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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)

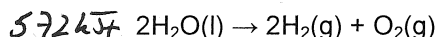
Heat released or absorbed during a chemical reaction

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

endothermic - heat is absorbed

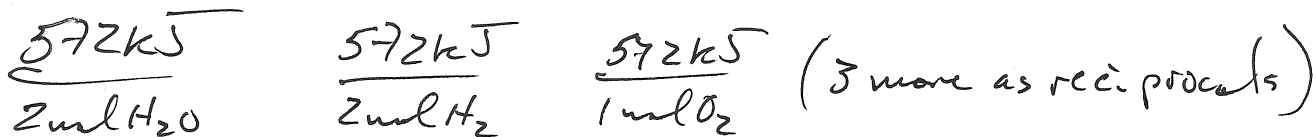
exothermic - heat is released

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



572 kJ are absorbed for 2 moles of H_2O to decompose

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

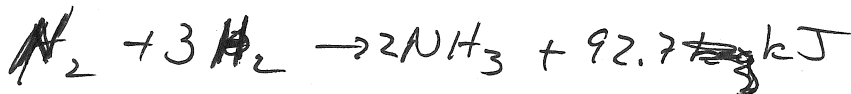


- Suppose we wanted to calculate the energy needed to decompose 9.00g of H_2O ...

$$\frac{9.00\text{g H}_2\text{O}}{18.02\text{g}} \times \frac{572\text{kJ}}{2\text{mol H}_2\text{O}} = \frac{143\text{kJ}}{143}$$

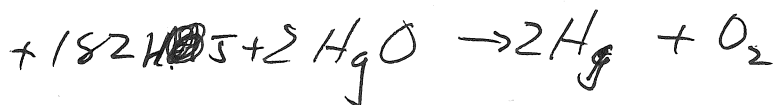
143 kJ to make H_2O

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



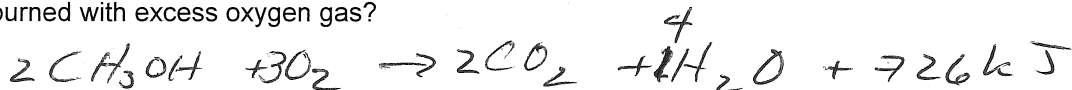
$$\frac{50.0 \text{ g NH}_3 / \text{mol}}{17.04 \text{ g}} \times \frac{92.7 \text{ kJ}}{2 \text{ mol NH}_3} = \boxed{136 \text{ kJ released in making NH}_3}$$

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



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

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



$$\frac{75.0 \text{ g CH}_3\text{OH} / \text{mol}}{32.05 \text{ g}} \times \frac{726 \text{ kJ}}{2 \text{ mol CH}_3\text{OH}} = \boxed{849 \text{ kJ}} \text{ to burn CH}_3\text{OH}$$

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



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

$$\frac{5.76 \text{ kJ}}{2.00 \text{ g}} \times \frac{34.02 \text{ g}}{\text{mol H}_2\text{O}_2} \times \frac{2 \text{ mol H}_2\text{O}_2}{\text{Reaction}} = \boxed{196 \text{ kJ}} \text{ Heat of Reaction "Balanced" Reaction}$$

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

$$\frac{275 \text{ g H}_2\text{O}_2 / \text{mol}}{34.02 \text{ g}} \times \frac{196 \text{ kJ}}{2 \text{ mol}} = \boxed{792 \text{ kJ}}$$

Essential Content and Skills:

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

Beyond
Question
need
kJ/mol
then x 2