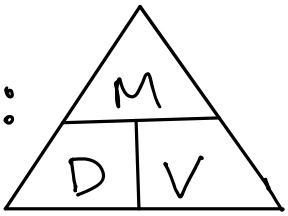
recall from Science 8:



In Chemistry 11, Density Calculations must show how units cancel

Chemistry 11
DENSITY

Density is defined as the mass contained in a given Volume of a substance.

density [Mass – grams
Volume → either mL (liquid/gas) or cm^3 (solid)

To calculate density we use a "MATHEMATICAL PYRAMID"

D = M ÷ V ; g ÷ cm^3 → g/cm^3 (solid)

D = M ÷ V ; g ÷ mL → g/mL (liquid)

M = V • D ; cm^3 • g/cm^3 = g ‖ mL • g/mL = g

V = M ÷ D ; g • mL/g = mL ‖ g • $1\ cm^3$/g = cm^3

g/mL

Example 1. An Iron bar has a mass of 19 600 g and a volume of 2.50 L. What is the density of the Iron Bar?

g/mL

$$D = \frac{m}{V} \rightarrow \frac{19\,600\ g}{2.50\ L} \cdot \left(\frac{1 \cdot 10^{-3}\ L}{1\ mL}\right) = 7.84\ g/mL$$

(3) (3)

IMPORTANT FACTS!!!

i. The volume of a liquid is meaured in mL
ii. The volume of a solid is measured in cm^3
In GENERAL 1 mL = 1 cm^3
iii. The density of PURE WATER (@ 4°C) is 1.00 g/mL
iv. A substance with a density greater that 1 g /mL will sink in water
v. A substance with a density smaller that 1 g /mL will float in water

l • w • h

Example 2. A brass cube has a density of 8 g/mL and is 2 cm on each side.

a. What is the volume of this brass cube?
V = l • w • h → 2.0 cm • 2.0 cm • 2.0 cm = $8.0\ cm^3$ = 8.0 mL

b. Calculate the mass of this brass cube.
m = d • v ; v • d → 8.0 mL • 8.0 g/mL = 64 g

c. State whether this cube will float or sink in liquid mercury (density = 13.6 g/mL)

8.0 g/mL < 13.6 g/mL

"float"

Name:_____
Blk:_____ Date:_____

Chemistry 11
DENSITY

31. A 3.50 mL chunk of boron has a mass of 8.19 g. What is the density of the boron? → Solid
32. An iron bar has a mass of 125 g. If iron's density is 7.86×10^3 g/L, what volume does the bar occupy ?
33. A block of beeswax has a volume of 200.0 mL and a density of 961 g/L. What is the mass of the block?
34. Alcohol has a density of 789 g/L. What volume of alcohol is required in order to have 46 g of alcohol?
35. A gas called neon is contained in a glass bulb having a volume of 22.4 L. If the density of the neon is 0.900 g/L, what is the mass of the neon in the bulb?
36. A 70.0 g sphere of manganese (density = 7.20×10^3 g/L) is dropped into a graduated cylinder containing 54.0 mL of water. What will be the water level indicated after the sphere is inserted?
37. A 25.0 mL portion of each of W, X, Y and Z is poured into a 100 mL graduated cylinder. Each of the 4 compounds is a liquid and will not dissolve in the others. If 55.0 mL of W have a mass of 107.3 g, 12.0 mL of X have a mass of 51.8 g, 42.5 mL of Y have a mass of 46.8 g and 115.0 mL of Z have a mass of 74.8 g, list the layers in the cylinder from top to bottom.
38. Explain why boats made of iron are able to float. The density of iron is 7.86×10^3 g/L.
39. If the density of copper is 8.92×10^3 g/L and the density of magnesium is 1.74×10^3 g/L, what mass of magnesium occupies the same volume as 100.0 g of copper?
40. The sun has a volume of 1.41×10^{30} L, an average density of 1.407 g/mL, and can be thought of as more or less pure hydrogen. If the sun consumes 4.0×10^6 t of hydrogen per second, how many years will it take at this rate to burn all of the hydrogen? Hint: use the results of exercise 17(k). The sun will actually cease burning its hydrogen in far less time than indicated by this simple calculation.
41. (OPTIONAL: A Stinker!) A hollow cylinder, closed at both ends, has a volume of 250.0 mL and contains 4.60 g of argon gas. A 90.0 g cube of sodium (density = 970.0 g/L) is inserted into the tube in such a way that no gas escapes. What is the density of the gas afterwards?

* Density Ex 31-39 KEY *

31. $D = \frac{M}{V} \rightarrow \frac{8.19\ g}{3.50\ mL}\left(\frac{1\ mL}{1\ cm^3}\right) = 2.34\ g/cm^3$

32. $V = \frac{M}{D} \rightarrow 125\ g \cdot \left(\frac{1\ L}{7.86 \cdot 10^3\ g}\right)\left(\frac{1\ mL}{1 \cdot 10^{-3}\ L}\right)\left(\frac{1\ cm^3}{1\ mL}\right)$

$= 15.9\ cm^3$

33. $M = V \cdot D \rightarrow 200.0\ mL\left(\frac{1 \cdot 10^{-3}\ L}{1\ mL}\right)\left(\frac{961\ g}{1\ L}\right)$

$= \boxed{192\ g}$

34. $V = m \div D \longrightarrow 46g \cdot \left(\frac{1L}{789\ g}\right)\left(\frac{1mL}{1\cdot10^{-3}L}\right)$

$= \boxed{58\ mL}$

35. $m = V \cdot D \longrightarrow 22.4L \cdot \left(\frac{0.900\ g}{1L}\right) = \boxed{20.2\ g\ Ne}$

36. $V = m \div D \longrightarrow 70.0g \cdot \left(\frac{1L}{7.20\cdot10^{3}g}\right)\left(\frac{1mL}{1\cdot10^{-3}L}\right) = 9.72mL$ sphere

water level $= 54.0\ mL$
$+ \ 9.72\ mL$
$63.72\ mL$ $\therefore$ water $\boxed{63.7\ mL}$

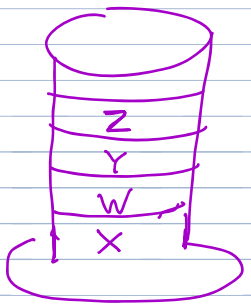
37.

$W_D = \frac{107.3\ g}{55.0mL} = 1.95\ g/mL$

$X_D = \frac{51.8\ g}{12.0mL} = 4.32\ g/mL$

$Y_D = \frac{46.8\ g}{42.5\ mL} = 1.10\ g/mL$

$Z_D = \frac{74.8\ g}{115.0mL} = 0.650\ g/mL$



38. Iron boat is filled with air (not solid iron) $\therefore$ will float in water

39. $Cu_D = \frac{8.92 \cdot 10^3 g}{1 L}$ $Mg_D = \frac{1.74 \cdot 10^3 g}{1 L}$

$100.0 g Cu \cdot \left(\frac{1 L}{8.92 \cdot 10^3 g Cu}\right)\left(\frac{1.74 \cdot 10^3 g Mg}{1 L}\right) = \boxed{19.5 g Mg}$