

**Project Advance Chemistry 106 Sample Questions**  
on Material in *General Chemistry*, Brown, LeMay, and Bursten, 6th ed.

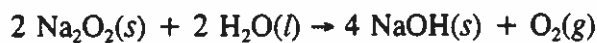
**Chapter 5. Energy Relationships in Chemistry: Thermochemistry**

- Calculate the kinetic energy in joules of an electron moving at  $6.00 \times 10^6$  m/s.
  - $4.98 \times 10^{-48}$
  - $3.28 \times 10^{-14}$
  - $1.64 \times 10^{-14}$
  - $2.49 \times 10^{-48}$
  - $6.56 \times 10^{-14}$
- Calculate the value of  $\Delta E$  for a system which performs 213 kJ of work on its surroundings and loses 79 kJ of heat?
  - +292 kJ
  - 292 kJ
  - +134 kJ
  - 134 kJ
  - 213 kJ
- Which statement is *incorrect* about an endothermic change in a chemical reaction?
  - The potential energy of the reacting chemicals increases.
  - The reaction mixture becomes cool.
  - Heat is absorbed by the reacting chemicals.
  - The law of conservation of mass is observed.
  - The surroundings absorb heat from the reaction mixture.
- Which of the following statements is false?
  - Enthalpy is not a state function.
  - Work is not a state function.
  - In a reaction run at constant pressure, the enthalpy change is equal to the energy flow as heat.
  - Under most conditions,  $\Delta H$  is close to  $\Delta E$ .
  - If  $\Delta E = w$  the process is adiabatic.
- Which one of the following processes is endothermic?
  - $2 \text{H}_2(g) + \text{O}_2(g) \rightarrow 2 \text{H}_2\text{O}$
  - $\text{H}_2\text{O}(g) \rightarrow \text{H}_2\text{O}(l)$
  - $\text{CH}_4(g) + 2 \text{O}_2(g) \rightarrow \text{CO}_2(g) + 2 \text{H}_2\text{O}(g)$
  - $\text{H}_2\text{O}(s) \rightarrow \text{H}_2\text{O}(l)$
  - none of these.

6. Which one of the following reactions has a negative value for  $\Delta H^\circ$ ?

- (a)  $\text{CO}_2(s) + \text{CO}_2(g)$
- (b)  $\text{C}(s) + \text{O}_2(g) \rightarrow \text{CO}_2(g)$
- (c)  $2 \text{H}_2\text{O}(l) \rightarrow 2 \text{H}_2(g) + \text{O}_2(g)$
- (d)  $\text{NH}_3(l) \rightarrow 2 \text{H}_2(g) + \text{O}_2(g)$
- (e) none of these.

7. The value of  $\Delta H^\circ$  for the following reaction is -126 kJ. Determine the amount of heat (in kJ) that would be evolved by the reaction of 25.0 g of sodium peroxide,  $\text{Na}_2\text{O}_2$ , with water.



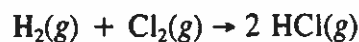
- (a) 20.2
- (b) 40.4
- (c) 67.5
- (d) 80.8
- (e) none of these.

8. The value of  $\Delta H^\circ$  for the reaction below is -6535 kJ. How many kJ of heat will be evolved during the combustion of 16.0 g of  $\text{C}_6\text{H}_6(l)$ ?



- (a)  $1.34 \times 10^3$
- (b)  $5.23 \times 10^4$
- (c)  $6.70 \times 10^2$
- (d)  $2.68 \times 10^3$
- (e) none of these.

9. 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)  $-3.72 \times 10^2$
- (b)  $-1.27 \times 10^2$
- (c) -186
- (d) -93.0
- (e) none of these.

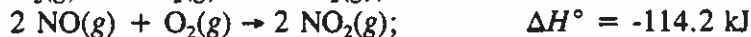
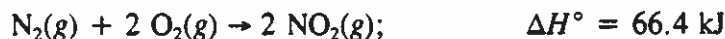
10. The reaction:  $2 \text{Al}(s) + 3 \text{O}_2(g) \rightarrow 2 \text{Al}_2\text{O}_3(s)$  has a  $\Delta H^\circ = -3351 \text{ kJ}$ . The reaction is \_\_\_\_\_ and therefore heat is \_\_\_\_\_ by the reaction.

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

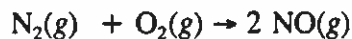
11. Given the values of  $\Delta H^\circ$  for the two reactions below, what is  $\Delta H^\circ$  in kJ for the reaction:  
 $\text{IF}_3(g) \rightarrow \text{IF}(g) + \text{F}_2(g)$ ?



- (a) +355  
 (c) +1135  
 (e) -35
- (b) -1135  
 (d) +35
12. Given the following thermochemical equations



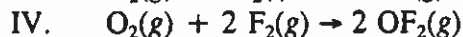
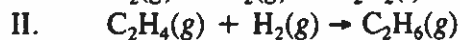
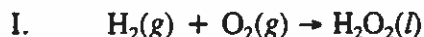
What is the value of  $\Delta H^\circ$  for the reaction shown below?



- (a) 181 kJ  
 (c) 47.8 kJ  
 (e) none of these.
- (b) -47.8 kJ  
 (d) 90.3 kJ
13. For which species below would  $\Delta H_f^\circ$  be zero?

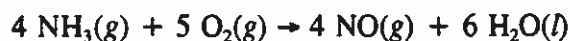


- (a) Ni(s)  
 (c) PF<sub>3</sub>(g)  
 (e) both CO(g) and PF<sub>3</sub>(g)
- (b) CO(g)  
 (d) Ni(CO)<sub>2</sub>(PF<sub>3</sub>)<sub>2</sub>(l)
14. Select the equation(s) shown below for which the enthalpy change is the heat of formation.



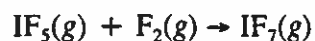
- (a) II only  
 (c) I, II, and III  
 (e) All of them I, II, III, and IV.
- (b) I and III  
 (d) I only

15. Calculate the value of  $\Delta H^\circ$  (in kJ) for the following reaction:



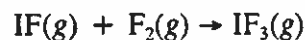
- (a) -1172  
(b) -150  
(c) -1540  
(d) -1892  
(e) none of these.

16. What is the value of  $\Delta H_f^\circ$  for the following reaction?



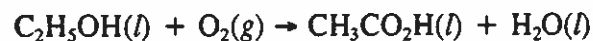
- (a) 1801 kJ  
(b) -1801 kJ  
(c) 121 kJ  
(d) -121 kJ  
(e) none of these.

17. The enthalpy change,  $\Delta H_f^\circ$  for the following reaction is -390 kJ. What is the value of  $\Delta H_f^\circ$  (in kJ/mol) for  $\text{IF}_3$ ?



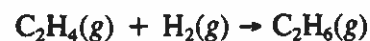
- (a) 295  
(b) -485  
(c) -295  
(d) 485  
(e) none of these.

18. Determine the value of  $\Delta H^\circ$  for the following reaction:



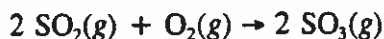
- (a) -79.0  
(b) -476.4  
(c) -492.6  
(d) -1048.0  
(e) none of these.

19. The value of  $\Delta H^\circ$  for the following reaction is -137.0 kJ. What is the value of  $\Delta H_f^\circ$  for  $\text{C}_2\text{H}_6(g)$ ?

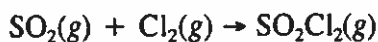


- (a) 189.3  
(b) -189.3  
(c) -84.7  
(d) 84.7  
(e) none of these.

20. Determine the value of  $\Delta H^\circ$  (in kJ) for the following reaction.



- (a) -99  
(b) 99  
(c) 198  
(d) -198  
(e) none of these.
21. Calculate the quantity of heat (in kJ) evolved when 7.5 g of  $\text{SO}_2$  reacts according to the following equation.



- (a) 77  
(b)  $5.7 \times 10^2$   
(c) 19  
(d) 7.9  
(e) none of these.
22. An iron sphere of diameter 4.00 cm and density 7.86 g/cm<sup>3</sup> at 20.0°C is dropped into a perfectly insulated beaker containing 90.0 g of  $\text{H}_2\text{O}$  at 50.0°C. [ $V = (4/3)\pi r^3$ ] The respective specific heats of Fe and  $\text{H}_2\text{O}$  are 0.45 and 4.18 J/g·°C. What is the final temperature (in °C) of the iron sphere?

- (a) 7  
(b) 73  
(c) 29  
(d) 48  
(e) 43
23. Determine the heat capacity per gram ( $C_g$ ) for metal X from the following information: 95 g of metal at 75°C are placed in 50 g of water ( $C_g = 4.184$ ) at 18°C. The final temperature of the water is 23°C.

- (a) 23  
(b) 0.21  
(c) 0.76  
(d) 3.6  
(e) none of these.
24. The density of gold is 19.3 g/cm<sup>3</sup>. The heat capacity of gold is 0.13 J/g·°C. A cube of gold at 75.0°C is dropped into 150 g of water at 25.0°C. The final temperature of the mixture is 27.5°C. What is the length of an edge of the gold cube? Heat capacity of water is 4.184 J/g·°C.

- (a) 13 cm  
(b) 6.3 cm  
(c) 2.4 cm  
(d) 0.42 cm  
(e) none of these.

25. Which of the following statements about energy usage in the United States is *false*?
- (a) Fossil fuels are our major energy source.
  - (b) Nuclear power accounts for about 35% of all electricity generated in the U.S.
  - (c) Coal is our most abundant fossil fuel.
  - (d) Solar energy falling on 0.1% of the land area of the U.S. is equivalent to current national energy use.
  - (e) Photovoltaic solar power cells are not yet practical on a large scale.
26. Which one of the following samples would require the least amount of thermal energy to bring its temperature to 80.0°C?
- (a) 200.0 g of H<sub>2</sub>O at 40.0 K
  - (b) 100.0 g of H<sub>2</sub>O at 20.0 K
  - (c) 200.0 g of H<sub>2</sub>O at 40.0 K
  - (d) 100.0 g of H<sub>2</sub>O at 20.0 K
  - (e) 200.0 g of H<sub>2</sub>O at 20.0 K
27. If 100 J of heat is removed from a mixture of 100 g of ice and 100 g of water at 0°C, then
- (a) the temperature will rise.
  - (b) some of the water will freeze.
  - (c) the temperature will decrease.
  - (d) some of the ice melts.
  - (e) some of the water vaporizes.
28. A calorimeter was calibrated using a heater rated at 35.0 W. When the heater was on for 128 s, the temperature rose 4.216 K. The calibration relation for the calorimeter is
- (a) 1.06 kJ per 4.216 K
  - (b) 3.65 kJ per 4.216 K
  - (c) 4.48 kJ per 4.216 K
  - (d) 35.0 J per 4.216 K
  - (e) 35.0 kJ per 30.4 s · K<sup>-1</sup>
29. To which of the following reactions does  $\Delta H_f^\circ$  for HCl(g) refer?
- (a)  $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{HCl}(\text{g})$
  - (b)  $\text{NaCl}(\text{s}) + \text{H}_2\text{SO}_4(\text{l}) \rightarrow \text{NaHSO}_4(\text{s}) + \text{HCl}(\text{g})$
  - (c)  $\frac{1}{2}\text{H}_2(\text{g}) + \frac{1}{2}\text{Cl}_2(\text{g}) \rightarrow \text{HCl}(\text{g})$
  - (d)  $\text{H}_2(\text{g}) + \text{Cl}_2(\text{l}) \rightarrow \text{HCl}(\text{l})$
  - (e)  $\text{H}(\text{g}) + \text{Cl}(\text{g}) \rightarrow \text{HCl}(\text{g})$

30. The equation that represents the standard enthalpy of formation of solid ammonium nitrate is

- (a)  $4\text{N}(g) + 8\text{H}(g) + 6\text{O}(g) \rightarrow 2\text{NH}_4\text{NO}_3(s)$
- (b)  $2\text{N}_2(g) + 4\text{H}_2(g) + 3\text{O}_2(g) \rightarrow 2\text{NH}_4\text{NO}_3(s)$
- (c)  $\text{N}_2(g) + 2\text{H}_2(g) + 3/2\text{O}_2(g) \rightarrow \text{NH}_4\text{NO}_3(s)$
- (d)  $2\text{N}(g) + 4\text{H}(g) + 3\text{O}(g) \rightarrow \text{NH}_4\text{NO}_3(s)$
- (e)  $\text{N}_2\text{O}(g) + 2\text{H}_2\text{O}(g) \rightarrow \text{NH}_4\text{NO}_3(s)$

Standard Heats of Formation for Selected Substances

Substance	Formula	$\Delta H_f^\circ$ (kJ/mole)
acetic acid	$\text{CH}_3\text{CO}_2\text{H}(l)$	-484.5
ammonia	$\text{NH}_3(g)$	-46
calcium carbonate	$\text{CaCO}_3(s)$	-1207
carbon dioxide	$\text{CO}_2(g)$	-193.7
carbon monoxide	$\text{CO}(g)$	-110.5
ethyl alcohol	$\text{C}_2\text{H}_5\text{OH}(l)$	-277.7
ethylene	$\text{C}_2\text{H}_4(g)$	52.3
hydrogen sulfide	$\text{H}_2\text{S}(g)$	-20.6
iodine heptafluoride	$\text{IF}_7(g)$	-941
iodine fluoride	$\text{IF}(g)$	-95
iodine pentafluoride	$\text{IF}_5(g)$	-840
nitric acid	$\text{HNO}_3(g)$	-207
nitrogen oxide	$\text{NO}(g)$	90
nitrous oxide	$\text{NO}_2(g)$	34
silver(I) sulfide	$\text{Ag}_2\text{S}(s)$	-32.6
silver(I) oxide	$\text{Ag}_2\text{O}(s)$	-31.0
sulfur dioxide	$\text{SO}_2(g)$	-297
sulfur trioxide	$\text{SO}_3(g)$	-396
sulfuric acid	$\text{H}_2\text{SO}_4(l)$	-814
thionyl chloride	$\text{SO}_2\text{Cl}_2(g)$	-364
water	$\text{H}_2\text{O}(l)$	-285.8