

# CHAPTER 0

## ENERGY AND TEMPERATURE

**0.1** Answer the following questions: (a) What is the name of the energy associated with the motion of particles in a substance? (b) What is the name of the energy stored in height?

**0.2** Discuss the changes in potential and kinetic energy in the following scenarios: (a) When water falls down a waterfall (b) When a person throws away an object high up in the air

**0.3** Indicate whether the following statement describes kinetic or potential energy: (a) Water on top of a waterfall (b) Hitting a wall with a hammer

**0.4** Indicate whether the following statement describes kinetic or potential energy: (a) a car moving in the road (b) Water on the bottom of a waterfall

**0.5** Carry the following conversions: (a)  $100^{\circ}\text{C}$  to K (b)  $200^{\circ}\text{F}$  to K (c)  $500\text{K}$  to  $^{\circ}\text{F}$

**0.6** Carry the following conversions: (a)  $20^{\circ}\text{C}$  to  $^{\circ}\text{F}$  (b)  $300\text{K}$  to  $^{\circ}\text{C}$  (c)  $41^{\circ}\text{F}$  to  $^{\circ}\text{C}$

**0.7** Carry the following conversions: (a) 100 Cal into kcal (b) 10000 cal into J (c) 4565J into Cal

**0.8** Carry the following conversions: (a) 650J into calories (b) 50 kcal into Cal (c) 3.25 kcal into joules

## FROM ENERGY TO TEMPERATURE

**0.9** A 50g piece of aluminum ( $c_e = 0.214 \frac{\text{cal}}{\text{g}^{\circ}\text{C}}$ ) initially at  $25^{\circ}\text{C}$  absorbs 100cal. Calculate the final temperature of the aluminum piece.

**0.10** A 200g piece of iron ( $c_e = 0.1 \frac{\text{cal}}{\text{g}^{\circ}\text{C}}$ ) initially at  $15^{\circ}\text{C}$  absorbs 1000cal. Calculate the final temperature of the metal piece.

**0.11** How many calories are required to raise the temperature of a 35 g sample of iron from  $25^{\circ}\text{C}$  to  $35^{\circ}\text{C}$ ? Iron has a specific heat of  $0.108 \frac{\text{cal}}{\text{g}^{\circ}\text{C}}$ .

**0.12** What is the final temperature of a 35 g sample of iron at  $25^{\circ}\text{C}$  after receiving 50cal? Iron has a specific heat of  $0.108 \frac{\text{cal}}{\text{g}^{\circ}\text{C}}$ .

**0.13** What is the initial temperature of a 50 g sample of aluminum that after receiving 50cal reaches a temperature of  $50^{\circ}\text{C}$ ? Al has a specific heat of  $0.2 \frac{\text{cal}}{\text{g}^{\circ}\text{C}}$ .

**0.14** What is the specific heat of a metal if a 100 g sample at  $25^{\circ}\text{C}$  warms up until  $50^{\circ}\text{C}$  after receiving 100cal?

## THE FIRST LAW OF THERMODYNAMICS

**0.15** A sample of gas expands from 3 to 4 L at constant pressure. Using  $1\text{L} \cdot \text{atm} = 101.3\text{J}$ , calculate the work done in J under the following conditions: (a) The gas expands against the vacuum. (b) The gas expands against a constant pressure of 5atm

**0.16** A sample of gas expands carrying out 120J of work to its surroundings while absorbing 150J of heat also from its surroundings. Calculate the change of the internal energy of the system in J.

## CALORIMETRY

**0.17** A 3 moles sample of C(s) is burned in a constant-volume calorimeter containing 40g of water. The temperature inside the calorimeter increases from  $25.0^{\circ}\text{C}$  to  $25.89^{\circ}\text{C}$ . The calorimeter constant is  $9.90 \frac{\text{kJ}}{^{\circ}\text{C}}$ . Calculate the molar heat of the reaction.

**0.18** A 10 grams sample of fructose ( $\text{MW}=180\text{g/mol}$ ) is burned in a constant-volume calorimeter containing 50g of water. The temperature inside the calorimeter increases  $7^{\circ}\text{C}$ . The calorimeter constant is  $10.8 \frac{\text{kJ}}{^{\circ}\text{C}}$ . Calculate the molar heat of the reaction.

**0.19** When a 0.09-g sample of trinitrotoluene (TNT,  $\text{MW}=213\text{g/mol}$ ), is burned in a bomb calorimeter, the temperature increases from  $23.5^{\circ}\text{C}$  to  $27.1^{\circ}\text{C}$ . The heat capacity of the calorimeter is  $400 \frac{\text{J}}{^{\circ}\text{C}}$ , and it contains 100 mL of water. Calculate the molar heat of the reaction. Remember that the density of water is  $1\text{g/mL}$ .

**0.20** We mix 50mL of 2M HCl with 100mL of 1.5M NaOH in a coffee-cup calorimeter. Both solutions are initially at 20°C. Calculate the final temperature of the solution in the calorimeter considering that the specific heat of the mixture is  $4.184 \frac{J}{g^{\circ}C}$  and the density of the solution is 1g/mL. The molar heat of the reaction is -56kJ/mol.

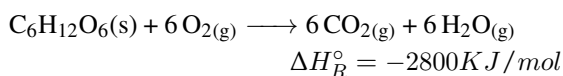
**0.21** A potato contains 20 g of carbohydrate. If carbohydrate has a caloric value of 4 kcal/g, how many kcal are obtained from the carbohydrate in the potato?

**0.22** A diet has a total caloric intake of 1400 kcal. The diet consists of 50.% carbohydrate, 35% protein, and 15% fat. The number of kcal of protein in the diet is

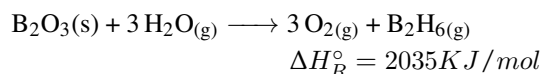
**0.23** A serving of fish contains 50 g of protein and 4 g of fat. If protein has a caloric value of 4.0 kcal/g and fat has 9 kcal/g, how many kcal are in the serving?

#### ENTHALPY

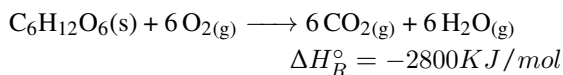
**0.24** Identify the following reaction as endothermic or exothermic.



**0.25** Identify the following reaction as endothermic or exothermic.



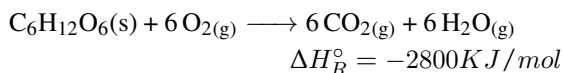
**0.26** For the following reaction:



Fill the conversion factor:

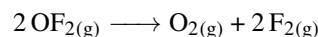
$$\frac{\text{moles of } O_2}{-2800 KJ}$$

**0.27** In the following combustion reaction:



glucose ( $C_6H_{12}O_6$ ) burns to produce carbon dioxide and water. Calculate the heat involved in the combustion of 3 moles of glucose.

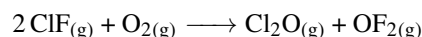
**0.28** Calculate the enthalpy of reaction for:



given:

$$\Delta H_f^{\circ}(OF_{2(g)}) = 24.5 KJ$$

**0.29** Calculate the enthalpy of reaction for:



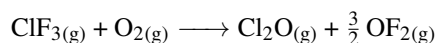
given:

$$\Delta H_f^{\circ}(ClF_{(g)}) = -56 KJ$$

$$\Delta H_f^{\circ}(Cl_2O_{(g)}) = 88 KJ$$

$$\Delta H_f^{\circ}(OF_{2(g)}) = 25 KJ$$

**0.30** Calculate the enthalpy of reaction for:



given:

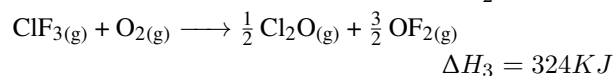
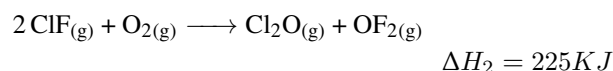
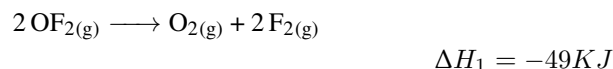
$$\Delta H_f^{\circ}(ClF_{3(g)}) = -156 KJ$$

$$\Delta H_f^{\circ}(Cl_2O_{(g)}) = 88 KJ$$

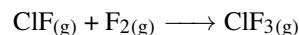
$$\Delta H_f^{\circ}(OF_{2(g)}) = 25 KJ$$

#### HESS'S LAW

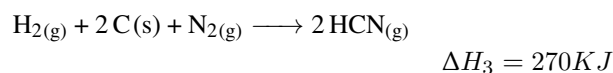
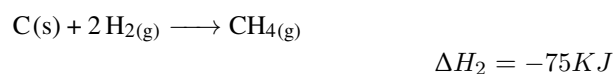
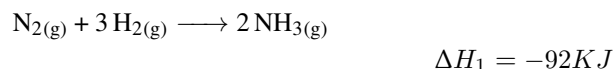
**0.31** Using the following reactions:



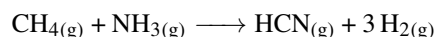
Determine the enthalpy change for:



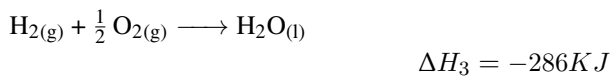
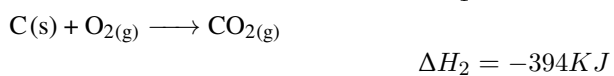
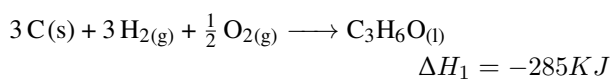
**0.32** Using the following reactions:



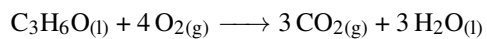
Determine the enthalpy change for:



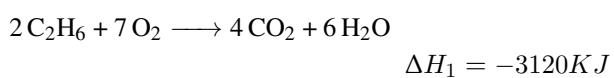
**0.33** Using the following reactions:



Determine the enthalpy change for:



**0.34** Using the following reactions:



Determine the enthalpy change for:

