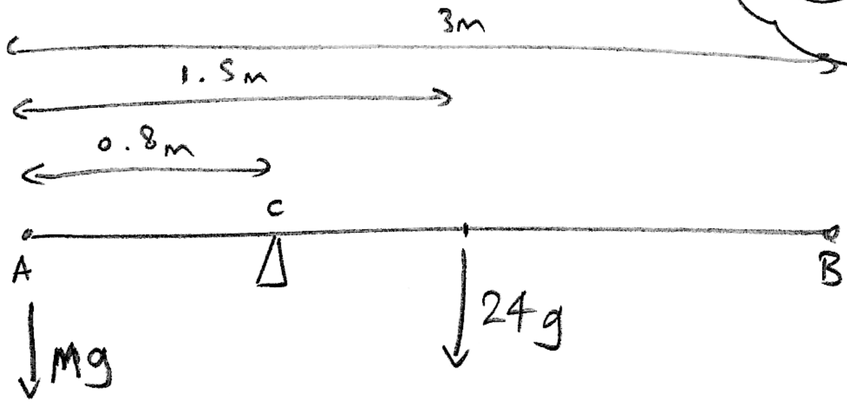
JDGM
20/XI/'18

1.)

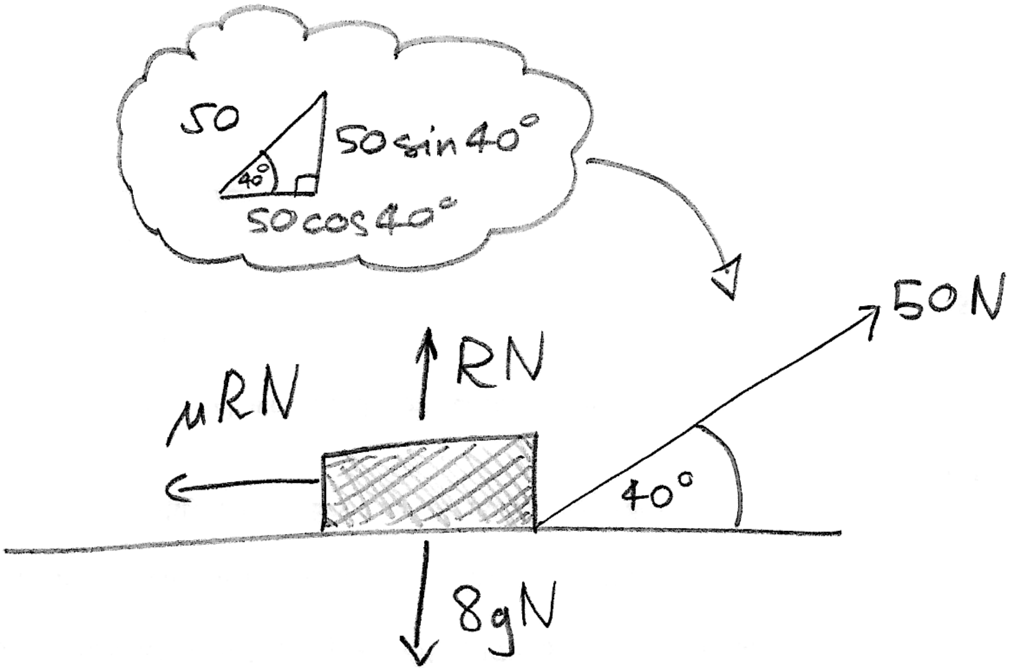


about "C": $(0.8)(Mg) - (0.7)(24g) = 0$

$0.8M\cancel{g} = 0.7 \times 24\cancel{g}$

$\boxed{M = 21 \text{ Kilograms}}$

2.) a)



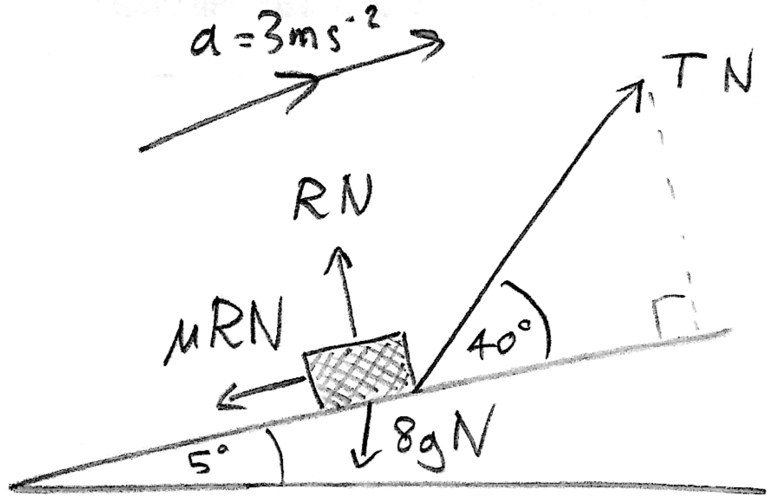
Constant speed so forces balanced.

$R = 8g - 50\sin 40°$

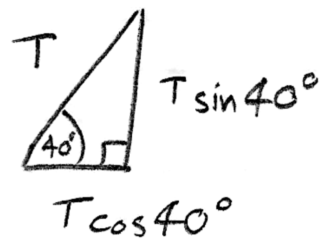
$50\cos 40° = \mu(8g - 50\sin 40°)$

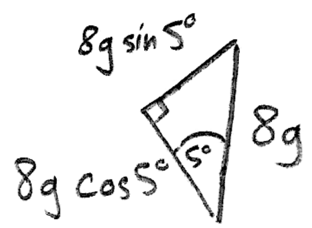
$\mu = 0.827966\ldots \approx \boxed{0.83}$

b.) i.)



ii.)





Box is not lifted off board, nor falling "through" it. Therefore forces perpendicular to the board are balanced.

$$R + T\sin 40° = 8g\cos 5°$$
$$R = 8g\cos 5° - T\sin 40°$$

$F = ma$ (considered parallel to board.)

$$T\cos 40° - \mu(8g\cos 5° - T\sin 40°) = 8 \times 3$$

$$T = \frac{24 + (0.83)(8g\cos 5°)}{\cos 40° + (0.83)\sin 40°} = 68.2961\ldots$$

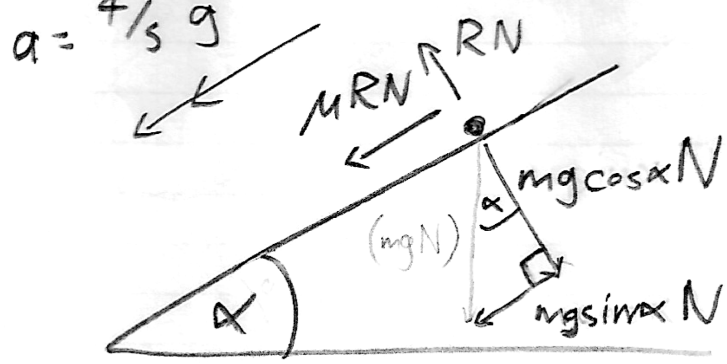
$$\boxed{68.3 \text{ Newtons}}$$

3.) $\tan\alpha = 3/4$

classic right-angled triangle.

$\therefore \quad \sin\alpha = 3/5 \quad , \quad \cos\alpha = 4/5$

(these will be useful.)



Note that because the particle is moving UP the plane the frictional force μR must be working DOWN the plane.

$R = mg\cos\alpha = mg(4/5)$

$F = ma$ (parallel to plane)

$\mu R + mg\sin\alpha = m(4/5\, g)$

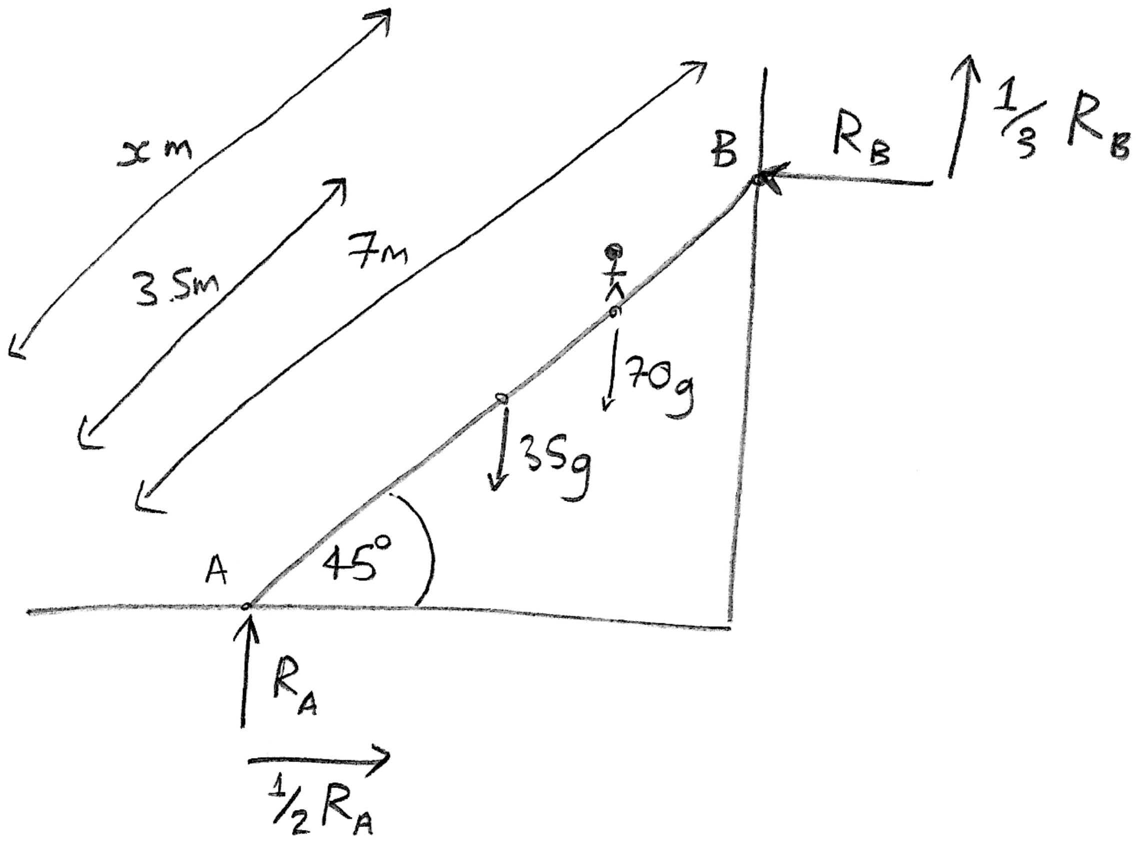
$\mu(mg(4/5)) + mg(3/5) = mg(4/5)$

$\boxed{\mu = 1/4}$

b.) When the particle comes to rest gravity works DOWN the plane, friction works UP. $mg\sin\alpha \,\langle ? \rangle\, (1/4)\, mg\cos\alpha$

$(3/5) > (1/4)(4/5)$ $\therefore$ particle accelerates DOWN plane

4)



The system is in equilibrium, therefore:

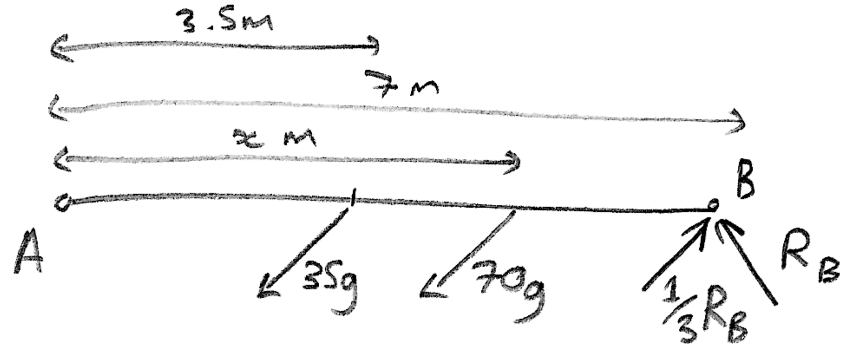
$$\frac{1}{2} R_A = R_B \quad \text{(horizontally)}$$

$$R_A + \frac{1}{3} R_B = 105g \quad \text{(vertically)}$$

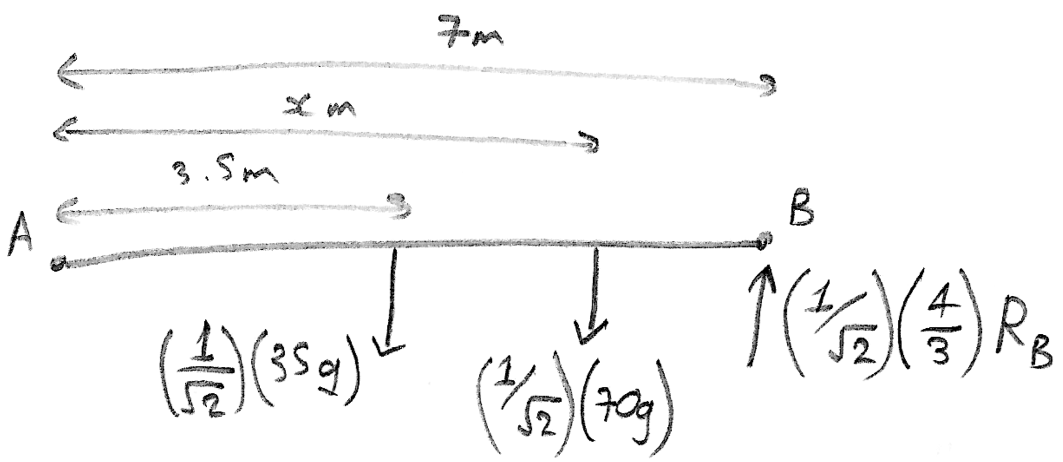
Solving gives: $R_A = 90g$

$R_B = 45g$

↷ moments about A :



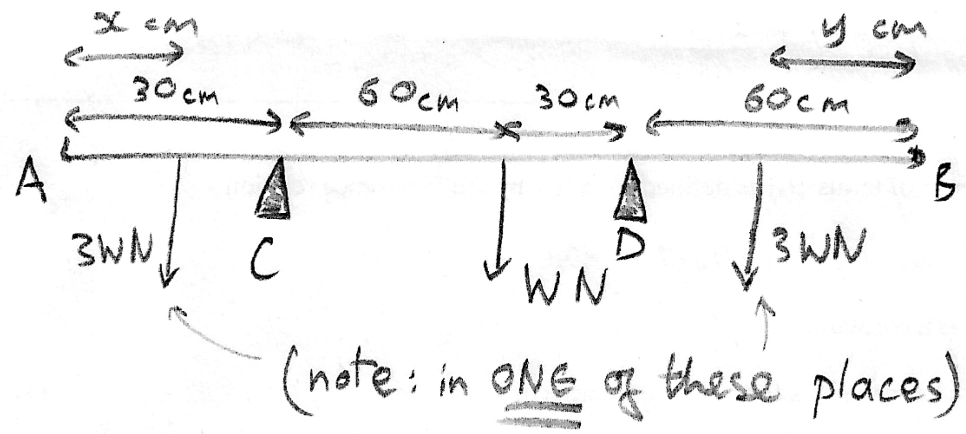
Converting forces into those components perpendicular to the ladder (ignore those parallel)



$$(3.5)\left(\frac{1}{\sqrt{2}}\right)(35g) + (x)\left(\frac{1}{\sqrt{2}}\right)(70g) = (7)\left(\frac{1}{\sqrt{2}}\right)\left(\frac{4}{3}\right)R_B$$

$$x = \frac{(7)(4/3)(45g) - (3.5)(35g)}{70g} = \boxed{4.25\text{ m}}$$

5.)



$\curvearrowright$ about C: $60W = (30 - x)3W$

$x = 10$

by similar argument with $\curvearrowright$ about D, we find $y = 50$

Therefore the weight must be placed at least 10cm from A and 50cm from B for the shelf not to tip.