Physics
Chapter 1:
The Science of Physics

Section 1.2:
Measurements in Physics

Measurement

Why do we measure things?

--We use measurements in science to allow us to make accurate comparisons of various quantities.

- --Qualitative measurements involve comparisons that do not use numbers; they tend to answer the question “what”

- --An example of a qualitative measurement is the statement “The melting point of aluminum is less than that of iron.”

--<u>Quantitative</u> measurements involve the use of numbers and units to make comparisons; they tend to answer the question “how much”.

--An example of a quantitative measure is the statement “The melting point of aluminum is 660^{o}C and that of iron is 1535^{o}C”.

The International System of Units (SI)

--The modern version of the metric system is called the International System of Units or Systeme International (SI).

--The SI system, while it is similar to the original metric system, is different.

--For example, the metric definition of a meter was 1/10,000,000 of the distance between the equator and the North Pole.

--The SI definition of a meter is the distance traveled by light in 3.33564095 x 10^{-9} s.

(See Text, Table 2, page 11)

The Seven Basic SI Units

--The SI system has only <u>seven basic units;</u> all quantities are measure using either one of the seven basic units or a unit derived from a combination of the seven basic units.

Quantity	SI Unit	Abbreviation
Length	meter	m
Mass	kilogram	kg
Time	second	s
Temperature	kelvin	K
Electric Current	ampere	A
Luminous Intensity	candela	cd
Amount of Matter	mole	mol

Derived SI Units

--All other measurements are made with units derived from the seven basic SI units.

--Volume is measured in <u>cubic decimeters</u>, commonly called a <u>liter</u>.

--Density is measured in g/cm^3.

$$D = \frac{m}{v}$$

SI Prefixes

--Smaller and larger units in the SI system are derived by using prefixes with the basic or derived unit.

Prefix	Abbreviation	Meaning
kilo	k	10^3
hecto	h	10^2
deka	da	10^1
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}

Accuracy and Precision

--Accuracy is how close a set of experiment measurements are to each other; the extent to which a report measurement approaches the accepted ("true") value of the quantity measured.

--Precision is how close a set of measured values are to each other; the degree of exactness or refinement of a measurement.

Example: A student measure the freezing point of water three times, and gets the following values.

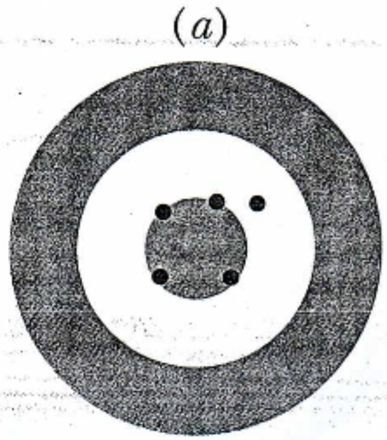
Trial	Freezing Point
1	2.2 ^oC
2	2.1 ^oC
3	1.9 ^oC

--If the accepted value for the freezing point is 0^oC, did the student's experiment have good accuracy? …good precision?

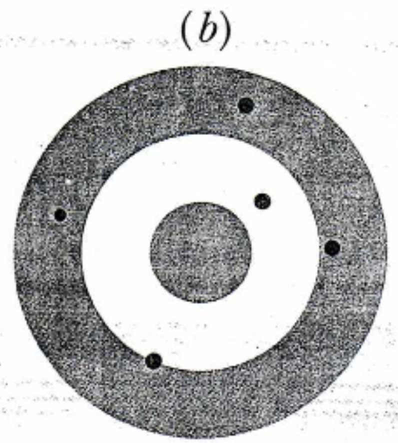
--Consider the following examples of target practice? Which are examples of:

a) good accuracy and precision?
b) good accuracy and poor precision?
c) poor accuracy and good precision?
d) poor accuracy and poor precision?

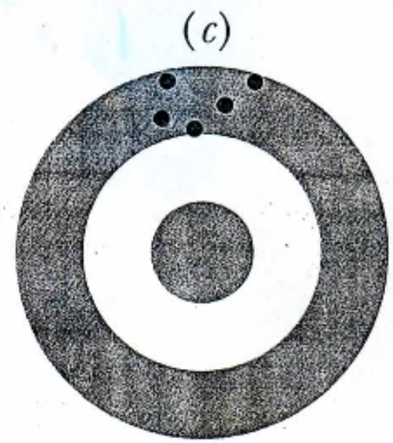
Transparency number 3 Unnumbered Figure



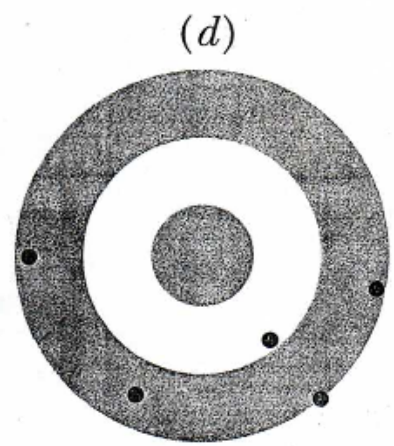
Good Accuracy,
Good Precision



Good Accuracy,
Poor Precision



Poor Accuracy,
Good Precision



Poor Accuracy,
Poor Precision

Overhead transparencies to accompany Reger/Goode/Mercer,
Chemistry: Principles & Practice, 2/e

Saunders College Publishing

Errors in Measurements

--<u>All</u> measurements involve some degree of error.

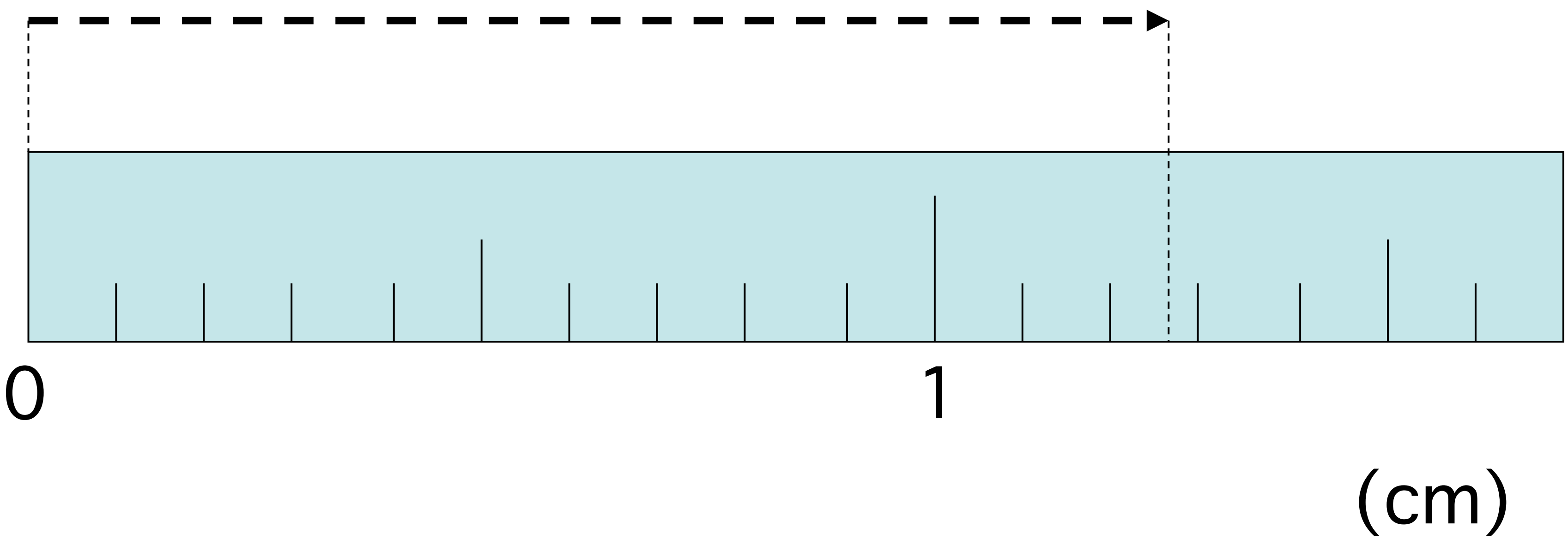
--Measurement errors are caused by two factors:

1) Different measuring devices are designed to measure to different degrees of accuracy. (Show the different balances in the lab; also the difference between a meter stick and a micrometer.)

2) Different people estimate reading on a scale differently. (Do Exercise 1.1)

--Scientific errors do <u>not</u> include a person reading an instrument incorrectly; it is assumed that the measurement is read correctly.

For Example:



1.26 cm

1.27 cm

1.28 cm

A

B

C

D

E