

## Thermochemistry

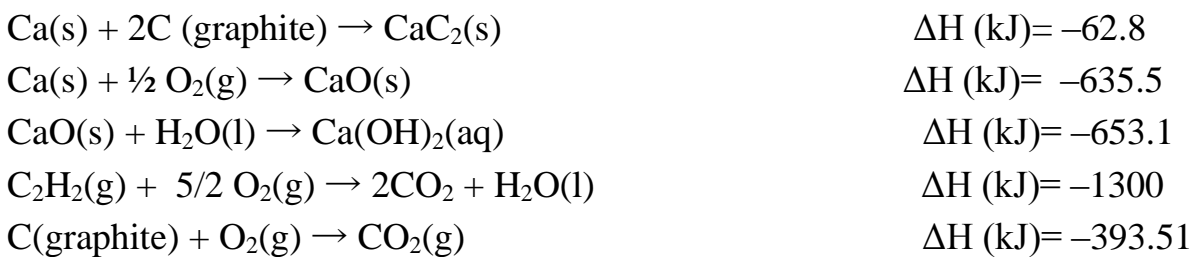
1. If 0.315 moles of hexane ( $C_6H_{14}$ ) burn in a bomb calorimeter containing 5.65 liters of water, what's the molar heat of combustion of hexane (the water temperature rises  $55.4^\circ C$ )? The heat capacity of water is  $4.184 J/g^\circ C$ .
  - a) **4150 kJ/mol**
  - b) 1310 kJ/mol
  - c) 4150 J/mol
  - d) 1310 J/mol
2. If I burn 22.0 grams of propane ( $C_3H_8$ ) in a bomb calorimeter containing 3.25 liters of water, what's the molar heat of combustion of propane if the water temperature rises  $88.5^\circ C$ ?
  - a)  $1.20 \times 10^3$  kJ
  - b)  **$2.40 \times 10^3$  kJ/mol.**
  - c)  $1.20 \times 10^3$  J
  - d)  $2.40 \times 10^3$  J/mol.
3. What units of energy are commonly used in chemistry?
  - a) **Joules**
  - b) Liters
  - c) Kilogram
  - d) Calories
4. What is the units for specific heat?
  - a) J
  - b)  $g / ^\circ C$
  - c)  **$J / g \cdot ^\circ C$**
  - d)  $J / ^\circ C$
5. What is the units for heat capacity?
  - a) J
  - b)  $g / ^\circ C$
  - c)  $J / g \cdot ^\circ C$
  - d)  **$J / ^\circ C$**

6. A piece of silver of mass 362 g has a heat capacity of  $85.7 \text{ J} \cdot ^\circ\text{C}^{-1}$ . What is the specific heat of silver?
- a)  **$0.237 \text{ J} / ^\circ\text{C}$**
  - b)  $237 \text{ J} / ^\circ\text{C}$
  - c)  $23 \text{ J} / ^\circ\text{C}$
  - d)  $47 \text{ J} / ^\circ\text{C}$
7. Calculate the amount of heat liberated (in kJ) from 366 g of mercury (specific heat of mercury  $0.139 \text{ J} / \text{g} \cdot ^\circ\text{C}$ ) when it cools from  $77.0$  to  $12.0$   $^\circ\text{C}$ .
- a)  $33.1 \text{ kJ}$
  - b)  **$-3.31 \text{ kJ}$**
  - c)  $3.31 \text{ J}$
  - d)  $1000 \text{ J}$
8. A  $6.22 \text{ kg}$  piece of copper metal (specific heat of copper  $0.385 \text{ J} / \text{g} \cdot ^\circ\text{C}$ ) is heated from  $20.5$   $^\circ\text{C}$  to  $324.3$   $^\circ\text{C}$ . Calculate the heat absorbed (in kJ) by the metal.
- a)  $728 \text{ J}$
  - b)  **$728 \text{ kJ}$**
  - c)  $72 \text{ J}$
  - d)  $27 \text{ kJ}$
9. A sheet of gold weighing  $10.0 \text{ g}$  and at a temperature of  $18.0$   $^\circ\text{C}$  is placed flat on a sheet of iron weighing  $20.0 \text{ g}$  and at a temperature of  $55.6$   $^\circ\text{C}$ . What is the final temperature of the combined metals? Assume that no heat is lost to the surroundings. (Hint: The heat gained by the gold must be equal to the heat lost by the iron.)
- a)  $32.7$   $^\circ\text{C}$
  - b)  **$50.7$   $^\circ\text{C}$**
  - c)  $60.5$   $^\circ\text{C}$
  - d)  $100$   $^\circ\text{C}$
10. SI unit of work is
- a) Atmosphere
  - b) **Joule**
  - c) Calories
  - d) Second

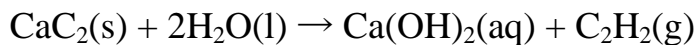
11. A chemical reaction that absorbs heat from the surroundings is said to be \_\_\_\_\_ and has a \_\_\_\_\_  $\Delta H$  at constant pressure
- a) **endothermic, positive**
  - b) endothermic, negative
  - c) exothermic, negative
  - d) exothermic, positive
12. Which one of the following statements is true?
- a) Enthalpy is an intensive property.
  - b) The enthalpy is not a state function
  - c) **Enthalpy is a state function.**
  - d) H is the value of q measured under conditions of constant volume.
13.  $\Delta H$  for an endothermic process is \_\_\_\_\_ while  $\Delta H$  for an exothermic process is \_\_\_\_\_.
- a) zero, positive
  - b) zero, negative
  - c) **positive, negative**
  - d) negative, positive
14. Of the following, which one is a state function?
- a) **H**
  - b) q
  - c) w
  - d) All of the above
15. When a system \_\_\_\_\_  $\Delta E$  is always negative.
- a) absorbs heat and does work
  - b) **gives off heat and does work**
  - c) absorbs heat and has work done on it
  - d) none of the above is always negative
16. Consider the following standard heats of formation:  
 $P_4O_{10}(s) = -3110 \text{ kJ/mol}$  ,  $H_2O(l) = -286 \text{ kJ/mol}$  ,  $H_3PO_4(s) = -1279 \text{ kJ/mol}$   
Calculate the change in enthalpy for the following process:
- $$P_4O_{10}(s) + 6H_2O(l) \rightarrow 4H_3PO_4(s)$$
- a) **290 kJ**
  - b) 2117 kJ
  - c) 1720 kJ
  - d) 0 kJ

17. 1. A gas absorbs 0.0 J of heat and then performs 15.2 J of work. The change in internal energy of the gas is
- a) -24.8 J
  - b) -55.2 J
  - c) 55.2 J
  - d) **-15.2 J**
- 18 . Calculate the work for the expansion of CO<sub>2</sub> from 1.0 to 2.5 liters against a pressure of 1.0 atm at constant temperature.
- a) 1.5 liter · atm
  - b) 2.5 liter · atm
  - c) **-1.5 liter · atm**
  - d) -2.5 liter · atm
- 19 One mole of an ideal gas is expanded from a volume of 1.00 liter to a volume of 10.00 liters against a constant external pressure of 1.00 atm. How much work (in joules) is performed on the surroundings? (T = 300 K; 1 L atm = 101.3 J)
- a) 456 J
  - b) **912 J**
  - c) 2740 J
  - d) 2870 J
- 20 A 25.0 g piece of aluminum (which has a molar heat capacity of **24.03J/°C mol**) is heated to 82.4°C and dropped into a calorimeter containing water (specific heat capacity of water is **4.18J/g°C**) initially at 22.3°C. The final temperature of the water is 24.9°C. Calculate the mass of water in the calorimeter.
- a) **187 g**
  - b) 6.57 g
  - c) 3180 g
  - d) 2120 g
- 21 A 40.2 g sample of a metal is heated to 99.3°C and then placed in a calorimeter containing 120.0 g of water (s = 4.18J/g°C) at 21.8°C. The final temperature of the water is 24.5°C. Which metal was used?
- a) Aluminum (s = 0.89J/g°C)
  - b) **Iron (s = 0.45J/g°C)**
  - c) Copper (s = 0.20J/g°C)
  - d) Lead (s = 0.14J/g°C)

22 Consider the following data:



Use Hess's law to find the change in enthalpy at 25° C for the following equation:



- a) **-713 kJ**
- b) 713 kJ
- c) -318.8 kJ
- d) -3045 kJ