

Exact and Measured Values

Quantitative Observations are measured **numerically**. All numbers used in technical applications can be categorized as being 1 of 2 types:

Exact Values: are the result of counting discrete items

Ex. **4 dogs, 100cm in a meter, 1 dozen eggs**

Measured Values: are the result of measurement relative to a continuous scale resulting in uncertainty of the last digit

= approximate values

Ex. **mass of an object 4.23g, length of the desk is 29.56 cm**

After the lab activity determine if the measures for each category are exact or approximate values.

Activity

Fill in the following chart:

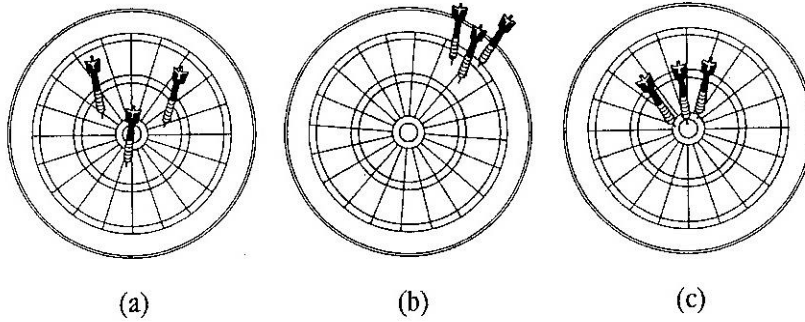
	Mass 1 sucker	# of suckers in the bag	Total Mass of all suckers in the bag	Mass on the bag
Value				
Exact or Measured Value?				

Accuracy and Precision

These words are used interchangeably in everyday language.

- **Accuracy:** the closeness of a measurement to the accepted value
- **Precision:** the degree of agreement among several measurements

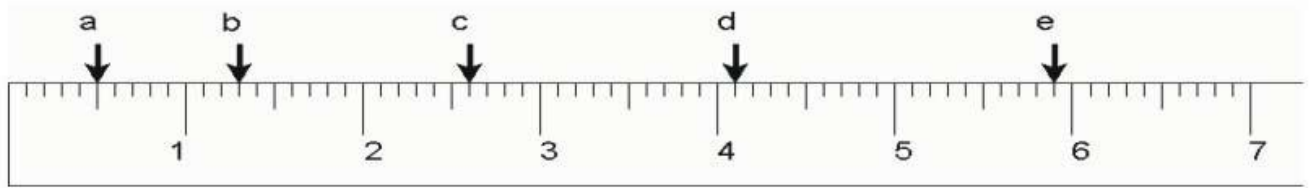
Example: playing darts... determine if the shots were accurate or precise?



What is the best combination of accuracy and precision for a major league baseball pitcher?

- a) bad accuracy, poor precision
- b) good accuracy, good precision
- c) average precision, good accuracy

Directions: What lengths are marked on the centimeter ruler shown?

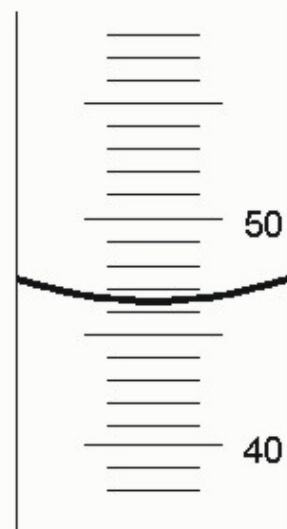
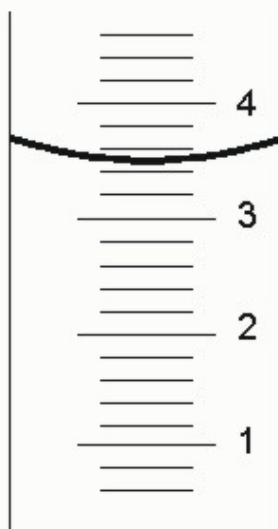
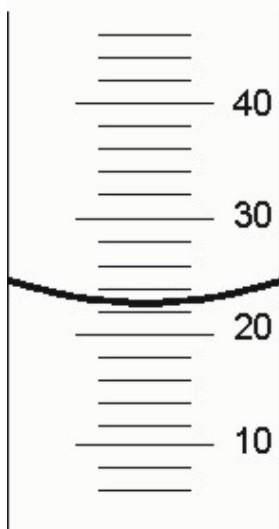
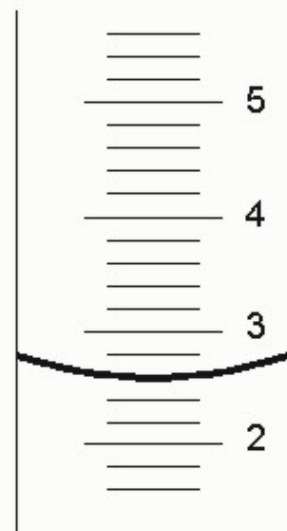
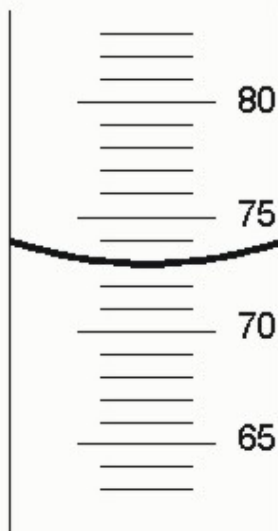
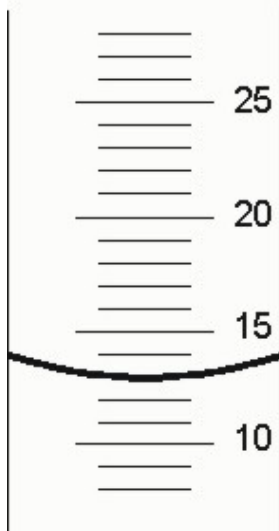
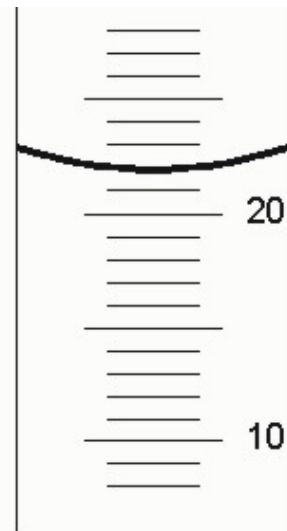
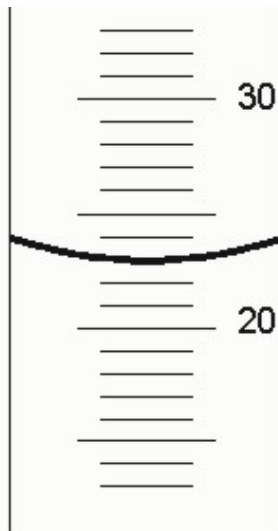
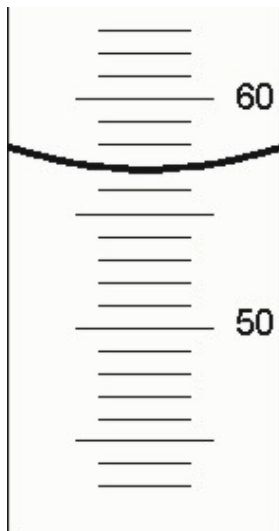


	cm	mm
A		
B		
C		
D		
E		

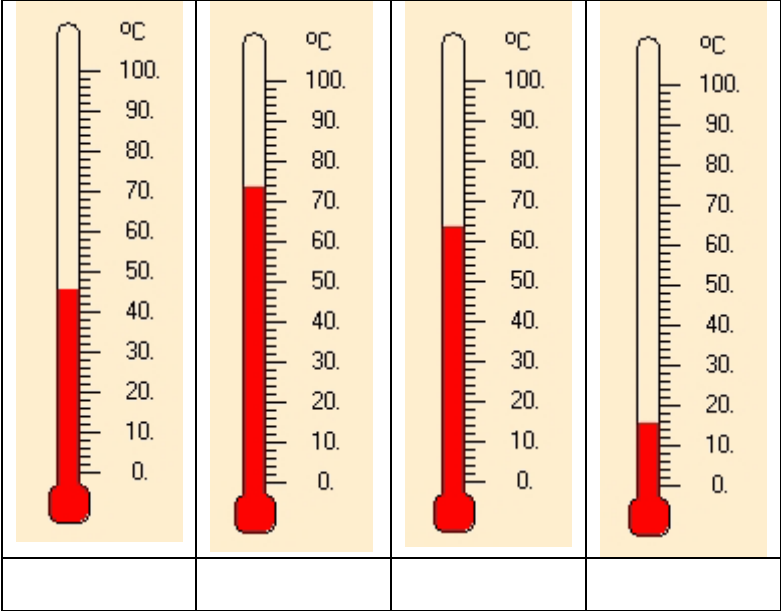
Directions: Measure each of the following lines with a centimeter ruler. Record your answers on the lines at right in centimeters

- F. _____
- G. _____
- H. _____
- I. _____
- J. _____
- K. _____
- L. _____

Directions: What does each of the graduated cylinders shown below read?

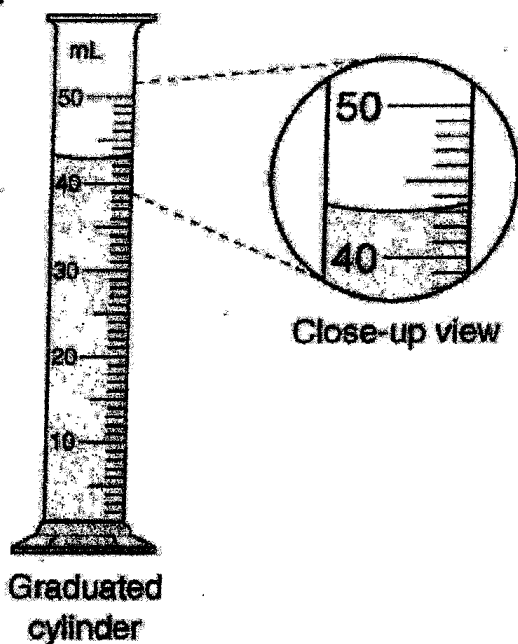


Directions: Write the temperature shown in the box below each thermometer.



UNCERTAINTY IN SCIENCE

In every observations made, there is always some uncertainty in the measurement being made.



Eg. the volume is 43.0 mL

- the reader is certain the volume is 43 mL but is uncertain about the 1/10th position
- the precision of the measurement depends upon on the construction of the measuring instrument if the reader can determine the ± 0.1 mL mark on the instrument
- so, the volume is 43.0 ± 0.1 mL

In other words, the volume could be as low as 42.9 or as high as 43.1 mL. In everyday conversation, the ± 0.1 mL is often omitted with the understanding the last recorded digit of any measurement is always uncertain.

The volume in the graduated cylinder is 43.0 ± 0.1 mL has 3 significant digits (figures). Even thou, the measurement has 3 significant digits the last recorded digit is uncertain.

Every measurement has a degree of uncertainty associated with it. The uncertainty derives from the measuring device and from the skill of the person doing the measuring.

