CHM151 Quiz 6 25 Pts Spring 2008 Name: Key

SHOW WORK TO RECEIVE CREDIT

1. Calculate the enthalpy change for the reaction:

$2C_8H_{18}(l) + 17O_2(g) \rightarrow 16CO(g) + 18H_2O(l)$ $\Delta H°_{rxn} = ?$

Given:

① $2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(l)$ $\Delta H°_{rxn} = -11{,}020$ kJ.

② $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$ $\Delta H°_f = -566.0$ kJ.

Goal: ΔH kJ

$2C_8H_{18}$: Eq. 1 as is: $2C_8H_{18}(l) + \overset{17}{\cancel{25}}O_2(g) \rightarrow \cancel{16CO_2(g)} + 18H_2O(l)$ −11,020

O_2: skip, found in more than one equation.

CO: Eq. 2, reverse x 2: $\cancel{16CO_2(g)} \rightarrow 16CO(g) + \cancel{8O_2(g)}$ 8(+566.0)

H_2O: Already used both Equations

$2C_8H_{18}(l) + 17O_2(g) \rightarrow 16CO(g) + 18H_2O(l)$ $\Delta H = -6492$ kJ

2. How much heat is given off to the surroundings when 9.0 g of aluminum reacts according to the equation? (molar mass of Al = 26.98)

$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$ $\Delta H°_{rxn} = -849$ kJ — wording makes heat signless

9.0g

$\frac{9.0\,\cancel{g\,Al}}{} \cdot \frac{\cancel{mol}}{26.98\,\cancel{g}} \cdot \frac{849\text{ kJ}}{2\,\cancel{mol\,Al}} = 142\text{ kJ}$

3. At 25°C, the following heats of reaction are known:

① $2ClF(g) + O_2(g) \rightarrow Cl_2O(g) + F_2O(g)$ $\Delta H°_{rxn} = 167.4$ kJ/mol

② $2ClF_3(g) + 2O_2(g) \rightarrow Cl_2O(g) + 3F_2O(g)$ $\Delta H°_{rxn} = 341.4$ kJ/mol

③ $2F_2(g) + O_2(g) \rightarrow 2F_2O(g)$ $\Delta H°_{rxn} = -43.4$ kJ/mol

At the same temperature, use Hess's law to calculate $\Delta H°_{rxn}$ for the reaction:

$ClF(g) + F_2(g) \rightarrow ClF_3(g)$ $\Delta H°_{rxn} =$ ______ kJ/mol.

Goal: ΔH kJ

ClF(g): Eq ① ÷ 2 $ClF(g) + \cancel{\tfrac{1}{2}O_2(g)} \rightarrow \cancel{\tfrac{1}{2}Cl_2O} + \cancel{\tfrac{1}{2}F_2O(g)}$ $\frac{167.4}{2}$

$F_2(g)$: Eq ③ ÷ 2 $F_2(g) + \cancel{\tfrac{1}{2}O_2(g)} \rightarrow \cancel{F_2O(g)}$ $\frac{-43.4}{2}$

$ClF_3(g)$: reverse Eq 2 and ÷ 2 $\cancel{\tfrac{1}{2}Cl_2O(g)} + \cancel{\tfrac{3}{2}F_2O(g)} \rightarrow ClF_3(g) + \cancel{O_2(g)}$ $-\frac{341.4}{2}$

$ClF(g) + F_2(g) \rightarrow ClF_3(g)$ $-108.7\ \frac{\text{kJ}}{\text{mol}}$

Over

Key 4. How many degrees of temperature rise will occur when a 25.0 g block of aluminum absorbs 10 kJ of heat? The specific heat of Al is 0.900 J/g•°C.

$$\frac{g\cdot°C}{0.900\,\cancel{J}} \left| \frac{}{25.0\,g} \right| \frac{10\times10^3\,\cancel{J}}{} = 444\ °C$$

400 °C

5. Octane (C_8H_{18}) undergoes combustion according to the following thermochemical equation:

$2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(l) \qquad \Delta H°_{rxn} = -11{,}020\ kJ.$

Given that: $\Delta H°_f[CO_2(g)] = -393.5\ kJ/mol$

$\Delta H°_f[H_2O(l)] = -285.8\ kJ/mol$

Calculate the enthalpy of formation of 1 mole of octane.

$\Delta H_{RXN} = \sum \Delta H_{products} - \sum \Delta H_{reactants}$ ⊖ value

$16CO_2 + 18H_2O \qquad 2C_8H_{18} + 25O_2$

$-11020 = \Delta H_{RXN} = [16(-393.5) + 18(-285.8)] - [2(x) + 25(0)] = -11{,}020$

$x = -210.2\ kJ = \Delta H_f^\circ\ C_8H_{18}(l)$

6. Copper metal has a specific heat of 0.385 J/g•°C. Calculate the amount of heat required to raise the temperature of 22.8 g of Cu from 20.0°C to 875°C.

$$\frac{0.385\,J}{g\cdot°C} \left| \frac{22.8\,\cancel{g}}{} \right| \frac{875-20.0\,°C}{} = 7505\ J$$

7510 J