Answer on Question#64046 – Physics – Mechanics – Relativity

Ashleigh and Bob dock a paddle boat. Ashleigh, who has a mass of 50kg moves forward at a 3.8 m/s as she leaves the boat. At what speed and in what direction do the paddle boat and bob move if their combined mass is 105kg.

Solution. If a system does not interact with its environment in any way, then certain mechanical properties of the system cannot change. They are sometimes called "constants of the motion". These quantities are said to be "conserved" and the conservation laws which result can be considered to be the most fundamental principles of mechanics. In mechanics, examples of conserved quantities are energy, momentum, and angular momentum. The conservation laws are exact for an isolated system. System Ashley Bob and the boat we can consider as an isolated. The momentum of an isolated system is a constant. The vector sum of the momenta mv of all the objects of a system cannot be changed by interactions within the system. This puts a strong constraint on the types of motions which can occur in an isolated system. If one part of the system is given a momentum in a given direction, then some other part or parts of the system must simultaneously be given exactly the same momentum in the opposite direction. As far as we can tell, conservation of momentum is an absolute symmetry of nature. That is, we do not know of anything in nature that violates it.

When the boat dock momentum of the system is zero. When Ashley begins to move forward the boat with the Bob moves in the opposite direction. According to the law of conservation of momentum

$$0 = M_A v_A - M_B v_B$$

where $M_A = 50\text{kg}$ – mass Ashleigh, $v_A = 3.8\frac{m}{s}$ – speed Ashleigh, $M_B = 105\text{kg}$ – combined mass.

Hence $v_B = \frac{M_A v_A}{M_B} = \frac{50 \cdot 3.8}{105} \approx 1.81\frac{m}{s}$.

Answer. $v_B = 1.81\frac{m}{s}$. (backward).