FW: 46.026   32.00   44.01   18.02

$$2HCHO_2(l) + O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(l)$$

If 50.3 kJ of heat was released when 5.48 g of formic acid are burned at constant pressure, then what is the enthalpy change of this reaction per mole of formic acid?

$$Q = -50.3\ kJ\ ;\ \Delta H = \frac{Q_{constant\ pressure}}{mol\ HCHO_2}$$

Find moles formic acid, then we can find enthalpy change PER MOLE

$$5.48\ g\ HCHO_2 \times \frac{mol\ HCHO_2}{46.026\ g\ HCHO_2} = 0.1190631382\ mol\ HCHO_2$$

$$\Delta H = \frac{Q_{constant\ pressure}}{mol\ HCHO_2} = \frac{-50.3\ kJ}{0.1190631382\ mol\ HCHO_2} = -422\ \frac{kJ}{mol\ HCHO_2}$$

Based on the calculation above, can we complete this thermochemical equation?

$$2HCHO_2(l) + O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(l)\ ;\ \Delta H = \underline{-844}\ kJ$$

We calculated the enthalpy change PER MOLE of formic acid (standard for a calorimetry experiment), but to use that enthalpy in this thermochemical equation, we've got to multiply it by TWO ... since this equation is written based on TWO moles of formic acid!

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)\ ;\ \Delta H = -906\ kJ$$

What is the enthalpy change when 150. L of nitrogen monoxide are formed by this reaction at 25.0 C and 1.50 atm pressure?

1 - Convert 150. L NO to moles. Use IDEAL GAS EQUATION
2 - Convert moles NO to enthalpy change using THERMOCHEMICAL EQUATION

$$PV = nRT \qquad n = \frac{PV}{RT}$$

$$P = 1.50\ atm \qquad V = 150.\ L$$

$$R = 0.08206\ \frac{L \cdot atm}{mol \cdot K} \qquad T = 25.0^\circ C = 298.2\ K$$

① $$n_{NO} = \frac{(1.50\ atm)(150.\ L)}{\left(0.08206\ \frac{L \cdot atm}{mol \cdot K}\right)(298.2\ K)} = 9.19482849\ mol\ NO$$

$$4\ mol\ NO = -906\ kJ$$

$$9.19482849\ mol\ NO \times \frac{-906\ kJ}{4\ mol\ NO} = \boxed{-2080\ kJ}$$

34.086g/mol

Heat of formation / enthalpy of formation!

$$\underset{-20.50}{2H_2S(g)} + \underset{0}{3O_2(g)} \rightarrow \underset{-285.8}{2H_2O(l)} + \underset{-296.8}{2SO_2(g)}$$

] ΔH_f^o, kJ/mol (Appendix C)

What is the enthalpy change at standard conditions when 25.0 grams of hydrogen sulfide gas is reacted?

1 - Calculate the enthalpy change for the reaction AS WRITTEN with HESS'S LAW
2 - Convert 25.0 grams hydrogen sulfide to moles using FORMULA WEIGHT.
3 - Convert moles hydrogen sulfide to enthalpy change using THERMOCHEMICAL EQUATION.

$$\Delta H = \sum \Delta H_f^o\text{, products} - \sum \Delta H_f^o\text{, reactants}$$

$$= [2(-285.8) + 2(-296.8)] - [2(-20.50) + 3(0)]$$

$$= -1124.2 \text{ kJ} \quad (1)$$

So the THERMOCHEMICAL EQUATION is ...

$$2H_2S(g) + 3O_2(g) \rightarrow 2H_2O(l) + 2SO_2(g); \Delta H = -1124.2 \text{ kJ}$$

34.086 g H_2S = mol H_2S	2 mol H_2S = −1124.2 kJ

$$25.0 \text{ g } H_2S \times \frac{\text{mol } H_2S}{34.086 \text{ g } H_2S} \times \frac{-1124.2 \text{ kJ}}{2 \text{ mol } H_2S} = \boxed{-412 \text{ kJ}}$$

(2) (3)

propane

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g) ; \Delta H = -2043 \text{ kJ}$$

Calculate the volume of propane gas at 25.0 C and 1.08 atm required to provide 565 kJ of heat using the reaction above.

1 - Convert the energy requirement to moles propane using THERMOCHEMICAL EQUATION
2 - Convert moles propane to volume using IDEAL GAS EQUATION

$$\text{mol } C_3H_8 = -2043 \text{ kJ}$$

Snce the reaction is the SYSTEM here, the energy requirement has a NEGATIVE sign (it's LOSING, or providing) the energy...

$$-565 \text{ kJ} \times \frac{\text{mol } C_3H_8}{-2043 \text{ kJ}} = 0.2765540871 \text{ mol } C_3H_8$$

$$PV = nRT$$

$$V = \frac{nRT}{P}$$

$P = 1.08$ atm, $R = 0.08206 \frac{\text{L-atm}}{\text{mol}\cdot\text{K}}$

$T = 25.0\,^\circ\text{C} = 298.2$ K

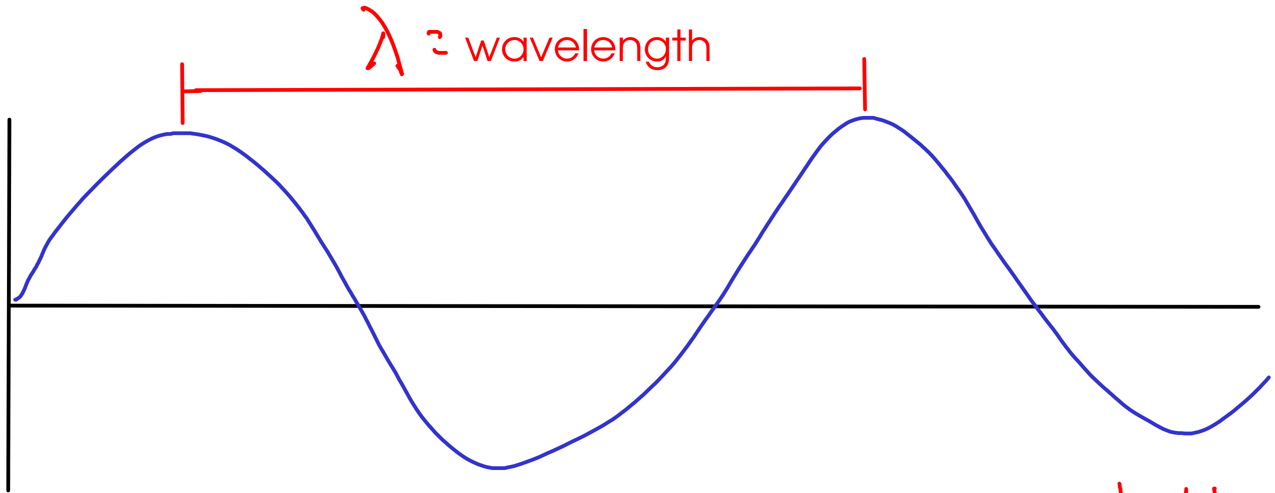
$n = 0.2765540871$ mol C_3H_8

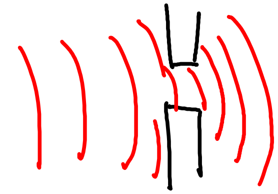
$$V = \frac{(0.2765540871 \text{ mol } C_3H_8)\left(0.08206 \frac{\text{L-atm}}{\text{mol}\cdot\text{K}}\right)(298.2 \text{ K})}{(1.08 \text{ atm})}$$

$$= 6.27 \text{ L } C_3H_8 \text{ @ } 25.0\,^\circ\text{C}, 1.08 \text{ atm}$$

END OF CHAPTER 6

LIGHT





Diffraction

frequency = wavelengths / time = ν s^{-1} : Hertz, Hz

- Light has properties of WAVES such as DIFFRACTION (it bends around small obstructions).

- Einstein noted that viewing light as a particle that carried an energy proportional to the FREQUENCY could explain the PHOTOELECTRIC EFFECT!

$$E_{photon} = h\nu$$

h: Planck's constant: 6.63×10^{-34} J·s

photon = particle or packet of light