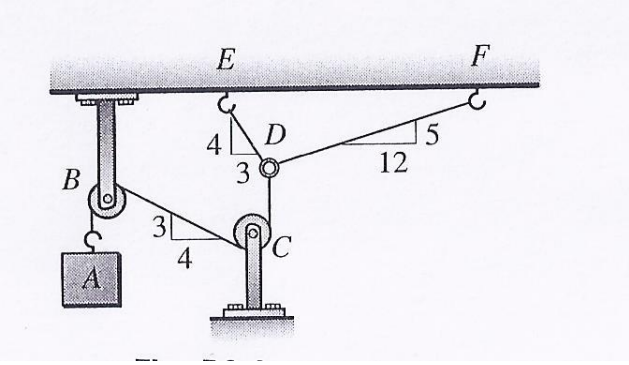
CIE200 Statics	Fall/2015	Test #1	5-October-2015	55 Minutes	Closed Book

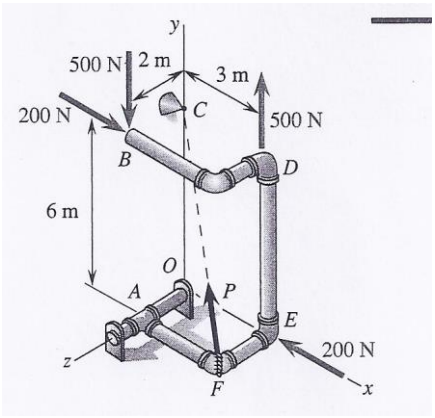
ALL the following apply in this test

1. Equations of statics should be based on a corresponding FBD that is clearly drawn and labeled. Points will be deducted for statics equations that do not have a corresponding FBD or an incomplete/incorrect FBD.
2. Show all your calculations in the solution sheet. Points will be deducted for answers that are not supported by proper calculations.

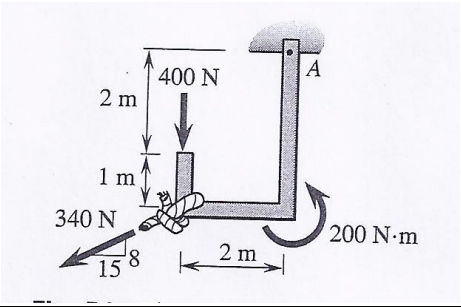
Name _____ ID# _____



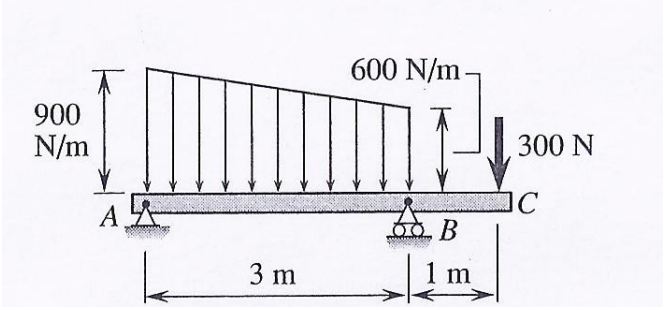
Problem 1 (25 Points)
The 840-N package A is supported as shown. Determine the tensions in cords DE and DF.
Draw the FBDs showing all your results.



Problem 2 (25 Points)
A system of forces consists of a 210-N force **P** and two couples as shown. Determine:
a. the resultant moment vector **M** of the two couples,
b. the moment of **P** about the z-axis



Problem 3 (25 Points)
Replace system #1 shown in the figure by an equivalent system #2 that consists of a single force at A and a couple.
Draw the updated diagram of system #2 showing all your results.

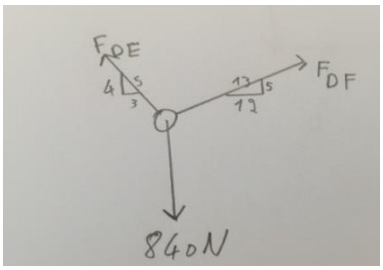


Problem 4 (25 Points)
Replace system #1 shown in the figure by an equivalent system #2 that consists of a single force and specify where its line of action intersects the beam measured from A.
Draw the updated diagram of system #2 showing all your results.

Problem 1 Solution

A pulley changes the direction of the cable tension but not its magnitude: $T_{CD} = T_{CB} = T_{BA} = W_A = 840N$

FBD of ring at D:



$$\overset{+}{\rightarrow} \sum F_x = \frac{12}{13}F_{DF} - \frac{3}{5}F_{DE} = 0 \quad (1)$$

$$+\uparrow \sum F_y = \frac{5}{13}F_{DF} + \frac{4}{5}F_{DE} = 840 \quad (2)$$

Solve (1) and (2) to yield: $F_{DF} = 520N$ and $F_{DE} = 800N$

Problem 2 Solution

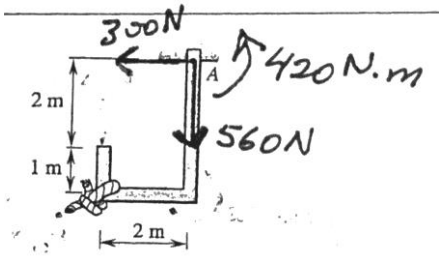
a. Let $\overrightarrow{M_1}$ be the moment of the 500 N couple and $\overrightarrow{M_2}$ be that of the 200 N. Add a zero system $\pm 500\vec{j}$ at C of coordinates $(0, 6, 0)$. And add another zero system $\pm 200\vec{\imath}$ at C as well. The resultant moment is:

$$\vec{M} = \overrightarrow{M_1} + \overrightarrow{M_2} = 500\left(3\vec{k} + 2\vec{\imath}\right) + 200\left(-6\vec{k} + 2\vec{j}\right) = 1000\vec{\imath} + 400\vec{j} + 300\vec{k}$$

b. $\overrightarrow{OF} = 3\vec{\imath} + 2\vec{k}; \quad \overrightarrow{FC} = -3\vec{\imath} + 6\vec{j} - 2\vec{k}; \quad FC = 7\ m;$

$$\overrightarrow{M_{P/z}} = \vec{k} \cdot \overrightarrow{M_{P/O}} = \vec{k} \cdot \left(\overrightarrow{OF} \times \vec{P}\right) = P\,\vec{k} \cdot \left(\overrightarrow{OF} \times \frac{\overrightarrow{FC}}{FC}\right) = \frac{210}{7}\begin{vmatrix} 0 & 0 & 1 \\ 3 & 0 & 2 \\ -3 & 6 & -2 \end{vmatrix} = 30 * 18 = 540\ N.m$$

Problem 3 Solution



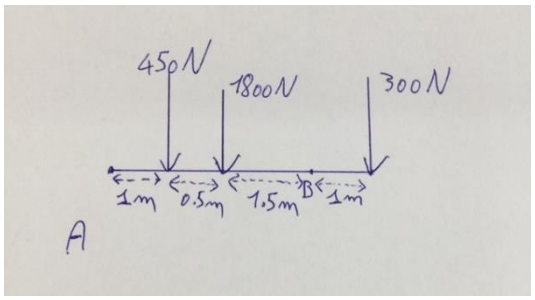
$$\overset{+}{\rightarrow} A_x = \sum F_x = -\frac{15}{17}340 = -300\ N\ \rightarrow = 300\ N \leftarrow$$

$$+\uparrow A_y = \sum F_y = -\frac{8}{17}340 - 400 = -560N\ \uparrow = 560\ N\ \downarrow$$

$$+\circlearrowleft \sum M_A = 200 + 400(2) + 160(2) - 300(3) = 420\ N.m$$

Problem 4 Solution

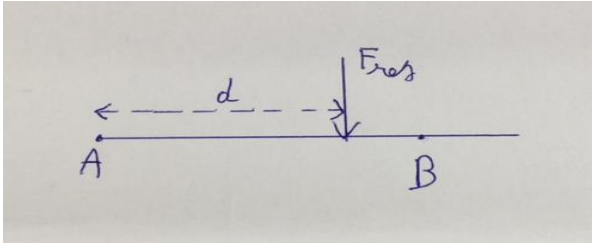
The loads may be replaced with the 3 forces shown:



$$+\downarrow F_{res} = \sum \mathrm{F_y} = 450 + 1800 + 300 = 2550\ N$$

$$+\circlearrowright \sum M_A = (450 * 1) + (1.5 * 1800) + (4 * 300) = F_{res} * d$$

$$d = 1.7\ m$$



$$\boxed{F_{res} = 2550N}$$

$$\boxed{d = 1.7m}$$