CONCEPT: BUOYANCY IN AIR

When weighing an analyte you must take into account *buoyancy*, the upward force exerted on an object in a liquid or gas.

The following equation below helps us determine the "true" mass, m, as though it were in a vacuum.

$$\text{Buoyancy Equation : } m = \frac{m'\left(1-\frac{d_a}{d_w}\right)}{\left(1-\frac{d_a}{d}\right)}$$

d_a = density of _____ (0.0012 g/mL @ 1 Bar, 25°C)

d_w = density of the _____ (8.0 g/mL)

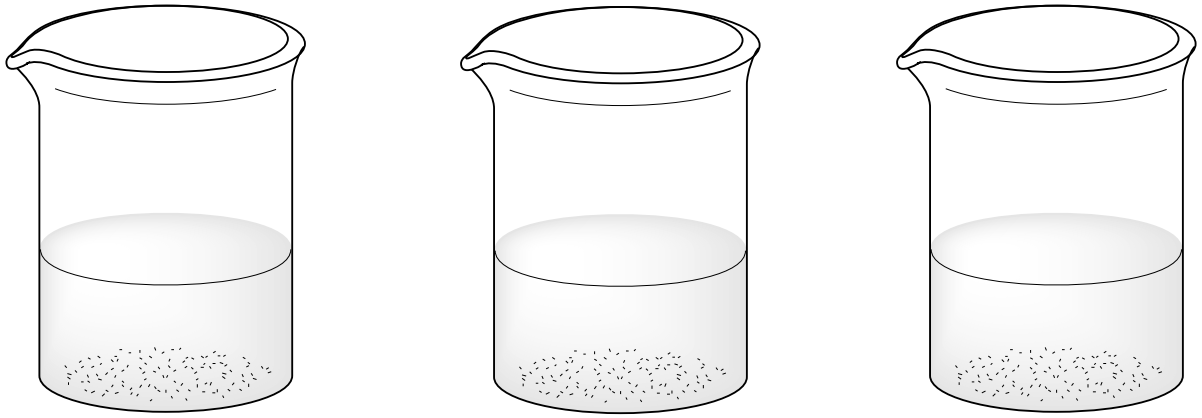
d = density of the _____

EXAMPLE: A convenient method in calibrating pipets is to weigh the water delivered from them. By using the density of water at a given temperature we can determine the volume of delivery with greater accuracy. Assume a 50.0 mL pipet is in need of calibration. An empty flask weighs 49.563 g. When water delivered from the pipet is added to the empty flask the new mass is recorded as 69.618 g. What is the mass of water delivered? The density of the standard weights is determined to be 8.40 g/mL.

CONCEPT: BUOYANCY IN FLUIDS

Under the _____, the buoyancy force acting on an object in a fluid is equal to the weight of the fluid displaced by the object.

Buoyant Force = Weight of Liquid Displaced



$F = mg = \rho Vg$

F = Buoyant Force
m = Mass of Liquid
g = Gravitational Field Strength
ρ = Density of Liquid
V = Volume of Liquid Displaced

EXAMPLE: A wooden block with measurements of 0.15 x 0.44 x 0.56 m is afloat on a lake. If it is submerged by 0.031 m, what is its mass?

PRACTICE: BUOYANCY CALCULATIONS 1

EXAMPLE: A small crystal of sucrose ($C_{12}H_{22}O_{11}$) had a mass of 5.345 mg. The dimensions of the box-like crystal were 2.20 mm x 1.36 mm x 1.12 mm. What is the density of the sucrose crystal expressed in g/mL?

PRACTICE: An empty container weighing 73.190 g is filled with an unknown liquid and the combined mass is recorded as 87.308 g. The container was then emptied and filled with water and recorded a new mass of 88.442 g at a temperature of 19^{o}C. (d = 1.0027 g/mL). Calculate the density of the unknown liquid.

PRACTICE: BUOYANCY CALCULATIONS 2

EXAMPLE 1: A piece of concrete weighs 120 N. When it is fully submerged, its apparent weight is 97 N. Determine the density of the water if the volume of the water displaced is 4200 cm^3. (g = 9.8 N/kg)

EXAMPLE 2: The density of propane, an odorless hydrocarbon compound used in cooking, is 0.922 g/mL. When a sample of it is placed on an analytical balance a weight of 8.15×10^8 ng is obtained. Calculate the true mass of propane.

PRACTICE: A 39.0 g piece of aluminum metal has a volume of 14.4 cm^3. Calculate the apparent weight of the piece of metal when it is immersed in chloroform. Density of chloroform at 25 °C is 1.49 g/cm^3.