

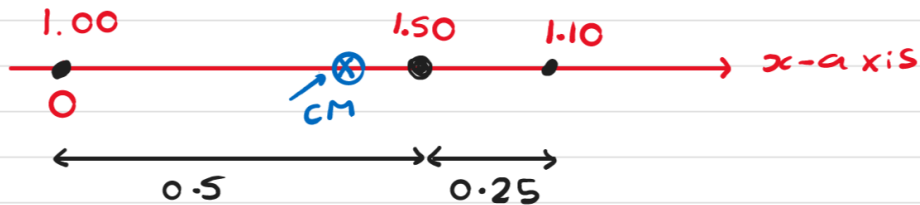
Solutions to Problems Sets of Chapter 7 (sections 8 and 9)

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Q46]



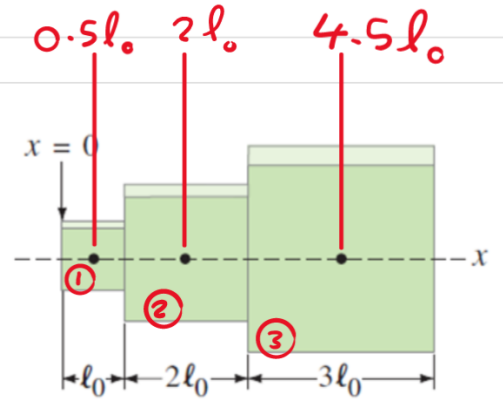
with respect to the 1kg mass \Rightarrow suppose the 1kg mass
is at $x=0 \Rightarrow$

$$x_{cm} = \frac{1.00(0) + 1.50(0.50) + 1.10(0.75)}{1.00 + 1.50 + 1.10} = 0.438 \text{ m}$$

Q51]

$$V_1 = l_0^3, V_2 = (2l_0)^3 = 8l_0^3 = 8V_1$$

$$V_3 = (3l_0)^3 = 27l_0^3$$



Remember $m = \rho V$
mass \uparrow density \uparrow volume

(all boxes have the same density)

$\therefore m \propto V$. Suppose box ① has mass m

\Rightarrow box ② has mass $8m$

box ③ has mass $27m$

$$x_{cm} = \frac{m(0.5l_0) + 8m(2l_0) + 27m(4.5l_0)}{m + 8m + 27m} = \frac{138m}{36m} l_0$$

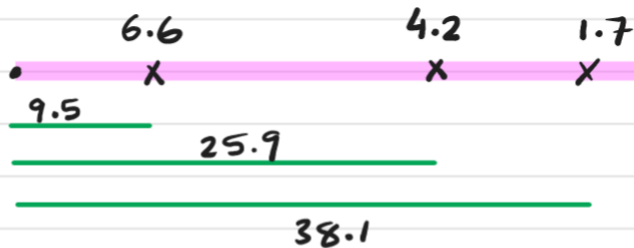
$$x_{cm} \approx 3.8 l_0$$

Q52]

		Percent height above ground	Percent mass
	Shoulder joint	• 81.2%	
	upper arms	x 71.7%	, 6.6%
	lower arms	x 55.3%	, 4.2%
	hands	x 43.1%	, 1.7%

$81.2 - 43.1 = 38.1$

So, we determined the distances between the shoulder joint and the centers of masses of the upper arm, lower arm and hands.



$$x_{cm} = \frac{6.6(9.5) + 4.2(25.9) + 1.7(38.1)}{6.6 + 4.2 + 1.7} = 19$$

∴ For 100 cm tall person, the CM of the stretch arm is at 19 cm from the shoulder joint.

For 160 cm tall person (for example) it is

$$\frac{19}{100} \times 160 = 30.4 \text{ cm.}$$

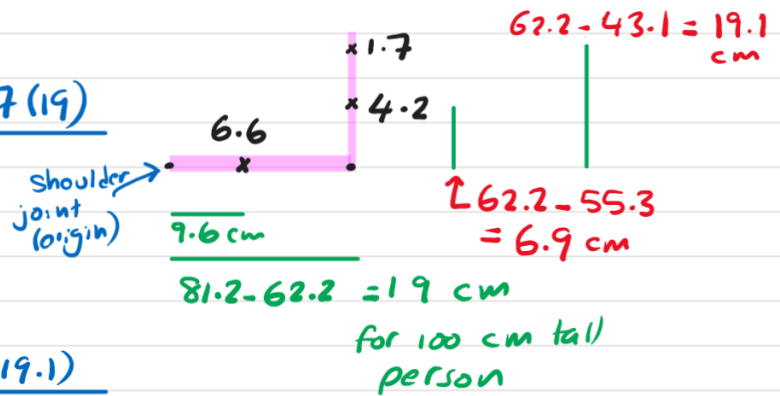
Q53]

$$x_{cm} = \frac{6.6(9.6) + 4.2(19) + 1.7(19)}{6.6 + 4.2 + 1.7}$$

$$x_{cm} = 14.0 \text{ cm}$$

$$y_{cm} = \frac{6.6(0) + 4.2(6.9) + 1.7(19.1)}{6.6 + 4.2 + 1.7}$$

$$= 4.9 \text{ cm} \quad \text{For a 100 cm tall person}$$



For a 155 cm tall person \Rightarrow

$$x_{cm} = \frac{14.0}{100} \times 155 = 21.7 \text{ cm}$$

$$y_{cm} = \frac{4.9}{100} \times 155 = 7.6 \text{ cm}$$