Unit 4 Review for Midterms

① a) $2NaCl(aq) + Pb(NO_3)_2(aq) \rightarrow PbCl_2(s) + 2NaNO_3(aq)$

b) $2Na^+(aq) + 2Cl^-(aq) + Pb^{2+}(aq) + 2NO_3^-(aq) \rightarrow$
$PbCl_2(s) + 2Na^+(aq) + 2NO_3^-(aq)$

c) $Pb^{2+}(aq) + 2Cl^-(aq) \rightarrow PbCl_2(s)$

d) Na^+ + NO_3^-

② a) $Ba(OH)_2(aq) + 2HCl(aq) \rightarrow 2H_2O(l) + BaCl_2(aq)$

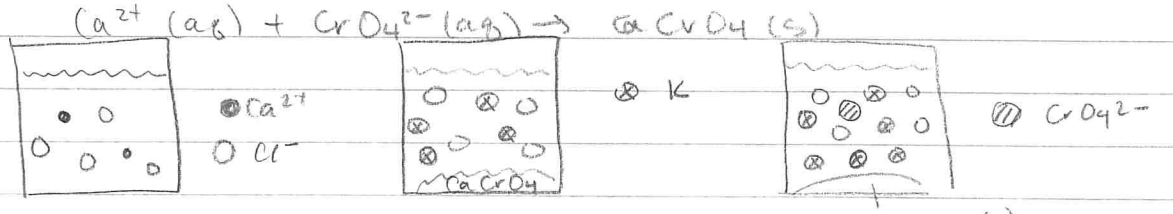
b) $Ba^{2+}(aq) + 2OH^-(aq) + 2H^+(aq) + 2Cl^-(aq) \rightarrow$
$2H_2O(l) + Ba^{2+}(aq) + 2Cl^-(aq)$

c) $2H^+(aq) + 2OH^-(aq) \rightarrow 2H_2O(l)$

d) Ba^{2+}, Cl^-

③ a) $K_2CrO_4(aq) + CaCl_2(aq) \rightarrow CaCrO_4(s) + 2KCl(aq)$

$Ca^{2+}(aq) + CrO_4^{2-}(aq) \rightarrow CaCrO_4(s)$



b) before
$1 Ca^{2+} : 2Cl^-$

c)
$1Cl^- : 1K^+$

d)
$1Cl^- : 1K^+$ + extra K^+
2 extra K^+ : 1 CrO_4^{2-} CrO_4^{2-}

④ a) $\frac{325 mg\ a.a.}{} \Big| \frac{1g}{1000 mg} = .325 g\ a.a.$ $\quad \frac{.325 aa}{2.00 g\ tab} \cdot 100 = 16.3\%$

b) A.A. + O_2 → CO_2 + H_2O

3.00g $\quad$ 3.72L $\quad$ 1.200g

750. mmHg

25°C = 298K

$PV = nRT$

$n = \frac{PV}{RT} = \frac{(750.)(3.72)}{(62.36)(298)}$ $\quad$ $1.200 g\ H_2O \cdot \frac{2(1.008) g H}{18.02 g H_2O} = .134 g H$

$= .150 mol\ CO_2 = .150 mol C$

$.150 mol C \Big| \frac{12.01 g C}{1 mol C} = 1.80 g C$

(4) b) 3.00g compd − 1.80g C − .134 g H = 1.07g O

(5) a i) several ways to calculate

$$\frac{250.\ mL}{} \left| \frac{1\ L}{1000\ mL} \right| \frac{.110\ mol\ AgNO_3}{1\ L} \left| \frac{1\ mol\ Ag^+}{1\ mol\ AgNO_3} \right| \frac{1\ mol\ Zn}{2\ mol\ Ag^+} \left| \frac{65.39\ g\ Zn}{1\ mol\ Zn} \right. = .899\ g\ Zn$$

$AgNO_3$ is LR

ii) .899 g Zn required to react w/ $AgNO_3$

$$.899\ g\ Zn \rightarrow \frac{.899\ g\ Zn^{2+}}{} \left| \frac{1\ mol\ Zn^{2+}}{65.39\ g\ Zn^{2+}} \right. = \frac{.0138\ mol\ Zn^{2+}}{.250\ L}$$

$[Zn^{2+}] = .0550\ M$

(6) a) $\frac{47.20\ mL}{} \left| \frac{1\ L}{1000\ mL} \right| \frac{.02240\ mol\ MnO_4^-}{1\ L} = .001057\ mol\ MnO_4^-$

b) $\frac{.001057\ mol\ MnO_4^-}{} \left| \frac{5\ mol\ Fe^{2+}}{1\ mol\ MnO_4^-} \right. = .005286\ mol\ Fe^{2+}$

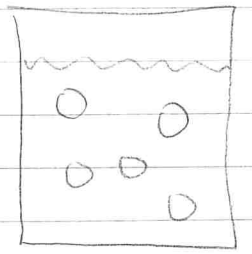
c) $\frac{.005286\ mol\ Fe^{2+}}{} \left| \frac{1\ mol\ Fe}{1\ mol\ Fe^{2+}} \right| \frac{55.85\ g\ Fe}{1\ mol\ Fe} = .2952\ g\ Fe$

d) $\frac{.2952\ g\ Fe}{.8890\ g\ sample} = 33.21\%\ Fe$

(7) a) $\frac{16.8\ mL}{} \left| \frac{1\ L}{1000\ mL} \right| \frac{.124\ mol\ MnO_4^-}{1\ L} \left| \frac{5\ mol\ H_2O_2}{2\ mol\ MnO_4^-} \right. = \frac{.00521\ mol\ H_2O_2}{.0100\ L}$

$= .521\ M$

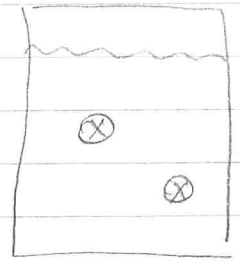
b)



O = H_2O_2

before

c)



⊗ Mn^{2+}

at equiv. pt

2 Mn^{2+} for every 5 H_2O_2

(8) $M_1 = 3.0M$ $M_2 = ?$ $M_1V_1 = M_2V_2$

$V_1 = 250mL$ $V_2 = 1L = 1000mL$ $(3.0)(250) = (M_2)(1000)$

$M_2 = .75M$

(9) $\frac{500.mL}{} \left| \frac{1L}{1000.mL} \right| \frac{.500 mol\ glucose}{1L} \left| \frac{180.16g}{1mol} \right. = 45.0g$ glucose

Place 45.0g glucose in 500mL volumetric flask. Add H_2O until line on neck.

(10) a) Single replacement, redox

b) Double replacement, precipitation

c) DR, acid-base

d) SR, redox

e) DR, precipitation

(11) a) $K_2SO_4 + Pb(NO_3)_2 \rightarrow 2KNO_3 + PbSO_4(s)$

DR, precipitation

b) $Mg(OH)_2 + 2HCl \rightarrow 2H_2O + MgCl_2$ DR, acid-base

c) $Zn + 2HCl \rightarrow ZnCl_2 + H_2(g)$ SR, redox

d) $C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$ combust, redox

e) $3Mg + N_2 \rightarrow Mg_3N_2$ combo/synthesis, redox

f) $CH_3COOH + NaOH \rightarrow NaCH_3COO + H_2O$ DR, acid/base

(12) a) H^+ being transferred from H_2O to NH_3

$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$

base acid c.acid c.base

(13) a) oxidation #s are changing

b) $3\ \overset{-1\ +1\ -2\ +1}{C_2H_5OH} + 2\ \overset{+6\ -2}{Cr_2O_7^{2-}} + 16\overset{+1}{H^+} \rightarrow 4\ \overset{+3}{Cr^{3+}} + \overset{+1\ -2\ +1}{CH_3\overset{-2}{C}OOH} + 11\ \overset{+1\ -2}{H_2O}$

$\overset{-3\ \ +3}{}$

c) Cr +6 → +3 Reduced

C −1 → +3 Oxidized

−1 → −3 Reduced

(14) $(Ag \rightarrow Ag^+ + 1e^-)\ 3$

$3e^- + 4H^+ + NO_3^- \rightarrow NO + 2H_2O$

$3Ag + \cancel{3e^-} + 4H^+ + NO_3^- \rightarrow 3Ag^+ + \cancel{3e^-} + NO + 2H_2O$

$3Ag + 4H^+ + NO_3^- \rightarrow 3Ag^+ + NO + 2H_2O$

$2e^-$

(15) $2OH^- + 2H^+ + ClO^- \rightarrow Cl^- + H_2O + 2OH^-\ )\ 3$

$(5OH^- + H_2O + Fe(OH)_3 \rightarrow FeO_4^{2-} + 5H^+ + 5OH^- + 3e^-\ )\ 2$

$6e^- + 6OH^- + 6H^+ + 3ClO^- \rightarrow 3Cl^- + 3H_2O + 6OH^-$

$10OH^- + 2H_2O + 2Fe(OH)_3 \rightarrow 2FeO_4^{2-} + 10H^+ + 10OH^- + 6e^-$

AP Questions

(1) a)

$CH_3CH_2COOH + H_2O \rightleftharpoons CH_3CH_2COO^- + H_3O^+$

acid, base, c. base, c. acid

b) 25.00 mL P.A.

.173 M NaOH

20.52 mL NaOH

$CH_3CH_2COOH + OH^- \rightarrow CH_3CH_2COO^- + H_2O$

20.52 mL NaOH	1 L / 1000 mL	.173 mol NaOH / 1 L	1 mol OH^- / 1 mol NaOH	1 mol P.A. / 1 mol OH^-

$\frac{.00355 \text{ mol P.A.}}{.02500 \text{ L}} = .142 \text{ M}$

not actually in the problem!

(2) a) $\frac{15.39\text{ g } Fe_2O_3}{} \cdot \frac{111.70\text{ g Fe}}{159.70\text{ g } Fe_2O_3} = 10.76\text{ g Fe}$ (% comp)

i) V = 16.2 L
P = 1.50 atm
T = 200.°C = 473 K
n = ?

$PV = nRT$

$n = \frac{PV}{RT} = \frac{(16.2\text{ L})(1.50\text{ atm})}{(.08206 \frac{\text{atm}}{\text{mol K}})(473\text{ K})}$

$= .626$ mol CO

ii) $\frac{15.39\text{ g } Fe_2O_3}{} \cdot \frac{1\text{ mol } Fe_2O_3}{159.70\text{ g } Fe_2O_3} \cdot \frac{2\text{ mol Fe}}{1\text{ mol } Fe_2O_3} = .193$ mol Fe

LR = Fe_2O_3

$\frac{.626\text{ mol CO}}{} \cdot \frac{2\text{ mol Fe}}{3\text{ mol CO}} = .417$ mol Fe

iii) work above, .193 mol Fe

b) i) $\frac{.600\text{ mol } Ba(NO_3)_2}{} \cdot \frac{1\text{ mol } Ba_3(PO_4)_2}{3\text{ mol } Ba(NO_3)_2} \cdot \frac{601.93\text{ g}}{1\text{ mol } Ba_3(PO_4)_2}$

$= 120.\text{ g } Ba_3(PO_4)_2$

$\frac{.300\text{ mol } H_3PO_4}{} \cdot \frac{1\text{ mol } Ba_3(PO_4)_2}{2\text{ mol } H_3PO_4} \cdot \frac{601.93\text{ g}}{1\text{ mol } Ba_3(PO_4)_2}$

$= 90.3\text{ g } Ba_3(PO_4)_2$

ii) *not in this unit*, will be in unit 8

$\frac{.300\text{ mol } H_3PO_4}{} \cdot \frac{6\text{ mol } HNO_3}{2\text{ mol } H_3PO_4} = .900$ mol HNO_3

$= .900$ mol H^+

$\frac{.900\text{ mol } H^+}{2.00\text{ L}} = .450\text{ M } H^+$

$pH = -\log[H^+]$

$= -\log(.450\text{ M}) = .347$

(just in case you were curious!)

iii) $.600\text{ mol } Ba(NO_3)_2 \cdot 2 = 1.20\text{ mol } NO_3^-$

NO_3^- not involved in rxn so concentration is unchanged

$[NO_3^-] = \frac{1.20\text{ mol } NO_3^-}{2.00\text{ L}} = .600\text{ M } NO_3^-$

③ a) $\%C = \frac{2 \cdot 12.01\,g\ C}{151.09\,g\ BeC_2O_4 \cdot 3H_2O} \cdot 100 = 15.90\%\ C$

b) i) $\frac{3.21\,g\ BeC_2O_4 \cdot 3H_2O}{} \left| \frac{1\ mol\ hydrate}{151.09\,g\ hydrate} \right| \frac{1\ mol\ BeC_2O_4}{1\ mol\ hydrate} \left| \frac{97.03\,g}{1\ mol\ BeC_2O_4} \right. = 2.06\,g\ BeC_2O_4$

* there are other ways to solve *

ii) $\frac{3.21\,g\ hydrate}{} \left| \frac{1\ mol\ hydrate}{151.09\,g\ hydrate} \right| \frac{3\ mol\ H_2O}{1\ mol\ hydrate} = .0637\ mol\ H_2O$

$P = 735\ mmHg$

$T = 220.°C = 493\ K$

$PV = nRT$

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

$= \frac{(.0637)(62.36)(493)}{735} = 2.67\,L$

ox #s

c) i) $\overset{+1}{16\,H^+} + \overset{+7\ -2}{2\,MnO_4^-} + \overset{+3\ -2}{5\,C_2O_4^{2-}} \rightarrow \overset{+2}{2\,Mn^{2+}} + \overset{+4\ -2}{10\,CO_2} + \overset{+1\ -2}{8\,H_2O}$

element reduced: Mn (goes from ox# +7 → +2)

ii) $\frac{17.80\,mL}{} \left| \frac{1\,L}{1000\,mL} \right| \frac{.0150\ mol\ KMnO_4}{1\,L} \left| \frac{1\ mol\ MnO_4^-}{1\ mol\ KMnO_4} \right. = 2.67 \cdot 10^{-4}\ mol\ MnO_4^-$

$\frac{2.67 \cdot 10^{-4}\ mol\ MnO_4^-}{} \left| \frac{5\ mol\ C_2O_4^{2-}}{2\ mol\ MnO_4^-} \right. = 6.68 \cdot 10^{-4}\ mol\ C_2O_4^{2-}$

iii) $\frac{6.62 \cdot 10^{-4}\ mol\ C_2O_4^{2-}}{20.0\,mL} = \frac{x\ mol}{100.\,mL}$ $\quad x = 3.34 \cdot 10^{-3}\ mol\ C_2O_4^{2-}$

iv) $\frac{3.34 \cdot 10^{-3}\ mol\ C_2O_4^{2-}}{} \left| \frac{1\ mol\ BeC_2O_4}{1\ mol\ C_2O_4^{2-}} \right| \frac{97.03\,g\ BeC_2O_4}{1\ mol\ BeC_2O_4} = .324\,g\ BeC_2O_4$

$\frac{.324\,g\ BeC_2O_4}{.345\,g\ sample} \cdot 100 = 93.9\%$