ME 270 – Spring 2016 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. If I detect cheating I will write a note on my exam and raise my hand as if asking a question.

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-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.

Instructor's Name and Section:

Sections: J Jones 9:30-10:20AM J Gibert 1:30-2:20PM I Bilionis 3:30-4:20PM
J Jones Distance Learning

Problem 1 _____

Problem 2 _____

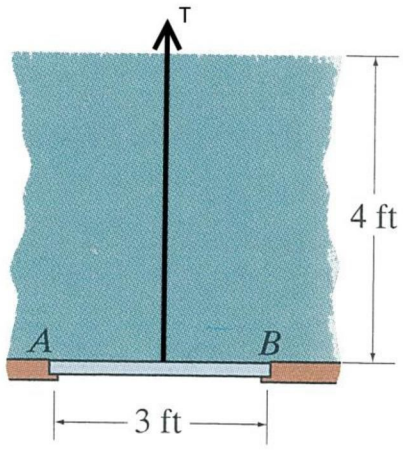
Problem 3 _____

Total _____

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

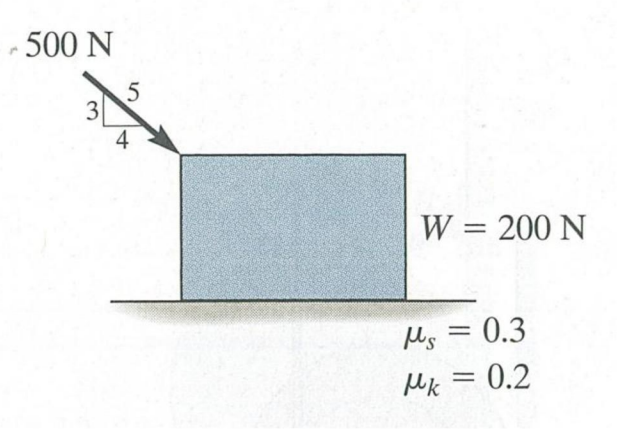
Please show all work.

1A. A square stopper AB with 3 ft sides is to be removed using a cable as shown. Determine the pressure (p) acting on stopper AB and the tension (T) required to pull up the stopper in order to drain the container. Assume $\rho g = 62.5 lb/ft^3$ and the weight of the stopper is negligible.



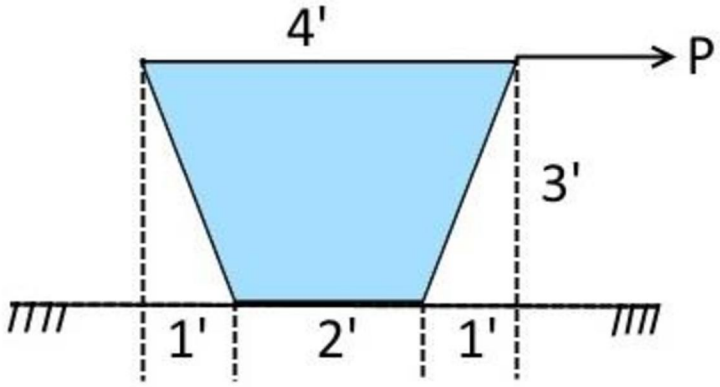
p =	(2 pts)
T =	(3 pts)

1B. Determine the normal force exerted on the block. Circle the correct magnitude and direction of the friction force at the surface of contact.



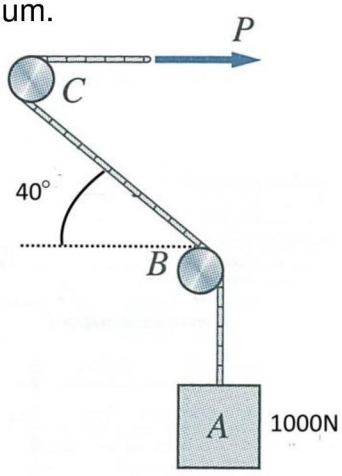
N =						(2 pts)
f =	40N,	60N,	100N,	150N,	400N (Circle One)	(2 pts)
Direction =	→		←		(Circle One)	(1 pt)

1C. A 1200 lb trapizodal crate with a uniform distribution is to be moved by force P. Determine the force P_T needed to tip the crate and the force P_S needed to slide the crate. Which motion would happen first? Assume the coefficient of friction between the crate and ground is $\mu_s = 0.5$.



P_T =		(2 pts)	P_S =	(2 pts)
Slip	or	Tip	(Circle One)	(1pt)

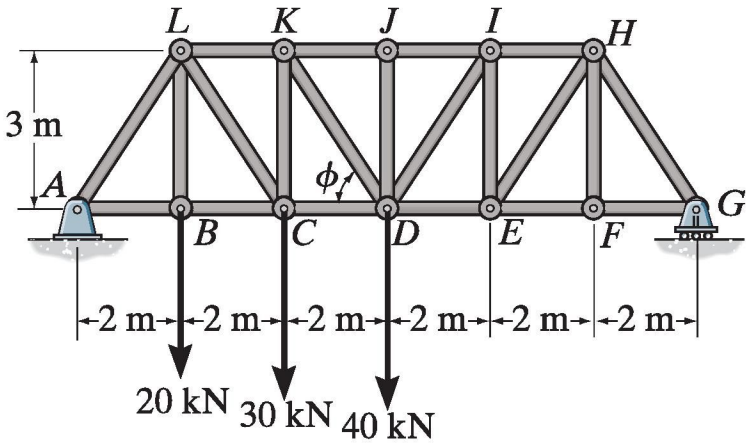
1D. A 1000N block A is suspended from a rope that runs around the fixed pegs B and C. The coefficient of friction between the pegs and the rope is μ_s = 0.25. Determine the total angle of wrap for both pegs and the minimum force P needed to hold the block in static equalibrium.



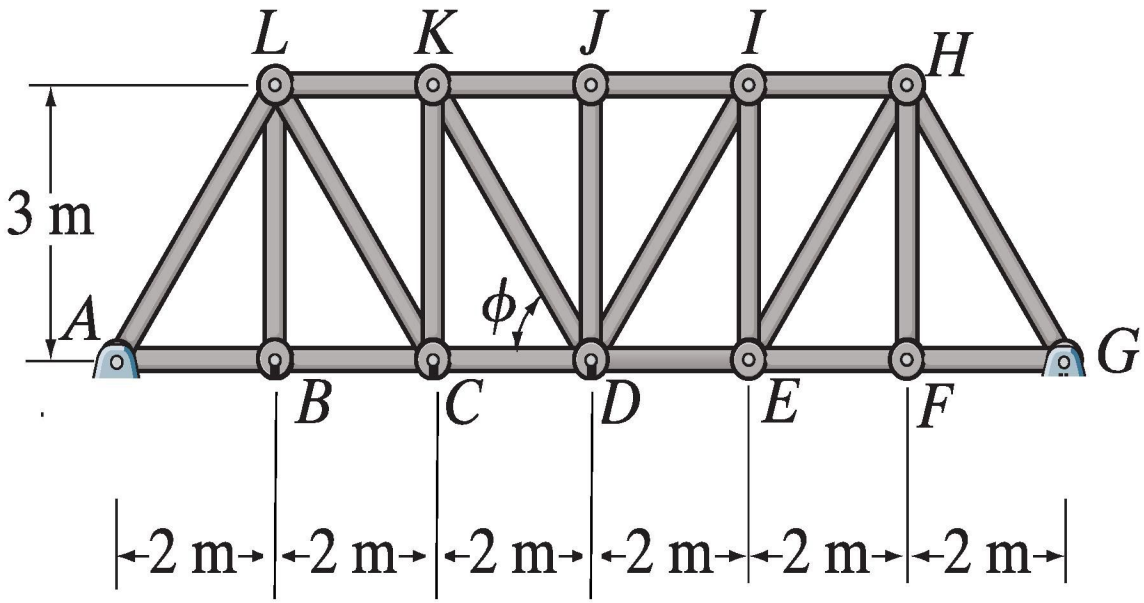
β_{Tot} =	(3 pts)
P_{Min} =	(2 pts)

PROBLEM 2. (20 points)

GIVEN: Truss A-L is loaded as shown on the left and is held in static equilibrium by a pin support at joint A and a roller support at joint G. You may assume the weights of the individual members of the truss are negligibly small.



FIND: a) On the sketch provided below, complete the free-body diagram of the overall truss. (3 pts):



b) Determine the scalar reactions at supports A and G. (3 pts)

$A_x =$ (1 pt)

$A_y =$ (1 pt)

$G_y =$ (1 pt)

c) List all the zero-force members in the truss. There is no need to show any work. (2 pts)

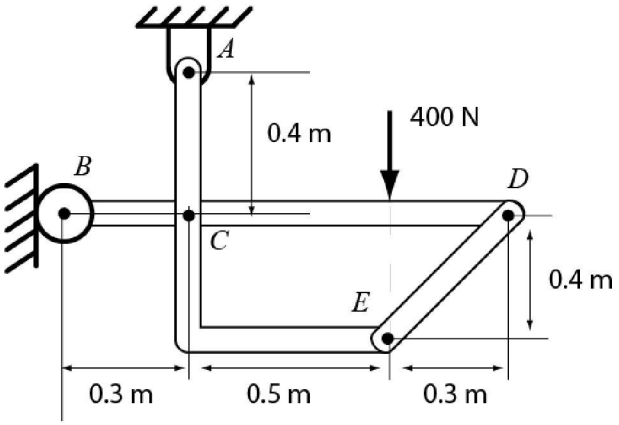
Zero-Force Members = _____ (2 pts)

d) Determine the loads in members CD, DK, IJ. Also, indicate whether each member is in tension, compression, or a zero-force member. Make sure you show all of your work and include any free body diagrams required. (12 pt)

$F_{CD} =$	(Tension, Compression, Zero) Circle One
$F_{DK} =$	(Tension, Compression, Zero) Circle One
$F_{IJ} =$	(Tension, Compression, Zero) Circle One

PROBLEM 3. (20 points)

GIVEN: The frame ABCDE is made out of simple weightless members ACE, BCD, and DE, which are joined with pins at C, D, and E. The frame is held in static equilibrium by a pin support at joint A and a roller support at B. A point load of 400N is applied to BCD.

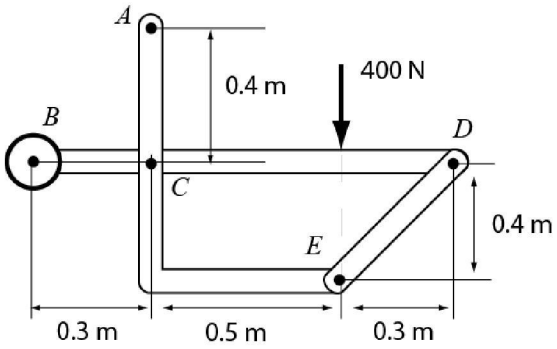


FIND:

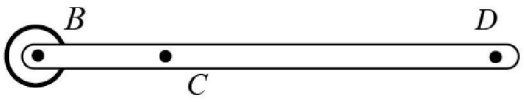
a) List all two force members of the frame. There is no need to show any work (2 pts.).

Two-Force Members = _____ (2 pts.)

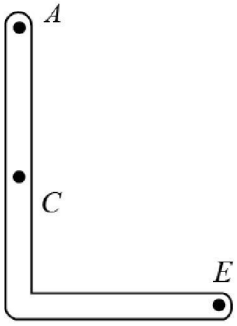
b) Draw the free body diagram of the overall frame and of each individual member. (8 pts.)



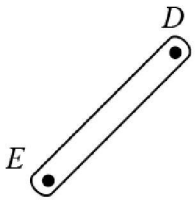
FBD 1



FBD 2



FBD 3



FBD 4

c) Determine the support reactions at A and B. Express each of the forces in vector form. (4 pts.)

$\overline{A}$ = (2pts)

$\overline{B}$ = (2pts)

d) Determine the forces at joints C and D acting on member BCD. Express each of the forces in vector form. (6 pts.)

$(\overline{C})_{onBCD}$ = (3pts)

$(\overline{D})_{onBCD}$ = (3pts)

Exam 2 – Equation Sheet

Buoyancy

$$F_B = \rho g V$$

Fluid Statics

$$P = \rho g h$$

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

Belt Friction

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

Final Answers

1A) $p = 250$ lbs/ft^2 $T = 2250$ lbs

1B) $N = 500$N $f = 100$N Direction = left

1C) $P_T = 400$ lbs $P_S = 600$ lbs Impending Motion = Tip

1D) $\beta_{Tot} = 190$ degrees $= 19/18\ \pi = 1.06\ \pi = 3.33$ radians Pmin = 436lbs.

2A) FBD 2B) $A_x = 0$ kN $A_y = 56.67$ kN $G_y = 33.33$ kN

2C) Zero-Force Members = FH, DJ

2D) $F_{CD} = 62.23$ kN T $F_{DK} = 8.02$ kN T $D_{IJ} = 66.68$ kN C

3A) Two-Force Members = DE 3B) FBDs

3C) $\bar{A} = -500\bar{\imath} + 400\bar{\jmath}\ N$ $\bar{B} = 500\bar{\imath}\ N$

3D) $\bar{C}_{on\ BCD} = -687.5\bar{\imath} + 150\bar{\jmath}\ N$ $\bar{D}_{on\ BCD} = 187.5\bar{\imath} + 250\bar{\jmath}\ N$