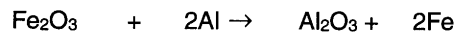


US110 Exam 2. October

Name Ky

(1)(6 points) A flask containing 5.00 g of Al and 14.1 g of Fe₂O₃ were reacted according to the following equation.



159.7 g/mole 26.98 g/mole

(a) Which reagent is the limiting reagent?

$$\text{Fe}_2\text{O}_3 \quad 14.1 \text{ g} \div 159.7 \frac{\text{g}}{\text{mole}} = 0.0883 \text{ moles Fe}_2\text{O}_3$$

$$\text{Al} \quad 5.00 \text{ g} \div 26.98 \frac{\text{g}}{\text{mole}} = 0.185 \text{ moles Al}$$

$$0.185 \text{ moles Al} \times \frac{1 \text{ mole Fe}_2\text{O}_3}{2 \text{ moles Al}} = 0.0926 \text{ moles Fe}_2\text{O}_3 \quad \text{needed}$$

Fe₂O₃ limits reagent

(b) How much Al₂O₃ should form?

$$0.0883 \text{ moles Fe}_2\text{O}_3 \times \frac{1 \text{ mole Al}_2\text{O}_3}{1 \text{ mole Fe}_2\text{O}_3} = 0.0883 \text{ moles Al}_2\text{O}_3$$

$$0.0883 \text{ moles Al}_2\text{O}_3 \times 101.96 \frac{\text{g}}{\text{mole}} = 9.00 \text{ g Al}_2\text{O}_3$$

(c) If the amount of Al₂O₃ formed was 7.62 g, what is the % yield?

$$\frac{7.62 \text{ g Al}_2\text{O}_3}{9.00 \text{ g Al}_2\text{O}_3} \times 100\% = 84.7\%$$

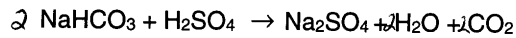
(2)(2 points) How would you make a 500.0 mL, 0.100 M solution of HCl from a 6.80 M stock solution?

$$(0.500 \text{ L}) \left(\frac{0.100 \text{ moles}}{\text{L}} \right) = 0.0500 \text{ moles HCl needed}$$

$$0.0500 \text{ moles} \times \frac{6.80 \text{ moles}}{\text{L}} = 7.35 \times 10^{-3} \text{ L} = 7.35 \text{ mL}$$

7.35 mL of 6.80M HCl will be diluted to 500 mL

(3)(4 points) If it takes 22.1 mL of 0.108 M H_2SO_4 to fully react with the NaHCO_3 (according to the unbalanced reaction below) in a 15.00 mL sample of water. How much NaHCO_3 was present (in grams)?



$$(0.0221 \text{ L})(0.108 \text{ M}) = 2.39 \times 10^{-3} \text{ moles } \text{H}_2\text{SO}_4$$

$$2.39 \times 10^{-3} \text{ moles } \text{H}_2\text{SO}_4 \times \frac{2 \text{ moles } \text{NaHCO}_3}{1 \text{ mole } \text{H}_2\text{SO}_4} = 4.77 \times 10^{-3} \text{ moles } \text{NaHCO}_3$$

$$4.77 \times 10^{-3} \text{ moles } \text{NaHCO}_3 \times 84.01 \frac{\text{g}}{\text{mole}} = 0.401 \text{ g } \text{NaHCO}_3$$

(4)(4 points) Aspirin is acetylsalicylic acid, $\text{C}_9\text{H}_8\text{O}_4$. It is derived from salicylic acid ($\text{C}_7\text{H}_6\text{O}_3$) which is found in willow tree bark. What is the elemental composition of aspirin (in mass %)?

$$9 \text{ C} \quad 9(12.01 \frac{\text{g}}{\text{mole}}) = 108.1 \frac{\text{g}}{\text{mole}}$$

$$8 \text{ H} \quad 8(1.01 \frac{\text{g}}{\text{mole}}) = 8.08 \frac{\text{g}}{\text{mole}}$$

$$4 \text{ O} \quad 4(16.00 \frac{\text{g}}{\text{mole}}) = 64.00 \frac{\text{g}}{\text{mole}}$$

$$\text{total} \quad 180.2 \frac{\text{g}}{\text{mole}}$$

$$\% \text{C} = \frac{108.1 \text{ g}}{180.2 \text{ g}} \times 100\% = 60.0\%$$

$$\% \text{H} = \frac{8.08 \text{ g}}{180.2 \text{ g}} \times 100\% = 4.48\%$$

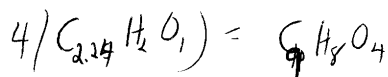
$$\% \text{O} = \frac{64.00 \text{ g}}{180.2 \text{ g}} \times 100\% = 35.5\%$$

more to problem

(5)(4 points) The active component in cannabis is tetrahydrocannabinol (THC) which has a chemical formula of $C_{21}H_{30}O_2$. This is produced as a prescription drug called Dronabinol (or Marinol). Some unknown powder was collected by police (who suspected it was THC) although they are told it is a headache powder. If the results of the elemental analysis are 60.0% C, 4.4% H, and 35.6% O, what is the empirical formula for the sample? Can it be THC (remember to show work)?

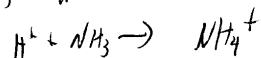
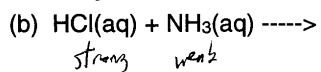
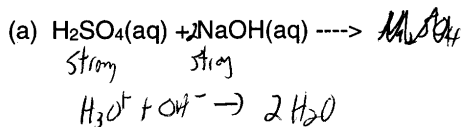
Assume 100g

$$\begin{aligned} \text{C } 60.0\% & \div 12.01 \frac{\text{g}}{\text{mol}} = 4.996 \text{ moles C} & 4.996 \div \frac{2.225 \text{ moles}}{2.225} = 2.24 \\ \text{H } 4.4\% & \div 1.01 \frac{\text{g}}{\text{mol}} = 4.4 \text{ moles H} & 4.4 \div \frac{2.225 \text{ moles}}{2.225} = 2 \text{ H} \\ \text{O } 35.6\% & \div 16.00 \frac{\text{g}}{\text{mol}} = 2.225 \text{ moles O} & 2.22 \div 2.225 \text{ moles} = 1 \text{ Oxygen} \end{aligned}$$

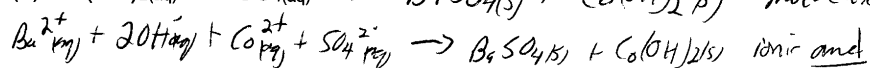
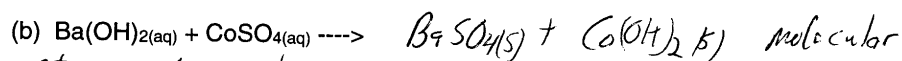
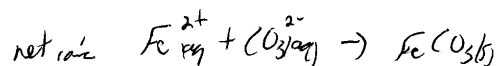
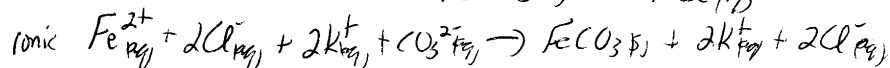
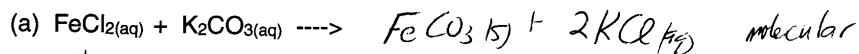


No, it can't be THC.

(6)(4 points) Write the net acid-base reactions for the following neutralizations

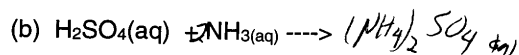
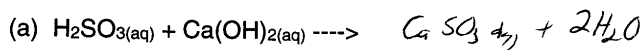


(7)(4 points) Write the ^{balanced} molecular, ionic and net ionic equations for the following reactions



net ionic

(8)(4 points) Complete the following neutralization reactions and balance them for complete neutralization (all acidic protons neutralized, all basic units neutralized).



(9)(2 points) Label the following strong electrolytes, weak electrolytes, or nonelectrolytes

(a) PBr_3 non electrolyte

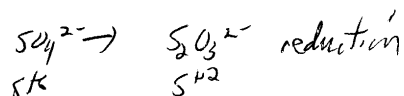
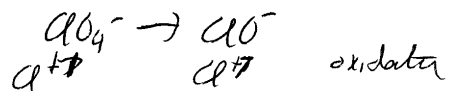
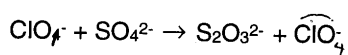
(b) HBr strong electrolyte

(c) NH_3 weak electrolyte

(d) MgS strong electrolyte

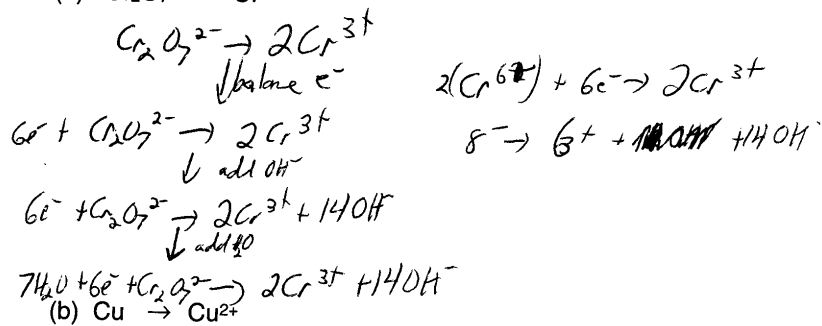
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(10)(4 points) Break the following reaction into an oxidation and a reduction 1/2 reaction. Show all work and the oxidation states of the species being oxidized and reduced. You don't have to balance the 1/2 reactions.



(11)(6 points) Balance the following half-reactions in base

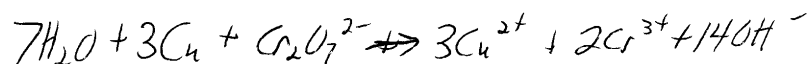
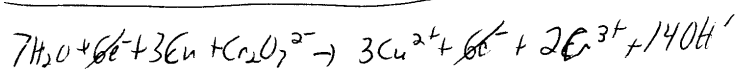
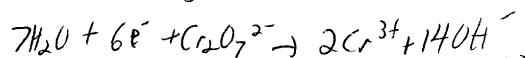
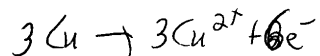
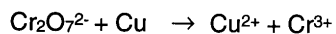
(a) $\text{Cr}_2\text{O}_7^{2-} \rightarrow \text{Cr}^{3+}$



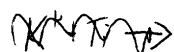
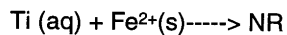
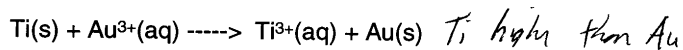
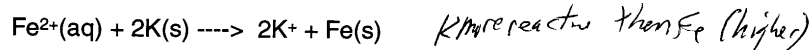
(b) $\text{Cu} \rightarrow \text{Cu}^{2+}$



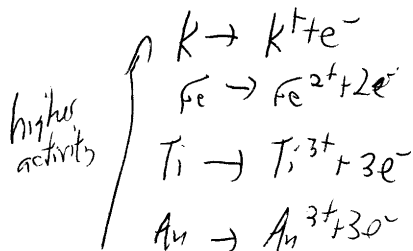
(12)(4 points) Balance the following oxidation-reduction reaction in base



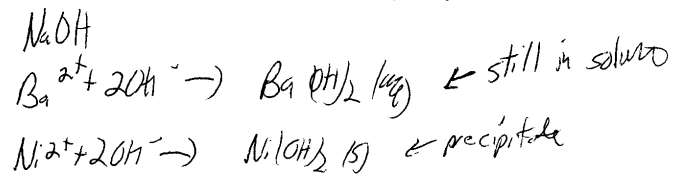
(13)(4 points) Construct an activity series based on the following experimental results



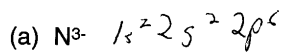
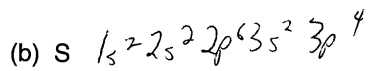
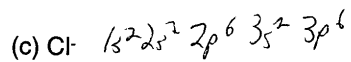
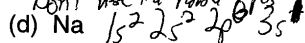
Ti lower than Fe



(14)(4 points) Name a reagent that you could use to separate the Ni^{2+} and Ba^{2+} from a solution of $\text{Ni}(\text{NO}_3)_2$ and $\text{Ba}(\text{NO}_3)_2$ by a precipitation. Write out the precipitation reaction and list which metal will be in the precipitate and which will be left in solution.



(15)(4 points) Write out the ground state electron configurations for the following atoms
 Don't use the noble gas shortcut.



Extra credit (2 points): On problem #5, if you found that it could be THC, could you list anything other than THC that has that formula? If you found that it could not be THC, what could it be?