

Chemistry 1105 Spring 2024 Test 2

Thursday, February 29, 2024

Time: 1 hour 50 minutes

Name: ANSWERS

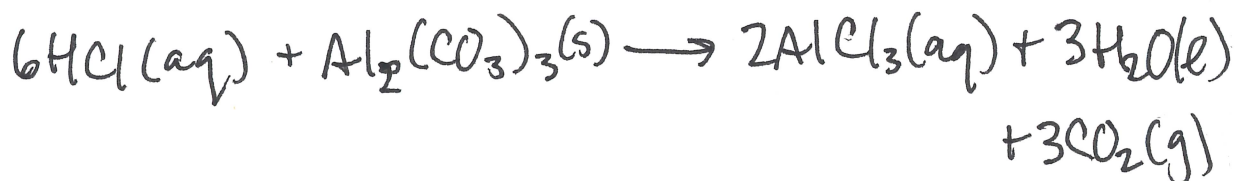
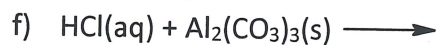
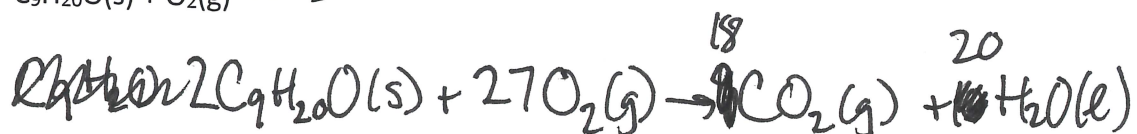
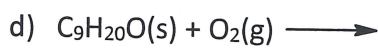
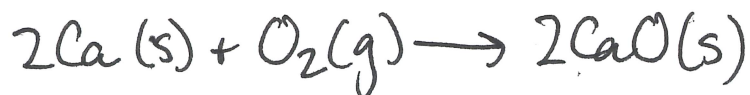
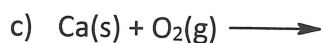
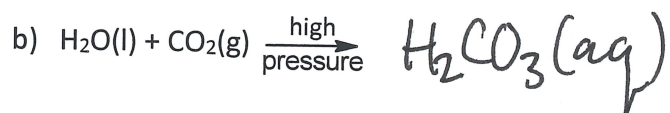
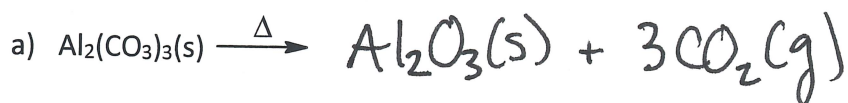
Student #: _____

This test consists of **six** pages of questions, a page containing the names, symbols, and masses of the elements, and a periodic table. Please ensure that you have a complete test and, if you do not, obtain one from me **immediately**. There are **42** marks available. Good luck!

1) [8 marks] Complete the following table:

Compound Formula	Compound Name
HCl(g)	hydrogen chloride
H ₂ S(aq)	hydrosulphuric acid
HClO	hypochlorous acid
HNO ₃	nitric acid
Fe(OH) ₂	iron(II) hydroxide
Ca(OH) ₂	calcium hydroxide
ClF ₃	chlorine trifluoride
P ₂ Cl ₄	diphosphorus tetrachloride

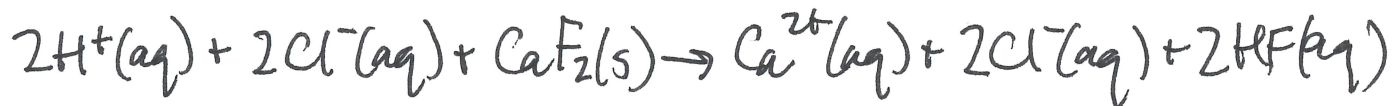
2) [10 marks] Complete and balance the following reactions. Assume a reaction occurs in each case. Give only the molecular equation for each reaction. Be sure to indicate the phases of the products.



3) [3 marks] Given the following balanced molecular equation:



a) Give the full ionic equation.



b) Identify any spectator ions.



c) Give the net ionic equation.



4) [3 marks] A 25.00-mL aliquot of H_2SO_4 required 12.50 mL of 0.08000 M NaOH for titration:



What was the concentration of the original H_2SO_4 solution?

$$\frac{12.50 \times 10^{-3} \text{ L} \times 0.08 \text{ moles NaOH} \times \frac{1 \text{ H}_2\text{SO}_4}{2 \text{ NaOH}}}{25.00 \times 10^{-3} \text{ L}} = 0.02 \text{ M}$$

- 5) [3 marks] In one experiment, 398.6 mg of MCl_3 (where M is a mystery element) was reacted with excess $AgNO_3$:



A total of 1285.3 mg of $AgCl$ (143.321 g/mol) was collected. What is the mystery element, M?

$$1285.3 \times 10^{-3} \text{ g } AgCl \times \frac{1 \text{ mol}}{143.321 \text{ g}} \times \frac{1 MCl_3}{3 AgCl} = 2.989 \times 10^{-3} \text{ mol } MCl_3$$

$$\frac{398.6 \times 10^{-3} \text{ g}}{2.989 \times 10^{-3} \text{ mol}} = 133.341 \frac{\text{g}}{\text{mol}}$$

$$= M + 3 \times 35.453$$

$$\Rightarrow M = 26.982 = \boxed{Al}$$

- 6) [3 marks] A 7.4551-gram sample of KCl (74.551 g/mol) was dissolved in enough water to make 100.0 mL of solution A. A 10.00 mL aliquot of solution A was taken and diluted to 250.0 mL to form solution B. What are the concentrations of solutions A and B?

$$7.4551 \text{ g} \times \frac{1 \text{ mol}}{74.551 \text{ g}} = 0.1 \text{ moles}$$

$$[A] = \frac{0.1 \text{ moles}}{100 \times 10^{-3} \text{ L}} = \boxed{1 \text{ M}}$$

$$\frac{1 \text{ mole } KCl \times 0.01 \text{ L}}{250 \times 10^{-3} \text{ L}} = \boxed{0.04 \text{ M} = [B]}$$

- 7) [3 marks] Calculate the percent by mass of Na_2SO_4 (142.041 g/mol) in a solution that has a density of 1.0905 g/mL and a concentration of Na_2SO_4 of 0.76774 M.

Assume 1000 mL sample size

$$\text{then: } 1000 \text{ mL} \times \frac{1.0905 \text{ g}}{\text{mL}} = 1090.5 \text{ g}$$

$$0.76774 \text{ moles} \times \frac{142.041 \text{ g}}{\text{mol}} = 109.05 \dots \text{ g}$$

$$\frac{109.05 \text{ g}}{1090.5 \text{ g}} \times 100\% = \boxed{10\%}$$

- 8) [3 marks] Calculate the percent by mass of each element in $\text{Al}_2(\text{SO}_4)_3$.

$$2 \times 26.982 = 53.964$$

$$3 \times 32.065 = 96.195$$

$$12 \times 15.999 = 191.988$$

$$\hline 342.147$$

$$\text{Al: } \frac{53.964}{342.147} \times 100 = 15.772\%$$

$$\text{S: } \frac{96.195}{342.147} \times 100 = 28.115\%$$

$$\text{O: } \frac{191.988}{342.147} \times 100 = 56.113\%$$

9) [6 marks] Ibuprofen is 75.6935 percent carbon, 8.7948 percent hydrogen, and the rest oxygen, all by mass.

a) What is the empirical formula of ibuprofen?

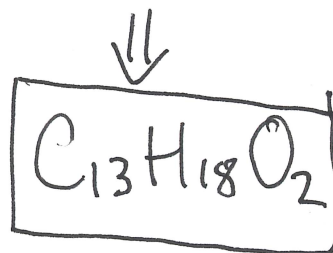
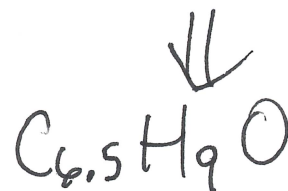
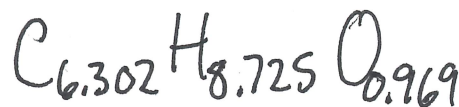
$$\%O = 100 - 75.6935 - 8.7948 = 15.5117$$

assume 100g sample...

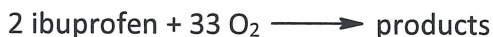
$$75.6935 \text{ g C} \times \frac{1 \text{ mol}}{12.011 \text{ g}} = 6.302... \text{ mol C}$$

$$8.7948 \text{ g H} \times \frac{1 \text{ mol}}{1.0079 \text{ g}} = 8.725... \text{ mol H}$$

$$15.5117 \text{ g O} \times \frac{1 \text{ mol}}{15.999 \text{ g}} = 0.969... \text{ mol O}$$



b) A 313-mg sample of ibuprofen requires 801.1 mg of oxygen for complete combustion, according to the balanced reaction:

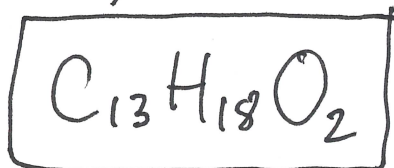


What is the molecular formula of ibuprofen?

$$801.1 \times 10^{-3} \text{ g O}_2 \times \frac{1 \text{ mol}}{31.998 \text{ g}} \times \frac{2 \text{ Ibu}}{33 \text{ O}_2} = 1.517 \times 10^{-3} \text{ mol Ibu.}$$

$$\frac{313 \times 10^{-3} \text{ g}}{1.517 \times 10^{-3} \text{ mol}} = 206.283... \frac{\text{g}}{\text{mol}}$$

$$n = \frac{206.283...}{206.2832} \approx 1, \text{ so}$$



$$13 \times 12.011$$

$$+ 18 \times 1.0079$$

$$+ 2 \times 15.999$$

$$\hline 206.2832$$