THE UNIVERSITY OF MANITOBA

Date : Friday, December 9, 2011 **Page No : 1 of 5**
Department & Course No : ENG 1440 **Time : 9:00 a.m.**
Sections A01-A02-A03, D01 **Duration : 2 Hours**
Examination : Introduction to Statics **Examiners : Dr. M. J. Frye**
Dr. D. Polyzois Mr. R. Chitikireddy
Place : Frank Kennedy Brown Gym **Seats: 1 - 250**

Answer all questions in the answer booklets provided:

Indicate the Following on the Front of your Answer Booklets

Name: Student Number: Section: Professor:

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!!!!**

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

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

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

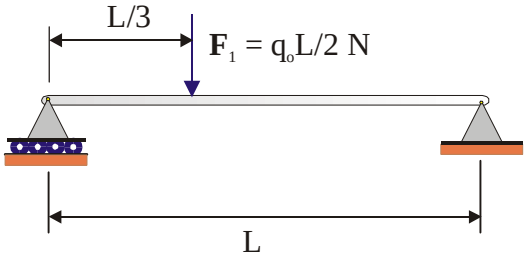
$$V = \left|\vec{V}\right| = \sqrt{V_x^2 + V_y^2 + V_z^2}$$

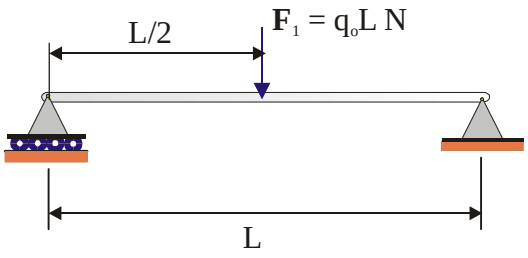
$$\cos\theta_x = \frac{V_x}{V}, \cos\theta_y = \frac{V_y}{V}, \cos\theta_z = \frac{V_z}{V}$$

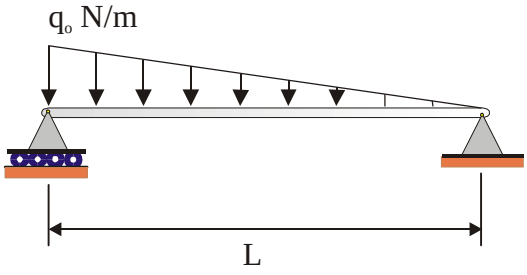
$$\vec{M} = \vec{r}\ x\ \vec{F}$$

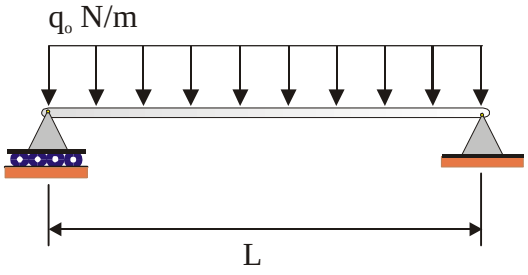
$$M_{OL} = \vec{\lambda}_{OL} \bullet \vec{M}_O$$

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









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Question 1

Two forces $\boldsymbol{F_1}$ and $\boldsymbol{F_2}$ are applied at the top of a pyramid with lines-of-action as shown in Figure 1. The magnitude of $\boldsymbol{F_1}$ is *100 kN* and the magnitude of $\boldsymbol{F_2}$ is *40 kN*.
Determine:

a) The magnitude and direction of the resultant, ***R***, of the two forces,
b) The angle between $\boldsymbol{F_1}$ and $\boldsymbol{F_2}$,
c) The moment that the resultant, ***R*** has about the *x*, *y* and *z* axes,
d) The perpendicular distance from *O* to the line-of-action of ***R*** and
e) The moment that the resultant ***R*** has about the line *OC*.

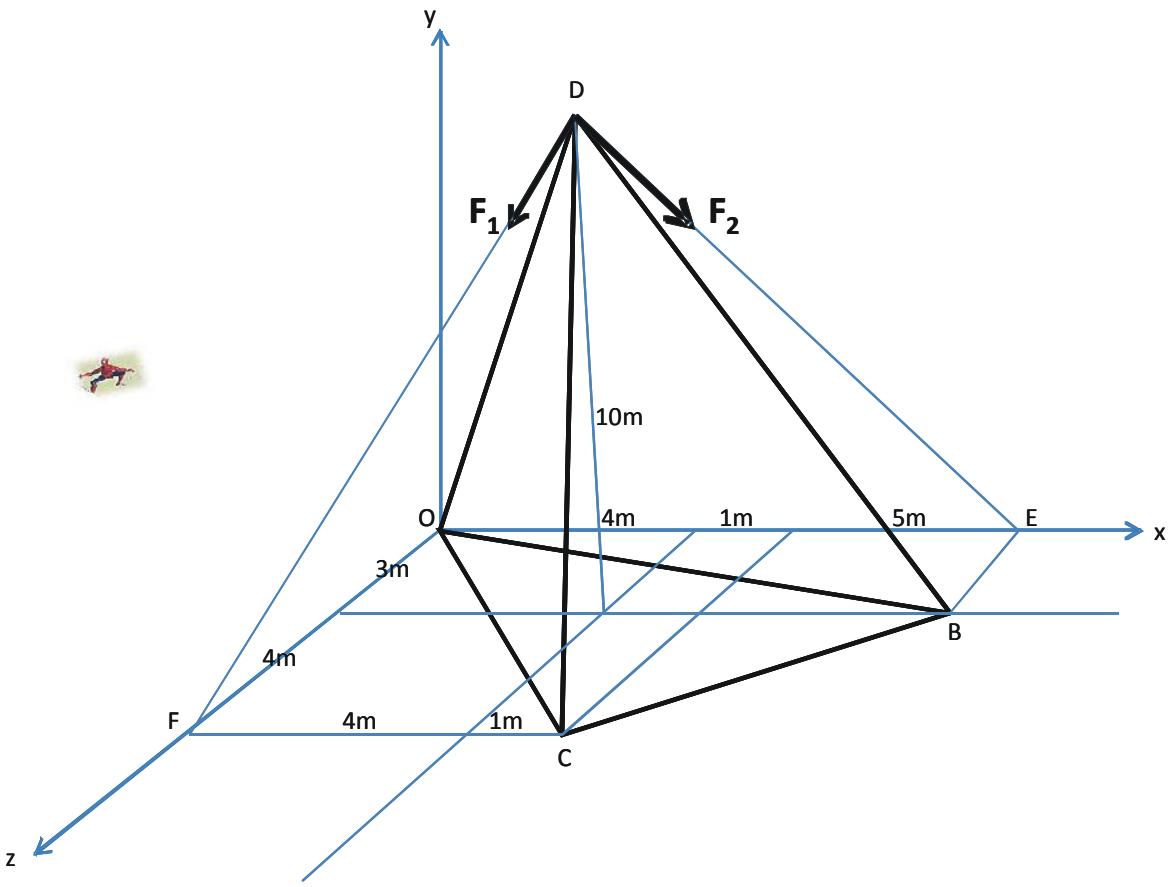

Figure 1

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Question 2

The truss shown in the Figure 2 below is supported by the "*short link*" *KC* and the pin (hinge) support at *A*. A beam is attached to the truss by cables *FH* and *GJ*. The beam carries *20 kN* point load and a distributed load that varies from *4 kN/m* to *0 kN/m* as shown in Figure 2.

Determine:

a) The tension in the two cables *FH* and *GJ* supporting the beam and
b) The force in each member of the truss. State whether the member is in tension, compression or a zero *(0)* force member. (**Indicate your results on the figure provided on Page 5. and put your name and student number on this page.**)

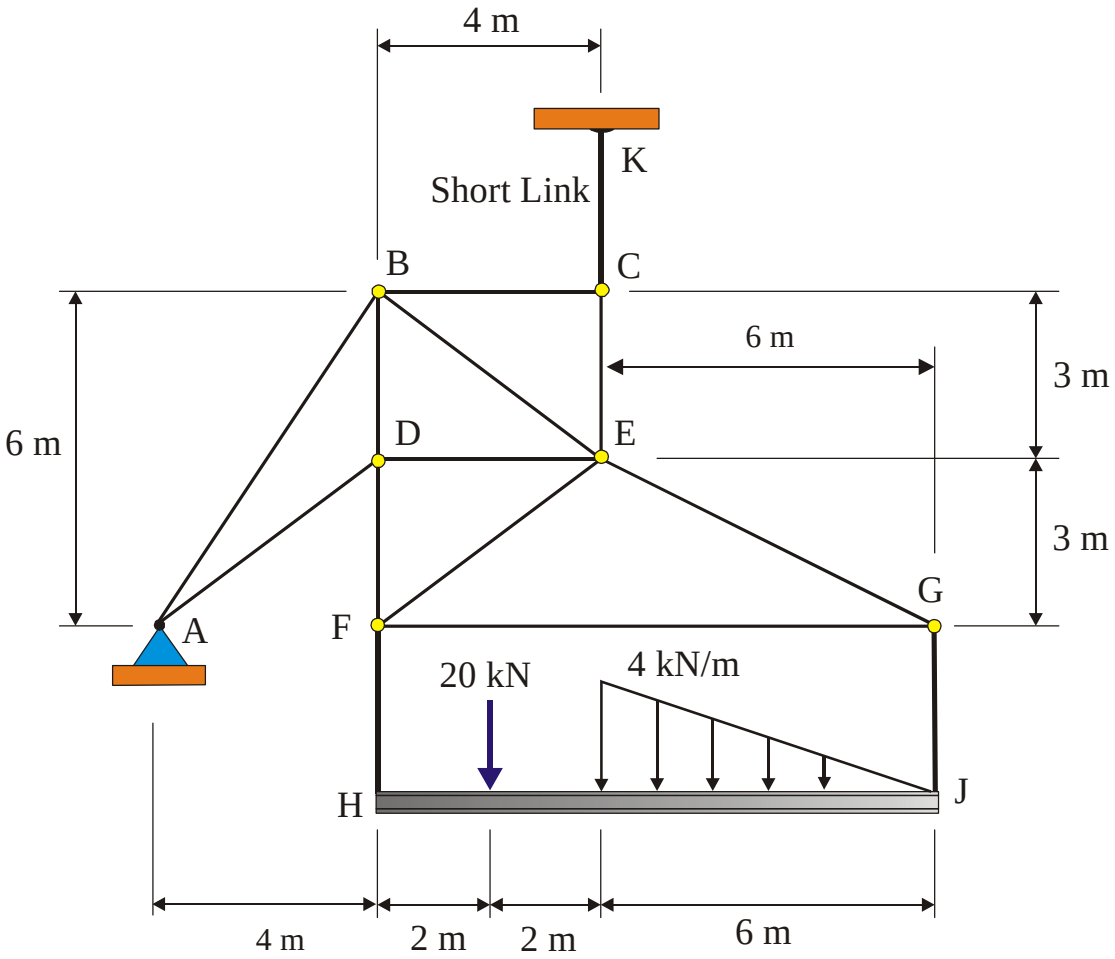

Figure 2

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Question 3

A *0.5 m* radius pulley and a *0.1 m* radius pulley are attached to the frame shown in Figure 3 below. A *250 kN* weight is attached to a cable that passes over the *0.5 m* radius pulley and is attached back to the frame at *G*. A *150 kN* weight is attached to a cable that passes over the *0.1 m* radius pulley and is attached back to the wall at *H*.

Determine the forces exerted on all members of the frame including the two pulleys.

Indicate your final results on separate Free Body Diagrams of each member of the frame.

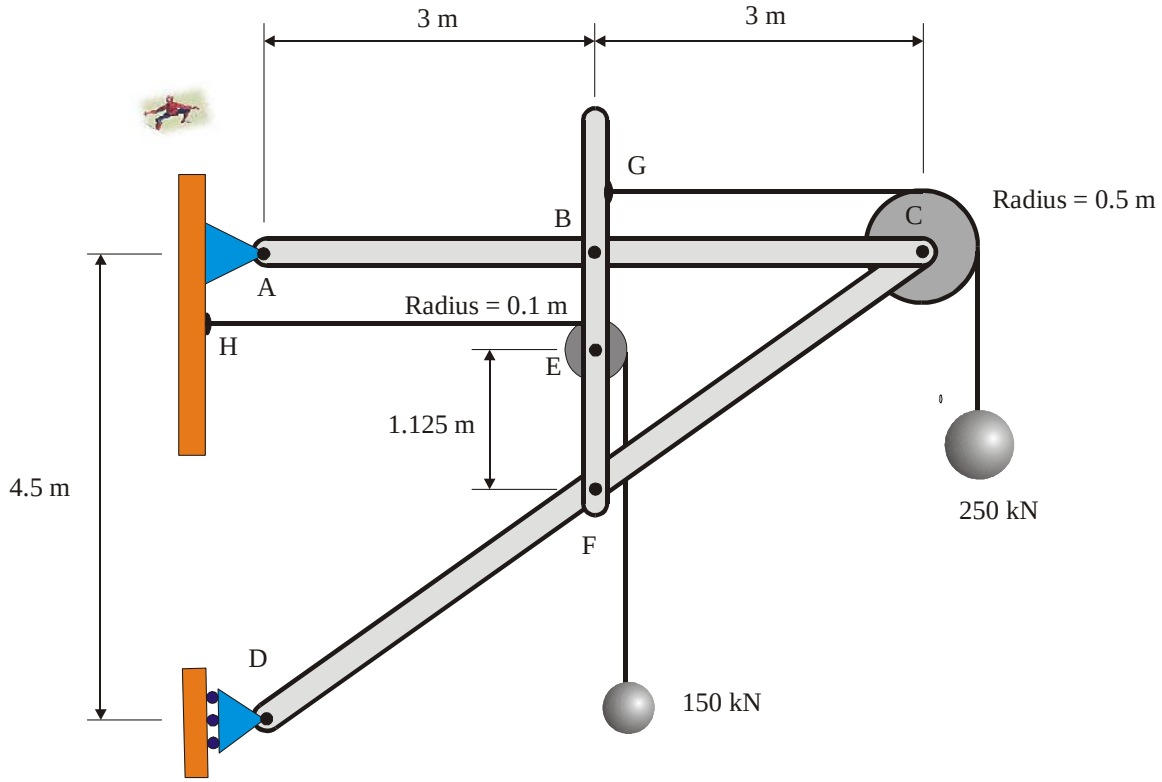

Figure 3

Question 2 – Results Page

NAME: _____ STUDENT NO. _____