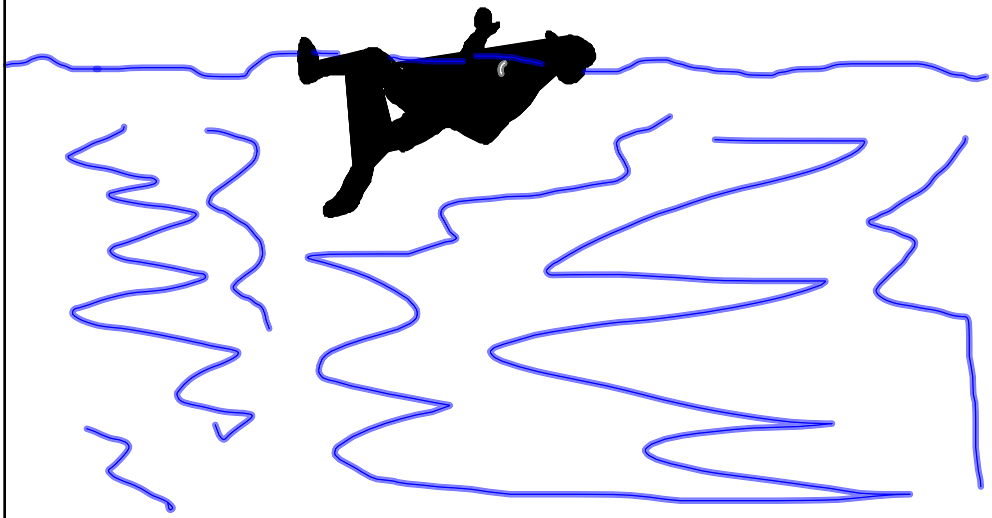
An 88.0 kg runner falls in the lake.

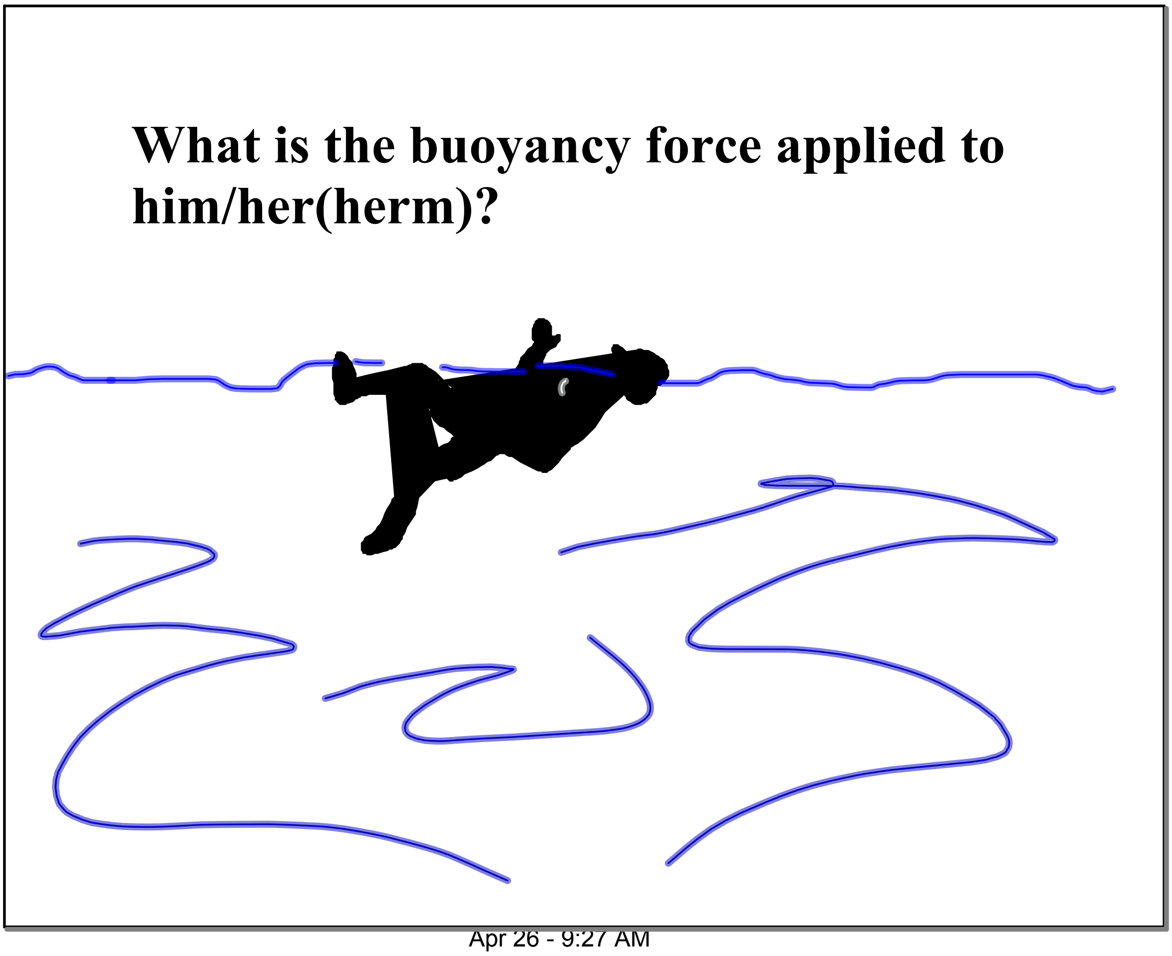
$\rho_o = 755\ \text{kg/m}^3$

Apr 26 - 9:23 AM

Oh no!

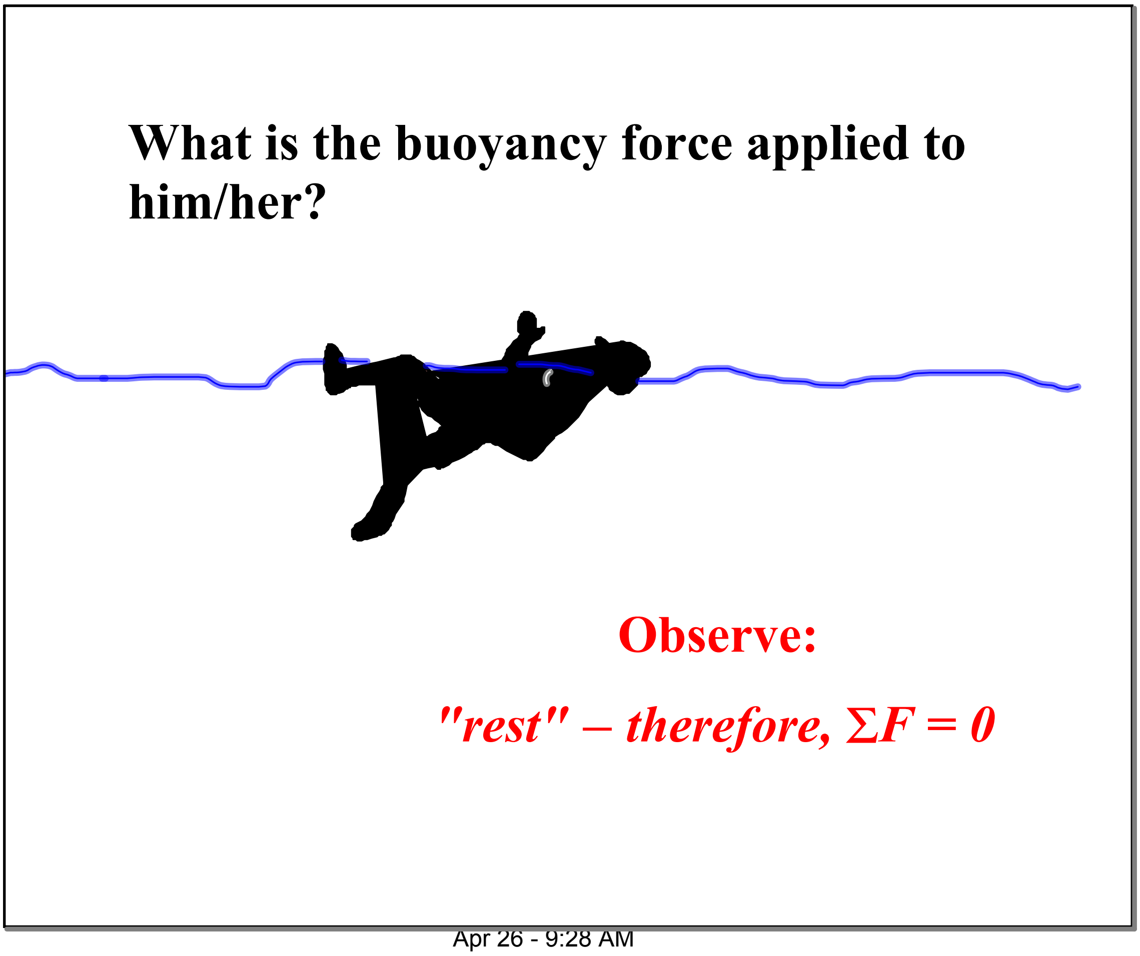


Apr 26 - 9:25 AM



What is the buoyancy force applied to him/her(herm)?

Apr 26 - 9:27 AM



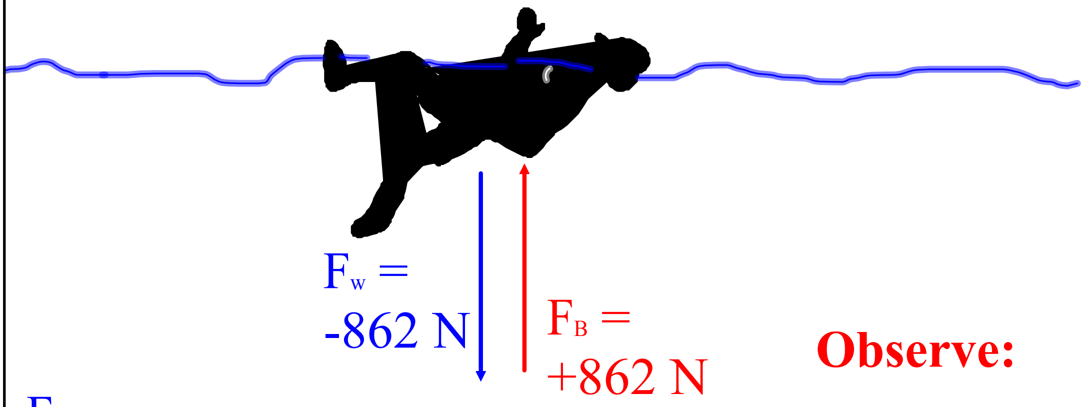
What is the buoyancy force applied to him/her?

Observe:

"rest" – therefore, $\Sigma F = 0$

Apr 26 - 9:28 AM

What is the buoyancy force applied to him/her?



Observe:

$F_w = mg$

$F_w = 88.0\ kg \times 9.8 m/s^2$

$F_w = -862\ N$

"rest" – therefore, $\Sigma F = 0$

$F_w + F_B = 0$

$F_B = +862\ N$

Apr 26 - 9:30 AM

$\rho = 755\ kg/m^3$

What is the volume of the runner?

$\rho = m/V$

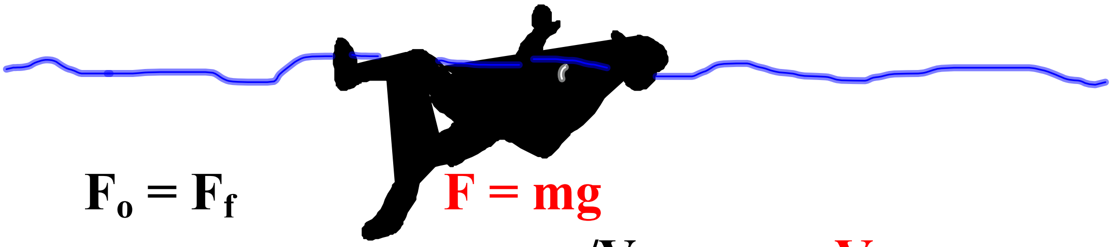
$V_o = m/\rho$

$V_o = 88.0\ kg/755\ kg/m^3$

$V_o = .117\ m^3$

Apr 26 - 9:38 AM

What is the volume of water displaced by the runner?



$F_o = F_f$

$mg_o = mg_f$

$\rho V g_o = \rho V g_F$

$\rho V_o = \rho V_F$

$V_F = \rho V_o / \rho_F$

$V_F = (755\ kg\ m^3\ 0.117m^3)/1000kg/m^3$

$V_F = .088\ m^3$

$F = mg$

$\rho = m/V$ ....$m = \rho V$

g's cancel

Apr 26 - 9:45 AM

What is the volume of water displaced by the runner?

$F_w = F_B$

$\rho V g_o = \rho V g_F$

$\rho V_o = \rho V_F$

$V_F = \rho V_o / \rho_F$

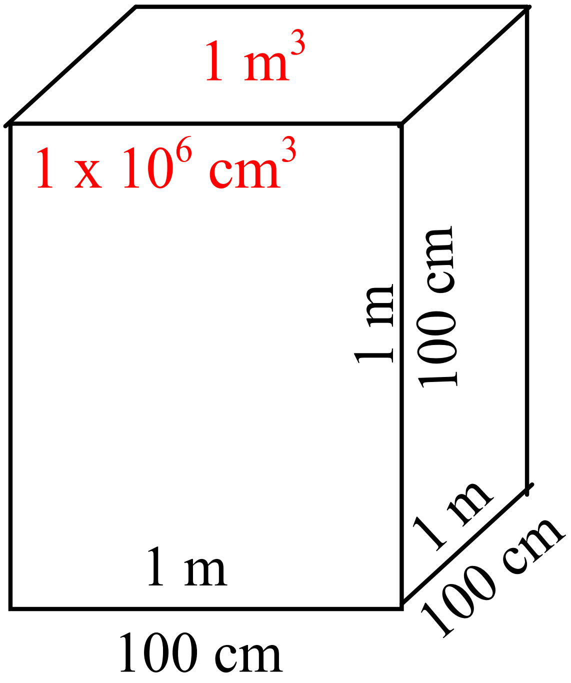
$V_F = (755\ kg\ m^3\ 0.117m^3)/1000kg/m^3$

$V_F = .088\ m^3$

What is the mass of the 0.088 m^3 of water?

1 *liter* of water has a mass of 1kg, and there are 1000 *liters* in 1 m^3 of water. *Therefore,* .088 m^3 of water is 88 *liters, is 88 kg!!!*

Apr 26 - 9:53 AM



Apr 26 - 10:29 AM

Fluid (water)

$V = .088\ m^3$

$\rho = m/V$

$m = \rho V$

$m = 1000\ kg/m^3(.088\ m^3)$

$m = 88\ kg$

Apr 26 - 10:26 AM

A Roman soldier has a mass of 125 kg and a volume of 0.117 m^3 when he's fitted for battle. March Roman soldier, march!

Apr 26 - 11:16 AM

The marching Roman soldier falling into the lake (Sea) and begins to sink in the water.

$m_o = 125$ kg; $V_o = 0.117$ m^3

a) What is his density?

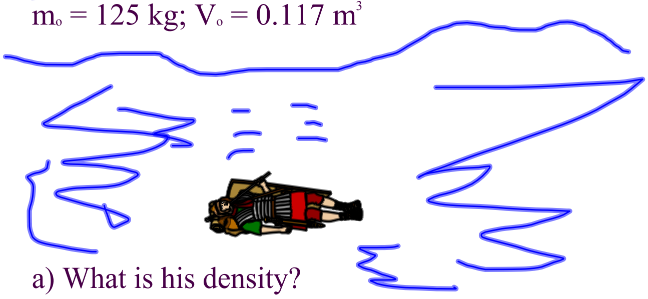
b) What buoyancy force does the water apply?

c) What is his apparent weight in water?

Apr 26 - 11:24 AM

The marching Roman soldier falling into the lake (Sea) and begins to sink in the water.

$m_o = 125$ kg; $V_o = 0.117$ m^3



a) What is his density?

b) What buoyancy force does the water apply?

c) What is his apparent weight in water?

Apparent weight is what you *appear* to weigh when you're submerged in a fluid. Gravity pushed down on you (that's your F_w) and the fluid pushes up (that's the buoyancy force, F_b). Your apparent weight is the difference of the two. $F_b = F_w - F_b$ (or, the sum of the two if you use vector directions)

Apr 6-6:27 AM

$\rho_o = ?$

$\rho_o = m/V = 125 \text{ kg}/0.117 \text{ m}^3 = 1070 \text{ kg/m}^3$

$F_B = ?$

$F_B = mg_f = \rho V g_f$

$F_B = \rho V g_f$

$F_B = 1000 \text{ kg/m}^3(0.117 \text{ m}^3)9.81 \text{ m/s}^2 = 1150 \text{ kg m/s}^2$

1150 N

his weigh is: $F_w = mg = 125 \text{ kg}(9.81 \text{ m/s}^2) = 1226$ N

$F_{app} = ?$

$F_w = F_{app} + F_B$

$F_{app} = F_w - F_B$

$F_{app} = mg - F_B$

$F_{app} = 125 \text{ kg}(9.81 \text{ m/s}^2) - 1150$ N

$F_{app} = 76$ N

Apr 26 - 12:19 PM

Specific Gravity: ratio of an objects density to that of water

$\rho = \frac{m}{v}$

floats

$m_o = m_f$

$\therefore$ m's cancel

$$\text{S.G.} = \frac{\rho_o}{\rho_f} = \frac{\frac{m_o}{V_o}}{\frac{m_f}{V_f}} = \frac{m_o V_f}{m_f V_o}$$

$$\therefore \frac{V_f}{V_o} \approx \frac{h_f}{h_o}$$

$$\therefore \frac{m_o}{m_f} \approx \frac{F_o}{F_f} = \frac{F_o}{F_B}$$

sinks

$V_o = V_f$

$\therefore$ V's cancel

$$F_B = \underset{\text{in air}}{\underset{\uparrow}{F_o}} - \underset{\text{in fluid}}{\underset{\uparrow}{F_{app}}}$$

Apr 16-6:46 AM

Specific Gravity: ratio of an objects density to that of water

floats

$m_o = m_f$

$\therefore$ m's cancel

$$\text{S.G.} = \frac{\rho_o}{\rho_f} = \frac{\frac{m_o}{V_o}}{\frac{m_f}{V_f}} = \frac{m_o V_f}{m_f V_o}$$

$$\therefore \frac{V_f}{V_o} \approx \frac{h_f}{h_o}$$

$$\therefore \frac{m_o}{m_f} \approx \frac{F_o}{F_f} = \frac{F_o}{F_B}$$

sinks

$V_o = V_f$

$\therefore$ V's cancel

$$F_B = \underset{\text{in air}}{\underset{\uparrow}{F_o}} - \underset{\text{in fluid}}{\underset{\uparrow}{F_{app}}}$$

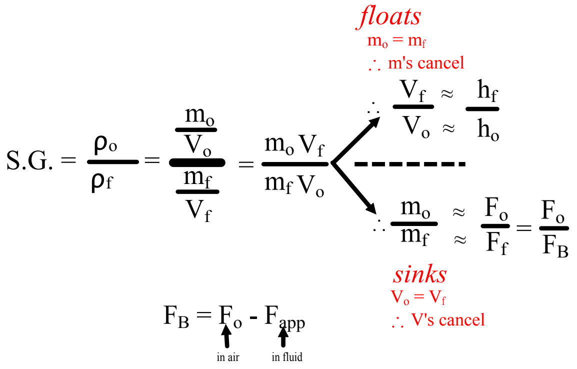
Roman soldier sinks. His density is 1070 kg/m^3

$$\text{S.G.} = \rho_o/\rho_f = \frac{1070\ \text{kg/m}^3}{1000\ \text{kg/m}^3} = 1.07$$

$$\text{S.G.} = m_o/m_f = 125\ \text{kg}/117\ \text{kg} = 1.07$$

Apr 6-6:40 AM

Specific Gravity: ratio of an objects density to that of water



$$\text{S.G.} = \frac{\rho_o}{\rho_f} = \frac{\frac{m_o}{V_o}}{\frac{m_f}{V_f}} = \frac{m_o V_f}{m_f V_o}$$

floats

$m_o = m_f$

∴ m's cancel

$$\therefore \frac{V_f}{V_o} \approx \frac{h_f}{h_o}$$

$$\therefore \frac{m_o}{m_f} \approx \frac{F_o}{F_f} = \frac{F_o}{F_B}$$

sinks

$V_o = V_f$

∴ V's cancel

$$F_B = \underset{\text{in air}}{F_o} - \underset{\text{in fluid}}{F_{app}}$$

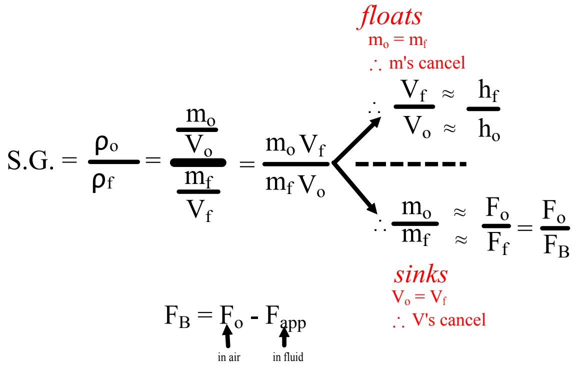
The runner floats: Its density is 755 kg/m³

$$\text{S.G.} = \rho_o/\rho_f = \frac{755\ \text{kg/m}^3}{1000\ \text{kg/m}^3} = .755$$

$$\text{S.G.} = V_f/V_o = .088\ \text{m}^3/.117\ \text{m}^3 = .752$$

Apr 6-6:48 AM

Specific Gravity: ratio of an objects density to that of water



$$\text{S.G.} = \frac{\rho_o}{\rho_f} = \frac{\frac{m_o}{V_o}}{\frac{m_f}{V_f}} = \frac{m_o V_f}{m_f V_o}$$

floats

$m_o = m_f$

∴ m's cancel

$$\therefore \frac{V_f}{V_o} \approx \frac{h_f}{h_o}$$

$$\therefore \frac{m_o}{m_f} \approx \frac{F_o}{F_f} = \frac{F_o}{F_B}$$

sinks

$V_o = V_f$

∴ V's cancel

$$F_B = \underset{\text{in air}}{F_o} - \underset{\text{in fluid}}{F_{app}}$$

The runner floats: Herm is 1.8 m tall.

$$\text{S.G.} = V_f/V_o = .088\ \text{m}^3/.117\ \text{m}^3 = .752$$

$$\text{S.G.} = h_f/h_o \quad h_f = \text{S.G. } h_o = .752\ (1.8\ \text{m}) = 1.35\ \text{m}$$

1.35 m of Herm is under water and .45 m is above.
(1.8 m - 1.35 m = .45 m)

Apr 6-6:54 AM

http://www.walter-fendt.de/ph11e/buoyforce.htm

Apr 3-11:22 AM