

CHEMISTRY 101
Hour Exam I
September 24, 2024
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Name _____

Signature _____

Section _____

“Challenges are gifts that force us to search for a new center of gravity. Don’t fight them. Just find a new way to stand.” - Oprah Winfrey.

This exam contains 17 questions on 9 numbered pages. Check now to make sure you have a complete exam. You have one hour and thirty minutes to complete the exam. Determine the best answer to the first 15 questions and enter these on the special answer sheet. Also, circle your responses in this exam booklet. Show all of your work and provide complete answers to questions 16 and 17.

1-15	(30 pts.)	_____
16	(15 pts.)	_____
17	(15 pts.)	_____
Total	(60 pts)	_____

Useful Information:

$$PV = nRT$$

$$R = 0.08206 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}$$

$$\text{Avogadro's number} = 6.022 \times 10^{23}$$

$$1 \text{ L} = 1000 \text{ mL}$$

$$1 \text{ atm} = 760. \text{ torr}$$

Assume atmospheric pressure is 1.00 atm (unless explicitly told otherwise).

Always assume ideal behavior for gases (unless explicitly told otherwise).

$$K = ^\circ\text{C} + 273$$

$$\text{Density} = \text{mass} / \text{volume}$$

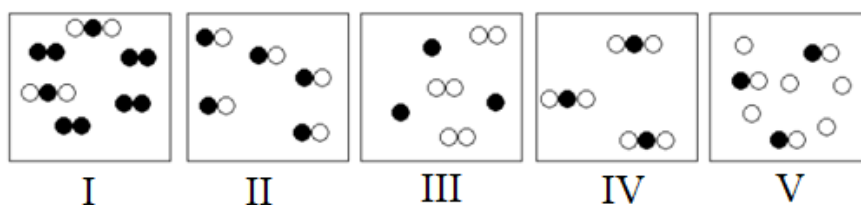
Section 1: Multiple Choice

1. Which of the following measurements below is the shortest length?

(Note: 1 cm = 10 mm, 1 inch = 2.54 cm, 12 inches = 1 foot)

- a. 1.0 inch
- b. 0.25 feet
- c. 37 mm
- d. Two of the measurements above (a-c) are equally short.
- e. All three measurements (a-c) represent the same length.

The diagrams below represent substances, with each circle representing an atom of a particular element. Different colors represent atoms of different elements. Use these diagrams to answer the next two questions.



2. Which two of the diagrams include at least one substance which is considered a molecular element?
- a. III and V
 - b. I and III
 - c. I and IV
 - d. II and IV
 - e. I and V
3. How many of the diagrams include at least one substance which is considered a compound?
- a. 1
 - b. 2
 - c. 3
 - d. 4
 - e. 5 (All five diagrams include at least one substance which is considered a compound.)

4. The molar mass of an ionic compound is 159.6 g/mol. The compound consists of a single cation of an unknown metal as well as a single sulfate anion. What is the name of this compound?
- calcium sulfate
 - copper(I) sulfate
 - copper(II) sulfate
 - cobalt(I) sulfate
 - cobalt(II) sulfate

5. Consider the following ionic compounds consisting of metal and nonmetal elements. Which of the following formulas is **correct** for the name provided?

	Name	Formula
a.	sodium oxide	NaO
b.	calcium chloride	Ca ₂ Cl
c.	potassium sulfide	KS ₂
d.	sodium phosphide	Na ₃ P
e.	aluminum nitride	Al ₃ N ₃

6. What is the mass of 1.75 moles oxygen gas?
- 0.0546 g oxygen gas
 - 0.109 g oxygen gas
 - 32.0 g oxygen gas
 - 28.0 g oxygen gas
 - 56.0 g oxygen gas
7. Recall the lab activity when you determined the number of atoms in a sheet of aluminum foil. Consider a sheet of 4.0 grams of aluminum foil. This foil consists of the same number of atoms as 8.3 grams of an unknown element. What is the unknown element?
- Ti
 - Ni
 - Cu
 - Fe
 - Sn
8. Which of the following is **false** related to neutral atoms of chlorine?
- All neutral atoms of chlorine contain 17 protons.
 - It is possible for a neutral atom of chlorine to contain 18 neutrons.
 - It is possible for a neutral atom of chlorine to contain 17 neutrons.
 - It is possible for a neutral atom of chlorine to contain 17 electrons.
 - It is possible for a neutral atom of chlorine to contain 18 electrons.

9. Which pair of compounds has the same empirical formula?
- CH and C₆H₆
 - CH₂ and C₂H
 - CO₂ and SO₂
 - CH₂ and CH₄
 - HNO₃ and HClO₃
10. What is **false** about ideal gas particles according to kinetic molecular theory?

Gas particles...

- are always moving.
 - attract one another.
 - exert pressure when colliding with the walls of their containers.
 - move around their entire containers.
 - move more slowly if temperature decreases.
11. What mass of argon gas is present at a temperature of 298 K, a pressure of 1.20 atm, and a volume of 7.50 L?
- 0.368 g
 - 4.39 g
 - 14.7 g
 - 29.4 g
 - 142 g
12. Consider a closed sample of argon gas at constant temperature with an initial pressure of P. If you decrease the volume of the argon sample from 3.0 L to 1.0 L, what is the new pressure of the gas?
- 1/3P
 - 1/2P
 - P
 - 2P
 - 3P
13. A closed balloon is at room temperature of 23.0°C. The balloon has a volume of 450. mL. After pouring liquid nitrogen onto the balloon, the balloon's temperature drops to -141°C. What is the new volume of the balloon?
- 73.4 mL
 - 201 mL
 - 1010 mL
 - 2580 mL
 - 2760 mL

14. Recall the lab experiment with the plastic cup on your face. Which of the following is **true** regarding this activity when you inhaled with the plastic cup on your face?

- a. The pressure inside the cup changed.
- b. The room pressure outside the cup changed.
- c. The temperature of air outside the cup was greater than the temperature inside the cup.
- d. The pressure inside the cup was greater than the pressure outside the cup.
- e. The volume of air inside the cup was greater than the volume outside the cup.



15. A closed, rigid 50.0 L container holds one mole of neon gas and two moles of helium gas which are at the same temperature. Both gases behave ideally. What is **true** about the gases in this container?

- a. The mass of the helium gas in the container is greater than the mass of the neon gas in the container.
- b. The neon gas particles are moving faster than the helium gas particles.
- c. The partial pressure of the helium gas is greater than the partial pressure of the neon gas.
- d. The neon gas takes up a greater volume than the helium gas.
- e. There are more neon gas particles present than helium gas particles.

Please go on to the next page.

Section 2: Free Response

16. Part of this unit involved the discussion of naming, formula writing, empirical formulas, and molecular formulas. For each of the three compounds below, use the information provided to find the formula of the compound, and give the name of the compound.

Compound 1

- a. One or more aluminum cations combine with one or more carbonate anions to form an ionic compound. What is the formula and name of this compound? Explain how you determined the formula of the compound.

Formula: _____

Name: _____

Compound 2

- b. A compound consisting of only boron and bromine is 6.33% boron by mass. The molar mass of the compound is 341.2 g/mol. Give the molecular formula and name of the compound. Show your work in the space below.

Molecular formula: _____

Name: _____

Compound 3

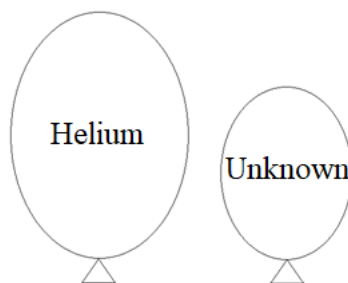
- c. An ionic compound has the formula X_2O , where X is an unknown metal element. The compound is 8.56% oxygen by mass. Identify X and use it to give the full formula and name of the compound. Show your work for identifying the element in the space below.

Formula: _____

Name: _____

Please go on to the next page.

17. You are holding two **sealed, flexible** balloons. One balloon holds helium, and the second balloon holds an unknown monatomic gas. The helium balloon is double the volume of the balloon holding the unknown gas.



Use this information to answer the questions in parts a. through d. related to the gases in both of the balloons.

- a. How do the temperatures of the balloons compare? Fill in the blank below with greater than, less than, or equal to. Then, explain.

The temperature of the helium balloon is _____ the temperature of the unknown balloon.

- b. How do the pressures of gases in the balloons compare? Fill in the blank below with greater than, less than, or equal to. Then, explain. Your explanation should include a definition of pressure and a discussion of pressure as it relates to gas particle behavior.

The pressure of gas in the helium balloon is _____ the pressure of gas in the unknown balloon.

The helium balloon contains 2.00 g of gas, and the balloon containing the unknown monatomic gas holds 21.0 grams of gas.

- c. How do the numbers of moles of gas in each of the balloons compare? Fill in the blank below with greater than, less than, or equal to. Then, explain.

The number of moles of gas in the helium balloon is _____ the number of moles of gas in the unknown balloon.

- d. What is the identity of the unknown gas? Name the element and show your work in the space below.

STOP. You have reached the end of the exam. Nothing written after this page will be graded.

CHEM 101 SCRATCH PAPER

Nothing written on this page will be graded.

1A

The diagram shows a single element box from the periodic table for Holmium (Ho). The box is light green and contains the following information:

- Atomic number:** 67, located at the top left of the box.
- Symbol:** Ho, located in the center of the box.
- Name:** Holmium, located at the bottom of the box.
- Atomic mass:** 164.93, located on the right side of the box.

 Arrows point from each label to its corresponding value in the box. A 'Key' label is positioned to the left of the box, indicating the meaning of the labels.

Lanthanides	58	Ce	Cerium 140.115	59	Pr	Praseodymium 140.9076	60	Nd	Neodymium 144.24	61	Pm	Promethium (145)	62	Sm	Samarium 150.36	63	Eu	Europium 151.965	64	Gd	Gadolinium 157.25	65	Tb	Terbium 158.9253	66	Dy	Dysprosium 162.50	67	Ho	Holmium 164.9303	68	Er	Erbium 167.26	69	Tm	Thulium 168.9342	70	Yb	Ytterbium 173.04	71	Lu	Lutetium 174.967	
	Actinides	90	Th	Thorium 232.0381	91	Pa	Protactinium 231.0369	92	U	Uranium 238.0289	93	Np	Neptunium (237)	94	Pu	Plutonium (244)	95	Am	Americium (243)	96	Cm	Curium (247)	97	Bk	Berkelium (247)	98	Cf	Californium (251)	99	Es	Einsteinium (252)	100	Fm	Fermium (257)	101	Md	Mendelevium (258)	102	No	Nobelium (259)	103	Lr	Lawrencium (260)