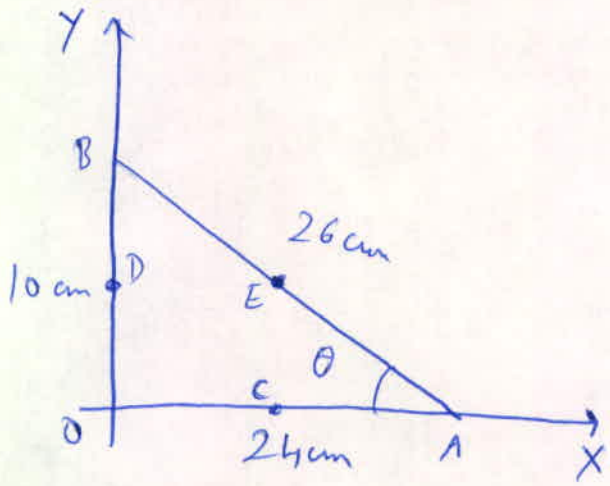
AS PER VERSION A

QUIZ 5 SOLUTIONS

PHYS 4A

WINTER '15

1.)



$L = 60$ cm

$M = 60$ g

$\therefore \rho = \frac{M}{L} = 1 \text{ g/cm}$

For OA →

$Y_{cm} = 0$

$X_{cm} = \frac{24}{2} = 12$ cm

For OB →

$X_{cm} = 0$

$Y_{cm} = \frac{10}{2} = 5$ cm

For AB →

$X_{cm} = \left(\frac{26}{2}\right) \cos\theta$

$= \frac{26}{2} \times \frac{24}{26}$

$= 12$ cm

$Y_{cm} = \left(\frac{26}{2}\right) \sin\theta$

$= \frac{26}{2} \times \frac{10}{26}$.

$= 5$ cm

∴ For OAB →

$$X_{CM} = \frac{M_{OA} X_{CM(OA)} + M_{OB} X_{CM(OB)} + M_{AB} X_{CM(AB)}}{M_{OA} + M_{OB} + M_{AB}}$$

$$= \frac{24 \times 12 + 10 \times 0 + 26 \times 12}{60}$$

$$= 10 \text{ cm}.$$

{since density $\rho = 1 g/cm$}

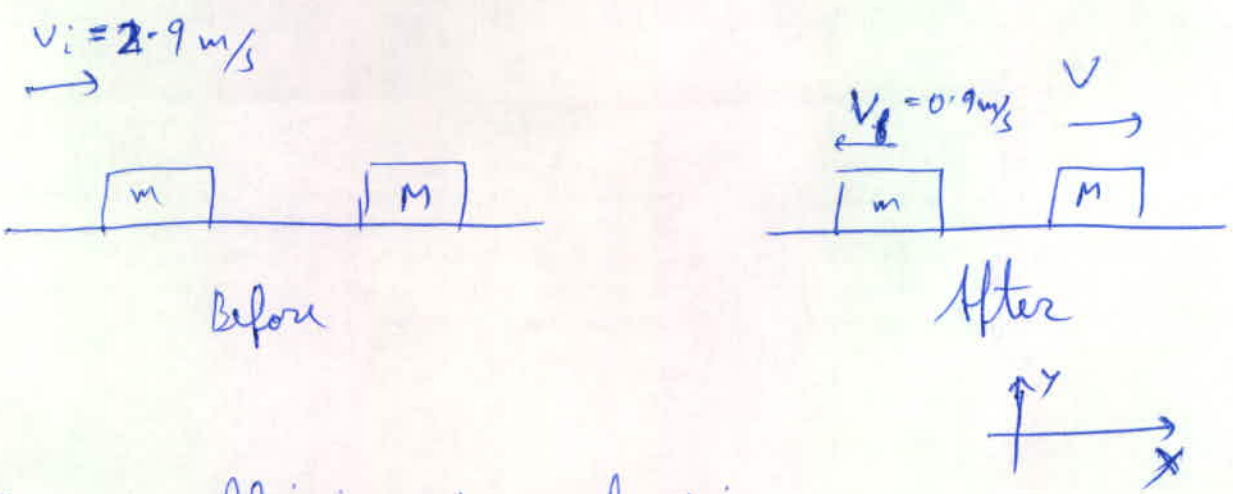
$$Y_{CM} = \frac{M_{OA} Y_{CM(OA)} + M_{OB} Y_{CM(OB)} + M_{AB} Y_{CM(AB)}}{M_{OA} + M_{AB} + M_{OB}}$$

$$= \frac{24 \times 0 + 10 \times 5 + 26 \times 5}{60}$$

$$= 3 \text{ cm}.$$

∴ (10, 3) E.

2.)



∵ the collision is elastic,

Conserving energy and momentum gives,

$$V_{1f} = \frac{m_1 - m_2}{m_1 + m_2} V_{1i} + \frac{2m_2}{m_1 + m_2} V_{2i}$$

{ Equations 11-9 from Book }

$$\Rightarrow -0.9 = \frac{4.2 - M}{(4.2 + M)} (2.9) + \frac{2M}{(4.2+M)} \times 0$$

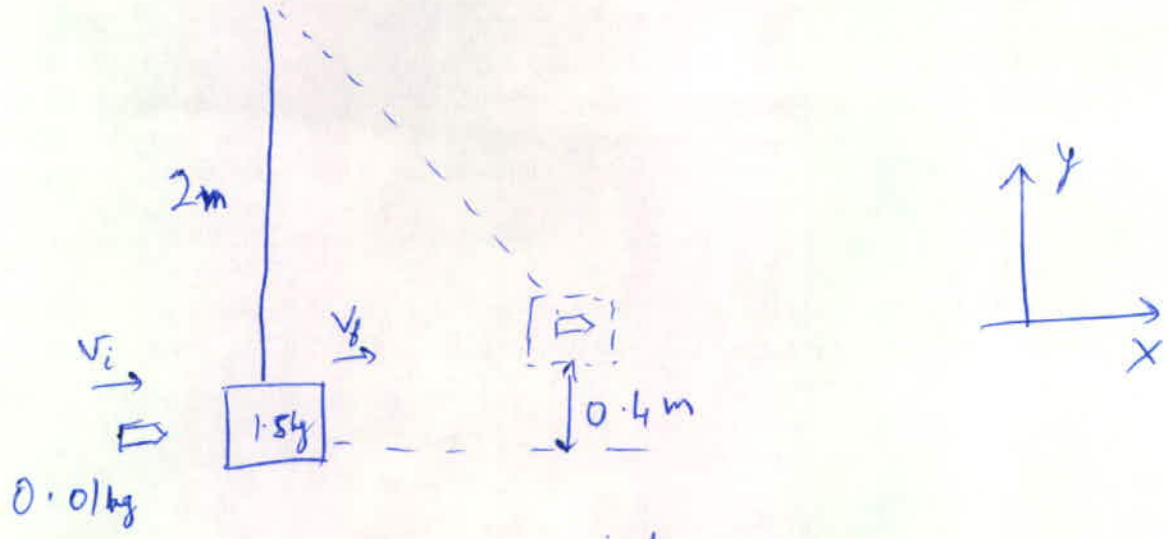
$$\Rightarrow M(2.9 - 0.9) = 4.2(2.9 + 0.9)$$

$$\Rightarrow M = 7.98$$

$$\Rightarrow M \simeq 8 \text{ kg}$$

E.

3.)



Conserving momentum just before and after the bullet strikes the block of wood.

$$m v_i = (m + M) v_f$$

$$\Rightarrow v_f = \frac{0.01}{(1.5+0.01)} v_i$$

$$\Rightarrow v_f = \frac{0.01}{1.51} v_i$$

Now, Conserving Energy between the points - after bullet strikes the block and when they reach a maximum height of 0.4 m

$$\Delta U + \Delta K = W_{nc} = 0$$

$$\Rightarrow (m+M)gh - 0 + 0 - \frac{1}{2}(m+M)v_f^2 = 0$$

$$\Rightarrow v_f = \sqrt{2gh}$$

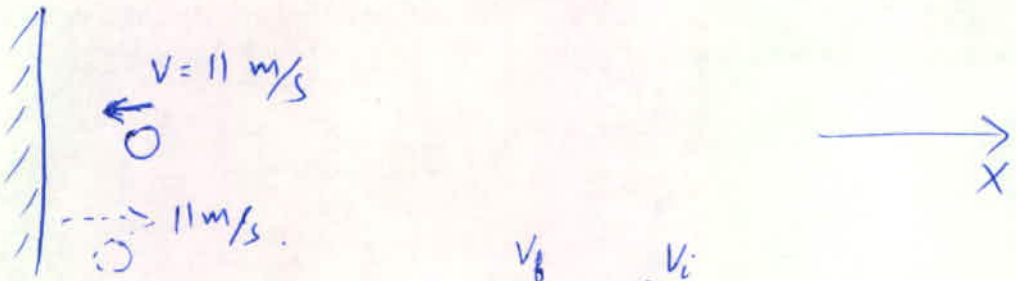
$$\Rightarrow \frac{0.01}{1.51} v_i = \sqrt{2gh}$$

$$\Rightarrow v_i = \frac{1.51}{0.01}\sqrt{2\times 9.8\times 0.4}$$

$$\Rightarrow v_i \approx 420 \text{ m/s}$$

B.

4.)



$$\therefore a_{avg} = \frac{11 - (-11)}{0.05} = \frac{22}{0.05} = 440 \text{ m/s}^2$$

(v_f = 11, v_i = −11)

$$\therefore F_{avg} = m a_{avg}$$

$$= 0.8 \times 440$$

$$= 350 \text{ N}$$

E.