ME 270 – Fall 2017 Exam 2 **NAME (Last, First): _____**

Please indicate your group number _____ (If applicable)

Circle Your Instructor's Name and Section:

MWF 8:30-9:20 AM	Prof. Kai Ming Li	MWF 2:30-3:20 PM	Prof. Fabio Semperlotti
MWF 9:30-10:20 AM	Prof. Jim Jones	MWF 4:30-5:30 PM	Prof. Vahid Zeinoddini Meimand
MWF 11:30-12:20 PM	Prof. Daniel Hoyniak	TTH 9:00-10:15 AM	Prof. Morgan Murphy
MWF 12:30-1:20 PM	Prof. Adrian Buganza Tepole	Distance Learning	Prof. Jim Jones

Please review and sign the following statement:

Purdue Honor Pledge – "As a Boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together – We are Purdue."

Signature: _____

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-30XIIS or the TI-30Xa.
- 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.
- Please use a **black pen** for the exam.

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.

Equations:

Buoyancy

$$F_B = \rho g V$$

Belt Friction

$$\frac{T_L}{T_s} = e^{\mu\beta}$$

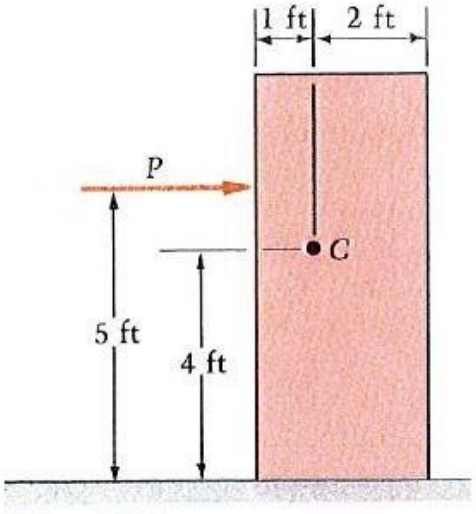
Fluid Statics

$$p = \rho g h$$

$$F_{eq} = p_{avg}\left(Lw\right)$$

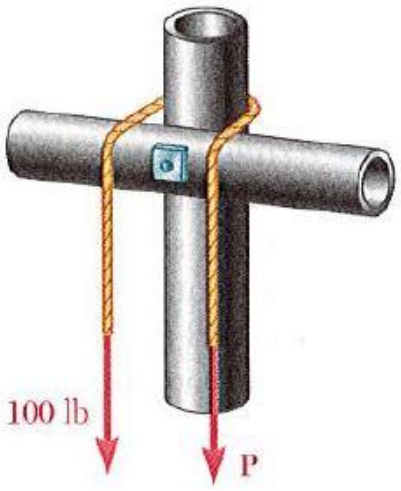
PROBLEM 1 (20 points)

1A. An electronics cabinet is 7 ft tall, weights 200 lbs and has a center of mass at C. The coefficient of friction between the cabinet and floor is μ_s=0.3. What is the force required to tip (P_{Tip}) and slide (P_{Slip}) the cabinet and which occurs first? (5 pts).



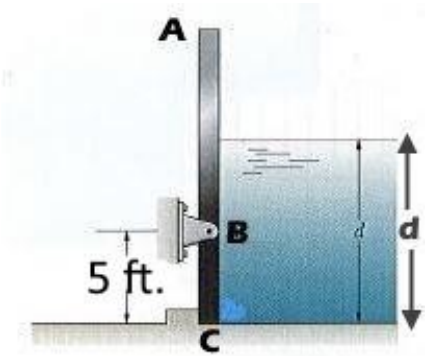
$(P_{Tip}) =$ _____	(2 pts)
$(P_{Slip}) =$ _____	(2 pts)
Impending Motion: Tip Slip Both (Circle One)	(1 pt)

1B. A 100 lb load is to be raised using a rope and two pipes using the configuration shown. Assuming the coefficient of friction between the rope and both pipes is μ_s=0.25, determine the total angle of wrap around the pipes (β) and the minimum load (P_{min}) required to hold the 100 lb weight in equilibrium. (5 pts)



$\beta =$	(3 pts)
$P_{min} =$	(2 pts)

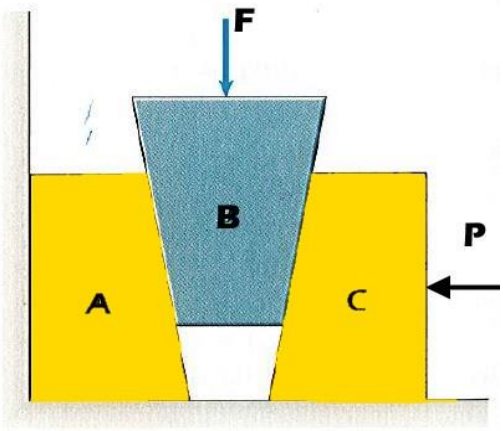
1C. Gate ABC is designed to rotate and release the water when the depth d exceeds a certain valve. Circle the correct expression for the equivalent force as a function of depth d. Assume ρg=62.4 lbs/ft^3, and w=10 ft (w=width of gate into the page). Gate ABC will just begin to open when the equivalent force (F_{eq}) is positioned at pin B. At what water depth d will this occur? (5 pts)

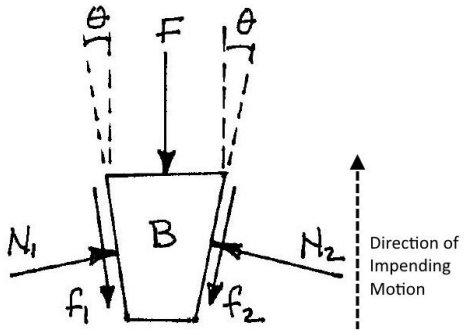


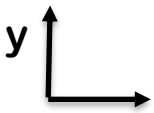
$F_{eq} =$ 312d 31.2d 312d^2 624d^2 None of These (Circle One) (3 pts)

$d =$ (2 pts)

1D. Blocks A and C are being squeezed together by force P. Wedge B is being used to separate the blocks. Given the free body diagram for Wedge B shown, circle the correct equilibrium equation. If force F for the case shown was determined to be negative (F<0), what can be stated about whether the wedge is self-locking? Neglect the weight of the wedge. (5 pts)







Circle One (3 pts)

a) $\sum F_y = 0 = N_1 \cos\theta - f_1 \sin\theta + N_2 \cos\theta - f_2 \sin\theta - F$

b) $\sum F_y = 0 = N_1 \sin\theta - f_1 \cos\theta + N_2 \sin\theta - f_2 \cos\theta + F$

c) $\sum F_y = 0 = -N_1 \sin\theta - f_1 \cos\theta - N_2 \sin\theta - f_2 \cos\theta - F$ 3 pts

d) $\sum F_y = 0 = N_1 \sin\theta - f_1 \cos\theta + N_2 \sin\theta - f_2 \cos\theta - F$

e) None of the Above

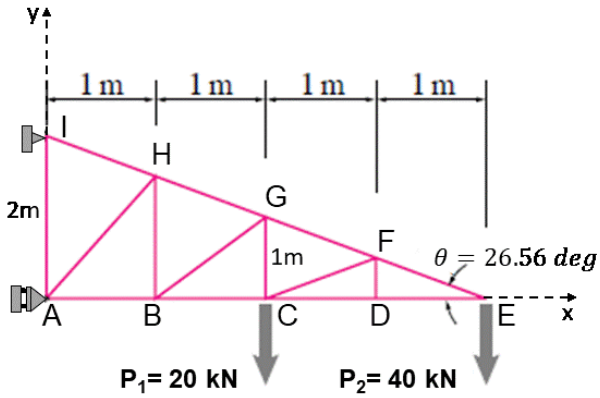
Circle One Self-Locking Not Self-Locking Cannot Tell (2 pts)

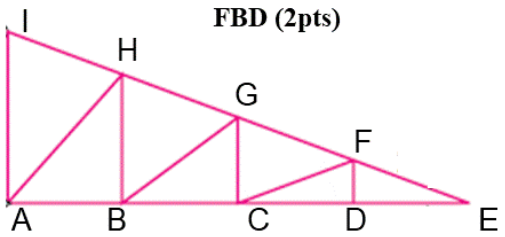
PROBLEM 2 (20 points)

2A. Consider the truss structure in figure that has pin support at I and a roller support at joint A.

Note: round your calculations to three decimal places.

a. Complete the free body diagram on the artwork provided below and find the reaction forces at point A and I. Express the reactions in vector form and specify the units.





$\bar{A} = ($ $)\hat{\imath}$	(3 pts)
$\bar{I} = ($ $)\hat{\imath} + ($ $)\hat{\jmath}$	

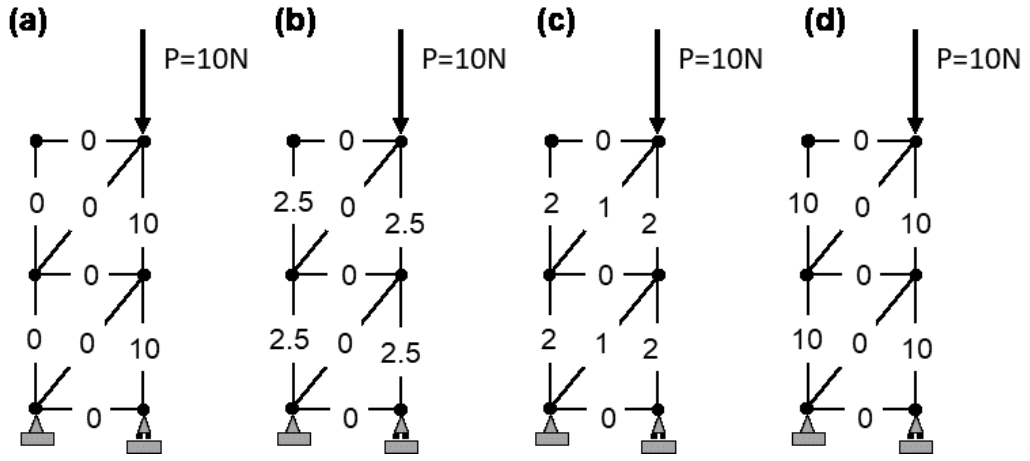
b. Use the method of joints to solve for the loads in the links DE and EF. Clearly state if the links are in tension, compression, or zero. Include a free-body diagram of the joint used. Specify the units.

$F_{DE=}$	Tension	Compression	Zero	(circle one)	(3 pts)
$F_{EF=}$	Tension	Compression	Zero	(circle one)	(3 pts)

c. Use the method of sections to find the loads in the links HG and BG. Clearly state if the links are in tension, compression, or zero. Include a free-body diagram of the section used. Specify the units.

$F_{HG=}$	Tension	Compression	Zero	(circle one)	(3 pts)
$F_{BG=}$	Tension	Compression	Zero	(circle one)	(3 pts)

2B. Identify which one of the following conditions describe the loads in the truss structure. No work needs to be shown.



Circle one

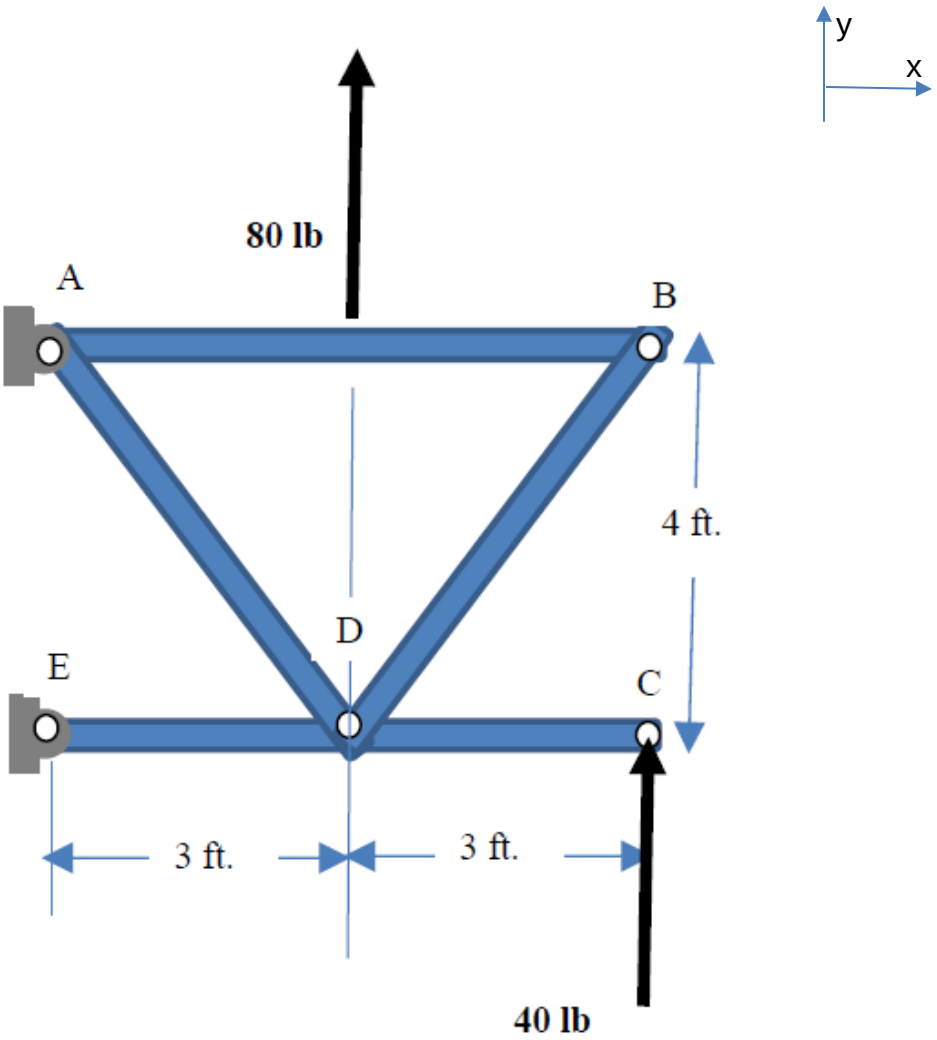
(a) **(b)** **(c)** **(d)** **none of the above** (3 pts)

PROBLEM 3 (20 points)

The machine is loaded as shown and includes members AB, AD, BD, and CDE connected by pin-joints. Assume the weight of each member is negligible.

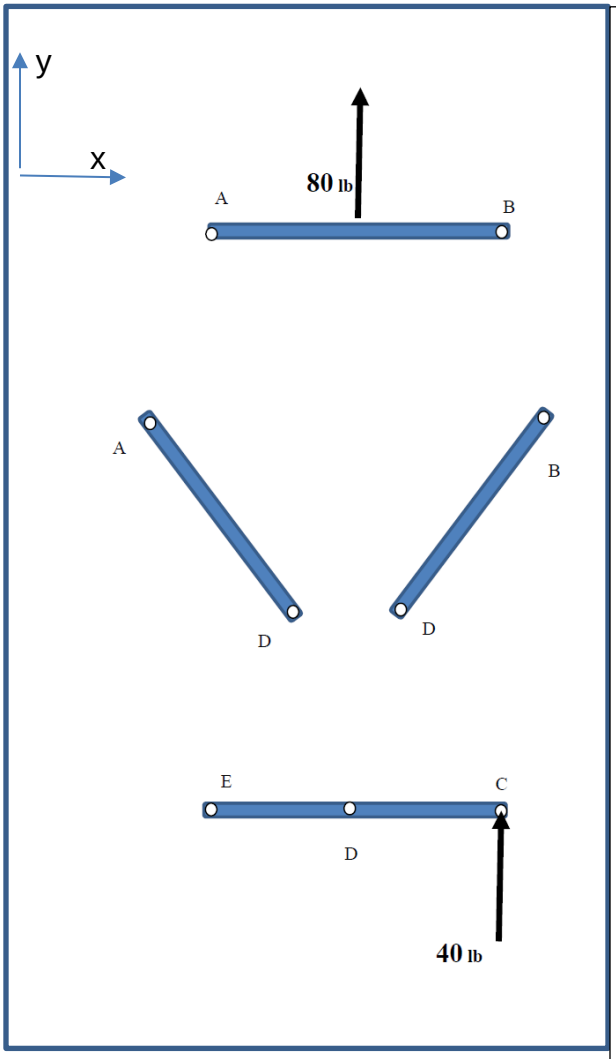
Please do your work on the next page:

a. Circle the two-force member(s) in the box provided on the next page (4 points).
b. Using the figure provided draw (on the next page) the free-body diagram for each member. **Two-force members MUST be drawn as two-force members with a single force in the appropriate direction** (6 points)
c. Determine the load carried by members AD and BD and indicate if the members are in tension or compression. Place your answer in the box provided on the next sheet (6 points)
d. Determine the reactions at E. Place your answer in the box on the next sheet (4 points)



a. Circle two-force members:	AB	AD	BD	CDE	(4 pts)

b. Complete the free-body diagram for each member separately. (6 pts)



Complete work for parts c and d in this area please.

c. Load Carried by AD _____ lb. _____ Tension or Compression. (6 pts)

Load Carried by BD _____ lb. _____ Tension or Compression.

d. Reaction at E _____ $\hat{\imath}$ + _____ $\hat{\jmath}$ lb. (4 pts)

1A. $(P_{Tip}) = 80\ lbs.$ $(P_{Slip}) = 60\ lbs.$ **Impending Motion: Slip**

1B. $\beta = 360° = 2\pi\ rad = 6.28\ rad.$ $(P_{min}) = 20.8\ lbs.$

1C. $F_{eq} = 312d^2$ $d = 15\ ft.$

1D. **d) Self-Locking**

2A. $A = (100)\hat{\imath} + (0)\hat{\jmath}\ kN$ $I = (-100)\hat{\imath} + (60)\hat{\jmath}\ kN$

2B. $DE = -80.017\ kN$ **Compression**

$EF = 89.46\ kN$ **Tension**

2C. $HG = 104.365\ kN$ **Tension**

$BG = -18.871\ kN$ **Compression**

2D. **(a)**

3A. **Two force members: AD BD**

3B. **Free body diagram**

3C. **Load Carried by AD 150 lb Compression**

Load Carried by BD 50 lb Tension

3D. **Reaction at E** $-120\hat{\imath} + 40\hat{\jmath}\ lb$