THE UNIVERSITY OF MANITOBA

Date : Thursday, December 16, 1999 | **Page No : 1 of 6**
Department & Course No : 130.135 | **Time : 1:30 p.m.**
Examination: Engineering Statics | **Duration : 2 Hours**
Paper No : 352 | **Examiners : E.Lajtai, N. Rajapakse,**
Place : University Center 210-214; | **and A. Shah**
Seats: 1 - 200

PRINT STUDENT NAME IN FULL

STUDENT SIGNATURE

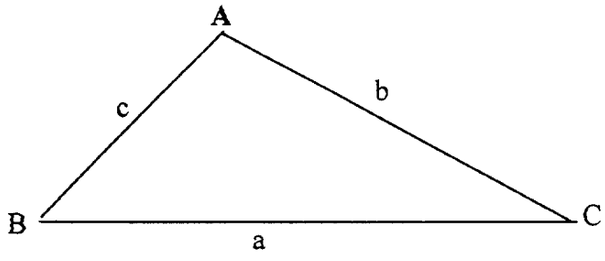
STUDENT NUMBER

SEAT NUMBER

Problem	Marks
1	
2	
3	
4	
5	
TOTAL	50

Notes:

- **Attempt any FOUR questions out of FIVE.**
- **CLOSED BOOK. Textbooks, notes, problems NOT permitted.**
- **Calculators are permitted.**
- **All questions are of equal value.**
- **STRAIGHT EDGE IS REQUIRED.**



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

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

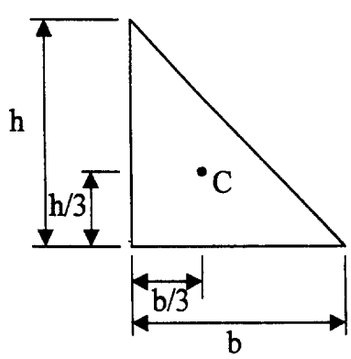
$$\vec{P} \times \vec{Q} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ P_x & P_y & P_z \\ Q_x & Q_y & Q_z \end{vmatrix} = \hat{i}(P_yQ_z - P_zQ_y) - \hat{j}(P_xQ_z - P_zQ_x) + \hat{k}(P_xQ_y - P_yQ_x)$$

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

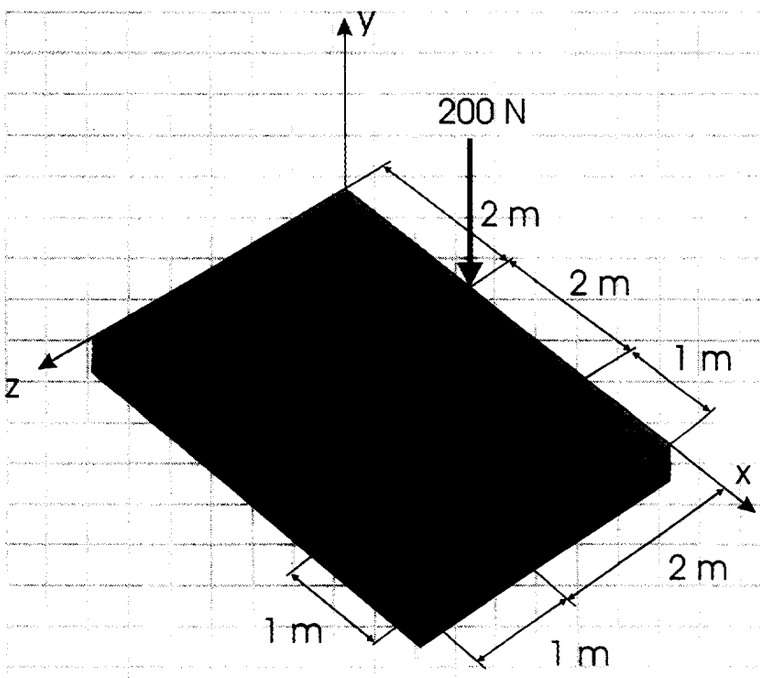
$$\cos\theta_x = \frac{V_x}{V}, \cos\theta_y = \frac{V_y}{V}, \cos\theta_z = \frac{V_z}{V}$$

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

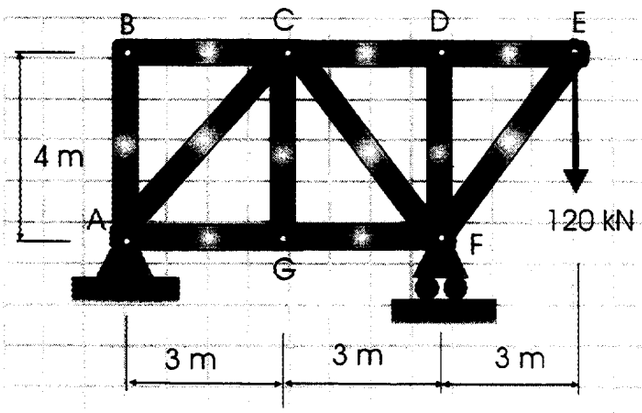
$$M_{OL} = \vec{\lambda}_{OL} \bullet \vec{M}_O$$



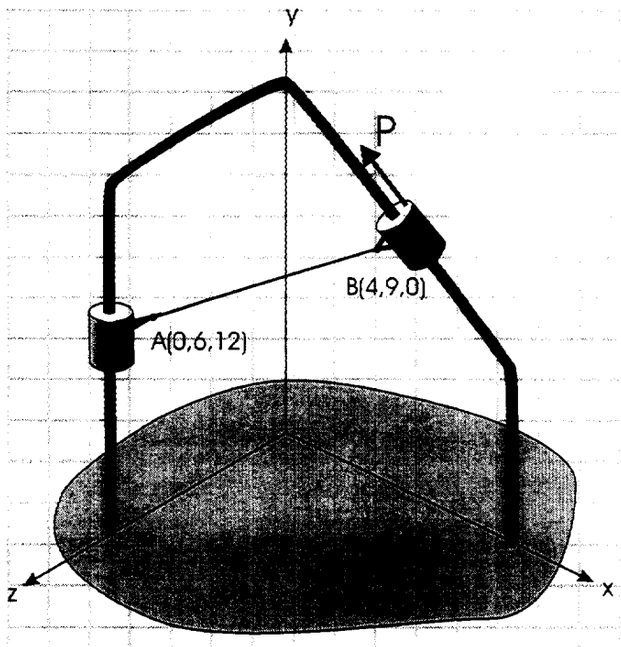
1. Find the magnitude and the position of the resultant of the three vertical forces!



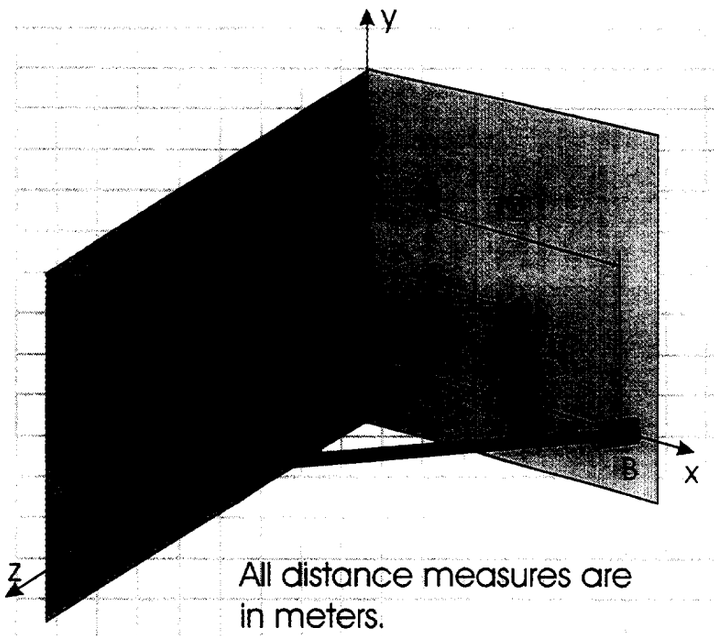
2. Find the force in members AB, AC, BC, CG, ED, EF!



3. Collars A and B, each weighing 4.5 kN are connected by wire AB and may slide freely on the smooth (frictionless) rod. The two collars are brought to equilibrium by applying the force P in the position shown. Find the tension in the wire!
Hint: assume that at both A and B, all the forces, including the reactions, are concurrent at points A and B.



4. A T-shaped lever (ABC) is supported by bearings at B and C. The lever is in equilibrium when a force F of 390 N is applied as shown. Determine the moment of F about the axis BC!



Find the reactions at A and D!