Name_____

Date_____Pd____

UNIT 1 CP WORKSHEET 1 - Units

Why are units important? Read the following story (which has been excerpted).

Metric mishap caused loss of NASA orbiter Orbiter

http://www.cnn.com/TECH/space/9909/30/mars.metric.02/ NASA's Climate Orbiter was lost September 23, 1999

September 30, 1999 By Robin Lloyd CNN Interactive Senior Writer

(CNN) -- NASA lost a \$125 million Mars orbiter because a Lockheed Martin engineering team used English units of measurement while the agency's team used the more conventional metric system for a key spacecraft operation, according to a review finding released Thursday.

The units mismatch prevented navigation information from transferring between the Mars Climate Orbiter spacecraft team in at Lockheed Martin in Denver and the flight team at NASA's Jet Propulsion Laboratory in Pasadena, California.

Lockheed Martin helped build, develop and operate the spacecraft for NASA. Its engineers provided navigation commands for Climate Orbiter's thrusters in English units although NASA has been using the metric system predominantly since at least 1990.

After a 286-day journey, the probe fired its engine on September 23 to push itself into orbit.

The engine fired but the spacecraft came within 60 km (36 miles) of the planet -- about 100 km closer than planned and about 25 km (15 miles) beneath the level at which the it could function properly, mission members said.

The latest findings show that the spacecraft's propulsion system overheated and was disabled as Climate Orbiter dipped deeply into the atmosphere, JPL spokesman Frank O'Donnell said.

That probably stopped the engine from completing its burn, so Climate Orbiter likely plowed through the atmosphere, continued out beyond Mars and now could be orbiting the sun, he said.

Error points to nation's conversion lag

Lorelle Young, president of the U.S. Metric Association, said the loss of Climate Orbiter brings up the "untenable" position of the United States in relation to most other countries, which rely on the metric system for measurement. She was not surprised at the error that arose.

"In this day and age when the metric system is the measurement language of all sophisticated science, two measurements systems should not be used," Young said.

"Only the metric system should be used because that is the system science uses," she said.

She put blame at the feet of Congress that she said has squeezed NASA's budget to the point that it has no funds to completely convert its operations to metric.

"This should be a loud wake-up call to Congress that being first in technology requires funding," she said, "and it's a very important area for the country."

- 1. What caused the loss of a \$125 million Mars orbiter in 1999?
- 2. What reasons does Lorelle Young give for using only the metric system?
- 3. Consider the following statements:
 - a. The water temperature is 32.
 - b. It's about 20 from here.
 - c. I'll call you back in about 2.

Why might these statements be confusing?

Rewrite the statements using appropriate units.

a.		

- b. _____
- c. _____



Figure 1. The top of this ruler reads in inches (in) and the bottom is in centimeters (cm).

- 4. The black lines above and below the ruler in fig. 1 are the same length. What is the length of the line in
 - a. centimeters? _____ cm
 - b. inches? _____ in
- 5. Make a mark on the top of the ruler in fig. 1 at 6 1/8 inches.
- 6. Make a mark on the bottom of the ruler in fig. 1 at 10.2 centimeters.



- 7. The ruler in fig. 1 is 1 foot (ft) long The ruler in fig. 2 shows the end of a yard stick. Using these rulers,, fill in the blanks
 - a. _____ in = 1 ft
 - b. _____ in = 1 yd

Figure 2.



- 8. The ruler in fig. 3 shows the end of a meter stick (a ruler that is 1 m long). Using this image, fill in the blanks:
 - a. ____ mm = 1 cm
 - b. _____ cm = 1 m
- 9. From your answers to #7 and #8, do a calculation to fill in the blanks:
 - a. _____ ft = 1 yd
 - b. ____ mm = 1 m
- 10. Using your experiences in answering questions #4 #9, why might the metric system (units like millimeters, centimeters & meters) be easier to use than the English system (units like inches, feet & yards)? You may also read <u>Metric⁴ Us!</u> for more information.

In a 12/20/99 letter to the editor of *Design News* magazine, Kevin Acheson, Chief Engineer of The Gear Works put it this way, "A number without units is meaningless. In high school I had a Physics teacher who constantly was harping on units. The only way you could pass her class was to show the units with the formulas, as well as with the final answer. At the time it seemed silly, but I did what she required to I could pass. Few things in my education have served me better than the lesson she drove how about always using units. In the 18+ years I have been doing engineering, I have seen more and more young engineers who haven't learned how easy it is to think you have a correct answer only to forget to apply some unit conversion. If anyone thinks that universally switching to the metric system will eliminate stupid errors, they are sadly mistaken. Is a meter the same as a kilometer? Of course not! Without units, no one knows what a number really means."

So, in physics class,

- \checkmark We will be using the metric system.
- \checkmark It is important for numbers to have units.
- \checkmark It is important that you check your answers to make sure they make sense.

All the units we use will be based on the following 3 units:

quantity	units	unit
		abbrev.
mass	kilogram	kg
length	meter	m
time	second	S

Let's look at some other units we will be using in physics:

Instructions

* Run this Applet - http://jersey.uoregon.edu/units/Units.html

While this may seem silly there is a point to it. The applet works by dragging either mass, length, or time into one of either the 4 boxes in the numerator, or the 4 boxes in the denominator. You may use them more than once.

When you hit a real physical entity, that key word will appear. For instance if you drag length into the numerator and time into the denominator that will be meters/second (m/s) which is a velocity.

Using this method, determine the units that correspond to the following terms and fill in the table. Some of these units have another name which is also included in the table.

quantity	units	alternate name for unit
velocity	m/s	
acceleration		
force		newton (N)
energy		joule (j)
momentum		
power		watt (W)
density		