Introductory Chemistry Math Drill   Key   prof. Golestaneh

Remember to deal with units in the same way as we deal with variables in algebra.

2. Solve the equation for ***R***: **PV = nRT**

divide by nT $\frac{PV}{nT} = \frac{nRT}{nT}$ $\boxed{\frac{PV}{nT} = R}$

3. Find the ratio (in lowest terms) of 15 kilograms to 5 kilograms. Show your set-up.

$\frac{15\ Kg}{5\ Kg} = 3$

4. Consider each of the following measurements. Determine the number of significant figures in each.

(a) 403.50 g	5	±.01	(e) 29.000 L	5	±.001
(b) 6.46555×10^5 g	6	±.00001 $\times 10^5$	(f) 0.0304 dg	3	±.0001
(c) 250.1 °C	4	±.1	(g) 0.00007 g	1	±.00001
(d) 2.700 g/cm^3	4	±.001	(h) 609 kg	3	±1

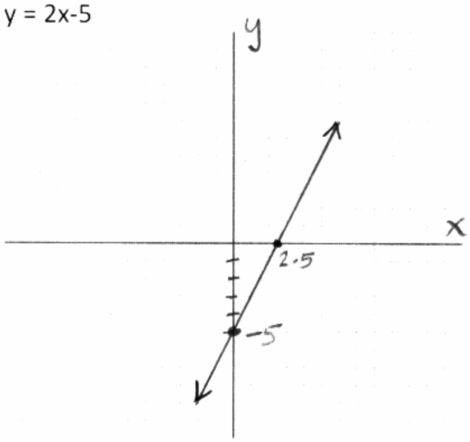
5. Round off each of the following measurements to *three* significant figures.

(a) 105.9 g	106 g	(d) 0.0098305 m	.00983 m
(b) 123256 cm	123000 cm	(e) 1003 K	1.00×10^3 K
(c) 0.0009999 g	.00100 g	(f) 6.46555×10^5 g	6.47×10^5 g

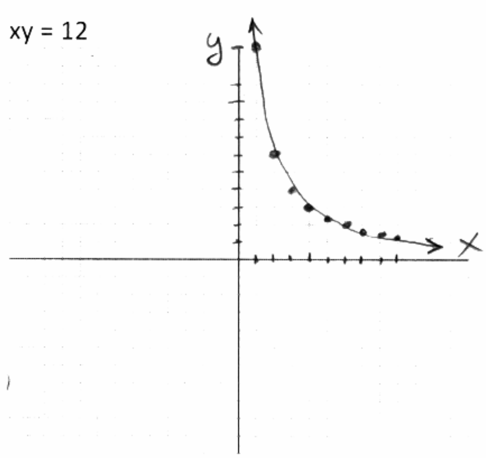
~~1000~~

Graph the Following:

y = 2x-5



xy = 12



using intercept method →

x	y
∅	-5
2.5	∅

linear equation
y=mx+b
(only 2 points define a line!)

x	y
1	12
2	6
3	4
4	3
5	2.4

x	y
6	2
7	1.7
8	1.5
9	1.3

← note SF must remain the same!

6. Write each of the following in *correct* scientific notation.

(a) 0.703 — 7.03×10^{-1}

(b) 0.00550 x 10^{-6} [5.50×10^{-3}] — 5.50×10^{-9}

(c) 10500 — 1.05×10^{4}

(d) 9002.0 — 9.0020×10^{3}

(e) 12000000 — 1.2×10^{7}

(f) 455 x 10^{4} [4.55×10^{2}] — 4.55×10^{6}

7. Solve these problems, rounding off your answer to the correct number of significant figures. (report units!)

(a) 13.44 in + 3.55 in + 240.1 in
(±.01, ±.01, ±.1)

257.09 → **257.1**

±.1 is the greatest uncertainty here!

(b) 88.7 g − 87.7 g

1.0 g

(c) (2.54 cm)(4.0050 cm)(2.5 cm)
(3 SF, 5 SF, 2 SF)

25 cm³

(d) $\frac{(4.33\ \text{m})(5.0\ \text{m})(655.5\ \text{m})}{(22.8\ °\text{C})}$

622.4 → **620 m³/°C**

(e) $\frac{145.5502\ \text{g}}{19.2\ \text{mL}}$ = **7.58 g/mL**

(f) (2.0×10^{-4} m)(1.56×10^{-6} m)

3.1×10^{-10} m²

(g) $\frac{6.25\ \text{g}}{(11.135\ \text{cm} + 2.9\ \text{cm})}$ (3 SF; ±.001, ±.1) → 14.035 cm

$\frac{6.25\ \text{g}}{14.035\ \text{cm}}$ (3 SF) = **0.445 g/cm**

← don't round off yet!

(h) (2.54×10^{-3} m)(5.2×10^{6} m)

8. Add the following masses, expressing your answer in grams to the correct number of significant figures. Show your work. note each entry should be converted to gram unit! easier to "move" the decimal

25.5 mg + 25.5 cg + 25.5 g

.0255 g + .255 g + 25.5 g
(±.0001, ±.001, ±.1)

= 25.78 g → **25.8 g**

(dimensional Analysis!)

9. Perform the following conversions using a factor label set-up.

(a) 5.0 m^3 to cm^3

$$? \, cm^3 = \frac{5.0\, m^3}{} \left| \frac{c}{.01} \right|^3 = \boxed{5.0\times10^6\, cm^3}$$

(b) 975 ft^2 to m^2

$$? \, m^2 = \frac{975\, ft^2}{} \left| \frac{12\, in}{ft} \right|^2 \left| \frac{2.54\, cm}{in} \right|^2 \left| \frac{.01}{c} \right|^2 = \boxed{90.6\, m^2}$$

(c) 0.75 m^3 to L

$$? \, L = \frac{0.75\, m^3}{} \left| \frac{mL}{cm^3} \right| \frac{.001}{m} \left| \frac{c}{.01} \right|^3 = \boxed{750\, L}$$

10. A rectangle has length of 6.5 cm and width of 25.3 mm.

$$? \, cm = \frac{25.3\, mm}{} \left| \frac{.001}{m} \right| \frac{c}{.01} = 2.53\, cm$$

or "move" the decimal (faster!)

(a) Calculate the area of the rectangle in units of cm^2.

$$? \, Area\, cm^2 = 6.5\, cm \times 2.53\, cm = 16.\overline{4} \rightarrow \boxed{16\, cm^2}$$

(b) Calculate the area in mm^2.

$$? \, mm^2 = \frac{16.\overline{4}\, cm^2}{} \left| \frac{.01}{c} \right|^2 \left| \frac{m}{.001} \right|^2 = 16\overline{40}\, mm^2 \rightarrow \boxed{1600\, mm^2}$$

11. Perform the following conversions using the *factor label method*. Write the answers, rounded off to the correct number of significant figures with correct units, in the indicated spaces.

(a) A car uses 6.0 liters of gasoline to travel 101 km. Convert the mileage into units of $\frac{mi}{gal}$.

Useful factors:
1.06 qt = 1 L
4 qt = 1 gal
1 mi = 5280 ft
1 m = 3.27 ft

$$? \, \frac{mi}{gal} = \frac{101\, km}{} \left| \frac{mi}{5280\, ft} \right| \frac{ft}{12\, in} \left| \frac{in}{2.54\, cm} \right| \frac{c}{.01} \left| \frac{1000}{k} \right| \ldots$$

$$\ldots \frac{}{6.0\, L} \left| \frac{3.785\, L}{gal} \right| = 39.\overline{6} \rightarrow \boxed{40.\, \frac{mi}{gal}}$$

(b) Convert the density of water, 1.00 $\frac{g}{mL}$ into pounds per cubic foot ($\frac{lbs}{ft^3}$).

$$? \frac{lb}{ft^3} = \frac{1.00\ g}{mL} \left| \frac{lb}{453.6\ g} \right| \frac{mL}{cm^3} \left| \frac{28.32\ L}{ft^3} \right| \frac{cm^3}{mL} \left| \frac{m}{.001} \right|$$

$$= 62.4\ \frac{lb}{cm^3}$$

(c) A person on a diet loses 10.0 pounds in 1.00 month. Calculate the average rate of mass loss in units of $\frac{mg}{s}$. Assume that 1.00 month = 30 days (exactly).

Useful factor:
453.6 g = 1 pound

$$? \frac{mg}{s} = \frac{10.0\ lb}{1.00\ mo} \left| \frac{453.6\ g}{lb} \right| \frac{m}{.001} \left| \frac{mo}{30\ d} \right| \frac{d}{24\ h} \left| \frac{h}{3600\ s} \right|$$

$$= 1.75\ mg/s$$

(d) The average car in the United States will travel 25.0 miles for each gallon of gas. Express this gas consumption rate of 25.0 miles per gallon ($\frac{mi}{gal}$) in the metric units of km per L ($\frac{km}{L}$).

Useful factors:
1.06 qt = 1 L
4 qt = 1 gal
1 mi = 5280 ft
1 m = 3.27 ft

$$? \frac{Km}{L} = \frac{25.0\ mi}{gal} \left| \frac{gal}{3.785\ L} \right| \frac{5280\ ft}{mi} \left| \frac{12\ in}{ft} \right| \frac{2.54\ cm}{in} \right| \ldots$$

$$\ldots \left| \frac{K}{1000} \right| \frac{.01}{c} \left| = 10.6\ \frac{Km}{L} \right.$$

(e) Rum is often sold by the fifth (0.200 gallon). Convert this volume into units of cubic meters.

$$? m^3 = \frac{0.200\ gal}{} \left| \frac{3.785\ L}{gal} \right| \frac{cm^3}{mL} \left| \frac{m}{.001} \right| \frac{.01}{c} \right|^3 =$$

$$= 7.57 \times 10^{-4}\ m^3$$

Problems With Units (Simplify each mathematical expression.)

1. (40.0 ft) (3.0 lb) = 120 ft-lb

2. $\frac{39005 \text{ mi}}{13.5 \text{ hr}}$ = 2889 → $2890 \frac{mi}{hr}$

3. 76.94 in + 75.4 ft

? ft = $\frac{76.94 \text{ in}}{} \Big| \frac{ft}{12 \text{ in}} \Big|$ = 6.4416 ft

75.4 ft + 6.4416 ft = 81.8 ft

4. $(3.6 \times 10^5 \ \mu L^2)^{\frac{1}{2}}$

$(3.6 \times 10^5)^{1/2} \cdot (\mu^2 L^2)^{1/2}$ = 600 μL

= $6.0 \times 10^2 \ \mu L$

5. $(9.800 \times 10^3 \text{ cm})(5.40 \times 10^{-10} \text{ s}^{-1})$

= $5.29 \times 10^{-6} \frac{cm}{s}$

6. $\frac{6.45 \times 10^{-35} \text{ ms}}{(4 \times 10^{18} \text{ ms})^3}$ = $1 \times 10^{-90} \ m^{-2} \cdot s^{-2}$

7. $\frac{(2.40 \times 10^4 \text{ g})(7.5 \times 10^6 \text{ cm}^2)}{3.0 \times 10^{-32} \text{ s}}$

= $6.0 \times 10^{30} \frac{g \cdot cm^2}{s}$

8. 6.568×10^{-5} L − 3.83×10^{-3} mL

6.568×10^{-5} L − $.00383 \times 10^{-3}$ L

6.568×10^{-5} L − $.383 \times 10^{-5}$ L

= 6.185×10^{-5} L

Unit Conversion Problems (Perform the indicated unit conversions.)

1. 25.0 μL to mL

? mL = $\frac{25.0 \ \mu L}{} \Big| \frac{10^{-6}}{\mu} \Big| \frac{m}{.001} \Big|$ = .0250 mL

2. 1.0 ft^2 to mm^2

? mm^2 = $\frac{1.0 \ ft^2}{} \Big| \frac{12 \text{ in}}{ft} \Big|^2 \frac{2.54 \ (c)m}{in} \Big|^2 \frac{.01}{c} \Big|^2 \frac{(m)}{.001} \Big|^2$ = $9.3 \times 10^4 \ mm^2$

3. 1.75×10^4 cm/s^2 to in/min^2

? $\frac{in}{min^2}$ = $\frac{1.75 \times 10^4 \ cm}{s^2} \Big| \frac{in}{2.54 \ cm} \Big| \frac{60 \ s}{min} \Big|^2$ = $2.48 \times 10^7 \ \frac{in}{min^2}$

4. 2.8 lb/ft^3 to g/L

? $\frac{g}{L}$ = $\frac{2.8 \ lb}{ft^3} \Big| \frac{453.6 \ g}{lb} \Big| \frac{ft^3}{28.32 \ L} \Big|$ = 45 g/L

5. $3.668 \times 10^{-5} \ m^3$ to L

? L = $\frac{3.668 \times 10^{-5} \ m^3}{} \Big| \frac{mL}{cm^3} \Big| \frac{c}{.01} \Big| \frac{.001}{m} \Big|^3$ = .03668 L

Logarithms (Simplify or solve for x.)

1. log (1×10^{-4}) = −4.0

2. log 5.44 = .736

3. log (2.66×10^7) = 7.425

4. log x = −11   x = 10^{-11}

5. log x = 8.75   x = 5.6×10^8

6. log x = −2.7   x = 2×10^{-3}