Chem 30A

Sept. 7, 2022

Lecture

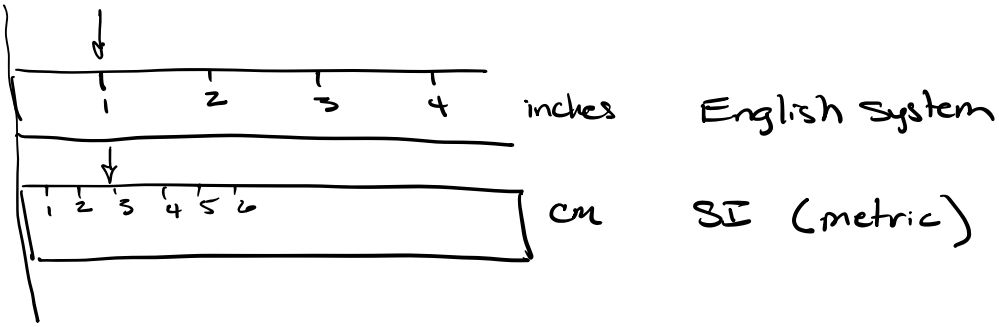
Problem Solving
Dimensional analysis
- Temperature
- Density
- Specific gravity

Word problem
- Conversion of a measurement into a different unit
- Solving for an unknown

Road map approach

Ex

Convert 37.6 inches into centimeters.



1 inch = 2.54 cm Equality (Conversion factor)

Eng SI

Road map

1 in = 2.54 cm

English Inches → SI cm

↑ Conversion factor

Given Unit × $\frac{\text{Desired unit}}{\text{Given unit}}$ = Desired unit

$37.6\ \text{in} \times \frac{2.54\ \text{cm}}{1\ \text{in}} = \text{cm}$

$$\frac{37.6\ \text{in}^3}{1} \times \frac{2.54\ \text{cm}^3}{1\ \text{in}^3} = 95.504\ \text{cm}$$

$$= 95.5\ \text{cm}$$

Ex

How many meters are in 372.7 yds?

(1 yd = 3 ft, 1 ft = 12 in, 1 in = 2.54 cm, 100 cm = 1 m)

✓ ① Parse problem
- ✓ Given
- ✓ Desired
- ✓ Equalities (Conversion factors)

✓ ② Road Map

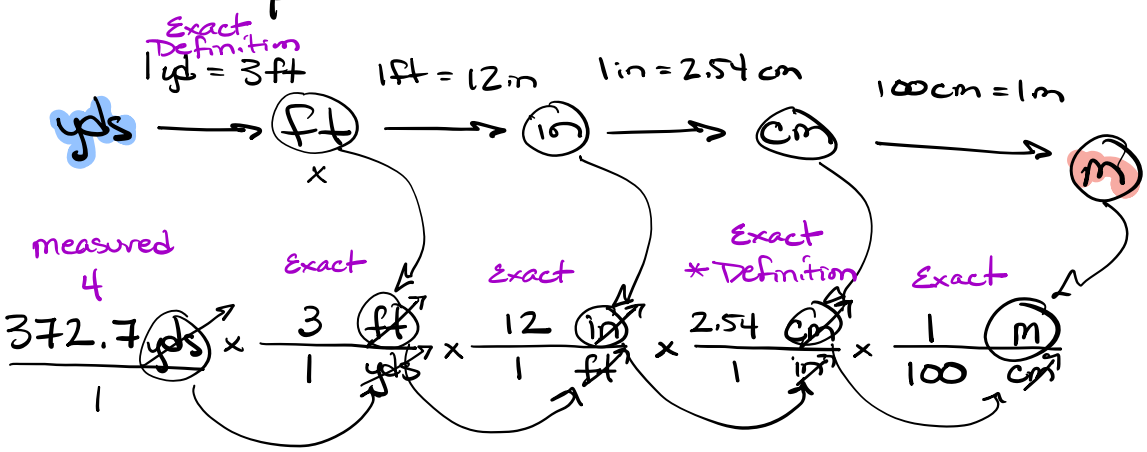
✓ ③ Identify required equalities if not provided

④ Construct problem

⑤ Math

⑥ Sig figs

Road Map



$$\frac{372.7 \times 3 \times 12 \times 2.54 \times 1}{1 \times 1 \times 1 \times 1 \times 100}$$

$372.7 \times 3 \times 12 \times 2.54 \div 100 = 340.79688\ m$

$= 340.8\ m$

3 Keys — Three Key Conversion Factors

	English		SI	
Length	1 in	=	2.54 cm	Exact
Mass	1 lb	=	453.6 g	Measured 4 Sig figs
Volume	1 gal	=	3.785 L	Measured 4 Sig figs

Memorize 3 keys & metric prefixes

→	Kilo	k	$\times 10^{3}$
	Base	—	$\times 10^{0}$
→	Centi	c	$\times 10^{-2}$
→	Milli	m	$\times 10^{-3}$
	Micro	μ	$\times 10^{-6}$

Temperature

Temp scales

1700 °F	1730 °C	1850 K
212	100	373.15
180°	100	100
32	0	273.15
− 459.67	−273.15	Ø Absolute Zero

no negative values

Temperature Conversions

°C ↔ K	°C → K	°C + 273.15 = K
Requires a Phase Shift	K → °C	K − 273.15 = °C
°F ↔ °C	°F → °C	$(°F - 32) \times \frac{100\,°C}{180\,°F}$
Requires a Phase & unit Shift	°C → °F	$°C \times \frac{180\,°F}{100\,°C} + 32°F$

Convert 82.6 °F to °C.

$$(82.6\,^{\circ}F - 32\,^{\circ}F) \times \frac{100\,^{\circ}C}{180\,^{\circ}F} = 28.11111\,^{\circ}C$$

(3 significant figures)

$$= 28.1\,^{\circ}C$$

75.72 °C into °F ?

$$75.72\,^{\circ}C \times \frac{180\,^{\circ}F}{100\,^{\circ}C} + 32\,^{\circ}F = 168.2769\,^{\circ}F$$

(4 significant figures)

$$= 168.3\,^{\circ}F$$

Density & Specific Gravity

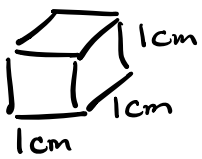
Ratio of the mass to volume of an object or material

All matter has mass

All matter has volume

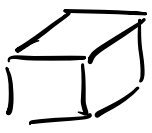
All matter has a density = $\frac{\text{mass}}{\text{volume}}$

gas	liquid	Solid
g/L	g/mL	g/mL
or	or	or
$\frac{g}{L}$	$\frac{g}{mL}$	$\frac{g}{mL}$
		or
		$\frac{g}{cm^3}$ or $\frac{g}{cc}$
		$cc = cm^3$



$1cm \times 1cm \times 1cm = 1cm^3 = 1mL$

Densities are measured properties & reported at the temperature they are measured at.

Object	0°C Cold	100°C Hot
Volume	 50 mL	 60 mL
mass	73 g	73 g
Density	$\frac{73\,g}{50.\,mL} = 1.46\ g/mL$ (2) $= 1.5\ g/mL$	$\frac{73\,g}{60.\,mL} = 1.216\ g/mL$ (2) $= 1.2\ g/mL$

Density can be an equality.

Types of problems

1. Find a density given mass & volume
2. Find a volume given mass & density
3. Find a mass given volume & density

Ex The density of iron (Fe) is $7.86\ g/cm^3$. How many grams would a block of iron weigh if it's volume was $394.7\ cm^3$?

Density $\quad 7.86\ g = 1\ cm^3 \qquad \frac{7.86\ g}{1\ cm^3}$

Road map

$cm^3 \xrightarrow{7.86\ g = 1\ cm^3} g$

$$\overset{4}{394.7}\ cm^3 \times \frac{\overset{3}{7.86}\ g}{1\ cm^3} = 3102.342\ g$$

$3100\ g$ 2 sig figs

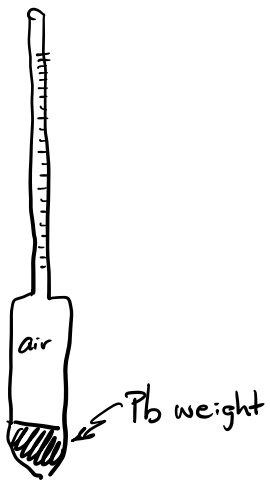
$3100.\ g$ 4 sig figs

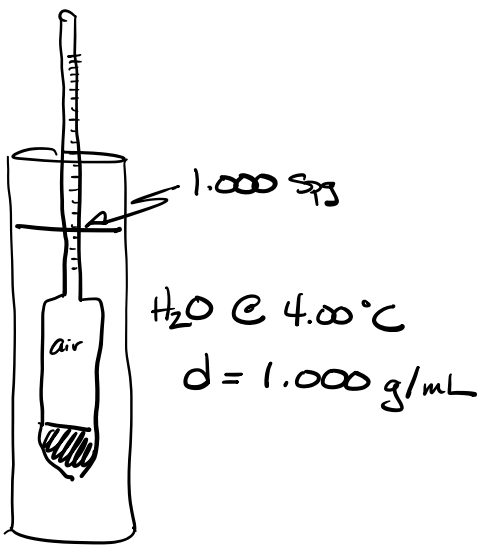
$3.10 \times 10^3\ g$ 3 sig figs !

Specific Gravity

What is the density of the Ocean?

Hydrometer





$$\text{Specific gravity} = \frac{\text{density object } \cancel{\text{g/mL}}}{\text{density of } H_2O \text{ @ } 4.00^\circ C \; \cancel{1.000\ \text{g/mL}}}$$

= unit less value