

## Chem 400 - What should I know already?

Many students mistakenly believe that Chem 400 is an introductory course, one that can be taken without having taken any chemistry courses in the past. This is not the case! At a minimum, you should be familiar with the following information already. "Familiar" means that you should be able to answer questions about these topics with a minimum of review. To help you review these topics, you will receive via email a review workshop that will be collected during the first weeks of class. Do not expect to be able to spend time reviewing these basic concepts during Chem 400: we will expect you to know, and use, this material from the very beginning of the course.

- The basic structure of the atom (protons/neutrons/electrons, how many, where they are).
- What a mole is, how to interconvert grams and moles, and the significance of Avogadro's number.
- How to recognize whether a chemical equation is balanced, and how to balance a simple chemical equation.
- How to deal with molarity (using any two of the mass of solute, the volume of solution, and the molarity to calculate the third).
- How to use a balanced equation to interrelate masses and numbers of moles of the chemicals in the reaction (stoichiometry). A typical example: "if you use 5 moles (or 5 grams) of chemical X, how many moles (or grams) of chemical Y will you make?"
- The difference between an ionic and a covalent bond, and the manner in which each type of bond is formed.
- Basic properties of gases and the simple gas laws and how to use them.
- How to write the formula of an ionic compound, if you know the formulas and charges on the constituent ions (for instance, "what is the formula of ammonium sulfide, given that ammonium ion is  $\text{NH}_4^+$  and sulfide ion is  $\text{S}^{2-}$  ?")
- You should also know the names and symbols for common elements and ions. A representative list will be emailed to you before the start of the semester. You need not know ALL of these, but you should know MOST of them.
- We are also assuming that you are familiar with dimensional analysis problem-solving techniques and the significant figure rules for arithmetic calculations, although you can learn/review these during the early part of the semester.

If you know more chemistry than this, good for you! The more you already know, the easier you will find Chem 400. We will cover a wide variety of topics including chemical reactions, intermolecular forces, atomic structure, electron orbitals, Lewis dot structures, chemical bonding theories, thermochemistry, solutions and so forth in detail in Chem 400, but these are also covered in most introductory courses (including our Chem 300). Prior knowledge of them is very helpful.

If you have not learned one or more of the above topics, you should seriously consider enrolling in Chem 300, even if you qualified for Chem 400 based on the placement test. "Passing" the placement test does NOT mean that you will pass Chem 400. We set the placement test cutoff at the point where students who scored below the cutoff are not successful in Chem 400.



- 8) Determine the density of an object that has a mass of 149.8 g and displaces 12.1 mL of water when placed in a graduated cylinder.
- 9) The outside air temperature is 30°F, what is the temperature in Kelvin?
- 10) How many mL are in 2.54 L?
- 11) How many mm are in 3.20 cm?
- 12) A person is 64.00 inches tall. How tall is she in cm?
- 13) If the walls in a room are 955 square feet in area, and a gallon of paint covers 15 square yards, how many gallons of paint are needed for the room? (3 ft = 1 yd)

14) A piece of metal ore weighs 8.25 g. When a student places it into a graduated cylinder containing water, the liquid level rises from 21.25 mL to 26.47 mL. What is the density of the ore?

15) The diameter of an atom is approximately  $1 \times 10^{-10}$  m. What is the diameter in millimeters?

16) Because of the high heat and low humidity in the summer in Death Valley, California, a visitor requires about one quart of water for every two miles traveled on foot. Calculate the approximate number of liters required for a person to walk 10. kilometers in Death Valley.

17) The recommended adult dose of Elixophyllin<sup>®</sup>, a drug used to treat asthma, is 6.00 mg/kg of body mass. Calculate the dose in milligrams for a 115-lb person. 1 lb = 453.59 g.

- 18) Which of the following measurements has three significant figures?
- A) 1,207 g
  - B) 4.250 g
  - C) 0.006 g
  - D) 0.0250 g
  - E) 0.03750 g
- 19) A laboratory technician reports that the mass of a growth removed from a patient is 274.06 g. How many significant figures does this measurement contain?
- A) 2
  - B) 3
  - C) 4
  - D) 5
  - E) none of the above
- 20) Which of the following numbers contains **four** significant figures?
- A) 230,110
  - B) 23,011.0
  - C) 0.23010
  - D) 0.0230100
  - E) 0.002301
- 21) What is the total length of two pieces of tubing which measure 4.5 cm and 3.222 cm? Express the answer to the correct number of significant figures.
- A) 3.722 cm
  - B) 4.722 cm
  - C) 7.722 cm
  - D) 7.7 cm
  - E) 8 cm
- 22) The volume of a gas sample is recorded as 0.0970 L. How many significant figures is this?
- A) 2
  - B) 3
  - C) 4
  - D) 5
  - E) none because this is an exact number

## Review of Chapter 2

- 1) In a chemical reaction, matter is neither created or destroyed. Which law does this refer to?
- A) Law of Definite Proportions
  - B) Law of the Conservation of Mass
  - C) Law of Modern Atomic Theory
  - D) Law of Multiple Proportions
  - E) First Law of Thermodynamics
- 2) Identify the description of an atom.
- A) neutrons and electrons in nucleus; protons in orbitals
  - B) neutrons in nucleus; protons and electrons in orbitals
  - C) protons and neutrons in nucleus; electrons in orbitals
  - D) protons and electrons in nucleus; neutrons in orbitals
  - E) electrons in nucleus; protons and neutrons in orbitals
- 3) Isotopes differ in the number of what particle?
- A) beta particles
  - B) protons
  - C) electrons
  - D) neutrons
  - E) gamma particles
- 4) Identify the element that has an atomic number of 40.
- 5) What element does "X" represent in the following symbol?
- $${}_{35}^{80}\text{X}$$
- 6) Determine the number of protons, neutrons and electrons in the following:
- $${}_{12}^{25}\text{X}$$
- 7) What element is defined by the following information?
- $$p^+ = 17 \quad n^0 = 20 \quad e^- = 17$$
- 8) Which of the following statements about subatomic particles is TRUE?
- A) A neutral atom contains the same number of protons and electrons.
  - B) Protons have about the same mass as electrons.
  - C) Electrons make up most of the mass of an atom.
  - D) Protons and neutrons have opposite, but equal in magnitude, charges.
  - E) Neutrons and electrons are found in the nucleus of an atom.

9) What species is represented by the following information?

$$p^+ = 12 \quad n^{\circ} = 14 \quad e^- = 10$$

- A) Si<sup>4+</sup>
- B) Mg
- C) Ne
- D) Si
- E) Mg<sup>2+</sup>

10) What ion is represented by the following information?

$$p^+ = 17 \quad n^{\circ} = 18 \quad e^- = 18$$

11) On the following periodic table, mark the following areas: metals, nonmetals, noble gases, alkali metals, alkaline earth metals, transition metals, inner transition metals and halogens.

The Periodic Table of the Elements

1 <b>H</b> Hydrogen 1.00794																	2 <b>He</b> Helium 4.003
3 <b>Li</b> Lithium 6.941	4 <b>Be</b> Beryllium 9.012182											5 <b>B</b> Boron 10.811	6 <b>C</b> Carbon 12.0107	7 <b>N</b> Nitrogen 14.00674	8 <b>O</b> Oxygen 15.9994	9 <b>F</b> Fluorine 18.9984032	10 <b>Ne</b> Neon 20.1797
11 <b>Na</b> Sodium 22.989770	12 <b>Mg</b> Magnesium 24.3050											13 <b>Al</b> Aluminum 26.981538	14 <b>Si</b> Silicon 28.0855	15 <b>P</b> Phosphorus 30.973761	16 <b>S</b> Sulfur 32.066	17 <b>Cl</b> Chlorine 35.4527	18 <b>Ar</b> Argon 39.948
19 <b>K</b> Potassium 39.0983	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandium 44.955910	22 <b>Ti</b> Titanium 47.867	23 <b>V</b> Vanadium 50.9415	24 <b>Cr</b> Chromium 51.9961	25 <b>Mn</b> Manganese 54.938049	26 <b>Fe</b> Iron 55.845	27 <b>Co</b> Cobalt 58.933200	28 <b>Ni</b> Nickel 58.6934	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.39	31 <b>Ga</b> Gallium 69.723	32 <b>Ge</b> Germanium 72.61	33 <b>As</b> Arsenic 74.92160	34 <b>Se</b> Selenium 78.96	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.80
37 <b>Rb</b> Rubidium 85.4678	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.90585	40 <b>Zr</b> Zirconium 91.224	41 <b>Nb</b> Niobium 92.90638	42 <b>Mo</b> Molybdenum 95.94	43 <b>Tc</b> Technetium (98)	44 <b>Ru</b> Ruthenium 101.07	45 <b>Rh</b> Rhodium 102.90550	46 <b>Pd</b> Palladium 106.42	47 <b>Ag</b> Silver 107.8682	48 <b>Cd</b> Cadmium 112.411	49 <b>In</b> Indium 114.818	50 <b>Sn</b> Tin 118.710	51 <b>Sb</b> Antimony 121.760	52 <b>Te</b> Tellurium 127.60	53 <b>I</b> Iodine 126.90447	54 <b>Xe</b> Xenon 131.29
55 <b>Cs</b> Cesium 132.90545	56 <b>Ba</b> Barium 137.327	57 <b>La</b> Lanthanum 138.9055	58 <b>Ce</b> Cerium 140.116	59 <b>Pr</b> Praseodymium 140.90765	60 <b>Nd</b> Neodymium 144.24	61 <b>Pm</b> Promethium (145)	62 <b>Sm</b> Samarium 150.36	63 <b>Eu</b> Europium 151.964	64 <b>Gd</b> Gadolinium 157.25	65 <b>Tb</b> Terbium 158.92534	66 <b>Dy</b> Dysprosium 162.50	67 <b>Ho</b> Holmium 164.93032	68 <b>Er</b> Erbium 167.26	69 <b>Tm</b> Thulium 168.93421	70 <b>Yb</b> Ytterbium 173.04	71 <b>Lu</b> Lutetium 174.967	
87 <b>Fr</b> Francium (223)	88 <b>Ra</b> Radium (226)	89 <b>Ac</b> Actinium (227)	104 <b>Rf</b> Rutherfordium (261)	105 <b>Db</b> Dubnium (262)	106 <b>Sg</b> Seaborgium (263)	107 <b>Bh</b> Bohrium (264)	108 <b>Hs</b> Hassium (265)	109 <b>Mt</b> Meitnerium (266)	110 <b>Ds</b> Darmstadtium (269)	111 <b>Rg</b> Roentgenium (272)	112 <b>Cn</b> Copernicium (285)	113 <b>Nh</b> Nihonium (286)	114 <b>Fl</b> Flerovium (289)				

A. List the 7 diatomic species:

B. List the elements that exist as gases and liquids at room temperature.

Gases (11 of them):

Liquids (2 of them):

All of the rest exist as solids at room temperature!

12) How many molecules are in 2.50 moles of CO<sub>2</sub>?

13) What mass (in kg) does 5.84 moles of titanium (Ti) have?

14) How many moles of Kr are contained in 398 mg of Kr?

15) How many Li atoms are contained in 97.9 g of Li?

16) Calculate the mass (in g) of  $1.9 \times 10^{24}$  atoms of Pb.

17) Calculate the mass (in kg) of  $4.87 \times 10^{25}$  atoms of Zn.



## Chapter 3

### Nomenclature

1) **Elements:** If the chemical symbol is given, please write the name of the element. If the name of the element is given, please write the chemical symbol.

- |             |           |         |             |
|-------------|-----------|---------|-------------|
| A. Br       | B. copper | C. iron | D. Hg       |
| E. Na       | F. oxygen | G. H    | H. P        |
| I. aluminum | J. Ba     | K. C    | L. chromium |
| M. fluorine | N. Li     | O. Pb   | P. S        |

2) **Ions:** If the chemical symbol/formula is given, please write the name of the ion. If the name of the ion is given, please write the chemical symbol/formula.

- |                     |                    |                     |  |
|---------------------|--------------------|---------------------|--|
| A. potassium ion    | B. copper (I) ion  | C. aluminum ion     | D. ammonium ion  |
| E. sulfide ion      | F. nitrite ion     | G. fluoride ion     | H. phosphate ion   |
| I. $\text{Mg}^{2+}$ | J. $\text{P}^{3-}$ | K. $\text{NO}_3^-$  | L. $\text{Fe}^{2+}$  |
| M. $\text{HCO}_3^-$ | N. $\text{Ag}^+$   | O. $\text{Be}^{2+}$ | P. $\text{C}_2\text{H}_3\text{O}_2^-$ or $\text{CH}_3\text{COO}^-$ |

3) **Ionic Compounds:** If the chemical formula is given, please write the name of the compound. If the name of the compound is given, please write the chemical formula.

- |                      |  |                               |                       |
|----------------------|--|-------------------------------|-----------------------|
| A. aluminum fluoride | B. iron(III) sulfide                           | C. zinc nitrate               | D. barium bicarbonate |
| E. CuI               | F. $\text{NH}_4\text{C}_2\text{H}_3\text{O}_2$ | G. $\text{Sn}(\text{SO}_4)_2$ | H. silver phosphide   |

4) **Acids:** If the chemical formula is given, please write the name of the acid. If the name of the acid is given, please write the chemical formula.

A. nitric acid

B. HCl (aq)

C. sulfuric acid

D. HC<sub>2</sub>H<sub>3</sub>O<sub>2</sub> (aq)

5) **Molecular Compounds:** If the chemical formula is given, please write the name of the compound. If the name of the compound is given, please write the chemical formula.

A. water

B. NH<sub>3</sub>

C. carbon dioxide

D. hydrogen peroxide

E. N<sub>2</sub>O<sub>5</sub>

F. Cl<sub>3</sub>F<sub>5</sub>

G. P<sub>4</sub>O<sub>10</sub>

H. NO

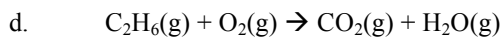
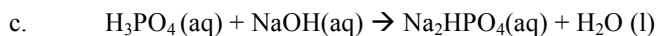
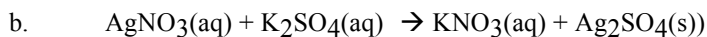
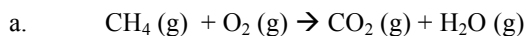
I. N<sub>2</sub>O

K. CCl<sub>4</sub>

L. S<sub>2</sub>F<sub>10</sub>

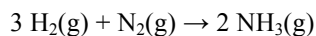
M. PCl<sub>5</sub>

6) **Balancing Equations:** Use coefficients to balance the equations below.



#### Chapter 4: Stoichiometry and Limiting Reactant Problems

1. Ammonia is produced by the reaction

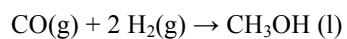


A. How many grams of ammonia can be produced from 22.7g of hydrogen with excess nitrogen present?

B. How many grams of ammonia can be formed from 36.3g of nitrogen with excess hydrogen present?

C. This is a limiting reactant problem: How many grams of ammonia can be produced from 22.7 g of hydrogen and 36.3 g of nitrogen?

2. Methyl alcohol (wood alcohol),  $\text{CH}_3\text{OH}$ , is produced via the reaction



A. How many grams of methyl alcohol can be produced from 147 g of CO with excess hydrogen present?

B. How many grams of methyl alcohol can be produced from 22.1 g of hydrogen with excess CO present?

C. How many grams of methyl alcohol can be produced from 147 g of CO and 22.1 g of hydrogen?