ME 270 – Fall 2014 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: _____

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 1 is 65 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 Hylton 8:30-9:20AM	J Jones 9:30-10:20AM	E Nauman 11:30AM-12:20PM
	J Seipel 12:30-1:20PM	I Bilionis 2:30-3:20PM	M Murphy 9:00-10:15AM
	Z Shen 4:30-5:20PM	J Jones Distance Learning	

Problem 1 _____

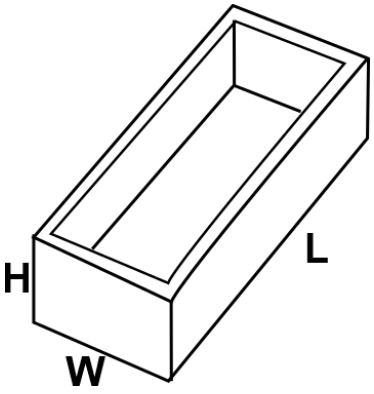
Problem 2 _____

Problem 3 _____

Total _____

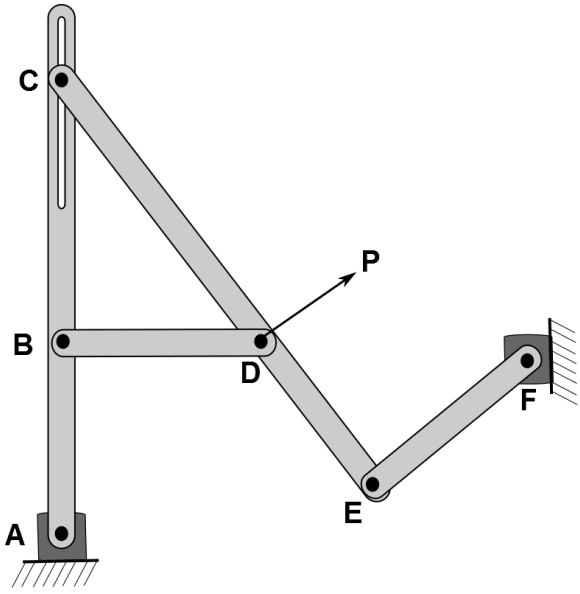
PROBLEM 1 (20 points) – Prob. 1 questions are all or nothing.

1A. A concrete canoe may be approximated as a rectangular prism with length 6 feet, width 3 feet and height 2 feet. Without a passenger, the canoe weighs 2000 lbs. What is the maximum weight of a passenger before the canoe sinks? The specific weight of water (ρg) is 62.4 lbs/ft^3. (4 points)



Passenger Weight = _____ lbs

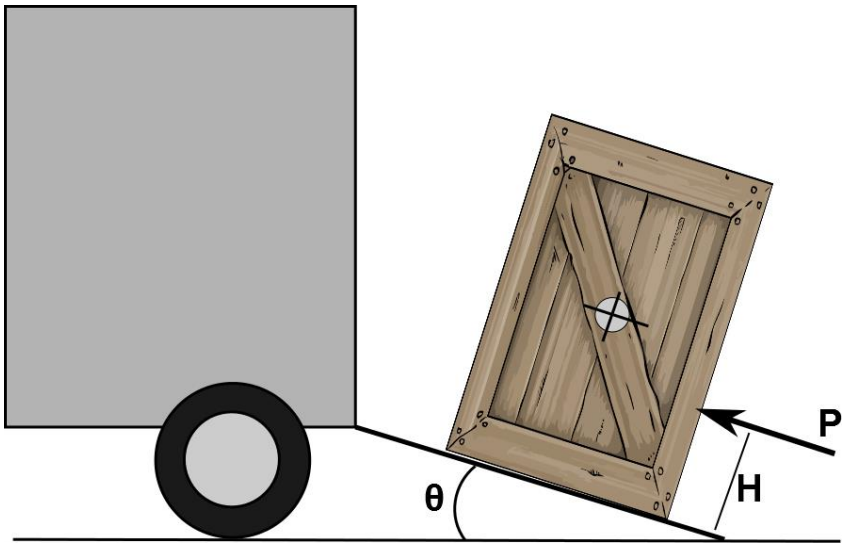
1B. Answer the following questions about the machine is shown below. The machine is pinned to the ground at points A and F. Neglect the mass of the links. (4 points)



Draw the FBD for link ABC

List all two force members, using AB notation: _____

1C. A crate is being unloaded off a truck using a ramp. A worker is pushing on the crate with force P at height H. The ramp is sloped at angle θ. With the current configuration, the crate is about to tip down the ramp. (3 points)



For the following questions, circle all that apply. Assume that all variables remain constant unless otherwise stated by the question.

i. How could the angle of the ramp, θ, be varied to prevent tipping?

Increase θ Decrease θ Changing θ has no effect

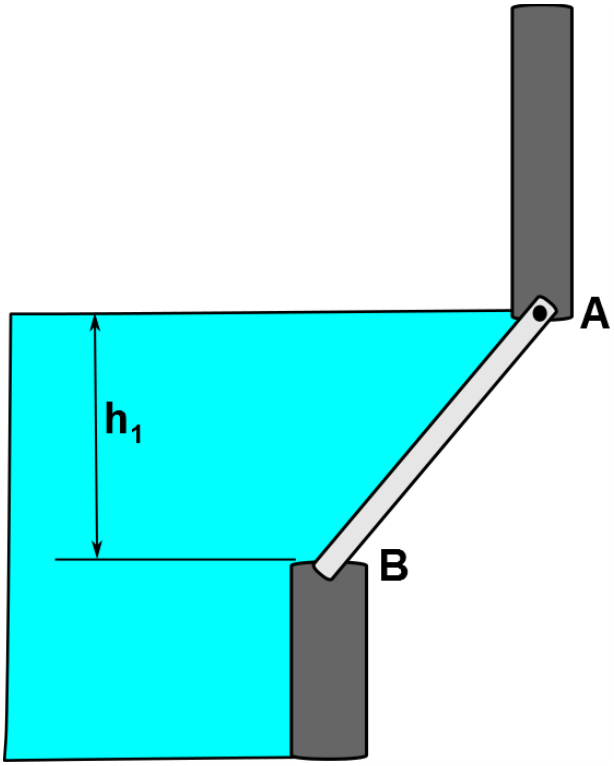
ii. How could the force position, H, be varied to prevent tipping?

Increase H Decrease H Changing H has no effect

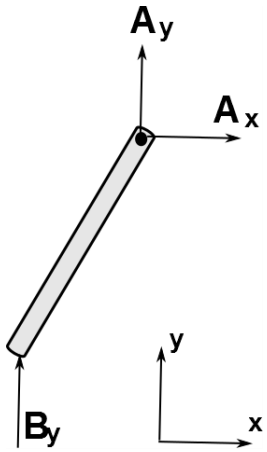
iii. Ignoring the possibility of slipping, how could the coefficient of friction, μ, be varied to prevent tipping?

Increase μ Decrease μ Changing μ has no effect

1D. A flood gate is shown below. The gate is pinned at A. The water is 4 meters deep at point B (h_1). The gate is 5 meters long and extends 1 meter into the page. Answer the following questions about the flood gate. (9 points)



On the FBD provided, draw the force distribution of the water acting on the gate.



Calculate the hydrostatic pressue of the water at point B. The density of water is 1000 kg/m^3.

Pressure at B = _____ N/m^2

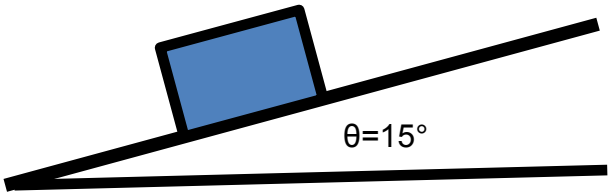
Calcluate the equivalent force of the water acting on the gate. Define the position of the equivalent force as the distance along the gate from point A.

Equivalent force magnitude = _____ N

Distance from point A = _____ m

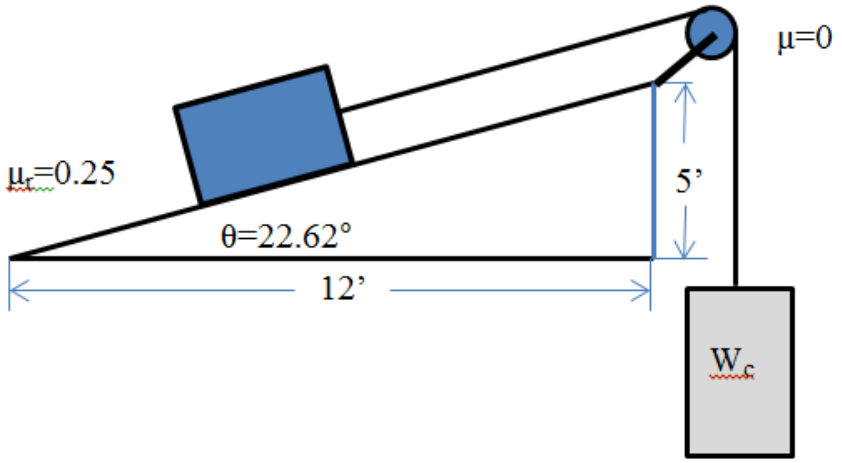
PROBLEM 2 (20 points)

2A. A 100-lb box is placed on a ramp and is at the point of pending sliding down the ramp when θ=15°. Please determine the coefficient of friction, μ, between the block and the ramp. Please place your answer in the box provided (4 points)



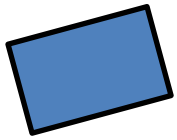
μ = _____

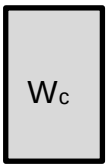
2B. A 91-lb box is held in place by a counter weight, W_c. The friction between the block and the ramp, μ_r = 0.25. The angle of the ramp is 22.62°. Use the figures provided for your free-body diagrams and show your axes.(12 points)

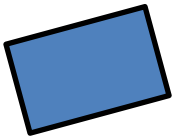


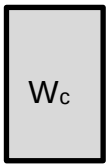
If there is NO friction at the pulley, draw a free-body diagram and determine the minimum weight, W_c, that will prevent the 91-lb box from **sliding down** the ramp.

If there is NO friction at the pulley, draw a free-body diagram and determine the maximum weight, W_c, that will prevent the 91-lb box from **sliding up** the ramp.





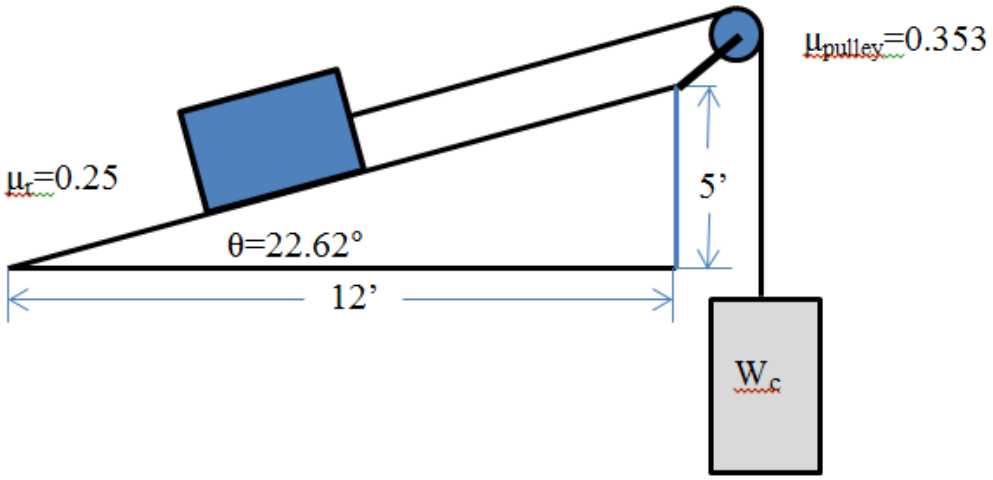




Minimum W_c to prevent the 91-lb box from sliding **down** the ramp_____lb.

Maximum W_c to prevent the 91-lb box from sliding **up** the ramp_____lb.

2C. Now assume the pulley friction applied and $\mu_{pulley}=0.353$.



If the friction is applied at the pulley, what will be the minimum weight, W_c, to prevent the 91-lb box from sliding **down** the ramp (2 points)

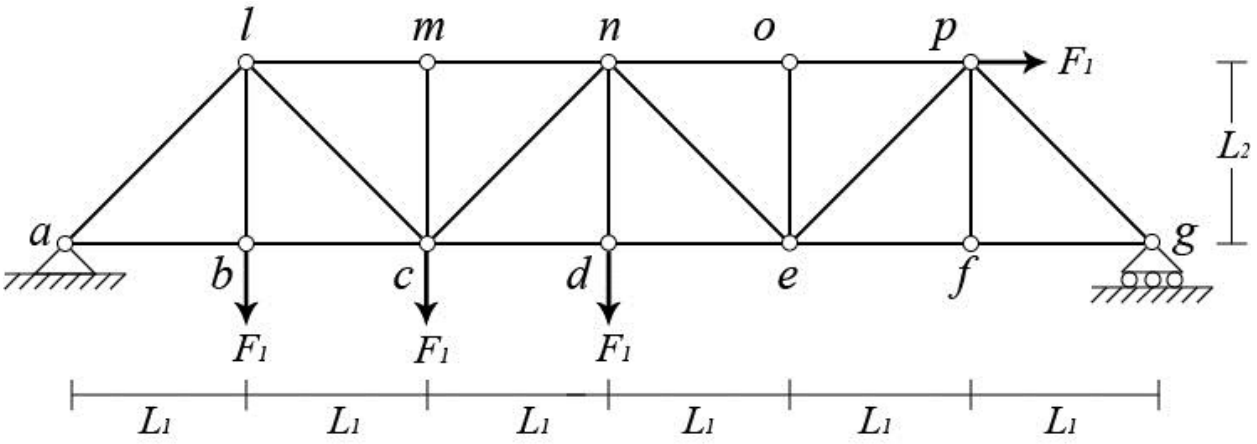
If the friction is applied at the pulley, what will be the maximum weight, W_c, to prevent the 91-lb box from sliding **up** the ramp (2 points)

When friction is applied to pulley, the minimum weight, W_c, to prevent the 91-lb box from sliding **down** the ramp is_____lb.

When friction is applied to pulley, the maximum weight, W_c, to prevent the 91-lb box from sliding **up** the ramp is _____lb.

PROBLEM 3 (20 points)

3A. The truss shown below is 8 meters tall and each panel has a length, L_1 = 6m. There are three vertical loads and one horizontal load. If F_1 = 2 kN, draw a free body diagram of the truss and determine the reactions at points (a) and (g). Note the pin joint at (a) and the roller joint at (g). (8 points)



3B. Use the method of joints or the method of sections as appropriate to determine the forces in the following links: *lm, lc, bc, mc,* and *cn*. Make sure that your free body diagrams are legible and your thought process is clearly established. (12 points)

Exam 2 – Equation Sheet

Buoyancy

$$F_B = \rho g V$$

Fluid Statics

$$P = \rho g h$$

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

Belt Friction

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

ME 270 Exam 2 (Version 1) Solution

1a. Passenger weight = 246.4 lbs

1b. Two-force members are: BD and EF

1c. i = increase H ii = decrease θ iii = change μ has no effect

1d. FBD Pressure at B = 39,240 N/m^2

Equivalent force magnitude = 98,100N Distance from point A = 10/3 m

2a. $\mu_{25^\circ} = 0.466$

2b. FBDs $(W_c)_{min} = 14$ lb $(W_c)_{max} = 56$ lb

2c. $(W_c)_{min} = 7$ lb $(W_c)_{max} = 112$ lb

3a. FBD $A_x = -2$ kN $A_y = 3.56$ kN $G_y = 2.44$ kN

3b. Method of Sections

$F_{LM} = -3.84$ kN $F_{LC} = 1.95$ kN $F_{BC} = 4.67$ kN

$F_{MC} = 0$

Method of Joints at point C

$F_{CN} = 0.55$ kN