Project Advance Chemistry 106 Study Questions
on Material in *General Chemistry*, Brown, LeMay, and Bursten

Chapter 5. Energy Relationships in Chemistry. Thermochemistry

Fall Semester 1996

1. Which one of the following will have a greater kinetic energy?

   (c) a 10 kg object traveling at 5 m/s

   (b) a 5 kg object traveling at 10 m/s

   (c) both of these have the same kinetic energy

   (d) Not enough information given to make a decision.

2. One Joule equals

   (a) 2 kg
   (b) 4.184 cal
   (c) 1 g·cm/s
   (d) none of these
   (e) 1 $kg \cdot m^2/s^2$

3. Calculate the kinetic energy in J of an electron (mass = 9.11×10^{-28} kg) moving at 6.00×10^6 m/s.

   (a) 2.49×10^{-48}

   (b) 3.28×10^{-14}

   (c) 6.56×10^{-14}

   (d) 4.98×10^{-48}

   (e) 1.64×10^{-14}

4. According to the first law of thermodynamics

   (a) energy is conserved during any process

   (b) the entropy of a pure, crystalline substance at absolute zero is zero

   (c) the amount of work done during a change is independent of the pathway of that change

   (d) all spontaneous processes are accompanied by an increase in disorder

   (e) none of the above.

5. Which one of the following conditions would always result in an increase in ΔE for a system?

   (a) the system gains heat and has work done on it by the surroundings
   (b) the system gains heat and does work on the surroundings
   (c) the system loses heat and has work done on it by the surroundings
   (d) the system loses heat and does work on the surroundings
   (e) none of the above.

6. Which one of the following reactions has a negative value for ΔH°?

   (a) $C(s) + O_2(g) \rightarrow CO_2(g)$

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

   (c) $2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$

   (d) $NH_3(l) \rightarrow 2H_2(g) + O_2(g)$

   (e) None of the above.

7. The value of ΔH° for the following reaction is -482 kJ. Determine the amount of heat (in kJ) exchanged with the surroundings when 12.0 g of CO(*g*) completely reacts.

   $2CO(g) + O2(g) \rightarrow 2CO_2(g)$

   (a) 2.89×10^3
   (b) 207
   (c) 65.7
   (d) 103
   (e) None of the above.

8. The value of ΔH° for the reaction below is -336 kJ. Determine the amount of heat (in kJ) exchanged with the surroundings when 23.0 g of HCl is formed.

   $CH_4(g) + 3Cl_2(g) \rightarrow CHCl_3(l) + 3HCl(g)$

   (a) 2.57×10^3
   (b) 70.7
   (c) 177
   (d) 211
   (e) None of the above.

9. The value of $\Delta H°$ for the following reaction is -186 kJ. How many kJ of heat would be evolved from the reaction of 25 g of Cl_2?

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

(a) 5.3×10^2
(b) 65
(c) 47
(d) 33
(e) None of the above.

10. The value of $\Delta H°$ for the following reaction is -186 kJ. Calculate the value of $\Delta H_f°$ (in kJ/mol) for $HCl(g)$.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

(a) -1.27×10^2
(b) -3.72×10^2
(c) -186
(d) -93.0
(e) none of the above.

11. For the reaction: $2Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$
$\Delta H° = -3351$ kJ. The reaction is _____ and therefore heat is _____.

(a) endothermic, evolved
(b) exothermic, evolved
(c) exothermic, absorbed
(d) endothermic, absorbed

12. From the reaction:

$$2Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s); \quad \Delta H° = -3351 \text{ kJ}$$

determine the value of $\Delta H_f°$ (in kJ) for $Al_2O_3(s)$.

(a) -32.86
(b) -16.43
(c) -3351
(d) -1676
(e) None of the above.

13. Fifty, 50.0, mL of 1.0 *M* HCl were mixed with 50.0 mL of 1.0 *M* NaOH in a coffee cup calorimeter. The resulting solution changed temperature from 23.0°C to 29.8°C. Which one of the following is *not true* concerning this experiment? Assume the resulting solution had the density and specific heat of pure water.

(a) for this reaction, $q_{rxn} = -2.84$ kJ
(b) 2.8 kJ of heat were transferred during the process
(c) the reaction was exothermic
(d) the heat flow monitored during this process was monitored under constant pressure
(e) none of the above.

14. A 1.96 g sample of titanium was burned in a bomb calorimeter that had a heat capacity of 9.84 kJ/°C. The temperature of the calorimeter increased from 36.84°C to 98.82°C. Calculate the amount of heat that would be released from the combustion of one mole of titanium.

(a) 311 kJ
(b) 1200 kJ
(c) 1.49×10^4 kJ
(d) 610 kJ
(e) 62.0 kJ

15. For the reaction: $HCl(aq) + KOH(aq) \rightarrow H_2O(l) + KCl(aq)$ $\Delta H°$ is -56.0 kJ. If the specific heat of the solution resulting from neutralization of 50.0 mL of 0.220 *M* HCl with 0.400 *M* KOH is 4.18 J/g·°C and the initial temperature is 22.2°C, what is the final solution temperature? (Assume the density of the solution to be 1.01 g/mL.)

(a) 24.1°C
(b) 41.1°C
(c) 36.9°C
(d) 3.4°C
(e) 27.8°C

16. Given the values of $\Delta H°$ for the two reactions below, what is $\Delta H°$ in kJ for the reaction: $IF_5(g) \rightarrow IF_3(g) + F_2(g)$?

$IF(g) + F_2(g) \rightarrow IF_3(g)$ $\quad \Delta H° = -390$ kJ
$IF(g) + 2F_2(g) \rightarrow IF_5(g)$ $\quad \Delta H° = -745$ kJ

(a) -1135
(b) +1135
(c) +35
(d) -35
(e) +355

17. Given the following thermochemical equations:

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ $\Delta H° = -28.0$ kJ

$3Fe + 4CO_2 \rightarrow 4CO + Fe_3O_4$ $\Delta H° = +12.5$ kJ

Calculate the value of $\Delta H°$ for:

$3Fe_2O_3 + CO \rightarrow CO_2 + 2Fe\ O_4$ $\Delta H° = ?$

(a) -59.0 kJ
(b) -109 kJ
(c) -15.5 kJ
(d) 40.5 kJ
(e) none of the above.

18. Consider the following reactions and their associated values of $\Delta H°$.

$N_2(g) + 2O_2(g) \rightarrow 2NO_2(g)$ $\Delta H° = 66.4$ kJ

$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$ $\Delta H° = -114.2$ kJ

What is the value of $\Delta H°$ for the reaction shown below?

$N_2(g) + O_2(g) \rightarrow 2NO(g)$

(a) 90.3 kJ
(b) -47.8 kJ
(c) 47.8 kJ
(d) 181 kJ
(e) None of the above.

19. For which one of the following reactions is the $\Delta H°$ a heat of formation?

(a) $12C(g) + 11H_2(g) + 11O(g) \rightarrow C_6H_{22}O_{11}(g)$

(b) $P(g) + 4H(g) + Br(g) \rightarrow PH_4Br(l)$

(c) $\frac{1}{2}N2(g) + O_2(g) \rightarrow NO_2(g)$

(d) $6C(s) + 6H(g) \rightarrow C_6H_6(g)$

(e) $N_2(g) + 3H_2(g) \rightarrow 2NH3(g)$

20. The value of $\Delta H°$ for the reaction shown below is 44 kJ. What is the value of $\Delta H_f°$ for $H_2O(g)$?

$$H_2O(l) \rightarrow H_2O(g)$$

(a) 242
(b) -242
(c) 330
(d) -330

21. What is the value of $\Delta H°$ for the following reaction?

$$IF_5(g) + F_2(g) \rightarrow IF_7(g)$$

(a) -1801 kJ
(b) -121 kJ
(c) 121 kJ
(d) 1801 kJ
(e) None of the above.

Substance	$\Delta H_f°$(kJ/mol)
$IF(g)$	-95
$IF_5(g)$	-840
$IF_7(s)$	-941

22. For the reaction given below $\Delta H°$ is -390 kJ.
What is the value of $\Delta H_f°$(in kJ/mol) for $IF_3(g)$? (Use the data in the previous question.)

$$IF(g) + F_2(g) \rightarrow IF_3(g)$$

(a) 295
(b) -295
(c) 485
(d) -485
(e) none of the above.

23. Compute $\Delta H°$in kJ for the following reaction.

$$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$$

(a) -566.4
(b) -283.3
(c) 283.3
(d) -677.0
(e) none of the above.

Substance	$\Delta H_f°$(kJ/mol)
$CO(g)$	-110.5
$CO_2(g)$	-393.7
$CaCO_3(s)$	-1207

24. Which one of the choices below is not considered a fossil fuel?

    (a) crude oil

    (b) anthracite coal

    (c) hydrogen

    (d) natural gas

    (e) peat

25. The average fuel value of sugar is 17 kJ/g. A 2.0 L pitcher of sweetened Kool-Aid contains 400 g of sugar. What is the fuel value (in kJ) of a 500 mL serving of Kool-Aid? (Assume the sugar is the only fuel source.)

    (a) 1.7×10^2

    (b) 1.7×10^6

    (c) 1.7×10^3

    (d) 4.2×10^4

    (e) none of the above.