UNIVERSITY OF TORONTO

Faculty of Applied Science and Engineering

CIV 100S – MECHANICS

Final Examination

18th April 2011

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**

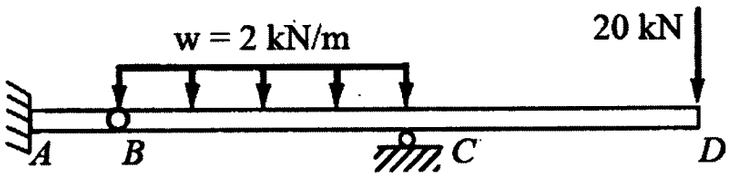
NOTES:

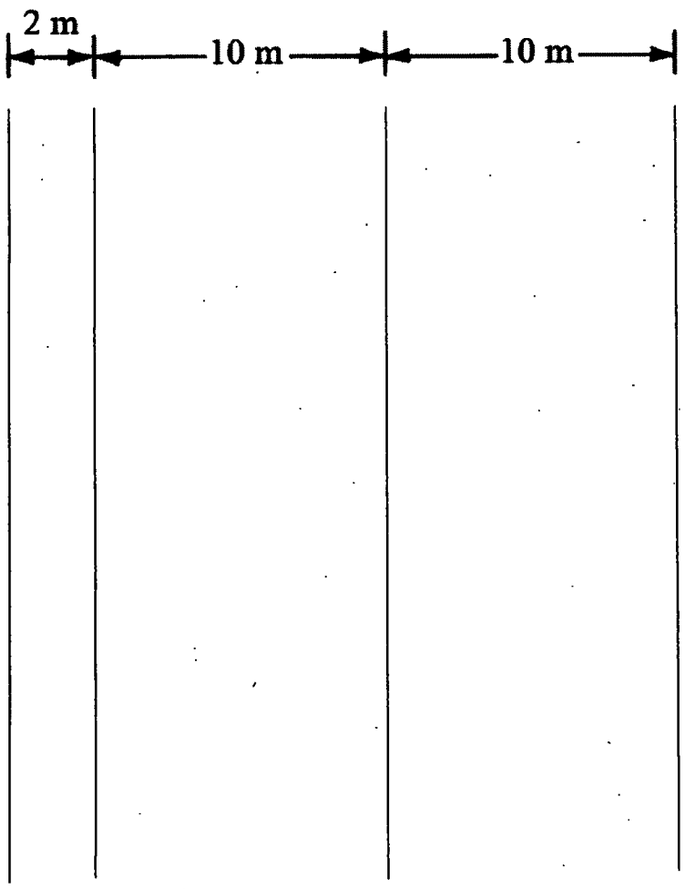
1. Make sure you have all 7 sheets of the examination paper. Page 7 is blank.
2. If you need more space for a question, please use the back of the preceding question. In all cases, please indicate clearly where your calculations are continued.
3. Answer all 5 (five) equal-value questions.
4. The only 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.

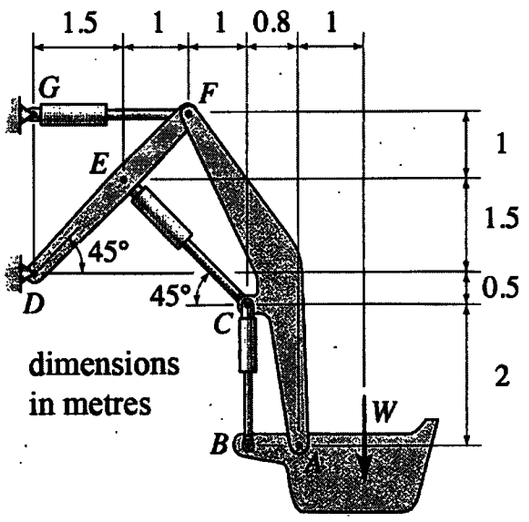
1	/12
2	/12
3	/12
4	/12
5	/12
TOTAL	**/60**

1. Draw the shear and bending moment diagrams for the beam hinged at *B* and loaded as shown, and indicate the values at 'critical' points. Assuming the beam is made of solid rectangular steel having a yield stress of 240 MPa, determine the dimensions of the beam cross-section, if the ratio of the dimensions of the cross-section is 2:1 and the beam is used 'efficiently' in bending. Steel rectangular bars are available in 10 mm increments. The load factor for steel in bending is 2.2.

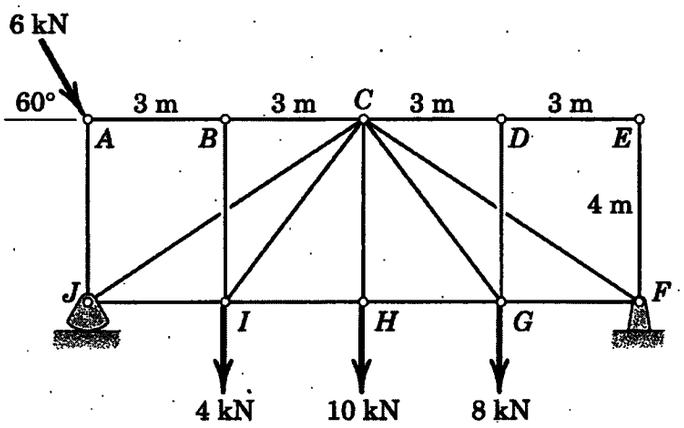


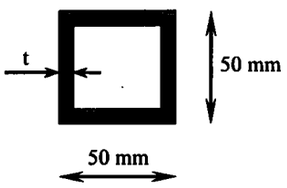


2. Shown below is a backhoe (a type of mechanical excavator) that is powered by three hydraulic cylinders (*BC*, *CE* and *FG*). If each of the three cylinders is capable of producing a maximum force of 1000 N, determine the largest weight, *W*, that can be supported in the position shown.



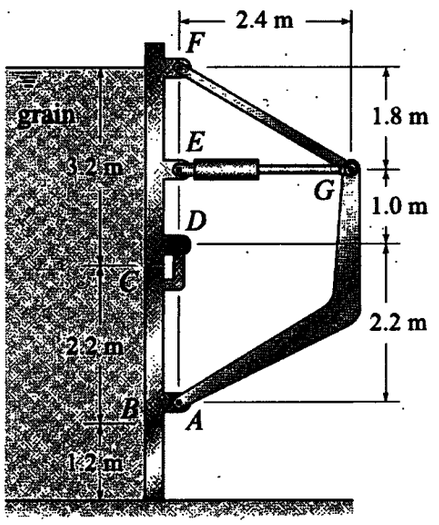
3. Members *CJ* and *CF* of the loaded truss cross but are not connected to members *BI* and *DG*. Calculate the forces in members *BC*, *CJ*, *CI* and *HI*. Determine the required wall thickness, t, for members *CI* and *HI*, if they have to be made from plywood and have the same square hollow section, as shown. The plywood is available in 2 mm increments. Also, determine the elongation of member *CH*. The modulus of elasticity for wood is 8000 MPa, the allowable stress in tension is 25 MPa and the load factor for members under axial load is 2.0.





Member Cross-Section

4. Grain is contained in a silo. The walls of the silo are fixed and the 0.8 m wide door *ABCD* can be opened to allow the grain to flow out. If the density of grain is 1500 kg/m^3, determine the force the hydraulic cylinder must support to keep the door closed, in the position shown.



5. Bar *ABCD* is supported by a cable *AED*, which passes over a frictionless pulley at *E*, and a collar *B* that can slide without friction along a vertical shaft with square cross-section. For the given force applied at *A*, determine the tension on the cable and all support reactions at collar *B*.