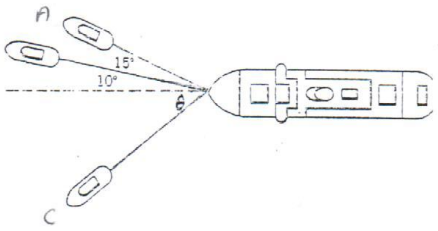
CONCORDIA UNIVERSITY

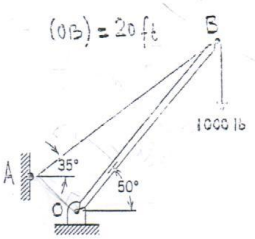
Faculty of Engineering and Computer Science
ENGR 242/2 Statics, Section V
Test #1

MARKS — Attempt all questions, only calculators permitted — TIME: 60 Minutes

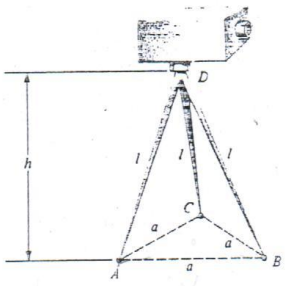
20 1) Three tugboats are towing the ship as shown, each exerting a force of 25 kN. What is the value of θ so that the direction of the resultant force is along the axis of the ship? What is the magnitude of the resultant force?



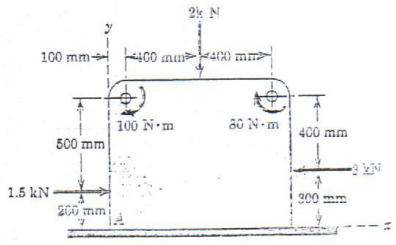
25 2) What will be the tension in the cable AB if the sum of moments about O, of the force this transmits to the boom and the 1000-lb force, is zero?



25 3) A tripod is designed to support a camera of weight W. The camera is at height h above the ground when the legs form an equilateral triangle ABC of side a. Determine the forces in the legs assuming that they share the load equally, and that the forces are axial (that is, longitudinal) in the legs.



30 4) Determine the resultant R of the three forces and two couples shown. Find the coordinate x of the point on the x-axis through which R passes.



ENGR 2321 - V Test #1 Solutions

1. $F_y = 25\left(\sin 25^\circ + \sin 10^\circ - \sin\theta\right) = 0 \Rightarrow \hat{\theta} = 36.5^\circ$

$R = 25\left(\cos 25^\circ + \cos 10^\circ + \cos 36.5^\circ\right) = 57.3$ kN

2. $T\cos 35^\circ$, $T\sin 35^\circ$, 1000 lb

It is given that $T\cos 35^\circ(\cos 50^\circ) - (T\sin 35^\circ + 1000)(\cos 50^\circ) = 0$

$\therefore T(\cos 35^\circ \sin 50^\circ - \sin 35^\circ \cos 50^\circ) = 1000\cos 50^\circ$

$\therefore T = 1000\cos 50^\circ / \sin(50^\circ - 35^\circ) = 2484$ lb

3. Let S each of the equal axial forces. Equilibrium in vertical direction gives $W = 3S$

$\therefore S = \dfrac{W}{3}$

4. Equivalent force-couple system at A: $(F_A)_x = 1.5 - 3 = -1.5$ kN

$(F_A)_Y = -2$ kN

$M_A = -1.5\times 0.2 - 2.0\times 0.5 + 3\times 0.3 - 0.1 - 0.08 = -0.58$ kN·m

1.5 kN, A, 0.58 kN·m, 2 kN

$\therefore z = \dfrac{0.58}{2.0} = 0.29$ m from A.

PLEASE LEARN FROM YOUR MISTAKES !!!

THANK YOU.

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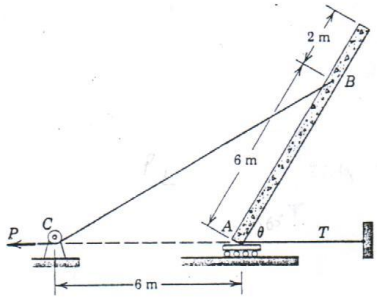
ENGR 242/2 Statics Section V

Test #2

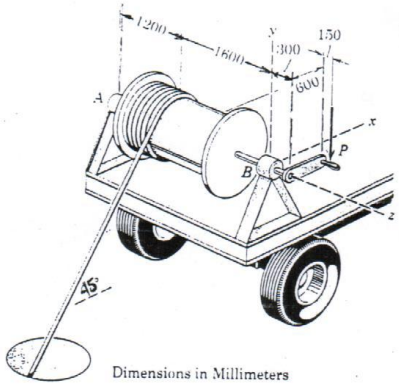
Please attempt all questions, only calculators permitted. Time: 60 minutes

Marks

35 1) The uniform concrete slab shown in edge view has a mass of 25 Mg and is being hoisted slowly into a vertical position by the tension P in the hoisting cable. For the position where $\theta = 60°$ calculate the tension T in the horizontal anchor cable by using only one equation of equilibrium.

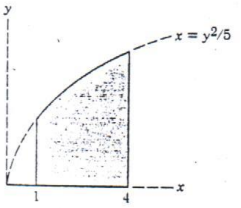


35 2) A force P of 200 N on the handle of the cable reel is required to wind up the underground cable as it comes from the manhole. The drum diameter is 1000 mm. For the horizontal position of the crank handle shown, calculate the tension of the cable.



Dimensions in Millimeters

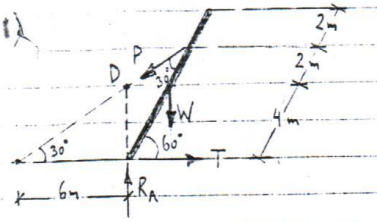
30 3) Determine the x coordinate of the centroid of the shaded area.



ENGR 242/2 STATICS - Section V

TEST #2 – SOLUTIONS

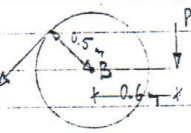
1)



$W = mg = 25 \times 9.81 = 245.2$ kN

$\Sigma M_D = 0 = T \times 6 \tan 30° - 245.2 \times 4 \cos 60° \Rightarrow$ **$T = 141.6$ kN**

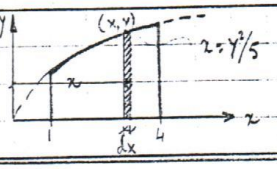
2)



$\Sigma M_{Bz} = 0 = 0.5\,T - 200 \times 0.6 \Rightarrow$ **$T = 240$ N**

N.B. B_z is the axis of rotation

3)



$A = \int y\,dx = \int_1^4 \sqrt{5}\sqrt{x}\,dx = \sqrt{5}\left[\frac{2}{3}x^{3/2}\right]_1^4 = \frac{2\sqrt{5}}{3} \times 7 = 10.435$

$\bar{x}A = \int_1^4 \bar{x}_{el}\,dA = \int_1^4 x\sqrt{5}\sqrt{x}\,dx = \sqrt{5}\left[\frac{2}{5}x^{5/2}\right]_1^4 = \frac{2\sqrt{5}}{5} \times 31 = 27.73 \Rightarrow$ **$\bar{x} = 2.66$**

ONCE AGAIN! PLEASE LEARN FROM YOUR MISTAKES !!! THANK YOU.

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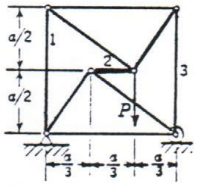
Test # 3

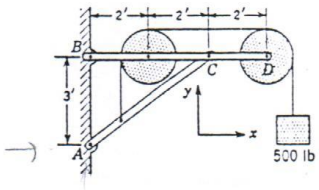
Please attempt all questions, only calculators permitted. Time: 60 minutes

Marks

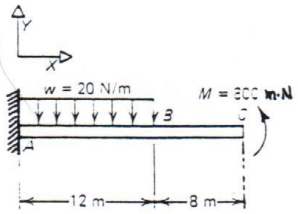
30 1) For the plane truss shown determine the forces in bars 1, 2 and 3 for a given load P. Indicate whether these bars are in tension or compression.



35 2) A bracket made up of two members BD and AC is loaded as shown. Neglecting the weights of the members and pulleys, calculate the horizontal and vertical components of the reactions at A and B. Each pulley has a radius r=1ft.



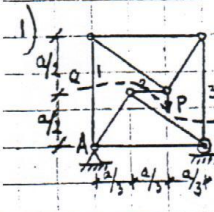
35 3) Draw the shear force and bending moment diagrams for the beam and loading shown.



ENGR 242/2 STATICS Section V

TEST #3 - SOLUTIONS

1)

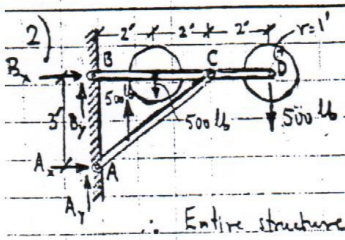


Section aa : $\Sigma F_x = 0 \Rightarrow S_2 = 0$

(top part) $\Sigma M_B = 0 = S_1 a + P\frac{a}{3} \Rightarrow S_1 = -\frac{P}{3}$ (compression)

$\Sigma M_A = 0 = S_3 a + P\frac{2a}{3} \Rightarrow S_3 = -\frac{2P}{3}$ (compression)

2)



Entire structure (without cable)

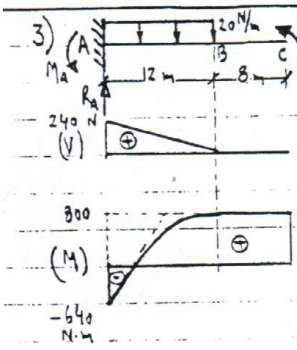
$\Sigma M_B = 0 = A_x \times 3 + 500 \times 1 - 500 \times 2 - 500 \times 6 \Rightarrow A_x = 1{,}167$ lb

$\Sigma F_x = 0 = A_x + B_x \Rightarrow B_x = -1{,}167$ lb

Member AC : $\Sigma M_C = 0 = A_y \times 4 - 1{,}167 \times 3 + 500 \times 3 \Rightarrow A_y = 50$

$\therefore$ Entire structure : $\Sigma F_y = 0 = A_y + B_y + 500 - 500 - 500 \Rightarrow B_y = 0$

3)



$\Sigma M_A = 0 = M_A - 20 \times 12 \times 6 + 800 \Rightarrow M_A = 640$ N·m

$\Sigma F_y = 0 = R_A - 20 \times 12 \Rightarrow R_A = 240$ N

Section AB

$M_x + 640 - 240x + 20x^2/2 = 0 \Rightarrow M_x = -10x^2 + 240x - 640$

For $x = 12 \Rightarrow M_{12} = -10 \times 12^2 + 240 \times 12 - 640 = 800$ N·m

$M_x = 0$ for $x = 3.05$ m

DO NOT FORGET TO LEARN FROM YOUR MISTAKES !!! THANKS ...