Chemistry 1105 Spring 2024 Test 1

Thursday, February 1, 2024 Time: 1 hour 50 minutes

Name: ANSWERS Student #: _____

*This test consists of **seven** 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 **44.5** marks available. Good luck!*

1) **[3 marks]** Perform the following mathematical operation, and report the result to the correct number of significant figures:

$$\frac{3.765 \times 4.81 - \frac{98.88}{7.2}}{4.14 \times 2.20 + 6.3 \times 1.1}$$

$$= \frac{18.\underline{1}0965 - 13.\underline{7}33\ldots}{9.\underline{1}08 + 6.\underline{9}3} = \frac{4.\underline{3}7631\ldots}{16.\underline{0}38}$$

$$= 0.\underline{2}7\ 2871721$$

$$\boxed{0.3}$$

2) **[2 marks]** Rewrite the following numbers in scientific notation, to the correct number of significant figures:

a) 0.000 000 000 000 000 06180

6.180×10^{-17}

b) 220 000 000 000 000 000

2.2×10^{17}

3) **[6 marks total]** To keep a pool germ-free, there should be 2.0 grams of chlorine (Cl) for every million grams of water the pool contains.

a) **[4 marks]** A certain Olympic swimming pool is 9 feet deep, 82 feet wide, and 164 feet long, and is filled with water. How many grams of chlorine must the pool contain to stay germ-free? The density of water is 0.998 g/mL, and the volume of the pool is given by length x width x depth. One inch is 2.54 cm, and one foot is 12 inches.

$$1\text{ ft} \times \frac{12\text{ in}}{1\text{ ft}} \times \frac{2.54\text{ cm}}{1\text{ in}} = 30.48\text{ cm in 1 ft.}$$

$$9\text{ ft} \times \frac{30.48\text{ cm}}{\text{Ft}} \times 82\text{ ft} \times \frac{30.48\text{ cm}}{\text{Ft}} \times 164\text{ ft} \times \frac{30.48\text{ cm}}{\text{Ft}}$$

$$= 3.427\ldots \times 10^9\text{ cm}^3\text{ of water}$$

$$3.427\ldots \times 10^9\text{ cm}^3 \times \frac{0.998\text{ g}}{1\text{ cm}^3} \times \frac{2\text{ g Cl}}{1 \times 10^6\text{ g } H_2O} = \boxed{6.84 \times 10^3\text{ g Cl}}$$

b) **[2 marks]** The source of the chlorine you add is a chemical called calcium hypochlorite. For every pound (453.6 g) of calcium hypochlorite you add, the amount of chlorine in the pool will increase by 333 grams. How many pounds of calcium hypochlorite do you add to the pool above to get the chlorine to the correct level?

$$6.84 \times 10^3\text{ g Cl} \times \frac{453.6\text{ g } Ca(OCl)_2}{333\text{ g Cl}} \times \frac{1\text{ lb}}{453.6\text{ g}}$$

$$= \boxed{20.5\text{ lbs } Ca(OCl)_2}$$

4) **[4 marks]** A tin can is filled to the very top with methanol (0.792 g/mL). The tin can and methanol together have a total mass of 628.31 grams. A marble of mass 31.75 grams is added to the can, which causes some methanol (equal to the volume of the marble) to spill out. The mass of the can, marble, and methanol left over in the can was 650.00 grams. What is the density of the marble?

If no spill: $628.31 + 31.75 = 660.06\ g$

$\therefore$ spilled $= 660.06 - 650.00 = 10.06\ g$

$$V_{spill} = 10.06\ g \times \frac{1\ mL}{0.792\ g} = 12.70\ldots\ mL$$

$$= V_{marble}$$

$$\therefore D_{marble} = \frac{31.75\ g}{12.70\ mL} = \boxed{2.5\ \frac{g}{mL}}$$

5) **[2 marks]** If you take a 4-gram sample of S_8 and convert it to S_2O_3 and an 8-gram sample of S_8 and convert it to SO_2, what will be the ratio $\frac{mass\ of\ O\ in\ S_2O_3}{mass\ of\ O\ in\ SO_2}$?

$$\frac{4\ S_8 \times \frac{85}{\cancel{188}} \times \frac{30}{25}}{8\ S_8 \times \frac{85}{\cancel{188}} \times \frac{20}{15}} = \frac{6}{16} = \boxed{\frac{3}{8}}$$

6) **[2 marks]** If 10 grams of NaCl contains 6.066 grams of chlorine, how many grams of sodium will 21.34 grams of NaCl contain?

$10 - 6.066 = 3.934\ g\ Na$ in $10\ g\ NaCl$

$$21.34\ g\ NaCl \times \frac{3.934\ g\ Na}{10\ g\ NaCl} = \boxed{8.395156\ g}$$

7) **[2 marks]** Classify the following as **He**terogeneous mixtures, **Ho**mogeneous mixtures, **E**lements, or **C**ompounds. Circle your choice.

Tea with milk (well-stirred)	He	(Ho)	E	C
Chalk	He	Ho	E	(C)
Cat fur on your clothes	(He)	Ho	E	C
The aluminum in pop cans	He	Ho	(E)	C

8) **[2 marks]** Classify the following as **C**hemical **P**roperties, **C**hemical **P**rocesses, **P**hysical **P**roperties, or **P**hysical **P**rocesses. Circle your choice.

Paper will burn when lit with a flame	(CPr)	CP	PPr	PP
Evaporating water from a salt solution	CPr	CP	PPr	(PP)
Magnesium is shiny and silver	CPr	CP	(PPr)	PP
Electrolyzing molten salt to give sodium and chlorine gas	CPr	(CP)	PPr	PP

9) **[1.5 marks]** Give the name of the subatomic particle that matches each description.

Lightest subatomic particle electron

Least charged subatomic particle neutron

Last subatomic particle to be discovered neutron

10) **[6 marks]** Give the symbol of an element from the periodic table that matches each description. (Give the symbol only; no names are required.)

Occurs naturally as diatomic *and* is a liquid Br

The only alkali metal that isn't a metal H

One of the three period 4 elements with the same group number Fe/Co/Ni

The lightest group IVA semi-metal Si

A solid halogen I

Found to form compounds only recently Kr/Xe (maybe Ar)

11) **[6 marks]** Complete the following table for antimony (Sb):

Nuclide Symbol	Mass (Da)	Percent Abundance
$^{121}_{51}Sb$	$x = 120.9040$	57.21
$^{123}_{51}Sb$	$y = 122.9044$	42.79

The heavier isotope has the lower percent abundance and weighs 2.0004 Da more than the lighter isotope.

(1) $0.5721x + 0.4279y = 121.76$

$(x - y = -2.0004) \times 0.4279$

(2) $0.4729x - 0.4279y = -0.85597116$

add (1) + (2):

$x = 120.9040$

$y = x + 2.0004 = 122.9044$

12) **[8 marks]** Complete the following table.

Compound Name	Compound Formula
calcium chloride	$CaCl_2$
barium nitride	Ba_3N_2
iron(III) sulphide	Fe_2S_3
mercury(I) phosphide	$(Hg_2)_3P_2$
ammonium arsenide	$(NH_4)_3As$
magnesium chlorite	$Mg(ClO_2)_2$
cobalt(III) sulphate pentahydrate	$Co_2(SO_4)_3 \cdot 5H_2O$
vanadium(II) hyponitrite trihydrate	$V(NO)_2 \cdot 3H_2O$