

1. 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 centre of mass of the system.

Solution.

If point X which measured from the left end of the boat is the centre of mass of the system:

$$X \times (60.0\text{kg} + 30.0\text{kg}) = 100.0\text{kg} \times \left(\frac{10.0\text{m}}{2} - X\right)$$

$$X = \frac{100.0\text{kg} \times 10.0\text{m}}{(60.0\text{kg} + 30.0\text{kg} + 100.0\text{kg}) \times 2} = 2.63$$

Answer: 2.63m from the left end of the boat

2. 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?

$$(m_b + m_g) \times v_b - m_d \times (v_d - v_b) = 0$$

$$160.0v_b - 30.0(v_d - v_b) = 0$$

$$\frac{v_b}{v_d} = \frac{3}{19}$$

If S is the length which boat passes:

$$S = 10.0\text{m} \times \frac{v_b}{v_d} = 1.58\text{m}$$

The boat is moving in the opposite direction to the dog's movement

Answer: The boat is moving in the opposite direction to the dog's movement; the length which boat passes is 1.58m

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