Solution for Worksheet Ch#5.6

1. Exothermic RXN :

4. $F(g) + \bar{e} \longrightarrow F^-(g)$ Electron Affinity (-ve) $\Rightarrow$ Exo

5. $Na^+(g) + F^-(g) \longrightarrow NaF(s)$ Enthalpy of formation ΔH_f (-ve) $\Rightarrow$ Exo

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2. CO_2 F.C.

2 g 5.09 g

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

$$PV = nRT$$

$$V_{CO_2} = \frac{nRT}{P} \quad ; \quad V_{F.C.} = \frac{nRT}{P}$$

since Both volumes are Equal

$$\frac{n_{CO_2} RT}{P} = \frac{n_{FC} RT}{P}$$

$$n_{CO_2} = n_{FC}$$

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

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

$\Rightarrow C_3F_4$ ($MM = 112\ g/mol$) [d]

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3) $Zn_{(s)} + H_2SO_{4(aq)} \rightarrow ZnSO_{4(aq)} + H_2(g)$

159 mL

$T = 24 + 273 = 297\ K$

$P_{atm} = P_{H_2} + P_{H_2O}$

$P_{H_2} = P_{atm} - P_{H_2O}$

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

$P_{H_2} = 0.942\ atm$

$PV = nRT$

$n_{H_2} = \frac{PV}{RT} = \frac{(0.942\ atm)(0.159L)}{(0.0821)(297\ K)}$

$= 6.14 \times 10^{-3}\ mol\ H_2 = mol\ Zn$ (1:1 ratio)

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

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

$= 0.401\ g\ Zn$

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4) $N_2 + H_2 + NH_3$

5.1 g 2.83 g 5.17 g

$n = 0.182\ mol$ $n = 1.415\ mol$ $n = 0.304\ mol$

$x_{N_2} = \frac{N_2}{n_{total}} = \frac{0.182\ mol}{0.182 + 1.415 + 0.304} = 0.096$

$P_{N_2} = x_{N_2} \cdot P_{total}$

$= (0.096)(2.35\ atm) = 0.226\ atm$

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

$\frac{5.9}{0.55} = \left(\frac{MM_X}{2\ amu}\right)^{1/2}$

$MM_X = (115)(2.02) = 232\ amu$

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

as $T \uparrow \Rightarrow KE \uparrow$

[a] $E_3 > E_1 > E_2$

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7) $50\ g\ H_2O$ ($100\ ^\circ C$) $+ 25.3\ g\ Zn$ ($25\ ^\circ C$) $\longrightarrow T_f = 96.68\ ^\circ C$

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

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

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

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

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8) $4\ NH_3(g) + 5\ O_2 \longrightarrow 4\ NO + 6\ H_2O \quad \Delta H = -906\ KJ$

10 g → 0.588 mol 20 g → 0.625 mol (limiting)

$0.588\ mol\ NH_3 * \frac{5\ mol\ O_2}{4\ mol\ NH_3} = 0.735\ mol\ O_2$

So, $0.625\ mol\ O_2 * \frac{-906\ KJ}{5\ mol\ O_2} = -113.25\ KJ$

113.25 KJ is released

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9) $\Delta E = q + w$

$= +250\,J - P\Delta V$

$= 250 - 460.92$

$= -210.92\,J$

$\simeq -211\,J$

$w = -P\Delta V$

$= -(0.5\,atm)(10.1\,L - 1\,L)$

$= -4.55\,atm\cdot L * \frac{101.3\,J}{1\,L\cdot atm}$

$= -460.92\,J$

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10) $K^+ + Cl^- \longrightarrow KCl$ $\quad L.E = -699\ KJ/mol$

$K_s \longrightarrow K^+ + \bar{e}$ $\quad I.E = 419$ "

$Cl_{(g)} + \bar{e} \longrightarrow Cl^-$ $\quad E.A = -348$ "

$\frac{1}{2} * [Cl_2 \longrightarrow 2\,Cl^-]$ $\quad B.E = (242) * \frac{1}{2}$

$K_{(s)} + \frac{1}{2}\,Cl_{2\,(g)} \longrightarrow KCl$ $\quad \Delta H_f = -436$ "

$\Delta H_f = \Sigma\ \Delta H\ (all\ E)$

$= L.E + I.E + E.A + B.E + \Delta H_{sub}$

$\Delta H_{sub} = \Delta H_f - L.E - I.E - E.A - B.E$

$= -436 - (-699) - 419 - (-348) - \frac{1}{2}(242)$

$= 71\ KJ/mol$

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11) $Cl_2 + 3\,F_2 \longrightarrow 2\,ClF_3$

[Bond Brocken : ΔH +ve (Reactant)

[Bond formation : ΔH -Ve (product)

ΔH° = Brocken bond − formed bond

= Reactant − product

$= 243 + 3(160) - [2(3)(255)]$

$= -807\ KJ/mol$

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12) $q = m \cdot s \Delta T$

$= (500\ g)(4.18\ J/g \cdot ^\circ C)(100-25)$

$= +157\ KJ$

$d = \frac{m}{V} \Rightarrow m = d \cdot V$

$= (1\ g/mL)\ 500\ mL$

$m_{H_2O} = 500\ g$

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13) $C(gr) + 2H_2(g) \longrightarrow CH_4, \quad \Delta H^\circ = -74.9\ KJ$

$CCl_4(l) \longrightarrow C(gr) + 2Cl_2(g) \quad \Delta H = -(-139)\ KJ$

$2H_2(g) + CCl_4(l) \longrightarrow CH_4(g) + 2Cl_2 \quad \Delta H = 64.1\ KJ$ (for 2 mol H_2)

for 5 g H_2 = 2.48 mol H_2

$2.48\ mol\ H_2 \times \frac{64.1\ KJ}{2\ mol\ H_2} = 79.4\ KJ$

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14) $C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O \quad \Delta H_{comb} = -1411.1\ KJ/mol$

$\Delta H_{rxn} = \sum \Delta H_f(Prod) - \sum \Delta H_f(react)$

$\Delta H_{comb.} = 2\Delta H_f(H_2O) + 2\Delta H_f(CO_2) - [\Delta H_f(C_2H_4) + 3\Delta H_f(O_2)]$ (O_2: 0)

$-1411.1 = 2(-285.9) + 2(-393.5) - [\Delta H_f(C_2H_4) + 0]$

$\Delta H_f(C_2H_4) = 52.3\ KJ/mol$

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15) $PV = nRT$

$n_1 = \frac{PV}{RT_1} = \frac{(1\ atm)(0.25L)}{(0.0821)(273K)} = 0.01116\ mol$

$n_2 = \frac{''}{T_2} = \frac{''}{(373K)} = 8.17 \times 10^{-3}\ mol$

% of the air $= \frac{8.17 \times 10^{-3}}{0.01116} = 73\ \%$

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16) $PV = nRT$

$P = \frac{\left(\frac{m}{MM \cdot V}\right)}{d} RT \qquad \left(d = \frac{m}{V}\right)$

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

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

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17) $P_{total} = P_{H_2} + P_{H_2O}$

$P_{H_2} = P_{total} - P_{H_2O}$

$= 758 - 23.76 = 734.24\ \cancel{mm\ Hg} * \left(\frac{1\ atm}{760\ \cancel{mm\ Hg}}\right)$

$= 0.966\ atm$

$PV = nRT$

$n_{H_2} = \frac{P_{H_2} V}{RT} = \frac{(0.966\ atm)(0.152\ L)}{\left(0.0821 \frac{atm \cdot L}{mol \cdot K}\right)(298\ K)}$

$= 6.00 \times 10^{-3}\ mol\ H_2$

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18) $\frac{Rate(x)}{Rate_{C_3H_8}} = \left(\frac{MM_{C_3H_8}}{MM_x}\right)^{1/2}$

$\frac{1.65}{1} = \left(\frac{44}{MM_x}\right)^{1/2} \Rightarrow MM_x = 16\ g/mol$

$\Rightarrow CH_4 \ (MM = 12 + 4 = 16)$

$$Mg_{(s)} + 2H^{+}_{(aq)} \rightarrow Mg^{2+}_{(aq)} + H_{2(g)}$$

20) $W = -P\Delta V$ $(PV = nRT)$

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

$= -1\,(8.314\ J/mol\,K)(298\ K)$ $= 1 - 0 = 1$

$= -2478\ J/mol$ for 1 mol

- for 50 g Mg $= 2.057$ mol Mg:

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

$= -5.1\ KJ$