* KEY *

More FLM* Practice and Density Worksheet

*FLM = Factor Label Method often called unit analysis.

SUBSTANCE	DESCRIPTION/ CHEMICAL SYMBOL	DENSITY (g/mL for liquids, g/cm^3 for solids)
gasoline	a mixture of hydrocarbons (l)	0.67 (variable)
ethyl alcohol	C_2H_5OH (l)	0.789
pure water	H_2O (l) at 4°C	1.00
sea water	a mixture of salts in water(aq)	1.20 (variable)
ice	H_2O (s)	0.917
quartz	SiO_2 (s)	2.20
magnesium	Mg (s)	1.738
aluminum	Al (s)	2.70
iron	Fe (s)	7.87
copper	Cu (s)	8.92
lead	Pb (s)	11.3
mercury	Hg (l)	13.5
gold	Au (s)	19.3

1. Calculate the volume, in quarts, of 439 mg of ethyl alcohol. (Don't forget to change mg to g)

$439\,mg \times \frac{1\,g}{1000\,mg} \times \frac{1\,cm^3(mL)}{0.789\,g} = 0.556\,mL\ EtOH \times \frac{1\,qt}{943\,mL} =$

$1\,qt. = 943\,mL$

$5.90 \times 10^{-4}\,qt$

2. What is the mass, in lbs., of 2.50×10^4 mm^3 of aluminum?

$$2.50\times10^4\,mm^3\,Al \left| \frac{(1\,cm)^3}{(10\,mm)^3} \right| \frac{2.70\,g}{1\,cm^3} \left| \frac{1\,lb}{454\,g} \right. = 0.149\,lbs$$

3. Calculate the density, in g/cm^3, of a 3.48 kg rectangular solid object that measures 3.4 cm by 23.9 cm by 22.8 cm. $d = \frac{m}{V}$

$$d = \frac{3.48\,kg \times \frac{1000\,g}{1\,kg}}{3.4\,cm \times 23.9\,cm \times 22.8} = \frac{3,480}{1853}\,cm^3 = 1.9\,g/cm^3$$

4. What is the volume, in gallons, of 6.6 kg of water?

Vol. in gallons $= 6.6\ kg\ H_2O \cdot \frac{1000\ g}{1\ kg} \cdot \frac{1\ mL\ H_2O}{1\ g\ H_2O} \cdot \frac{1\ L}{1000\ mL} \cdot \frac{1\ qt}{0.943\ L} \cdot \frac{1\ gal}{4\ qts} = \boxed{1.7\ gal}$

Answers: (3) 1.9 g/mL (4) 1.7 gal

5. How many sig figs are in each of the following:

a. 30406 cm 6 b. 13030 L 4

c. 0.003040 g 4 d. 2.00×10^{-3} mL 3

e. 3005 kg 4 f. 3 ft/yd Exact (defined)

6. Round the following to 3 sig figs:

a. 3.05900 L 3.06 L b. 179,501 g 1.80×10^5 g

c. 199,624,428 g 2.00×10^8 g d. 0.0034950 kg 3.50×10^{-3} kg

e. 344,500 mm 344,000 mm f. 23,550 cm 23,600 cm

g. 699,500 Mg 7.00×10^5 Mg h. 99,950 km 1.00×10^5 km or 100,000 km

7. Perform the following arithmetic operations and report your answer with the correct number of sig figs and correct units.

a. 23.098 cm + 0.040 cm + 2300.0 cm = 2,323.1 cm to nearest tenth

b. 450600 L - 0.4030 L = 450,600 L (to nearest unit)

c. (2300 mm)(2.3080 mm) = 5300 mm^2
(2 SF) (5 SF)

d. (0.00340 km)(3.4 X 10^{-5} km) = 1.2×10^{-7} km^2
(3 SF) (2 SF)

e. (2.03 x 10^{-6} m)(3.0 x 10^7 m)(3.500 x 10^{-2} m) / 23.00 m = 9.3×10^{-2} mm^2
(3 SF) (2 SF) (4 SF) (4 SF)

8. An acre is 43,560 square feet. A hectare (ha) is a square plot of land 100 m on each side. How many hectares are in 25.0 acres? → 3 SF

You can start with acres but probably easier to start with the definition of hectar.

$$\#\text{ of Hec. (ha)} = \frac{1\text{ ha}}{100\text{ m} \times 100\text{ m}} \cdot \left(\frac{1\text{ m}}{1.0936\text{ yds}}\right)^2 \left(\frac{1\text{ yd}}{3\text{ ft}}\right)^2 \cdot \frac{43{,}560\text{ ft}^2}{1\text{ acre}} \cdot 25\text{ acres} = \boxed{10.1\text{ ha}}$$

9. What is the volume, in cm^3, of a block of stone measuring 25.0 ft x 12.5 ft x 8 ft.? → 1 SF

$$\text{Volume} = L \times W \times h = 25.0\text{ ft} \times 12.5\text{ ft} \times 8\text{ ft} = 2.5 \times 10^3\text{ ft}^3$$

$$\text{Volume in } cm^3 = 2.5 \times 10^3\text{ ft}^3 \times \left(\frac{12\text{ in}}{1\text{ ft}}\right)^3 \times \left(\frac{2.54\text{ cm}}{1\text{ in}}\right)^3 = \boxed{7 \times 10^7\text{ cm}^3}$$

10. Calculate the mass, in g, of 23.9 mL of benzene (d = 0.879 g/mL). → 3 SF

$$D = \frac{m}{V} \quad \therefore \quad m = d \times V$$

$$m = 23.9\text{ mL benzene} \times \frac{0.879\text{ g benzene}}{1\text{ mL benzene}} = \boxed{21.0\text{ g benzene}}$$

11. Calculate the volume, in L, of 34 kg of carbon tetrachloride (d = 1.59 g/mL) → 2 SF

$$d = \frac{m}{V} \quad \therefore \quad V = \frac{m}{d}$$

$$V = \frac{34\text{ kg} \cdot \frac{1000\text{ g}}{1\text{ kg}}}{\frac{1.59\text{ g } CCl_4}{1\text{ mL } CCl_4}} = \frac{34000\text{ g}}{1.59\text{ g/mL}} = \boxed{2.1 \times 10^4\text{ mL}}$$

Answers: 8) 10.1 ha, 9) 7 x 10^7 cm^3, 10) ~~21.9~~ 21.0g, 11) 2.1 x 10^4 mL

12. What mass of lead (Pb) has the same volume as 46.8 g of iron (Fe)?

$d_{Pb} = 11.3\ g/cm^3$ $d_{Fe} = 7.87\ g/cm^3$

or the density of Pb is $\frac{11.3}{7.84}$ or 1.441 greater than the density of Fe

Therefore, the mass of Pb with the same volume = $46.8\ g \times 1.441$

= **67.4 g Pb**

13. A car is rated with a highway gasoline mileage of 41 (2 SF) miles per gallon of gas. How many liters of gasoline will be needed for a highway trip of 555 kilometers?

$$\text{Liters of gas} = 555\ km \cdot \frac{1\ mi}{1.61\ km} \cdot \frac{1\ gal}{41\ mi} \cdot \frac{3.77\ L}{1\ gal} = 31.7\ L = \boxed{32\ L}$$

14. Suppose that a standard snail's pace is measured to be 0.040 ft per min. Measured in cm per second, what is the value of the snail's pace?

$$\text{migration of snail in cm/s} = \frac{0.040\ ft}{1\ min} \cdot \frac{12\ in}{1\ ft} \cdot \frac{2.54\ cm}{1\ in} \cdot \frac{1\ min}{60\ s} = \boxed{0.020\ cm/s}$$

15. A piece of aluminum foil ($d_{Al} = 2.70\ g/cm^3$) measures 10.4 cm by 12.6 cm and has a mass of 1.334 g. Calculate the thickness, in mm, of the aluminum foil. (hint: you will need the density of aluminum)

$d_{Al} = \frac{2.70\ g}{1\ cm^3}$ or $\frac{1\ cm^3}{2.70\ g}$ ← start here

realize that area x thickness = volume

$$\therefore \text{Al thickness} = \frac{1\ cm^3}{2.70\ g} \times 1.334\ g \times \frac{1}{10.4\ cm \times 12.6\ cm\ (\text{area})} = 3.77 \times 10^{-3}\ cm$$

$$= \boxed{3.77 \times 10^{-2}\ mm}$$

Answers: 12) ~~67.2~~ 67.4 g, 13) ~~31.7~~ 32 L, 14) 0.020 cm/s, 15) 3.77×10^{-2} mm