Tuesday 12/3/19

has mass, takes up space (volume)

ALL MATTER IN THE UNIVERSE

"pure"

substances $\xleftrightarrow{\text{physical } \Delta}$ mixtures

substances:

elements $\xleftrightarrow{\text{chemical } \Delta}$ compounds

elements
- made up of atoms of one type
- ex: O_2, O_3, S_8, H_2, Ag

compounds
- made up of atoms of two or more different types
- ex: H_2O, NaCl, Fe_2O_3, $C_6H_{12}O_6$

mixtures:

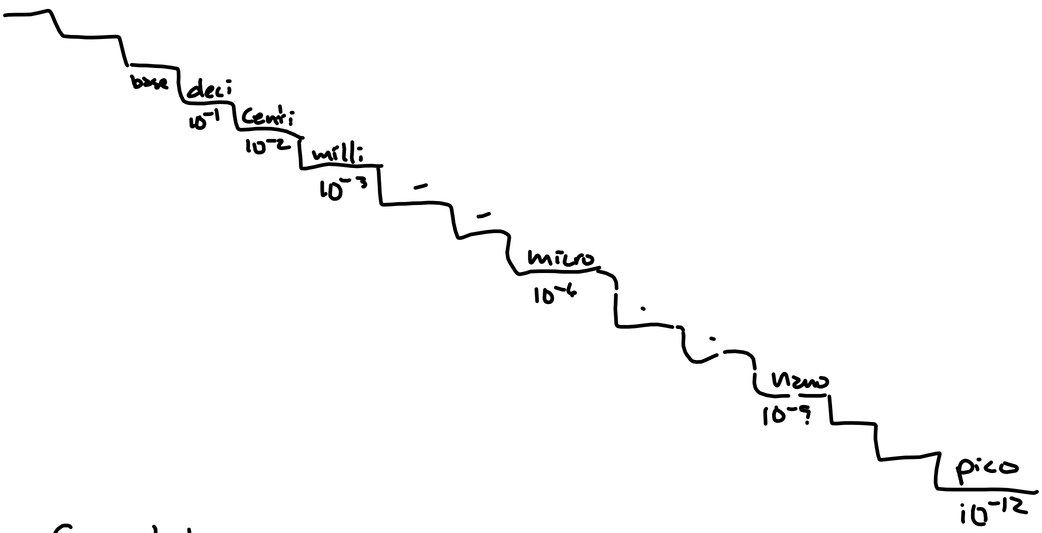
homogeneous
- AKA "solutions"
- two or more substances in only one phase.

heterogeneous
- two or more substances in two or more phases.

ionic: cations/anions

molecular: shared valence e^-, nonmetal

*phase = a region of constant composition.



Convert 1.0 mi → cm

$$1.0\,\cancel{mi} \times \frac{5280\,\cancel{ft}}{1\,\cancel{mi}} \times \frac{12\,\cancel{in}}{1\,\cancel{ft}} \times \frac{2.54\,cm}{1\,\cancel{in}} =$$

Tuesday 12/3/19

ALL MATTER IN THE UNIVERSE

$A \xrightarrow{\Delta} B$

"pure" Substances — physical Δ — mixtures

Substances: element, compound — chemical Δ always bond breaking/making

Mixtures: homogeneous, heterogeneous

element
- made up of only one type of atom.

ex: O_2, O_3, Cl_2, Au, P_4

compound
- made up of two or more types of atoms

ex: H_2O, NaCl, Fe_2O_3, $C_6H_{12}O_6$

homogeneous
- two or more substances in one phase.*

heterogeneous
- two or more substances, 2 or more phases.

* phase - a region of constant composition.

3 moles A_2 (g)

2 moles B(g)

5 moles C(g)

mole fraction of A_2 $\Rightarrow$ $\frac{3\text{ mol } A_2}{3\text{ mol } A_2 + 2\text{ mol } B + 5\text{ mol } C} =$

$$P_{total} = P_{A_2} + P_B + P_C$$

$$P_{A_2} = \chi_{A_2} P_{total}$$

mole fraction

$$P_B = \chi_B P_{total}$$

$$P_C = \chi_C P_{total}$$

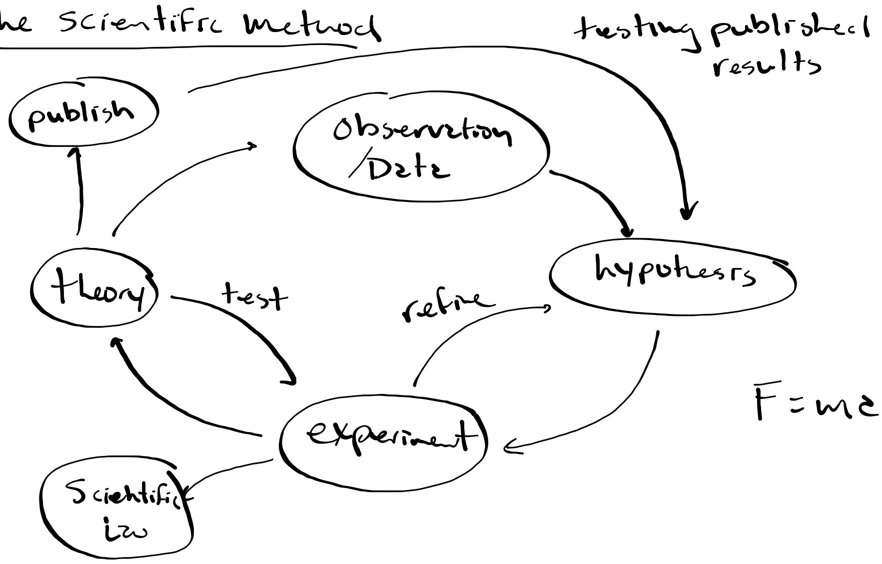
χ

Monday 12/9/19

The Book

observation
↓
hypothesis
↓
experiment
↓
theory
↓
publish

The scientific method



hypothesis - a testable statement with an explanation "why"?

"guess" "educated"

Scientific law - a concise statement that summarizes the results of many experiments $F=ma$

FACT

$F_G = G\frac{m_1 m_2}{r^2}$

theory - AKA 'model' → an extensively tested explanation of why experiments give the results they do.

→ can never be proven, only disproven
→ must predict the results of future experiments
→ tend to change/be refined as new results are obtained.

Physical & chemical properties of matter

A

Physical

density

boiling point / melting point

color, shape, size

magnetic susceptibility

hardness

polarity / charge

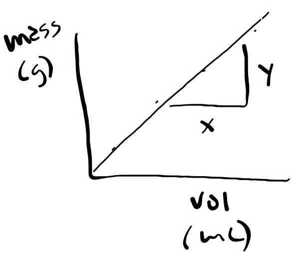
Chemical

- reactivity
- acid / base characteristics
- functional group type
  eg. alcohol, ketone, hydrocarbon
  oxidizer, reducer etc.

Evidence of a chemical change

- color change
- heat absorbed / evolved
- new substance formed
  e.g. - bubbled, formation of precipitate
- density
- light emitted
- not reversible
- bond making / breaking

Intensive properties of matter - characteristics of matter that do not change depending on the sample size.
ex: density, color, mp, bp, polarity
specific heat capacity



Extensive prop. of matter → characteristics of matter that do change as sample size changes.
ex: mass, fuel content, calories (food)
volume, surface area

Tuesday 12/10/19

The SI System of Units & Dimensional Analysis

Seven Base Units

quantity	Name	symbol
length	meter	m
mass	Kilogram	kg
time	second	s
x electric current	ampere	A
temperature	kelvin	K
amount of substance	mole	mol
x luminous intensity	candela	cd

$m^3 = vol$

Wed: 12/11/19

$+ \; - \; \times \; \div \; \sqrt[3]{x}$

The SI system Units and prefixes

0.0×10^0

prefix	abbrev.	what it does	how many in 1 base unit
Mega	M	1,000,000 x ___ 10^6 x	$\frac{1}{1,000,000}$
Kilo	k	1,000 x ___ 10^3	$\frac{1}{1,000}$
"base"	~	1	1
deci	d	$\frac{1}{10}$ x ___ 10^{-1} ___	10 (10^1)
centi	c	$\frac{1}{100}$ x ___ 10^{-2} x ___	100 (10^2)
milli	m	$\frac{1}{1000}$ x ___ or 10^{-3} x ___	1000 (10^3)
micro	"mu" μ	$\frac{1}{1,000,000}$ x ___ or 10^{-6} x ___	1,000,000 (10^6)
nano	n	$\frac{1}{10^9} = \frac{1}{1,000,000,000}$ x ___ 10^{-9} x ___	1,000,000,000 (10^9)
pico	p	$\frac{1}{1,000,000,000,000}$ x ___ 10^{-12} x ___	1,000,000,000,000 (10^{12})

have

76.0 in long

31.8 in wide

$$\boxed{1\,in = 2.54\,cm}$$

$$\frac{1\,in}{2.54\,cm} \quad \text{or} \quad \frac{2.54\,cm}{1\,in}$$

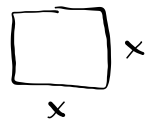
A   B

76.0 in → cm → m

$$76.0\,\cancel{in} \times \frac{2.54\,\cancel{cm}}{1\,\cancel{in}} \times \frac{1\,m}{100\,\cancel{cm}} = 1.93\,m$$

x

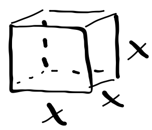
$1.56\,m^2$



$$31.8\,in \times \frac{2.54\,cm}{1\,in} \times \frac{1\,m}{10^2\,cm} = 0.808\,m$$

method 2

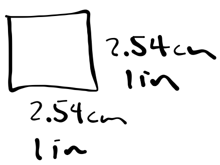
$$x \cdot x = ?$$



$V = x^3$

$$76.0\,in \times 31.8\,in = 2420\,in^2$$

$2420\,in^2 \rightarrow cm^2 \rightarrow m^2$



$$2420\,in^2 \times \left(\frac{2.54\,cm}{1\,in}\right)^2 \times \left(\frac{1\,m}{10^2\,cm}\right)^2 = 1.56\,m^2$$

The mess of \$100 bill is ~ 1.00g

$$\$18\times10^{9} \times \frac{1\ \text{bill}}{\$100} \times \frac{1.00\text{g}}{1\ \text{bill}} \times \frac{1\text{kg}}{1000\text{g}} \times \frac{2.2\#}{1\text{kg}} =$$

396,000 #

200 tons of \$100 bills

Thursday 12/12/19

Determining Significant Zeros

① All non-zero digits are significant

ex: 1.365 g 565.3 mL 124 ft

② Placeholder zeros are NOT significant.

ex: 100 m (1 sf) 356 000 L (3 sf) 0.0005 s (1 sf)

1.00×10^2 m 0.0501

③ "Trapped" zeros ARE significant

ex: 1001 m 356.004 L 5040 m

1.001×10^3 m 3.56004×10^2 L 5.04×10^3 m

④ Zeros to the right of nonzero digits and also to the right of the decimal point ARE significant

ex: 1.00 L (3 sf) 3.5600 g (5 sf) 5.0050 s (5 sf)

5.0000 s

⑤ Exceptions

i) counting numbers
eggs, people, protons

H_2O

ii) conversion factors used in dimensional analysis problems

12 in = 1 ft

Rules for calculations involving sfs

+/−	x/÷
The number reported has as many DIGITS TO THE RIGHT of D.P. as the value used in calc that had the fewest DIGITS TO THE RIGHT OF D.P.	The number reported has as many s.f.s as did the value used in calculation that had the FEWEST SIG. FIGS

$3.650 - 1.40 =$

$D = \frac{12.00g}{3.53mL} =$ 3sf

-0.5sf

1000mL → dL

$5280\,ft = 1\,mi$

Convert $60.\ mi/hr \rightarrow ft/s$

$$\frac{60.\ \cancel{mi}}{1\ \cancel{hr}} \times \frac{5280\ ft}{1\ \cancel{mi}} \times \frac{1\ \cancel{hr}}{60\ \cancel{min}} \times \frac{1\ \cancel{min}}{60\ s} = 88\ \frac{ft}{s}$$

$$134\,\text{mmol} \times \frac{1\ \text{mol}}{10^3\ \text{mmol}} = 0.134\,\text{mol}$$

3) $$3500\,\cancel{\mu g} \times \frac{1\ \cancel{g}}{10^6\ \cancel{\mu g}} \times \frac{10^1\ dg}{1\ \cancel{g}} = 3500 \times 10^{-5}$$

$$3.5 \times 10^{-2}\,dg$$

from the homework 12/12/19

18, 19

18) known | want
$V = 55.1 cm^3$ | $m = ?$
$D = 6.72 g/cm^3$

memorizing | dsw

$D = \frac{m}{V}$ | $55.1 cm^3 \times \frac{6.72 g}{1 cm^3} =$

$m = V \cdot D$

$= (55.1 cm^3)\left(\frac{6.72 g}{1 cm^3}\right)$

$m = 370.2 g$

$3.70 \times 10^2 g$

19) known | want
$D = 0.824 \frac{g}{mL}$ | $V = ?$
$m = 0.451 g$

$D = \frac{m}{V}$ | $0.451 \cancel{g} \times \frac{1 mL}{0.824 \cancel{g}} = 0.547 mL$

$V = \frac{m}{D} = \frac{0.451 \cancel{g}}{0.824 \frac{\cancel{g}}{mL}} =$

$\frac{1}{\frac{1}{x}} = x$ | $\frac{\frac{1}{x}}{1} = \frac{1}{x}$

22) Known want

2 $D_{Au} = 19.3\,g/cm^3$ $V = ?$ $\frac{1}{\frac{1}{x}} = x$ $\frac{\frac{1}{x}}{1} =$

$m = 0.715\,kg \times \frac{10^3\,g}{1\,kg} = 715\,g$

$\frac{V \cdot \cancel{D}}{\cancel{D}} = \frac{m}{\cancel{V}} \cdot \frac{\cancel{V}}{D}$

$V = \frac{m}{D} = \frac{715\,g}{19.3\,\frac{g}{cm^3}} =$

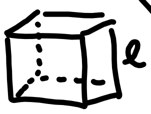
$0.715\,\cancel{kg} \times \frac{10^3\,\cancel{g}}{1\,\cancel{kg}} \times \frac{1\,cm^3}{19.3\,\cancel{g}} = 37.046$

$37.0\,cm^3$

$\sqrt[x]{y}$

b)

$\sqrt[3]{V} = \sqrt[3]{l^3}$



$l = \sqrt[3]{V} = \sqrt[3]{37.0\,cm^3} = 3.33\,cm$

3.5×10^{-4}

$1.0\,\mu g = 0.000001\,g$

$\frac{1.0\,\mu g}{0.000001\,g}$ or $\frac{0.000001\,g}{1.0\,\mu g}$

$19.3\,g \times \frac{10^9\,ng}{1\,g} = 19.3\times10^9\,ng$

$1.93\times10^{10}\,ng$

from the homework
35-43 p. 65

#38 a) 0.4004 mL 4 sf
b) 6000 g 1 sf
c) 1.00030 km 6 sf
d) 400. mm 3 sf

Perform the following calculation and report to correct # of significant digits.

a) 9.30 m − 9.2980 m = 0.00 m

39) 6.078 g + 0.3329 g = 6.41090 g
6.411 g

40) 8.2 cm − 7.11 cm = 1.1 cm

41) 0.8102 m × 3.44 m = 2.78709 m^2
2.79 m^2

$$\frac{ft}{s} \qquad \frac{ft}{min} \qquad \frac{ft}{hr} \qquad \frac{mi}{hr}$$

$$\frac{1200\,\cancel{ft}}{1\,\cancel{s}} \times \frac{60\,\cancel{s}}{1\,\cancel{min}} \times \frac{60\,\cancel{min}}{1\,hr} \times \frac{1\ mi}{5280\,\cancel{ft}} =$$

$$\frac{1200\,ft}{1\,s} \times \frac{3600\,s}{1\,hr} = 4.32\times10^{6}\,\frac{ft}{hr}$$

$$\frac{4.32\times10^{6}\,ft}{1\,hr} \times \frac{1\ mi}{5280\,ft} = 818\,\frac{mi}{hr} = 820\,\frac{mi}{hr}$$

from the homework 12/13

1.05 x salary

#35 p.65

$$\%\text{error} = \frac{\left|\text{experimental value} - \text{true/known value}\right|}{\text{true/known value}} \times 100\%$$

Student mass = 9.67g

Known mass = 9.82g

$$\frac{\left|9.67g - 9.82g\right|}{9.82g} \times 100\% =$$

%error = 1.53% error

25)

have

E ← 225 million km → m

225×10^6 km

want

time in min for signal to travel E → m

S.O.L. = 3.00×10^8 m/s

$$225 \times 10^6 \cancel{km} \times \frac{10^3 \cancel{m}}{1 \cancel{km}} \times \frac{1 \cancel{s}}{3.00 \times 10^8 \cancel{m}} \times \frac{1 \text{ min}}{60 \cancel{s}} = 12.5 \text{ min}$$

2.25×10^8 km

8.0 mi → time

Sound 343 m/s

$$8.0\,mi \times \frac{ft}{mi} \times \frac{in}{ft} \times \frac{cm}{in} \times \frac{m}{cm} \times \frac{1\,s}{343\,m} =$$

LIGHT

$$8.0\,mi \times \frac{ft}{mi} \times \frac{in}{ft} \times \frac{cm}{in} \times \frac{m}{cm} \times \frac{1\,s}{3.00 \times 10^{8}\,m}$$

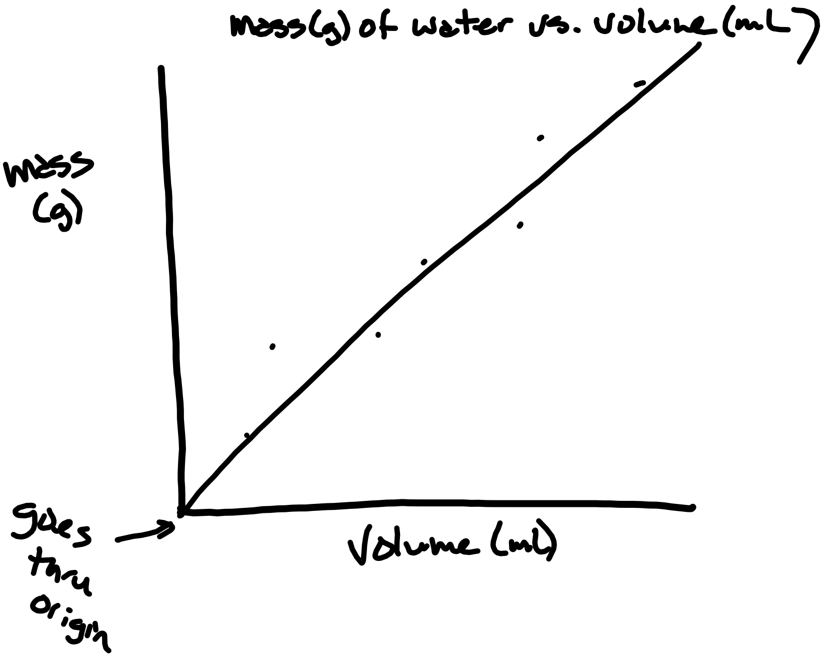
$60\,m/s \rightarrow mi/hr$

$$\frac{60\,m}{\cancel{s}} \times \frac{60\,\cancel{s}}{1\,\cancel{min}} \times \frac{60\,\cancel{min}}{hr} \times \frac{10^2\,\cancel{cm}}{1\,\cancel{m}} \times \frac{1\,\cancel{in}}{2.54\,\cancel{cm}} \times \frac{1\,\cancel{ft}}{12\,\cancel{in}} \times \frac{1\,mi}{5280\,ft} =$$

$$\frac{60\,m}{1\,s} \times \frac{1\,mi}{1.609 \times 10^3\,m} \times \frac{3600\,s}{1\,hr} = 134\,\frac{mi}{hr} \approx 130\,\frac{mi}{hr} \quad 1.609 \times 10^3\,m = 1\,mi$$

$$1\,mi \times \frac{5280\,ft}{1\,mi} \times \frac{12\,in}{1\,ft} \times \frac{2.54\,cm}{1\,in} \times \frac{1\,m}{100\,cm} = 1.609 \times 10^3\,m/1\,mile$$

Tuesday 12/17/19



Wed 12/18/19

(1) Perform the indicated math operations and report each result to the correct # of sig. figs and units.

a) $3.06\,m \times 1.0060\,m = 3.0784\,m^2$

$3.08\,m^2$

b) $100.1\,L + 0.0365\,L + 25.6\,L = 125.74\,L$

$\boxed{125.7\,L}$

c) $28.6320\,g / 10.50\,mL = 2.726857143\,g/mL$

$\boxed{2.727\,g/mL}$

Perform the following indicated conversions
using dimensional analysis as demonstrated in class.

a) 3.567 dm → nm

$$3.567\,\cancel{dm} \times \frac{1\ \cancel{m}}{10^1\ \cancel{dm}} \times \frac{10^9\ nm}{1\ \cancel{m}} =$$

$$3.567\,dm \times \frac{10^9\,nm/\cancel{m}}{10^1\,dm/\cancel{m}} = \quad 3.567\times10^8\ nm$$

b) 600.5 µL → cL

.06005 0.06005
6005×10^{-2}
6.02×10^{23}

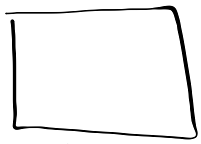
$$600.5\ \mu L \times \frac{1\ L}{10^6\ \mu L} \times \frac{10^2\ cL}{1\ L} = 600.5\times10^{-4}\ cL$$

$$\boxed{6.005\times10^{-2}\ cL}$$

$$\frac{10^2\ cL}{10^6\ \mu L} =$$

0.06005 cL

c) $1.00\ mi^2 \rightarrow m^2$



($\boxed{2.54cm = 1in}$, 5280ft = 1mi, 12in = 1ft)

$$1.00\ mi^2 \times \left(\frac{5280\ ft}{1\ mi}\right)^2 \times \left(\frac{12\ in}{1\ ft}\right)^2 \times \left(\frac{2.54\ cm}{1\ in}\right)^2 \times \left(\frac{1\ m}{10^2\ cm}\right)^2 = 2{,}589{,}988.11\ m^2$$

$$\boxed{2{,}590{,}000\ m^2}$$

d) $2.70\ g/cm^3 \rightarrow kg/m^3$

10^6

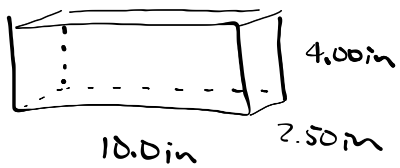
$$\frac{2.70\ g}{1\ \cancel{cm^3}} \times \left(\frac{10^2\ \cancel{cm}}{1\ m}\right)^3 \times \frac{1\ kg}{10^3\ g} = 2.70\times10^3\ kg/m^3$$

3) A platinum bar measures 10.0 in x 4.00 in x 2.50 in

the density of platinum is 21.45 g/cm³.

What is the mass of the bar in pounds?

(454 g = 1 lb) (2.54 cm = 1 in)



$V = 10.0\,in \times 4.00\,in \times 2.50\,in$

$= 100.\,in^3$

$in^3 \rightarrow \#$

$$100.\,in^3 \times \left(\frac{2.54\ cm}{1\ in}\right)^3 \times \frac{21.54\ g}{1\ cm^3} \times \frac{1\ \#}{454\ g} = \dot{7}\dot{7}.\dot{7}4831686\ \#$$

$77.7\#$

26)

have

$\longleftarrow$ 8.0mi $\longrightarrow$

S.O.L. = 3.00×10^8 m/s

S.O.S. = 343 m/s

want

time for signal to reach me

$$1.00\,\cancel{mi} \times \frac{5280\,\cancel{ft}}{1\,\cancel{mi}} \times \frac{12\,\cancel{in}}{1\,\cancel{ft}} \times \frac{2.54\,\cancel{cm}}{1\,\cancel{in}} \times \frac{1\,m}{10^2\,\cancel{cm}} = 1609\,m$$

1609 m = 1 mi

Light

$$8.0\,mi \times \frac{1609\,m}{1\,mi} \times \frac{1\,s}{3.00 \times 10^8\,m} = 4.3 \times 10^{-5}\,s$$

Sound

$$8.0\,mi \times \frac{1609\,m}{1\,mi} \times \frac{1\,s}{343\,m} = 37.528\,s = \boxed{38\,s}$$

can't be true

$$\frac{4.3 \times 10^{11}\,s}{8.64 \times 10^4\,\frac{s}{d}}$$

$$\frac{4.97\,d}{365\,\frac{d}{y}}$$ 13,640

27)

Known

$3.73 \times 10^{8}\, km^3$

$1\, L = 1\, dm^3$

Want

V in m^3

in L

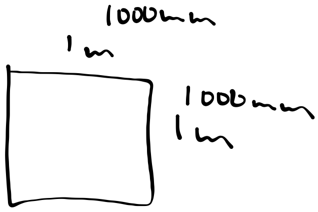
$$3.73\times10^{8}\,km^3 \times \left(\frac{10^{3}\ m}{1\ km}\right)^3 = 3.73\times10^{17}\,m^3$$

$$\times \left(\frac{10^{1}\ dm}{1\ m}\right)^3 \times \frac{1\ L}{1\ dm^3} = 3.73\times10^{20}\,L$$

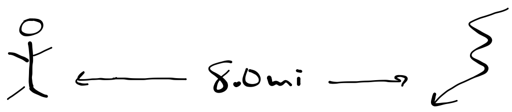
10) $1.34\ m^2 \rightarrow mm^2$

$$1.34\ m^2 \times \left(\frac{10^3\ mm}{1\ m}\right)^2 = 1.34\times10^6\ mm^2$$

$10^6\ mm^2 = 1\ m^2$



26)



S.O.L. = $3.00\times10^8\ m/s$

S.O.S. = $343\ m/s$

mi → m → s

$$8.0\ mi \times \frac{5280\ ft}{1\ mi} \times \frac{12\ in}{1\ ft} \times \frac{2.54\ cm}{1\ in} \times \frac{1\ m}{10^2\ cm} \times \frac{1\ s}{343\ m} =$$

$\hookrightarrow \frac{1\ s}{3.00\times10^8\ m} =$

$$mi \times \frac{1609\ m}{1\ mi} \times \frac{1\ s}{343\ m} =$$

$\hookrightarrow \frac{1\ s}{3.00\times10^8\ m} =$

$$1 \times \frac{5280\ ft}{1\ mi} \times \frac{12\ in}{1\ ft} \times \frac{2.54\ cm}{1\ in} \times \frac{1\ m}{10^2\ cm} = \boxed{1609\ m = 1\ mi}$$

60. $6.0\times10^1\ m/s$

$$\frac{60\ m}{s} \times \frac{1\ mi}{1609\ m} \times \frac{3600\ s}{1\ hr} = 134.2448726\ \frac{mi}{hr}$$

2sf $130\ \frac{mi}{hr}$

1s $100\ \frac{mi}{hr}$

from the dimensional analysis ws

14) $550760\,\text{min} \times \frac{1\ \text{hr}}{60\ \text{min}} \times \frac{1\ \text{day}}{24\,\text{hr}} \times \frac{1\ \text{yr}}{365\,\text{day}} =$

$\frac{m}{min}$ $\frac{m}{hr}$ $\frac{cm}{hr}$ $\frac{in}{hr}$ $\frac{ft}{hr}$ $\frac{mi}{hr}$

15) $\frac{60\ \text{m}}{1\ \text{s}} \times \frac{60\ \text{s}}{1\ \text{min}} \times \frac{60\ \text{min}}{1\ \text{hr}} \times \frac{10^2\ \text{cm}}{1\ \text{m}} \times \frac{1\ \text{in}}{2.54\,\text{cm}} \times \frac{1\ \text{ft}}{12\,\text{in}} \times \frac{1\ \text{mi}}{5280\,\text{ft}}$

$= 134\ \frac{mi}{hr}$

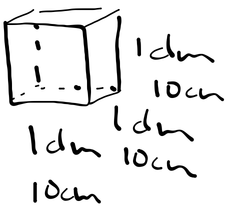
$\frac{60\,\cancel{\text{m}}}{1\,\cancel{\text{s}}} \times \frac{60\,\cancel{\text{s}}}{1\,\cancel{\text{min}}} \times \frac{60\,\cancel{\text{min}}}{1\ \text{hr}} \times \frac{1\ \text{mi}}{1\text{ki}} =$

1 sf $100\ \frac{mi}{hr}$

2 sf $130\ \frac{mi}{hr}$

mi → m $\quad 1.00\,\text{mi} \times \frac{5280\,\text{ft}}{1\ \text{mi}} \times \frac{12\ \text{in}}{1\ \text{ft}} \times \frac{2.54\,\text{cm}}{1\ \text{in}} \times \frac{1\ \text{m}}{10^2\,\text{cm}} = 1609\,\text{m} = 1\,\text{mi}$

1-L box



$V = 1\,\text{dm}^3 = 1\ \text{L}$

$V = 1000\,\text{cm}^3 = 1\,\text{L} = 1000\,\text{mL}$

$1\,\text{cm}^3 = 1\,\text{mL}$

$1.20\,\text{L} \times \frac{10^3\ \text{mL}}{1\ \text{L}} = 1200\ \text{mL}$

$1.20 \times 10^3\,\text{mL}$

3) $3500\,\mu g \rightarrow \underline{dg}$

$$3500\,\cancel{\mu g} \times \frac{1\ \cancel{g}}{10^6\ \cancel{\mu g}} \times \frac{10^1\ dg}{1\ \cancel{g}} = 3500 \times 10^{-5}\,dg$$

$$3.5 \times 10^{-2}\,dg$$

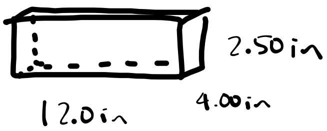
or

$$3500\,\mu g \times \frac{10^1\ dg/g}{10^6\ \mu g/g} = 3.5 \times 10^{-2}\,dg$$

5) $$0.100\,nm \times \frac{1\ m}{10^9\ nm} = 0.100 \times 10^{-9}\,m$$

$$= 1.00 \times 10^{-10}\,m$$

12) 1000



$V = 100.\ in^3$

$$100.\ in^3 \times \left(\frac{2.54\ cm}{1\ in}\right)^3 \times \frac{19.3\ g}{1\ cm^3} \times \frac{1\ \#}{454\ g}$$

1

$$\frac{65\ \cancel{mi}}{1\ hr} \times \frac{1\ trip}{105\ \cancel{mi}} = 0.619\ \frac{trip}{hr} = 1.61 \quad \frac{hr}{trip}$$

$$\frac{\$15}{hr} \quad \frac{1\ hr}{\$15} \times$$