Full Name: February 22, 2023

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

0.2 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°C to 25.89 °C. The calorimeter constant is 9.90 $\frac{kJ}{^\circ C}$. Calculate the molar heat of the reaction.

0.3 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.

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

0.5

0.6 We mix 50mL of 2M HCl with 50mL of 2M NaOH in a coffee-cup calorimeter. Both solutions are initially at 40°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 -100kJ/mol.

0.7 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

0.8 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?

0.9 One large egg contains 6 g of protein and 6 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 egg?

0.10 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?

0.11 Calculate the enthalpy of reaction for:

$$2\,\mathrm{ClF_{(g)}} + \mathrm{O_{2(g)}} \longrightarrow \mathrm{Cl_2O_{(g)}} + \mathrm{OF_{2(g)}}$$

given:

$$\Delta H_f^\circ(\mathrm{ClF_{(g)}}) = -56KJ$$
$$\Delta H_f^\circ(\mathrm{Cl_2O_{(g)}}) = 88KJ$$
$$\Delta H_f^\circ(\mathrm{OF_{2(g)}}) = 25KJ$$

0.12 Calculate the enthalpy of reaction for:

$$2\,\mathrm{OF_{2(g)}} \longrightarrow \mathrm{O_{2(g)}} + 2\,\mathrm{F_{2(g)}}$$

given:

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

0.13 Calculate the enthalpy of reaction for:

$$\mathrm{C_6H_{12}O_{6(s)}} + 6\,\mathrm{O_{2(g)}} \longrightarrow 6\,\mathrm{CO_{2(g)}} + 6\,\mathrm{H_2O_{(l)}}$$

given:

$$\Delta H_f^\circ(\mathrm{CO_{2(g)}}) = -393.5KJ$$
$$\Delta H_f^\circ(\mathrm{H_2O_{(l)}}) = -285.8KJ$$
$$\Delta H_f^\circ(\mathrm{C_6H_{12}O_{6(s)}}) = -1273.3KJ$$

0.14 Calculate the enthalpy of reaction for:

$$\mathrm{ClF_{3(g)}} + \mathrm{O_{2(g)}} \longrightarrow \mathrm{Cl_2O_{(g)}} + \tfrac{3}{2}\,\mathrm{OF_{2(g)}}$$

given:

$$\Delta H_f^\circ(\mathrm{ClF_{3(g)}}) = -156KJ$$
$$\Delta H_f^\circ(\mathrm{Cl_2O_{(g)}}) = 88KJ$$
$$\Delta H_f^\circ(\mathrm{OF_{2(g)}}) = 25KJ$$

0.15 Identify the following reaction as endothermic or exothermic.

$$B_2O_3(s) + 3\,H_2O_{(g)} \longrightarrow 3\,O_{2(g)} + B_2H_{6(g)}$$
$$\Delta H_R^\circ = 2035 KJ/mol$$

0.16 Identify the following reaction as endothermic or exothermic.

$$C_6H_{12}O_6(s) + 6\,O_{2(g)} \longrightarrow 6\,CO_{2(g)} + 6\,H_2O_{(g)}$$
$$\Delta H_R^\circ = -2800 KJ/mol$$

0.17 In the following combustion reaction:

$$C_6H_{12}O_6(s) + 6\,O_{2(g)} \longrightarrow 6\,CO_{2(g)} + 6\,H_2O_{(g)}$$
$$\Delta H_R^\circ = -2800 KJ/mol$$

0.18 For the following reaction:

$$C_6H_{12}O_6(s) + 6\,O_{2(g)} \longrightarrow 6\,CO_{2(g)} + 6\,H_2O_{(g)}$$
$$\Delta H_R^\circ = -2800 KJ/mol$$

Fill the conversion factor:

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

0.19 The same amount of heat is provided to a sample of two different metals, metal A ($c_e(A) = 0.5\frac{cal}{g^\circ C}$) and metal B ($c_e(B) = 0.4\frac{cal}{g^\circ C}$). Both samples have the same mass and are at the same temperature. Which metal A or B would reach a higher temperature?

0.20 The same amount of heat is provided to a sample of two different metals, metal A ($c_e(A) = 0.3\frac{cal}{g^\circ C}$) and metal B ($c_e(B) = 0.4\frac{cal}{g^\circ C}$). Both samples have the same mass and are at the same temperature. Which metal A or B would reach a higher temperature?

0.21 Two samples, A and B, have the same mass and are at the same temperature. If they are equally heated the final temperature of B is two times the one for A. Compare the specific heats of the samples.

0.22 Two samples, A and B, have the same mass and are at the same temperature. If they are equally heated the final temperature of A is three times the one for B. Compare the specific heats of the samples.

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

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

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

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

0.27 What is the specific heat of a metal if a 100 g sample at 25°C warms up until 50°C after receiving 100cal?

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

0.29 Using the following reactions:

$$N_{2(g)} + 3\,H_{2(g)} \longrightarrow 2\,NH_{3(g)} \qquad \Delta H_1 = -92KJ$$

$$C(s) + 2\,H_{2(g)} \longrightarrow CH_{4(g)} \qquad \Delta H_2 = -75KJ$$

$$H_{2(g)} + 2\,C(s) + N_{2(g)} \longrightarrow 2\,HCN_{(g)} \qquad \Delta H_3 = 270KJ$$

Determine the enthalpy change for:

0.30 Using the following reactions:

$2\,OF_{2(g)} \longrightarrow O_{2(g)} + 2\,F_{2(g)}$

$\Delta H_1 = -49KJ$

$2\,ClF_{(g)} + O_{2(g)} \longrightarrow Cl_2O_{(g)} + OF_{2(g)}$

$\Delta H_2 = 225KJ$

$ClF_{3(g)} + O_{2(g)} \longrightarrow \frac{1}{2}\,Cl_2O_{(g)} + \frac{3}{2}\,OF_{2(g)}$

$\Delta H_3 = 324KJ$

Determine the enthalpy change for:

0.31 Using the following reactions:

$2\,C_2H_6 + 7\,O_2 \longrightarrow 4\,CO_2 + 6\,H_2O$

$\Delta H_1 = -3120KJ$

$2\,H_2 + O_2 \longrightarrow 2\,H_2O$

$\Delta H_2 = -479KJ$

$2\,CO + O_2 \longrightarrow 2\,CO_2$

$\Delta H_3 = -566KJ$

Determine the enthalpy change for:

0.32 Using the following reactions:

$3\,C\,(s) + 3\,H_{2(g)} + \frac{1}{2}\,O_{2(g)} \longrightarrow C_3H_6O_{(l)}$

$\Delta H_1 = -285KJ$

$C\,(s) + O_{2(g)} \longrightarrow CO_{2(g)}$

$\Delta H_2 = -394KJ$

$H_{2(g)} + \frac{1}{2}\,O_{2(g)} \longrightarrow H_2O_{(l)}$

$\Delta H_3 = -286KJ$

Determine the enthalpy change for:

0.33 Carry the following conversions: (a) 20°C to °F (b) 300K to °C (c) 41°F to °C

0.34 Carry the following conversions: (a) 100°C to K (b) 200°F to K (c) 500K to °F

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

0.36 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 heigh?

Answersv. 20 **0.1** -1387KJ/mol **0.2** -3KJ/mol **0.3** 29°C **0.4** -6973KJ/mol **0.5** **0.6** 64°C **0.7** 490 kcal. **0.8** 80 cal **0.9** 78 cal **0.10** 236 cal **0.11** 225KJ **0.12** -49KJ **0.13** -2802.5KJ **0.14** 281KJ **0.15** endothermic **0.16** exothermic **0.17** 8400KJ **0.18** 6 **0.19** B **0.20** A **0.21** $2 \times c_e(B)$=$c_e(A)$ **0.22** $3 \times c_e(A)$=$c_e(B)$ **0.23** $T_{Final} = 65°\text{C}$ **0.24** $34.34°\text{C}$ **0.25** 38°C **0.26** 38 cal **0.27** $0.04cal/g°\text{C}$ **0.28** 45°C **0.29** 256KJ **0.30** -187KJ **0.31** -276KJ **0.32** -1755KJ **0.33** (a) $68°F$ (b) 27°C (c) 5°C **0.34** (a) 373K (b) 366K (c) 441°F **0.35** (a) potential energy converts into kinetic while water falls down (b) kinetic energy converts into potential energy **0.36** (a) kinetic energy (b) potential energy