Name: Key Date: _____ Period: _____

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Chemical Quantities in Reactions

(CHEMACTIVITY: Mass-Energy Problems)

How is the concept of the mole used to quantify chemical reactions?

1. Define **heat of reaction:** (A.K.A. enthalpy)

Heat released or adsorbed during a chemical reaction

2. How do the terms endothermic and exothermic relate to mass energy problems?

endothermic — heat is adsorbed

exothermic — heat is released

3. The following chemical reaction is stated as having a ΔH of +572kJ, what does this mean?

$$572\text{kJ} \quad 2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

572 kJ are adsorbed for 2 moles of H_2O to decompose

- What "heat conversion factors" can be made with this information?

$\frac{572\text{kJ}}{2\text{mol}\,H_2O}$ $\frac{572\text{kJ}}{2\text{mol}\,H_2}$ $\frac{572\text{kJ}}{1\text{mol}\,O_2}$ (3 more as reciprocals)

- Suppose we wanted to calculate the energy needed to decompose 9.00g of H_2O...

$$\frac{9.00\text{g}\,H_2O}{} \left| \frac{\text{mol}}{18.02\text{g}} \right| \frac{572\text{kJ}}{2\text{mol}\,H_2O} = \text{kJ to make } H_2O$$

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4. The heat of reaction for the formation of ammonia (NH_3) from nitrogen and hydrogen gases is $\Delta H = -92.7kJ$. How much heat, in kJ, is involved when 50.0g of ammonia forms? Is the heat released or absorbed?

$N_2 + 3H_2 \rightarrow 2NH_3 + 92.7kJ$

$$\frac{50.0g\ NH_3}{17.04g} \Big/ \frac{mol}{2mol\ NH_3} \Big/ \frac{92.7kJ}{} = \boxed{136kJ \text{ released in making } NH_3}$$

5. Mercury (II) oxide decomposes into liquid mercury and oxygen gas, with a $\Delta H = 182kJ$. How many kJ are needed if 25.0g of mercury (II) oxide reacts?

$+182kJ + 2HgO \rightarrow 2Hg + O_2$

$$\frac{25.0g\ HgO}{216.59g} \Big/ \frac{mol}{2mol} \Big/ \frac{182kJ}{} = \boxed{10.5kJ \text{ to react } HgO}$$

6. Methanol (CH_3OH) undergoes combustion with a $\Delta H = -726kJ$. How many kJ are released when 75.0g of methanol is burned with excess oxygen gas?

$2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O + 726kJ$

$$\frac{75.0g\ CH_3OH}{32.05g} \Big/ \frac{mol}{2mol\ CH_3OH} \Big/ \frac{726kJ}{} = \boxed{849kJ \text{ to burn } CH_3OH}$$

7. Hydrogen peroxide decomposes into water and oxygen gas, according to the *unbalanced* equation:

$2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g) + 196kJ$

Beyond Question

- If 2.00g of H_2O_2 releases 5.76kJ of energy, what is the heat of reaction?

need kJ/mol then x2

$$\frac{5.76kJ}{2.00g} \Big/ \frac{34.02g}{mol\ H_2O_2} \Big/ \frac{2mol\ H_2O_2}{Reaction} = \boxed{196kJ \text{ "Heat of Reaction" "Balanced"}}$$

- How many kJ are released if 275g of hydrogen peroxide decomposes?

$$\frac{275g\ H_2O_2}{34.02g} \Big/ \frac{mol}{2mol} \Big/ \frac{196kJ}{} = \boxed{792kJ}$$

Essential Content and Skills:

How do we use heat of reaction to calculate the energy absorbed or released during chemical reactions?