

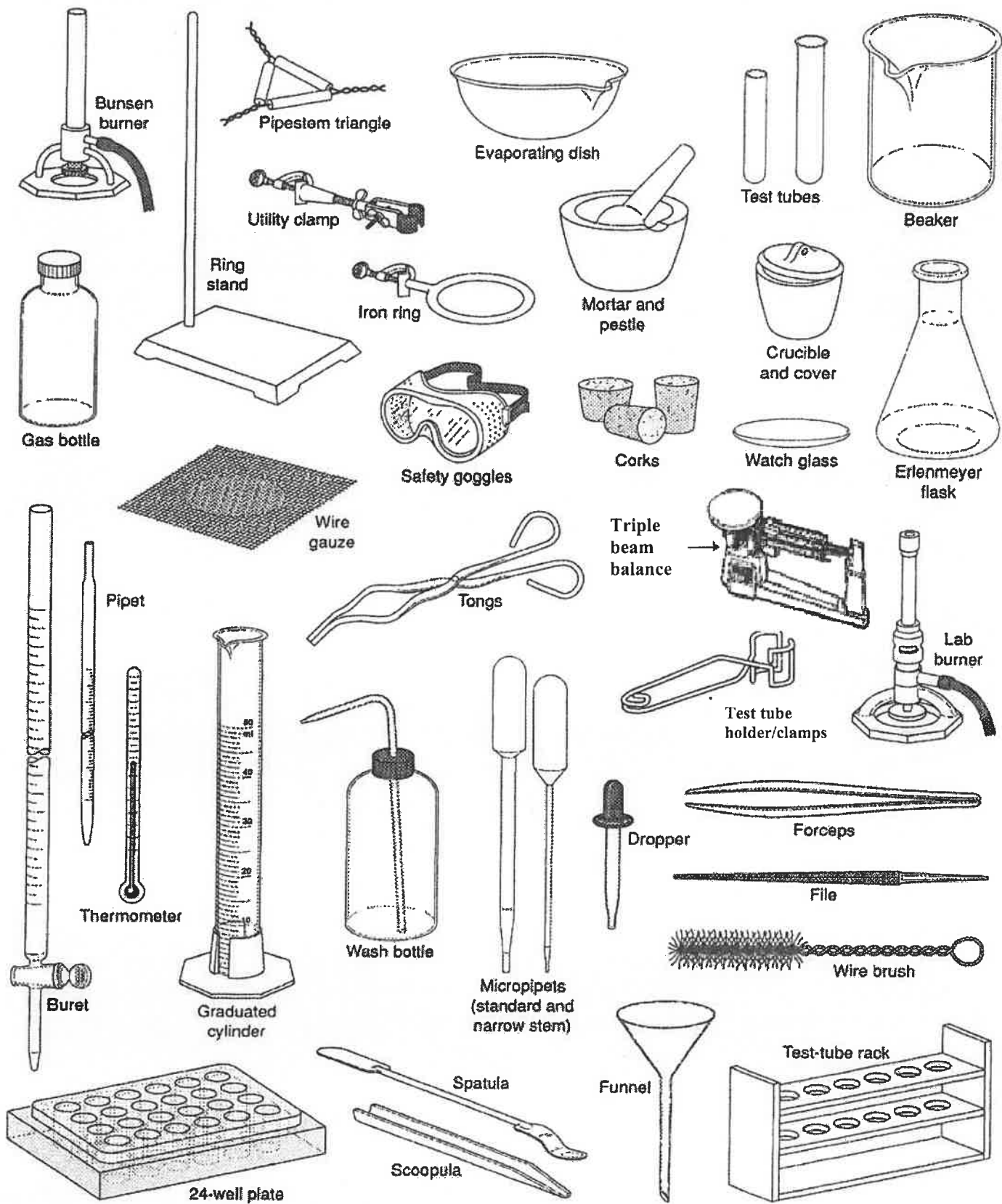
**Academic Chemistry**  
**Unit 1: Properties of Matter**

Date	Classwork	Homework
Tues. 1/28	Class Introduction Lab Equipment Activity	- Lab Equipment Practice (pgs 1-2) - Study for Elements Quiz # 1-20
Wed. 1/29	No School - Teacher Workday	- Lab Equipment Practice (pgs 1-2) - Study for Elements Quiz # 1 Elements 1-20
Thurs. 1/30	<b>Element Quiz #1</b> Notes and Practice: (pg 3) - Classification of Matter (pgs 4-7) - Physical and Chemical Properties/Changes(pg 8) - Signs of Chemical Changes (pg 9) Assignment Element and Me Project	- Classification of Matter and Physical/chemical changes worksheet (pgs 10-11) - Study for Safety Quiz <b>- Element and Me Project due Thurs (2/6)</b>
Fri. 1/31	<b>Safety Quiz</b> Lab - physical and chemical changes and types of matter	- Study for Elements Quiz #2 <b>- Element and Me Project due Thurs (2/6)</b>
Mon. 2/3	<b>Elements Quiz #2</b> Notes: Phase Diagrams (pg 12) CW: Phase Diagrams Practice (13-18)	- Phase Diagram Practice worksheet (pgs 19-20) - Study for Quiz <b>- Element and Me Project due Thurs (2/6)</b>
Tues. 2/4	<b>States of Matter and Phase Diagrams Quiz</b> Notes: Heating Curves (pg 21) CW: Heating Curves (pg 22-27)	- Heating Curve Worksheet (pg 28) <b>- Element and Me Project due Thurs (2/6)</b>
Wed. 2/5	Notes: Density (pg 29) CW: Density (pg 30)	- Density Worksheet (pg 31) <b>- Element and Me Project due Thurs (2/6)</b>
Thurs. 2/6	<b>Heating Curves and Density Quiz</b> Density Lab Review	- Complete Review sheet - study for test
Fri. 2/7	<b>Test</b> Start Unit 2	

Objectives:

1. Identify piece of lab equipment and know what they are used to measure.
2. Be able to classify different types of matter (element, compound, homogenous and heterogenous mixtures) based on descriptions and pictures.
3. Classify properties and changes as either chemical or physical.
4. Describe the evidence of a chemical change.
5. Interpret/read a phase change diagrams (where states of matter are, names and locations of phase changes, triple point, critical point, and normal melting, freezing and boiling point)
6. Interpret heating curves (states of matter, freezing, melting, boiling, condensation points)
7. Know the difference between endothermic and exothermic and apply to phase changes.
8. Be able to solve the density equation for mass, volume, and density.

Directions: A number of items that may be used in the laboratory are shown below. Study this page and decide what the items may be used for. Use the names of the equipment shown to answer the questions included.



Name \_\_\_\_\_ Date \_\_\_\_\_ Hour \_\_\_\_\_ Table # \_\_\_\_\_

## Lab Equipment

*Name each piece of equipment that would be useful for each of the following tasks:*

1. Holding 100mL of water (ebkare) \_\_\_\_\_
2. Measuring 27 mL of liquid (daudgtear ldnreiy) \_\_\_\_\_
3. Measuring exactly 43mL of an acid (rtube) \_\_\_\_\_
4. Massing out 120 g of sodium chloride (acbnela) \_\_\_\_\_
5. Suspending glassware over the Bunsen burner (rwei zeagu) \_\_\_\_\_
6. Used to pour liquids into containers with small openings or to hold filter paper (unfenl) \_\_\_\_\_
7. Mixing a small amount of chemicals together (lewl letpa) \_\_\_\_\_
8. Heating contents in a test tube (estt ubet smalcp) \_\_\_\_\_
9. Holding many test tubes filled with chemicals (estt ubet karc) \_\_\_\_\_
10. Used to clean the inside of test tubes or graduated cylinders (iwer srboh) \_\_\_\_\_
11. Keeping liquid contents in a beaker from splattering (tahcw sgasl) \_\_\_\_\_
12. A narrow-mouthed container used to transport, heat or store substances, often used when a stopper is required (ymerereel kslaf) \_\_\_\_\_
13. Heating contents in the lab (nuesnb bneurr) \_\_\_\_\_
14. Transport a hot beaker (gntos) \_\_\_\_\_
15. Protects the eyes from flying objects or chemical splashes (ggloges) \_\_\_\_\_
16. Used to grind chemicals to powder (tmraor nda stlepe) \_\_\_\_\_

# Notes: Matter

# Classification of Matter

Name \_\_\_\_\_

**WHY?** Everything in this room is made up of matter. The “matter” may be pure or it may be a mixture. How can you tell by looking at it? What if you could see the particles that make up the matter? This activity asks you to explore the smallest chemical units of matter. You should be able to determine why a substance is classified as an element or a compound and understand the difference between a pure substance and a mixture.

**Model 1**

The diagram consists of a 3x3 grid of boxes, each containing particle models. The boxes are labeled as follows:

- Top-left:** Labeled **R**. Contains 8 circles. One circle is labeled **atom**. Below the box is the text **8 particles**.
- Top-middle:** Labeled **T & RSq & R**. Contains triangles, squares, and circles. Below the box is the text **chemical bond**.
- Top-right:** Labeled **?**. Contains several triangles.
- Middle-left:** Labeled **?**. Contains groups of circles and squares. One group is labeled **molecule**. Below the box is the text **chemical bond**.
- Middle-middle:** Labeled **RSq molecule**. Contains circles and squares. One group is labeled **molecule**. Below the box is the text **atoms**.
- Middle-right:** Labeled **Sq<sub>2</sub>**. Contains pairs of squares. One pair is labeled **molecule**. Below the box is the text **chemical bond**.
- Bottom-left:** Labeled **?**. Contains circles and squares.
- Bottom-middle:** Labeled **TSq<sub>2</sub>R**. Contains triangles, squares, and circles. Below the box is the text **5 particles**.
- Bottom-right:** Labeled **SqR<sub>3</sub> & TSq**. Contains squares, circles, and triangles. One group is labeled **molecule**. Below the box is the text **chemical bond**.

- 1) If **R** represents “round” and **T** stands for “triangle”, what does the **Sq** represent?
- 2) Find the blocks labeled “?” and write the appropriate label above each of these blocks. (there are 3 to do)
- 3) What do you think it means when the shapes are touching each other? \_\_\_\_\_

4) Several squares in Model 1 have “subscripts”. What does the 2 mean in “TSq<sub>2</sub>R”?

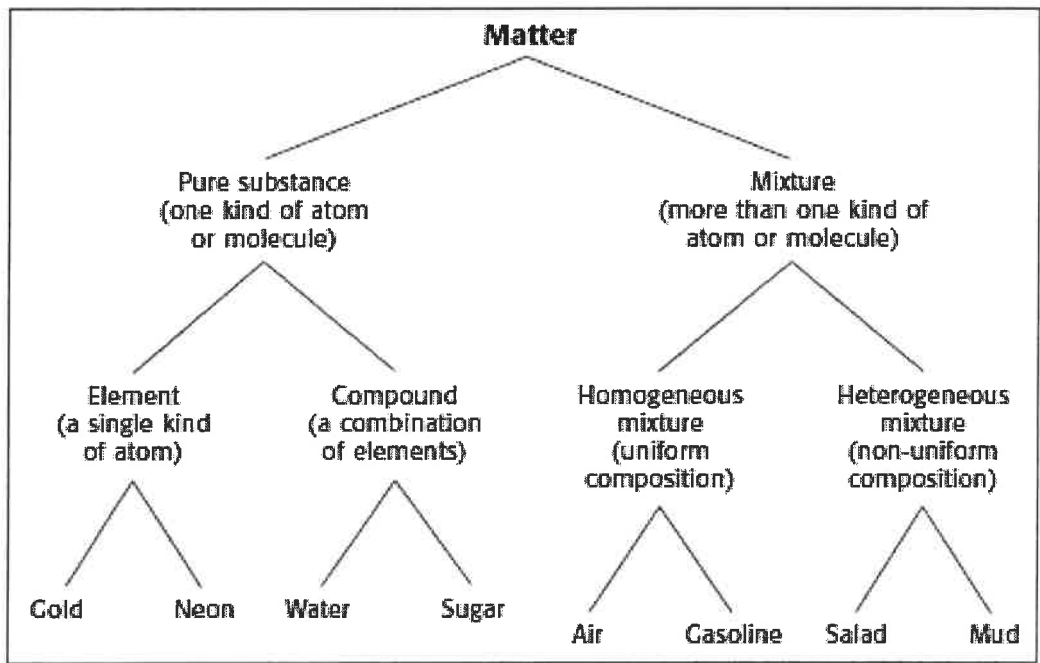
5) A “mixture” is a combination of 2 or more different things that are not bonded together. How can you identify the mixtures shown in Model 1?

Complete the chart to show your understanding of atoms and molecules.

#	Code	How many different types of <i>molecules</i> ?	How many different types of <i>atoms</i> ?
6	RSq		
7	Sq <sub>2</sub>		
8	T & RSq & R		
9	TSq <sub>2</sub> R		
10	SqR <sub>3</sub> & TSq		

12) Can a particle be a single atom? \_\_\_\_\_ Can a particle be a molecule? \_\_\_\_\_

13) How many different kinds of particles are in the drawing represented by the code T & RSq & R in Model 1? \_\_\_\_\_ How many total particles are in this same drawing? \_\_\_\_\_



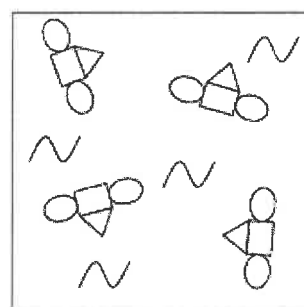
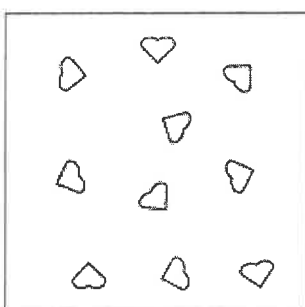
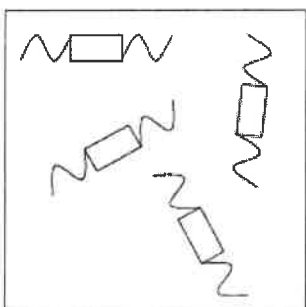
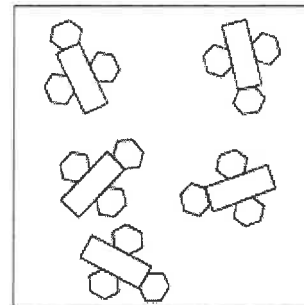
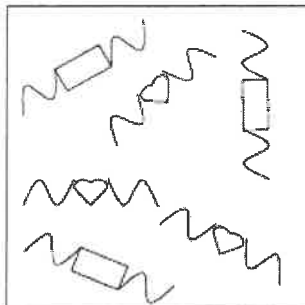
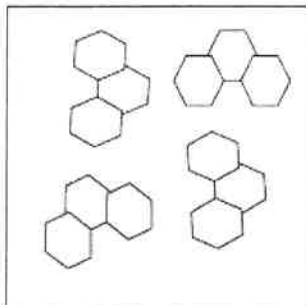
**Vocabulary**

- Element- only one kind of atom
- Compound- 2 or more kinds of atoms bonded together
- Pure substance- either an element or a compound; homogeneous
- Mixture- 2 or more things combined together but not chemically bonded
- Solution- 2 or more substances that are dissolved; a solute in a solvent; homogeneous mixture

14) Using the Concept Map and the Vocabulary above, classify each of the 9 drawings in Model 1 as an ELEMENT, COMPOUND, or MIXTURE. Write the correct label below each of the drawings.

### Assessment Questions:

1. Identify each of the drawings below as an element, a compound or a mixture.



2. Identify the common household items shown below as an element (E), a compound (C), or a mixture (M). The chemical formulas are shown to help you decide how these should be classified.

a) gold (Au)	g) sugar ( $C_{12}H_{22}O_{11}$ )
b) salt water ( $NaCl$ & $H_2O$ )	h) sodium chloride ( $NaCl$ )
c) granite ( $SiO_2$ & $KAlSi_3O_8$ & $K_2Si_2O_7$ )	i) battery acid ( $H_2SO_4$ )
d) oxygen ( $O_2$ )	j) vinegar ( $H_2O$ & $HC_2H_3O_2$ )
e) air ( $N_2$ & $O_2$ & $CO_2$ ...)	k) water ( $H_2O$ )
f) drain cleaner ( $Al$ & $NaOH$ )	l) baking soda ( $NaHCO_3$ )

I. Identify each material below as:

HE – heterogeneous (must be a heterogeneous mixture) or

HO – homogeneous (element, compound, or homogeneous mixture)

- 1. water
- 2. oxygen
- 3. vegetable soup
- 4. notebook paper
- 5. salt water
- 6. orange juice
- 7. bread
- 8. a cupcake

- 9. air
- 10. wood
- 11. silver
- 12. salt (sodium chloride)

II. Identify each material below as:

M - mixture (heterogeneous or homogeneous),

C - compound, or E - element

- 13. calcium
- 14. sugar ( $C_{12}H_{22}O_{11}$ )
- 15. mud
- 16. iced tea
- 17. wood
- 18. chalk (calcium carbonate)
- 19. aluminum
- 20. pencil
- 21. chocolate
- 22. carbon dioxide
- 23. salt (sodium chloride)
- 24. salt water



## Physical and Chemical Changes

Name: \_\_\_\_\_

Date: \_\_\_\_\_ Hour: \_\_\_\_

Place a check in the appropriate column:

Change	Physical Change	Chemical Change
Salt dissolves in water.		
Hydrochloric acid reacts with magnesium to produce hydrogen gas.		
A piece of copper is cut in half.		
A sugar cube is ground up.		
Water is heated and changed to steam.		
Iron rusts.		
Ethyl alcohol evaporates.		
Ice melts.		
Milk sours (goes bad).		
Sugar dissolves in water.		
Sodium and potassium react violently with water.		
Pancakes cook on a griddle.		
Grass grows on a lawn.		
A tire is inflated with air.		
Food is digested in the stomach.		
Water is absorbed by a paper towel.		
Ethyl alcohol boils at 79°C.		
Paper burns.		
Water freezes at 0°C.		
Fireworks explode.		
Alka-Seltzer gives off carbon dioxide when added to water.		
Clouds form in the sky.		

**Part B**

Read each scenario. Decide whether a physical or chemical change has occurred and give evidence for your decision. The first one has been done for you to use as an example.

	Scenario	Physical or Chemical Change?	Evidence...
1.	Umm! A student removes a loaf of bread hot from the oven. The student cuts a slice off the loaf and spreads butter on it.	Physical	No change in substances. No unexpected color change, temperature change or gas given off.
2.	Your friend decides to toast a piece of bread, but leaves it in the toaster too long. The bread is black and the kitchen is full of smoke.		
3.	You forgot to dry the bread knife when you washed it and reddish brown spots appeared on it.		
4.	You blow dry your wet hair.		
5.	In baking biscuits and other quick breads, the baking powder reacts to release carbon dioxide bubbles. The carbon dioxide bubbles cause the dough to rise.		
6.	You take out your best silver spoons and notice that they are very dull and have some black spots.		
7.	A straight piece of wire is coiled to form a spring.		
8.	Food color is dropped into water to give it color.		
9.	Chewing food to break it down into smaller particles represents a _____ change, but the changing of starch into sugars by enzymes in the digestive system represents a _____ change.		
10.	In a fireworks show, the fireworks explode giving off heat and light.		

**Part C: True (T) or False (F)**

1.	Changing the size and shapes of pieces of wood would be a chemical change.
2.	In a physical change, the makeup of matter is changed.
3.	Evaporation occurs when liquid water changes into a gas.
4.	Evaporation is a physical change.
5.	Burning wood is a physical change.
6.	Combining hydrogen and oxygen to make water is a physical change.
7.	Breaking up concrete is a physical change.
8.	Sand being washed out to sea from the beach is a chemical change.
9.	When ice cream melts, a chemical change occurs.
10.	Acid rain damaging a marble statue is a physical change.

## Elements, Compounds, and Mixtures

Classify each of the pictures below by placing the correct label in the blanks below:

A= Element

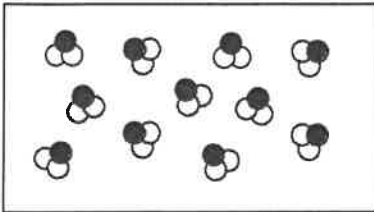
D= Mixture of compounds

B= Compound

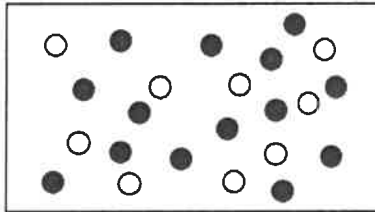
E= Mixture of elements and compounds

C= Mixture of elements

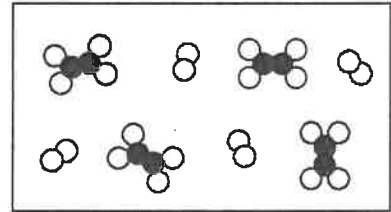
Each circle represents an atom and each different color represents a different kind of atom. If two atoms are touching then they are bonded together.



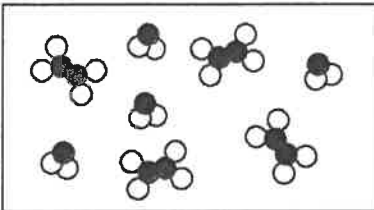
1) \_\_\_\_\_



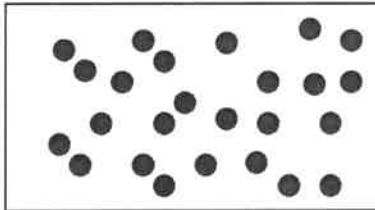
2) \_\_\_\_\_



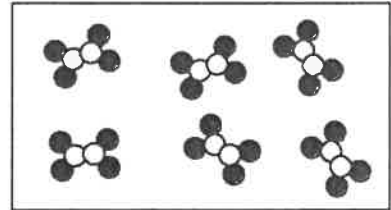
3) \_\_\_\_\_



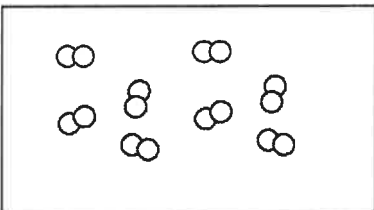
4) \_\_\_\_\_



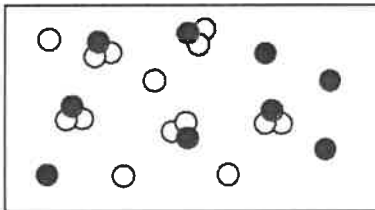
5) \_\_\_\_\_



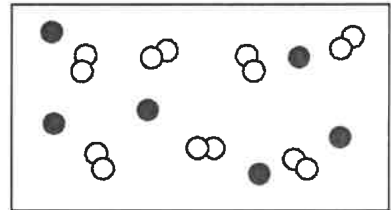
6) \_\_\_\_\_



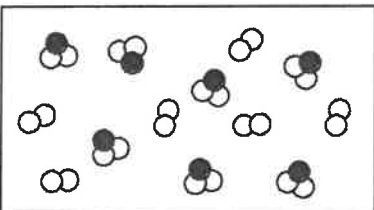
7) \_\_\_\_\_



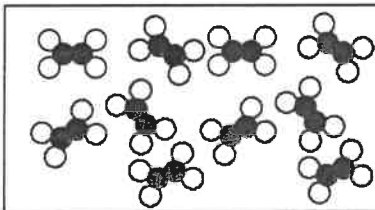
8) \_\_\_\_\_



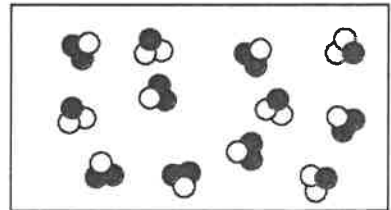
9) \_\_\_\_\_



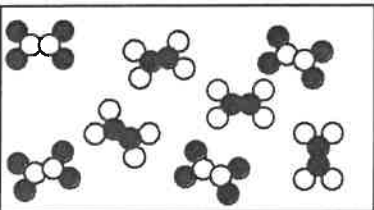
10) \_\_\_\_\_



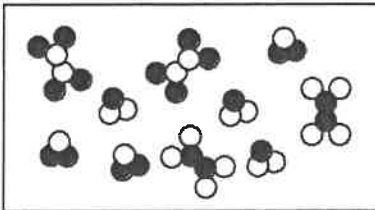
11) \_\_\_\_\_



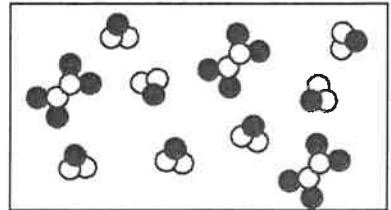
12) \_\_\_\_\_



13) \_\_\_\_\_



14) \_\_\_\_\_



15) \_\_\_\_\_

NAME \_\_\_\_\_

**INSTRUCTIONS:** Write **E** in the blank if the material is *heterogeneous* or **O** if it is *homogeneous*.

- |                                |       |                               |       |
|--------------------------------|-------|-------------------------------|-------|
| 1. Wood                        | _____ | 6. Dirt                       | _____ |
| 2. Freshly-brewed black coffee | _____ | 7. Sausage-and-mushroom pizza | _____ |
| 3. Water                       | _____ | 8. Air                        | _____ |
| 4. Lucky Charms®               | _____ | 9. Milk                       | _____ |
| 5. Salt                        | _____ | 10. Gold                      | _____ |

**INSTRUCTIONS:** Classify each of the following as an *element* [E], a *compound* [C], or a *mixture* [M].

- |                        |       |                    |       |
|------------------------|-------|--------------------|-------|
| 11. Gold               | _____ | 16. Air            | _____ |
| 12. Water              | _____ | 17. Carbon dioxide | _____ |
| 13. Seawater           | _____ | 18. Silver         | _____ |
| 14. Sugar              | _____ | 19. Ice            | _____ |
| 15. A chocolate sundae | _____ | 20. A Big Mac®     | _____ |

**INSTRUCTIONS:** Classify each of the following properties of matter as *physical* [P] or *chemical* [C].

- |                              |       |                                    |       |
|------------------------------|-------|------------------------------------|-------|
| 21. Color                    | _____ | 26. Reacts violently with chlorine | _____ |
| 22. Density                  | _____ | 27. Good conductor of heat         | _____ |
| 23. Burns easily (flammable) | _____ | 28. Dissolves readily in water     | _____ |
| 24. Not affected by acids    | _____ | 29. Melts at 145 °C                | _____ |
| 25. Boils at 450 °C          | _____ | 30. Malleable                      | _____ |

**INSTRUCTIONS:** Classify each of the following changes in matter as *physical* [P] or *chemical* [C].

- |                                 |       |                                |       |
|---------------------------------|-------|--------------------------------|-------|
| 31. Grinding chalk into powder  | _____ | 36. Burning gasoline           | _____ |
| 32. Dissolving salt in water    | _____ | 37. Hammering gold into foil   | _____ |
| 33. Dissolving zinc in acid     | _____ | 38. Melting ice                | _____ |
| 34. Tearing a piece of paper    | _____ | 39. Digesting food             | _____ |
| 35. Stretching copper into wire | _____ | 40. Making hydrogen from water | _____ |

**INSTRUCTIONS:** Classify each of the following as an *intensive property* [I] or an *extensive property* [E].

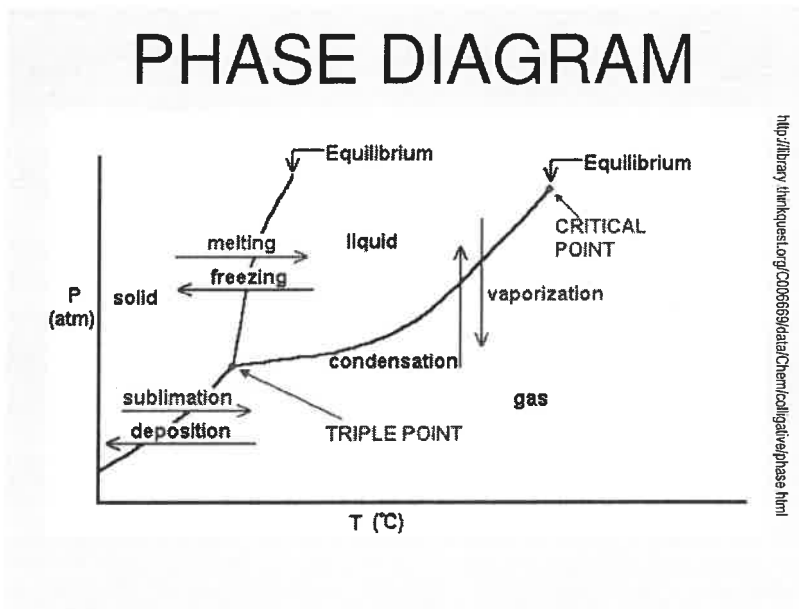
- |                   |       |            |       |
|-------------------|-------|------------|-------|
| 41. Mass          | _____ | 46. Color  | _____ |
| 42. Density       | _____ | 47. Volume | _____ |
| 43. Melting point | _____ | 48. Length | _____ |

# Notes: Phase Diagrams

# Phase Diagram POGIL

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Model 1

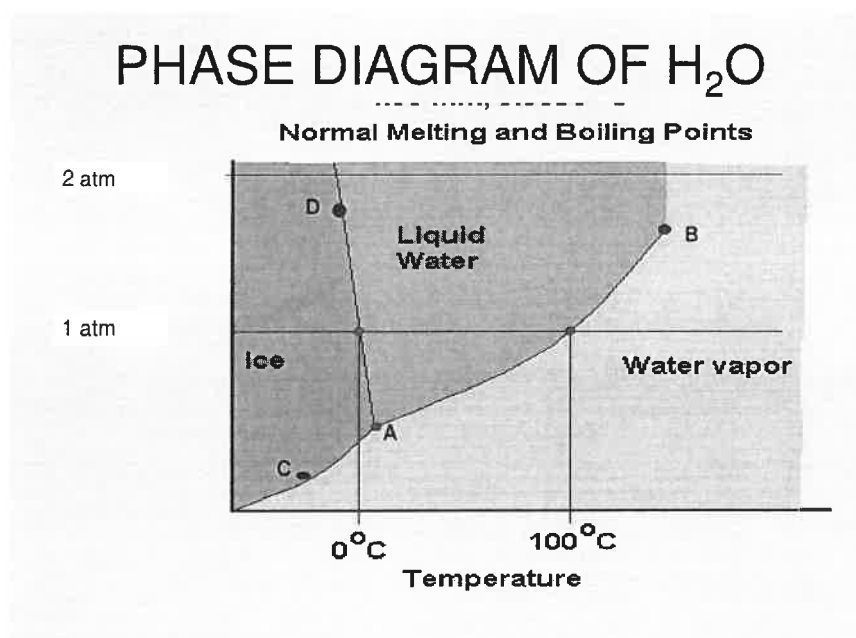
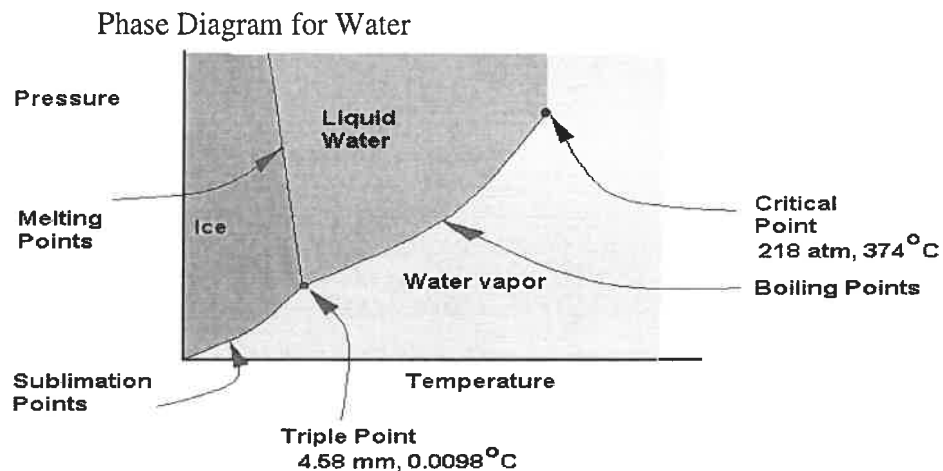


A phase diagram is a graphical way to summarize the conditions under which equilibria exist between the different states of matter. It also allows us to predict the phase of a substance that is stable at any given temperature and pressure.

### Critical Thinking Questions

1. What Label is on the x-axis?
2. What Label is on the y-axis?
3. List the three phases of matter that are on the diagram.
4. At which point do all three phases on the diagram meet?
5. In your own words, define what you think the triple point is.
6. The line extending from the triple point to the critical point stops. What does this mean in terms of phase change?
7. In your own words, define what you think the critical point is.

## Model 2

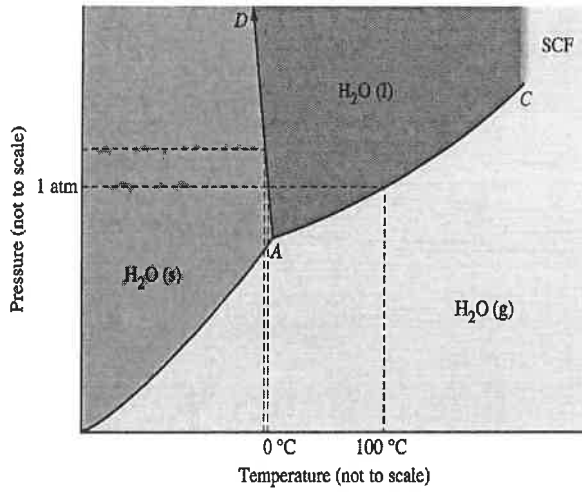


### Critical Thinking Questions

- Identify the following points: A, B, C, D
- If the line AD represents the melting/freezing line for water, what would the AB line represent? What would the AC line represent?

10. Given the phase diagram above, what phase would water be in if it had the following properties:
- 50 °C, and 0.5 atm pressure
  - 50°C, and 0.5 atm pressure
  - 125 °, and 1.0 atm pressure

### Model 3



11. In the diagram above, what do (s), (l), and (g) represent?

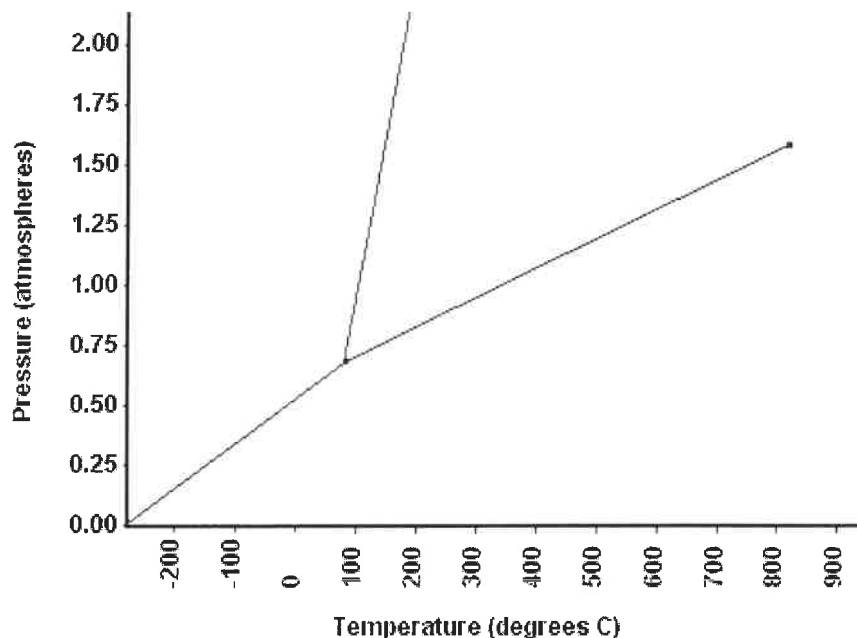
Using the phase diagram of the liquid above, describe any changes in phase present when H<sub>2</sub>O is:

- Kept at 0°C while the pressure is increased from 1 atm to 5atm (vertical line)
- Kept at 1.00 atm while the temperature is increased from 0 °C to 125 °C. (horizontal line)



## Phase Diagram Worksheet

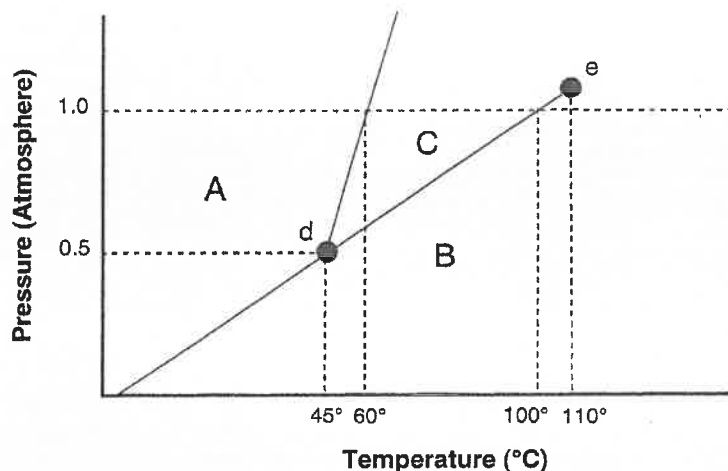
Refer to the phase diagram below when answering the questions on this worksheet:



- 1) What is the normal freezing point of this substance?
- 2) What is the normal boiling point of this substance?
- 3) What is the triple point of this substance?
- 4) If I had a quantity of this substance at a pressure of 2.00 atm and a temperature of 300<sup>o</sup> C and lowered the pressure to 0.5 atm, what phase transition(s) would occur?
- 5) If I had a quantity of this substance at a pressure of 0.75 atm and a temperature of -100<sup>o</sup> C, what phase change(s) would occur if I increased the temperature to 600<sup>o</sup> C? At what temperature(s) would they occur?

## PHASE DIAGRAM WORKSHEET

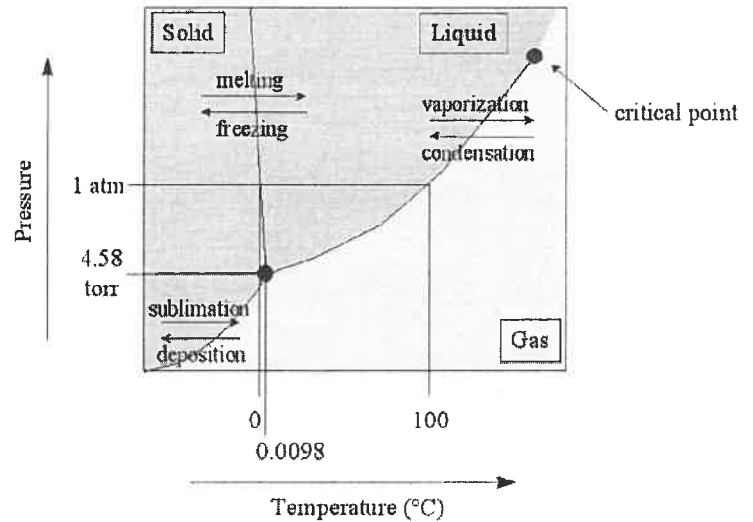
**Part A** – Answer the questions below in relation to the following phase diagram.



1. Which section represents the solid phase? \_\_\_\_\_
2. What section represents the liquid phase? \_\_\_\_\_
3. What section represents the gas phase? \_\_\_\_\_
4. What letter represents the triple point? \_\_\_\_\_ In your own words, what is the definition of a triple point?
  
5. What is this substance's normal melting point, at 1 atmosphere of pressure? \_\_\_\_\_
6. What is this substance's normal boiling point, at 1 atmosphere of pressure? \_\_\_\_\_
7. Above what temperature is it impossible to liquefy this substance, no matter what the pressure? \_\_\_\_\_
8. At what temperature and pressure do all three phases coexist? \_\_\_\_\_
9. At a constant temperature, what would you do to cause this substance to change from the liquid phase to the solid phase?
10. What does sublimation mean?
11. What does deposition mean? \_\_\_\_\_

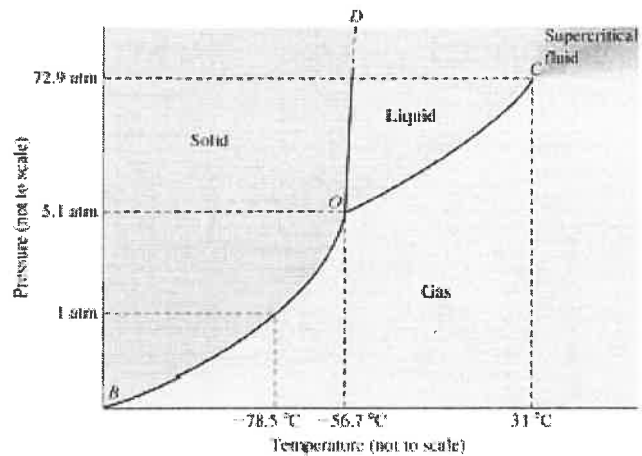
**Part B – Phase Diagram for Water.**

12. At a pressure of 1 atmosphere, what is the normal freezing point of water? \_\_\_\_\_
13. What is the normal boiling point of water, at one atmosphere of water? \_\_\_\_\_
14. Albuquerque, NM is approximately 5,500 feet above sea level, which means the normal atmospheric pressure is less than 1 atm. In Albuquerque, will water freeze at a lower temperature or a higher temperature than at 1 atmosphere? \_\_\_\_\_ Will water boil at a higher or lower temperature, than at 1 atmosphere? \_\_\_\_\_



**Part C – Phase Diagram for Carbon Dioxide.**

15. At 1 atmosphere and room temperature (25°C), would you expect solid carbon dioxide to melt to the liquid phase, or sublime to the gas phase? \_\_\_\_\_
16. Some industrial processes require carbon dioxide. The carbon dioxide is stored on-site in large tanks as liquid carbon dioxide. Assuming the tanks are at sea level (1 atm), how could carbon dioxide be liquefied?



# Phase Diagram Worksheet #1

A **phase diagram** is a graphical way to depict the effects of **pressure** and **temperature** on the phase of a substance:

The **CURVES** indicate the conditions of **temperature** and **pressure** under which “equilibrium” between different phases of a substance can exist. **BOTH** phases exist on these lines:

**Melting/Freezing:** Any point on this line (pressure & temperature) the substance is both **solid** and **liquid**

**Sublimation/Deposition:** Any point on this line (pressure & temperature) the substance is both **solid** and **gas**

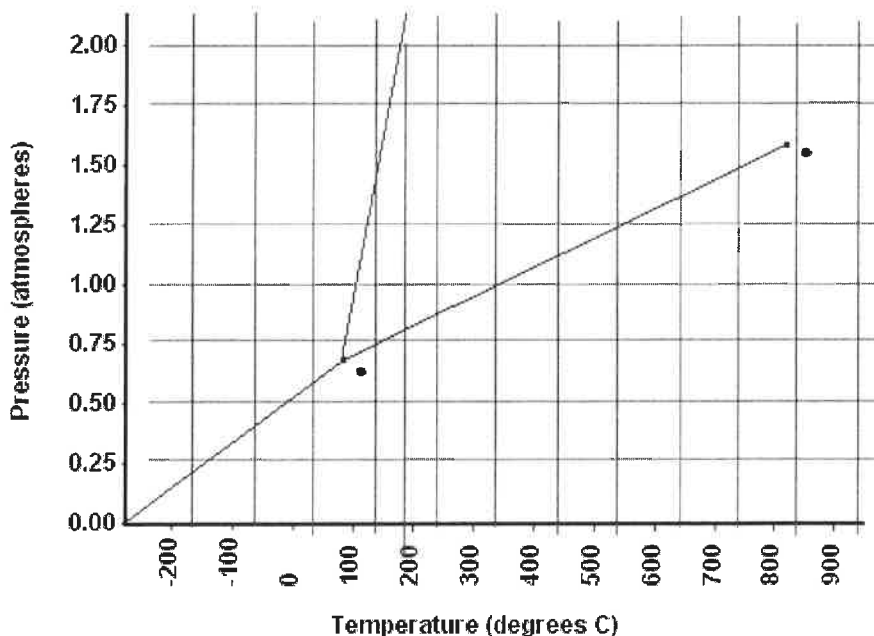
**Vaporization/Condensation:** Any point on this line (pressure & temperature) the substance is both **liquid** and **gas**

**NOTE:** the vapor pressure curve ends at the **critical point**, the temperature above which the gas cannot be liquefied no matter how much pressure is applied (the kinetic energy simply is too great for attractive forces to overcome). Any substance beyond this critical point is called a **supercritical fluid** – *indistinguishable* between gas or liquid (*neither one*)

The **TRIPLE POINT** is the condition of temperature and pressure where ALL THREE phases exist in equilibrium (solid, liquid, gas)

Remember that pressure can be expressed in many units where: **1 atm = 101.3 kpa = 760 mmHg**

**NOTE:** “Normal” refers to Standard Pressure.



- 1) What are the values for temperature and pressure at STP? T= \_\_\_\_\_, P= \_\_\_\_\_
- 2) What is the *normal* freezing point of this substance? \_\_\_\_\_
- 3) What is the *normal* boiling point of this substance? \_\_\_\_\_
- 4) What is the *normal* melting point of this substance? \_\_\_\_\_
- 5) What is the phase (s, l, g) of a substance at **2.0 atm** and 100 °C? \_\_\_\_\_
- 6) What is the phase (s, l, g) of a substance at **0.75 atm** and 100 °C? \_\_\_\_\_

- 7) What is the phase (s, l, g) of a substance at **0.5 atm** and 100 °C? \_\_\_\_\_
- 8) What is the phase (s, l, g) of a substance at 1.5 atm and **50 °C**? \_\_\_\_\_
- 9) What is the phase (s, l, g) of a substance at 1.5 atm and **200 °C**? \_\_\_\_\_
- 10) What is the phase (s, l, g) of a substance at 1.5 atm and **800 °C**? \_\_\_\_\_
- 11) What is the condition of the **triple point** of this substance? T= \_\_\_\_\_, P= \_\_\_\_\_
- 12) If a quantity of this substance was at an initial pressure of 1.25 atm and a temperature of **300° C** was lowered to a pressure of 0.25 atm, what phase transition(s) would occur? \_\_\_\_\_
- 13) If a quantity of this substance was at an initial pressure of 1.25 atm and a temperature of **0° C** was lowered to a pressure of 0.25 atm, what phase transition(s) would occur? \_\_\_\_\_
- 14) If a quantity of this substance was at an initial pressure of **1.0 atm** and a temperature of 200° C was lowered to a temperature of -200° C, what phase transition(s) would occur? \_\_\_\_\_
- 15) If a quantity of this substance was at an initial pressure of **0.5 atm** and a temperature of 200° C was lowered to a temperature of -200° C, what phase transition(s) would occur? \_\_\_\_\_
- 16) If this substance was at a pressure of 1.25 atm, at what temperature would it **melt**?  
\_\_\_\_\_
- 17) If this substance was at a pressure of 1.25 atm, at what temperature would it **boil**? \_\_\_\_\_
- 18) If this substance was at a pressure of 0.75 atm, at what temperature would it **melt**? \_\_\_\_\_
- 19) If this substance was at a pressure of 0.75 atm, at what temperature would it **boil**? \_\_\_\_\_
- 20) At what temperature do the gas and liquid phases become indistinguishable from each other? \_\_\_\_\_
- 21) At what pressure would it be possible to find this substance in the gas, liquid, **and** solid phase? \_\_\_\_\_
- 22) If I had a quantity of this substance at a pressure of 1.00 atm and a temperature of -100° C, what phase change(s) would occur if I **increased the temperature** to 600° C? At what temperature(s) would they occur? (**NOTE: multiple answers needed for this question**)
- 22) If I had a quantity of this substance at a pressure of 2.00 atm and a temperature of -100° C, what phase change(s) would occur if I **decreased the pressure** to 0.25 atm? At what pressure(s) would they occur? (**NOTE: multiple answers needed for this question**)

# Notes: Heating/Cooling Curves

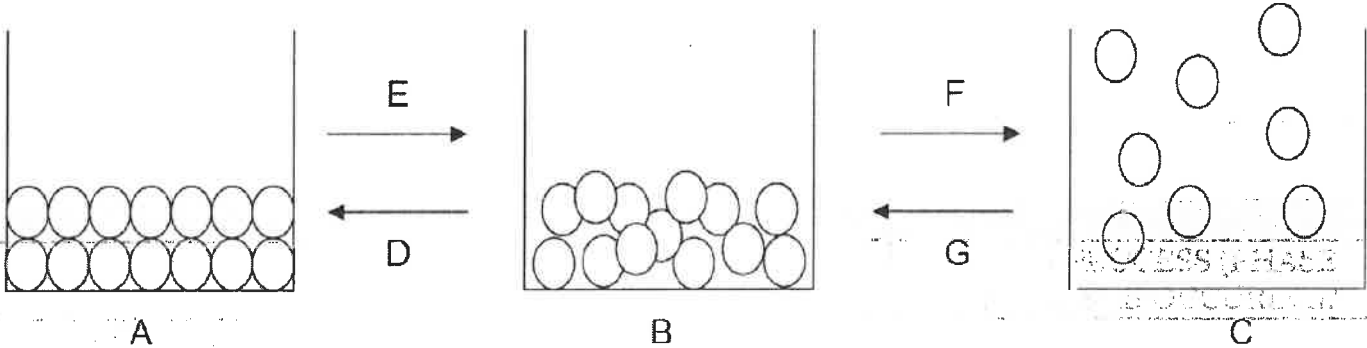
# Physical Behavior of Matter Heating and Cooling Curves

**OBJECTIVES:**

- Be able to distinguish between molecules in each phase of matter
- Predict phases of matter by location on a heating/cooling curve graph
- Create a cooling curve when given data and identify phase changes, E changes

Model 1 represents molecules in the three phases of matter. Based on what you already know about these phases, complete the table that follows. A word bank has been provided for the last column.

### MODEL 1: PHASE CHANGE PARTICLE DIAGRAM



**Word Bank for Column 3:**

Gas    Melting/Fusion    Vaporization    Solid    Freezing    Liquid    Condensation

COLUMN 1	COLUMN 2	COLUMN 3
	DESCRIBE THE PARTICLE DIAGRAM	WHAT PHASE IS THIS?
PARTICLE DIAGRAM A		
PARTICLE DIAGRAM B		
PARTICLE DIAGRAM C		
IS HEAT BEING ADDED OR RELEASED (TAKEN AWAY)?		
	IS HEAT BEING ADDED OR RELEASED (TAKEN AWAY)?	WHAT PROCESS (PHASE CHANGE) IS OCCURRING?
ARROW E (FROM A TO B)		
ARROW F (FROM B TO C)		
ARROW G (FROM C TO B)		
ARROW D (FROM B TO A)		

Some portions of this pogil were authored by: Erin Graham; Revised by: Josephine Parlagreco, Lizabeth Tumminello Edited by Linda Padwa and David Hanson, Stony Brook University. Regents questions from June 2009 NYS exam. Heating Curves from GCSD website.

Look at the word ENDOTHERMIC. Based on the prefix endo-, do you think energy is being added (entering), or being released (exiting)? \_\_\_\_\_

Which phase change processes indicate an ENDOTHERMIC reaction? \_\_\_\_\_

Look at the word EXOTHERMIC. Based on the prefix exo-, do you think energy is being added (entering), or being released (exiting)? \_\_\_\_\_

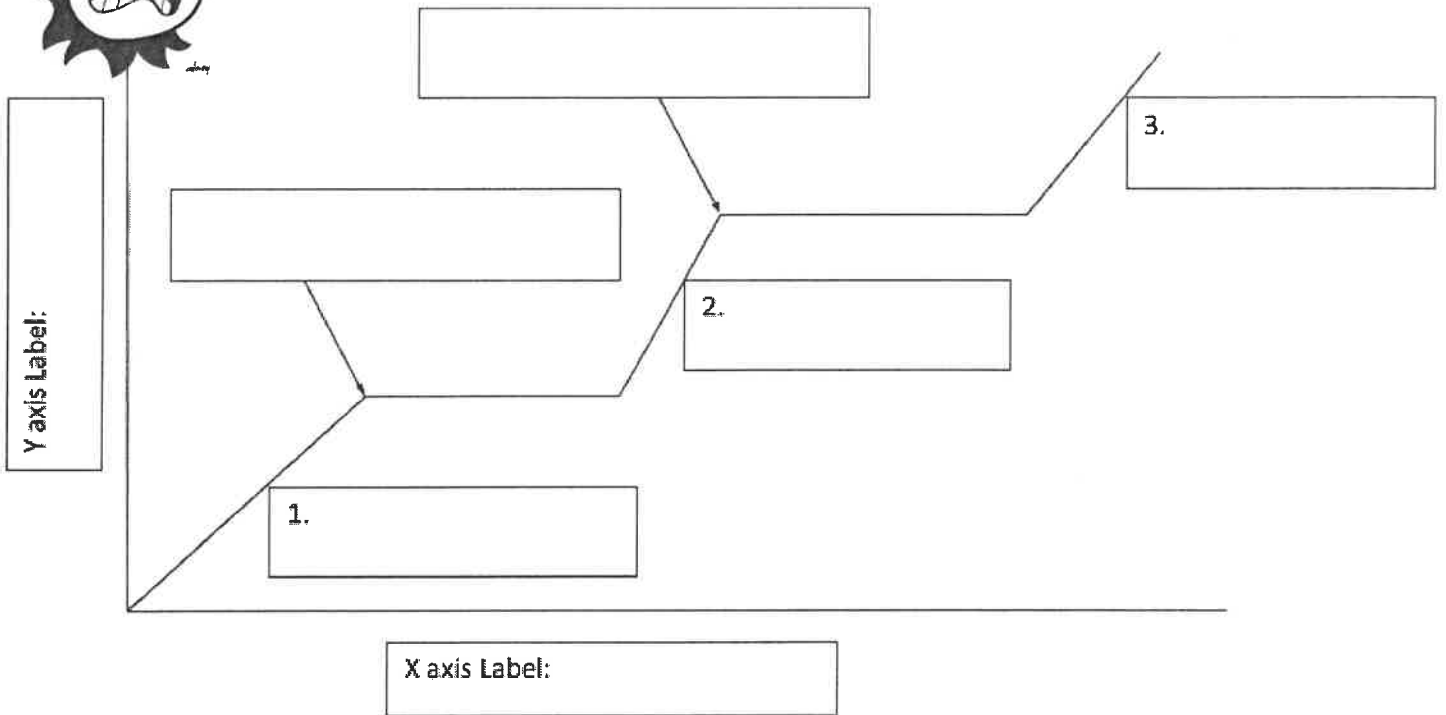
Which phase change processes indicate an EXOTHERMIC reaction? \_\_\_\_\_

### MODEL 2: HEATING CURVE GRAPH

The following graph shows what happens to water as it goes from ice to liquid water to water vapor. Use the word bank and heating curve graph below to identify these phases and phase changes.

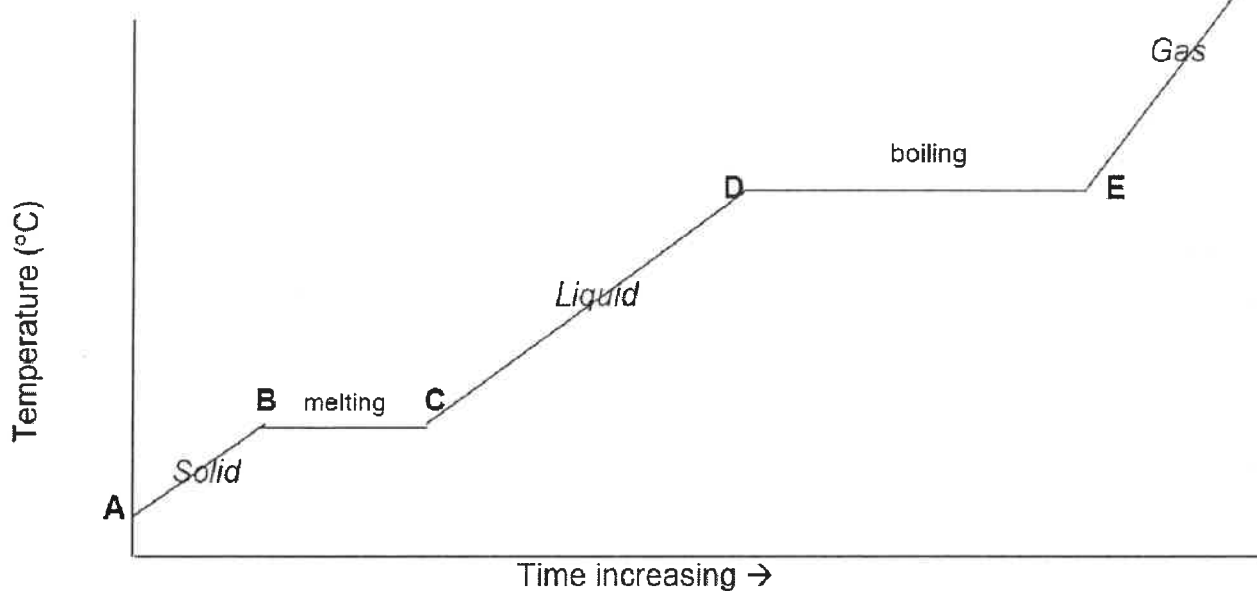


WORD BANK		
Temperature	Time	Melting/Freezing Point
Solid	Liquid	Gas
Boiling/Vaporization Point		



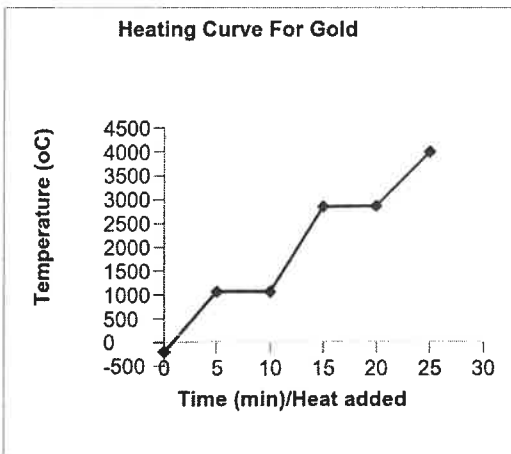
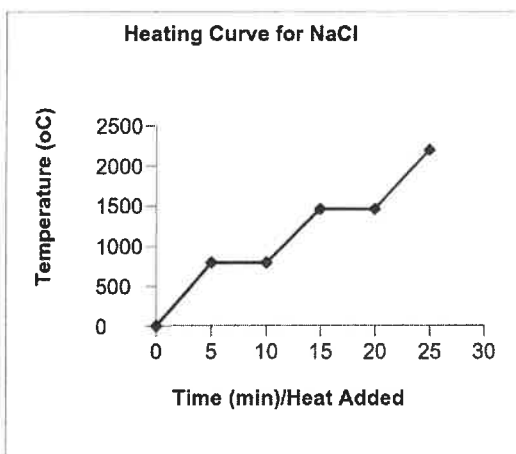
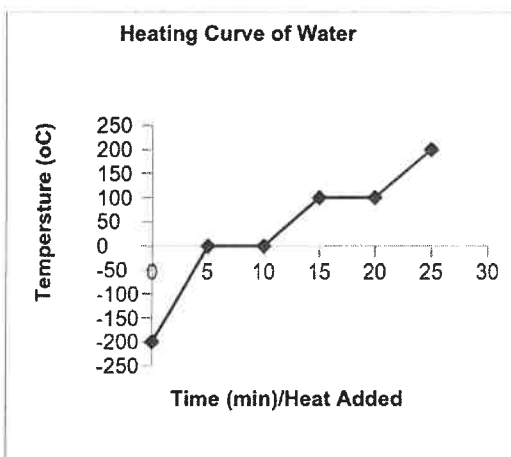
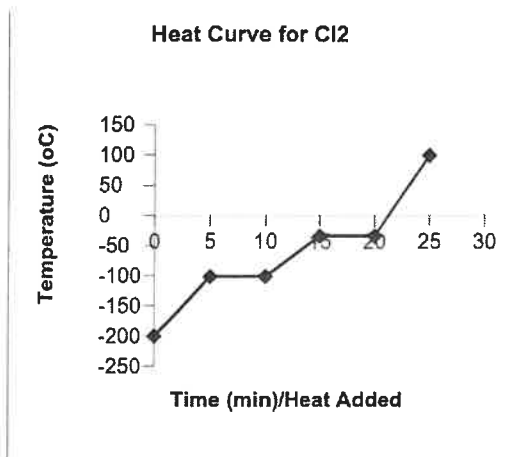


**Model 2: Temperature of a Substance as Heat is Added Over Time**



1. During which line segment(s) does temperature increase? \_\_\_\_\_
2. During which line segment(s) is there no change in temperature? \_\_\_\_\_
3. If this substance were water, at what temperature would segment B – C occur? \_\_\_\_\_
4. If this substance were water, at what temperature would segment D – E occur? \_\_\_\_\_
5. **Kinetic energy** is the energy of motion. It can be used interchangeably with the word temperature. Which line segment(s) show an increase in kinetic energy? \_\_\_\_\_
6. **Potential energy** is stored energy. When kinetic energy is not increasing, but heat is still being added to the system this potential energy increases. Which line segment(s) show this?  
\_\_\_\_\_
7. Compare segments B – C and D – E. Why is segment D – E is longer than B – C?

Here are the heating curves for 4 different substances. Use these curves to answer the questions that follow.



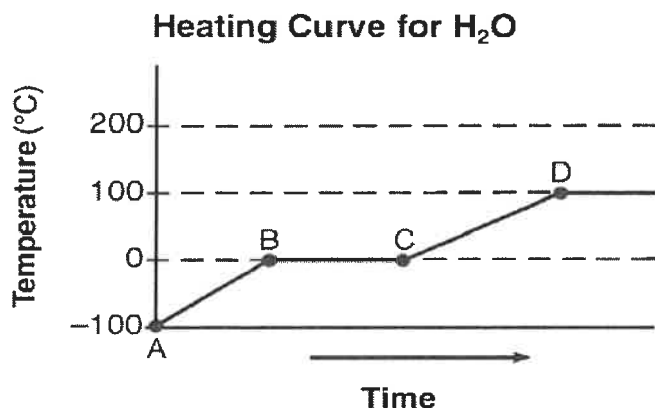
- Which substance does have the highest boiling point? \_\_\_\_\_
- What is the boiling point of this substance? \_\_\_\_\_
- At what temperature range is NaCl a solid? \_\_\_\_\_
- What is the melting point for Cl<sub>2</sub>? \_\_\_\_\_
- Which substance is a liquid at room temperature? \_\_\_\_\_
- What phase is Cl<sub>2</sub> in at room temperature? \_\_\_\_\_
- What is NaCl's boiling point? \_\_\_\_\_
- What phase is water in at -100°C? \_\_\_\_\_
- What temperature is Cl<sub>2</sub> at after being heated for 20 minutes? \_\_\_\_\_

### **BIG IDEA**

- As temperature decreases, substances go from the \_\_\_\_\_ to the \_\_\_\_\_ to the \_\_\_\_\_ phase. This shows a decrease in \_\_\_\_\_ energy.
- Potential energy decreases when a substance is \_\_\_\_\_ & \_\_\_\_\_. These are \_\_\_\_\_ reactions because energy is being released.

### **BIG IDEA**

- As temperature increases, substances go from the \_\_\_\_\_ to the \_\_\_\_\_ to the \_\_\_\_\_ phase. This shows an increase in \_\_\_\_\_ energy.
- Potential energy increases when a substance is \_\_\_\_\_ & \_\_\_\_\_. These are \_\_\_\_\_ reactions because energy is being added.

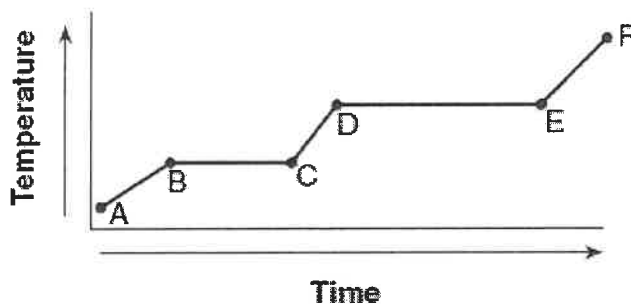


1. Which statement correctly describes the energy of the particles of the sample during interval *BC*?

- (a) Potential energy decreases and average kinetic energy increases.
- (b) Potential energy increases and average kinetic energy increases.
- (c) Potential energy increases and average kinetic energy remains the same.
- (d) Potential energy remains the same and average kinetic energy increases

3. Which line segment is a liquid, only? \_\_\_\_\_

Use the following graph to answer questions 4 and 5. The graph below represents the uniform heating of a substance, starting with the substance as a solid below its melting point.

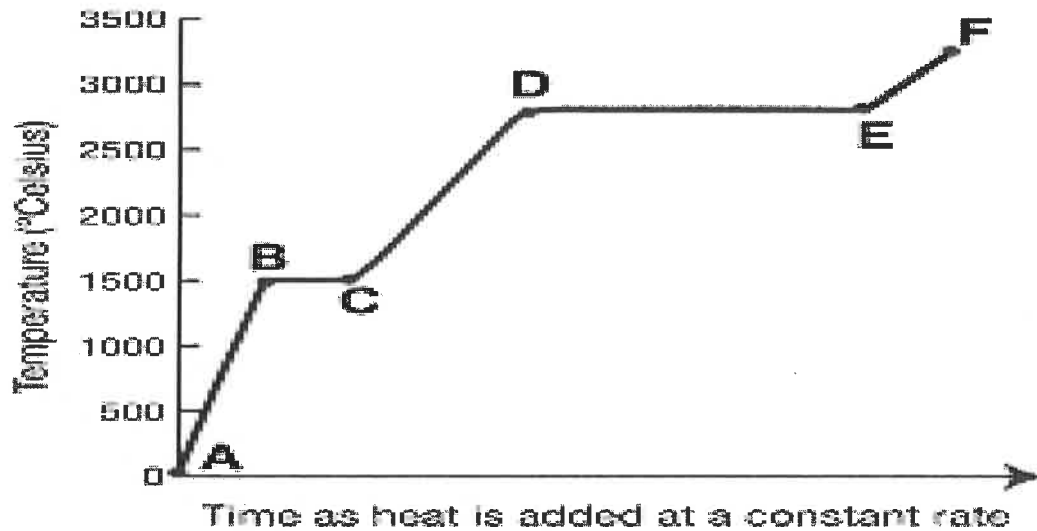


4. Which line segment represents an increase in potential energy and no change in average kinetic energy?

- (a)  $\overline{AB}$
- (b)  $\overline{BC}$
- (c)  $\overline{CD}$
- (d)  $\overline{EF}$

5. CIRCLE ONE: This graph represents an ( endothermic / exothermic ) reaction.

## Heating Curve for Iron



1. What is the freezing point temperature of the substance? \_\_\_\_\_
2. What is the boiling point temperature of the substance? \_\_\_\_\_
3. What is the melting point temperature of the substance? \_\_\_\_\_
4. What letter(s) represents the range where the solid is being warmed? \_\_\_\_\_
5. What letter(s) represents the range where the vapor/gas is being warmed? \_\_\_\_\_
6. What letter(s) represents the range where the liquid is being warmed? \_\_\_\_\_
7. What letter(s) represents the melting of the solid? \_\_\_\_\_
8. What letter(s) represents the vaporization of the liquid? \_\_\_\_\_
9. What letter(s) show a change in potential energy? \_\_\_\_\_
10. What letter(s) show a change in kinetic energy? \_\_\_\_\_
11. What letter(s) represents condensation? \_\_\_\_\_
12. What letter(s) represents freezing? \_\_\_\_\_

# Notes: Density

Name: \_\_\_\_\_

## Density Calculations Worksheet

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

UNITS OF DENSITY  
g/cm<sup>3</sup> or g/mL

- 1) Find the density of a wood block that has a volume of 5.0 cm<sup>3</sup> and a mass of 30.5 g.
- 2) Which has the greater mass – 10 cm<sup>3</sup> of copper or 5 cm<sup>3</sup> of mercury?
- 3) Calculate the mass of a wooden block that is 4 cm long, 2 cm wide, 6 cm high, and has a density of 0.5 g/cm<sup>3</sup>. (hint: find the volume of a block first)
- 4) In the table below are the mass and volume of some mineral samples. Calculate the density of sample B.

Sample	Mass (g)	Volume (mL)
A	19.5	6.54
B	12.4	3.1
C	6.8	3.4

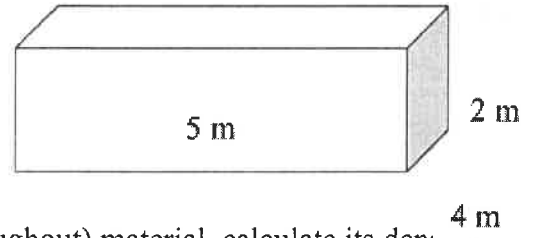
- 5) What volume would a rock occupy if it had a mass of 31.2 g and a density of 10.4 g/cm<sup>3</sup>?
- 6) The density of oak is 0.7 g/cm<sup>3</sup>, and the density of pine is 0.4 g/cm<sup>3</sup>. Compare the masses of a 30 cm<sup>3</sup> block of each type of wood.
- 7) How large a container would you need to hold 195 g of a liquid that has a density of 1.3 g/mL?
- 8) A jeweler suspects that a piece of gold jewelry in his collection is fake. If the volume of the piece of jewelry is 6 cm<sup>3</sup>, and its mass is 109 g, is the piece fake? Why or why not?
- 9) Substances A and B have the same volume, but the mass of B is twice as great as the mass of A. How do the densities of the two substances compare?
- 10) 28.5 g of metal is added to a graduated cylinder containing 45.50 mL of water. The water level rises to the 49.10 mL mark. From this information, calculate the density of this metal. Identify the metal.
- 11) Calculate the density of a metal that has a mass of 36.457 g and a volume of 13.5 cm<sup>3</sup>. Identify the metal.

## Density

Show all work and correct units.

1. A rock has a mass of 210 grams and occupies a volume of  $70 \text{ cm}^3$ . What is its density?
2. How does the volume occupied by a cubic centimeter ( $\text{cm}^3$ ) compare with the volume occupied by a milliliter (ml)?

3. A rectangular solid of unknown density is 5 meters long, 2 meters high and 4 meters wide. The mass of this solid is 300



grams. Given this information for this homogeneous (alike throughout) material, calculate its density.

(Hint: What is its volume?)

4. An unknown substance from planet X has a density of  $10 \text{ g/ml}$ . It occupies a volume of  $80 \text{ ml}$ . What is the mass of this unknown substance?

5. A piece of copper is found on the side of the road with a mass of  $35.0 \text{ grams}$ . Calculate its volume.

Hint: Use your reference packet!