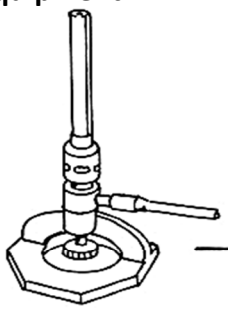
Chemistry Midterm Review **Name**_____

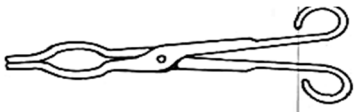
Unit 1

- **Lab Equipment**



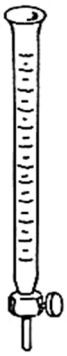
Bunsen burner

Evaporating dish



tongs

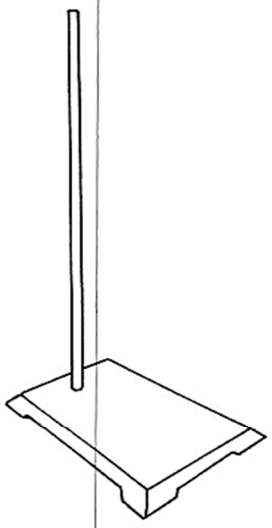
Wire gauze



Buret

crucible

Graduated cylinder

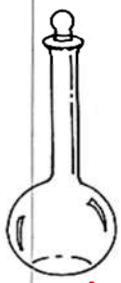


Ring stand

Beaker

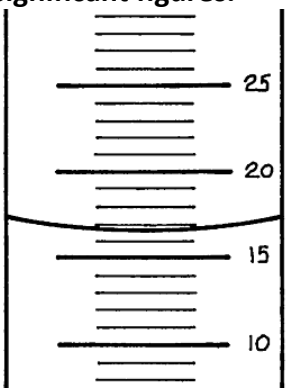
clay triangle

Erlenmeyer flask

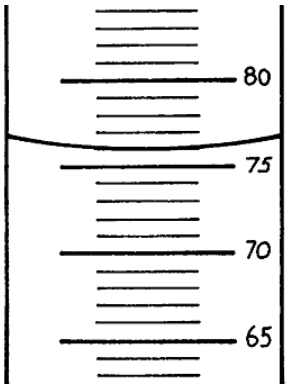


Volumetric flask

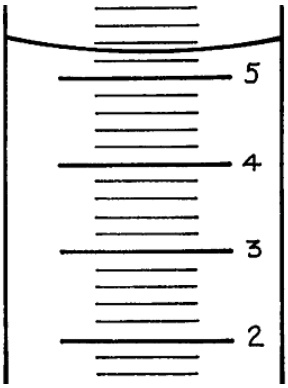
What is the volume of liquid in the graduated cylinders below? Express your answer using the proper number of significant figures.



16.8 mL



76.0 mL



5.32 mL

- **Scientific Method, Experimental Design**

MOUTHWASH: The makers of brand A mouthwash want to prove that their mouthwash kills more bacteria than the other 4 leading brands of mouthwash. They organize 60 test subjects into 6 groups of 10 test subjects. The data for the experiment is shown to the right.

Mouthwash used	time mouthwash was in mouth	# of bacteria in mouth (average)
none		135
A	60 sec.	23
B	60 sec.	170
C	60 sec.	84
D	60 sec.	39
E	60 sec.	81

1. Identify the independent variable **Mouthwash brand**
2. Identity the dependent variable: **# bacteria**
3. List any constants in this experiment **Time**
4. What was the control group? **No mouthwash**
5. What should the conclusion be?
6. How can the makers of brand A mouthwash now test the rinse time (time mouthwash was in mouth) vs how much bacteria is found in the mouth?

- **Metric Conversions**

mega	kilo	hecto	deca	**Basic Unit**	deci	centi	milli	micro
(M)	(k)	(h)	(da)	gram (g)	(d)	(c)	(m)	(μ)
1,000,000	1000	100	10	liter (L)	.1	.01	.001	.000001
10^6	10^3	10^2	10^1	meter (m)	10^{-1}	10^{-2}	10^{-3}	10^{-6}

Convert the following.

1. 35 mL = **0.35** dL
2. 950 g = **0.950** kg
3. 275 mm = **27.5** cm
4. 1,000 L = **1** kL
5. 1,000 mL = **1** L
6. 4,500 mg = **4.5** g
7. 25 cm = **250** mm
8. 0.005 kg = **0.5** dag
9. 0.075 m = **7.5** cm
10. 15 g = **15000** mg

- **Scientific Notation**

Convert the following to scientific notation.

1. 0.005 = 5×10^{-3}
2. 5,050 = 5.05×10^{3}
3. 0.0008 = 8×10^{-4}
4. 1,000 = 1×10^{3}

Convert the following to standard notation.

1. 1.5×10^{3} = 1500
2. 1.5×10^{-3} = 0.0015
3. 3.75×10^{-2} = 0.0375
4. 3.75×10^{2} = 375

- **Significant Figures**

1. 0.02 1
2. 0.020 2
3. 501 3
4. 501.0 4
5. 5,000 1
6. 5,000. 4
7. 6,051.00 6
8. 0.0005 1
9. 0.1020 4
10. 10,001 5

- **Sig Figs and Calculations**

Perform the following operations expressing the answer in the correct number of significant figures.

1. 1.35 m x 2.467 m = $3.33\ m^2$
3. 12.01 mL + 35.2 mL + 6 mL = 53 mL
4. 55.46 g − 28.9 g = 26.6 g
5. .021 cm x 3.2 cm x 100.1 cm = $6.7\ cm^3$
6. 0.15 cm + 1.15 cm + 2.051 cm = 3.35 cm

- **Density**

1. Calculate the density of an object whose mass is 1.6g and volume is 0.234 mL. Report your answer using the proper number of significant figures!

   6.8 g/mL

2. A cube has a mass of 3.56g with a length of 33.3cm, width of 10.9cm, and a height of 0.22cm. Calculate the density. Report your answer using the proper number of significant figures!

   $0.045\ g/cm^3$

- **Percent Error**

Determine the percentage error in the following problems.

1. Experimental Value = 1.24 g
   Accepted Value = 1.30 g

   Answer: 4.62%

3. Experimental Value = 252 mL
   Accepted Value = 225 mL

   Answer: 12%

Unit 2

- **Classification of Matter**

Classify each of the following as to whether it is a substance or a mixture. If it is a substance, write Element or Compound in the substance column. If it is a mixture, w Heterogeneous or Homogeneous in the mixture column.

Type of Matter	Substance	Mixture
1. chlorine	E	
2. water	C	
3. soil		Het
4. sugar water		Hom
5. oxygen	E	
6. carbon dioxide	C	
7. rocky road ice cream		Het
8. alcohol	C	
9. pure air		Hom
10. iron	E	

- **Percent Composition**

Determine the percentage composition of each of the compounds below.

1. $KMnO_4$
   K = 24.74%
   Mn = 34.76%
   O = 40.50%

2. HCl
   H = 2.77%
   Cl = 97.23%

3. $Mg(NO_3)_2$
   Mg = 16.39%
   N = 18.89%
   O = 64.72%

- **Mole, Molar Conversions**

1. What is the number of moles of 512 grams of methanol, CH_3OH?

16.0 moles

2. How many moles are in 352 g of calcium carbonate, $CaCO_3$?

3.52 moles

3. How many atoms are in solid piece of iron (Fe) that has the mass of 62.0 g?

6.68×10^{23} atoms

4. A solid piece of Sodium (Na) has 1.01×10^{22} atoms, what is the mass of the sample of sodium?

0.386 grams

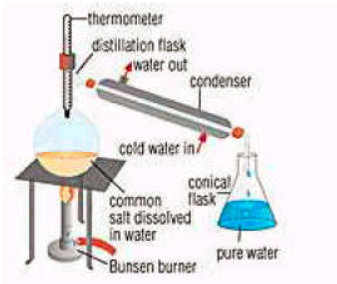
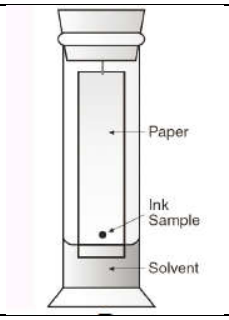
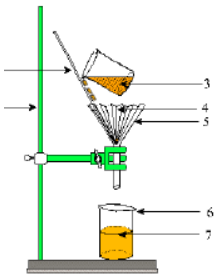
5. How many molecules are in 46.5 mol of potassium hydroxide, KOH?

2.80×10^{25} molecules

6. What is the mass of 5.3×10^{22} molecules of $CuSO_4$?

14 grams

- **Separation Techniques**

Image of separation technique			
Name of technique			
Physical properties taken advantage of			

- **Empirical and Molecular Formulas**

1. The empirical formula of a compound is NO_2. Its molecular mass is 92 g/mol. What is its molecular formula?

   N_2O_4

2. The empirical formula of a compound is CH_2. Its molecular mass is 70 g/mol. What is its molecular formula?

   C_5H_{10}

3. A compound is found to be 40.0% carbon, 6.7% hydrogen and 53.5% oxygen. Its molecular mass is 60. g/mol. What is its molecular formula?

   $C_2H_4O_2$

4. A compound is 64.9% carbon, 13.5% hydrogen and 21.6% oxygen. Its molecular mass is 74 g/mol. What is its molecular formula?

   $C_4H_{10}O$

- **Molarity**

1. What is the molarity of a solution in which 58 g of NaCl are dissolved in 1.0 L of solution?

   0.99 M

2. What is the molarity of a solution in which 10.0 g of $AgNO_3$ is dissolved in 500. mL of solution?

   0.118 M

3. How many grams of KNO_3 should be used to prepare 2.00 L of a 0.500 M solution?

   101 grams

4. To what volume should 5.0 g of KCl be diluted in order to prepare a 0.25 M solution?

   0.27 L

- **Dilutions**

1. How much concentrated 18 M sulfuric acid is needed to prepare 250 mL of a 6.0 M solution?	83.3 mL
2. How much concentrated 12 M hydrochloric acid is needed to prepare 100 mL of a 2.0 M solution?	16.7 mL
3. To what volume should 25 mL of 15 M nitric acid be diluted to prepare a 3.0 M solution?	125 mL
4. To how much water should 50. mL of 12 M hydrochloric acid be added to produce a 4.0 M solution?	100 mL water (V_2 = 150 mL)

- **Physical vs Chemical Properties and Changes**

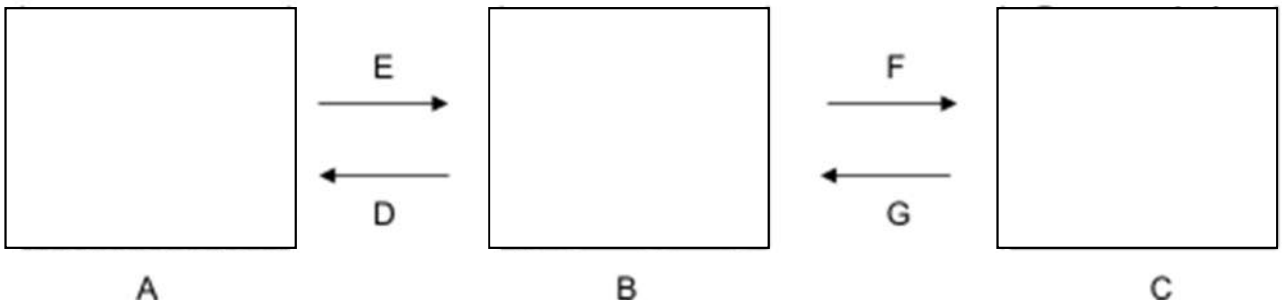
	Physical Property	Chemical Property
1. blue color	X	
2. density	X	
3. flammability		X
4. solubility	X	
5. reacts with acid to form H_2		X
6. supports combustion		X
7. sour taste	X	
8. melting point	X	
9. reacts with water to form a gas		X
10. reacts with a base to form water		X
11. hardness	X	
12. boiling point	X	
13. can neutralize a base		X
14. luster	X	
15. odor	X	

Unit 3

Classify the following as being a physical or chemical change.

1. Sodium hydroxide dissolves in water. PC
2. Hydrochloric acid reacts with potassium hydroxide to produce a salt, water and heat. CC
3. A pellet of sodium is sliced in two. PC
4. Water is heated and changed to steam. PC
5. Potassium chlorate decomposes to potassium chloride and oxygen gas. CC
6. Iron rusts. CC
7. When placed in H_2O, a sodium pellet catches on fire as hydrogen gas is liberated sodium hydroxide forms. CC
8. Evaporation PC
9. Ice melting PC
10. Milk sours. CC
11. Sugar dissolves in water. PC
12. Wood rotting CC
13. Pancakes cooking on a griddle CC
14. Grass growing in a lawn PC
15. A tire is inflated with air. PC
16. Food is digested in the stomach. CC
17. Water is absorbed by a paper towel. PC

- **Phase Changes**
  1. Draw a particle diagram for a sample in the:
     (i) solid phase (labeled A), (ii) liquid phase (labeled B), and (iii) gas phase (labeled C).
  2. Label each arrow (D, E, F, G, H, I) with the appropriate phase change (ex. fusion/melting).
  3. Indicate which phase changes are endothermic and which are exothermic.



- **Reaction Rate**

During a laboratory activity to investigate reaction rate, a student reacts 1.0-gram samples of solid zinc with 10.0-milliliter samples of HCl(aq). The table below shows information about the variables in five experiments the student performed. For the following pairings, identify which experiment would have a faster reaction rate and explain why.

Reaction of Zn(s) with HCl(aq)

Experiment	Description of Zinc Sample	HCl(aq) Concentration (M)	Temperature (K)
1	lumps	0.10	270.
2	powder	0.10	270.
3	lumps	0.10	290.
4	lumps	1.0	290.
5	powder	1.0	280.

a. Exp 1 vs 2

b. Exp 1 vs 3

c. Exp 1 vs 4

- **Stoichiometry Questions:**
  - **Balance the Chemical Equation**
  - **Identify the Type of Reaction**
  - **Solve the Stoichiometry Question**

___1. **___Na + ___H_2O → ___NaOH + ___H_2** **Single Replacement**

How many moles of hydrogen gas are produced when 0.066 moles of sodium is completely reacted?

a. 0.022 mol H_2 **b. 0.033 mol H_2** c. 0.066 mol H_2 d. 0.099 mol H_2

___2. ___CH_4 + ___O_2 → ___CO_2 + ___H_2O **Combustion**

If 1.0 mole of methane reacts with oxygen to produce carbon dioxide and water, what mass of water is produced?

a. 16 grams b. 18 grams **c. 36 grams** d. 44 grams

___3. ___NH_3 → ___N_2 + ___H_2 **Decomposition**

If a student starts with 21.7 g of NH_3, how many grams of hydrogen gas will be produced by the reaction?

a. 1.28 g b. 2.55 g **c. 3.85 g** d. 32.5 g

___4. For the reaction **1 P_4 + 6 H_2 → 4 PH_3**, what is the theoretical yield of PH_3 when 6.2 g of phosphorus reacts with excess hydrogen to form PH_3? **Synthesis**

a. 0.43 g **b. 6.8 g** c. 270 g d. 45 g

Unit 4

INTERMOLECULAR FORCES

1. Fill in the diagram (with **high** or **low**) to show how intermolecular forces influence the **volatility**, **vapor pressure**, and **boiling point** of a substance.

When IMFs are…

weak

volatility is **High**

vapor pressure is **High**

boiling point is **Low**

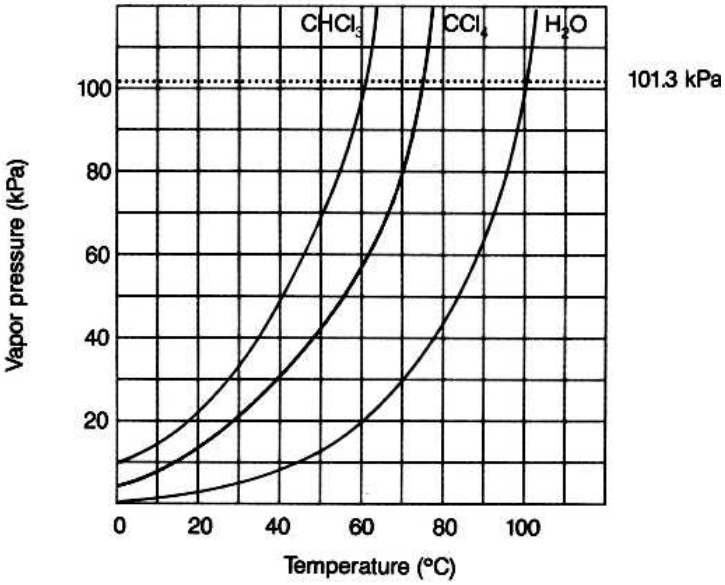
strong

volatility is **low**

vapor pressure is **low**

boiling point is **high**

VAPOR PRESSURE: Use the graph below to answer the following questions.



2. What is the vapor pressure of $CHCl_3$ at 50°C?

70 kPa

3. What is the boiling point of H_2O when the external pressure is 30 kPa?

70°C

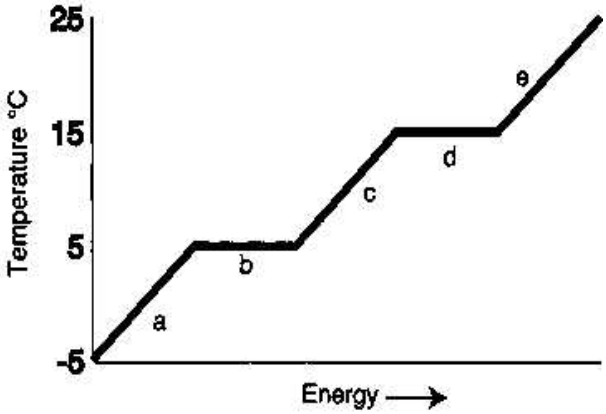
4. What is the normal boiling point of CCl_4?

75°C

5. Which substance has the weakest IMF?

$CHCl_3$

HEATING CURVES. Use the heating curve below to answer the following questions.



6. What is the melting point of the substance?

5°C

7. What is the boiling point of the substance?

15°C

8. Which letter represents heating of the solid?

a

9. Which letter represents heating of the vapor?

e

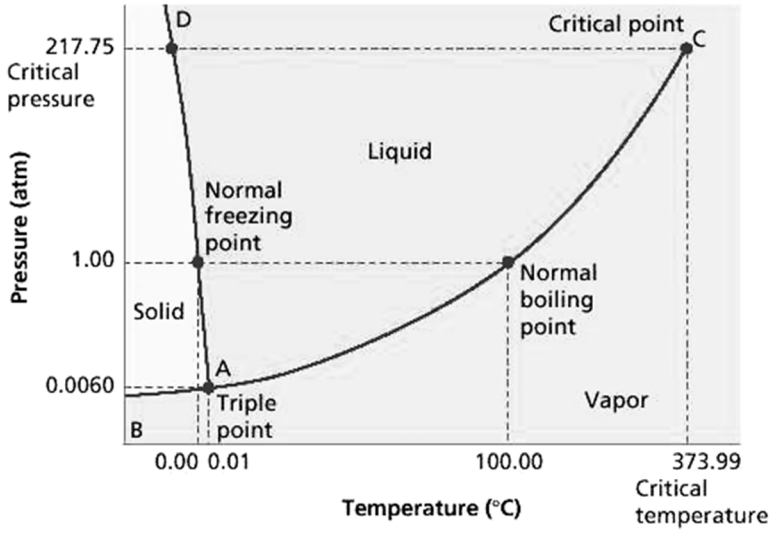
10. Which letter represents melting of the solid?

b

11. Which letter represents boiling of the liquid?

d

PHASE DIAGRAMS. Use the phase diagram for water below to answer the following questions.



12. What is the state of water at 2 atm and 50°C?

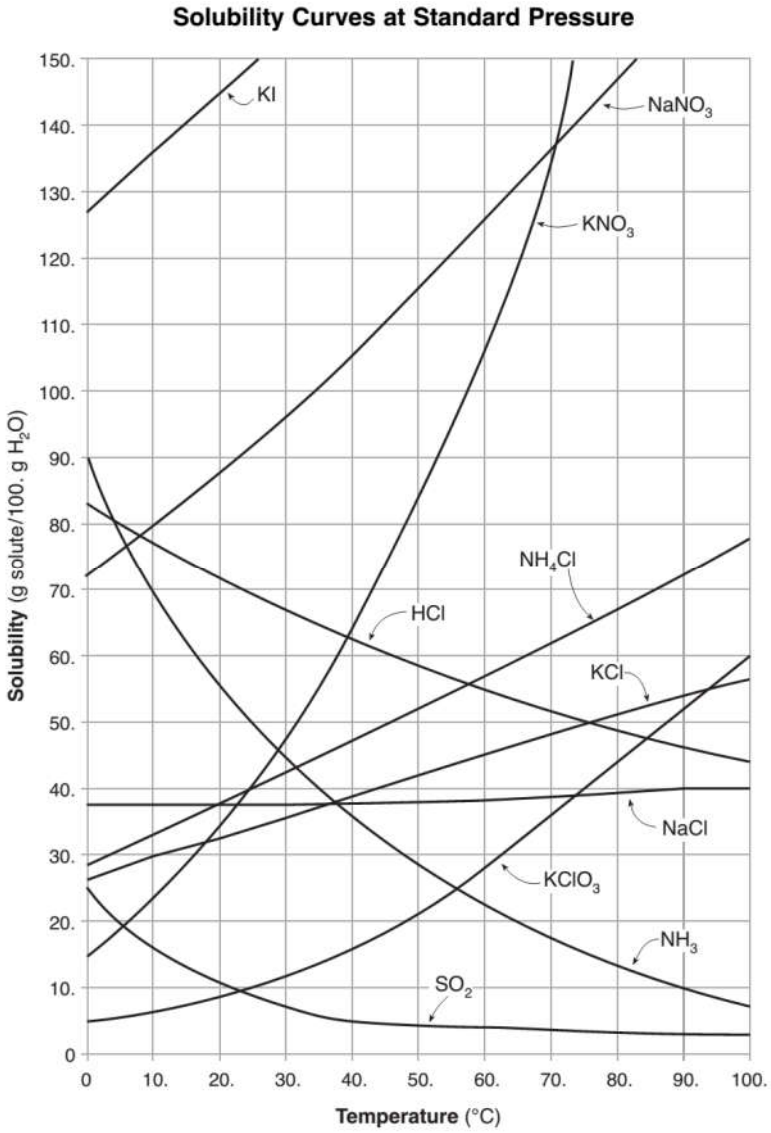
    Liquid

13. What phase change will occur if the temperature is lowered from 80°C to -5°C at 1 atm? **Freezing**

14. You have ice at -10°C and 1 atm. What could you do in order cause the ice to sublime?

    Decrease the pressure

Solubility: Use the solubility curve below to answer the following questions:



1. How is the solubility of gases in water different from the solubility of solids in water?

2. Which compound's solubility is most affected by the change in temperature?

   KNO_3

3. At 60ºC, what is the saturation point for NaCl? In other words, how much NaCl can be dissolved in 100 g of water at 60ºC to make a saturated solution?

   38 g

4. At 80ºC, 160 g of **$NaNO_3$** has been dissolved in water. Is this solution saturated, unsaturated, or supersaturated?

   Supersaturated

5. At 20ºC, 100 g of **KI** has been dissolved in water. Is this solution saturated, unsaturated, or supersaturated?

   Unsaturated

6. At 5ºC, 60 g of **KCl** has been dissolved in water. Is this solution saturated, unsaturated, or supersaturated?

   supersaturated

7. Explain the term "like dissolves like" regarding how polarity and solubility are related.

Heat Calculations:

1. The specific heat of ethanol is 2.44J/g·˚C. Find the heat required to raise the temperature of 193g of ethanol from 19˚C to 35˚C.

7535 J

2. When a 120 g sample of aluminum absorbs 9612 J of energy, its temperature increases from 25˚C to 115˚C. Find the specific heat of aluminum. Be sure to include the correct unit for specific heat!

0.89 J/g°C

3. When a solid is melting to a liquid, does the temperature change? Why or why not?

no

4. When a liquid is being heated up to, but not at its boiling point, does the temperature change? Why or why not?

yes

5. What is the relationship between temperature and equilibrium vapor pressure? Explain.

direct

6. ΔH represents the change in temperature of a reaction. The sign of the ΔH, whether positive or negative, indicates if the reaction going forwards or backwards.

a. ΔH_{fus}=23.4kJ/mol, therefore melting is occurring. If ΔH_{fus}=–23.4kJ/mol, what change in state is occurring?

freezing

b. ΔH_{vap}=105kJ/mol, what change in state is occurring?

boiling

7. What is the energy required to melt 2.34g of zinc metal? (ΔH_{fus}=7.323kJ/**mole)**

0.26 kJ