

Solution for Worksheet Ch#5, 6

1. Exothermic RXN:



2. CO_2

2 g

$$n_{CO_2} = \frac{m}{MM} = \frac{2g}{44} = 0.0455 \text{ mol}$$

F.C.

5.09 g

$$PV = nRT$$

$$V_{CO_2} = \frac{nRT}{P}$$

$$; \quad V_{F.C.} = \frac{nRT}{P}$$

Since both volumes are equal

$$\frac{n_{CO_2} RT}{P} = \frac{n_{F.C.} RT}{P}$$

$$n_{CO_2} = n_{F.C.}$$

$$0.0455 = \frac{m_{F.C.}}{MM_{F.C.}} = \frac{5.09}{MM_{F.C.}}$$

$$MM_{F.C.} = 111.98 \approx 112 \text{ g/mol}$$





$$T = 24 + 273 = 297 \text{ K}$$

$$P_{\text{atm}} = P_{\text{H}_2} + P_{\text{H}_2\text{O}}$$

$$P_{\text{H}_2} = P_{\text{atm}} - P_{\text{H}_2\text{O}}$$

$$= 738 - 22.38 = 715.6 \text{ torr} \times \frac{1 \text{ atm}}{760 \text{ torr}}$$

$$P_{\text{H}_2} = 0.942 \text{ atm}$$

$$PV = nRT$$

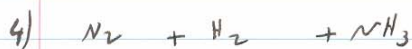
$$n_{\text{H}_2} = \frac{PV}{RT} = \frac{(0.942 \text{ atm})(0.159 \text{ L})}{(0.0821)(297 \text{ K})}$$

$$= 6.14 \times 10^{-3} \text{ mol H}_2 = \text{mol Zn} \quad (1:1 \text{ ratio})$$

$$n_{\text{Zn}} = \frac{m}{MM} \quad ; \quad m_{\text{Zn}} = n_{\text{Zn}} \cdot MM$$

$$= (6.14 \times 10^{-3} \text{ mol})(65.38 \text{ g/mol})$$

$$= 0.401 \text{ g Zn}$$



$$5.1 \text{ g} \quad 2.83 \text{ g} \quad 5.17 \text{ g}$$

$$\downarrow \quad \downarrow \quad \downarrow$$

$$n = 0.182 \text{ mol} \quad n = 1.415 \text{ mol} \quad n = 0.304 \text{ mol}$$

$$X_{\text{N}_2} = \frac{n_{\text{N}_2}}{n_{\text{total}}} = \frac{0.182 \text{ mol}}{0.182 + 1.415 + 0.304} = 0.096$$

$$P_{\text{N}_2} = X_{\text{N}_2} \cdot P_{\text{total}}$$

$$= (0.096)(2.35 \text{ atm}) = 0.226 \text{ atm}$$

$$5) \frac{\text{Rate H}_2}{\text{Rate X}} = \left(\frac{MM_X}{MM_{H_2}} \right)^{1/2}$$

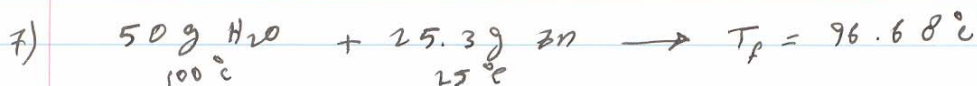
$$\frac{9.9}{0.55} = \left(\frac{MM_X}{2 \text{ amu}} \right)^{1/2}$$

$$MM_X = (115)^2 (2.02) = 232 \text{ amu}$$

$$6) KE = \frac{3}{2} RT$$

$$25 < T_1 \Rightarrow KE \uparrow$$

$$\boxed{a} \quad E_3 > E_1 > E_2$$



$$q_{\text{gain}} = -q_{\text{lost}}$$

$$S_{Zn} m_{Zn} \Delta T = -S_{H_2O} m_{H_2O} \Delta T$$

$$S_{Zn} (25.3 \text{ g}) (96.68 - 25) = - (4.18 \text{ J/g}\cdot^\circ\text{C}) (50 \text{ g}) (96.68 - 100)$$

$$S_{Zn} = 0.383 \text{ J/g}\cdot^\circ\text{C}$$



$$\begin{array}{ccc} 108 & & 209 \\ \downarrow & & \downarrow \\ 0.588 \text{ mol} & & 0.625 \text{ mol (limiting)} \end{array}$$

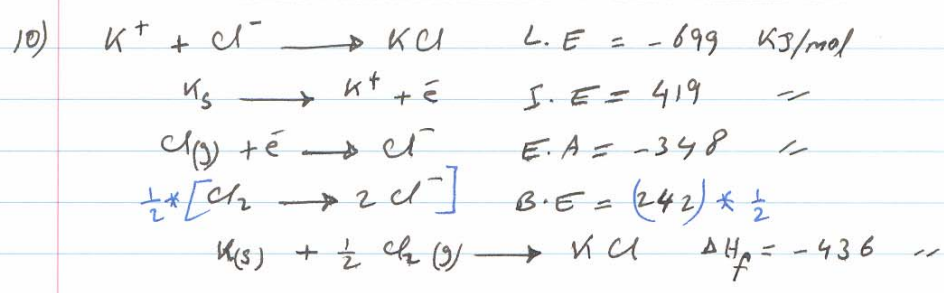
$$0.588 \text{ mol NH}_3 \times \frac{5 \text{ mol O}_2}{4 \text{ mol NH}_3} = 0.735 \text{ mol O}_2$$

$$\text{So, } 0.625 \text{ mol O}_2 \times \frac{-906 \text{ kJ}}{5 \text{ mol O}_2} = -113.25 \text{ kJ}$$

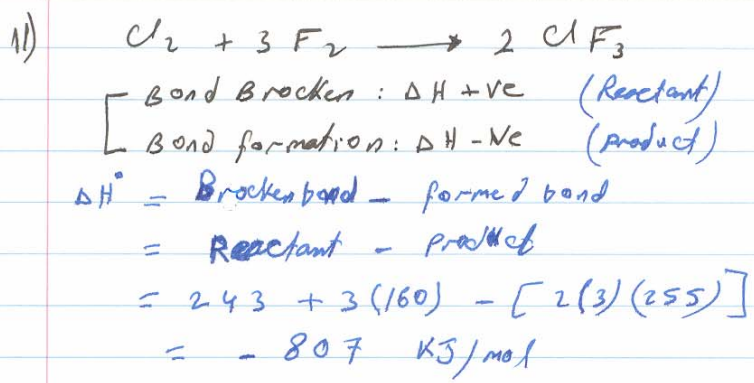
113.25 kJ is released

$$\begin{aligned}
 9) \quad \Delta E &= q + w \\
 &= +250\text{ J} - P\Delta V \\
 &= 250 - 460.92 \\
 &= -210.92\text{ J} \\
 &\approx -211\text{ J}
 \end{aligned}$$

$$\begin{aligned}
 w &= -P\Delta V \\
 &= -(0.5\text{ atm})(10.1\text{ L} - 1\text{ L}) \\
 &= -4.55\text{ atm}\cdot\text{L} \times \frac{101.3\text{ J}}{1\text{ L}\cdot\text{atm}} \\
 &= -460.92\text{ J}
 \end{aligned}$$

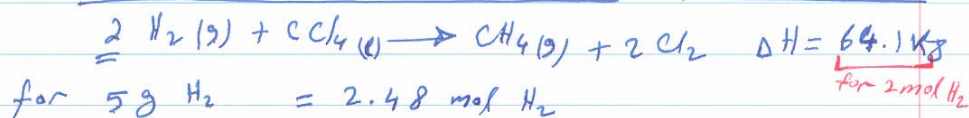
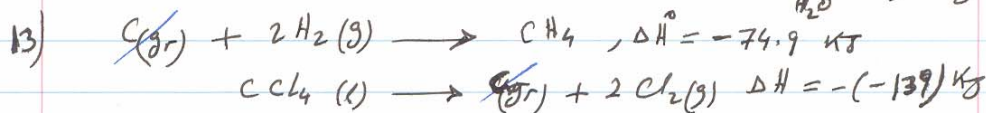


$$\begin{aligned}
 \Delta H_f &= \Sigma \Delta H \text{ (all E)} \\
 &= \text{L.E} + \text{I.E} + \text{E.A} + \text{B.E} + \Delta H_{\text{sub}} \\
 \Delta H_{\text{sub}} &= \Delta H_f - \text{L.E} - \text{I.E} - \text{E.A} - \text{B.E} \\
 &= -436 - (-699) - 419 - (-348) - \frac{1}{2}(242) \\
 &= 71 \text{ KJ/mol}
 \end{aligned}$$

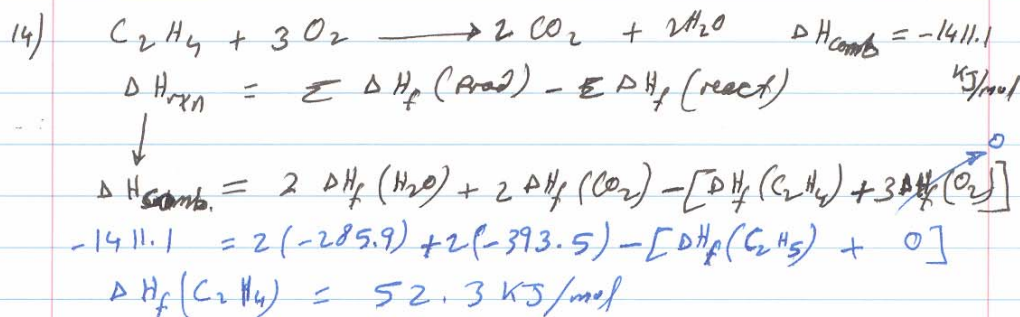


$$\begin{aligned}
 12) \quad q &= m \cdot s \cdot \Delta T \\
 &= (500 \text{ g})(4.18 \text{ J/g}\cdot\text{C})(100-25) \\
 &= +157 \text{ kJ}
 \end{aligned}$$

$$\begin{aligned}
 d &= \frac{m}{V} \Rightarrow m = d \cdot V \\
 &= \left(\frac{1 \text{ g}}{\text{mL}}\right) 500 \text{ mL} \\
 m_{\text{H}_2\text{O}} &= 500 \text{ g}
 \end{aligned}$$



$$2.48 \text{ mol H}_2 \times \frac{64.1 \text{ kJ}}{2 \text{ mol H}_2} = 79.4 \text{ kJ}$$



$$\begin{aligned}
 15) \quad PV &= nRT \\
 n_1 &= \frac{PV}{RT_1} = \frac{(1 \text{ atm})(0.25 \text{ L})}{(0.0821)(273 \text{ K})} = 0.0116 \text{ mol} \\
 n_2 &= \frac{PV}{RT_2} = \frac{(1 \text{ atm})(0.25 \text{ L})}{(0.0821)(373 \text{ K})} = 8.17 \times 10^{-3} \text{ mol}
 \end{aligned}$$

$$\% \text{ of the air} = \frac{8.17 \times 10^{-3}}{0.0116} = 73 \%$$

$$16) PV = nRT$$

$$P = \frac{m}{MM \cdot V} RT \quad (d = \frac{m}{V})$$

$$P = \frac{d}{MM} RT$$

$$\text{so, } d = \frac{P \cdot MM}{RT} = \frac{(1 \text{ atm})(29 \text{ g/mol})}{(0.0821)(293 \text{ K})} = 1.21 \text{ g/L}$$

$$17) P_{\text{total}} = P_{\text{H}_2} + P_{\text{H}_2\text{O}}$$

$$P_{\text{H}_2} = P_{\text{total}} - P_{\text{H}_2\text{O}}$$

$$= 758 - 23.76 = 734.24 \text{ mmHg} \times \left(\frac{1 \text{ atm}}{760 \text{ mmHg}} \right)$$

$$= 0.966 \text{ atm}$$

$$PV = nRT$$

$$n_{\text{H}_2} = \frac{P_{\text{H}_2} V}{RT} = \frac{(0.966 \text{ atm})(0.152 \text{ L})}{(0.0821 \frac{\text{atm} \cdot \text{L}}{\text{mol} \cdot \text{K}})(298 \text{ K})}$$

$$= 6.00 \times 10^{-3} \text{ mol H}_2$$

$$18) \frac{\text{Rate}_x}{\text{Rate}_{\text{C}_3\text{H}_8}} = \left(\frac{MM_{\text{C}_3\text{H}_8}}{MM_x} \right)^{1/2}$$

$$\frac{1.65}{1} = \left(\frac{44}{MM_x} \right)^{1/2}$$

$$\Rightarrow MM_x = 16 \text{ g/mol}$$

$$\Rightarrow \text{CH}_4 \quad (MM = 12 + 4 = 16)$$



$$20) \quad w = -P\Delta V$$

$$(PV = nRT)$$

$$= -nRT$$

$$= -1 (8.314 \text{ J/mol K})(298 \text{ K})$$

$$= -2478 \text{ J/mol}$$

for 1 mol

$$\Delta n = n_{\text{prod}} - n_{\text{react}} (\text{gases})$$

$$= 1 - 0 = 1$$

- for 50 g Mg = 2.057 mol Mg:

$$2.057 \text{ mol Mg} \times \frac{-2478 \text{ J}}{1 \text{ mol Mg}} = -5097 \text{ J}$$

$$= -5.1 \text{ kJ}$$