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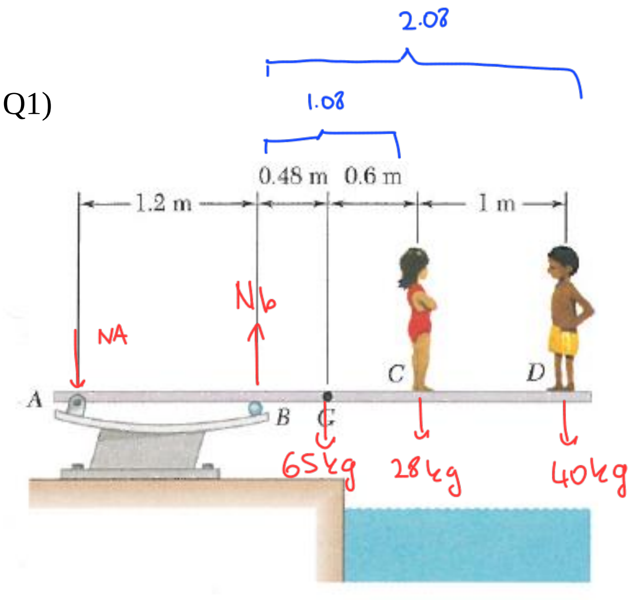
HOMEWORK 4

Q1)



We have two equations for the equilibrium of rigid body.

$\sum F_i = 0$

$-N_a + N_b = 65g + 28g + 40g = 133g$

$\sum M_i = 0$

Moment with respect to point B.

$1.2 \times N_A = 0.48 \times 65g + 1.08 \times 28g + 2.08 \times 40g$

$N_A = \dfrac{0.48 \times 65g + 1.08 \times 28g + 2.08 \times 40g}{1.2}$

$N_A = 120.53g$

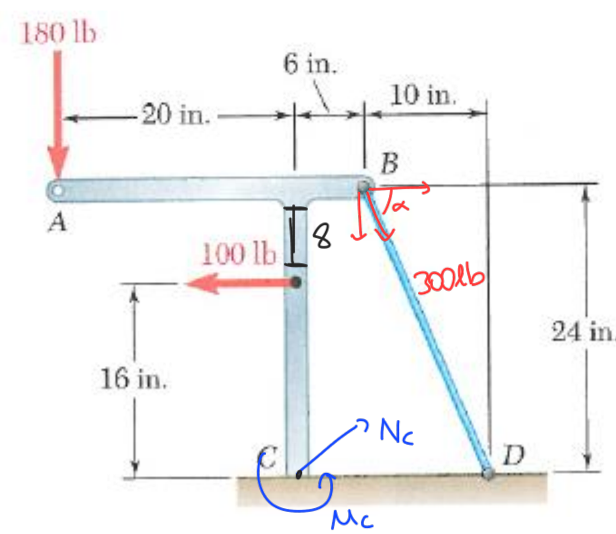
$N_B = 133g + 120.53g = 253.53g$

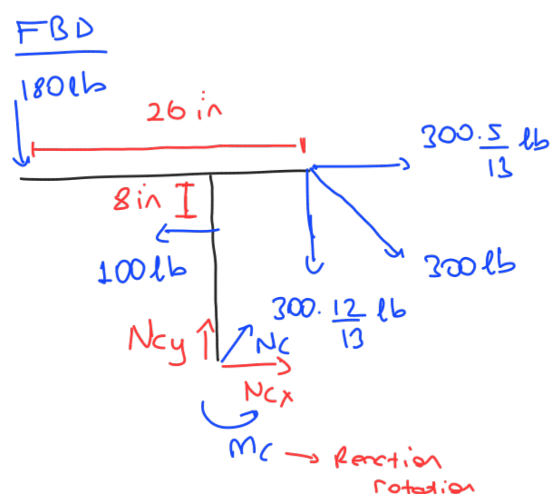
I take g (gravity) = 9.8 N

$\boxed{\begin{array}{l} a)\ N_A = 120.53g \approx 1181.2\ N \\ b)\ N_B = 253.53g \approx 2484.6\ N \end{array}}$ $\left.\begin{array}{l}\downarrow \\ \uparrow\end{array}\right\}$ directions

Two children are standing on a diving board of mass 65 kg. Knowing that the masses of the children at C and D are 28 kg and 40 kg, respectively, determine (a) the reaction at A, (b) the reaction at B.

Q2)





10 − 24 − 26
5 − 12 − 13

$\sin\alpha = \frac{12}{13}$, $\cos\alpha = \frac{5}{13}$

Knowing that the tension in wire BD is 300 lb, determine the reaction at fixed support C for the frame shown.

There is Reactive force N_c with component N_{cx} and N_{cy}.

There is also reactive moment M_c that prevents from rotating.

We have 2 equations

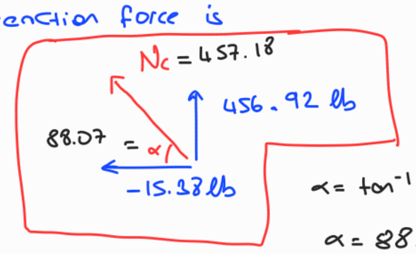
1) $\sum F_i = 0$ → $\sum F_{xi} = 0$ } Horizontal sum ; $\sum F_{yi} = 0$ } Vertical sum

2) $\sum M_i = 0$

$$\sum F_{xi} = 0 = -100 + N_{cx} + 300 \cdot \frac{5}{13} = 0 \Rightarrow N_{cx} = 100 - \frac{300}{13} \cdot 5 = -15.38 \text{ lb}$$

$$\sum F_{yi} = 0 = -180 + N_{cy} - 300 \cdot \frac{12}{13} = 0 \Rightarrow N_{cy} = 180 + \frac{300 \cdot 12}{13} = 456.92 \text{ lb}$$

so, the reaction force is



$$N_c = \sqrt{(456.92)^2 + (15.38)^2} = 457.18$$

π — 180 ; x — ? } $? = \frac{x \cdot 180}{\pi}$

$$\alpha = \tan^{-1}\left(\frac{456.92}{15.38}\right)$$

$$\alpha = 88.07$$

We also need to find moment reaction M_c.

$$\sum M_i = 0 = M_c + 180 \cdot 20 + 100 \cdot 16 - 300 \cdot \frac{12}{13} \cdot 6 - 300 \cdot \frac{5}{13} \cdot 24 = 0$$

$$M_c = 300 \cdot \frac{12}{13} \cdot 6 + 300 \cdot \frac{5}{13} \cdot 24 - 180 \cdot 20 - 100 \cdot 16 =$$

$$M_c = -769.23 \text{ lb.in}$$

so, there is also reactive moment with magnitude $\boxed{769.23 \circlearrowright}$ clockwise

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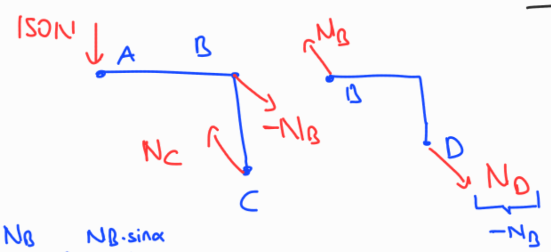
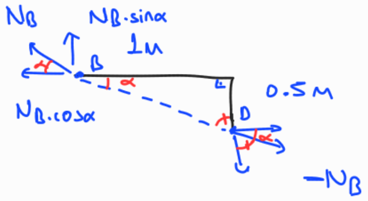
Q3)

FBD



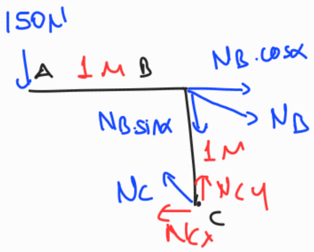
N_B and N_D are two force members

180 — π ; x — ? ; $? = \frac{x \cdot \pi}{180}$



$\alpha = \arctan\left(\frac{1}{2}\right)$

$\alpha = 26.57°$



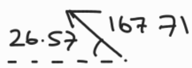
$\cos 26.57 \approx 0.89$

Moment w.r.t C $\sum M_i = 0$

$$150 \times 1 - N_B \cdot \cos\alpha = 0 \rightarrow N_B \cdot \cos\alpha = 150$$

$$N_B = \frac{150}{\cos 26} = \frac{150}{0.89} = 167.71 \text{ N}$$

We have found N_B



$\sum F_i = 0$ → $\sum F_{xi} = 0$; $\sum F_{yi} = 0$

$$\sum F_{xi} = 0 = -N_{cx} + N_B \cdot \cos(26.57°) = 0 \rightarrow N_{cx} \approx 150 \text{ N}$$

$$\sum F_{yi} = 0 = -150 - N_D \cdot \sin(26.57°) + N_{cy} = 0 \rightarrow N_{cy} \approx 225.02 \text{ N}$$

π — 180

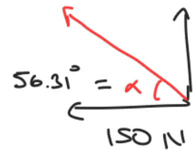
x — ?

$? = \frac{x \cdot 180}{\pi}$

Therefore, the result is

C

$N_c = 270.42$



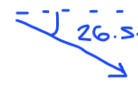
$N_c = \sqrt{225^2 + 150^2}$

$N_c = 270.42$

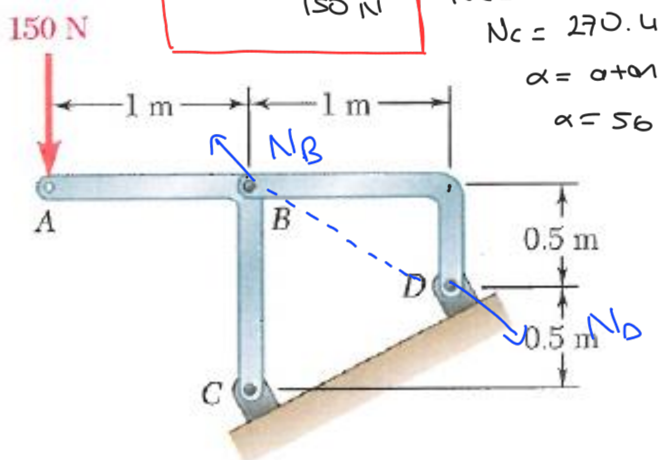
$\alpha = \operatorname{atan}\left(\frac{3}{2}\right)$

$\alpha = 56.31°$

D $\quad N_D = -N_B$



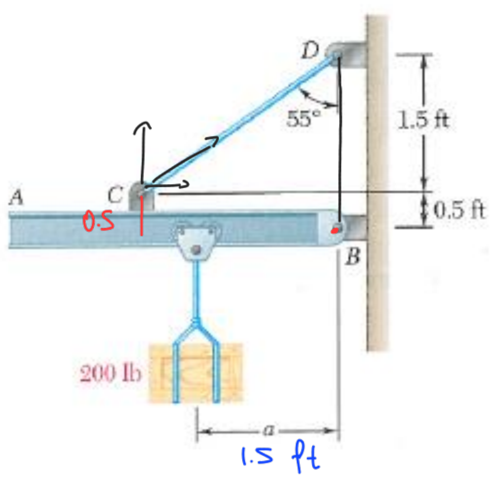
Q3)

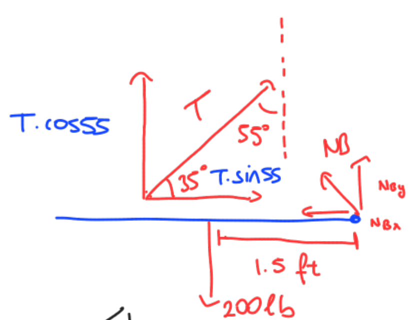


For the frame and loading shown, determine the reactions at C and D.

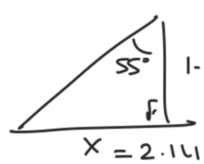
Q4)

FBD





$N_{Bx} = T \cdot \sin 55°$



$\frac{x}{1.5} = \tan 55 \qquad x = 1.5 \cdot \tan 55$

$x = 2.141$

A 200-lb crate is attached to trolley-beam system shown. Knowing that a=1.5 ft, determine (a) the tension in cable CD, (b) the reaction at B.

$\sum F_{xi} = 0 = -N_{Bx} + T \cdot \sin 55 = 0 \longrightarrow N_{Bx} = T \cdot \sin 55$ (1)

$\sum F_{yi} = 0 = -200 + T \cdot \cos 55 + N_{By} = 0$ (2)

w.r.t (B) $\sum M_i = 0 = -T \cdot \cos 55 \cdot 2.14 - T \cdot \sin 55 \cdot 0.5 + 300 = 0$

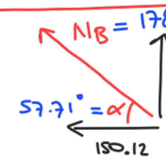
$-T \cdot 1.23 - T \cdot 0.41 + 300 = 0$

a) $\boxed{T = 183.26 \text{ lb}}$

$N_{Bx} = 183.26 \cdot \sin 55 = 150.12$ lb

$N_{By} = 200 - T \cdot \cos 55 = 94.87$ lb

$N_B = 178.58$ lb



b)

$\alpha = \operatorname{atan}\left(\frac{150.12}{94.87}\right)$

$\alpha = 57.71$

$N_B = \sqrt{(150.12)^2 + (94.87)^2}$

$N_B \approx 178.58$ lb