Chemistry 141 Name Key

Dr. Cary Willard

Quiz 6A (20 points) October 15, 2012

1. (8 points) In a coffee cup calorimeter, 1.60 g of NH4NO3 is mixed with 75.0 g of water at an initial temperature of 25.00oC. After dissolution of the salt, the final temperature of the calorimeter contents is 23.34oC. Assuming the solution has a heat capacity of 4.184 J/goC and assuming no heat loss to the calorimeter, calculate the enthalpy change for the dissolution of NH4NO3 in units of J/mol.

Heat lost reaction = heat gained warming calorimeter

 $=\left(1.66℃\right)\left(\frac{4.184 J}{g ℃}\right)\left(76.6 g\right)=532 J$

$$∆H\_{dissolution}=\frac{-532 J}{1.60 g NH\_{4}NO\_{3}}×\frac{80.05 g NH\_{4}NO\_{3}}{1 mol NH\_{4}NO\_{3}}=\frac{-26600 J}{mol}or \frac{-26.6 kJ}{mol}$$

1. (8 points) Given the following data:

Ca(s) + 2 C(graphite) 🡪 CaC2(s) ΔH= −62.8 kJ

Ca(s) + ½ O2(g) 🡪 CaO(s) ΔH = −635.5 kJ

CaO(s) + H2O(l) 🡪 Ca(OH)2(aq) ΔH = −653.1 kJ

C2H2(g) + 5/2 O2(g) 🡪 2 CO2(g) + H2O(l) ΔH = −1300 kJ

C(graphite) + O2(g) 🡪 CO2(g) ΔH = −393.5 kJ

Calculate the ΔH for the reaction

CaC2(s) + 2 H2O(l) 🡪 Ca(OH)2(aq) + C2H2(g)

CaC2(s) 🡪 ~~Ca(s)~~ + ~~2 C(graphite)~~ ΔH= +62.8 kJ

~~CaO(s)~~ + H2O(l) 🡪 Ca(OH)2(aq) ΔH = −653.1 kJ

~~2 CO~~~~2~~~~(g)~~ + H2O(l) 🡪 C2H2(g) + ~~5/2 O~~~~2~~~~(g)~~ ΔH = +1300 kJ

~~Ca(s)~~ + ~~½ O~~~~2~~~~(g)~~ 🡪 ~~CaO(s)~~ ΔH = −635.5 kJ

~~2 C(graphite)~~ + ~~2 O~~~~2~~~~(g)~~ 🡪 ~~2 CO~~~~2~~~~(g)~~ ΔH = 2(−393.5 kJ) = −787.0

CaC2(s) + 2 H2O(l) 🡪 Ca(OH)2(aq) + C2H2(g) ΔH = −713 kJ

1. (4 points) The enthalpy change for the oxidation of naphthalene, C10H8, is measured by calorimetry.

C10H8(s) + 12 O2(g) 🡪 10 CO2(g) + 4 H2O(l) ΔHrxn= −5156 kJ

How many grams of naphthalene are required to heat 500.0 g of water from 25.0oC to boiling?

$$?kJ to warm water=\left(75.0℃\right)\left(\frac{4.184 J}{g ℃}\right)\left(500.0 g\right)\left(\frac{1 kJ}{1000J}\right)=157 kJ$$

$$?g C\_{10}H\_{8}=157 kJ×\frac{1 mol C\_{10}H\_{8}}{5156 kJ}×\frac{128.2 g C\_{10}H\_{8}}{1 mol C\_{10}H\_{8}}=3.90 g$$

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Quiz 6B (20 points) October 15, 2012

1. (8 points) In a coffee cup calorimeter, 1.60 g of NH4NO3 is mixed with 95.0 g of water at an initial temperature of 25.00oC. After dissolution of the salt, the final temperature of the calorimeter contents is 22.34oC. Assuming the solution has a heat capacity of 4.184 J/goC and assuming no heat loss to the calorimeter, calculate the enthalpy change for the dissolution of NH4NO3 in units of J/mol.

Heat lost reaction = heat gained warming calorimeter

 $=\left(2.66℃\right)\left(\frac{4.184 J}{g ℃}\right)\left(96.6 g\right)=1075 J$

$$∆H\_{dissolution}=\frac{-1075 J}{1.60 g NH\_{4}NO\_{3}}×\frac{80.05 g NH\_{4}NO\_{3}}{1 mol NH\_{4}NO\_{3}}=\frac{-53800 J}{mol}=\frac{-53.8 kJ}{mol}$$

1. (8 points) Given the following data:

Ca(s) + 2 C(graphite) 🡪 CaC2(s) ΔH= −62.8 kJ

Ca(s) + ½ O2(g) 🡪 CaO(s) ΔH = −635.5 kJ

CaO(s) + H2O(l) 🡪 Ca(OH)2(aq) ΔH = −653.1 kJ

C2H2(g) + 5/2 O2(g) 🡪 2 CO2(g) + H2O(l) ΔH = −1300 kJ

C(graphite) + O2(g) 🡪 CO2(g) ΔH = −393.5 kJ

Calculate the ΔH for the reaction

CaC2(s) + 2 H2O(l) 🡪 Ca(OH)2(aq) + C2H2(g)

CaC2(s) 🡪 ~~Ca(s)~~ + ~~2 C(graphite)~~ ΔH= +62.8 kJ

~~CaO(s)~~ + H2O(l) 🡪 Ca(OH)2(aq) ΔH = −653.1 kJ

~~2 CO~~~~2~~~~(g)~~ + H2O(l) 🡪 C2H2(g) + ~~5/2 O~~~~2~~~~(g)~~ ΔH = +1300 kJ

~~Ca(s)~~ + ~~½ O~~~~2~~~~(g)~~ 🡪 ~~CaO(s)~~ ΔH = −635.5 kJ

~~2 C(graphite)~~ + ~~2 O~~~~2~~~~(g)~~ 🡪 ~~2 CO~~~~2~~~~(g)~~ ΔH = 2(−393.5 kJ) = −787.0

CaC2(s) + 2 H2O(l) 🡪 Ca(OH)2(aq) + C2H2(g) ΔH = −713 kJ

1. (4 points) The enthalpy change for the oxidation of naphthalene, C10H8, is measured by calorimetry.

C10H8(s) + 12 O2(g) 🡪 10 CO2(g) + 4 H2O(l) ΔHrxn= −5156 kJ

How many grams of naphthalene are required to heat 800.0 g of water from 25.0oC to boiling?

$$?kJ to warm water=\left(75.0℃\right)\left(\frac{4.184 J}{g ℃}\right)\left(800.0 g\right)\left(\frac{1 kJ}{1000J}\right)=251 kJ$$

$$?g C\_{10}H\_{8}=251 kJ×\frac{1 mol C\_{10}H\_{8}}{5156 kJ}×\frac{128.2 g C\_{10}H\_{8}}{1 mol C\_{10}H\_{8}}=6.24 g$$