ENGR 220 Statics and Mechanics of Materials

Practice Exam – Winter 2009

The following represents some of the types of problems that you might encounter in ENGR 220 Exam 1. This document is intended to give you additional practice for your exam preparation, but should not be considered a comprehensive collection of ENGR 220 Exam 1 problems. Solutions to the problems will not be explicitly provided.

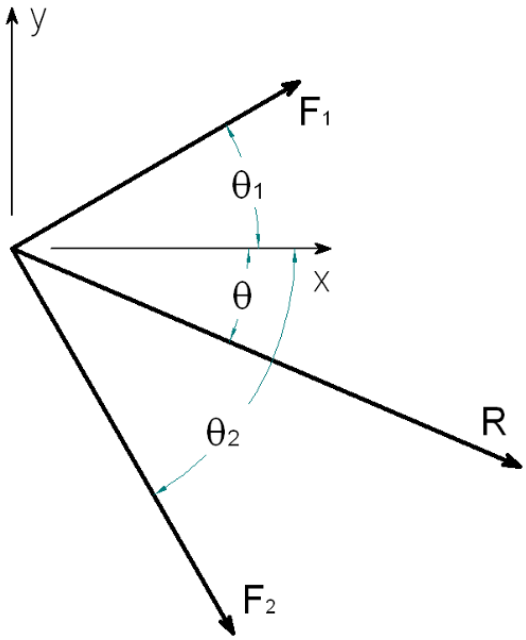
REMINDER: You are responsible for all content covered in your ENGR 220 coursework.

NOTE 1: Qualitative questions have been omitted from this exam. You should also be able to answer content-based questions / fill-in-the-blank / etc.

NOTE 2: Page 10 is intentionally left blank.

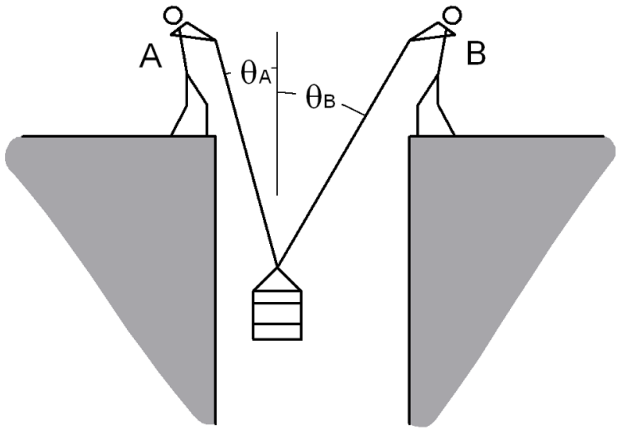
1. If $F_1 = 21\,N$, $\theta_1 = 23\,deg$, $F_2 = 54\,N$, and $\theta_2 = 62\,deg$, the direction (θ) of the resultant from the combination of forces F_1 and F_2 is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 33.89 \\ \text{"B"} & 36.4 \\ \text{"C"} & 38.93 \\ \text{"D"} & 41.46 \\ \text{"E"} & 43.97 \end{pmatrix} \text{deg}$$



2. Workers standing on opposite sides of a hole are lifting a box of tools with rope. If the tension in worker A's rope is $F_A = 24\,lbf$, and the angles of the ropes are $\theta_A = 14\,deg$ and $\theta_B = 34\,deg$, then the weight of the box of tools is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 31.9 \\ \text{"B"} & 33.83 \\ \text{"C"} & 35.77 \\ \text{"D"} & 37.71 \\ \text{"E"} & 39.66 \end{pmatrix} \text{lbf}$$

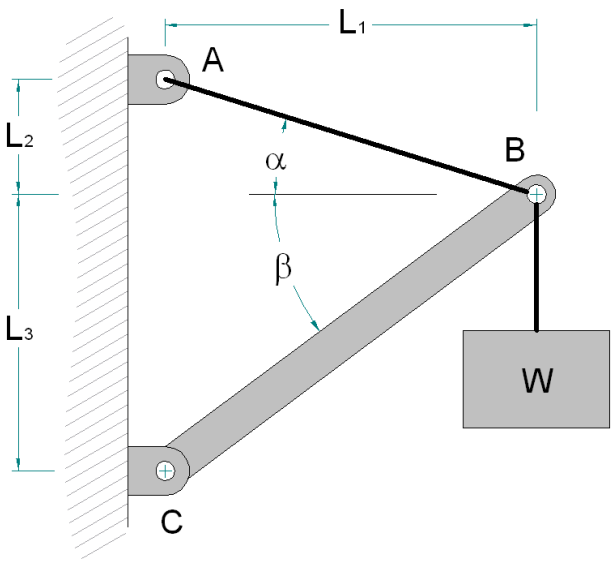


3. A cable and a weightless rod support a weight of $W = 205\,N$ as shown. If:

$L_1 = 120\,cm,\ \alpha = 19\,deg,\ L_3 = 126\,cm$

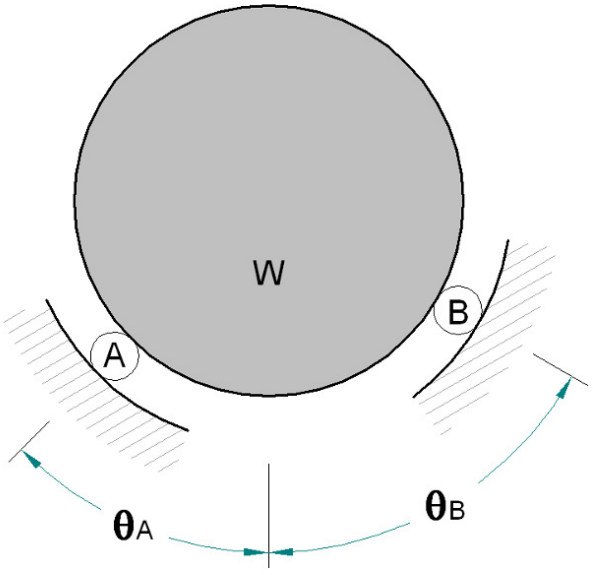
the force in rod BC is closest to:

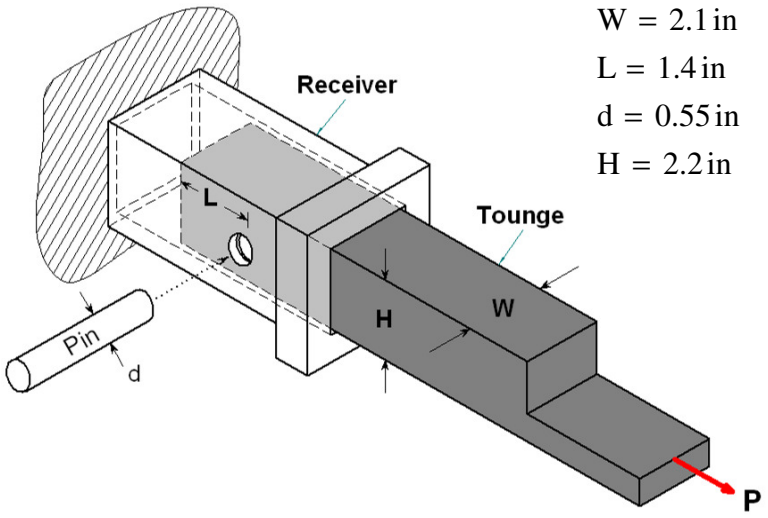
$$Choices = \begin{pmatrix} "A" & 200.3 \\ "B" & 213.2 \\ "C" & 226.1 \\ "D" & 239.1 \\ "E" & 252 \end{pmatrix} N$$



4. A drum with weight $W = 13\,kN$ is suspended on two rollers in the position shown. The angles on the figure are $\theta_A = 45\,deg$ and $\theta_B = 53\,deg$. The force placed on the drum by roller A is closest to:

$$Choices = \begin{pmatrix} "A" & 9.85 \\ "B" & 10.48 \\ "C" & 11.12 \\ "D" & 11.76 \\ "E" & 12.4 \end{pmatrix} kN$$





$W = 2.1\,\text{in}$

$L = 1.4\,\text{in}$

$d = 0.55\,\text{in}$

$H = 2.2\,\text{in}$

Figure for questions 5 through 7. The pin is shown removed from the hole only for clarity. Assume the pin passes through the receiver on both sides.

5. Assuming the mode of failure of the joint above will be tearout (also called punching shear) of the hole in the solid tongue, and that the allowable shearing stress in the tongue is $\tau_{all} = 4.9\,\text{ksi}$, the maximum allowable load **P** is closest to:

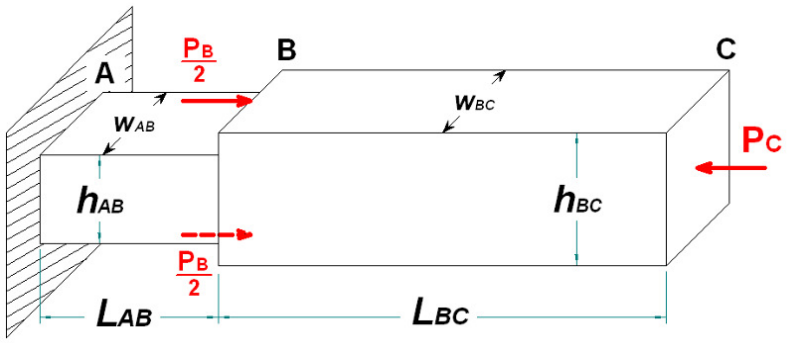
$$\text{Choices} = \begin{pmatrix} \text{"A"} & 27.06 \\ \text{"B"} & 28.81 \\ \text{"C"} & 30.56 \\ \text{"D"} & 32.30 \\ \text{"E"} & 34.04 \end{pmatrix} \text{kip}$$

6. Assume the mode of failure of the joint above will be normal stress in the tongue at a cross section at the hole. If the tongue is composed of structural steel, then the maximum load **P** allowable to maintain a factor of safety of $FS = 2.7$ against yielding is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 43.39 \\ \text{"B"} & 46.20 \\ \text{"C"} & 49.02 \\ \text{"D"} & 51.80 \\ \text{"E"} & 54.61 \end{pmatrix} \text{kip}$$

7. Assume the mode of failure of the joint above will be bearing stress in the hole in the tongue. If the allowable normal compressive stress in the tongue is $\sigma_{all} = 28\,\text{ksi}$, then the maximum allowable load **P** is closest to: (Only consider average stress in the hole, not peak stress.)

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 32.34 \\ \text{"B"} & 34.31 \\ \text{"C"} & 36.26 \\ \text{"D"} & 38.21 \\ \text{"E"} & 40.19 \end{pmatrix} \text{kip}$$



$P_B = 37\,\text{kN}$ $P_C = 128\,\text{kN}$

$L_{AB} = 6.1\,\text{cm}$ $L_{BC} = 10\,\text{cm}$

$w_{AB} = 4.1\,\text{cm}$ $w_{BC} = 6.1\,\text{cm}$

$h_{AB} = 2.1\,\text{cm}$ $h_{BC} = 3.1\,\text{cm}$

8. Section AB is composed of 6061 aluminum, and section BC is composed of titanium. The change in length of member ABC due to the applied loads is closest to:

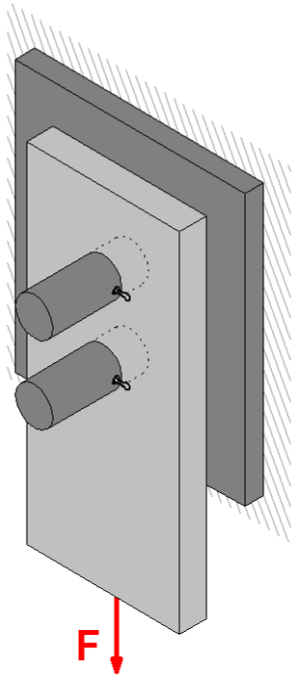
$$\text{Choices} = \begin{pmatrix} \text{"A"} & -0.065 \\ \text{"B"} & -0.097 \\ \text{"C"} & -0.130 \\ \text{"D"} & -0.163 \\ \text{"E"} & -0.195 \end{pmatrix} \text{mm}$$

9. Wakeboarders usually prefer ropes that stretch less. A wakeboarder is considering two ropes, one a nylon rope with a diameter of $d_n = 0.375\,\text{in}$ and an effective elastic modulus of $E_n = 2500\,\text{ksi}$, and the other a spectra rope with a diameter of $d_s = 0.25\,\text{in}$ and an effective elastic modulus of $E_k = 6000\,\text{ksi}$. How much more will an $L = 30\,\text{ft}$ length of the nylon rope stretch under an $F = 300\,\text{lbf}$ load versus the kevlar rope?

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 0.0195 \\ \text{"B"} & 0.0244 \\ \text{"C"} & 0.0294 \\ \text{"D"} & 0.0343 \\ \text{"E"} & 0.0392 \end{pmatrix} \text{in}$$

10. The large pins shown are to be constructed with wrought iron and are to have a factor of safety of $FS = 1.8$ against fracture. If the bracket must support a load of $F = 8300\,lbf$ the minimum required diameter of the pins is closest to:

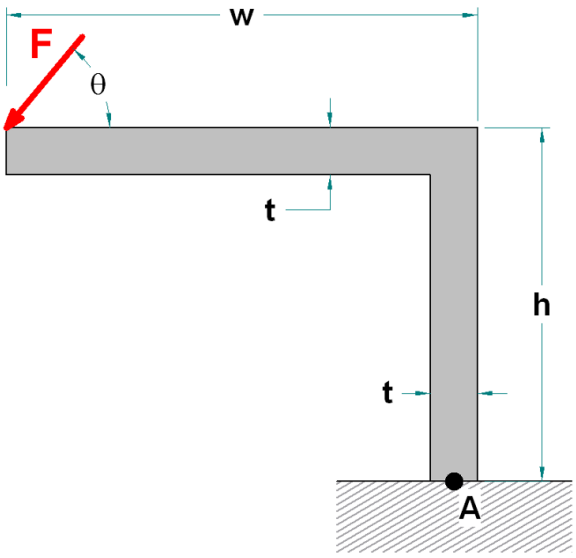
$$Choices = \begin{pmatrix} "A" & 0.393 \\ "B" & 0.449 \\ "C" & 0.505 \\ "D" & 0.561 \\ "E" & 0.617 \end{pmatrix} in$$



11. If a cold-rolled red brass rod with an initial length of $L = 7.2\,ft$ is stretched by $\delta = 0.05\,in$, the axial stress in the rod is closest to:

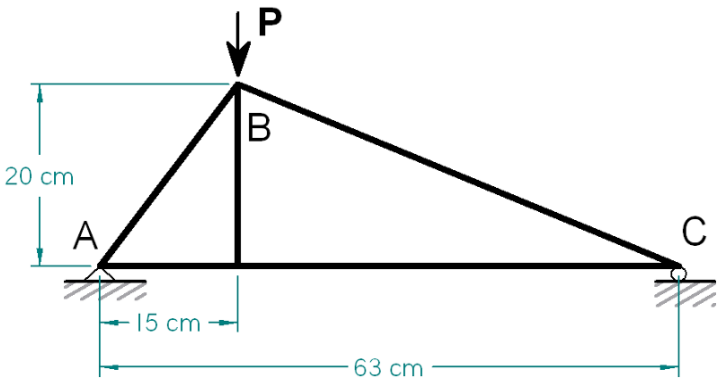
$$Choices = \begin{pmatrix} "A" & "not\ enough\ information" \\ "B" & 7.106 \\ "C" & 7.892 \\ "D" & 8.681 \\ "E" & 9.470 \end{pmatrix} ksi$$

12. The bracket shown has dimensions $w = 48\,in$, $h = 36\,in$, and $t = 4.6\,in$. A force of $F = 612\,lbf$ is applied at an angle of $\theta = 51\,deg$ at the end of the bracket. The moment that this force creates about point A is closest to:



$$\text{Choices} = \begin{pmatrix} \text{"A"} & 2665 \\ \text{"B"} & 2817 \\ \text{"C"} & 2967 \\ \text{"D"} & 3117 \\ \text{"E"} & 3268 \end{pmatrix} \text{ft·lbf}$$

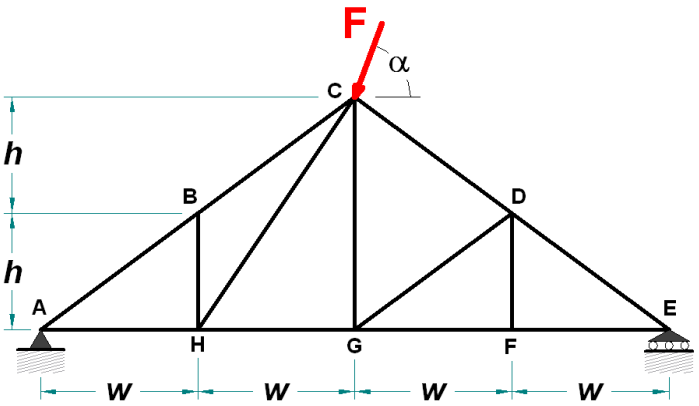
13. If the truss shown is loaded with $P = 77.5\,kN$, then the force in member AB is closest to:



$$\text{Choices} = \begin{pmatrix} \text{"A"} & 44.2 \\ \text{"B"} & 59.0 \\ \text{"C"} & 73.8 \\ \text{"D"} & 88.6 \\ \text{"E"} & 103.4 \end{pmatrix} \text{kN}$$

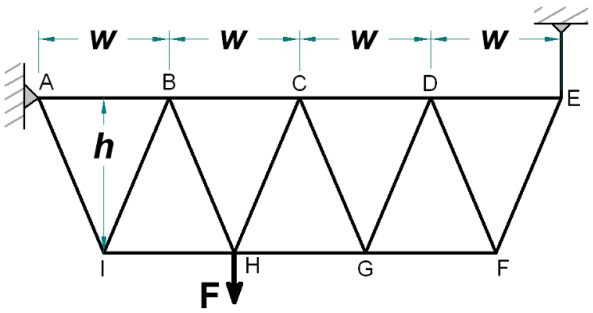
14. The truss shown is loaded with $F = 1023\,\text{lbf}$ at an angle of $\alpha = 81.7\,\text{deg}$. If $h = 3\,\text{ft}$ and $w = 2\,\text{ft}$, then the force in member GH is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 210.6 \\ \text{"B"} & 263.6 \\ \text{"C"} & 316.5 \\ \text{"D"} & 369.4 \\ \text{"E"} & 422.4 \end{pmatrix} \text{lbf}$$



15. The truss shown is loaded with $F = 54\,\text{kN}$. If $h = 1\,\text{m}$ and $w = 1.5\,\text{m}$, then the force in member GH is closest to:

$$\text{Choices} = \begin{pmatrix} \text{"A"} & 54.57 \\ \text{"B"} & 57.67 \\ \text{"C"} & 60.75 \\ \text{"D"} & 63.82 \\ \text{"E"} & 66.89 \end{pmatrix} \text{kN}$$

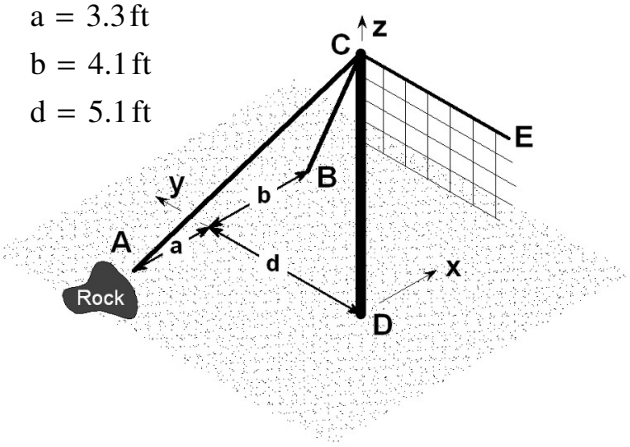


16. The Volleyball net shown is supported by two cables: AC and BC. The stakes for both cables are driven into the ground the same distance away from the pole in the y direction, but stake A could not be placed as far from the y-z plane as stake B because a rock was in the way. If the height of the pole (length CD) is $h = 8.1\,\text{ft}$, and there is $F = 52\,\text{lbf}$ of tension in the top strand of the net (CE) the tension in cable BC is closest to:

$a = 3.3\,\text{ft}$

$b = 4.1\,\text{ft}$

$d = 5.1\,\text{ft}$



$$\text{Choices} = \begin{pmatrix} \text{"A"} & 37.71 \\ \text{"B"} & 40.14 \\ \text{"C"} & 42.54 \\ \text{"D"} & 44.95 \\ \text{"E"} & 47.35 \end{pmatrix} \text{lbf}$$