Answer on Question #80036, Physics / Mechanics | Relativity

Question:

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

Solution:

So, there are: M = 100, m = 60 and μ = 30, all in kg; l = 10 m.

If zero point of X axis corresponds to the left end of the boat, then center of mass position $x_c = \frac{0.5lM}{M+m+\mu} = \frac{500}{100+60+30} = 2.6$ (m).

After the dog displacement, owing to the lack of force in horizontal plane, center of mass position drift δ is such as $\frac{-m\delta + M(0.5l-\delta) + \mu(l-\delta)}{M+m+\mu} = x_c$ what means $\delta = \frac{\mu l}{M+m+\mu} = \frac{300}{190} = 1.6$ (m).

The answer:

Center of mass position x_c = 2.6 m;

Center of mass position drift δ =1.6 m, the boat moves in left.