

Question #72844, Physics / Mechanics | Relativity

A girl is sitting with her dog at the left end of a boat of length 10.0 m. The mass of the girl, her dog and the boat are 60.0 kg, 30.0 kg and 100.0 kg respectively. The boat is at rest in the middle of the lake. Calculate the center of mass of the system. If the dog moves to the other end of the boat, the girl staying at the same place, how far and in what direction does the boat move?

Solution

	m / kg	x / m	m×x
boat	100	5	500
girl	60	0	0
dog	30	0	0
Total	190		500

(Centers of masses are considered relatively to the left end of the boat)

The center of mass of the system is calculated as follows.

$$x = \frac{\sum mx}{\sum m} = \frac{500}{190} = 2.63 \text{ m}$$

After the dog moves to the right, the center of its mass relatively to the boat changes.

	m / kg	x / m	m×x
boat	100	5	500
girl	60	0	0
dog	30	10	300
Total	190		800

$$x = \frac{\sum mx}{\sum m} = \frac{800}{190} = 4.21$$

Assuming water drag negligible, the center of mass of the system should not change its position relatively to water. Hence, the boat moves to the left by $4.21 - 2.63 = 1.58 \text{ m}$.

Answer: initial center of mass of the system is 2.63 m; the boat moves by 1.58 m to the left.

Answer provided by <https://www.AssignmentExpert.com>