

June 2008 Solutions

1) B

2) C

$$n_1 = n_2$$

$$\text{moles of NH}_3 = (537.2 - 524.3)\text{g}/(17\text{g/mole}) = .7588235294 \text{ moles}$$

$$.7588235294 \text{ moles of F}_2^* (38 \text{ g/mole}) = 28.8 \text{ g}$$

$$\text{Total mass} = 487.6\text{g} + 28.8 \text{ g} = 521 \text{ g}$$

3) B

$$P_1/T_1 = P_2/T_2$$

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

$$T_2 = 1003 \text{ K}$$

$$1003 - 273 = 730 \text{ }^\circ\text{C}$$

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

5) A

6) A

$$\begin{aligned} -Q_{\text{hot}} &= Q_{\text{cold}} \\ -250(4.19)(x - 24) &= 2000(4.19)(x - 4) \\ x &= 6.2 \text{ }^\circ\text{C} \end{aligned}$$

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 $[H^+][OH^-] = K_w = 10^{-14}$.

$$[H^+] = [OH^-]$$

$$[H^+]^2 = 10^{-14}$$

$$[H^+] = 10^{-7}$$

$$pH = 7$$

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) $P_1/(T_1 n_1) = P_2/(T_2 n_2)$ notice that V cancels.

$$315/[(23+273) * 84/28] = 235/[(15+273) * n_2]$$

$$n_2 = 2.3 \text{ moles}$$

$$\text{mass} = 2.3 \text{ moles} (28 \text{ g/mole}) = 64.4 \text{ g remained}$$

17) $PV = nRT$

$$3.42/106.5 = 0.032 \text{ moles of } NaClO_3$$

$$0.032 \text{ moles of } NaClO_3 (3 O_2/2 NaClO_3) = 0.048 \text{ moles}$$

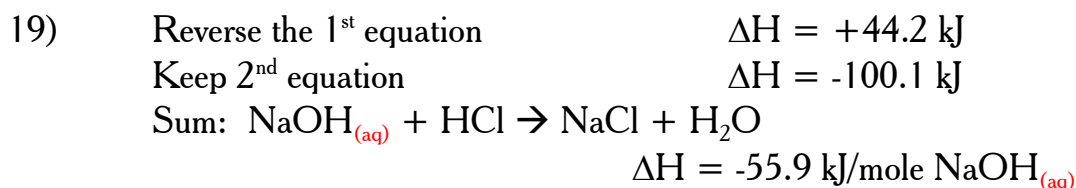
$$R = PV/(nT) = 102.5 \text{ kPa} (1.240 \text{ L}) / ((0.048 \text{ mole} * (74 + 273 \text{ K})))$$

$$= 7.6 \text{ LkPa/(K mole)}$$

18) $85\,000 \text{ L} (22.4 \text{ L/mole}) = 3794 \text{ moles } NH_3$

$$3794 \text{ moles } NH_3 (1 \text{ ammonium sulfate} / 2 NH_3) = 1897 \text{ moles ammonium sulfate}$$

$$1897 \text{ moles ammonium sulphate} (132 \text{ g/mole}) = 2.50 \times 10^5 \text{ g}$$



$$Q = mc\Delta T$$

$$= (150 + 150) \text{ g} (4.19)(38 - 25) = 16\,341 \text{ J}$$

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

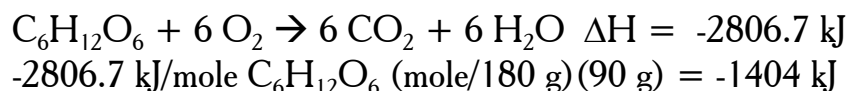
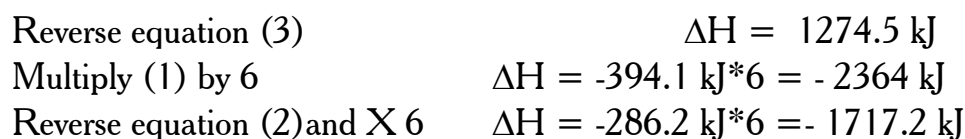
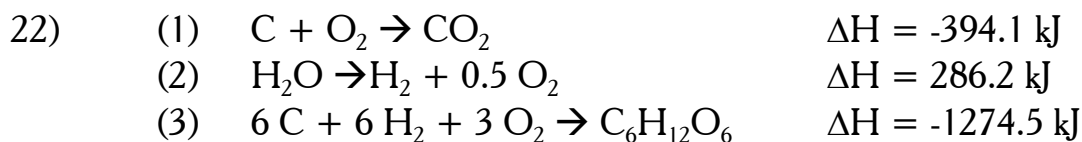
$$-16\,341 \text{ J}(\text{mole}/-55\,900 \text{ J}) = 0.29 \text{ moles of NaOH reacted}$$

20) $-3.02 \text{ kJ/mole} (1000 \text{ J/kJ}) (\text{mole}/138\text{g})(3.84 \text{ g}) = -84 \text{ J}$

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

$$\Delta T = 0.2 \text{ }^\circ\text{C}$$

21) $-Q_{\text{hot}} = Q_{\text{cold}}$
 $-m(4.19)(63 - 100) = 3000(0.84)(63 - 21)$
 $m = 683 \text{ g} = 683 \text{ mL}$



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

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

$$24) \quad (0.12 \text{ g} - 0.08 \text{ g}) \text{ H}_2(\text{mole}/2\text{g})(2 \text{ Ag}/1 \text{ H}_2)(108 \text{ g}/\text{mole})$$

$$= 4.32 \text{ g Ag}$$

$$\text{Rate} = 4.32 \text{ g Ag} / (25-5) \text{ s} = 0.2 \text{ g/s}$$

$$25) \quad \text{If pH changes from 1 to 2, then } 10^{-1} - 10^{-2} = 0.09 \text{ moles/L of H}^+$$

reacted. 1L = 0.09 moles

$$\text{Recall } [\text{H}^+] = 10^{-\text{pH}}$$

$$0.09 \text{ moles of H}^+ = 0.09 \text{ moles of HCl}$$

$$0.09 \text{ moles of HCl}(1 \text{ CO}_2/2 \text{ HCl}) (44\text{g}/\text{mole}) = 1.98 \text{ g}$$

$$1.98 \text{ g}/25 \text{ s} = 0.079 \text{ g/s}$$

- 26)
- remove water as it is being formed
 - lower the pressure of the system
 - lower heat since reaction is exothermic
 - increase the concentration of H₂O₂

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

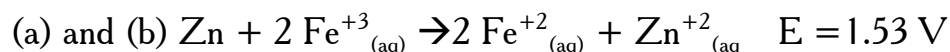
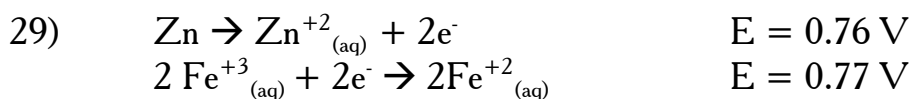
4 L container

$$K = [\text{SO}_3]^2 / [\text{SO}_2]^2 [\text{O}_2] = (0.8/4)^2 / \{(0.4/4)^2 (0.6/4)\} = 26.7$$

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

$$X = [\text{H}^+] = 0.00023 \text{ moles/L}$$

$$\text{pH} = -\log(0.00023) = 3.64$$



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

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