Name _____ Date _____ Class _____

SKILLS INTRODUCTION

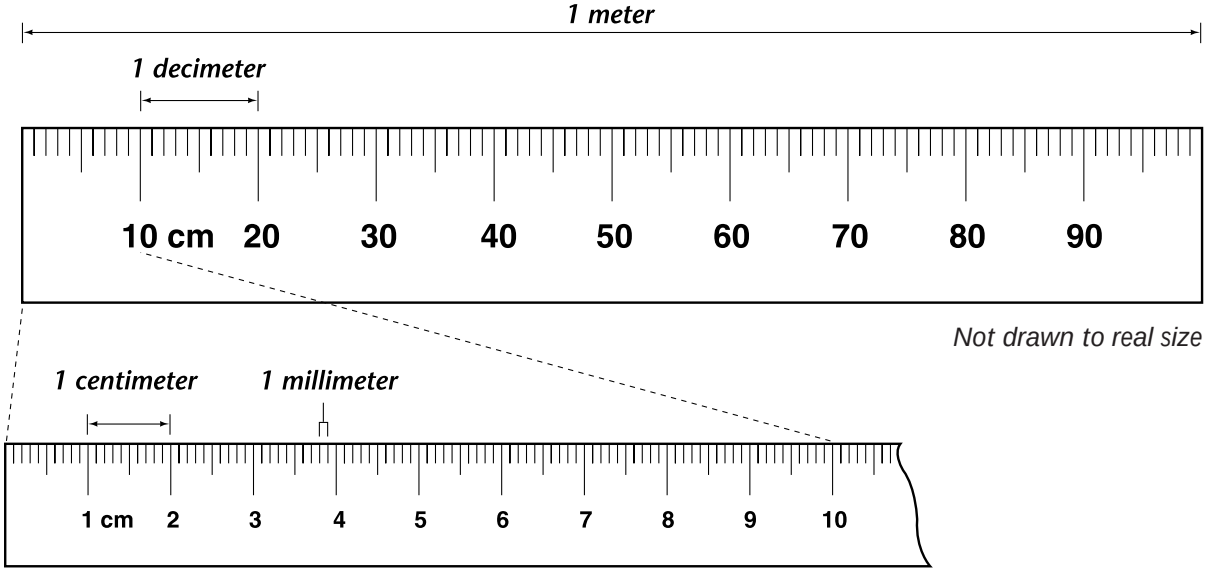
Measuring

If you enjoy sports, you know how exciting it is when an athlete swims faster, runs longer, or hits a ball farther than other competitors. You also know that people aren't satisfied with descriptions like "faster" or "longer"—they want exact statistics showing just how fast an athlete ran and how great the margin of victory was. Measurements can help make sports more fun.

Common SI Units		
Property	Basic Unit	Symbol
Length	meter	m
Liquid volume	liter	L
Mass	gram	g
Temperature	degree Celsius	°C

Measurements are also important in science because they provide important specific information and help observers avoid bias. **Measuring** is comparing an object or process to a standard. Scientists use a common set of standards, called the International System of Units. This system is often abbreviated as SI (for its French name, *Système International d'Unités*). The table above lists the basic units for four common properties.

The basic unit for length is the meter. For a property such as length, researchers often need to measure amounts that are much smaller or much larger than the basic unit. In the SI system, the smaller or larger units are based on multiples of 10. For example, notice that the meter below is divided into 10 main sections, called decimeters. Each decimeter is then divided into ten sections, called centimeters. That means that a decimeter is $\frac{1}{10}$ (or 0.1) of a meter. A centimeter is $\frac{1}{100}$ (or 0.01) of a meter. A millimeter is $\frac{1}{1{,}000}$ (or 0.001) of a meter.



Name _____ Date _____ Class _____

Measuring *(continued)*

The same prefixes that are used for naming smaller and larger units of length are also used for naming different size units of volume and mass. Look at the chart below to see the meaning of some common prefixes.

Common SI Prefixes			
Prefix	Symbol	Meaning	Example
kilo-	k	1,000	kilometer (km)
hecto-	h	100	hectometer (hm)
deka-	da	10	dekameter (dam)
deci-	d	0.1 ($\frac{1}{10}$)	decimeter (dm)
centi-	c	0.01 ($\frac{1}{100}$)	centimeter (cm)
milli-	m	0.001 ($\frac{1}{1,000}$)	millimeter (mm)

Tips for Making Measurements

- Know the purpose of your measurement. Choose the most suitable size unit, for example, centimeters for a book or meters for the classroom floor.
- Know how your measuring tool works, for example what main units it measures and what the smaller units mean.
- Always label your measurements. If you perform any math operations such as adding or subtracting measurements, always label the resulting numbers properly.
- Determine whether you will need one, two, or a series of measurements. Figure out whether you will have to perform any math operations. For example, if you need to find how much the temperature of a liquid increased, you will need to subtract the original temperature from the final temperature.
- Know any special rules that apply. For example, read the water level in a graduated cylinder at eye level and at the lowest point of the curved surface.

☑ *Checkpoint* How could you demonstrate that there are 1,000 millimeters in 1 meter?

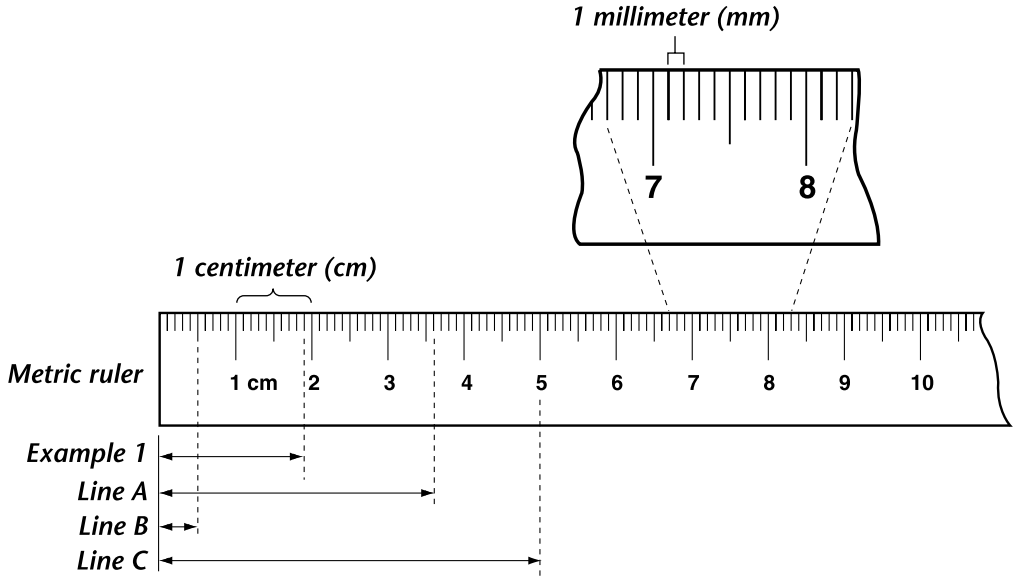
Name _____ Date _____ Class _____

SKILLS PRACTICE

Measuring: Length

Write your answers to the questions below in the spaces provided. If you need more space, use the back of this sheet.

Length is the distance between two points. Length is usually measured with rulers. Examine the metric ruler diagramed below. Notice that the labeled units are in centimeters (cm). Small vertical lines separate each centimeter into 10 sections. Each of these sections measures 0.1 (or $\frac{1}{10}$) of a centimeter, which equals 1 millimeter (mm). When you use a metric ruler, decide which of these units you will use. For example, if you measure the line in Example 1 in millimeters, you would say it's 19 mm long. If you measure it in centimeters, you would say it's 1.9 cm long.



1. How many millimeters long is Line A? _____

2. How many centimeters long is Line A? _____

3. How many millimeters long is Line B? _____

4. How many centimeters long is Line B? _____

5. How many millimeters long is Line C? _____

6. How many centimeters long is Line C? _____

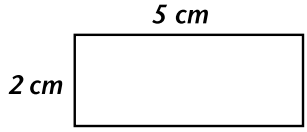
Hint: Did you include the proper unit in each of your measurements? If not, go back and label them.

Name _____ Date _____ Class _____

Measuring: Length *(continued)*

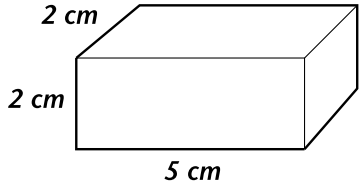
Using Length Measurements to Find Area and Volume

You can use metric measurements to find the area of a figure by multiplying length × width.



Area = 5 cm × 2 cm = 10 cm^2

You can use metric measurements to find the volume by multiplying length × width × height.



Volume = 5 cm × 2 cm × 2 cm = 20 cm^3

7. What is the length of the figure on the right?

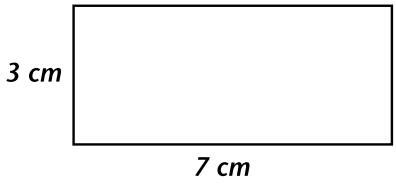
_____

8. What is the width of the figure on the right?

_____

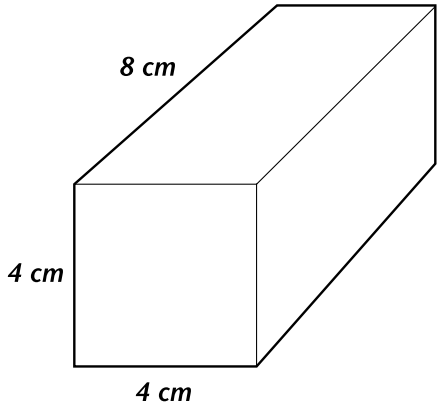
9. What is the area of the figure on the right?

_____



10. What is the volume of the figure on the right?

_____



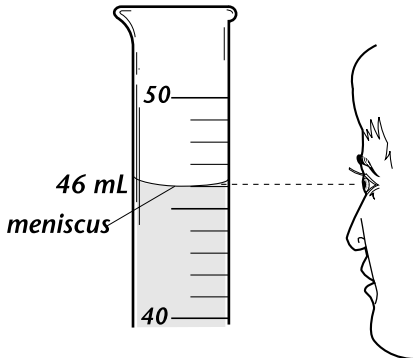
11. Think About It If the measurements of a rectangle are 30 mm by 70 mm, would its area be the same size as the area of the rectangle for Questions 7–9? Explain.

Name _____ Date _____ Class _____

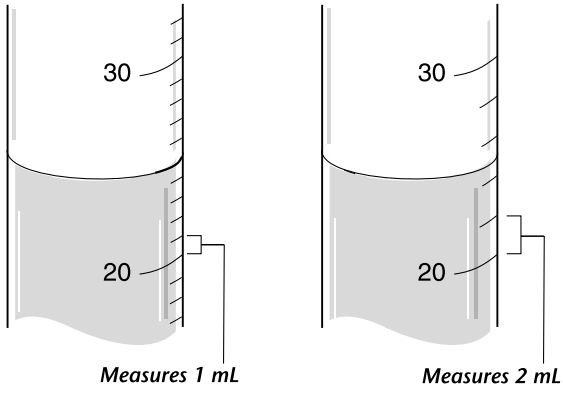
SKILLS PRACTICE

Measuring: Liquid Volume

Write your answers to the questions below in the spaces provided. If you need more space, use the back of this sheet.

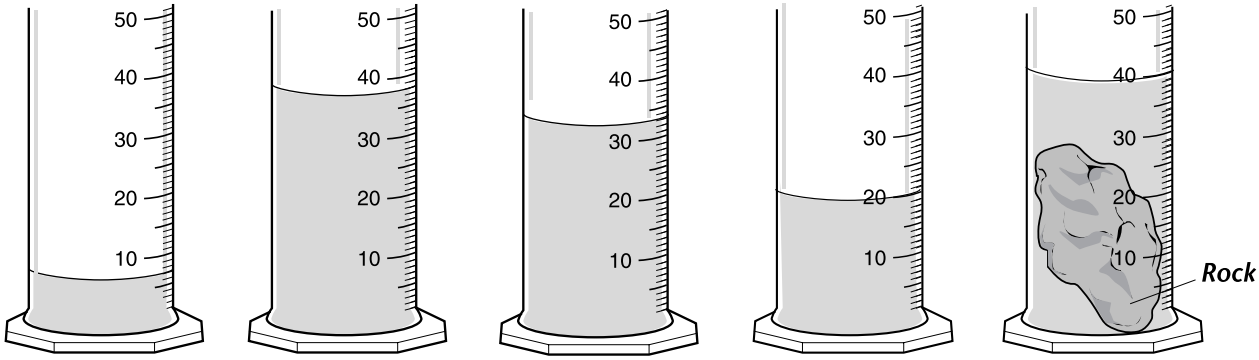


The volume of an object is the amount of space it takes up. You will often measure the volume of liquids using a graduated cylinder. ("Graduated" means that the cylinder is marked with measurement units.) Always read a graduated cylinder at eye level. Also, water in a graduated cylinder has a curved surface called the meniscus. Read the volume at the bottom of the meniscus.



Hints: Always check the unnumbered marks on a graduated cylinder to see how many sections there are and what they measure. Also, sometimes you have to estimate a measurement between two marks. Prove to yourself that both graduated cylinders on the right contain 25 mL.

What is the volume of the liquid shown in graduated cylinders 1–4 below? What is the total volume in graduated cylinder 5?



1. _____ **2.** _____ **3.** _____ **4.** _____ **5.** _____

6. If the diagrams for Questions 4 and 5 show the same graduated cylinder before and after the rock was added, what can you infer about the volume of the rock?

_____

7. Think About It Describe how you can use a graduated cylinder to measure the volume of an irregular object.

Name _____ Date _____ Class _____

SKILLS PRACTICE

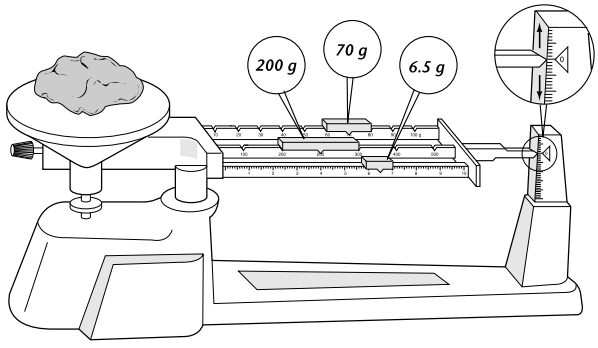
Measuring: Mass

Write your answers to the questions below in the spaces provided. If you need more space, use the back of this sheet.

Mass is the amount of matter in an object. There are different kinds of balances used to measure mass. Be sure you understand how your balance works. Some balances give a single reading. Others give two or more readings that you have to add together.

For example, look at the triple-beam balance on the right. Notice that the middle beam measures the largest amounts. To read the mass of an object, find and record the masses shown on each of the beams. Then add the readings.

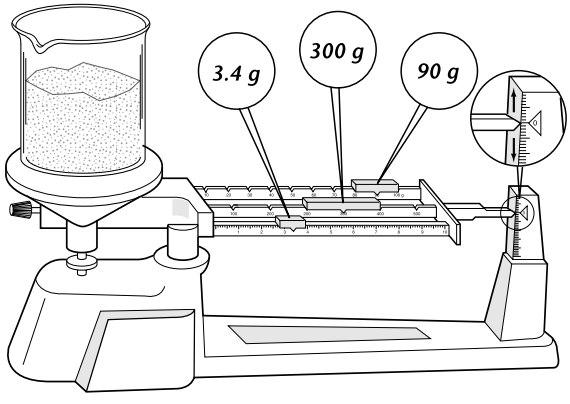
$$200\text{ g} + 70\text{ g} + 6.5\text{ g} = 276.5\text{ g}$$



Hint: Sometimes you have to find the mass of a substance in a container. Find the mass of the container alone. Then subtract that mass from the combined mass.

Mass of substance and container	29 g
Mass of container	− 13 g
Mass of substance	16 g

1. Using the diagram on the right, find the combined mass of the substance and its container. What is the mass of the substance if the mass of the container is 25 g?



_____

_____

_____

2. What is the mass of a powder if the combined mass of the powder and its container is 12 grams and the mass of the container alone is 4 grams? _____

_____

3. Think About It How are the three beams on a triple-beam balance different?

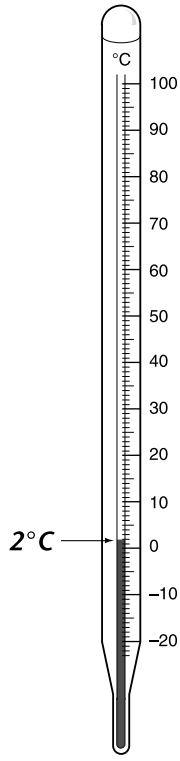
Name _____ Date _____ Class _____

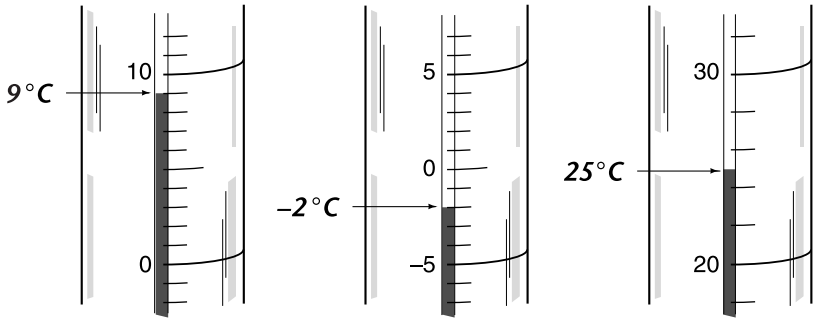
SKILLS PRACTICE

Measuring: Temperature

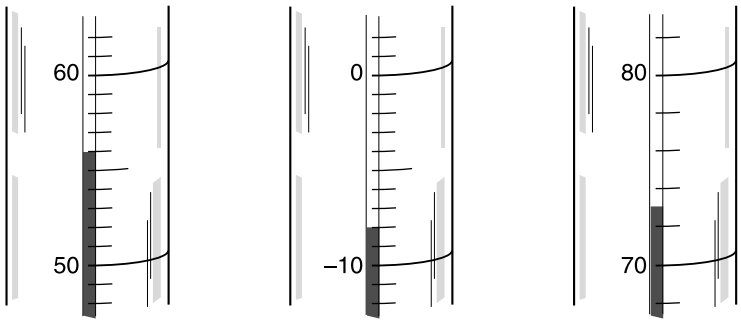
Write your answers to the questions below in the spaces provided. If you need more space, use the back of this sheet.

Temperature is a measure of how hot or cold something is. In science, you will measure temperature with a Celsius thermometer like the one at the right. The correct unit for readings on this thermometer is °C. As you read the temperatures in the first three diagrams below, notice which thermometer marks are labeled and unlabeled, and determine what the unlabeled marks represent. Also, always check whether you are reading temperatures above or below zero. Temperatures below zero should be shown with a minus sign.





What temperature is shown in each of the diagrams below?



1. _____ **2.** _____ **3.** _____

4. Suppose that at 9:00 A.M. the temperature of a room is 18°C, and at noon it is 24°C. What was the increase in temperature?_____

_____

5. If you add ice to water that is at 65°C and the water temperature drops to 40°C, what was the temperature decrease? _____

_____

6. Think About It Describe how you found the temperature increase and temperature decrease in Questions 4 and 5.