

Chemistry 121
Spring 2005
Test 1, FORM A

Name: KEY

Instructions: You have 75 minutes to complete this 100-point exam. You may use a simple scientific calculator. No programmable calculators allowed.

I. Multiple Choice (15 pts, 3 points each) Carefully and clearly circle the best answer. If you circle two answers, *one of which is correct*, you will receive 1 point.

1. Which of the following is the correct molar mass for $\text{Cd}(\text{NO}_3)_2$?
- a. 142.41 g/mol
 - b. 174.71 g/mol
 - C c. 236.42 g/mol
 - d. 349.42 g/mol
 - e. None of the above.

$$\begin{array}{r} 1 \text{ Cd} \quad 112.40 \\ 2 \text{ N} \quad 2(14.01) \\ 6 \text{ O} \quad \underline{6(16.00)} \\ \hline 236.42 \text{ g/mol} \end{array}$$

2. A temperature of 579 K is _____ °C.

- a. 2.1
- b. 273
- C c. 306
- d. 852
- e. None of the above.

$$579 - 273 = 306^\circ\text{C}$$

3. Elements in Group 7A of the periodic table are called:

- a. Nonmetals
- B b. Halogens
- c. Alkaloids
- d. Alkaline Earth Metals
- e. Noble Gases

4. The number of significant figures in 0.01020 is:

- a. 2
- b. 3
- C c. 4
- d. 6
- e. None of the above

5. What is the chemical formula of a molecule with 2 nitrogen atoms, 6 hydrogen atoms, 6 carbon atoms and 1 sulfur atom?

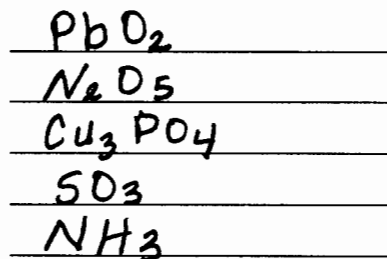
- a. $\text{N}_2\text{H}_6\text{C}_6\text{S}$
- b. $\text{C}_6\text{SH}_6\text{N}_2$
- c. $\text{C}_6\text{H}_6\text{SN}_2$
- D d. $\text{C}_6\text{H}_6\text{N}_2\text{S}$
- e. None of the above



II. Chemical Formulas, Naming and Atomic Notation

1. (15 pts) Give the chemical formulas for the following:

- Lead (IV) oxide
- Dinitrogen pentoxide
- Copper (I) phosphate
- Sulfur trioxide
- Ammonia



2. (15 pts) Name the following:

- LiF
- MgSO₄
- Na₂Cr₂O₇
- Ca(OH)₂
- TiCl₄

lithium fluoride
magnesium sulfate
sodium dichromate
calcium hydroxide
titanium (IV) chloride

3. (16 pts) Fill in the blanks:

Symbol	Name	# of protons	# of neutrons	# of electrons	Mass number
P	phosphorous	15	26	15	41
Ca	calcium	20	22	20	42
S	sulfur	16	17	16	33
As	arsenic	33	42	33	75

III. Calculations: Show all work in the space provided. Partial credit will be given for correct work. If I cannot read the work, it will not be graded.

1. (10 pts) Silver has 2 isotopes: ¹⁰⁷Ag with a mass of 106.905092 g/mol and ¹⁰⁹Ag with a mass of 108.904756 g/mol. The molar mass of silver is 107.87 g/mol. What are the percent abundances of both of the isotopes?

$$\begin{aligned}
 {}^{107}\text{Ag} & (106.905092)(x) = 106.905092x \\
 {}^{109}\text{Ag} & (108.904756)(1-x) = 108.904756 - 108.904756x \\
 & \hline
 & 107.87
 \end{aligned}$$

$$\begin{aligned}
 106.905092x + 108.904756 - 108.904756x &= 107.87 \\
 -1.999664x &= -1.034756
 \end{aligned}$$

$$x = 0.5175 \text{ fractional abundance}$$

$$0.5175 \times 100 = 51.75\% \text{ abundance}$$

$$\begin{aligned}
 {}^{107}\text{Ag} &= 51.75\% \\
 {}^{109}\text{Ag} &= 100 - 51.75\% = 48.25\%
 \end{aligned}$$

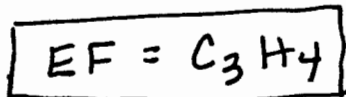
2. (15 pts) Cumene is a hydrocarbon that is 89.94% carbon and 10.06% hydrogen. Its molar mass is 120.2 g/mol. What are the empirical and molecular formulas of cumene?

Assume 100. g

$$89.94 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 7.489 \text{ mol C}$$

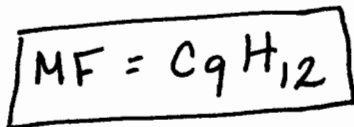
$$10.06 \text{ g H} \times \frac{1 \text{ mol H}}{1.008 \text{ g H}} = 9.980 \text{ mol H}$$

$$\frac{\text{H}}{\text{C}} = \frac{9.980}{7.489} = \frac{1.333}{1} \cdot \frac{3}{3} = \frac{4}{3}$$



$$\text{MM of EF} = 3(12.01) + 4(1.008) = 40.062 \text{ g/mol}$$

$$\frac{\text{MM of MF}}{\text{MM of EF}} = \frac{120.2}{40.062} = \frac{3}{1} \quad \text{Multiplier is 3}$$



3. (10 pts) Saccharin is a common sweetener in low calorie soft drinks. It has a formula of $\text{C}_7\text{H}_5\text{NSO}_3$. (MM = 183.18 g/mol) How many molecules of saccharin are in 27 mg of saccharin? (don't forget to convert mg to g)

$$27 \text{ mg C}_7\text{H}_5\text{NSO}_3 \times \frac{1 \text{ g}}{1000 \text{ mg}} \times \frac{1 \text{ mol C}_7\text{H}_5\text{NSO}_3}{183.18 \text{ g C}_7\text{H}_5\text{NSO}_3} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}}$$

$$= \boxed{8.9 \times 10^{19} \text{ molecules of saccharin}}$$

4. (10 pts) How many moles of nitrate ions are in 1.56 g of $\text{Ca}(\text{NO}_3)_2$? (MM of $\text{Ca}(\text{NO}_3)_2 = 128.10$ g/mol)

$$1.56 \text{ g Ca}(\text{NO}_3)_2 \times \frac{1 \text{ mol Ca}(\text{NO}_3)_2}{128.10 \text{ g Ca}(\text{NO}_3)_2} \times \frac{2 \text{ mol NO}_3^-}{1 \text{ mol Ca}(\text{NO}_3)_2} = \boxed{0.0244 \text{ mol NO}_3^-}$$

5. (4 pts) What is the volume in milliliters of 15 g of Si? (density of Si = 2.33 g/mL)

$$15 \text{ g Si} \times \frac{1 \text{ mL Si}}{2.33 \text{ g Si}} = \boxed{6.4 \text{ mL Si}}$$