

THE UNIVERSITY OF MANITOBA

Date : Wednesday, December 10, 2008
Department & Course No : ENG 1440
Paper No : 326/322Sections 1-2, D01
Examination : Introduction to Statics

Place : Frank Kennedy Brown Gym

Page No : 1 of 7
Time : 1:30 p.m.
Duration : 2 Hours
Examiners : Dr. M. J. Frye
Dr. D. Polyzois
Seats: 1 - 223

PRINT STUDENT NAME IN FULL

STUDENT SIGNATURE

STUDENT NUMBER

SECTION and INSTRUCTOR

Problem	Marks
1	
2	
3	
4	
TOTAL	40

Notes:

- CLOSED BOOK. Textbooks, notes, problems NOT permitted.
- Calculators are permitted.
- All questions are of equal value.
- STRAIGHT EDGE IS REQUIRED.
- Wherever necessary a FBD must be drawn!!!!

$a^2 = b^2 + c^2 - 2bc \cos A$

$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

$\vec{V} = \vec{P} \times \vec{Q} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ P_x & P_y & P_z \\ Q_x & Q_y & Q_z \end{vmatrix} = \hat{i}(P_yQ_z - P_zQ_y) - \hat{j}(P_xQ_z - P_zQ_x) + \hat{k}(P_xQ_y - P_yQ_x)$

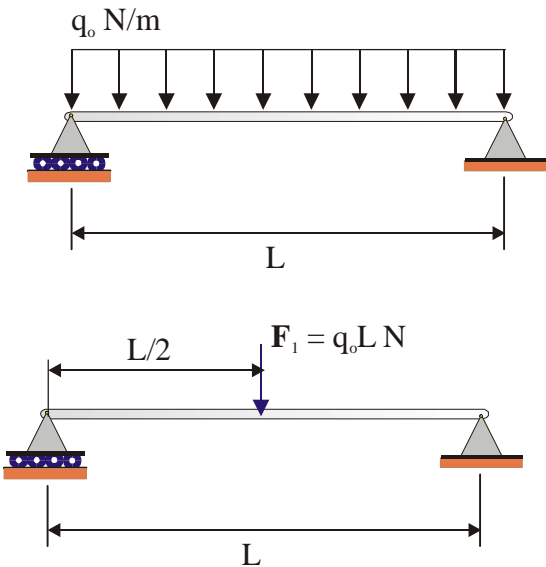
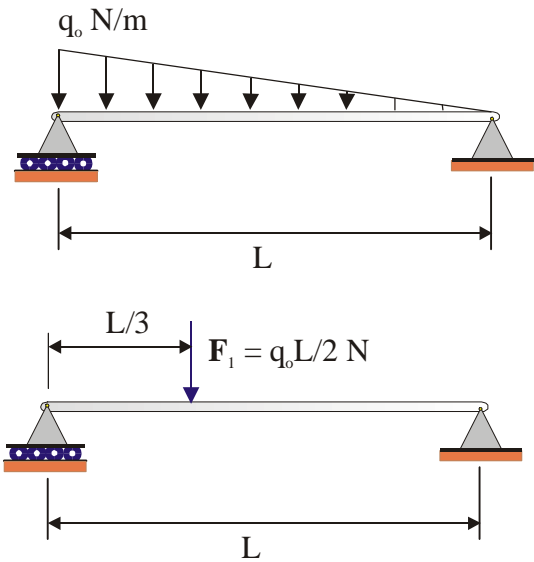
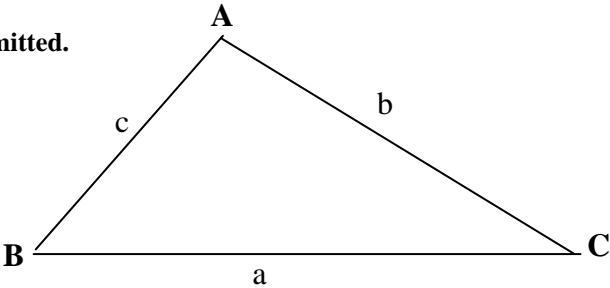
$V = |\vec{V}| = \sqrt{V_x^2 + V_y^2 + V_z^2}$

$\cos \theta_x = \frac{V_x}{V}, \cos \theta_y = \frac{V_y}{V}, \cos \theta_z = \frac{V_z}{V}$

$\vec{M} = \vec{r} \times \vec{F}$

$M_{OL} = \vec{\lambda}_{OL} \cdot \vec{M}_O$

$\vec{P} \bullet \vec{Q} = P_xQ_x + P_yQ_y + P_zQ_z$



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Question 1

A UFO (Unidentified Flying Object) landed in South Winnipeg (near the U of M campus) and was seen taking off carrying three (3) unidentified packages (rumor has it they were Engineering students). The masses of the students are $M_1 = 100 \text{ kg}$, $M_2 = 65 \text{ kg}$ and $M_3 = 140 \text{ kg}$. Their location in the 5 m radius space craft is shown in Figure 1(b) below.

The message back from the space craft is that the students will be returned if you can replace these forces by a single force and correctly locate its point of application with respect to the origin, O in the figure. (Use $g = 9.8 \text{ m/sec}^2$)

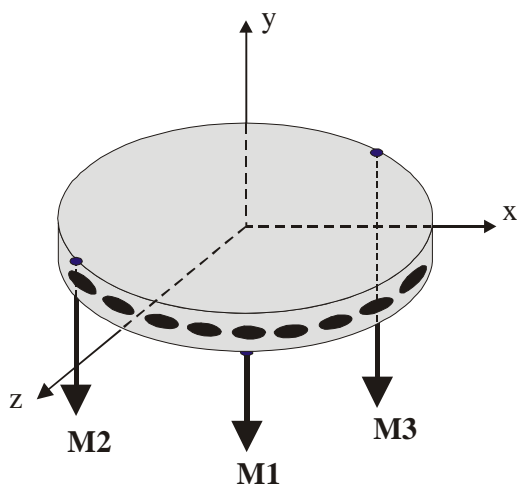


Figure 1(a)

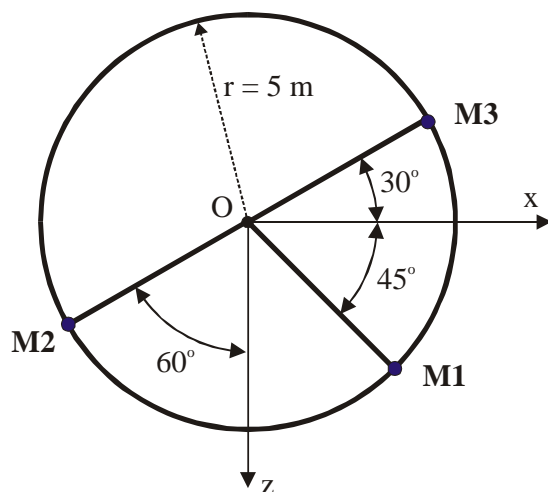


Figure 1(b) - Location of Masses

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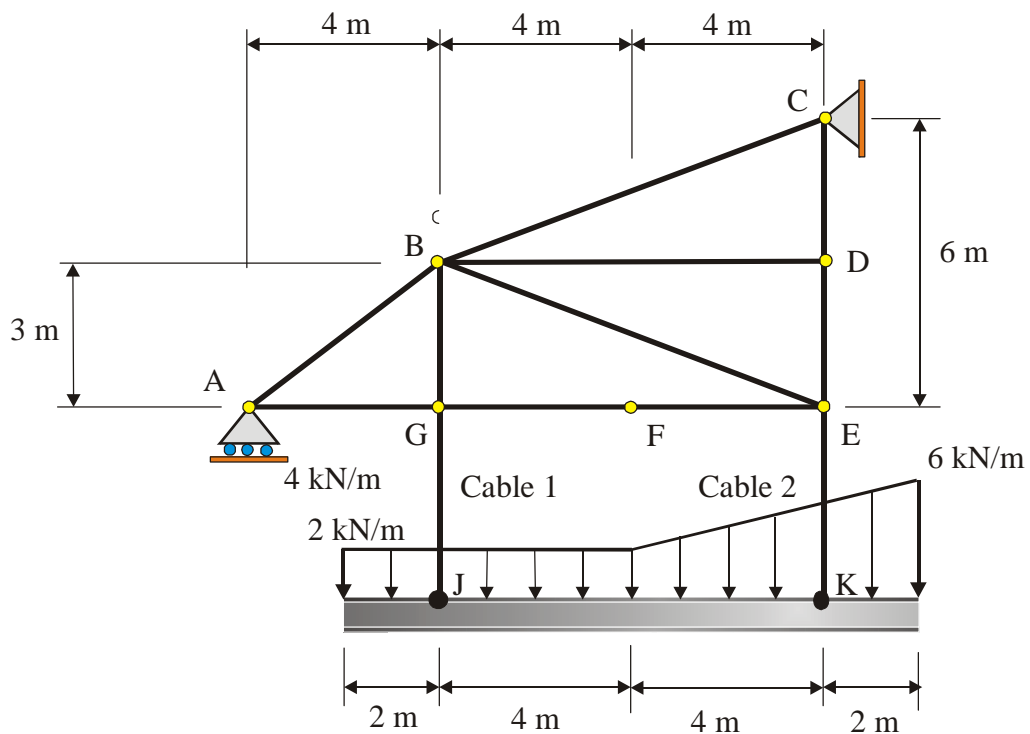
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Question 2

The truss shown in the figure below has a beam suspended from two (2) cables. The beam supports the distributed load indicated. The truss has a pin support at *C* and a roller support at *A*. Determine:

- The tension in *Cable 1* (*GJ*) and *Cable 2* (*EK*),
- The reactions at *A* and *C*, and
- The force in each member of the truss and state whether it is in tension or compression. (**Indicate your results on the figure provided on the next page.**)



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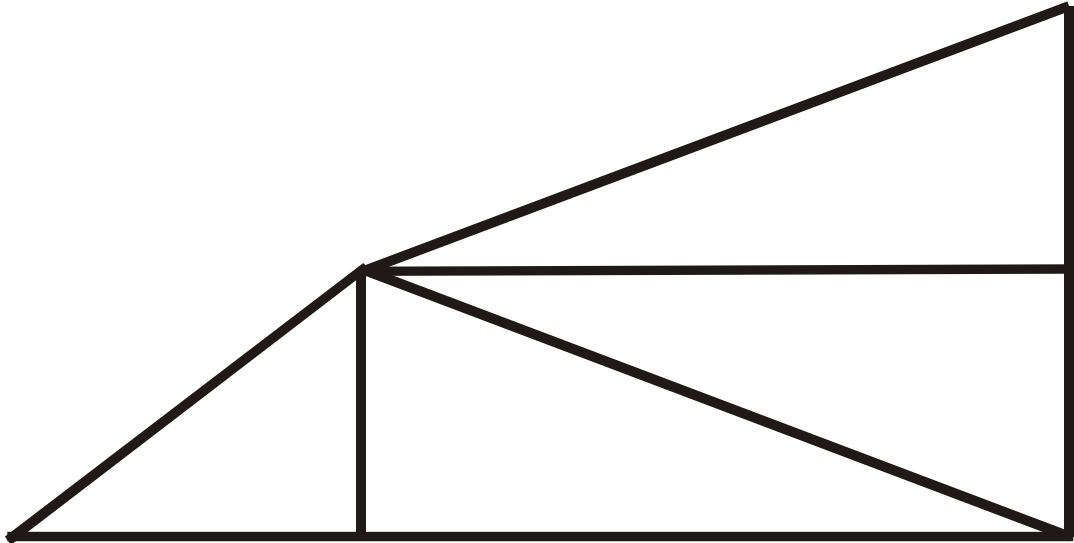
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Question 2 (continued)



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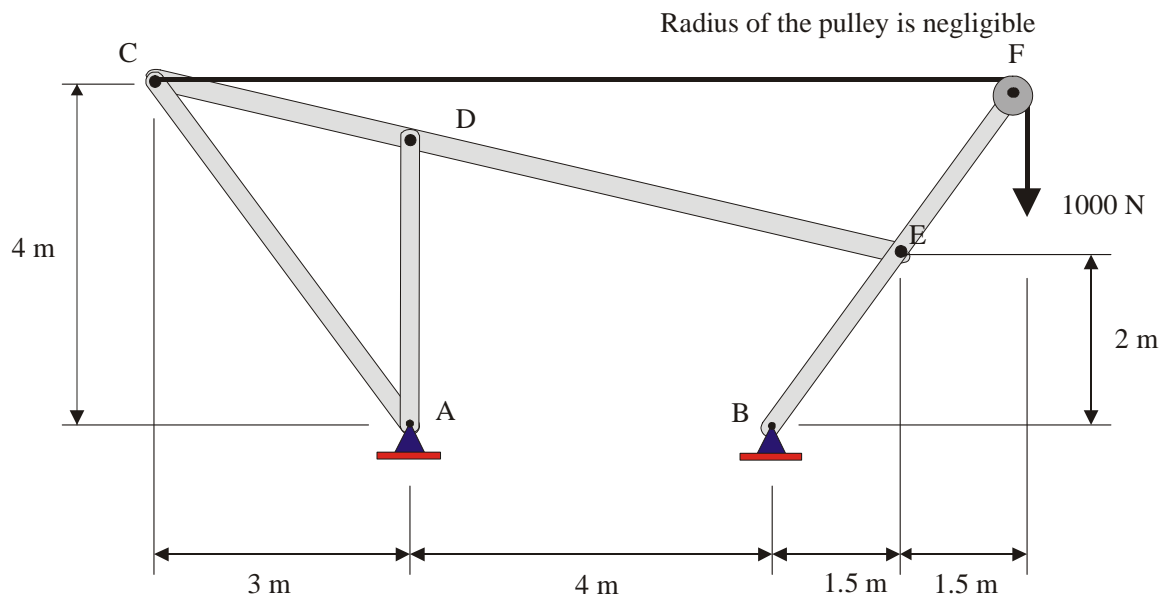
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Question 3

The frame shown in the figure below supports a 1000 N load suspended from a pulley (neglect the radius of the pulley) and has pin supports at A and B .

- Identify any two force members in the frame.
- Determine the reactions at pin supports A and B .
- Determine the forces acting on ALL members of the frame.



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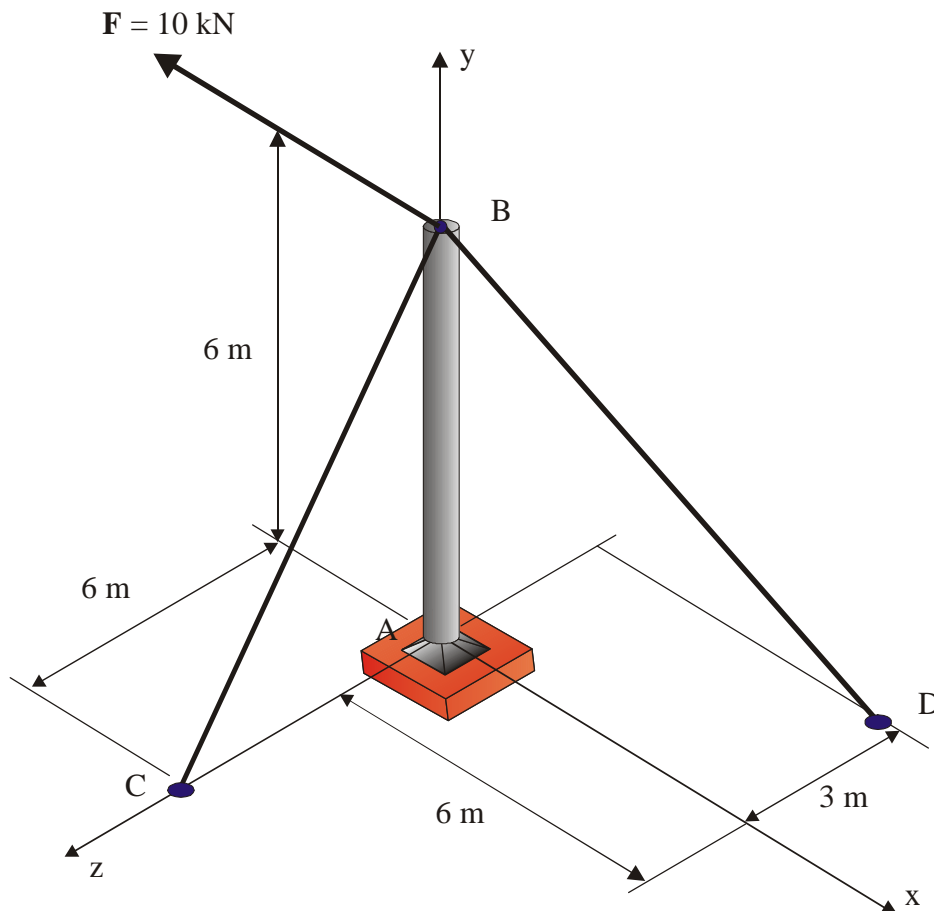
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Question 4

A 6 m long pole has a ball-and socket joint at A and is supported by two (2) cables, BD and BC as shown in the figure below. A 10 kN force acting in the x - y plane and parallel to the x axis is applied to the pole at B . Determine:

- The tensions in the two cables,
- The reactions at the ball-and-socket joint at A ,
- The angle between cables BC and BD and
- The moment of the 10 kN force about the line CD .



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