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 K Zhao 1:30-2:20PM F Semperlotti 4:30-5:20PM

J Jones Distance Learning

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. Also, please make note of the following instructions.

- The only authorized exam calculators are the TI-30XIIS or the TI-30Xa.
- The allowable exam time for Exam 1 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.
- Do not write on the back side of your exam paper.

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.

Fluid Statics

$$\mathrm{P} = \rho \mathrm{gh}$$

$$\mathrm{F_{eq}} = \mathrm{P_{avg}}(\mathrm{Lw})$$

Belt Friction

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

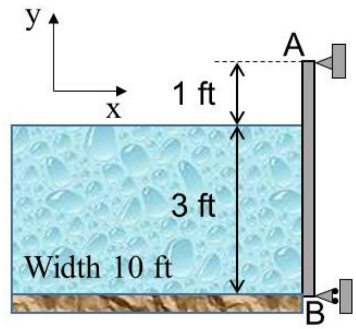
Buoyancy

$$\mathrm{F_B} = \rho \mathrm{gV}$$

PROBLEM 1 - (20 points) – The grading of all the parts of problem 1 is <u>all or nothing</u>. Solution procedure must be shown, showing only the final value will not get points.

1A. Consider the rectangular gate AB shown in figure. The gate is hinged at A and supported at B. The gate contains fresh water ($\rho g = 62.4 lbs/ft^3$) and has a width of 10 ft (into the page). Neglect the weight of the gate. **Find:**

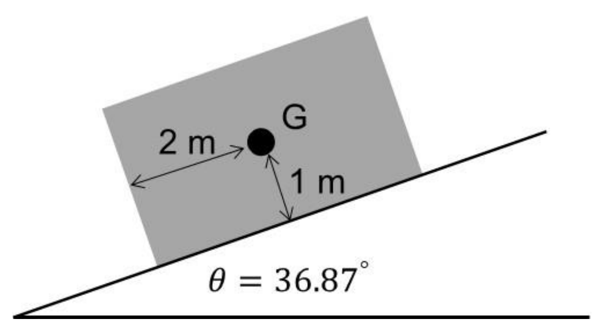
- The magnitude of the equivalent force F_{eq} produced by the fluid on the gate.
- The reaction force at B. Express it in vector form.



$F_{eq} =$	(2 pts)
$R_B = (\qquad)\hat{\imath} + (\qquad)\hat{\jmath}$	(3 pts)

1B. A rectangular box is placed on a non-smooth inclined plane. When the incline has an angle $\theta = 36.87^{\circ}$ the box starts slipping. **Determine**:

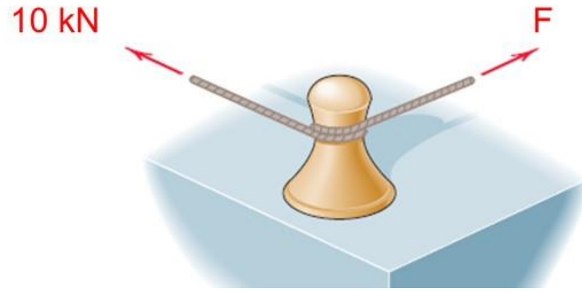
- The normal reaction force N between the box and the incline as a function of the weight W and angle θ.
- The friction force as a function of the weight W and the angle θ.
- The coefficient of static friction μ_s between the box and the incline.



$N =$	(1pts)	$f =$	(1 pts)
$\mu_s =$			(3 pts)

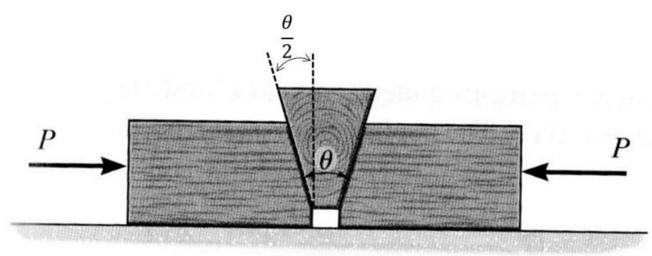
1C. A ship is anchored to a mooring bit using a rope. The rope can only sustain a tension equal to 10 kN. Knowing that the coefficient of static friction is 0.4, **find:**

- The angle of wrap β expressed in radians.
- The maximum force F that the boat can apply before starting drifting away from the dock.



$\beta =$	(2 pts)
$F\ =$	(3 pts)

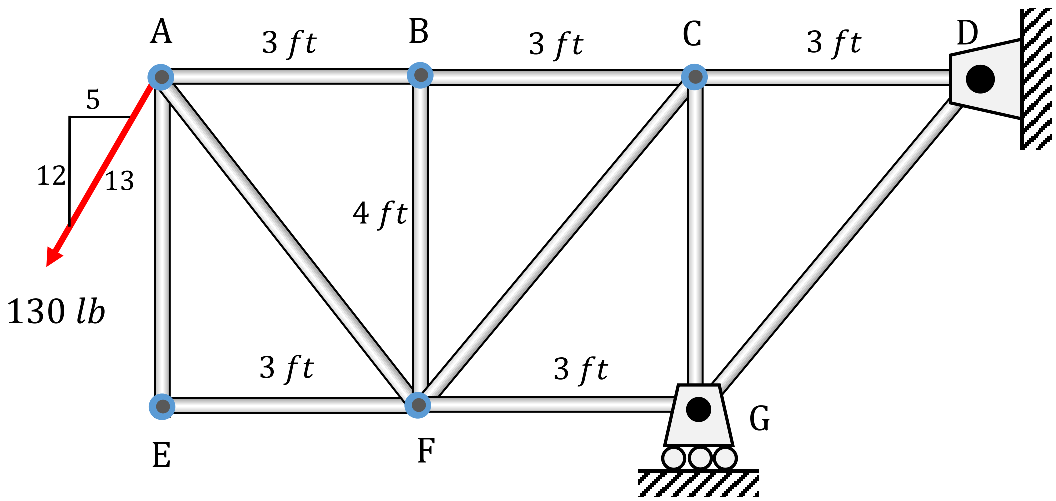
1D. Determine the maximum value of the wedge angle (θmax) for which the wedge will remain self-locking regardless of the magnitude of the force P. The coefficient of static friction between the wedge and the blocks is $\mu_s = 0.3$. Neglect the weight of the wedge and the friction between the blocks and the ground. If the wood happened to be wet causing μ_s to be lower than 0.3, how would this qualitatively change the maximum wedge angle (θmax) to maintain the self-locking condition?



$\theta_{max}\ =$		(degrees)			(3 pts)
$\theta_{max}\ =$	Increase	Remain the same	Decrease	(circle one)	(2 pts)

Problem 2 (20 points)

The truss ABCDEFG is loaded with a single force 130 *lb* at joint A and is in static equilibrium. The truss is supported by a pin at D and a roller at G.



a) Identify the number of zero-force members. No work needs to be shown. **No partial credit**.

1	2	3	4	(circle one)	(4 pts)

b) Use the **method of sections** to find the loads in the members CF and FG. Clearly state if the truss members are in tension, compression, or zero force. Include a free-body diagram and specify the units.

F_{CF}=	Tension	Compression	Zero	(circle one)	(4 pts)
F_{FG}=	Tension	Compression	Zero	(circle one)	(4 pts)

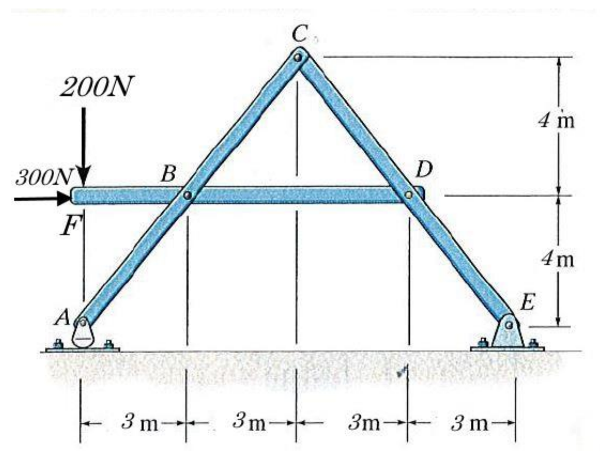
c) Use the **method of joints** to find the loads in the members AB and AF. Clearly state if the truss members are in tension, compression, or zero force. Include a free-body diagram and specify the units.

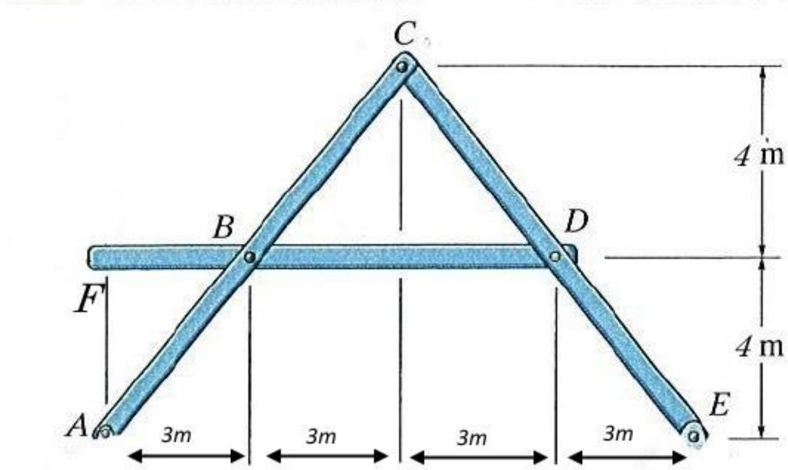
F_{AB}=	Tension	Compression	Zero	(circle one)	(4 pts)
F_{AF}=	Tension	Compression	Zero	(circle one)	(4 pts)

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 E and a rocker support at A.

FIND:
a) Complete the overall free-body diagram on the artwork provided. (2 pts)



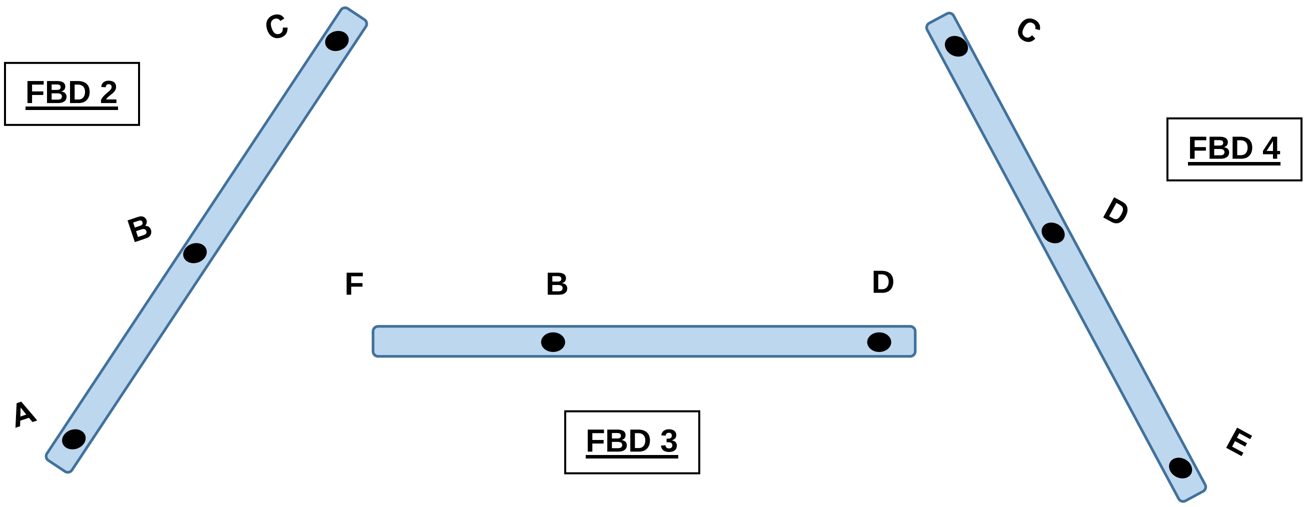


FBD 1

b) Determine the reactions at supports A and E. Express these reactions in vector form. (5 pts)

$\bar{A} =$	(2 pts)
$\bar{E} =$	(3 pts)

c) On the artwork provided, complete the free body diagram for each individual member. (4 pts)



d) Determine the forces on member ABC at joints B and C. Express these forces in vector form. Remember to reference the free-body diagrams used in your calculations. (8 pts)

$\bar{\mathbf{B}}$ **on ABC =**	(4 pts)
$\bar{\mathbf{C}}$ **on ABC =**	(4 pts)

e) How does the force at joint C on member ABC differ from that on member CDE? Circle one.

No Difference	***Same Magnitude, Opposite Direction***	***Neither***	(1 pt)

1A. $F_{eq} = 2808\ lbs$ $R_B = (-2106)\hat{\imath} + (0)\hat{\jmath}$
1B. $N = W\cos\theta$ $f = W\ \sin\theta$ $\mu_s = 0.75$
1C. $\beta = 7.85 rad$ $F = 231.407\ kN$
1D. $\theta_{max} = 33.4$ **degrees** **Decrease**

2A. **3**
2B. $F_{CF} = 150\ lb$ **Tension**
$F_{FG} = -180\ lb$ **Compression**
2C. $F_{AB} = 140\ lb$ **Tension**
$F_{AF} = -150\ lb$ **Compression**

3A. **Free Body Diagram**
3B. $\overline{A} = +100\bar{\jmath}\ N$ $\overline{E} = -300\ \bar{\imath} + 100\ \bar{\jmath}\ N$
3C. **Free Body Diagrams**
3D. $\overline{B}_{on\ ABC} = -75\ \bar{\imath} - 300\ \bar{\jmath}\ N$ $C_{on\ ABC} = 75\ \bar{\imath} + 200\ \bar{\jmath}\ N$
3E. **Same Magnitude, Opposite Direction**