ME 270 – Spring 2017 Exam 2 **NAME (Last, First):** ________________________________

Please review the following statement:

I certify that I have not given unauthorized aid nor have I received aid in the completion of this exam.

Signature: ______________________________________

Instructor's Name and Section: (Circle Your Section)

Sections: J Jones 9:30-10:20AM A Buganza 1:30-2:20PM B Li 3:30-4:20PM
J Jones Distance Learning

INSTRUCTIONS

Begin each problem in the space provided on the examination sheets. If additional space is required, use the white lined paper provided to you.

Work on one side of each sheet only, with only one problem on a sheet.

Each problem is worth 20 points.

Please remember that for you to obtain maximum credit for a problem, it must be clearly presented, i.e.

- The only authorized exam calculator is the TI-30IIS
- The allowable exam time for Exam 2 is 70 minutes.
- The coordinate system must be clearly identified.
- Where appropriate, free body diagrams must be drawn. These should be drawn separately from the given figures.
- Units must be clearly stated as part of the answer.
- You must carefully delineate vector and scalar quantities.

If the solution does not follow a logical thought process, it will be assumed in error.

When handing in the test, please make sure that all sheets are in the correct sequential order and make sure that your name is at the top of every page that you wish to have graded.

Problem 1 __________

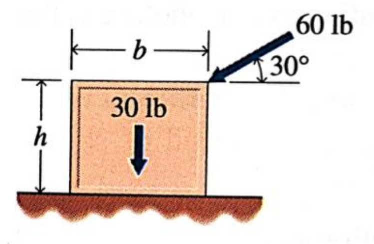
Problem 2 __________

Problem 3 __________

Total ______________

PROBLEM 1. (20 points) These questions are all or nothing

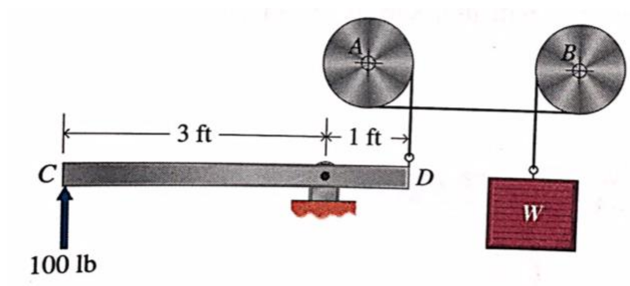
1A. Consider the figure on the right. What should the coefficient of friction μ be in order to prevent slipping? What is the maximum value of the ratio h/b in order to prevent tipping?



$\boldsymbol{\mu} >$ ____________________ (2 pts)

$\boldsymbol{h/b} >$ ____________________ (3 pts)

1B. Consider the figure on the right: A force of $100\ lbs$ is applied to keep the weight W in equilibrium. The coefficient of static friction between the stationary drums and the cable is $\mu = 0.2$. What is the tension T_D of the cable at D? What is the total angle β that the cable is wrapped around the drums (in radians)? What is the maximum weight W that can be hold?

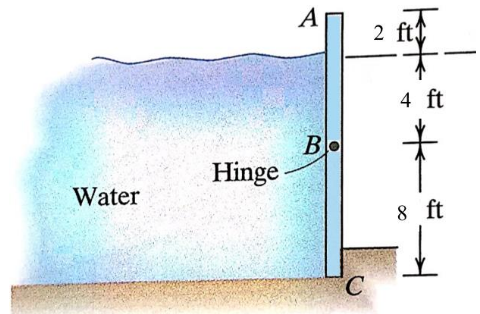


$\boldsymbol{T_D} =$ ______________ (1 pts)

$\boldsymbol{\beta} =$ ______________ (1 pts)

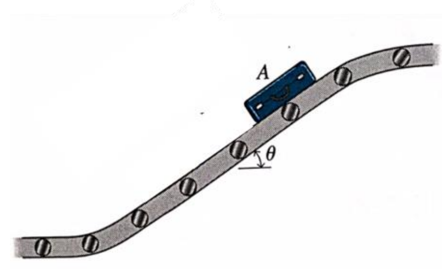
$\boldsymbol{W} =$ ______________ (3 pts)

1C. Consider the system shown in the figure in which a gate is supposed to pivot around point B when the water exceeds a certain level. The width of the gate (dimension outside of the page) is $20\ ft$. Determine the equivalent force F_{eq} exerted by the water on the gate. Determine the normal reaction force F_c at the contact point C. Use $\rho g = 62.5\ lb/ft^3$



$\boldsymbol{F_{eq}}$ = ____________	(2 pts)
$\boldsymbol{F_c}$ = ____________	(3 pts)

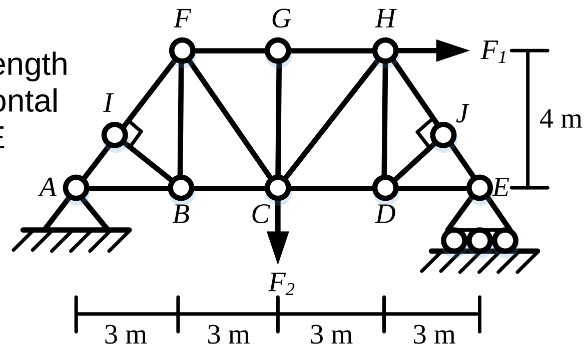
1D. A suitcase A of weight $W_A = 50\ lbs$ is being carried up the conveyor shown. The coefficient of friction between the suitcase and the conveyor is $\mu = 0.2$. Express the normal force N and the friction force f in terms of the angle θ. What is maximum angle θ_{max} in order to prevent slipping of the suitcase?



$\boldsymbol{N}$ = ________________, $\boldsymbol{f}$ = _______________	(3 pts)
$\boldsymbol{\theta_{max}}$ =_______________	(2 pts)

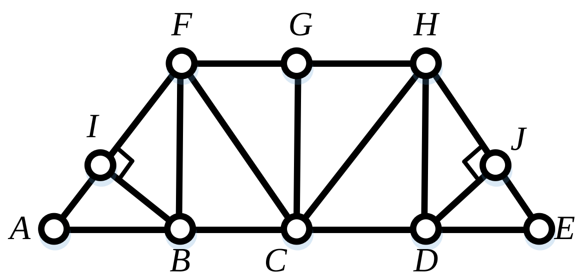
PROBLEM 2. (20 points)

GIVEN: The truss shown is 4 m tall and each panel has a length of 3 m. There is one vertical load $\mathbf{F_2 = 10\ kN}$ and one horizontal load $\mathbf{F_1 = 5\ kN}$. A pin support at A and a roller support at E hold the truss in static equilibrium.



FIND:

a) Complete the overall free body diagram of the system on the sketch provided below (2 pts).

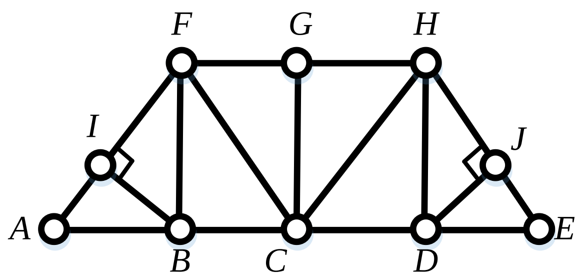


b) Solve for the reactions at joints A and E (4 pts).

$\overline{F_A} = $ ____________________ $\bar{\mathbf{i}} +$ ____________________ $\bar{\mathbf{j}}$ kN (2 pts)

$\overline{F_E} = $ ____________________ $\bar{\mathbf{i}} +$ ____________________ $\bar{\mathbf{j}}$ kN (2 pts)

a) Place a zero on all zero-force members in the diagram shown below (5 pts):



d) Using the method of sections, sketch an appropriate free-body diagram, determine the magnitudes of the forces in members CH and CD, and identify whether each member is in tension, zero, or compression (6 pts):

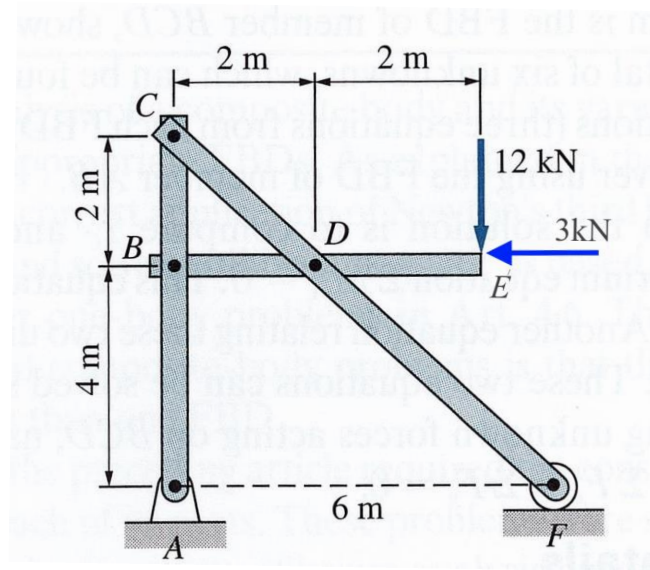
F_{CH} =_____________	Tension Zero Compression (circle one)	(3 pts)
F_{CD} =_____________	Tension Zero Compression (circle one)	(3 pts)

e) Using the method of joints, sketch an appropriate free-body diagram, determine the magnitude of the force in member JE, and identify whether this member is in tension, zero, or compression (3 pts):

F_{JE} =____________ Tension Zero Compression (circle one) (3 pts)

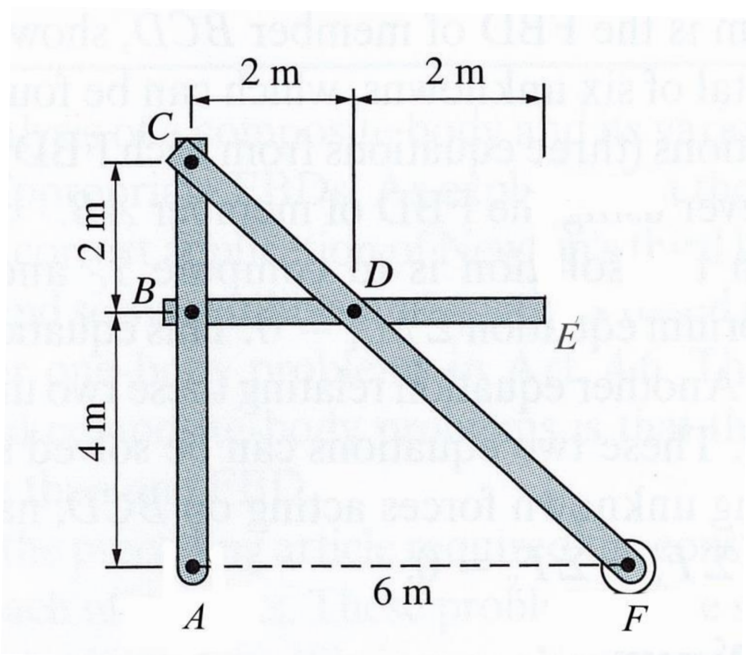
PROBLEM 3. (20 points)

GIVEN: Frame A-F is loaded with two forces as shown and held in static equilibrium by a pin support at A and a roller support at F.



FIND:

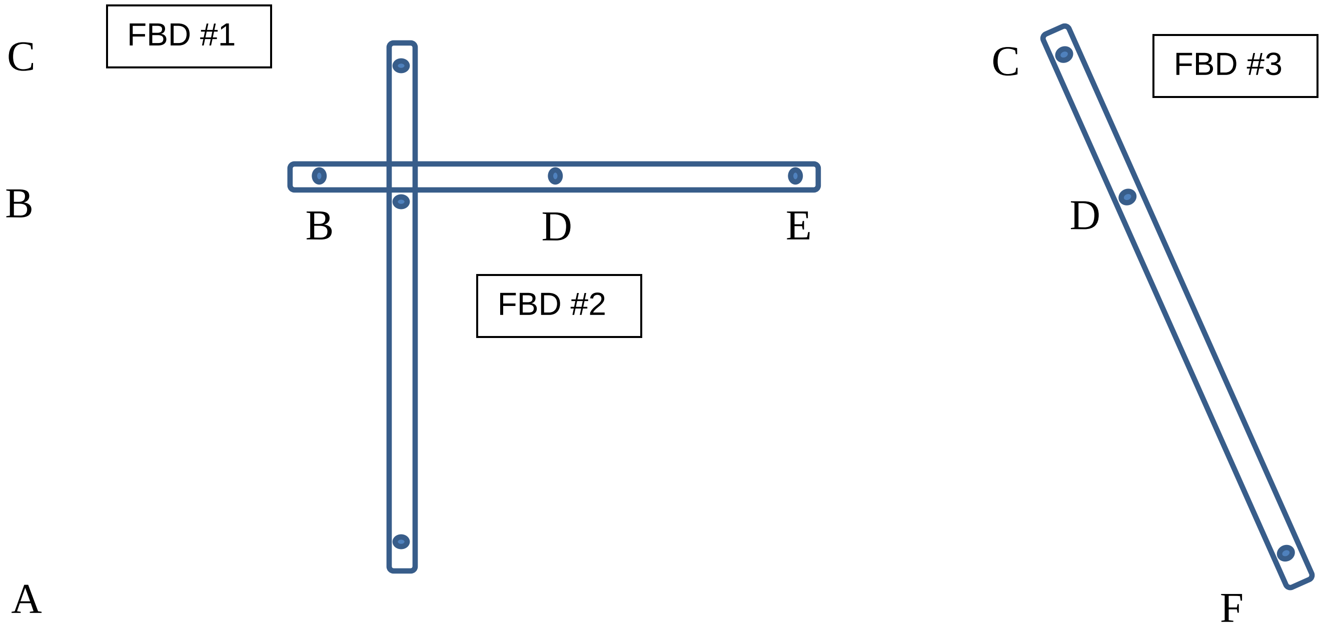
a) On the art work shown below, complete overall free body diagram. (2 pts)



b) Solve for the reactions at A and F and express the results in vector form. (6 pts)

$\bar{A} =$	(3 pts)
$\bar{F} =$	(3 pts)

c) On the art work provided below, complete the individual free body diagrams of members ABC, BDE, and CDF. (4 pts)



c) Solve for the forces at pins B and D on member BDE. Express the resultant forces in vector form. (8 pts)

$\bar{\boldsymbol{B}}_{on\ BDE} =$	(4 pts)

$\bar{D}_{on\ BDE} =$	(4 pts)

ME 270 Exam 1 Equations

Distributed Loads

$$F_{eq} = \int_0^L w(x)\,dx$$

$$\bar{x}F_{eq} = \int_0^L x\,w(x)\,dx$$

Centroids

$$\bar{x} = \frac{\int x_c dA}{\int dA}$$

$$\bar{y} = \frac{\int y_c dA}{\int dA}$$

$$\bar{x} = \frac{\sum_i x_{ci}A_i}{\sum_i A_i}$$

$$\bar{y} = \frac{\sum_i y_{ci}A_i}{\sum_i A_i}$$

In 3D, $\bar{x} = \dfrac{\sum_i x_{ci}V_i}{\sum_i V_i}$

Centers of Mass

$$\tilde{x} = \frac{\int x_{cm}\rho dA}{\int \rho dA}$$

$$\tilde{y} = \frac{\int y_{cm}\rho dA}{\int \rho dA}$$

$$\tilde{x} = \frac{\sum_i x_{cmi}\rho_i A_i}{\sum_i \rho_i A_i}$$

$$\tilde{y} = \frac{\sum_i y_{cmi}\rho_i A_i}{\sum_i \rho_i A_i}$$

Buoyancy

$$F_B = \rho g V$$

Fluid Statics

$$p = \rho g h$$

$$F_{eq} = p_{avg}(Lw)$$

1A. $\mu > 0.866$ $h/b > 0.866$

1B. $T_D = 300lbs$ $\beta = 3\pi$ $W = 1975.8\ lbs$

1C. $F_{eq} = 90{,}000\ lbs$ $F_C = 45{,}000\ lbs$

1D. $N = W cos\theta$ $f = W sin\theta$ $\theta_{max} = 0.19rad = 11.31°$

2A. Free body diagram

2B. $\bar{F}_A = -5\bar{\imath} + 3.33\,\bar{\jmath}\ kN$ $\bar{F}_E = 0\bar{\imath} + 6.67\,\bar{\jmath}\ kN$

2C. Diagram

2D. $F_{CH} = 8.34\ kN$ $Tension$ $F_{CD} = 4.99\ kN$ $Tension$

2E. $F_{JE} = 8.34\ kN$ $Compression$

3A. Free body diagram

3B. $\bar{A} = 3\,\bar{\imath} + 6\,\bar{\jmath}\ kN$ $\bar{F} = 6\,\bar{\jmath}\ kN$

3C. Free body diagram

3D. $\bar{B}_{on\ BDE} = 9\,\bar{\imath} - 12\,\bar{\jmath}\ kN$ $\bar{D}_{on\ BDE} = -6\,\bar{\imath} + 24\,\bar{\jmath}\ kN$