

CHEMISTRY 101
Hour Exam I
September 26, 2017
Andino/McCarren

Name _____

Signature _____

Section _____

“My greatest point is my persistence. I never give up in a match. However down I am, I fight until the last ball. My list of matches shows that I have turned a great many so-called irretrievable defeats into victories.” - Bjorn Borg, tennis

This exam contains 17 questions on 8 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:

$$PV = nRT$$

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

$$R = 0.08206 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K} \approx 0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}$$

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

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

$$\text{Area} = \text{length} \times \text{width}$$

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

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

$$1 \text{ hour} = 60 \text{ minutes}$$

$$1 \text{ mile} = 1.61 \text{ kilometers}$$

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

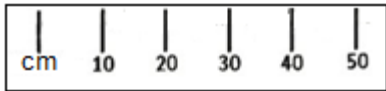
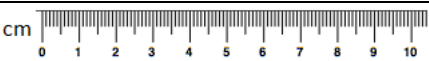
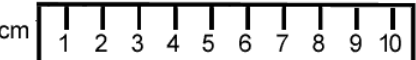
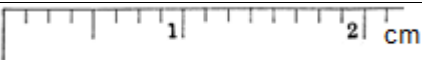
Always assume ideal behavior for gases (unless explicitly told otherwise).

Part 1: Multiple Choice

In the laboratory, you measured your introductory chemistry textbook using four different rulers. Problems 1. and 2. relate to this experience.

1. In the laboratory, you measured your textbook using four different rulers. Measurements are shown in the table below for a different book. Select the ruler that was used to make these measurements:

Length	Width	Perimeter	Area
10.4 cm	9.2 cm	39.2 cm	(blank)

- a) 
- b) 
- c) 
- d) 
- e) None of these rulers could have resulted in the given measurement.

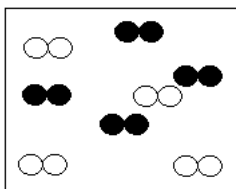
2. Choose the value which should be reported for “Area” in the table above.

- a) 96 cm²
 b) 95.68 cm²
 c) 95.68 cm
 d) 95.7 cm²
 e) 19.6 cm²

3. You are driving from Chicago to Champaign at a speed of 55 miles per hour. How long (in minutes) will it take you to reach your destination? Assume that there are 221 kilometers between Champaign and Chicago (1 mile = 1.61 km, 1 hour = 60 minutes).

- a) 2.5 minutes
 b) 89 minutes
 c) 130 minutes
 d) 150 minutes
 e) 240 minutes

4. The substance in the picture shown below can best be described as...
(Select the statements that apply).



- (I) A liquid
(II) A pure substance.
(III) A mixture of two compounds.
(IV) A mixture of two elements.
(V) A mixture of monoatomic gases.
(VI) A mixture of diatomic gases.
- a) II, IV, VI
b) IV, VI
c) IV, V
d) III, IV, VI
e) II, III, VI
5. The names of five ionic compounds are shown below. How many of the formulas of these names are written correctly?

Name	Formula
Iron(II) sulfide	FeS
Sodium phosphate	Na ₃ PO ₄
Ammonium phosphide	(NH ₄) ₃ P
Silver acetate	AgC ₂ H ₃ O ₂
Aluminum nitrate	Al(NO ₃) ₃

- a) 1 b) 2 c) 3 d) 4 e) 5 (All are correct.)
6. Select the sample that has the **lowest** mass.
- a) 1.0 mol silicon
b) 1.0 mol nitrogen gas
c) 1.0 mol oxygen gas
d) All three of the samples (a. – c.) above have approximately the same mass.
e) Two of the samples (a. – c.) above have approximately the same lowest mass.

7. A metal bonds with oxygen to form an oxide which is roughly 26% percent oxygen by mass. Identify the compound formed.
- Magnesium oxide
 - Sodium oxide
 - Potassium oxide
 - Aluminum oxide
 - Calcium oxide

8. One **ion** of oxygen in a particular ionic compound contains two more neutrons than it does protons. Give the number of neutrons and electrons in this oxygen ion.

<u>Neutrons</u>	<u>Electrons</u>
a) 10 neutrons	10 electrons
b) 8 neutrons	8 electrons
c) 10 neutrons	8 electrons
d) 16 neutrons	18 electrons
e) 10 neutrons	6 electrons

9. The compound acetaldehyde contains carbon, hydrogen, and oxygen. A 3.00-g sample of this compound contains 1.64 g carbon and 0.275 g hydrogen. What is the empirical formula of this compound?
- CH₂
 - C₂H₄
 - C₂H₄O
 - C₃H₆O₄
 - C₆HO₄
10. Barium sulfate is a white, insoluble substance, commonly used as a pigment in order to color white paint. Addition of 0.0345 moles of BaSO₄ (molar mass = 233.43 g/mol) to a graduated cylinder of water raises the water level from 13.2 mL to 15.0 mL. What is the density of the sample of barium sulfate?
- 0.0192 g/mL
 - 4.47 g/mL
 - 19.2 g/mL
 - 4470 g/mL
 - 4.47×10^6 g/mL

11. How many **total** atoms are present in 10.0 grams aluminum chloride? (molar mass $\text{AlCl}_3 = 133.3 \text{ g/mol}$)
- 0.0750 atoms
 - 4.52×10^{22} atoms
 - 9.65×10^{22} atoms
 - 1.81×10^{23} atoms
 - 1.93×10^{23} atoms
12. If 3.25 moles argon gas occupy a volume of 100. L at a particular temperature and pressure, how many moles of argon gas must be **added** to the container for the container to expand to a volume of 435 L?
- 562 moles
 - 300 moles
 - 14.15 moles
 - 10.9 moles
 - 0.07 moles
13. A closed balloon containing 40.0 g Ar rests next to a balloon containing 40.0 g Ne. Both balloons are at the same temperature and pressure. Select the option below which shows the correct volume ratio of the argon balloon vs. the neon balloon.
- 1:2
 - 2:1
 - 1:1
 - 1.18: 1
 - 1:1.18
14. Just before it burst, a 2.00 L tank held a mixture of 40.0 g Ne gas and 40.0 g Ar gas at 30°C . What was the pressure in the container?
- 0.0268 atm
 - 0.0985 atm
 - 3.69 atm
 - 37.3 atm
 - 5995 atm
15. A closed tank consists of a mixture of 4.00 grams of helium and 160. grams of an unknown monatomic gas. The partial pressure of the unknown gas is four times the partial pressure of helium. Identify the gas.
- Kr
 - Tb
 - Ar
 - Br
 - F

Free Response

16. Explanation: Show what you know. Please answer the questions and provide explanations in complete sentences, including examples and/or diagrams as necessary.
- a. Sample A contains 1.0 mole of an unknown monatomic element A. Sample B contains 2.0 moles of an unknown monatomic element B. The molar mass of element A is greater than the molar mass of element B. Explain why sample A does not necessarily have a higher overall mass than sample B. Show mathematical support.
- b. Is any substance that is a compound also a heterogeneous mixture? Explain why or why not, including one or more molecular level diagrams in your explanation.

c. Recall from lecture the demonstration in which a soda can containing a small volume of water was placed on the hot plate and heated until it was steaming. Then, the can was inverted into a bucket of cold water and crushed. Thoroughly explain why the can “crushed.” You may include diagrams to support your explanation if you wish. A comprehensive explanation will address pressure, temperature, moles, and volume.



17. A gas consisting of only carbon and hydrogen is placed into a **rigid, sealed** 30.5 liter container at 27°C and 1.2 atm.

a. The gas present has a mass of 62.7 g. Determine the molar mass of the gas. Clearly show all work.

b. This gas consists of 85.7% carbon and 14.3% hydrogen by mass. Determine the empirical and molecular formulas of this gas, clearly showing all relevant work.

c. The closed container of gas is heated from 27°C to 45°C. Determine whether each of the following increases, decreases, or remains constant. For each quantity that does not remain constant, calculate the new value after the temperature increase.

Variable	Increase, decrease, or constant?
Moles of gas	
Pressure	
Volume	

d. For any variable you said changed in part c), explain why you said this using principles of kinetic molecular theory.