Unit 6 Review for Midterms

① a) warmer

b) exo

c) $\frac{14.0\text{ g KOH}}{} \left| \frac{1\text{ mol}}{56.11\text{ g}} \right| \frac{43\text{ kJ}}{1\text{ mol}} = 10.7\text{ kJ}$

② a) $Ba(NO_3)_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2\,NaNO_3(aq)$

b) $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$

c) total volume = 2.00 L = 2000 mL = 2000 g (w/ 3 SF)

$\Delta T = 28.1°C - 25.0°C = 3.1°C$

$q = mc\Delta T$

$= (2000\text{ g})(4.18\text{ J/g°C})(3.1°C) = 26000\text{ J} = 26\text{ kJ}$

1.00 L of 1.00 M $Ba(NO_3)_2$ = 1 mol $Ba(NO_3)_2$ } 1 mol $BaSO_4$

1.00 L of 1.00 M Na_2SO_4 = 1 mol Na_2SO_4

$\frac{26\text{ kJ}}{1\text{ mol } BaSO_4} = 26\text{ kJ/mol}$

③ a) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

b) $\frac{5.8\text{ g } CH_4}{} \left| \frac{1\text{ mol}}{16.04\text{ g}} \right| \frac{890\text{ kJ}}{1\text{ mol}} = 320\text{ kJ}$

④ ice −40° → ice 0° ice 0° → l 0° l 0° → l 100°

l 100° → g 100° g 100° → g 350.°

ice −40° → ice 0°

$q = mc\Delta T$

$= (89.70\text{ g})(2.11\text{ J/g°C})(0 - -40°C)$

$= 7570\text{ J} = 7.57\text{ kJ}$

ice 0° → l 0°

$\frac{89.70\text{ g}}{} \left| \frac{1\text{ mol}}{18.02\text{ g}} \right| \frac{6.01\text{ kJ}}{1\text{ mol}}$

$= 29.9\text{ kJ}$

$l\ 0° \rightarrow l\ 100°C$

$q = (89.70\,g)(4.184\,J/g°C)(100-0)$

$= 37500\ J = 37.5\ kJ$

$l\ 100° \rightarrow g\ 100°$

$\frac{89.70\,g}{} \left| \frac{1\ mol}{18.02\,g} \right| \frac{40.7\ kJ}{1\ mol} = 203\ kJ$

$g\ 100° \rightarrow g\ 350°$

$q = (89.70\,g)(2.02\,J/g°C)(350-100)$

$= 45300\ J = 45.3\ kJ$

$7.57\ kJ + 29.9\ kJ + 37.5\ kJ + 203 + 45.3$

$= 323\ kJ$

⑤ $\Delta H_{rxn} = \Sigma \Delta H_f$ products $- \Sigma \Delta H_f$ reactant

$= (-1676 + -704 + 3(90) + 6(-242)) - (3(-295))$

$= -2677\ kJ/mol$

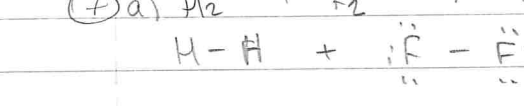
⑥ $(2\,H_3BO_3 \rightarrow 2\,HBO_2 + 2\,H_2O)\ 2$ $\quad \Delta H = -.02\ kJ/mol \times 2$

$(2\,HBO_2 \rightarrow \frac{1}{2}H_2B_4O_7 + \frac{1}{2}H_2O)\ \frac{1}{2}$ $\quad \Delta H = +11.3 \times \frac{1}{2}$

$(\frac{1}{2}H_2B_4O_7 \rightarrow 1\,B_2O_3 + \frac{1}{2}H_2O)\ \frac{1}{2}$ $\quad \Delta H = 17.5 \times \frac{1}{2}$

$2\,H_3BO_3 \rightarrow B_2O_3 + 3\,H_2O$ $\quad \Delta H = 14.4\ kJ/mol\ rxn$

⑦ a) $H_2 + F_2 \rightarrow 2\,HF$



broken H−H 432 kJ/mol

F−F 154 kJ/mol

formed 2 H−F 2·565 kJ/mol

+ Bonds broken − bonds formed = ΔH

$\Delta H = (432 + 154) - (2 \cdot 565) = -544\ kJ/mol$

AP Question ① a) $\Delta H° = \Sigma \Delta H_f°$ products $- \Sigma \Delta H_f°$ reactants

$= (0 + 33) - (143 + 90) = -200.\ kJ\,mol^{-1}$

① d) as $[O_3]$ is constant + $[NO]$ doubles (expt 1+2)
rate doubles, ∴ 1st order $[NO]$
as $[NO]$ is constant + $[O_3]$ doubles (expt 1+3)
rate doubles, ∴ 1st order $[O_3]$
rate = $k[O_3][NO]$

e) step 1 is rate determining step
Rate law for step 1 matches part d
bimolecular

② a) ΔH = bonds broken − bonds formed

O		:N≡N:		
0	−	950	=	−950 kJ/mol

d) The activation energy is high. the reactant molecules do not have enough energy to overcome energy barrier

③ ai) Fe(s): $\frac{75.0\text{ g Fe}}{} \left| \frac{1\text{ mol}}{55.85\text{ g}} \right. = 1.34\text{ mol Fe}$

ii) O_2:

$V = 11.5\text{ L}$
$P = 2.66\text{ atm}$
$T = 298\text{ K}$

$PV = nRT$

$n = \frac{PV}{RT} = \frac{(2.66)(11.5)}{(.08206)(298)} = 1.25\text{ mol O}$

b) $\frac{1.34\text{ mol Fe}}{} \left| \frac{1\text{ mol } Fe_2O_3}{2\text{ mol Fe}} \right. = .670\text{ mol } Fe_2O_3$

LR = Fe

$\frac{1.25\text{ mol } O_2}{} \left| \frac{1\text{ mol } Fe_2O_3}{3/2\text{ mol } O_2} \right. = 1\text{ mol } Fe_2O_3$

c) .670 mol Fe_2O_3 (see work part b)

e) $2FeO + \frac{3}{2}O_2 \rightarrow Fe_2O_3$ $\Delta H^\circ = -280$

ΔH_f° ? 0 -824

$\Delta H^\circ = \Sigma \Delta H_f^\circ$ products $- \Sigma \Delta H_f^\circ$ reactants

$-280 = -824 - 2(X)$

$X = \Delta H_f^\circ{}_{FeO} = -272$ kJ/mol