Task. Man weighs $m_1 = 100$ kg hurries forward at $v_1 = 0.500$ m/sec. The boat he is in weighs $m_2 = 155$ kg moves backward at some other velocity, v_2. What is that velocity?

Solution. Assume that the system "man-boat" is closed and its total impulse is zero. In particular, there is no water resistance.

Then the total impulse of the system is given by the formula:

$$\vec{p} = m_1\vec{v_1} + m_2\vec{v_2} = 0.$$

Notice that $\vec{v_1}$ and $\vec{v_2}$ have opposite directions, so

$$p = m_1v_1 - m_2v_2 = 0.$$

Hence

$$m_1v_1 = m_2v_2 \qquad \Rightarrow \qquad v_2 = \frac{m_1v_1}{m_2}.$$

Substituting values we obtain

$$v_2 = \frac{m_1v_1}{m_2} = \frac{100 * 0.5}{155} = 0.32 \ m/s.$$

Answer. $v_2 = 0.32$ m/s.