**CHE1031 Exam 1: Essential knowledge through naming compounds KEY**

You’ll find a periodic table and table of conversion factors attached. You are allowed notes on one side of a 3x5-inch card and a calculator. Please show all work for partial credit and please ask if you have questions.

**1: Introduction & essential knowledge**

**1.1: Chemistry in context**

**1.** Identify each as an example of either the macroscopic domain, the microscopic domain, or the symbolic domain of chemistry. For those in the symbolic domain, indicate whether they are symbols for a macroscopic or a microscopic feature.

(a) A certain molecule contains one H atom and one Cl atom.

(b) Copper wire has a density of about 8 g/cm3.

(c) The bottle contains 15 grams of Ni powder.

(d) A sulfur molecule is composed of eight sulfur atoms.

(a) microscopic / symbolic

(b) macroscopic

(c) macroscopic / symbolic

(d) microscopic

**1.2: Phases and classification of matter**

**2.** How does a homogeneous mixture differ from a pure substance? How are they similar?  
Pure substances and homogenous mixtures are both uniform (smooth) throughout. But pure substances are elements or molecules, combinations of elements at constant ratios. Mixtures are combinations of substances at varying ratios.

**3.** How does an element differ from a compound? How are they similar?  
Elements and molecules are both microscopic and both are made of atoms. Elements are collections of identical atoms while molecules or compounds are combinations of atoms (different elements) at constant ratios.

**1.3 Physical and chemical properties**

**4.** The volume of a sample of oxygen gas changed from 10 mL to 11 mL as the temperature changed. Is this a chemical or physical change?  
physical: the volume of gases increases as temperature increases

**1.5: Measurement, uncertainty, accuracy, and precision**

**5.** Indicate whether each of the following can be determined exactly or must be measured with some degree of uncertainty (i.e. inexact):

(a) the number of seconds in an hour

(b) the number of pages in a book

(c) the number of grams in your weight

(d) the number of grams in 3 kilograms

(e) the volume of water you drink in one day

(a) exact

(b) exact

(c) inexact

(d) exact

(e) inexact

**6.** Calculate the answer with the proper number of significant figures.  
(a) 4.30 x 0.0033 =

(b) 2.03 + 129.6 =  
(a) 1.4 E-2

(b) 131.6

**7.** Define and contrast the terms accurate and precise.  
Accuracy is a measure of how close a value is to the truth or a known value.  
Precision is a measure how close a group of repeated measurements or values are to one another.  
Precise values may not be accurate and accurate values aren’t necessarily precise.

**1.6: Mathematical treatment of measurement results**

**8.** The distance between the centers of the two oxygen atoms in an oxygen molecule is 1.21 × 10−8 cm. What is this distance in inches?

1.21 E-8 cm 1 in = 4.76 E-9 in

2.54 cm

**9.** Calculate these masses.

(a) What is the mass of 4.00 cm3 of sodium, density = 0.97 g/cm3 ?

(b) What is the mass of 125 mL gaseous chlorine, density = 3.16 g/L?

(a) 4.00 cm3 0.97 g = 3.88 g

1 cm3

(b) 125 mL 1 L 3.16 g = 0.395 g

1000 mL 1 L

**10.** One liter of water contains 3.34 E25 molecules. How many molecules of water are held in a buret with a volume of 4.78 cubic inches?  
4.78 in3 2.543 cm3 1 mL 1 L 3.34 E25 molecules = 2.62 E24 molecules

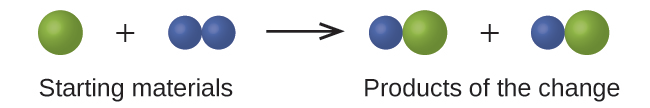
13 in3 1 cm3 1 E3 mL 1 L

**2: Atoms, molecules & ions**

**2.1: Early ideas in atomic theory**

**11.** In the following drawing, the green spheres represent atoms of a certain element. The purple spheres represent atoms of another element. If the spheres of different elements touch, they are part of a single unit of a compound.

The following chemical change represented by these spheres may violate one of the ideas of Dalton’s atomic theory. *Which one?*



Law of conservation of mass. Dalton said that chemical reactions didn’t create or destroy atoms or mass, but rearranged atoms.

**12.** Identify the postulate of Dalton’s theory that is violated by the following observations: 59.95% of one sample of titanium dioxide is titanium; 60.10% of a different sample of titanium dioxide is titanium.  
Dalton believed that all atoms of the same element were identical. However, we now know that isotopes exist. If these two samples of titanium contained different isotopes their masses and percent composition could vary.

**2.2: Evolution of atomic theory**

**13.** What if Rutherford had performed his ‘gold foil’ experiment with these two atoms as the target for his alpha particles rather than gold? Would the patterns produced by the alpha particles differ? If so, how?  
(a) lithium foil

(b) uranium foil

(a) The nucleus of gold is much larger, heavier and denser than the nucleus of lithium, so lithium foil would scatter fewer alpha particles.

(b) The nucleus of uranium is much larger, heavier and denser than the nucleus of gold, so uranium foil would scatter more alpha particles.

**2.3: Atomic structure and symbolism**

**14.** Write the symbol for each of the following ions:

(a) the ion with a 3+ charge, 28 electrons, and a mass number of 71

(b) the ion with 36 electrons, 35 protons, and 45 neutrons

(c) the ion with 86 electrons, 142 neutrons, and a 4+ charge

(d) the ion with a 2+ charge, atomic number 38, and mass number 87

(a) Ga+3

(b) Br-1

(c) Th+4

(d) Sr+2

**15.** Give the number of protons, electrons, and neutrons in neutral atoms of each of the following isotopes:

(a) 10947Ag

(b) 157N

(c) 3115P

(a) 47 p+, 62 n (=109 – 47), 47 e-

(b) 7 p+, 8 n (=15 – 7), 7 e-

(c) 15 p+, 16 n (=31 – 15), 15 e-

**16.** There are three naturally occurring isotopes of oxygen. Calculate the average atomic mass of oxygen.

|  |  |  |
| --- | --- | --- |
| **isotope** | **mass (amu)** | **abundance (%)** |
| 16O | 15.994915 | 99.757 |
| 17O | 16.999132 | 0.038 |
| 18O | 17.999160 | 0.205 |

average atomic mass = (15.994915\*0.99757)+(16.999132\*0.00038)+(17.999160\*0.00205)

= 15.96 + 0.0065 + 0.037 = 16.00

**2.4: Chemical formulas**

**17.** Determine the empirical formulas for these compounds.

(a) acetic acid, C2H4O2

(b) citric acid, C6H8O7

(a) CH2O

(b) C6H8O7

**2.5: The periodic table**

**18.** Use the periodic table to give the name and symbol for each of the following elements:

(a) the noble gas in the same period as germanium

(b) the alkaline earth metal in the same period as selenium

(c) the halogen in the same period as lithium

(d) the chalcogen in the same period as cadmium

(a) Kr

(b) Ca

(c) F

(d) Te

**2.7: Chemical nomenclature (naming)**

**19.** Combine these ions to (i) create formulas for ionic compounds, and (ii) name the ionic compounds.

(a) Mg+2, (C2H3O2)-1

(b) Mo+4, (NO2)-1

(a) Mg(C2H3O2)2, magnesium acetate

(b) Mo(NO2)4, molybdenum (IV) nitrite

**20.** Write the names or formulas of these compounds.

(a) Cu(SO4)

(b) hydrosulfuric acid

(c) tetraphosphorus nonasulfide

(d) aluminum carbonate

(a) copper (II) sulfate

(b) H2S

(c) P4S9

(d) Al2(CO3)3

**Extra credit**

**A.** As stated in the text, convincing examples that demonstrate the law of conservation of matter outside of the laboratory are few and far between. Indicate whether the mass would increase, decrease, or stay the same for the following scenario.

* Exactly one pound of bread dough is placed in a baking tin. The dough is cooked in an oven at 350 °F releasing a wonderful aroma of freshly baked bread during the cooking process. Is the mass of the baked loaf less than, greater than, or the same as the one pound of original dough? Explain.

The finished loaf will have lost a very small amount of mass that is lost as the wonderful aroma. Gas molecules are the aroma and they leave the loaf.

**B.** Explain the difference between extensive properties and intensive properties.  
Extensive properties depend on mass and volume while intensive properties don’t.