Chemistry 141 Name

Dr Cary Willard

Quiz 7a (20 points) March 15, 2012

1. (10 points) Under nonstandard conditions, oxidation of SO2 to form SO3 in oxygen gas absorbs 89.7 kJ/mol. The heat of formation of SO3 under these same conditions is -204.1 kJ/mol.
	1. Write an equation to show the oxidation of SO2 gas to SO3 gas including the correct ΔHrxn for the equation as written.

SO2(g) + ½ O2(g) 🡪 SO3(g) ΔH=+89.7 kJ

Or

2 SO2(g) + O2(g) 🡪 2 SO3(g) ΔH=+179.4 kJ

* 1. Calculate the heat of formation of SO2 under these conditions.

For equation #1

$$∆H\_{rxn}=∆H\_{f}^{o}\left(SO\_{3},g\right)-\left(∆H\_{f}^{o}\left(SO\_{2},g\right)+\frac{1}{2}\left(∆H\_{f}^{o}\left(O\_{2},g\right)\right)\right)$$

$$89.7 kJ=-204.1 kJ- \left(∆H\_{f}^{o}\left(SO\_{2},g\right)+0 kJ\right)$$

$$∆H\_{f}^{o}\left(SO\_{2},g\right)=-204.1 kJ-89.7 kJ=-293.8 kJ$$

For equation #2

$$∆H\_{rxn}=2\left(∆H\_{f}^{o}\left(SO\_{3},g\right)\right)-\left(2\left(∆H\_{f}^{o}\left(SO\_{2},g\right)\right)+\left(∆H\_{f}^{o}\left(O\_{2},g\right)\right)\right)$$

$$179.4 kJ=2\left(-204.1 kJ\right)- \left(2\left(∆H\_{f}^{o}\left(SO\_{2},g\right)\right)+0 kJ\right)$$

$$179.4 kJ=\left(-408.2 kJ\right)- 2\left(∆H\_{f}^{o}\left(SO\_{2},g\right)\right)$$

$$2\left(∆H\_{f}^{o}\left(SO\_{2},g\right)\right)=-408.2 kJ-179.4 kJ=-587.6 kJ$$

$$∆H\_{f}^{o}\left(SO\_{2},g\right)=\frac{-587.6 kJ}{2}=-293.8 kJ$$

1. (10 points) Calculate the ΔHrxn for the combustion of 1-pentene (C5H10) using bond energies from the back of your periodic chart.
	1. Write the balanced chemical reaction for the combustion of 1-pentene.

2 C5H10 + 15 O2 🡪 10 CO2 + 10 H2O

* 1. Calculate the heat of reaction for 1-pentene per mole. Useful Lewis electron dot structures are shown below:



Bonds broken

20 C−H 20 (+414 kJ) = + 8280 kJ

2 C=C 2 (+ 611 kJ) = + 1222 kJ

6 C−C 6 (+347 kJ) = + 2082 kJ

15 O=O 15(+498 kJ) = + 7470 kJ

Total + 19,054 kJ

Bonds formed

20 C=O 20 (−741 kJ) = −14,820 kJ

20 O−H 20 (−464 kJ) = − 9,280 kJ

Total −24,100 kJ

ΔHrxn = −5046 kJ (per 2 mol 1 pentene)

ΔHrxn = −2523 kJ/mol 1-pentene



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Quiz 7b (20 points) March 15, 2012

1. (10 points) Under nonstandard conditions, oxidation of SO2 to form SO3 in oxygen gas absorbs 96.8 kJ/mol. The heat of formation of SO3 under these same conditions is -218.1 kJ/mol.
	1. Write an equation to show the oxidation of SO2 gas to SO3 gas including the correct ΔHrxn for the equation as written.

SO2(g) + ½ O2(g) 🡪 SO3(g) ΔH=+96.8 kJ

Or

2 SO2(g) + O2(g) 🡪 2 SO3(g) ΔH=+193.6 kJ

* 1. Calculate the heat of formation of SO2 under these conditions.

For equation #1

$$∆H\_{rxn}=∆H\_{f}^{o}\left(SO\_{3},g\right)-\left(∆H\_{f}^{o}\left(SO\_{2},g\right)+\frac{1}{2}\left(∆H\_{f}^{o}\left(O\_{2},g\right)\right)\right)$$

$$96.8 kJ=-218.1 kJ- \left(∆H\_{f}^{o}\left(SO\_{2},g\right)+0 kJ\right)$$

$$∆H\_{f}^{o}\left(SO\_{2},g\right)=-218.1 kJ-96.8 kJ=-314.9 kJ$$

For equation #2

$$∆H\_{rxn}=2\left(∆H\_{f}^{o}\left(SO\_{3},g\right)\right)-\left(2\left(∆H\_{f}^{o}\left(SO\_{2},g\right)\right)+\left(∆H\_{f}^{o}\left(O\_{2},g\right)\right)\right)$$

$$193.6 kJ=2\left(-218.1 kJ\right)- \left(2\left(∆H\_{f}^{o}\left(SO\_{2},g\right)\right)+0 kJ\right)$$

$$193.6 kJ=\left(-436.2 kJ\right)- 2\left(∆H\_{f}^{o}\left(SO\_{2},g\right)\right)$$

$$2\left(∆H\_{f}^{o}\left(SO\_{2},g\right)\right)=-436.2 kJ-193.6 kJ=-629.8 kJ$$

$$∆H\_{f}^{o}\left(SO\_{2},g\right)=\frac{-629.8 kJ}{2}=-314.9 kJ$$

1. (10 points) Calculate the ΔHrxn for the combustion of cyclohexene (C6H10) using bond energies from the back of your periodic chart.
	1. Write the balanced chemical reaction for the combustion of 1-pentene.

2 C6H10 + 17 O2 🡪 12 CO2 + 10 H2O

* 1. Calculate the heat of reaction for 1-pentene per mole. Useful Lewis electron dot structures are shown below:



Bonds broken

20 C−H 20 (+414 kJ) = + 8280 kJ

2 C=C 2 (+ 611 kJ) = + 1222 kJ

10 C−C 10 (+347 kJ) = + 3470 kJ

17 O=O 17(+498 kJ) = + 8466 kJ

Total + 21,438 kJ

Bonds formed

24 C=O 24 (−741 kJ) = −17,784 kJ

20 O−H 20 (−464 kJ) = − 9,280 kJ

Total −27,064 kJ

ΔHrxn = −5626 kJ (per 2 mol cyclohexene)

ΔHrxn = −2813 kJ/mol cyclohexene

