

# Standards for Measurement

## Chapter 2

# Writing numbers

- In chemistry we will use scientific notation for writing large and small numbers.
- We will always write numbers to the correct number of significant figures.
  - Rules for writing numbers correctly will be covered in the laboratory. These must be followed.

# Conversion Factors

- Anytime we have an equality, we can turn it into a conversion factor.

– Examples:

$$\text{– } 3 \text{ ft} = 1 \text{ yd} \text{ --> } \frac{3 \text{ ft}}{1 \text{ yd}} = \frac{1 \text{ yd}}{3 \text{ ft}} = 1$$

Remember to keep the units!

# Examples

- How many inches are in 6.27 yds?
- You have just won 2410 nickels in Las Vegas. How many \$3 chips can you get to play with?

# Units of Measurement



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**TABLE 2.1** Units of Measurement

Measurement	Metric	SI
Length	meter (m)	meter (m)
Volume	liter (L)	cubic meter (m <sup>3</sup> )
Mass	gram (g)	kilogram (kg)
Temperature	degree Celsius (°C)	kelvin (K)
Time	second (s)	second (s)

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# Metric prefixes

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kilo	k	$10^3$ or 1000 base units
deci	d	$10^{-1}$ or 0.1 base units
centi	c	$10^{-2}$ or 0.01 base units
milli	m	$10^{-3}$ or 0.001 base units
micro	$\mu$	$10^{-6}$ or 0.000 001 base units
nano	n	$10^{-9}$ or 0.000 000 001 base units

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# Metric prefixes again

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kilo	k	$1 \text{ k}_{unit} = 1000_{unit}$
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deci	d	$10 \text{ d}_{unit} = 1_{unit}$
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centi	c	$100 \text{ c}_{unit} = 1_{unit}$
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milli	m	$1000 \text{ m}_{unit} = 1_{unit}$
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micro	$\mu$	$1,000,000 \mu_{unit} = 1_{unit}$
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nano	n	$1,000,000,000 \text{ n}_{unit} = 1_{unit}$
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- Convert 4.6 cm to nm.
- Convert 750 ml to L.
- A glass of orange juice contains 0.85 dL of juice. How many milliliters of orange juice is that?



- The recommended daily allowance of phosphorus for an adult male is 800 mg. How many grams of phosphorus are recommended?
- A student's height is 175 cm. How tall is the student in meters?
- A hummingbird has a mass of 0.0055 kg. What is the mass of the hummingbird in grams?

## Some Common Equalities

Quantity	U.S.	Metric (SI)	Metric–U.S.
Length	1 ft = 12 in.	1 km = 1000 m	2.54 cm = 1 in. (exact)
	1 yd = 3 ft	1 m = 1000 mm	1 m = 39.37 in.
	1 mi = 5280 ft	1 cm = 10 mm	1 km = 0.6214 mi
Volume	1 qt = 4 cups	1 L = 1000 mL	1 L = 1.057 qt
	1 qt = 2 pints	1 dL = 100 mL	946.4 mL = 1 qt
	1 gal = 4 qt	1 mL = 1 cm <sup>3</sup>	
Mass	1 lb = 16 oz	1 kg = 1000 g	1 kg = 2.205 lb
		1 g = 1000 mg	453.6 g = 1 lb
Time		1 h = 60 min	
		1 min = 60 s	

# Useful Conversion Factors

- $1 \text{ in} = 2.54 \text{ cm}$
- $1 \text{ lb} = 454 \text{ g}$                       or                       $1 \text{ kg} = 2.20 \text{ lb}$
- $1 \text{ qt} = 946 \text{ ml}$                       or                       $1 \text{ L} = 1.06 \text{ qt}$

- A person is 60.0 in tall. What is this height in cm?
- If someone weighs 80.7 kg, how much is this in pounds?

- The daily dose of ampicillin for the treatment of an ear infection is 115 mg/kg body weight. What is the daily dose for a 34-lb toddler?

- A person on a diet has been losing weight at the rate of 3.5 lb. per week. If the person has been on the diet for 6 weeks, how many kilograms were lost?

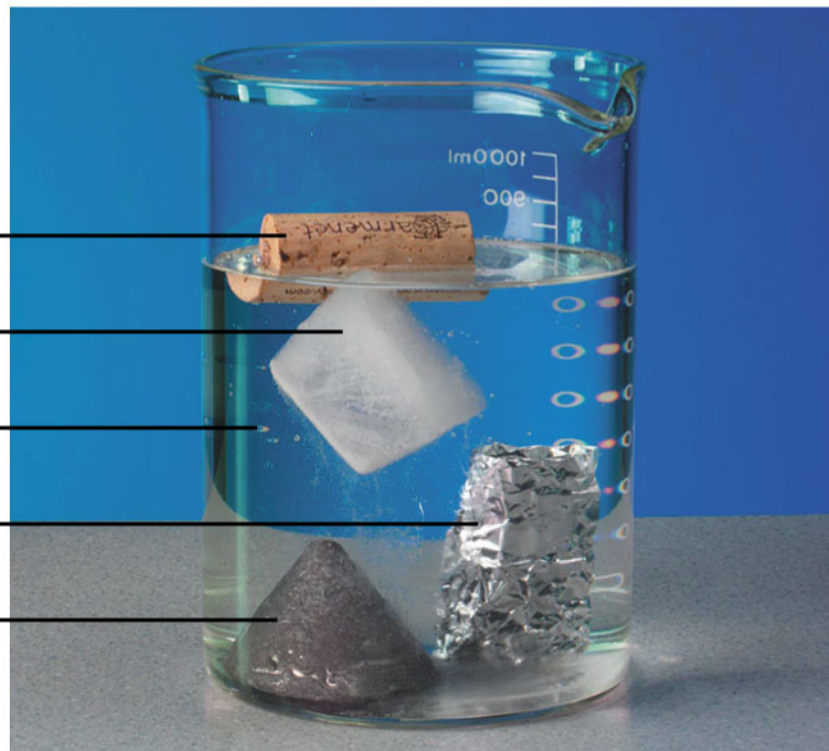
- A plastics manufacturing plant uses 3.3 tons of oil per week. If oil costs \$4.65/kg, how much will 1 years worth of oil cost the plastics manufacturer?

- Mercury has a density of 13.6 g per mL. What is the density of mercury in lbs. per gallon?



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

- Cork (D = 0.26 g/mL)
- Ice (D = 0.92 g/mL)
- H<sub>2</sub>O (D = 1.00 g/mL)
- Aluminum (D = 2.70 g/mL)
- Lead (D = 11.3 g/mL)



# Which cube has the greater density?



(a)

# Which cube has the greater density?



**(b)**

- Ebony is a dark hard wood. A rectangular piece of ebony has a mass of 522g and a volume of 435 cm<sup>3</sup>. Find the density of ebony.
- Gasoline has a density of 0.68 g/mL. What is the mass of 90.5 mL of gasoline?

- A bottle containing 325 g of cleaning solution has fallen and broken on the floor. If the solution in the bottle has a density of 0.850 g/mL, what volume of solution needs to be cleaned up?
- A fish tank holds 30.0 gal of water. Using a density of 1.0 g/mL for water, determine the number of pounds of water in the fish tank.

# Percentage

$$\text{Mass}\% = \frac{\text{MassPart}}{\text{MassWhole}} \times 100\%$$

- A sample of sugar weighing 2.47 g contains 0.988g of carbon. What is the mass % carbon in sugar?

# Percentage (cont.)

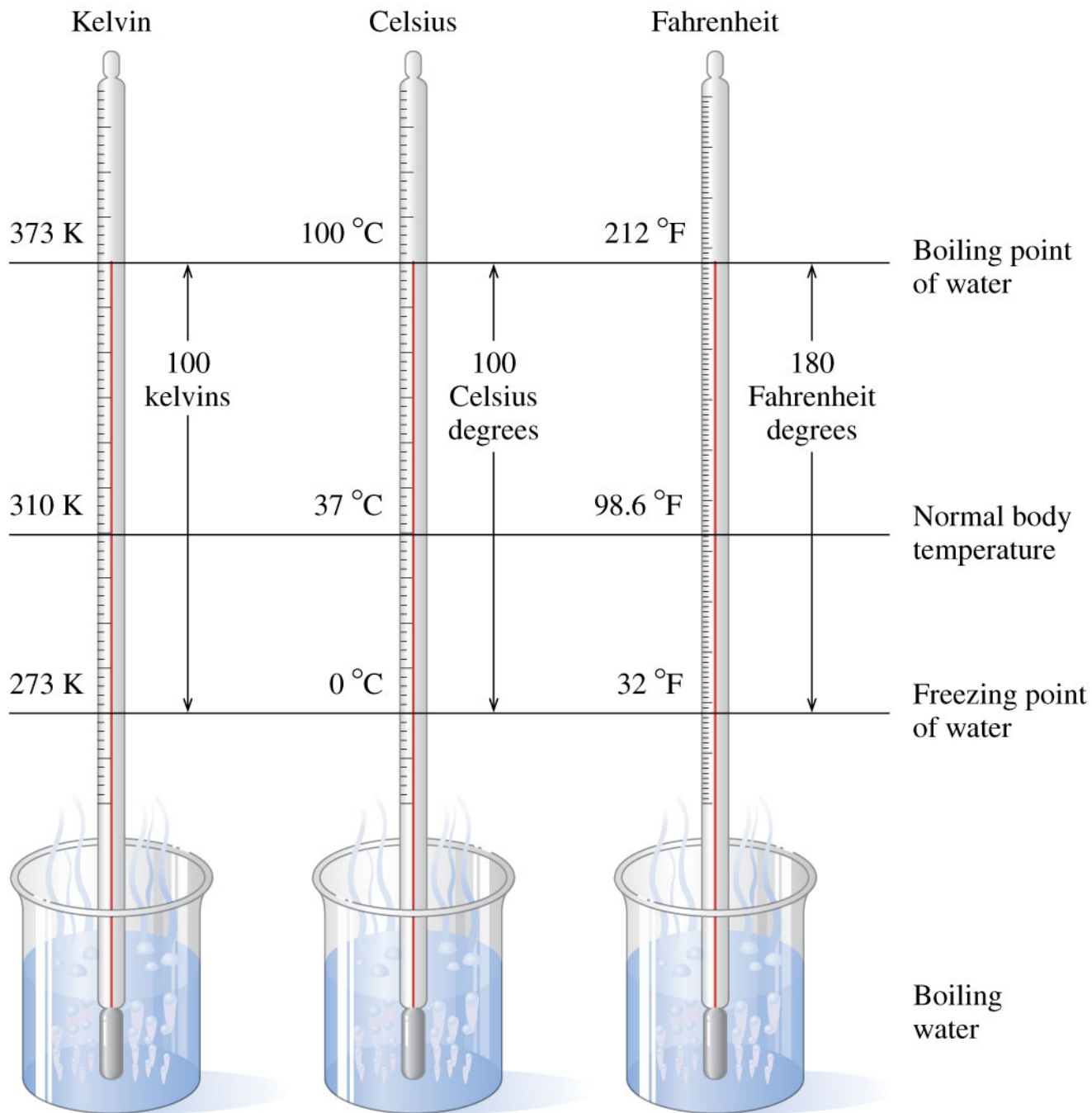
- Dr. Willard's Chem115 class began with 127 students. Of the original enrollment, 11.2% received a final grade A. How many students earned an A?
- Water is composed of 11.2% H and 88.8% O. What is the mass of water contains 15.0 g of O?

- Jodi, a sculptor, has prepared a mold for casting a bronze figure. The figure has a volume of 325 mL. If bronze has a density of 7.8 g/mL and Jodi likes to use 90.0% of the bronze melted (she sometimes spills), how many ounces of bronze does Jodi need to melt in the preparation of the bronze figure.



# Squared units

- A poster has an area of  $2 \text{ yd}^2$ . What is the area of the poster in  $\text{ft}^2$ ?



# Temperature Conversions

- $T(^{\circ}\text{F}) = 1.8 T(^{\circ}\text{C}) + 32$
- $T(^{\circ}\text{C}) = [T(^{\circ}\text{F}) - 32] / 1.8$
- $T(\text{K}) = T(^{\circ}\text{C}) + 273.16$

- If I set my thermostat at 72°F, what will the temperature be in Celsius?

- A young woman recovered from extreme hypothermia, during which her temperature had dropped to  $20.6^{\circ}\text{C}$ .
- What was her temperature on
  - the Fahrenheit scale
  - the Kelvin scale

- A 4-year-old child has a temperature of  $38.7^{\circ}\text{C}$ . Since high fevers cause convulsions in children, it is recommended that Phenobarbital be given if the temperature exceeds  $101.0^{\circ}\text{F}$ . Should Phenobarbital be given now?