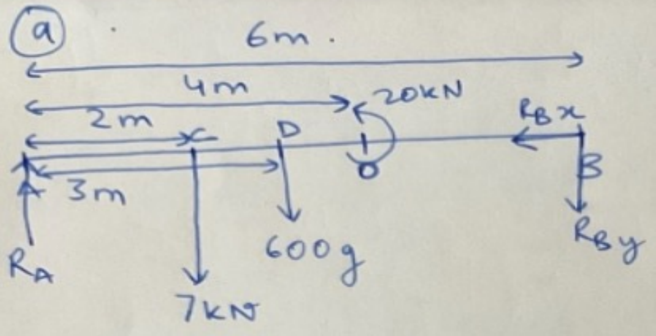
Apoorva Choudhary - 10401042020 - MAE-2- EM - 17/2/21

3 (a)



For Equilibrium,

(I) $\Sigma F_x = 0 \Rightarrow R_{Bx} = 0$

(II) $\Sigma F_y = 0 \Rightarrow R_A - 7000 - 5880 - R_{By} = 0$

$\Rightarrow R_A - R_{By} = 12,880$ N. —— (1)

(III) $\Sigma M_o = 0 \Rightarrow -20,000 + R_{By} \times 2 - 5880 \times 1 - 7000 \times 2 + R_A \times 4 = 0.$

(Taking clockwise as positive)

$\Rightarrow 2R_{By} + 4R_A = 39880$

$\Rightarrow R_{By} + 2R_A = 19,940$ —— (11)

Adding ~~from~~ (1) and (11), we get,

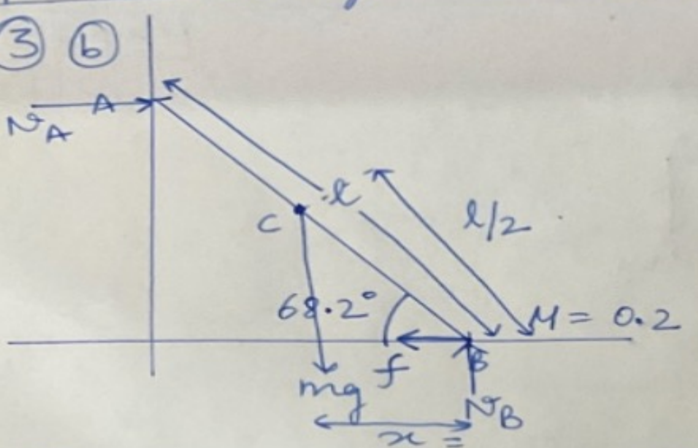
$3R_A = 32,820$

$\Rightarrow \boxed{R_A = 10,940 \text{ N}}$

$\boxed{R_{By} = -1940 \text{ N}}$

$\hookrightarrow R_{By}$ would act upwards.

3 (b)



let the weight of man be mg.

(I) $\Sigma F_x = N_A - f = 0$ —— (I)

(II) $\Sigma F_y = N_B - mg = 0$ —— (II)

(III) $\Sigma M_B = -mg \times \frac{l}{2}\cos(68.2) + N_A\, l \sin(68.2) = 0$ —— (III)

(taking clockwise as positive)

$\Rightarrow$ From (I), we get, $N_A = f = \mu N_B = 0.2 N_B$

(II) $\Rightarrow N_B = mg$

(III) $\Rightarrow N_A\, \cancel{l} \sin(68.2) = \frac{mg\cancel{l}}{2}\cos(68.2)$

$\Rightarrow \tan(68.2) = \frac{mg}{2} \times \frac{1}{N_A}$ —— (IV)

~~$\Rightarrow \tan(68.2) =$~~

R.H.S of (IV) $\Rightarrow \frac{mg}{2} \times \frac{1}{N_A} = \frac{mg}{2} \times \frac{1}{\mu mg} = \frac{1}{2} \times \frac{1}{0.2}$

$= \frac{1}{0.4} = \tan(68.2)$

$=$ L.H.S of (IV)

Hence Proved that the man with weight mg cannot climb further than the half point of the ladder when $\mu = 0.2$ and $\theta = 68.2$.