

**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?
  - (a) 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·m<sup>2</sup>/s<sup>2</sup>
  
3. Calculate the kinetic energy in J of an electron (mass =  $9.11 \times 10^{-28}$  kg) moving at  $6.00 \times 10^6$  m/s.
  - (a)  $2.49 \times 10^{-48}$
  - (b)  $3.28 \times 10^{-14}$
  - (c)  $6.56 \times 10^{-14}$
  - (d)  $4.98 \times 10^{-48}$
  - (e)  $1.64 \times 10^{-14}$
  
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.

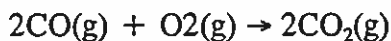
5. Which one of the following conditions would always result in an increase in  $\Delta E$  for a system?

- (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  $\Delta H^\circ$ ?

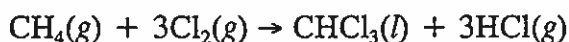
- (a)  $C(s) + O_2(g) \rightarrow CO_2(g)$
- (b)  $CO_2(s) \rightarrow CO_2(g)$
- (c)  $2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$
- (d)  $NH_3(l) \rightarrow 2H_2(g) + O_2(g)$
- (e) None of the above.

7. The value of  $\Delta H^\circ$  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.



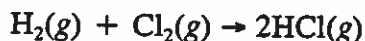
- (a)  $2.89 \times 10^3$
- (b) 207
- (c) 65.7
- (d) 103
- (e) None of the above.

8. The value of  $\Delta H^\circ$  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.



- (a)  $2.57 \times 10^3$
- (b) 70.7
- (c) 177
- (d) 211
- (e) None of the above.

9. The value of  $\Delta H^\circ$  for the following reaction is -186 kJ. How many kJ of heat would be evolved from the reaction of 25 g of  $\text{Cl}_2$ ?

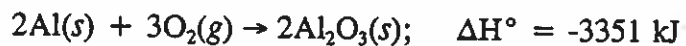


- (a)  $5.3 \times 10^2$   
(b) 65  
(c) 47  
(d) 33  
(e) None of the above.
10. The value of  $\Delta H^\circ$  for the following reaction is -186 kJ. Calculate the value of  $\Delta H_f^\circ$  (in kJ/mol) for  $\text{HCl}(g)$ .



- (a)  $-1.27 \times 10^2$   
(b)  $-3.72 \times 10^2$   
(c) -186  
(d) -93.0  
(e) none of the above.
11. For the reaction:  $2\text{Al}(s) + 3\text{O}_2(g) \rightarrow 2\text{Al}_2\text{O}_3(s)$   
 $\Delta H^\circ = -3351 \text{ kJ}$ . The reaction is \_\_\_\_\_ and therefore heat is \_\_\_\_\_.
- (a) endothermic, evolved  
(b) exothermic, evolved  
(c) exothermic, absorbed  
(d) endothermic, absorbed

12. From the reaction:



determine the value of  $\Delta H_f^\circ$  (in kJ) for  $\text{Al}_2\text{O}_3(s)$ .

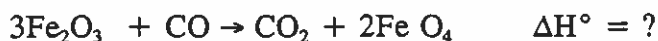
- (a) -32.86  
(b) -16.43  
(c) -3351  
(d) -1676  
(e) None of the above.

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,  $q_{\text{rxn}} = -2.84 \text{ kJ}$
  - (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)  $1.49 \times 10^4 \text{ kJ}$
  - (d) 610 kJ
  - (e) 62.0 kJ
15. For the reaction:  $\text{HCl}(aq) + \text{KOH}(aq) \rightarrow \text{H}_2\text{O}(l) + \text{KCl}(aq)$   $\Delta H^\circ$  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  $\Delta H^\circ$  for the two reactions below, what is  $\Delta H^\circ$  in kJ for the reaction:  $\text{IF}_5(g) \rightarrow \text{IF}_3(g) + \text{F}_2(g)$ ?
- $$\text{IF}(g) + \text{F}_2(g) \rightarrow \text{IF}_3(g) \quad \Delta H^\circ = -390 \text{ kJ}$$
- $$\text{IF}(g) + 2\text{F}_2(g) \rightarrow \text{IF}_5(g) \quad \Delta H^\circ = -745 \text{ kJ}$$
- (a) -1135
  - (b) +1135
  - (c) +35
  - (d) -35
  - (e) +355

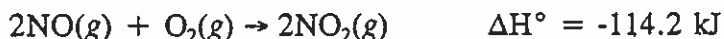
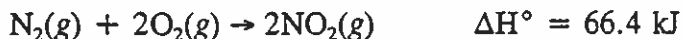
17. Given the following thermochemical equations:



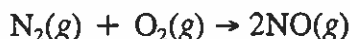
Calculate the value of  $\Delta H^\circ$  for:



- (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  $\Delta H^\circ$ .



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

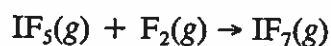


- (a) 90.3 kJ  
(b) -47.8 kJ  
(c) 47.8 kJ  
(d) 181 kJ  
(e) None of the above.
19. For which one of the following reactions is the  $\Delta H^\circ$  a heat of formation?
- (a)  $12\text{C}(\text{g}) + 11\text{H}_2(\text{g}) + 11\text{O}(\text{g}) \rightarrow \text{C}_6\text{H}_{22}\text{O}_{11}(\text{g})$   
(b)  $\text{P}(\text{g}) + 4\text{H}(\text{g}) + \text{Br}(\text{g}) \rightarrow \text{PH}_4\text{Br}(\text{l})$   
(c)  $\frac{1}{2}\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{NO}_2(\text{g})$   
(d)  $6\text{C}(\text{s}) + 6\text{H}(\text{g}) \rightarrow \text{C}_6\text{H}_6(\text{g})$   
(e)  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$

20. The value of  $\Delta H^\circ$  for the reaction shown below is 44 kJ. What is the value of  $\Delta H_f^\circ$  for  $\text{H}_2\text{O}(g)$ ?



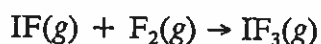
- (a) 242  
(b) -242  
(c) 330  
(d) -330
21. What is the value of  $\Delta H^\circ$  for the following reaction?



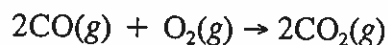
- (a) -1801 kJ  
(b) -121 kJ  
(c) 121 kJ  
(d) 1801 kJ  
(e) None of the above.

Substance	$\Delta H_f^\circ$ (kJ/mol)
IF(g)	-95
IF <sub>5</sub> (g)	-840
IF <sub>7</sub> (s)	-941

22. For the reaction given below  $\Delta H^\circ$  is -390 kJ. What is the value of  $\Delta H_f^\circ$  (in kJ/mol) for  $\text{IF}_3(g)$ ? (Use the data in the previous question.)



- (a) 295  
(b) -295  
(c) 485  
(d) -485  
(e) none of the above.
23. Compute  $\Delta H^\circ$  in kJ for the following reaction.



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

Substance	$\Delta H_f^\circ$ (kJ/mol)
CO(g)	-110.5
CO <sub>2</sub> (g)	-393.7
CaCO <sub>3</sub> (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)  $1.7 \times 10^2$
  - (b)  $1.7 \times 10^6$
  - (c)  $1.7 \times 10^3$
  - (d)  $4.2 \times 10^4$
  - (e) none of the above.