CHEMISTRY 101
Hour Exam I
September 25, 2018
McCarren

Name _____

Signature _____

Section _____

"You cannot hope to build a better world without improving the individuals. To that end each of us must work for his own improvement and at the same time share a general responsibility for all humanity, our particular duty being to aid those to whom we think we can be most useful." – Marie Curie

This exam contains 17 questions on 9 numbered pages. Check <u>now</u> 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	(12 pts.)	_____
17	(18 pts.)	_____
Total	(60 pts)	_____

<u>Useful Information</u>:

PV = nRT

K = °C + 273

R = 0.08206 L•atm/mol•K

Density = mass / volume

Avogadro's number = 6.022×10^{23}

1 L = 1000 mL

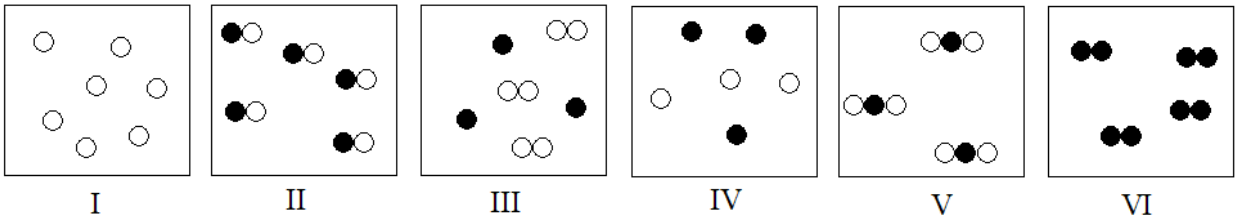
1 atm = 760. torr

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

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

Part 1: Multiple Choice

Consider the series of molecular diagrams below to answer the next two questions. Assume that each circle represents an atom and the dark and light circles represent atoms of different elements.



1. How many of the diagrams are **not** mixtures and instead show pure substances?
   a) 1
   b) 2
   c) 3
   d) 4
   e) 5

2. Which two of the diagrams include a molecular element?
   a) I and IV
   b) I and VI
   c) III and VI
   d) I and V
   e) III and IV

3. Consider the following formulas for several ionic compounds. For which formula is the **cation** named ***correctly***?

	Formula	**Name**
a)	K_3PO_4	Potassium(I) phosphate
b)	$MnCl_2$	Manganese chloride
c)	Cu_2O	Copper(I) oxide
d)	$Co_2(SO_4)_3$	Cobalt(II) sulfate
e)	ZnS	Zinc(IV) sulfide

4. Consider the following names for several ionic compounds. For how many of the compounds are the formulas written correctly?

Name	**Formula**
Calcium chloride	$CaCl_2$
Barium chlorate	$Ba(ClO_3)_2$
Magnesium carbonate	$MgCO_3$
Strontium nitride	Sr_3N_2
Ammonium oxide	$(NH_4)_2O$

a) 1
b) 2
c) 3
d) 4
e) 5 (All compounds have correct formulas)

5. In which of the following compounds is the number of **electrons** in the **cation** identified ***correctly***?

	Compound	**Electrons in Cation**
a)	$CuCl_3$	29
b)	NaBr	12
c)	AlP	13
d)	LiF	10
e)	KNO_3	18

6. A compound is 82.6% carbon by mass and the rest hydrogen. What is its empirical formula?
a) CH_3
b) C_2H_5
c) CH_2
d) CH_5
e) C_2H_4

7. An unknown compound containing only nitrogen and oxygen has a molar mass of 90.0 g/mol. How many of the following have the same empirical formula as this compound?
I. Nitrogen monoxide
II. Nitrogen dioxide
III. Dinitrogen dioxide
IV. Dinitrogen monoxide
V. Trinitrogen hexoxide

a) 1 b) 2 c) 3 d) 4 e) 5 (all have same empirical)

In the first part of your "Empirical and Molecular Formula" lab activity, you measured the mass of a piece of aluminum foil and calculated the number of atoms it contained. Use this idea to answer the next two questions.

8. A particular sheet of aluminum foil has mass 7.60 g. How many atoms of aluminum are in this foil?
   a) 0.282 atoms Al
   b) 1.70×10^{23} atoms Al
   c) 7.60×10^{23} atoms Al
   d) 4.58×10^{24} atoms Al
   e) 1.23×10^{26} atoms Al

9. The sheet of aluminum foil with mass of 7.60 g has the same number of atoms as another sheet of a different element. This new sheet has a mass of 33.4 grams. What is the sheet of the other element made of?
   a) Sn
   b) Cu
   c) Li
   d) Ag
   e) Cs

10. In the second part of your "Empirical & Molecular Formula" lab, you measured mass percentages of various compounds using hypothetical elements A and B. A hypothetical compound has formula AB and is 40% B by mass. If element A is magnesium, what is the identity of element B?
    a) oxygen
    b) nickel
    c) sulfur
    d) selenium
    e) potassium

11. A gas at constant temperature occupies a volume of 9.94 L and exerts a pressure of 890. torr. What volume (in L) will the gas occupy at a pressure of 510. torr?
    a) 5.70 L
    b) 17.3 L
    c) 1730 L
    d) 5700 L
    e) 13,200 L

12. A 25.0 L gas tank holds 200. g of argon gas at a pressure of 5.0 atm. What is the temperature of the gas in the container (in °C)?
    a) -265°C
    b) 0.131°C
    c) 7.61°C
    d) 31.5°C
    e) 305 °C

13. A **closed, rigid** container of gas is present at 25°C and some initial pressure. The temperature of gas increases to 75.°C. How does the final pressure (P_2) in the container compare to the initial pressure (P_1)?
    a) P_2 is three times P_1.
    b) P_2 is greater than twice P_1 but less than three times as great as P_1.
    c) P_2 is twice P_1.
    d) P_2 is greater than P_1 but less than twice as great.
    e) P_2 is equal to P_1.

14. An empty gas tank has a mass of 5,000. grams. A typical 3.5 liter tank like the one shown to the right holds an unknown gas at a pressure of 138 atm. The gas is at room temperature of 22.0°C. The mass of the gas and tank together is 5,880 grams. Which gas is present in the container?
    a) Carbon dioxide (CO_2)
    b) Fluorine (F_2)
    c) Oxygen (O_2)
    d) Argon (Ar)
    e) Helium (He)

15. In your "Explorations with Gases" lab, you held a 'hand boiler' and made observations. Which best explains why the bubbles appeared and the liquid rose after holding the hand boiler?

    Due to the heat from your hand….
    a) the **liquid** increases temperature to its boiling point and it begins to vaporize quickly as it moves into the gas phase within the top bulb.
    b) the **molecules** in the liquid increase in kinetic energy, and cause the liquid to expand and bubble into the higher bulb.
    c) the size of the individual **gas particles** get bigger, increasing the pressure, which cause the gas to bubble and rise in the boiler.
    d) the kinetic energy of the **gas and liquid increase**, which causes some of the gas particles to bubble into the higher chamber and return to the liquid state.
    e) the kinetic energy of the **gas particle**s increases which also increases the pressure on the liquid by the gas, pushing the liquid into the higher chamber and creating bubbles.

Part 2: Free Response

Please write your answers in the spaces below and clearly show all work.

16. Consider the following pairs of substances. Determine which choice in each pair has a greater mass, or if both have equal masses. Explain and/or show work to justify your choice.

Set 1

- **Choice A** consists of 4.0 moles oxygen gas (O_2).
- **Choice B** consists of 2.0 moles ozone gas (O_3).

Set 2

- **Choice A** is a sample of helium gas contained within a 20.0 ounce bottle. The helium gas has density 0.20 g/L. (1 L = 34 ounces)
- **Choice B** is a sample of 2.0 L of helium gas at 2.0 atm and 25°C.

Please go on to the next page to finish question #16.

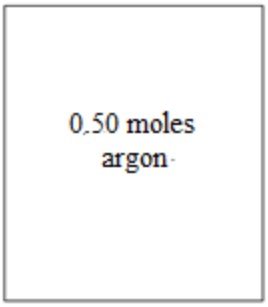
For the following pair of substances, determine which choice contains more oxygen. The samples in choices A and B below both have the **same mass.**

Set 3

- **Choice A** is a sample of strontium oxide.
- **Choice B** is a sample of sodium oxide.

Please go on to question 17 on the next page.

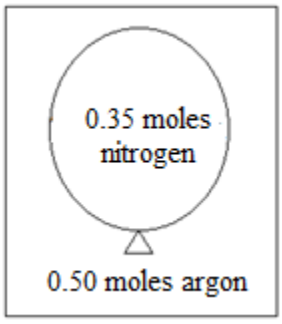
17. A vacuum chamber, similar to the one seen in lecture, contains 0.50 moles argon gas at room temperature.



a. The vacuum chamber is turned on and some of the argon leaves the chamber. As this occurs, determine whether each of the following increases, decreases, or remains the same, considering the **argon** in the vacuum chamber as the system. Explain your reasoning below using kinetic molecular theory and include a molecular level diagram to support your explanation.

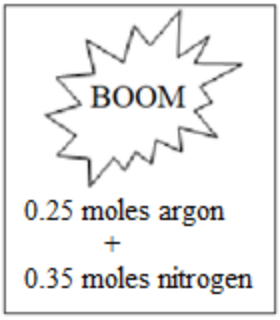
	Increase, decrease, or constant?
Pressure of argon in chamber	
Volume of argon in chamber	
Temperature of argon in chamber	
Moles of argon in chamber	decrease

b. A balloon containing 0.35 moles nitrogen gas is placed into the original vacuum chamber still holding 0.50 moles of argon and the vacuum pump is turned on. The balloon expands. Fill out the table below stating whether each increases, decreases, or remains constant **as the balloon expands**, considering the **balloon** as the system. Then, explain why this happens using kinetic molecular theory.



	Increase, decrease, or constant?
Pressure inside balloon	
Temperature inside the balloon	
Moles of nitrogen inside the balloon	
Volume of the balloon	increase

The vacuum pump remains on until the balloon pops, at which point only 0.25 moles of argon gas are remaining in the container. The 0.35 moles of nitrogen gas from the original balloon mix with the 0.25 moles argon.

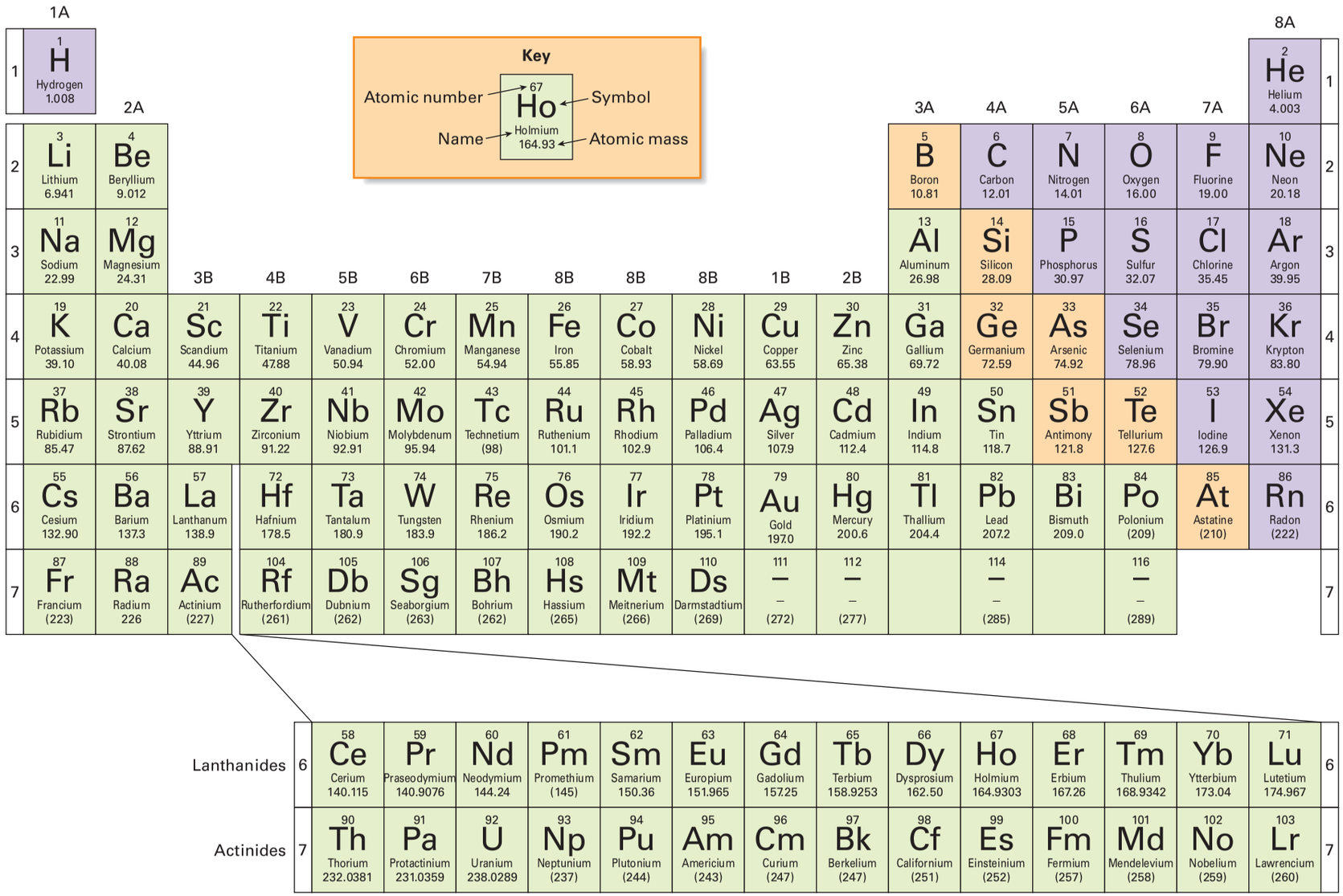


a. Determine the partial pressure of the argon gas in the container as well as the total pressure in the container. Assume the temperature of the 10.0 L container is 25.0°C.

b. What is the total number of atoms in the container?

STOP **This is the end of the exam. Nothing written after this page will be graded.**

Periodic Table of the Elements



Chem 101 Scratch Paper

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