June 2008 Solutions

1) B
2) C

$n_1 = n_2$

moles of NH_3 = (537.2 – 524.3)g/(17g/mole)= .7588235294 moles
.7588235294 moles of F_2* (38 g/mole)= 28.8 g
Total mass = 487.6g + 28.8 g =521 g

3) B

$P_1/T_1 = P_2/T_2$

$101.3/(25+273) = 341/ T_2$

$T_2 = 1003$ K

1003 – 273 = 730 °C

4) A-----The problem with D is that the collision frequency should end up constant because of constant atmospheric pressure
5) A
6) A

$-Q_{hot} = Q_{cold}$

$-250(4.19)(x – 24) = 2000(4.19)(x – 4)$

x = 6.2 °C

7) B (I = rotations; III=vibration)
8) C (evaporation = 4 absorbs heat)
9) D
10) A
11) D (remember only $_{(aq)}$ and $_{(g)}$ are used in K expressions)
12) A

Since the expression is products/reactants, then an endothermic reaction will create a larger K. Let's say the new value was 10^{-13} which is greater than 10^{-14}.

Since $[H^+][OH^-]$ = newK = 10^{-13}.
$[H^+] = [OH^-]$
$[H^+]^2 = 10^{-13}$
$[H^+] = 10^{-6.5}$
pH = 6.5

13) B -------because it has a bigger K_A

14) C

Pb would react with Cu^{+2} (see E values), but Pb^{+2} will not react with Cu. But it will react with Al and Fe which are better reducing agents than Cu.

15) NH_3 will be smelled because it diffuses faster because of its lower molar mass. (Since kinetic energies are equal, the velocity has to be faster to compensate for the lower mass)

16) $P_1/ (T_1n_1) = P_2/ (T_2n_2)$ notice that V cancels.
$315/[(23+273)* 84/28] = 235/[(15+273)* n_2]$
n_2 = 2.3 moles
mass = 2.3moles(28 g /mole) = 64.4 g remained

17) PV = nRT
3.42/106.5 = 0.032 moles of $NaClO_3$
0.032 moles of $NaClO_3$ (3 O_2/2 $NaClO_3$) = 0.048 moles
R = PV/(nT) = 102.5 kPa(1.240 L)/((0.048mole*(74+273 K))
= 7.6 LkPa/(K mole)

18) 85 000 L (22.4 L/mole) = 3794 moles NH_3

3794 moles NH_3 (1 ammonium sulfate/ 2 NH_3) = 1897 moles ammonium sulfate
1897 moles ammonium sulphate (132 g/mole) = 2.50 X10^5 g

19) Reverse the 1st equation $\Delta H = +44.2$ kJ

Keep 2nd equation $\Delta H = -100.1$ kJ

Sum: $NaOH_{(aq)} + HCl \rightarrow NaCl + H_2O$

$\Delta H = -55.9$ kJ/mole $NaOH_{(aq)}$

$Q = mc\Delta T$

$= (150 + 150)\ g\ (4.19)(38 - 25) = 16\ 341$ J

This implies that 16 341 J were released for a certain number of moles of NaOH

-16 341 J(mole/-55 900 J) = 0.29 moles of NaOH reacted

20) -3.02 kJ/mole (1000 J /kJ) (mole/138g)(3.84 g) = -84 J

$Q = 84$ J $= 100(4.19)\ \Delta T$

$\Delta T = 0.2\ ^oC$

21) $-Q_{hot} = Q_{cold}$

$-m(4.19)(63 - 100) = 3000(0.84)(63 - 21)$

$m = 683$ g = 683 mL

22) (1) $C + O_2 \rightarrow CO_2$ $\Delta H = -394.1$ kJ

(2) $H_2O \rightarrow H_2 + 0.5\ O_2$ $\Delta H = 286.2$ kJ

(3) $6\ C + 6\ H_2 + 3\ O_2 \rightarrow C_6H_{12}O_6$ $\Delta H = -1274.5$ kJ

Reverse equation (3) $\Delta H = 1274.5$ kJ

Multiply (1) by 6 $\Delta H = -394.1$ kJ*6 = - 2364 kJ

Reverse equation (2)and X 6 $\Delta H = -286.2$ kJ*6 =- 1717.2 kJ

$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$ $\Delta H = -2806.7$ kJ

-2806.7 kJ/mole $C_6H_{12}O_6$ (mole/180 g)(90 g) = -1404 kJ

23) To increase effective collisions between reactants, increase the concentration of either $HCl_{(aq)}$ or $O_{2(g)}$. Increase the temperature so that more molecules

have enough activation energy. Finally you can increase the pressure of O_2 to ensure that more O2 will get into solution and react.

24) (0.12 g – 0.08 g) H_2(mole/2g)(2 Ag/1 H_2)(108 g/mole)
= 4.32 g Ag
Rate = 4.32 g Ag/ (25-5) s = 0. 2 g/s

25) If pH changes from 1 to 2, then $10^{-1} - 10^{-2} = 0.09$ moles/L of H^+ reacted. 1L = 0.09 moles
Recall $[H^+] = 10^{-pH}$
0.09 moles of H^+ = 0.09 moles of HCl
0.09 moles of HCl(1 CO_2/2 HCl) (44g/mole) = 1.98 g
1.98 g/25 s =0.079 g/s

26)

- remove water as it is being formed
- lower the pressure of the system
- lower heat since reaction is exothermic
- increase the concentration of H_2O_2

27)

moles	2 SO_2	O_2 =	2 SO_3
I	1.2	1	0
C	1.2 – 0.4 = 0.8	0.8/2 = 0.4	0.8
E	0.4	1- 0.4 = 0.6	0.8

4 L container
$K = [SO_3]^2/[SO_2]^2[O_2] = (0.8/4)^2/\{(0.4/4)^2(0.6/4)\} = 26.7$

28) $K_A = 1.8 \text{ X } 10^{-7} = x^2/(0.30 - x)$

X = $[H^+]$ = 0.00023 moles/L
pH = -log(0.00023) = 3.64

29) $Zn \rightarrow Zn^{+2}_{(aq)} + 2e^-$ E = 0.76 V
$2\ Fe^{+3}_{(aq)} + 2e^- \rightarrow 2Fe^{+2}_{(aq)}$ E = 0.77 V

(a) and (b) $Zn + 2\ Fe^{+3}_{(aq)} \rightarrow 2\ Fe^{+2}_{(aq)} + Zn^{+2}_{(aq}$ E =1.53 V

(c) oxidizing agent is $Fe^{+3}_{(aq)}$

(d) no it would encourage the reverse reaction because the Fe^{+2} needs more Zn^{+2} to react