

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?

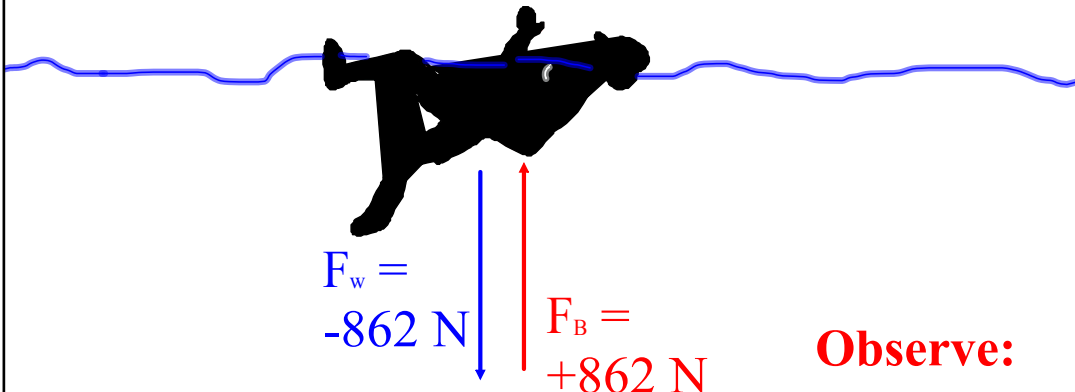


Observe:

"rest" – therefore, $\Sigma F = 0$

Apr 26 - 9:28 AM

What is the buoyancy force applied to him/her?



$$F_w = mg$$

$$F_w = 88.0 \text{ kg} \times 9.8 \text{ m/s}^2 \approx \text{"rest"} - \text{therefore, } \Sigma F = 0$$

$$F_w = -862 \text{ N}$$

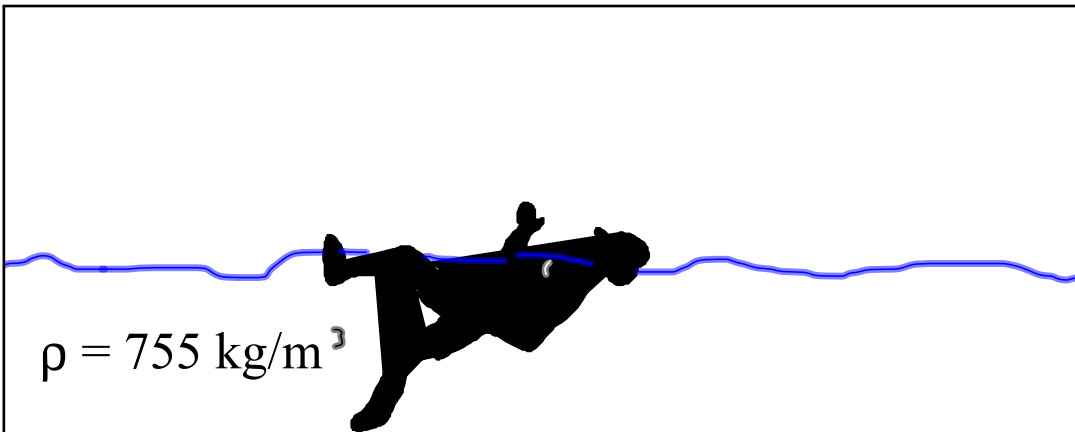
$$F_B = +862 \text{ N}$$

Observe:

$$F_w + F_B = 0$$

$$F_B = +862 \text{ N}$$

Apr 26 - 9:30 AM



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

What is the volume of the runner?

$$\rho = m/V$$

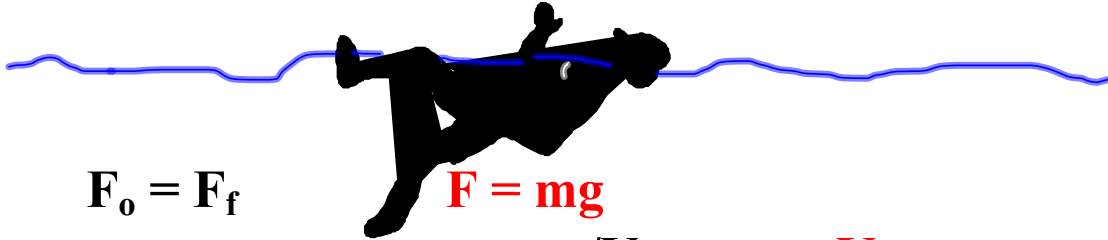
$$V_o = m/\rho$$

$$V_o = 88.0 \text{ kg} / 755 \text{ kg/m}^3$$

$$V_o = .117 \text{ m}^3$$

Apr 26 - 9:38 AM

What is the volume of water displaced by the runner?



$$F_o = F_f$$

$$mg_o = mg_f$$

$$\rho V g_o = \rho V g_f$$

$$\rho V_o = \rho V_f$$

$$V_f = \rho V_o / \rho_f$$

$$V_f = (755 \text{ kg m}^3 \cdot 0.117 \text{ m}^3) / 1000 \text{ kg/m}^3$$

$$V_f = .088 \text{ m}^3$$

$$F = mg$$

$$\rho = m/V \dots m = \rho V$$

g's cancel

Apr 26 - 9:45 AM

What is the volume of water displaced by the runner?



$$F_w = F_B$$

$$\rho V g_o = \rho V g_f$$

$$\rho V_o = \rho V_f$$

$$V_f = \rho V_o / \rho_f$$

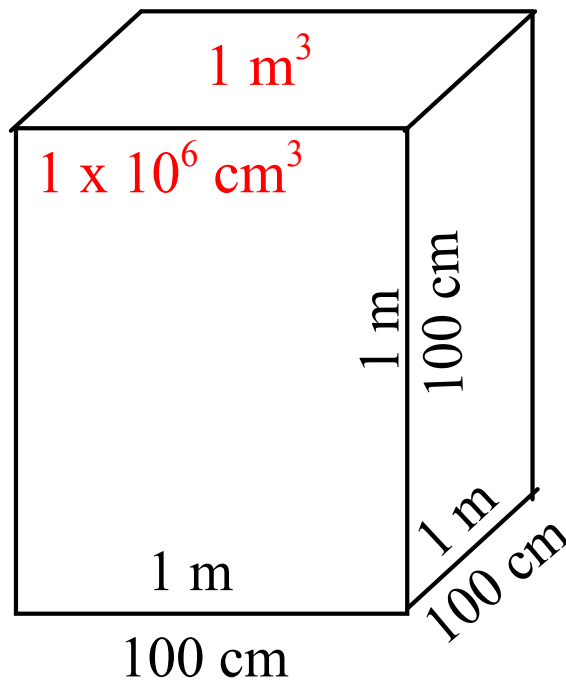
$$V_f = (755 \text{ kg m}^3 \cdot 0.117 \text{ m}^3) / 1000 \text{ kg/m}^3$$

$$V_f = .088 \text{ m}^3$$

What is the mass of the 0.088 m³ of water?

1 liter of water has a mass of 1kg, and there are 1000 liters in 1 m³ of water. Therefore, .088 m³ of water is 88 liters, is 88 kg!!!

Apr 26 - 9:53 AM



Apr 26 - 10:29 AM

Fluid (water)

$$V = .088 \text{ m}^3$$

$$\rho = m/V$$

$$m = \rho V$$

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

$$m = 88 \text{ kg}$$

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.

$m_o = 125 \text{ kg}$; $V_o = 0.117 \text{ m}^3$

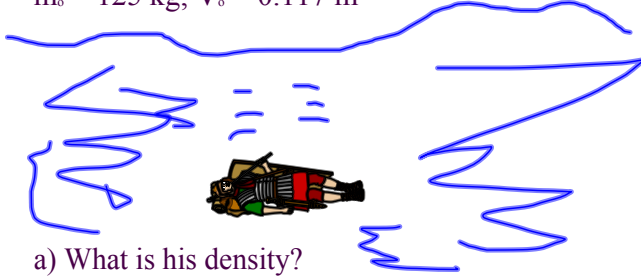


- What is his density?
- What buoyancy force does the water apply?
- What is his apparent weight in water?

Apr 26 - 11:24 AM

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

$$m_o = 125 \text{ kg}; V_o = 0.117 \text{ m}^3$$



- What is his density?
- What buoyancy force does the water apply?
- 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

$$\rho_o = ?$$

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

$$F_B = ? \quad F_B = mg_f = \rho V g_f$$

$$F_B = \rho V g_f$$

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

$$1150 \text{ N}$$

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

$$F_{\text{app}} = ? \quad F_w = F_{\text{app}} + F_B$$

$$F_{\text{app}} = F_w - F_B$$

$$F_{\text{app}} = mg - F_B$$

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

$$F_{\text{app}} = 76 \text{ N}$$

Apr 26 - 12:19 PM

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

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

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

floats
 $m_o = m_f$
 $\therefore m\text{'s cancel}$

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

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

sinks
 $V_o = V_f$
 $\therefore V\text{'s cancel}$

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

Apr 16-6:46 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
 $m_o = m_f$
 $\therefore m\text{'s cancel}$

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

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

sinks
 $V_o = V_f$
 $\therefore V\text{'s cancel}$

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

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

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

floats
 $m_o = m_f$
 $\therefore m\text{'s cancel}$
 $\therefore \frac{V_f}{V_o} \approx \frac{h_f}{h_o}$

$\therefore \frac{m_o}{m_f} \approx \frac{F_o}{F_f} = \frac{F_o}{F_B}$
sinks
 $V_o = V_f$
 $\therefore V\text{'s cancel}$

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

The runner floats: Its density is 755 kg/m^3

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

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

Apr 6-6:48 AM

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

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

floats
 $m_o = m_f$
 $\therefore m\text{'s cancel}$
 $\therefore \frac{V_f}{V_o} \approx \frac{h_f}{h_o}$

$\therefore \frac{m_o}{m_f} \approx \frac{F_o}{F_f} = \frac{F_o}{F_B}$
sinks
 $V_o = V_f$
 $\therefore V\text{'s cancel}$

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

The runner floats: Herm is 1.8 m tall.

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

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

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