Name: _____ Class: _____

Fluid Math

1. Syrup flows at a rate of 60 ml/minute. If a container of syrup holds 420 ml, how long will it take to empty all of the syrup out of the container?

$FR = 60\ ml/minute$
$V = 420\ ml$
$t = ?$

$t = \frac{V}{FR}$
$t = \frac{420\ ml}{60\ ml/minute}$
$t = 7.0\ minutes$

∴ It would take 7 minutes to completely empty the container.

2. A piece of aluminum that is 20 cm^3 has a mass of 54 g.
   a. What is the density of the aluminum?
   b. How much mass would a 35 cm^3 piece of aluminum have?
   c. How big would a 15 g piece of aluminum be?

$m = 54\ g$
$V = 20\ cm^3$
$D = ?$

$D = \frac{m}{V}$
$D = \frac{54\ g}{20\ cm^3}$
$D = 2.7\ \frac{g}{cm^3}$

∴ The density of aluminum is $2.7\ \frac{g}{cm^3}$.

$m = ?$
$V = 35\ cm^3$
$D = 2.7\ \frac{g}{cm^3}$

$m = DV$
$m = 2.7\ \frac{g}{cm^3} \times 35\ cm^3$
$m = 94.5\ g$

∴ The mass of the aluminum is $94.5\ g$.

$m = 15\ g$
$V = ?$
$D = 2.7\ \frac{g}{cm^3}$

$V = \frac{m}{D}$
$V = \frac{15\ g}{2.7\ \frac{g}{cm^3}}$
$V = 5.\bar{5}\ cm^3$

∴ The volume of aluminum is $5.\bar{5}\ cm^3$.

3. If 100 ml of water has a mass of 100 g and a piece of wood has a mass of 200 g can the wood float on the water? Explain.

It depends. We are not told the volume of the wood, so we do not know the density of the wood. If the wood is larger than 200 cm^3, then the density is less than the water and it will float. If the wood is smaller than 200 cm^3, then the density is greater than the water, and it will sink.
Alternatively, the shape of the wood will also come into play. If it is not a solid object, similar calculations would need to be done based on average density.

4. If 100 ml of water has a mass of 100 g and 50 ml of ethanol has a mass of 40 g, when the two materials are poured into a bowl which substance will float on top of the other (assuming they are insoluble)? Justify your answer with calculations.

$m_{water} = 100\ g$
$V_{water} = 100\ ml$
$D_{water} = ?$

$D_{water} = \frac{m_{water}}{V_{water}}$
$D_{water} = \frac{100\ g}{100\ ml}$
$D_{water} = 1.0\ \frac{g}{ml}$

$m_{ethanol} = 40\ g$
$V_{ethanol} = 50\ ml$
$D_{ethanol} = ?$

$D_{ethanol} = \frac{m_{ethanol}}{V_{ethanol}}$
$D_{ethanol} = \frac{40\ g}{50\ ml}$
$D_{ethanol} = 0.8\ \frac{g}{ml}$

∴ Because the density of ethanol is less than the density of water, the ethanol will float on top.

5. Vegetable oil has a density of 0.92 g/ml. Cork has a density of 0.24 g/cm^3. If a piece of cork is 3.45 cm^3, how much of it will be submerged in the oil if it were to be placed on top?

To solve this problem we must recall that the volume of cork submerged is equal to the volume of oil displaced. The rules of buoyancy tell us that the mass of this oil is equal to the total mass of the cork.

$m_{cork} = ?$
$V_{cork} = 3.45\ cm^3$
$D_{cork} = 0.24\ \frac{g}{cm^3}$

$m_{cork} = DV$
$m_{cork} = 0.24\ \frac{g}{cm^3} \times 3.45\ cm^3$
$m_{cork} = 0.828\ g$

$m_{oil} = m_{cork} = 0.828g$
$V_{oil} = ?$
$D_{oil} = 0.92\ \frac{g}{ml}$

$V_{oil} = \frac{m_{oil}}{D_{oil}}$
$V_{oil} = \frac{0.828\ g}{0.92\ \frac{g}{ml}}$
$V_{oil} = 0.9\ ml = V_{submerged\ cork}$

Note: 1 ml is the equivalent of 1 cm^3

∴ The amount of cork submerged in the oil would be 0.9 cm^3.

6. How would you determine the volume of an apple? Explain.

If you know the density of an apple, you could then weigh it and perform a calculation. However, an apple is not uniform and so a simple calculation will not be accurate.
An easier way would be to submerge the apple in water and measure how much water is displaced (noting that an apple floats and will need to be held down.)