THE UNIVERSITY OF MANITOBA

Thursday, December 17 (Morning) 19 98 — FINAL EXAMINATION

PAPER NO.: 584 SEATS: 1–187 PAGE NO.: 1 of 8

DEPARTMENT & COURSE NO.: 130.135 TIME: 2 HOURS

EXAMINATION: Engineering Statics EXAMINERS: N. Rajapakse & R. B. Pinkney

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Notes:

1. **Section L01 (Rajapakse): ATTEMPT ANY FOUR OF QUESTIONS 1,2,3,4,6.**
   Section L02 (Pinkney): ATTEMPT ANY FOUR OF QUESTIONS 1,2,3,5,6.
2. CLOSED BOOK. Textbooks, notes, problems NOT permitted.
3. Calculators permitted.
4. All questions are of equal value.
5. Solutions presented in scientific notation shall be expressed such that the power of ten is a multiple of 3.

   Incorrect: ..... 3.45×10^5
   Correct: ..... 345×10^3

6. Results shall be presented to an accuracy of three significant figures except where the first digit is unity, in which case four significant figures shall be presented.

AFFIX UPPER PORTION OF FLAP HERE

(I UNDERSTAND THAT CHEATING IS A VERY SERIOUS OFFENSE)

STUDENT SIGNATURE

PRINT STUDENT NAME IN FULL

STUDENT NUMBER

EXAMINATION CENTRE SEAT NUMBER

AFFIX LOWER PORTION OF FLAP HERE

Circle Problems Attempted	Marks
1	
2	
3	
4	
5	
6	
TOTAL	/40

INSTRUCTIONS TO CANDIDATES

1. Fill in the blank spaces above.
2. Write your name, examination centre and seat number in the spaces provided above.
3. Affix flap as indicated
4. Do not indicate in any manner your name, student number, college (if a college student) or address on any other part of this book.
5. Do not tear any paper out of this book.
6. Candidates must not have in their possession at the time of examination any unauthorized books, tables, notes or other extraneous material.
7. Books or tables authorized for use in any examination must not contain any additional notes, formulae or other extraneous material.

Useful Information:

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

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

$$\mathbf{P} \bullet \mathbf{Q} = PQ\cos\theta = P_x Q_x + P_y Q_y + P_z Q_z$$

$$\mathbf{P} \times \mathbf{Q} = \mathbf{n}PQ\sin\theta = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ P_x & P_y & P_z \\ Q_x & Q_y & Q_z \end{vmatrix} = \mathbf{i}(P_y Q_z - P_z Q_y) + \mathbf{j}(P_z Q_x - P_x Q_z) + \mathbf{k}(P_x Q_y - P_y Q_x)$$

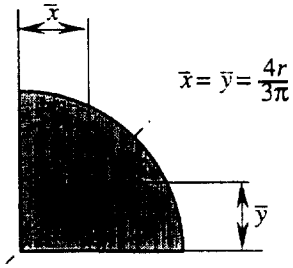
$$V = |\mathbf{V}| = \sqrt{V_x^2 + V_y^2 + V_z^2}$$

$\cos\theta_x = \frac{V_x}{V}$, etc.

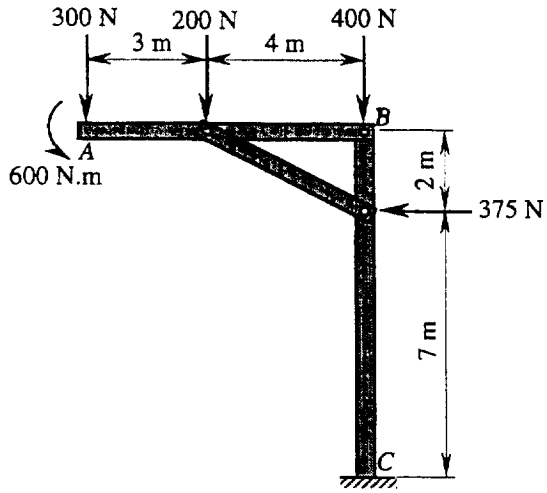
$$\lambda_{AB} = \frac{\mathbf{i}(x_B - x_A) + \mathbf{j}(y_B - y_A) + \mathbf{k}(z_B - z_A)}{\sqrt{(x_B - x_A)^2 + (y_B - y_A)^2 + (z_B - z_A)^2}}$$

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

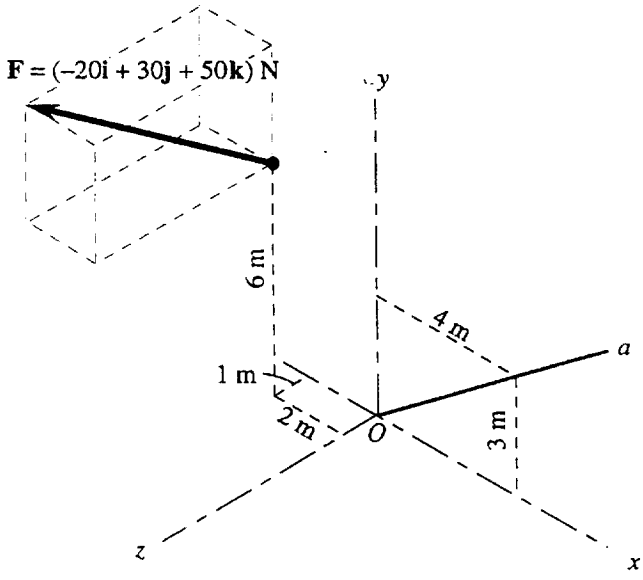
$$\mathbf{M}_{oL} = \lambda_L \bullet \mathbf{M}_o = \begin{vmatrix} \lambda_x & \lambda_y & \lambda_z \\ x & y & z \\ F_x & F_y & F_z \end{vmatrix}$$



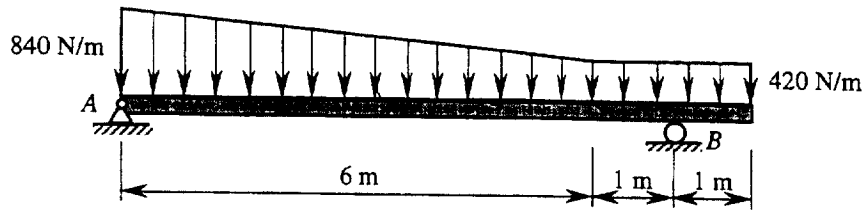
1. Replace the loading on the frame by a single resultant force. Specify where its line of action intersects member *AB*, measured from *A*.



2. Determine the moment of the force **F** about the line *Oa*.

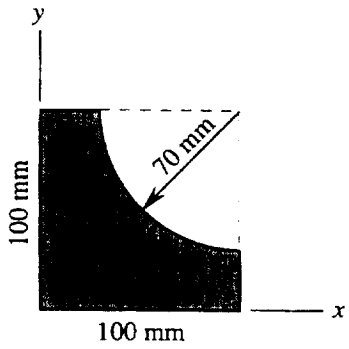


3. Determine the reactions at the supports of the beam loaded as shown.

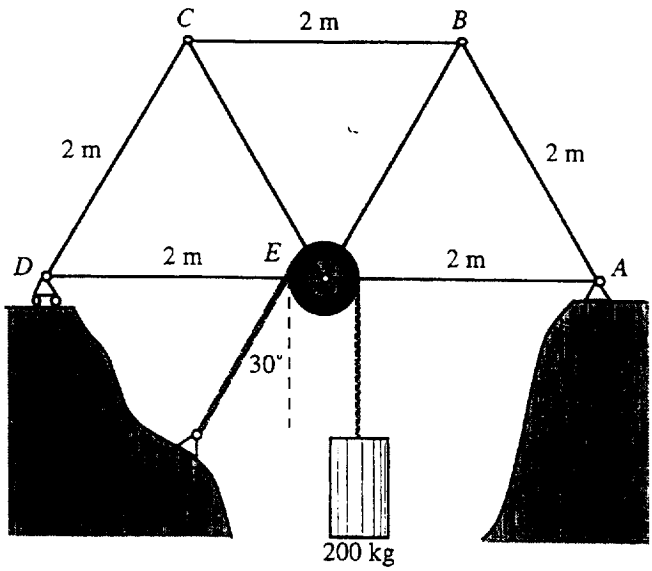


Answers:

(b) Determine the x- and y-coordinates of the centroid of the shaded area.



4. Calculate the force in each member of the truss shown.

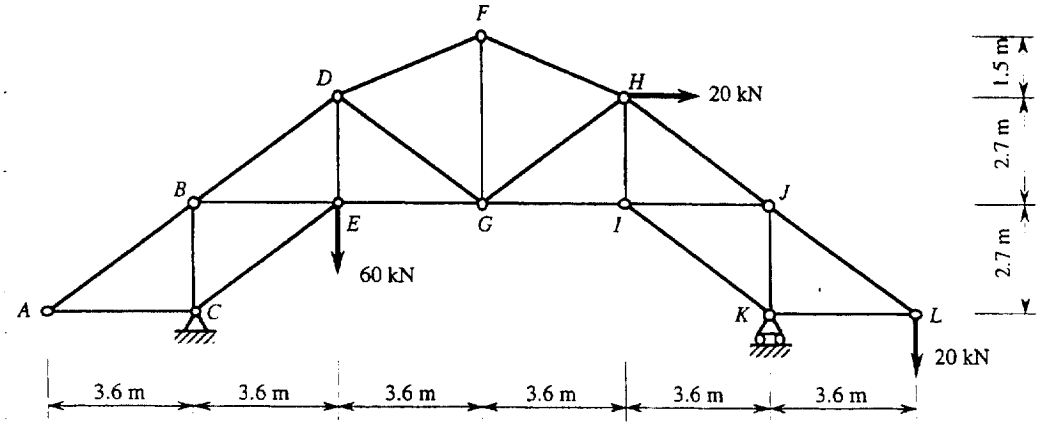


5. For the truss shown, compute

   a) the reactions;
   b) the force in member *AB*;
   c) the force in member *BE*;
   d) the force in member *EG*; and
   e) the force in member *KL*.

   Show your results on the given diagram of the truss.

   Remember: Incorrect reactions mean incorrect member forces!



6. Determine the horizontal and vertical components of the force at C that member ABC exerts on member CEF.