UNIVERSITY OF TORONTO

Faculty of Applied Science and Engineering

CIV 100S – MECHANICS

Final Examination

23rd April 2012

Examiner: Prof. Michael Seica

Time allowed: 2½ hours

FAMILY NAME:_____ **GIVEN NAME(S):**_____
(Please print clearly)

STUDENT NUMBER: _____

CIRCLE MODEL NUMBER OF YOUR CALCULATOR:

CASIO 260 **TEXAS INSTRUMENTS 30** **SHARP 520**

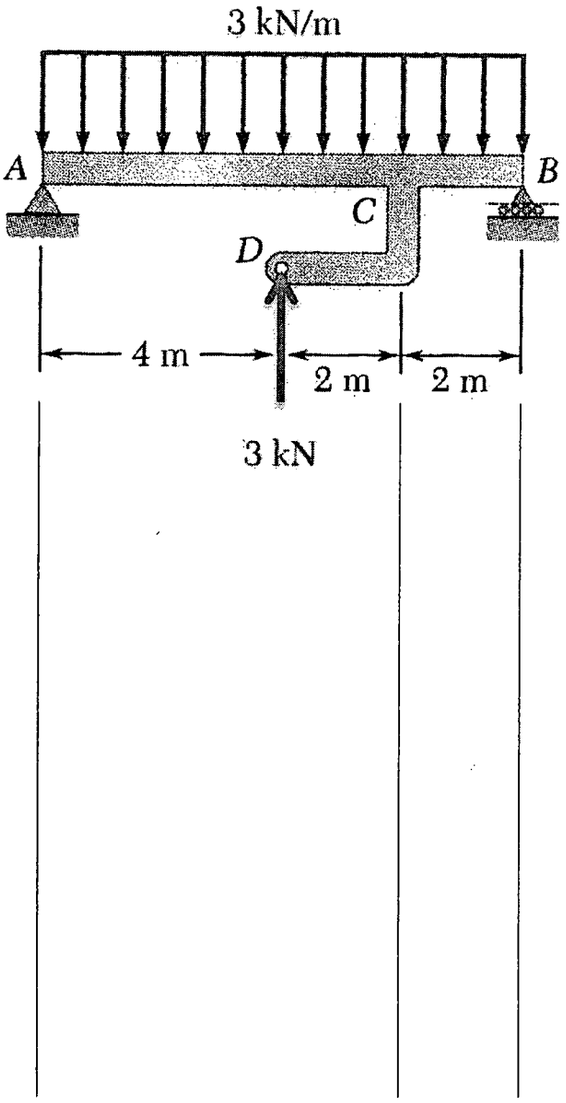
NOTES:

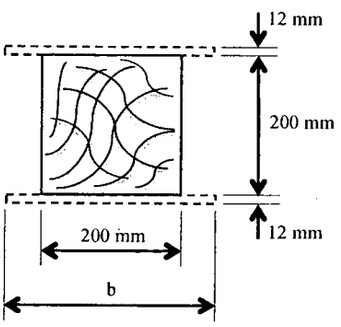
1. Make sure you have all 7 sheets of the examination paper. Page 7 is blank.
2. If you need more space for a question, please use the back of the preceding question. In all cases, please indicate clearly where your calculations are continued.
3. Answer all 5 (five) equal-value questions.
4. The only calculators permissible are listed above. Please circle your model.
5. No other paper will be accepted for marking or 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
TOTAL	**/60**

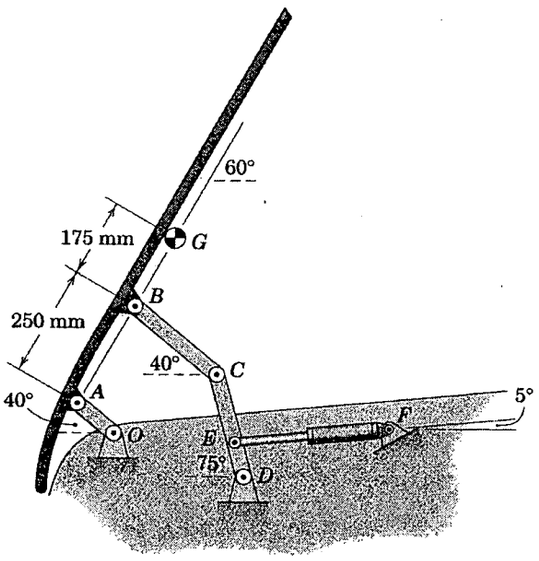
1. Draw the shear and bending moment diagrams for beam *ACB* and indicate the values at 'critical' points. Assuming that the beam is made of a solid square wood section having an allowable stress of 20 MPa, determine from a design perspective whether a 200 x 200 mm section would be able to safely support the applied forces. If not, the beam could be strengthened by the addition of two, 12-mm thick plywood sheets, as shown in the figure (the dashed lines). If the plywood has the same allowable stress, determine the necessary width, b, of the plywood sheets. The plywood sheets can be cut in 20 mm increments. The load factor for steel in bending is 2.0.





Cross-Section of Beam

2. The elements of a front-hinged automobile hood assembly are illustrated in the figure. The light linkages *BC* and *CD*, and the gas-pressurised strut *EF* hold the hood in the open position shown. In this position, the hood is free to rotate clockwise about pin *O*; pin *A* is locked against rotation. For a hood mass of 40 kg with the centre of mass at *G*, determine the minimum compression force in the strut that will maintain the hood in the open position shown.



$\overline{AO}$ = 100 mm $\overline{DE}$ = 75 mm

$\overline{BC} = \overline{CD}$ = 225 mm

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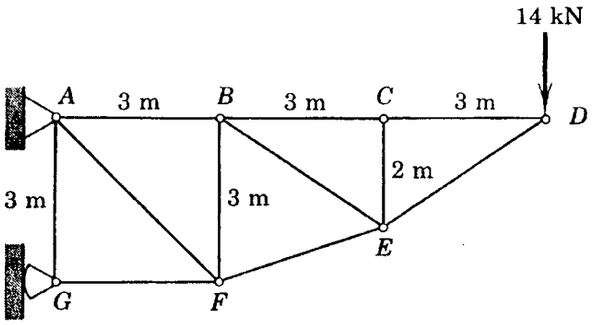
3. Calculate the forces in members *BC*, *BE* and *EF*. If members *BC* and *BE* are to be made of identical steel square sections, determine the required sizes given that steel bar sizes are available in 5-mm increments. Also, what is the elongation of member *BC*? The modulus of elasticity for steel is 200,000 MPa, the yield stress is 240 MPa and the load factor 2.0.



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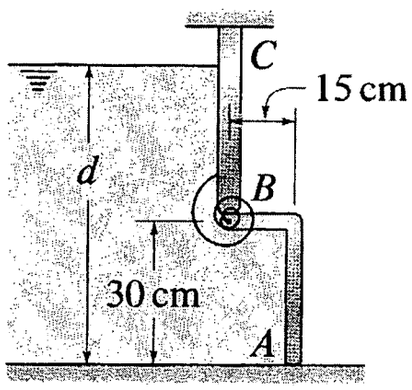
4. Water in a channel is retained by a gate which is 10 cm wide (perpendicular to the page). The gate is supported by a pin at *B* and by frictionless contact with the bottom of the channel at *A*. The gate is outfitted with a pre-wound torsional spring at *B*. The vertical wall *BC* is fixed in position. If the gate has negligible weight, determine the magnitude of the bending moment that the spring must apply to the gate at *B*, such that the gate will just begin to open when $d = 50$ cm.



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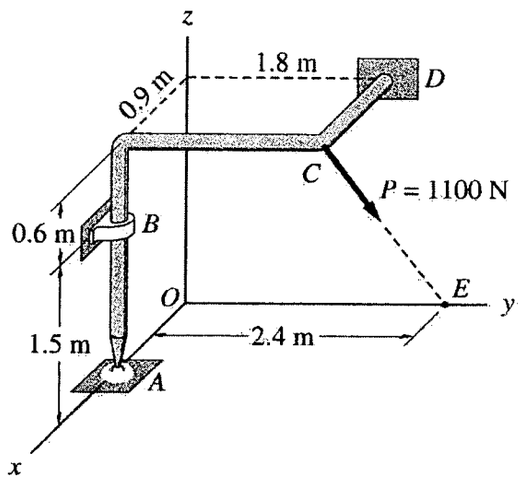
5. The bent rod of negligible weight is supported by a ball-and-socket joint at *A* and a single journal bearing at *B*. End *D* of the rod rests against a frictionless vertical surface. Find the reaction forces at *B* and *D*.



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