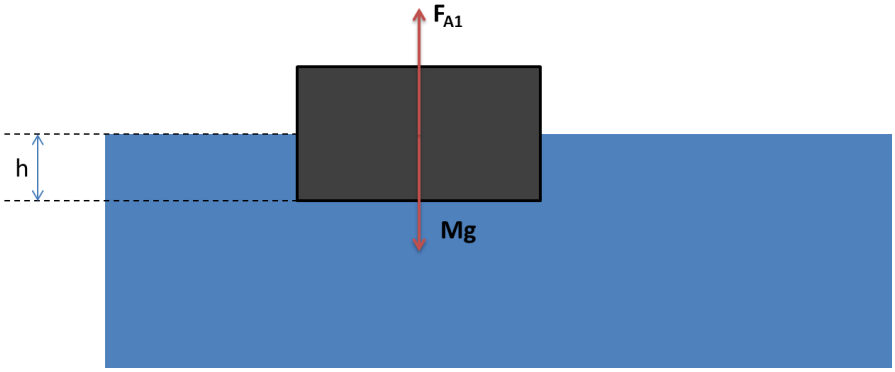
Answer on Question #49184, Physics, Mechanics | Kinematics | Dynamics

A rectangular barge floats in freshwater. When a 400 kg block is loaded on the 5 m long by 2 m wide barge, the barge sinks a few centimeters deeper. How much deeper does the barge lower?

Solution.

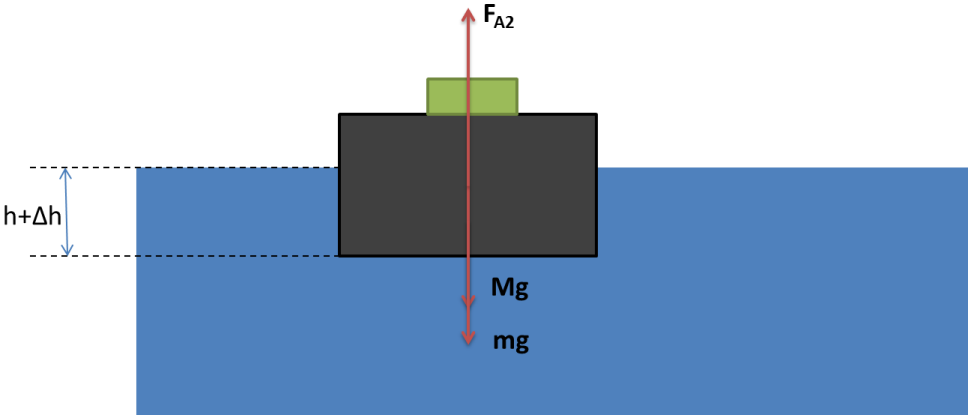
Before:



Due to 1st Newton's law:

$$Mg = F_{A1}$$

After:



Due to 1st Newton's law:

$$Mg + mg = F_{A2}$$

By definition:

$$F_A = \rho_{water} g V_{under\_water}$$

So:

$$\begin{cases} Mg = \rho_w g S h \\ Mg + mg = \rho_w g S (h + \Delta h) \end{cases}$$

So:

$$Mg + mg = \rho_w g S (h + \Delta h) = \rho_w g S h + \rho_w g S \Delta h = Mg + \rho_w g S \Delta h$$

$$mg = \rho_w g S \Delta h$$

$$\Delta h = \frac{m}{\rho_w S} = \frac{m}{\rho_w \cdot ab}$$

Where a is the width and b is the length of barge.

Numerically:

$$\Delta h = \frac{400\ kg}{1000 \frac{kg}{m^3} \cdot 5m \cdot 2m} = 0.04m = 4cm$$

Answer: $\Delta h = 4cm$