Chemistry 141 Name Key

Dr. Cary Willard

Quiz 6A (20 points) October 9, 2013

Specific heat water = 4.184 J/g oC

1. (4 points) A system absorbs 428 kJ of heat and the system does 284 kJ of work on the surroundings. What is the change in internal energy of the system?

Energy = heat + work

 = (+428 kJ) + (− 284 kJ)

 = + 144 kJ

1. (6 points) You need to calibrate a calorimeter. To do this, you fill the calorimeter with 250.0 g of water at 18.5oC and add 247.7 g of water at 74.2oC. If the temperature of the calorimeter and its contents after mixing is 38.6oC, what is the heat capacity of the calorimeter?

qgained = qlost

qgained cold water + qgained calorimeter = qlost hot water

$$\left(250.0 g\right)\left(\frac{4.184 J}{g ℃}\right)\left(20.1℃\right)+\left(C\right)\left(20.1℃\right)=\left(247.7 g\right)\left(\frac{4.184 J}{g ℃}\right)\left(35.6℃\right)$$

$$21000 J+\left(C\right)\left(20.1℃\right)=36800 J$$

$$\left(C\right)\left(20.1℃\right)=15800 J$$

$$C=\frac{15800 J}{20.1℃}=\frac{786 J}{℃}$$

1. (4 points) You are now going to use this calorimeter to determine the heat of combustion for a hydrocarbon. If you burn a 3.64 gram sample of the hydrocarbon in the calorimeter without any water present the calorimeter increases in temperature from 21.5oC to 46.2oC. What is the heat of the reaction(q)? (Be sure to use correct sign conventions.)

qlost = qgained

qlost reaction = qgained calorimeter

$$q\_{reaction}=\left(C\right)\left(24.7℃\right)=\left(\frac{786 J}{℃}\right)\left(24.7℃\right)=19400 J or 19.4 kJ$$

The reaction releases 19.4 kJ of energy so the q = −19.4 kJ

1. (6 points) Calculate the ΔHrxn for the reaction:

CaO(s) + CO2(g) 🡪 CaCO3(s)

Given

Ca(s) + CO2(g) + ½ O2(g) 🡪 CaCO3(s) ΔH= −812.8 kJ

2Ca(s) + O2(g) 🡪 2 CaO(s) ΔH = −1269.8 kJ

CaO(s) 🡪 Ca(s) + ½ O2(g) ΔH = +1269.8 kJ/2 = +634.9 kJ

Ca(s) + CO2(g) + ½ O2(g) 🡪 CaCO3(s) ΔH= −812.8 kJ

CaO(s) + CO2(g) 🡪 CaCO3(s) ΔH = −177.9 kJ

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Quiz 6B (20 points) October 9, 2013

Specific heat water = 4.184 J/g oC

1. (4 points) A system absorbs 381 kJ of heat and the system does 599 kJ of work on the surroundings. What is the change in internal energy of the system?

Energy = heat + work

 = (+381 kJ) + (− 599 kJ)

 = − 218 kJ

1. (6 points) You need to calibrate a calorimeter. To do this, you fill the calorimeter with 250.0 g of water at 18.5oC and add 247.7 g of water at 74.2oC. If the temperature of the calorimeter and its contents after mixing is 41.3oC, what is the heat capacity of the calorimeter?

qgained = qlost

qgained cold water + qgained calorimeter = qlost hot water

$$\left(250.0 g\right)\left(\frac{4.184 J}{g ℃}\right)\left(22.8℃\right)+\left(C\right)\left(22.8℃\right)=\left(247.7 g\right)\left(\frac{4.184 J}{g ℃}\right)\left(32.9℃\right)$$

$$23800 J+\left(C\right)\left(22.8℃\right)=34100 J$$

$$\left(C\right)\left(20.1℃\right)=10300 J$$

$$C=\frac{10300 J}{22.8℃}=\frac{452 J}{℃}$$

1. (4 points) You are now going to use this calorimeter to determine the heat of combustion for a hydrocarbon. If you burn a 3.64 gram sample of the hydrocarbon in the calorimeter without any water present the calorimeter increases in temperature from 21.5oC to 46.2oC. What is the heat of the reaction(q)? (Be sure to use correct sign conventions.)

qlost = qgained

qlost reaction = qgained calorimeter

$$q\_{reaction}=\left(C\right)\left(24.7℃\right)=\left(\frac{452 J}{℃}\right)\left(24.7℃\right)=11200 J or 11.2 kJ$$

The reaction releases 11.6 kJ of energy so the q = −11.2 kJ

1. (6 points) Calculate the ΔHrxn for the reaction:

CaO(s) + CO2(g) 🡪 CaCO3(s)

Given

Ca(s) + CO2(g) + ½ O2(g) 🡪 CaCO3(s) ΔH= −812.8 kJ

2Ca(s) + O2(g) 🡪 2 CaO(s) ΔH = −1269.8 kJ

CaO(s) 🡪 Ca(s) + ½ O2(g) ΔH = +1269.8 kJ/2 = +634.9 kJ

Ca(s) + CO2(g) + ½ O2(g) 🡪 CaCO3(s) ΔH= −812.8 kJ

CaO(s) + CO2(g) 🡪 CaCO3(s) ΔH = −177.9 kJ