

STUDENT NUMBER: \_\_\_\_\_

**CIRCLE THE MODEL NUMBER OF YOUR CALCULATOR:**

# SHARP EL520

**NOTES:**

1. Ensure that you have all 7 sheets of the examination paper. Page 7 is blank.
2. Answer all five questions. The value of the questions is indicated below.
3. If you need more space for a question, please use the back of the preceding question. In all cases, please indicate clearly where your calculations are continued.
4. The only calculators permissible are listed above. Please circle your model.
5. This is a closed-book examination. No other paper will be allowed on the desk.
6. Do not remove the staple.

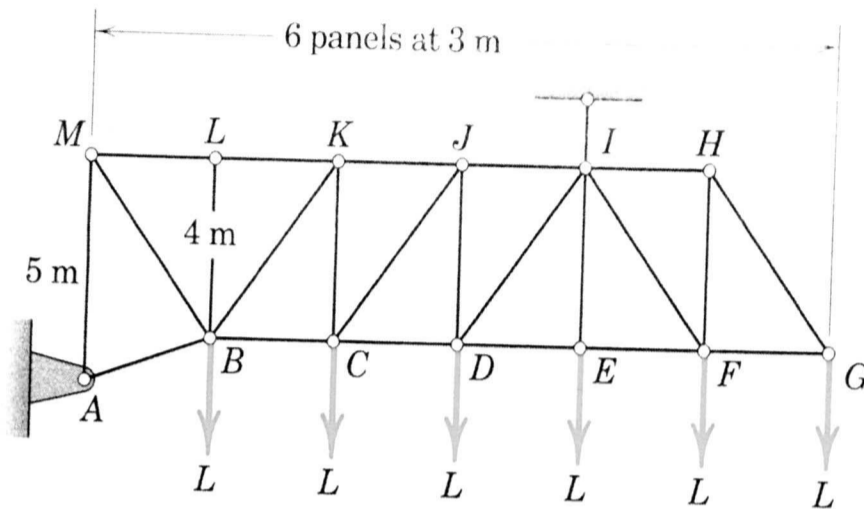
**DO NOT WRITE IN THIS SPACE.**

1	/12
2	/12
3	/12
4	/12
5	/12
<b>TOTAL</b>	<b>/60</b>

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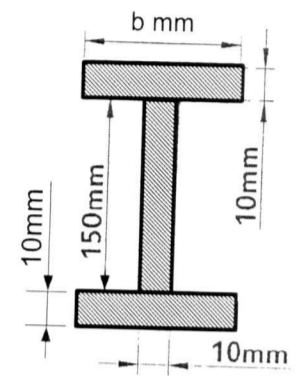
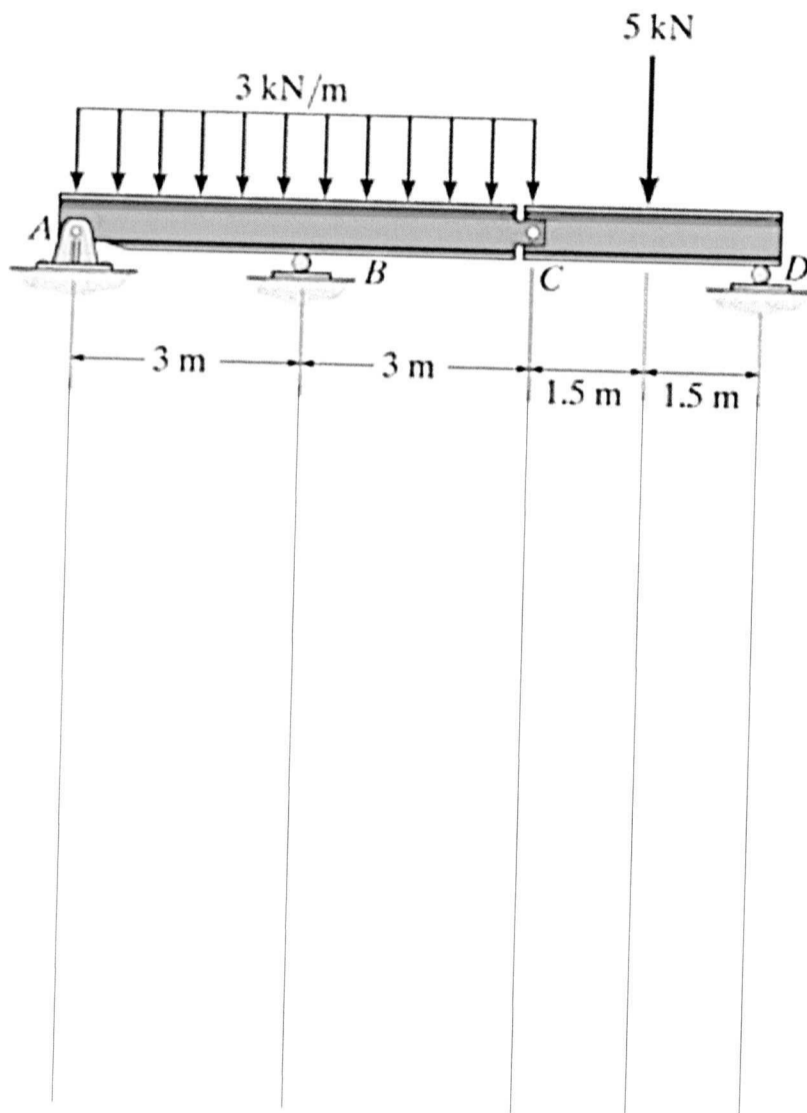
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1. For the wood truss illustrated below, supported by a pin at  $A$  and a vertical cable at  $I$ :
- Determine the forces in members  $CD$ ,  $CJ$ ,  $DJ$  and  $EI$ , and indicate if they are in tension or compression, if the magnitude of the force  $L = 200$  kN.
  - Member  $EI$  has a square solid cross-section. If the load factor for axial tension is 1.9 and the failure stress for timber is 40 MPa, determine the required size,  $a$ , of the cross-section. Wood sections can be cut in 10 mm size increments.
  - What is the actual elongation of member  $EI$ , as designed? The modulus of elasticity for timber is  $12.0 \times 10^3$  MPa.



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2. The hinged beam ABCD, made of cast iron, is supported at A, B and D, and has an internal pin at C. You are required to:
- In the space provided, draw the shear force and bending moment diagrams for the beam, indicating the values at points A, B, C and D, and any potential local maxima and minima;
  - Determine the width of the identical flanges of the beam section,  $b$ , knowing that the failure stress for cast iron is 145 MPa in tension and 540 MPa in compression. Cast iron sections can be manufactured having dimensions in 5 mm increments. The load factor for flexure is 1.75.

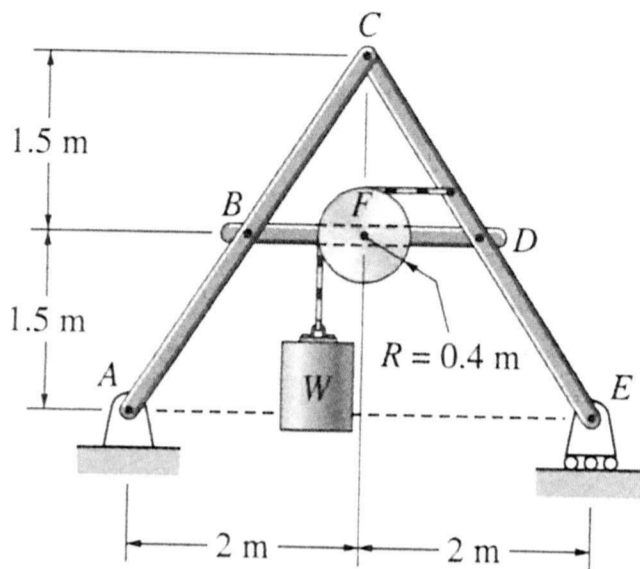


Cross-Section of Beam

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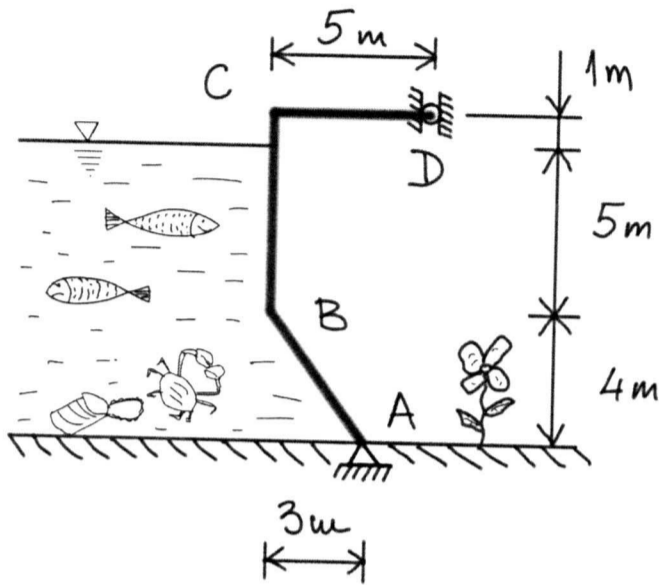
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3. The weight,  $W = 6 \text{ kN}$ , hangs from the cable, which passes over the pulley at  $F$ . Neglecting the mass of the bars and the pulley, determine the magnitude of the pin reaction force at  $D$ .



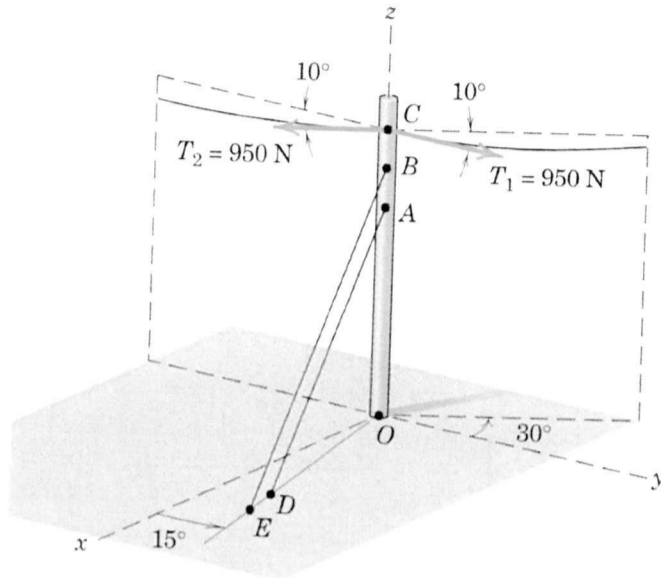
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4. The 6-metre long, light (i.e. its weight can be neglected) gate  $ABCD$  retains sea water having a mass density of  $1.050 \text{ kg/m}^3$ . Determine the components of the reaction forces on the gate at the hinge at  $A$  and the vertical roller support at  $D$ . Neglect any potential effects of the marine fauna and objects.



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5. The vertical plane containing the utility cable turns  $30^\circ$  at the vertical pole  $OC$ , which is fixed at the base, at  $O$ . The magnitude of both tension forces,  $T_1$  and  $T_2$ , is 950 N. In order to prevent long-term leaning of the pole, guy wires  $AD$  and  $BE$  are utilized. If the two guy wires are adjusted so as to carry equal tension forces,  $T$ , which together reduce the moment at  $O$  to zero, determine the magnitude of the horizontal reaction force at  $O$ . Also, determine the required magnitude of  $T$ . Neglect the mass of the pole.



Dimensions:  $\overline{OA} = 9 \text{ m}$      $\overline{OD} = 8 \text{ m}$   
 $\overline{OB} = 11 \text{ m}$      $\overline{OE} = 10 \text{ m}$   
 $\overline{OC} = 13 \text{ m}$

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