THE UNIVERSITY OF MANITOBA
FINAL EXAMINATION

Date : December 07, 1996 — Page No : 1 of 6
Department & Course No : 23.135 — Time : 1:30 p.m. to 3:30 p.m
Paper No : 363 — Duration : 2 Hours
Examination : Applied Mechanics 1A — Location : Bison East Gym.
Examiners : K. Dick, R.B. Pinkney, N. Rajapakse, A. Shah, E. Wilms

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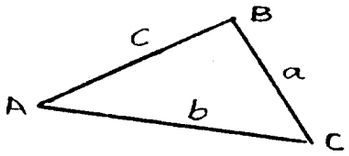
NAME:		
SIGNATURE:		
STUDENT NUMBER:		
QUESTIONS TO BE GRADED (CIRCLE ONLY FOUR)	1	
	2	
	3	
	4	
	5	

NOTE:
- Attempt any FOUR questions out of five.
- All questions are of equal value.
- Calculators are permitted.
- No textbooks or other aids allowed.



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

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

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

$$\mathbf{P}\cdot\mathbf{Q} = PQ\cos\theta$$

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

$$\cos\alpha = \frac{V_x}{V}, \cos\beta = \frac{V_y}{V}, \cos\gamma = \frac{V_z}{V}$$

$$\mathbf{M}_o = \mathbf{r} \times \mathbf{F}$$

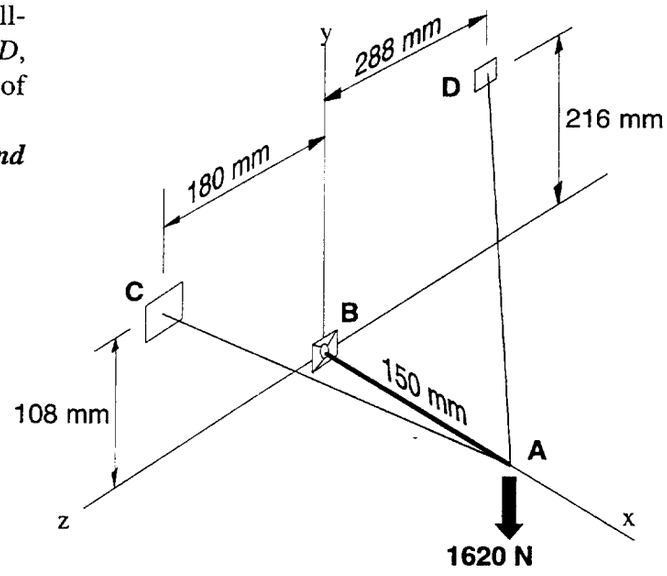
$$M_{oL} = \boldsymbol{\lambda}_{oL} \cdot \mathbf{M}_o = \begin{vmatrix} \lambda_x & \lambda_y & \lambda_z \\ x & y & z \\ F_x & F_y & F_z \end{vmatrix}$$

continued ...

Question 1.)

A strut *AB* is supported at *B* by a ball-and-socket and at *A* by cables *AC* and *AD*, as shown in the figure. A vertical load of 1620 N is attached at A.

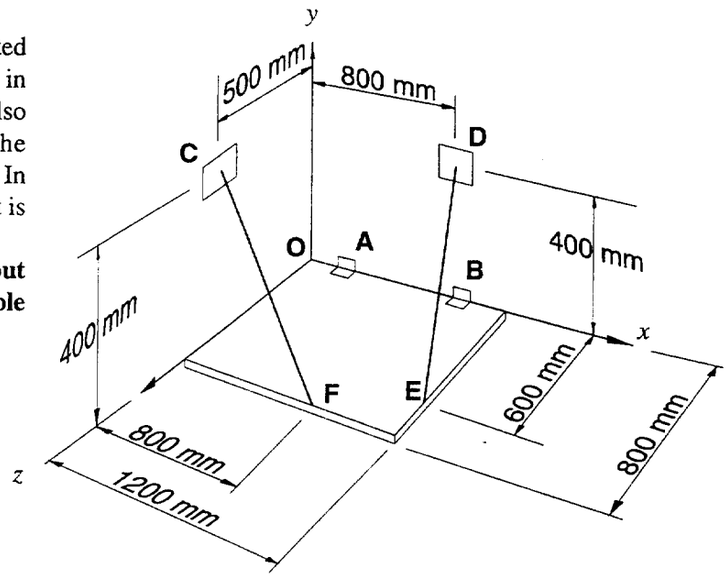
Find the tension in cables *AC and AD*.



Question 2.)

A rectangular plate is supported by brackets at *A* and *B*, as shown in the figure. Two cables *CF* and *DE* also support the plate as shown. The tension is known for both cables. In cable *CF* it is 500 N. In cable *DE* it is 400 N.

Determine the moment about line *OE* of the forces exerted by cable *CF* at *F* and by cable *DE* at *E*.

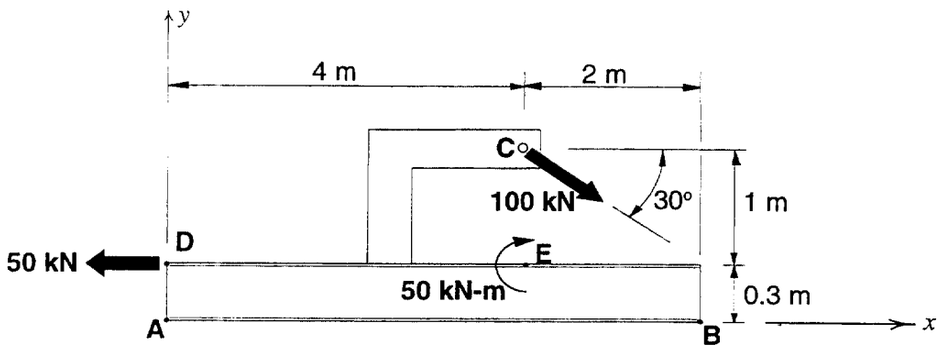


Question 3.)

Two forces and a couple are applied to a bracket as shown in the figure. Determine:

i.) The equivalent force-couple system at A

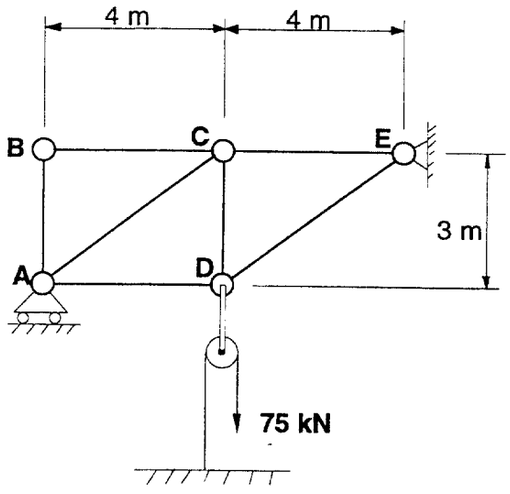
ii.) The points where the line of action of the resultant intersects the *x* and *y* axes.



Question 4.)

The truss shown in the figure is loaded by means of a rope-pulley system. A ~~50~~ 75 kN force is applied vertically down to the rope. There is a pinned support at *E* and a roller support at *A*.

i.) Determine the reactions at A and E.
ii.) Determine all of the member forces in the truss.



Question 5.)

A force **P** is applied to a weightless frame *ABCD* as shown in the figure. There is also a 100 N force applied vertically at *B*. The frame is supported by a roller at *A*. The frame is also pinned to a block at *D* which rests on a floor. The block at *D* has a mass of 10 kg. The coefficient of static friction between the block and the floor is, $\mu_s = 0.3$.

Determine the smallest force *P* required to move the block.