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Chemistry 1094 Spring 2017 Test 1

Wednesday, February 1, 2017 Time: 1 hour 50 minutes

Name: ANSWERS Student #: _____

*This test consists of **eight** pages of questions, a periodic table, and a sheet containing the names, masses, and symbols of the elements. Please ensure that you have a complete test and, if you do not, obtain one from me **immediately**. There are **49.5** marks available. Good luck!*

1) **[8 marks]** Perform the following mathematical operations. Express the result to the correct number of significant figures. No numbers in this question are exact.

a) $(4.0 \times 10^3 + 1.00 \times 10^{-2})(5.75 \times 10^{-3} + 2.113 \times 10^{-2})$

$4000.01 \times 0.02688 = 107.5202688$

$(1.1 \times 10^2)\ (110)$

b) $\frac{2.1+0.016}{9.9-1.115}$ $\frac{2.116}{8.785} = 0.240865110985$

$(2.4 \times 10^{-1})\ (0.24)$

c) $\frac{2.128 \times 9.61 - 10.315}{4.96 - \frac{2.61}{0.523}}$ $\frac{20.45008 - 10.315}{4.96 - 4.990439770555} = \frac{10.13508}{-0.030439770555}$

$= -332.9552035 18$

$(-3 \times 10^2)\ (-300)$

d) $\frac{\frac{2.68}{4.446} - \frac{4.12}{6.778}}{\frac{3.1}{1.05} - \frac{1.01}{0.55}} = \frac{0.602789... - 0.607848 9...}{2.95238... - 1.83636...}$

$= \frac{-0.0050598...}{1.11601...}$ $= -0.004533889...$

$(-5 \times 10^{-3})\ (-0.005)$

2) **[4 marks]** Perform the following conversions. Your answers do not need to be expressed to the correct number of significant figures.

a) 4.68 km to nm

$$4.68\,km \times \frac{1000\,m}{1\,km} \times \frac{1\,nm}{1\times10^{-9}\,m} = \boxed{4.68\times10^{12}\,nm}$$

b) 5.12 feet to cm, if 1 inch is 2.54 cm exactly & 12 in = 1 ft.

$$5.12\,ft \times \frac{12\,in}{1\,ft} \times \frac{2.54\,cm}{1\,in} = \boxed{156.0576\,cm}$$

c) 98.6°F to °C

$$98.6 = 1.8 \cdot °C + 32 \Rightarrow °C = \boxed{37°C}$$

d) 212°F to K

$$212 = 1.8\,°C + 32 \Rightarrow °C = 100°C$$

$$K = °C + 273.15 = \boxed{373.15}$$

3) **[4 marks]** A Boeing 767-200 aircraft requires 22,300 kg of fuel to fly safely from Montreal to Edmonton.

a) Suppose a 767 being prepared for that flight started out with 7682 litres of fuel on board. How many more litres of fuel would the plane require for the flight from Montreal to Edmonton? The density of jet fuel is 0.803 g/mL.

$$0.803\ \frac{g}{mL} \times \frac{1\ mL}{1\times10^{-3}\ L} \times \frac{1\ kg}{1000\ g} = 0.803\ \frac{kg}{L}$$

$$22{,}300\ kg \times \frac{1\ L}{0.803\ kg} - 7682\ L = \boxed{20{,}089\ L}$$

b) The distance between the Montreal and Edmonton airports is 2972 km (by air). Assuming a 767-200 uses 4.83 kg of fuel per km flown, how many litres of fuel will remain in a 767-200 after it has flown from Montreal to Edmonton, assuming that it started out with the 22,300 kg it needed to make the journey safely?

$$4.83\ \frac{kg}{km} \times 2972\ km = 14354.76\ kg\ used$$

$$(22{,}300 - 14{,}354.76)\ kg \times \frac{1\ L}{0.803\ kg} = \boxed{9894\ L}$$

4) **[6 marks]** A container is completely filled with ethanol (density 0.789 g/mL). The container and ethanol have a combined mass of 1000.00 grams. A rock of mass 650.00 grams is then added to the container, causing some of the ethanol to spill out (the volume of ethanol spilled is exactly equal to the volume of the ~~container~~ rock). The container, rock, and leftover ethanol are then reweighed, and found to have a mass of 1571.10 grams.

a) What is the density of the rock? Give your answer in g/mL (g/cm^3).

If no ethanol spilled:

$1000 + 650 = 1650\,g$ is total mass.

So ethanol spilled is

$1650 - 1571.10 = 78.9\,g$

So $V_{eth} = V_{rock} = 78.9\,g \times \frac{1\,mL}{0.789\,g} = 100\,mL$

So $D_{rock} = \frac{650\,g}{100\,mL} = 6.5\,\frac{g}{mL}$

b) Convert your answer to kg/dm^3.

$$6.5\,\frac{g}{cm^3} \times \left(\frac{1\,cm}{1\times10^{-2}\,m}\right)^3 \times \left(\frac{0.1\,m}{1\,dm}\right)^3 \times \frac{1\,kg}{1000\,g} = 6.5\,\frac{kg}{dm^3}$$

5) **[2 marks]** Classify the following as **E**lements, **C**ompounds, **He**terogeneous **M**ixtures, or **Ho**mogeneous **M**ixtures. Circle your choice:

Air	E	C	HeM	**(HoM)**
Water	E	**(C)**	HeM	HoM
Earth (soil)	E	C	**(HeM)**	HoM
Iron	**(E)**	C	HeM	HoM

6) **[2 marks]** Classify the following as **C**hemical **C**hanges or **P**hysical **C**hanges to the indicated matter. Circle your choice:

Burning ethanol	(CC)	PC
Boiling ethanol	CC	(PC)
Removing ice cubes from water	CC	(PC)
Converting water to elemental hydrogen and oxygen	(CC)	PC

7) **[1 mark]** In one experiment, 15.0 grams of hydrogen was mixed with 15.0 grams of oxygen, and the mixture ignited. All the oxygen was used up, leaving some hydrogen left over and 16.9 grams of water. How many grams of hydrogen remained?

$15+15-16.9 = \boxed{13.1\ g}$

8) **[1 mark]** A 1.00-gram sample of the compound acetylene is 7.74 percent hydrogen by mass. A 10.00-gram sample of acetylene will be:

a) 0.774 percent hydrogen by mass
b) 7.74 percent hydrogen by mass
c) 77.4 percent hydrogen by mass
d) There is not enough information to answer this question

9) **[2 marks]** Suppose you took 2 grams of N_2 and converted it into NH_3, and 3 grams of N_2 and converted it into N_2H_4. Calculate the ratio $\frac{mass\ of\ H\ in\ NH_3}{mass\ of\ H\ in\ N_2H_4}$.

$$\frac{2N_2 \times \frac{2N}{1N_2} \times \frac{3H}{1N}}{3N_2 \times \frac{4H}{1N_2}} = \boxed{1}$$

10) **[2.5 marks]** Classify the following elements as **G**ases, **L**iquids, **S**olid **N**on-metals, **S**olid **S**emi-metals, or **S**olid **M**etals. Circle your choice. You may assume all elements are at room temperature.

arsenic	G	L	SN	(SS)	SM
chlorine	(G)	L	SN	SS	SM
lead	G	L	SN	SS	(SM)
mercury	G	(L)	SN	SS	SM
sulphur	G	L	(SN)	SS	SM

11) **[2 marks]** Circle the correct form for each element as it occurs naturally and at room temperature:

chlorine	Cl	(Cl_2)	Cl_4	Cl_8
iron	(Fe)	Fe_2	Fe_4	Fe_8
phosphorus	P	P_2	(P_4)	P_8
sulphur	S	S_2	S_4	(S_8)

12) **[5 marks total]** The weighted average mass of a chromium (Cr) atom is 51.9961 Da.

a) **[3 marks]** Complete the following table for chromium:

Nuclide Symbol	Isotope Mass (Da)	Percent Abundance
$^{50}_{24}Cr$	49.9460	4.345
$^{52}_{24}Cr$	$X = 51.9405$	83.789
$^{53}_{24}Cr$	52.9407	9.501
$^{54}_{24}Cr$	53.9389	2.365

$100 - (4.345 + 9.501 + 2.365) = 83.789$

$(49.946)(0.04345) + X(0.83789) + (52.9407)(0.09501)$

$+ (53.9389)(0.02365) = 51.9961$

$\Rightarrow X = 51.9405$

b) **[1 mark]** How many protons will there be in the heaviest isotope of chromium?

24 (all same)

c) **[1 mark]** How many electrons will there be in the lightest isotope of a neutral atom of chromium?

24 (all same)

13) **[10 marks]** Complete the following table:

Formula	Name
NaI	sodium iodide
Na_3N	sodium nitride
Fe_3P_2	iron(II) phosphide
Au_2S_3	gold(III) sulphide
$Ca_3(PO_3)_2$	calcium phosphite
$Al(ClO_4)_3$	aluminum perchlorate
$NiSO_3 \cdot 3H_2O$	nickel sulphite trihydrate
$Cr_2(CO_3)_3 \cdot 4H_2O$	chromium(III) carbonate tetrahydrate
$HBrO_4$	perbromic acid
H_2SO_4	sulphuric acid