1.7×10^2

14. Which one of the following changes will have a positive value of ΔH^0 ?
a. $H_2O_{(l)} \longrightarrow H_2O_{(s)}$
b. $CH_{4(g)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(g)}$
c. $2H_2O_{(l)} \longrightarrow 2H_{2(g)} + O_{2(g)}$
d. $2\ C_4H_{10(l)} + 13O_{2(g)} \longrightarrow 8\ CO_{2(g)} + 10H_2O_{(g)}$

15. The value of ΔH^0 for the following reaction is - 336 kJ. Determine the amount of heat in kJ exchanged with the surroundings when 23.0 g of $HCl_{(g)}$ is formed.

$$CH_{4(g)} + 3Cl_{2(g)} \longrightarrow CHCl_{3(l)} + 3\ HCl_{(g)}$$

a. 177 b. 2.57×10^3 c. 70.7 d. 211

16. A 0.1326 g sample of magnesium was burned in an oxygen bomb calorimeter. The total heat capacity of the calorimeter plus water was 5.760 J $^{O}C^{-1}$. If the temperature rise of the calorimeter with water was 0.570 ^{O}C, calculate the enthalpy of combustion of magnesium.

$$Mg_{(s)} + 1/2\ O_{2(g)} \longrightarrow MgO_{(s)}$$

a. - 3280 kJ mol^{-1} b. 435 kJ mol^{-1} c. 106 kJ mol^{-1} d. - 602 kJ mol^{-1}

Problem (4)

1. When a 4.25 g sample of solid ammonium nitrate dissolves in 60.0 g of water in a coffee cup calorimeter, the temperature drops from 22.0 ^{O}C to 16.9 ^{O}C. Calculate ΔH (in kJ mol^{-1} NH_4NO_3) for the solution process:

$$NH_4NO_{3(s)} \longrightarrow NH_4^{+1}{}_{(aq)} + NO_3^{-1}{}_{(aq)}$$

Assume that the specific heat of the solution is the same as that of pure water. Write a thermochemical equation dissolution of ammonium nitrate.