ME 270 – Fall 2015 Exam 2 **NAME (Last, First): _____**

Group #_____

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 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	I Bilionis 12:30-1:20PM	Yangfan Liu 4:30-5:20PM
J Jones Distance Learning	J Gilbert 2:30-3:20PM	M Murphy 10:30-11:45AM
E Nauman 8:30-9:20AM	KM Li 11:30AM-12:20PM	

Problem 1 _____

Problem 2 _____

Problem 3 _____

Total _____

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

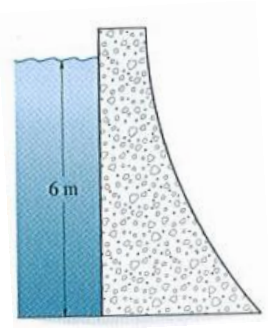
1A. In your own words, state each of Newton's three laws of motion. Be sure to write legibly. Unreadable definitions will be marked wrong.

Newton's 1st Law: (2 pts)

Newton's 2nd Law: (1pt)

Newton's 3rd Law: (2pts)

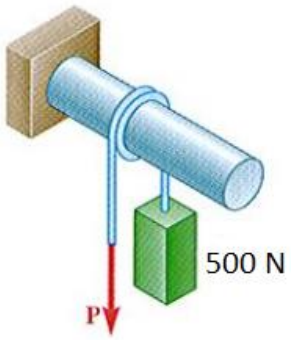
1B. A dam has a width of 10 m. The density of water ρ can be taken as 1000 kg/m3.
(i) Calculate the magnitude of the resultant hydrostatic force acting on the dam (3pts)
(ii) the location of the resultant force measured from the top of the water surface. (2 pts)



Total Hydrostatic Force: _____ N (3 pts)

Location of the force from the water surface: _____m (3 pts)

1C. A 500 N block is looped around a horizontal rod as shown in the diagram. The coefficient of static friction between the rope and the rod is 0.2. Determine the angle of wrap β and the smallest value of *P* to prevent the block from moving down?



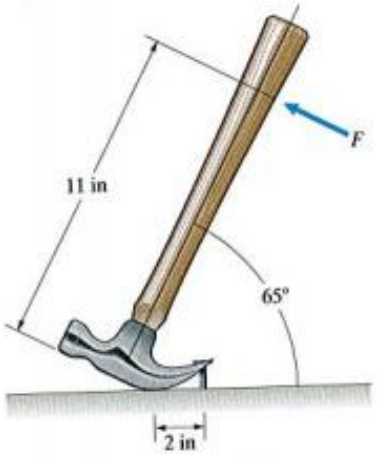
β = _____ (2 pts)

P = _____ N (3 pts)

1D. A hammer is used to pull out a nail shown in the diagram. Assume that the force exerted on the head of the nail by the hammer is vertical and the weight of hammer is negligible.

(i) Complete the free body diagram below. (2 pts)
(ii) If *F* = 10 lb, find the magnitude of the force (F_N) exerted on the nail by the hammer (3pts)

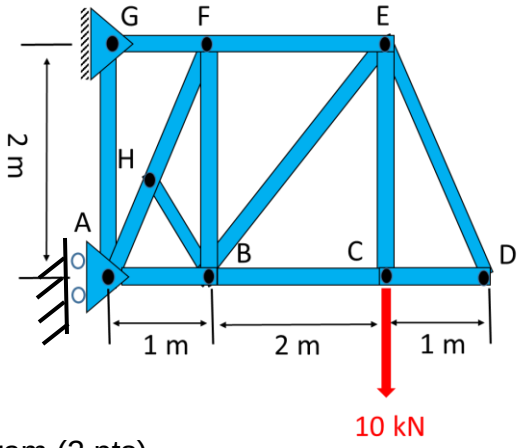
FBD (2pts)



F_N = _____lb (3 pts)

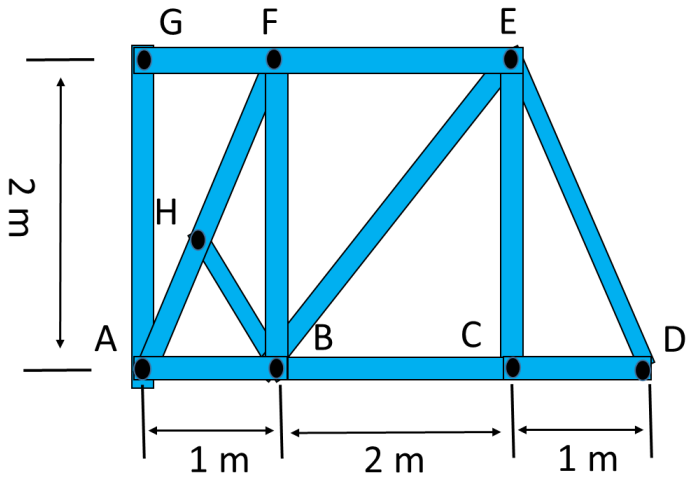
PROBLEM 2. (20 points)

GIVEN: The truss shown is held in static equilibrium by a roller support at joint A and a pin support at G. The truss is loaded with a single 10kN force as shown.



FIND:

a) On the artwork provided, complete the overall free body diagram (2 pts)



b) Determine the support reactions at A and G. The signs of the reaction forces should be consistent with your free body diagram. (3 pts)

$A_x =$	(1 pt)
$G_x =$	(1 pt)
$G_y =$	(1 pt)

c) Identify all zero-force members in the truss. No work is required. (3 pts)

Zero − Force Members:	(3 pts)

d) Use the method of sections to determine the magnitudes of the loads in members EF, BE, and BC and indicate whether each is in tension, compression, or zero. You need to indicate where to cut the original truss and include a Free Body Diagram of the part of the truss you are working on. (9 points)

$F_{EF} =$	$Tension \ or \ Compression \ or \ Zero \ \ (Circle \ One)$	(3 pts)
$F_{BE} =$	$Tension \ or \ Compression \ or \ Zero \ \ (Circle \ One)$	(3 pts)
$F_{BC} =$	$Tension \ or \ Compression \ or \ Zero \ \ (Circle \ One)$	(3 pts)

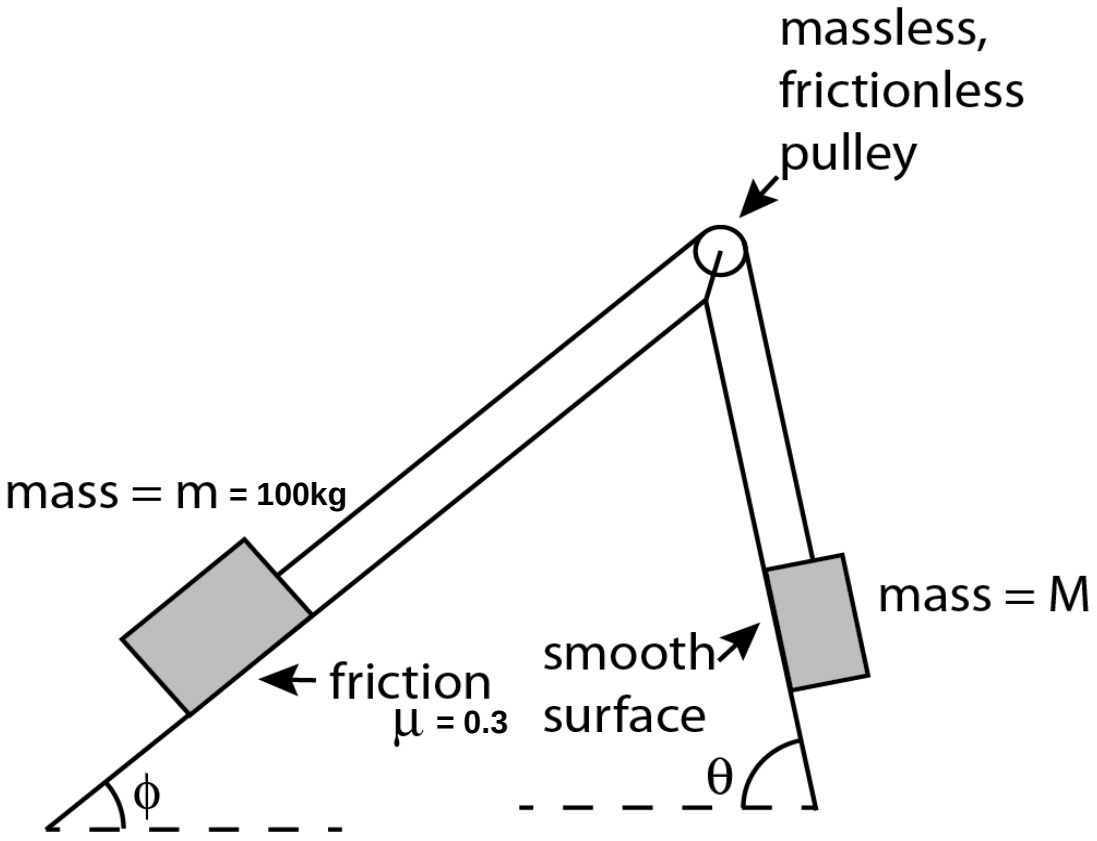
e) Use the method of joints to determine the magnitude of the load in member AB and indicate whether it is in tension, compression, or zero. Please indicate which joint you chose and include a Free Body Diagram of that joint. (3 pts)

$F_{AB} =$ $Tension \ \ or \ \ Compression \ \ or \ \ Zero \ \ (Circle \ One)$ (3 pts)

PROBLEM 3. (20 points)

Problem 3: The goal of this problem is to determine the **maximum** and **minimum** values of the mass, M, for which the system will remain in equilibrium. The pulley is frictionless and only one of the surfaces is rough.

You may assume that m = 100 kg, $\mu = 0.3$, $\phi = 40^o$, and $\theta = 80^o$.



3A) Draw free body diagrams of both masses assuming that you want to find the **<u>maximum</u>** value of M. (4 points)

3B) Write out the governing equations for the two masses and solve for the mass, M. (6 points)

3C) Draw free body diagrams of both masses assuming that you want to find the **minimum** value of M. (4 points)

3D) Write out the governing equations for the two masses and solve for the mass, M. (6 points)

ME 270 Exam 2 Equations

Buoyancy

$$F_B = \rho g V$$

Fluid Statics

$$P = \rho g h$$

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

Belt Friction

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

Fall 2015 Exam 2 Solutions

1a. Newton's Three Laws of Motion

1b. Total Hydrostatic Force: 1.77×10^5 N Location of the force from the water surface: 4 m

1c. $\beta = 3\pi$ (540°) P = 75.9 N

1d. F_N = 55 lb

2a. Free Body Diagram

2b. A_x = 15 kN G_x = -15 kN G_y = 10 kN

2c. Zero-Force Members: DE, CD, BC, BH

2d. F_{EF} = 10 Tension F_{BE} = 14.14 Compression F_{BC} = 0 Zero

2e. F_{AB} = 10 kN Compression

3a. Free Body Diagrams

3b. M = 88.6 Kg

3c. Free Body Diagrams

3d. M = 41.9 Kg