

This is a problem involving systems of particles.



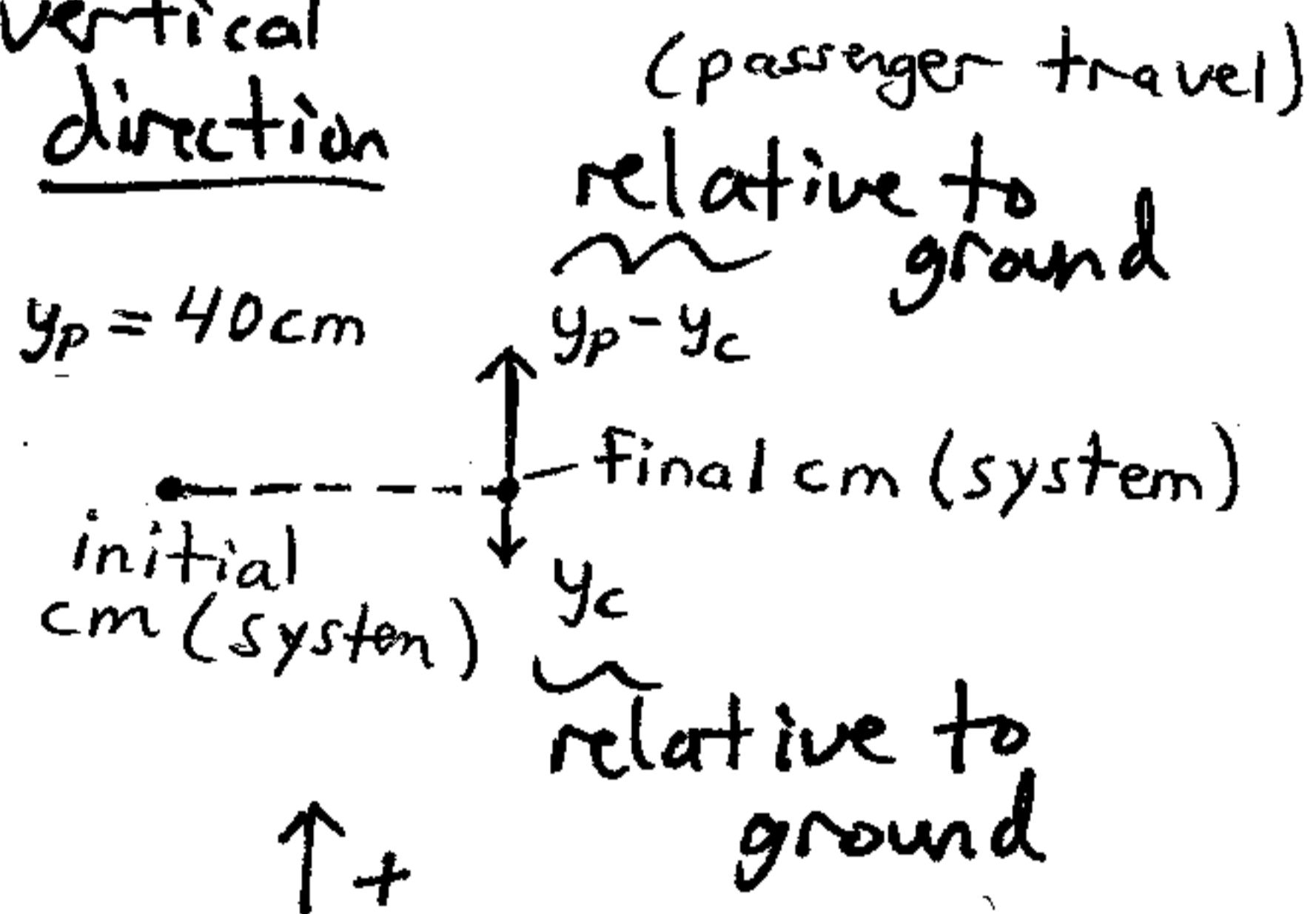
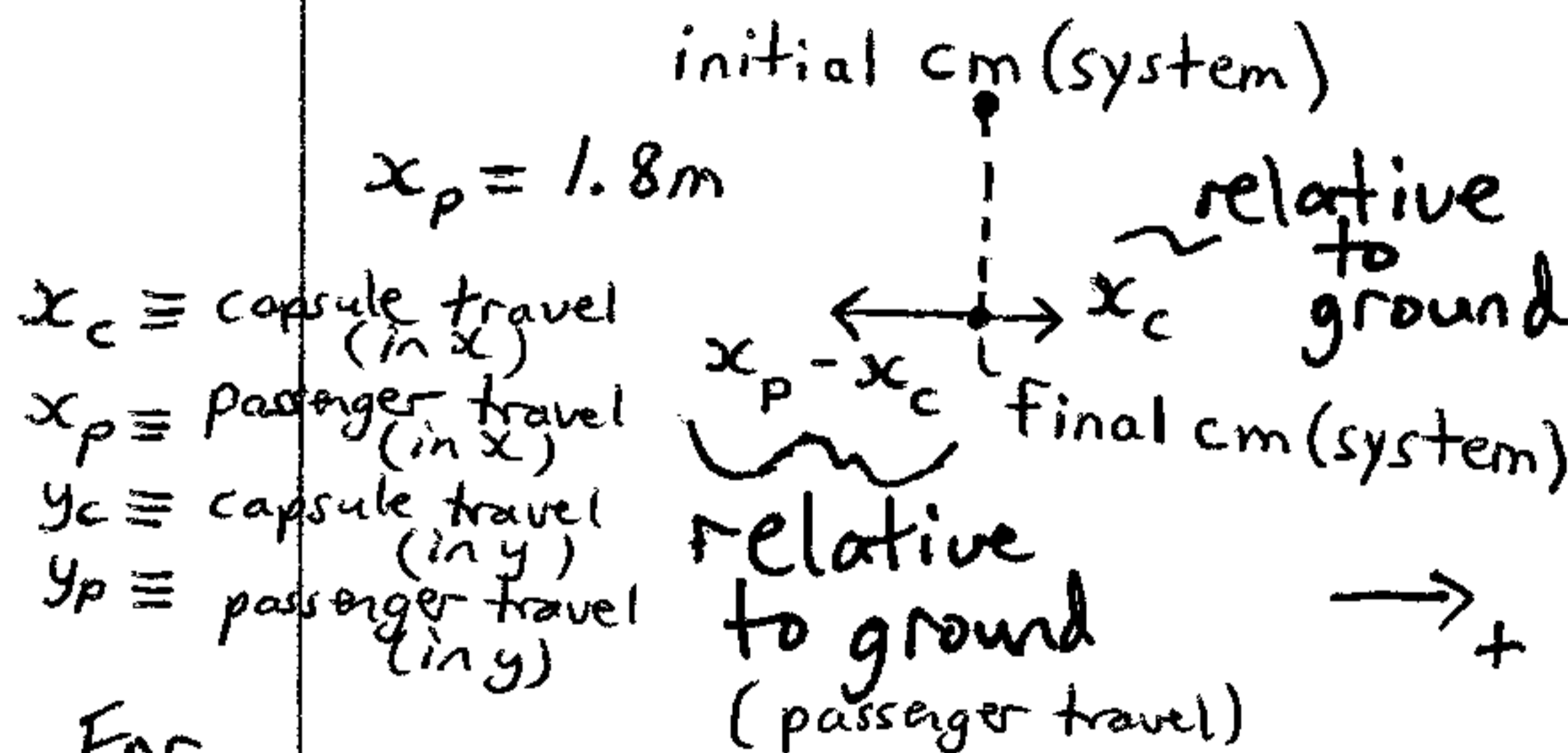
An underwater capsule is stationary relative to the sea floor. The capsule has a mass of 2200 kg. An 80 kg passenger in the capsule stands up, causing his center of mass to rise 40 cm. The passenger then walks to the left a distance of 1.8 m. What is the displacement of the capsule as a result of the movement of the passenger?

relative to capsule

Solution:

horizontal direction

vertical direction



- $x_c \equiv$  capsule travel (in x)
- $x_p \equiv$  passenger travel (in x)
- $y_c \equiv$  capsule travel (in y)
- $y_p \equiv$  passenger travel (in y)

For system:  $\sum F_x = 0$  and  $\sum F_y = 0$

Note, the capsule is completely underwater and not touching the sea floor.

which means the center of mass of system doesn't move, in x and y direction.

Use the initial center of mass of the system as the reference point.

In horizontal direction:

$$0 = -80(x_p - x_c) + 2200x_c, \quad x_p = 1.8\text{m}$$

$$x_c = \frac{80x_p}{2280} = 0.063\text{m} \rightarrow$$

(horizontal displacement of capsule, to the right)

In vertical direction:

$$0 = 80(y_p - y_c) - 2200y_c, \quad y_p = 0.40\text{m}$$

$$y_c = \frac{80y_p}{2280} = 0.014\text{m} \downarrow$$

(vertical displacement of capsule, downward)