

## Glug Activity

Objective: To make measurements meaningful.

Materials: Glug (a flat stick), whiteboard, masking tape, looseleaf paper

Directions:

1. Using the glug, determine the area of your whiteboard.
  - You need to justify the value you are reporting (show how you got to your answer). This can be done on the whiteboard.
  - Your answer needs to have units on the end of it
2. Put your final answer on the front board.

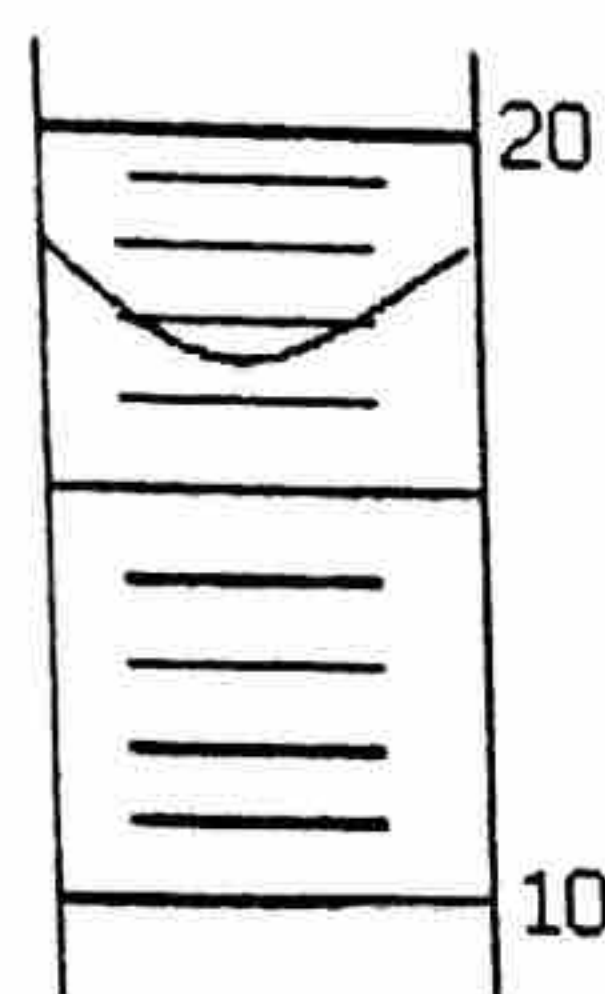
**WAIT for your teacher to continue!**

1. Put a piece of a masking tape over the length of your glug. Using pieces of looseleaf paper, lay the glug so that one end touches one line and the other end touches the 20<sup>th</sup> line. Make a mark on the masking tape on every second line to break the glug into 10 equal intervals.
2. Using your glug, again determine the area of your whiteboard.
  - You need to justify the value you are reporting (show how you got your answer). This can be done on the whiteboard.
  - Your answer needs to have units on the end of it
3. Put your final answer on the front board.

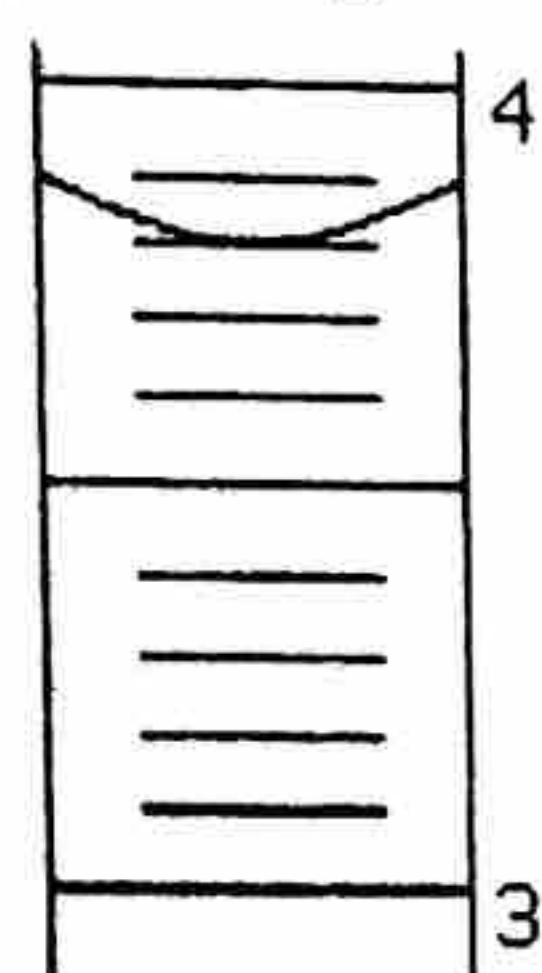


**READING MEASURING DEVICES NOTES**

Here are a couple of examples of graduated cylinders:



A



B

An important part of Chemistry is measurement. It is very important that you read the measuring devices we use in lab as accurately as possible. Here is how to determine how accurately a measuring device can be read:

Look at the graduation marks on the piece of equipment. (Those are the lines or marks that are not numbered.) Decide what each mark is worth using the numbers given as a guide. You should read the instrument to one more decimal place to the right than the smallest graduation mark. This last number

will be an estimate on your part. This will lead us into our next topic in measurement – significant figures. A: Each of the smaller lines represents 1 mL. That means that our reading should be to one place to the right of the decimal point. To me, it looks like the bottom of the curve is about halfway between the 16 and the 17, so I would say that the reading on this graduated cylinder would be 16.5 mL.

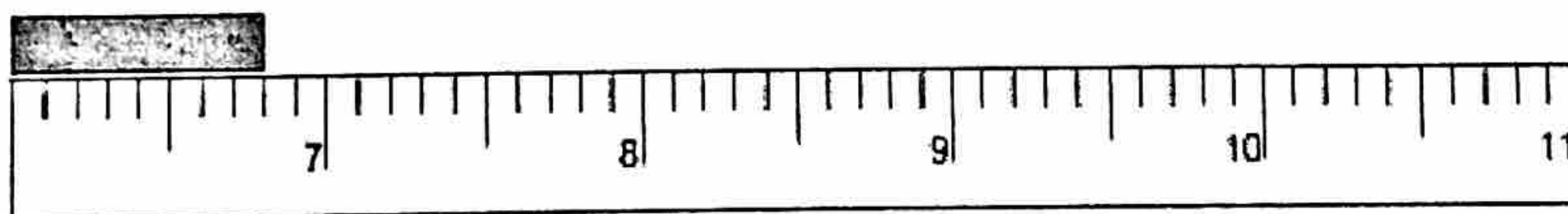
B: Each line represents 0.1 mL. That means that our reading should be to two places to the right of the decimal point. The bottom of the curve looks to me like it is exactly on the line that would represent 3.8. My reading, however, needs to be to two places to the right of the decimal. Because it is exactly on the line, my reading will be 3.80 mL.

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**PRACTICE WITH READING MEASURING DEVICES WORKSHEET**

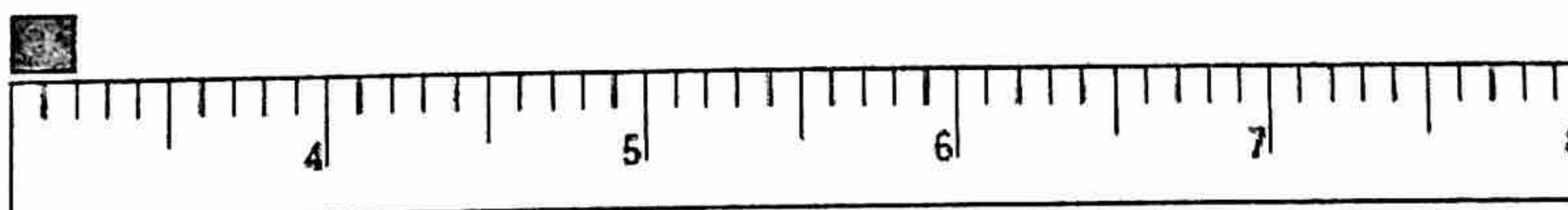
Part 1 - What are the readings on these metric rulers? Be sure to include units with your answers.

1.)



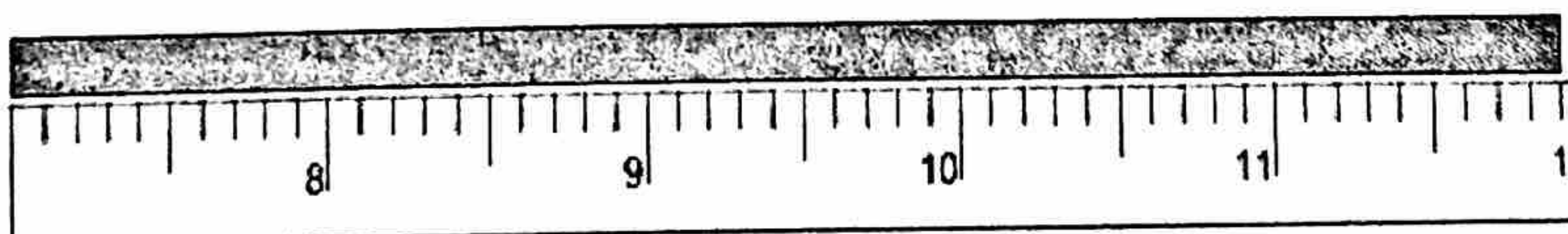
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2.)



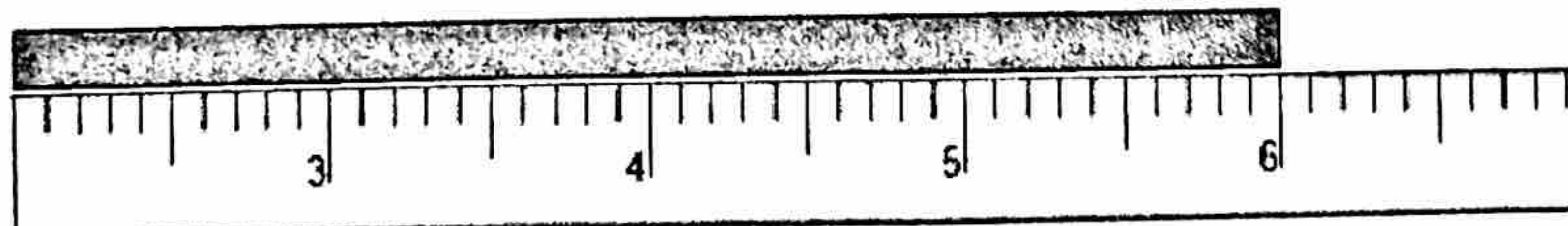
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3.)



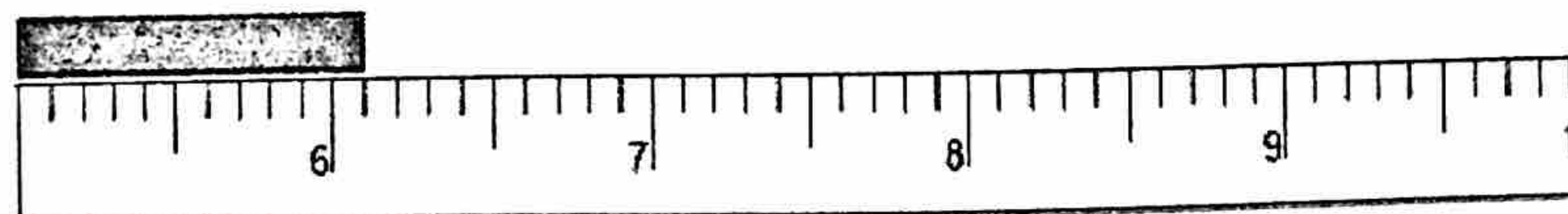
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4.)



\_\_\_\_\_

5.)

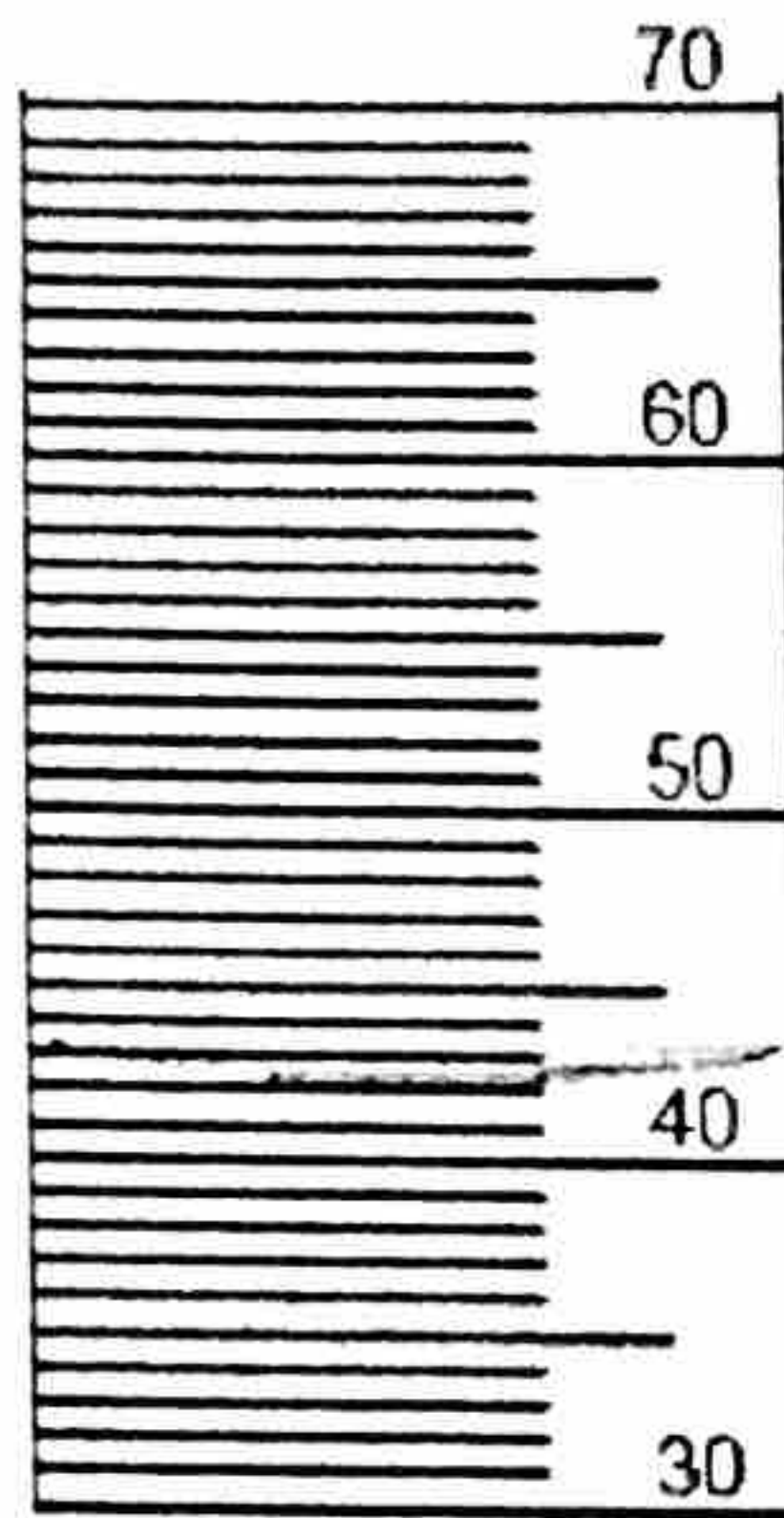


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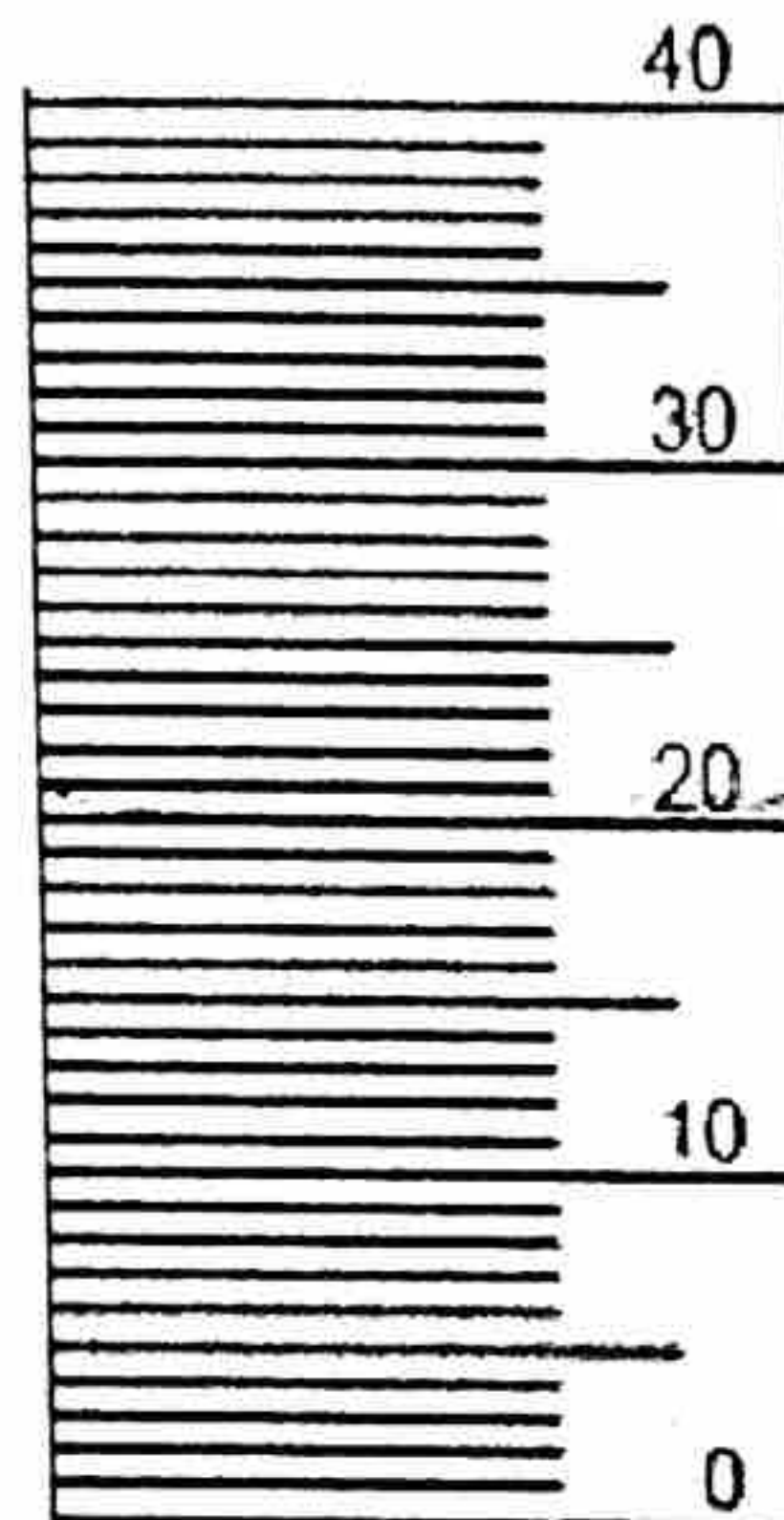


Part 2 – What are the readings on these graduated cylinders? Be sure to include units with your answers.

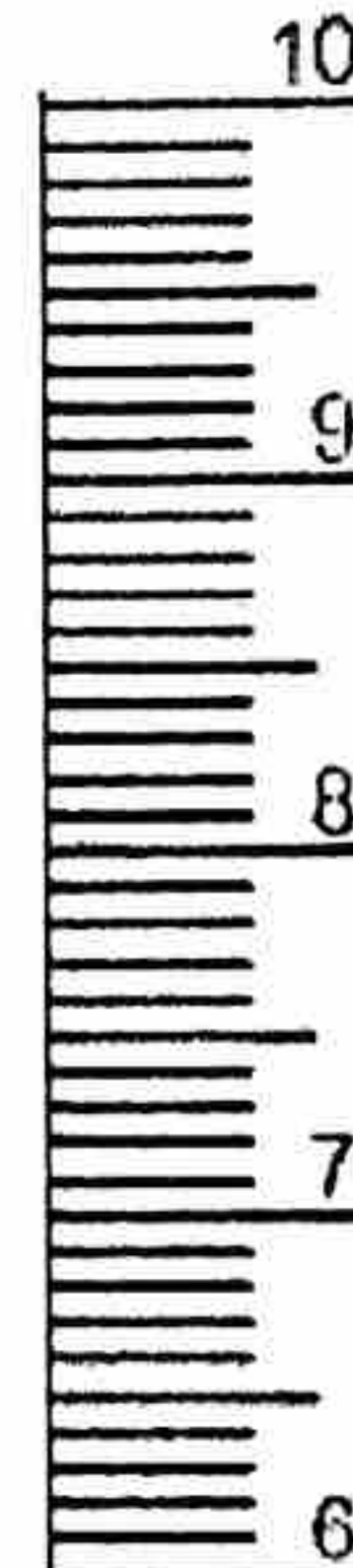
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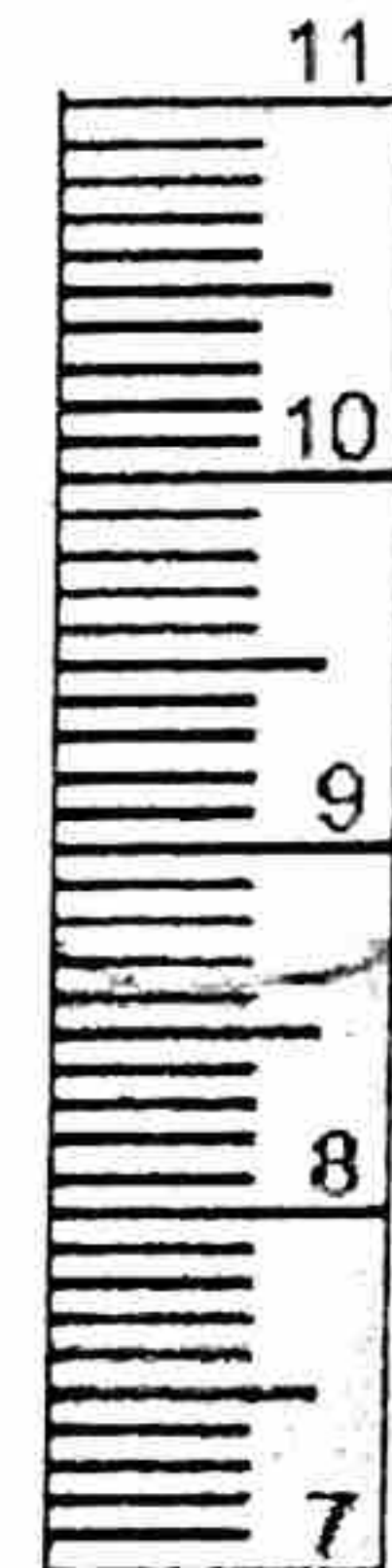
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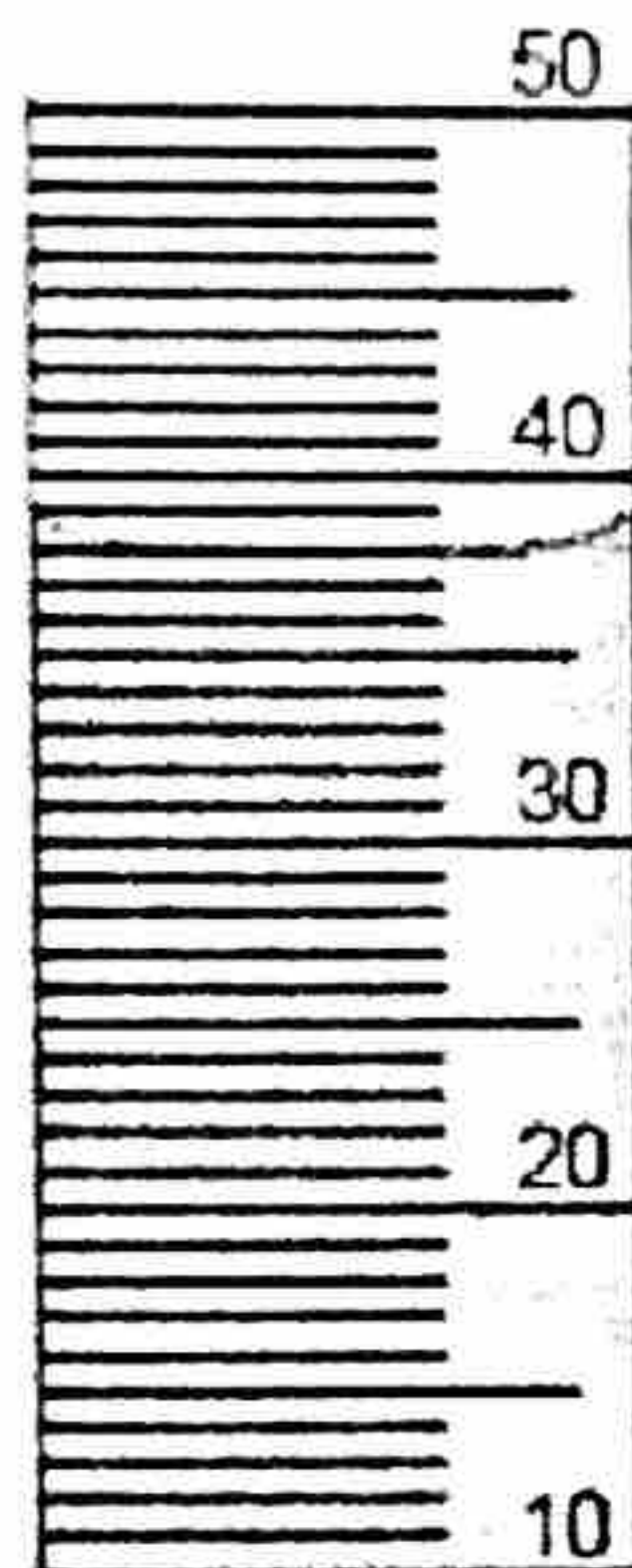
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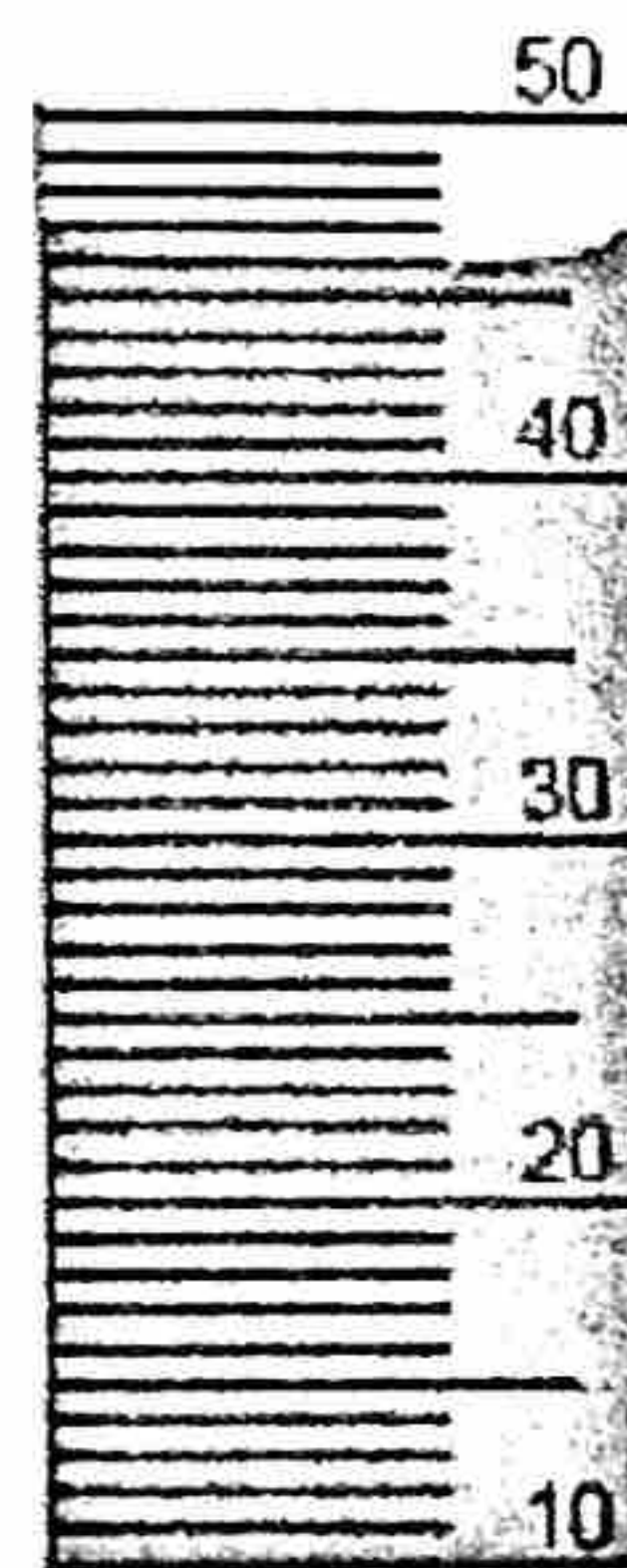
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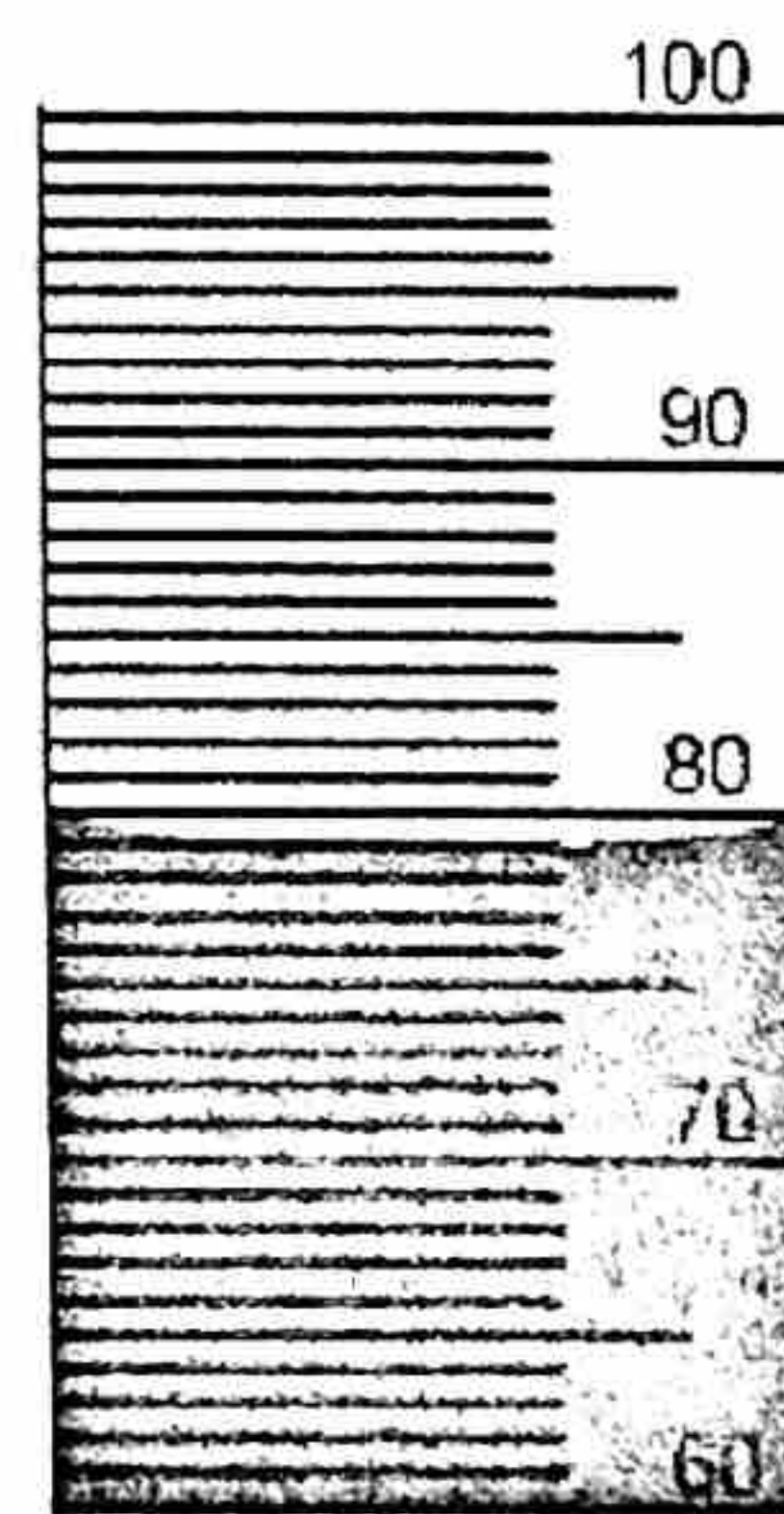
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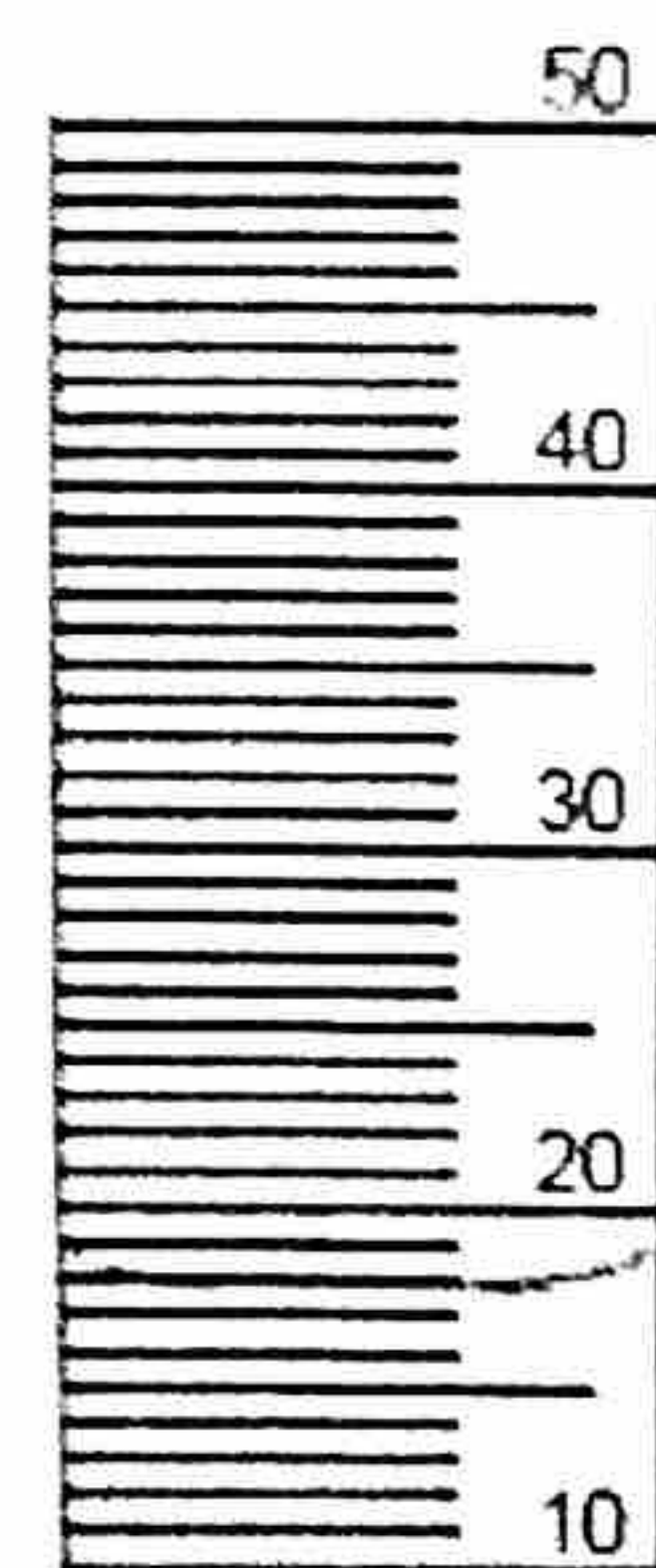
11.)



12.)

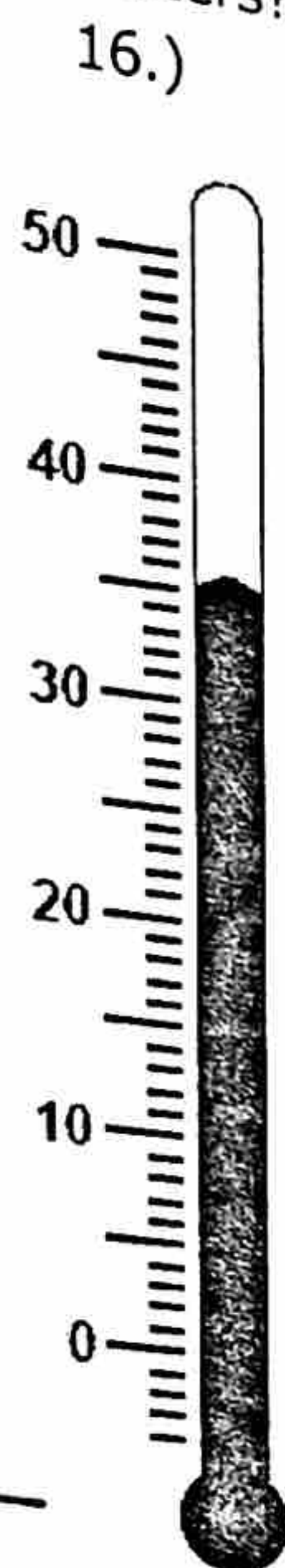
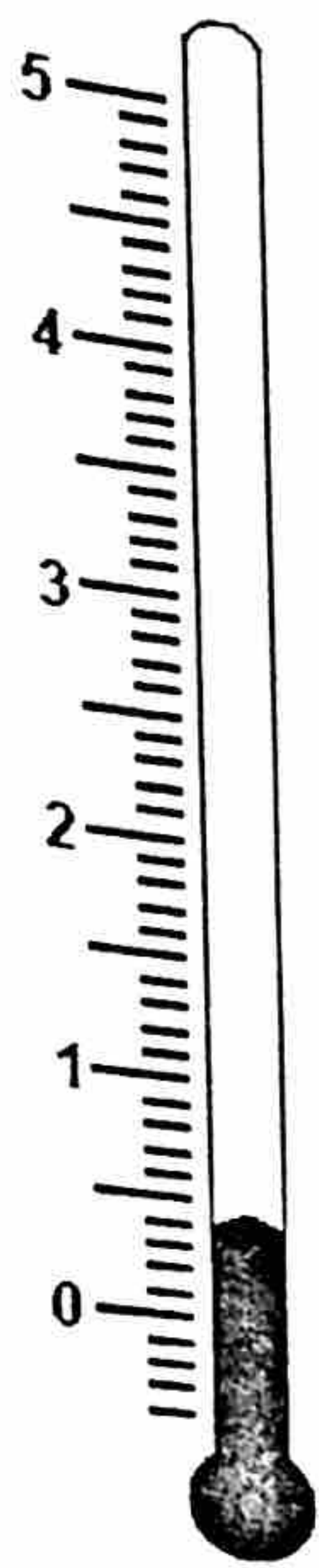


13.)

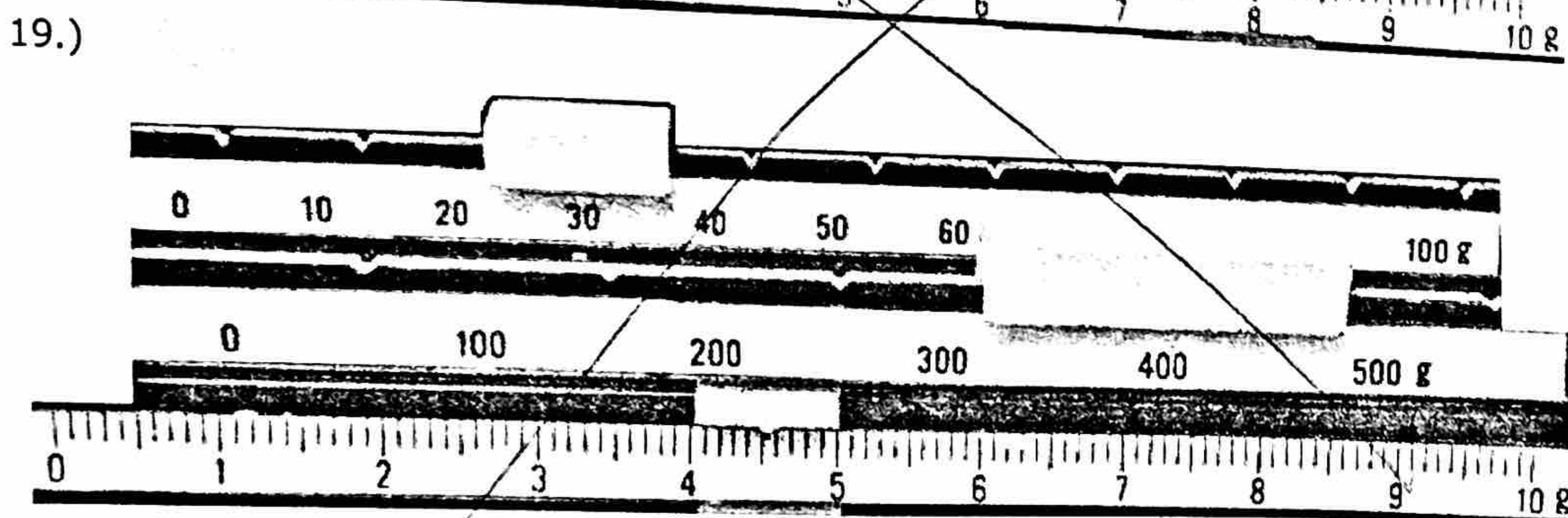
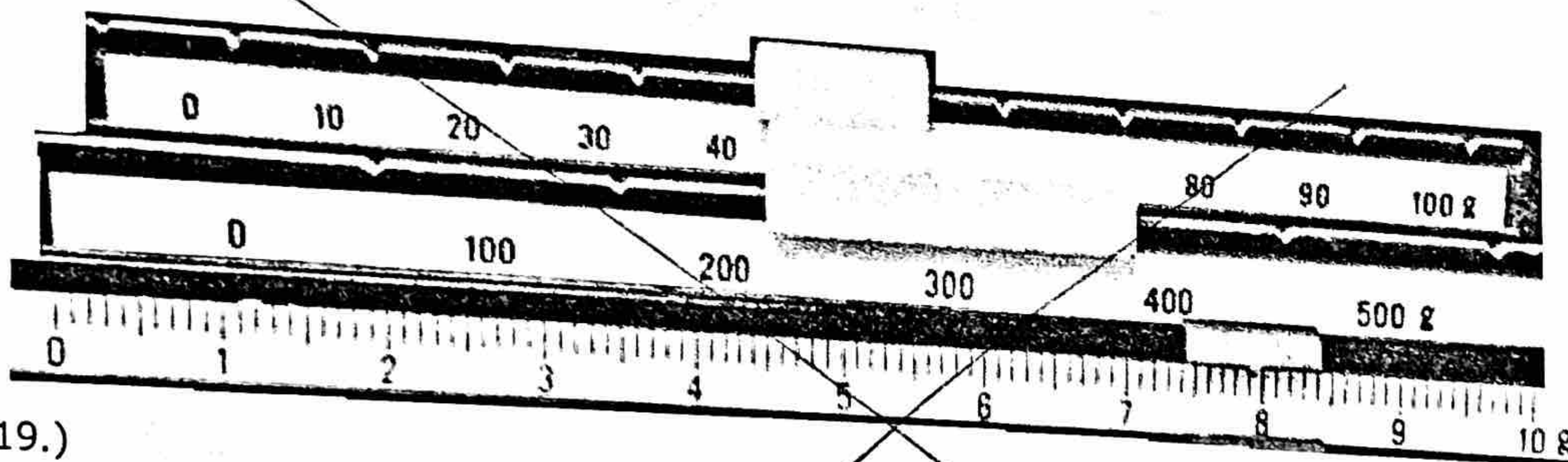




Part 3 – What are the readings on these thermometers? Be sure to include units with your answers.



Part 4 – What are the readings on these triple beam balances? Be sure to include units with your answers.





## Scientific Notation Worksheet

Convert the following numbers into scientific notation:

- 1) 3,400 \_\_\_\_\_
- 2) 0.000023 \_\_\_\_\_
- 3) 101,000 \_\_\_\_\_
- 4) 0.010 \_\_\_\_\_
- 5) 45.01 \_\_\_\_\_
- 6) 1,000,000 \_\_\_\_\_
- 7) 0.00671 \_\_\_\_\_
- 8) 4.50 \_\_\_\_\_

Convert the following numbers into standard notation:

- 9)  $2.30 \times 10^4$  \_\_\_\_\_
- 10)  $1.76 \times 10^{-3}$  \_\_\_\_\_
- 11)  $1.901 \times 10^{-7}$  \_\_\_\_\_
- 12)  $8.65 \times 10^{-1}$  \_\_\_\_\_
- 13)  $9.11 \times 10^3$  \_\_\_\_\_
- 14)  $5.40 \times 10^1$  \_\_\_\_\_
- 15)  $1.76 \times 10^0$  \_\_\_\_\_
- 16)  $7.4 \times 10^{-5}$  \_\_\_\_\_

### Worksheet #3: Scientific Notation

Name \_\_\_\_\_

Express these numbers in scientific notation.

1. 0.0023 \_\_\_\_\_

4. 14,000 \_\_\_\_\_

2. 0.258 \_\_\_\_\_

5. 0.000036 \_\_\_\_\_

3. 10.236 \_\_\_\_\_

6. 2.52 \_\_\_\_\_

Express these numbers in decimal notation.

1.  $4.36 \times 10^2$  \_\_\_\_\_

4.  $1.45 \times 10^{-2}$  \_\_\_\_\_

2.  $3.40 \times 10^{-3}$  \_\_\_\_\_

5.  $5.02 \times 10^4$  \_\_\_\_\_

3.  $2.67 \times 10^5$  \_\_\_\_\_

6.  $1.21 \times 10^{-7}$  \_\_\_\_\_

Use your calculator to solve the following. Be sure to express your answer in scientific notation even if your calculator does not.

1.  $(3.0 \times 10^3) + (5.0 \times 10^3)$  \_\_\_\_\_

2.  $(6.9 \times 10^3)(2.455 \times 10^4)$  \_\_\_\_\_

3.  $\frac{(4.3 \times 10^9)(3.1 \times 10^{-3})}{(5.0214 \times 10^5)}$  \_\_\_\_\_

4.  $(4.58 \times 10^{-5}) \div (3.2 \times 10^{-2})$  \_\_\_\_\_



## Significant Figures, Version 2.0, 6/11/08, Blas & Lee

Answer the questions below based on the tables provided. In this document, "SF" stands for *Significant Figures*.

**Group 1**

Number	# of SF
7	1
3.2	2
6.54	3
855	3

### Critical Thinking Questions

- Engage in a group discussion that tries to determine what pattern or rules exist between the **Numbers** and **# of SF** listed in Group 1 and write that rule below...
- How many SF's would be in the following numbers?
  - 95 \_\_\_\_\_
  - 7.56 \_\_\_\_\_
  - 45256 \_\_\_\_\_

**Group 2**

Number	# of SF
305	3
3005	4
6.05	3
6.005	4
9.05006	6
9.50006	6

- Engage in a group discussion that tries to determine what pattern or rules exist between the **Numbers** and **# of SF** listed in Group 2 and write that rule below...
- How many SF's would be in the following numbers?
  - 35 \_\_\_\_\_
  - 706 \_\_\_\_\_
  - 35.06 \_\_\_\_\_
  - 60.701 \_\_\_\_\_

**Group 3**

Number	# of SF
30	1
300	1
3000	1

**Group 4**

Number	# of SF
30.	2
300.	3
3000.	4

**Group 5**

Number	# of SF
1.0	2
35.0	3
35.00	4
10.0	3
300.00	5

5. Engage in a group discussion that tries to determine what pattern or rules exist between the **Numbers** and **# of SF** listed in Groups 3, 4 & 5 and write that rule below...

6. How many SF's would be in the following numbers?

- a. 722 \_\_\_\_\_
- b. 702.05 \_\_\_\_\_
- c. 50 \_\_\_\_\_
- d. 50. \_\_\_\_\_
- e. 500 \_\_\_\_\_
- f. 700 \_\_\_\_\_
- g. 7.700 \_\_\_\_\_

**Group 6**

Number	# of SF
0.1	1
0.020	2
0.00213	3
0.0303	3

**Group 7**

Number	# of SF
$1 \times 10^{-1}$	1
$2.0 \times 10^{-3}$	2
$2.13 \times 10^{-4}$	3
$3.03 \times 10^{-2}$	3
$1.20 \times 10^{-4}$	3
$2.060 \times 10^{10}$	4
$2.060 \times 10^{-10}$	4

7. Engage in a group discussion that tries to determine what pattern or rules exist between the **Numbers** and **# of SF** listed in Groups 6 & 7 and write that rule below...



8. How many SF's would be in the following numbers?

- a. 0.01      \_\_\_\_\_
- b. 0.0023      \_\_\_\_\_
- c.  $23.6 \times 10^{-4}$       \_\_\_\_\_
- d.  $23.0 \times 10^{-4}$       \_\_\_\_\_
- e.  $1.234 \times 10^3$       \_\_\_\_\_

9. Now, condense all of the rules that you've written above into the shortest, most condensed list as possible that still applies to every group listed above. These rules must be grammatically correct.

Now, go to the board as directed by the instructor and add your rules to the appropriate section. After the class discussion and editing session, write the final SF rules on your note card.

### Exercises

Complete the following table:

Number	# if SF	Group above (1-7) that this number would fit into
2.307	4	_____
_____	5	4
5.230	_____	5
271.2	_____	_____
$1.750 \times 10^{-3}$		7
_____	4	6
5000	_____	3



## Exercises

Complete the following table:

Number	# of SF	Do the number of SF match the example to the left (circle Yes or No)
8.020	3	Yes...No
0.23060	5	Yes...No
$5.670 \times 10^{10}$	3	Yes...No
5000.00	5	Yes...No

## Problems

1. If you were to weigh a handful of 14 marbles and the entire lot weighed 17.3 g, what would each marble weigh? As a group, decide how many decimal places you should report in your answer.

Answer \_\_\_\_\_ g

2. Discuss as a group and explain why you decided on that number of decimal places? Use grammatically correct sentences.

3. Do you think that there should be a standard number of decimal places reported in answers to problems? How would this benefit/harm science as a whole? Discuss this as a group and explain. Use grammatically correct sentences.



## Significant Figures Worksheet

1. Indicate how many significant figures there are in each of the following measured values.

246.32	_____	1.008	_____	700000	_____
107.854	_____	0.00340	_____	350.670	_____
100.3	_____	14.600	_____	1.0000	_____
0.678	_____	0.0001	_____	320001	_____

2. Calculate the answers to the appropriate number of significant figures.

$$\begin{array}{r} 32.567 \\ 135.0 \\ + 1.4567 \\ \hline \end{array}$$

$$\begin{array}{r} 246.24 \\ 238.278 \\ + 98.3 \\ \hline \end{array}$$

$$\begin{array}{r} 658.0 \\ 23.5478 \\ + 1345.29 \\ \hline \end{array}$$

3. Calculate the answers to the appropriate number of significant figures.

- |                                   |         |                         |         |
|-----------------------------------|---------|-------------------------|---------|
| a) $23.7 \times 3.8$              | = _____ | e) $43.678 \times 64.1$ | = _____ |
| b) $45.76 \times 0.25$            | = _____ | f) $1.678 / 0.42$       | = _____ |
| c) $81.04 \text{ g} \times 0.010$ | = _____ | g) $28.367 / 3.74$      | = _____ |
| d) $6.47 \times 64.5$             | = _____ | h) $4278 / 1.006$       | = _____ |

4.  $(12.01 - 11.59) / 36.1 =$

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

5. Calculate the density of an object that has a mass of 23.0 g and the volume is found by water displacement. The water level starts at 5.05 mL and after the object is put in, has a water level of 11.3 mL.



### Unit Conversion Worksheet

**Directions:** Use the Factor-label method (or dimensional analysis) to convert between the following units. Remember to use unit equalities as conversion fractions to cancel out variables until ending with the desired new variable(s).

1. 1.2 kg = \_\_\_\_\_ mg

2.  $2.00 \times 10^{-5} \text{ m}$  = \_\_\_\_\_ cm

3. 25.4 mm = \_\_\_\_\_ cm

4. 1.2 m = \_\_\_\_\_ km

5. 15.47 g = \_\_\_\_\_ ng

6. 45.1 mg = \_\_\_\_\_ cg

7. 1.45 g = \_\_\_\_\_ mg

8. 4.100 mL = \_\_\_\_\_ L



9. 1.2 kL = \_\_\_\_\_ nL

10. 145 mL = \_\_\_\_\_ nL

11. 6.51 L = \_\_\_\_\_ cL

12. 17.0 m/s = \_\_\_\_\_ mm/min

13. 342 m/hr = \_\_\_\_\_ km/s

14. 2.00 m/s = \_\_\_\_\_ cm/hour



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

# Density Calculations Worksheet - Honors

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

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

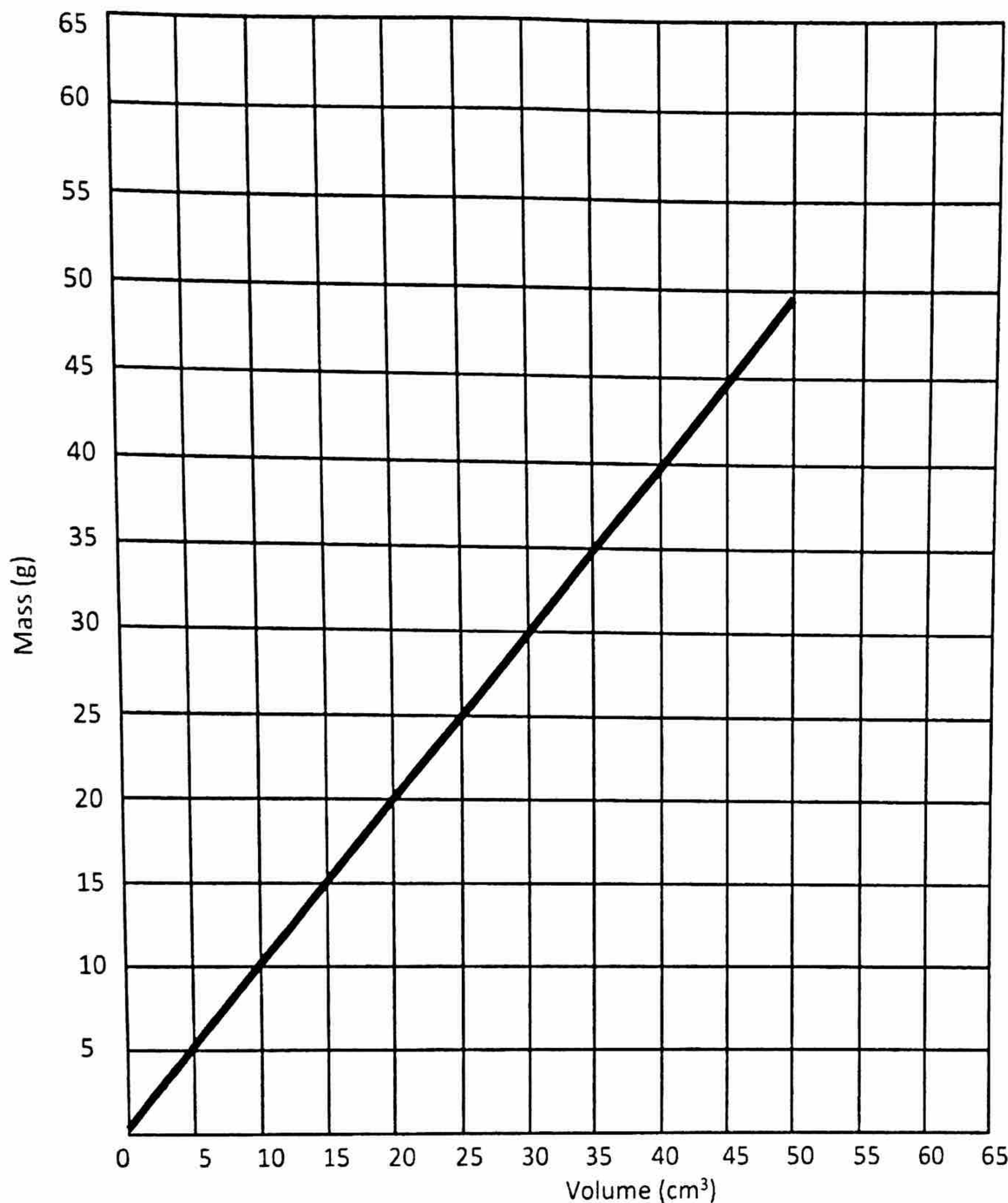
- 5) What volume would a rock occupy if it had a mass of 31.2 g and a density of 10.4 g/cm<sup>3</sup>?
- 6) The density of oak is 0.7 g/cm<sup>3</sup>, and the density of pine is 0.4 g/cm<sup>3</sup>. Compare the masses of a 30 cm<sup>3</sup> block of each type of wood.
- 7) How large a container would 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.



# Interpreting Mass vs. Volume Graphs

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

Graphing is a very important tool in science since it enables us to see trends that are not always obvious. Graph the following data and answer the questions below.



1. Using the graph and data chart try to figure out if you increased the substance to 55 mL, how many grams would the substance have..
2. How much space would 65 g of the substance take up?

Data Chart

Mass of substance (g)	Volume of Substance
5 g	5 cm <sup>3</sup>
25 g	25 cm <sup>3</sup>
50 g	50 cm <sup>3</sup>
_____ g	55 cm <sup>3</sup>
65 g	_____ cm <sup>3</sup>

3.. As the volume of a sample increases from 20. mL to 30. mL, does the mass increase or decrease?

4. Calculate the Density of the substance. Show your work!

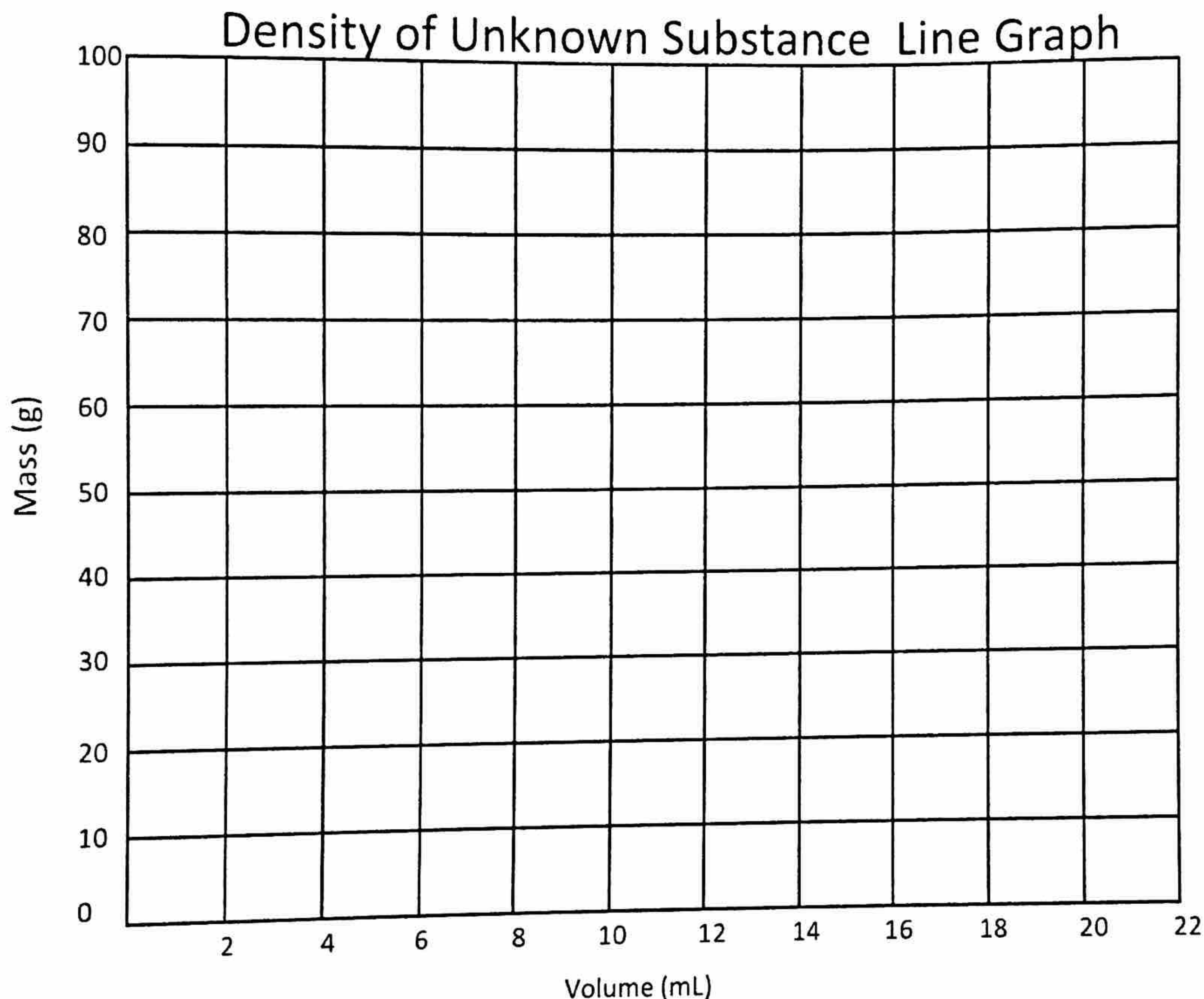
5. According to your calculation of density which substance is graphed?

Substance	Density
Hydrogen	0.00009 g/mL
Mercury	13.5 g/mL
Carbon	2.3 g/mL
Water	1.00 g/mL
Sucrose	1.6 g/mL



6. Graph the following mass and volume numbers on the graph below. This graph is a line graph and will look like the graph on the other side of the homework.

Mass of liquid (g)	20	100	75	40	10
Volume of liquid (cm <sup>3</sup> )	4	20	15	8	2



7. As mass increases, what happens to the volume?
8. As volume increases, what happens to the mass?
9. Find 12 mL on the volume line. Follow that line until it touches the line you drew. How many grams would it be?
10. What volume would 90 g occupy?
11. What is the density of the liquid? Calculate using the data table.