UNIVERSITY OF TORONTO

Faculty of Applied Science and Engineering

CIV 100S – MECHANICS

Final Examination

25th April 2014

Examiner: Prof. Michael Seica

Time allowed: 2½ hours

FAMILY NAME:_____GIVEN NAME(S):_____

(Please print clearly)

STUDENT NUMBER: _____

CIRCLE THE MODEL NUMBER OF YOUR CALCULATOR:

CASIO FX991   **SHARP EL520**

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.
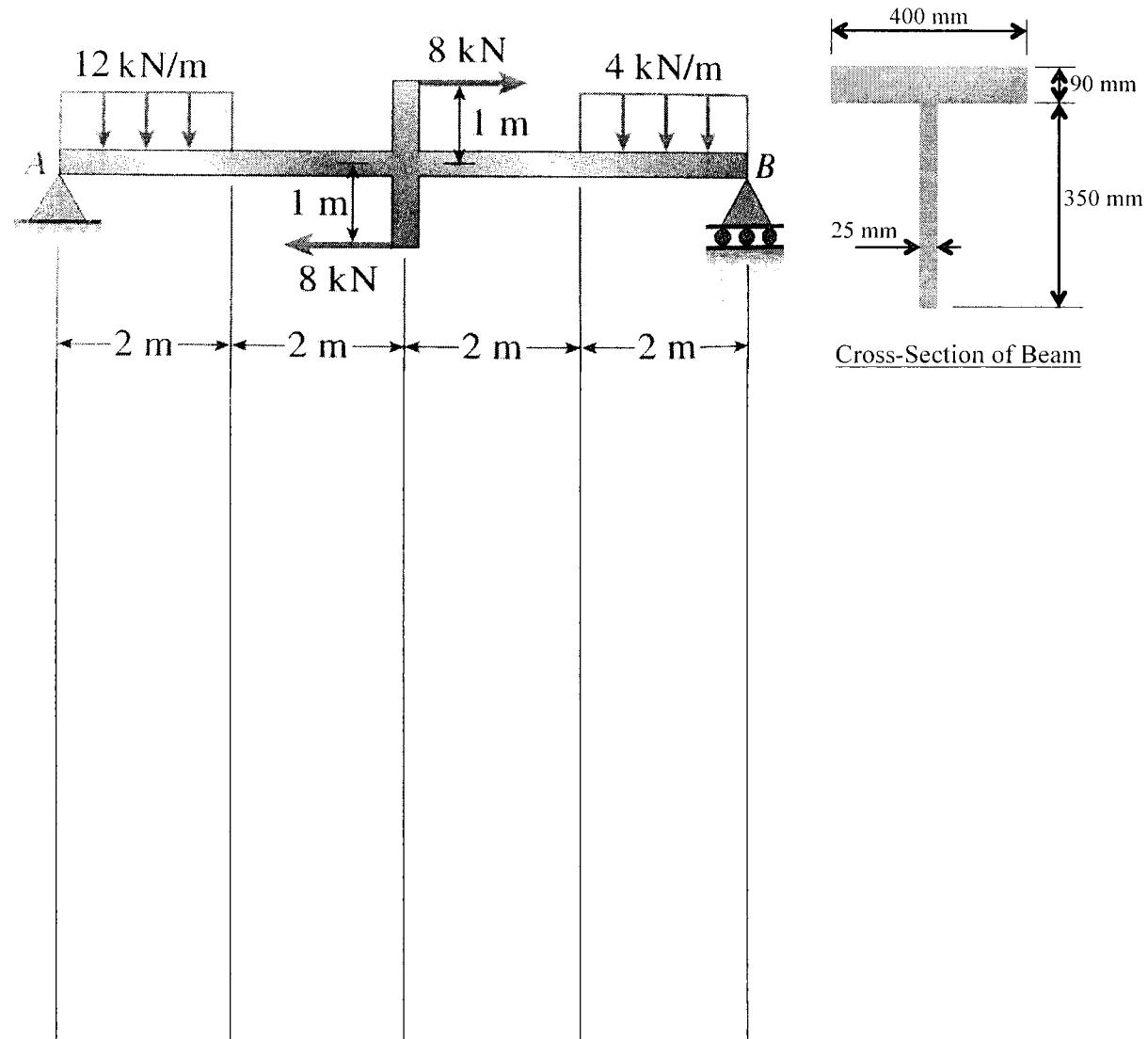
DO NOT WRITE IN THIS SPACE.

|	
1	/12
2	/12
3	/12
4	/12
5	/12
TOTAL	**/60**
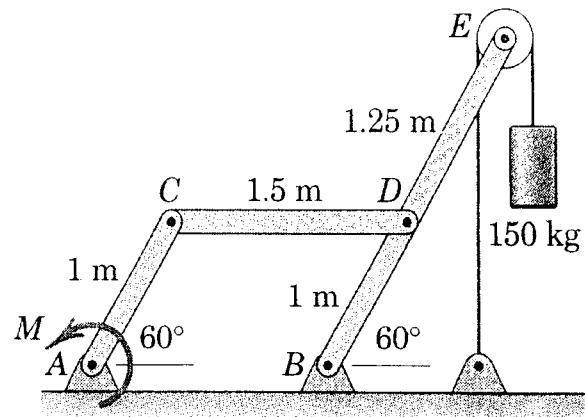
1. An eight-metre long wood beam has a 'T'-shaped cross-section, as indicated.
   (a) Draw the shear force and bending moment diagrams in the space provided.
   (b) Determine the load factor that was used for the design of the beam. The allowable stress for
        wood is 25 MPa.

12 kN/m   8 kN   4 kN/m

1 m

A   B

1 m

8 kN

|←—2 m—→|←—2 m—→|←—2 m—→|←—2 m—→|

400 mm

90 mm

350 mm

25 mm

Cross-Section of Beam
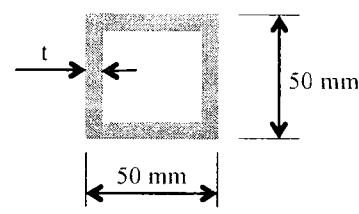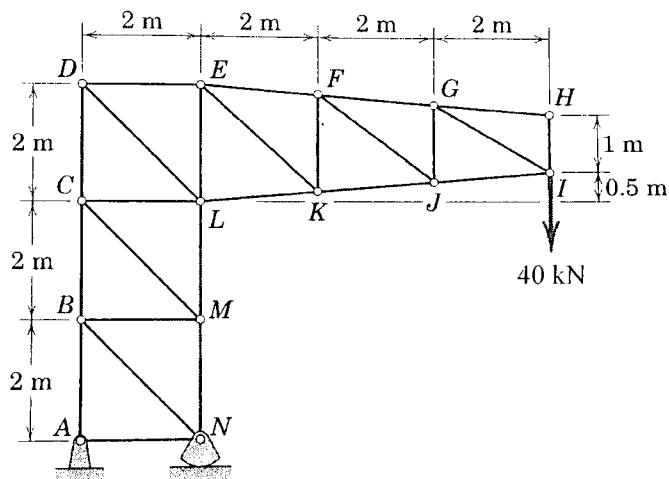
2. For the frame given, determine the moment M which must be applied at the pin support A to keep the frame in static equilibrium in the position shown. Also, calculate the magnitude of the reaction force components at A.
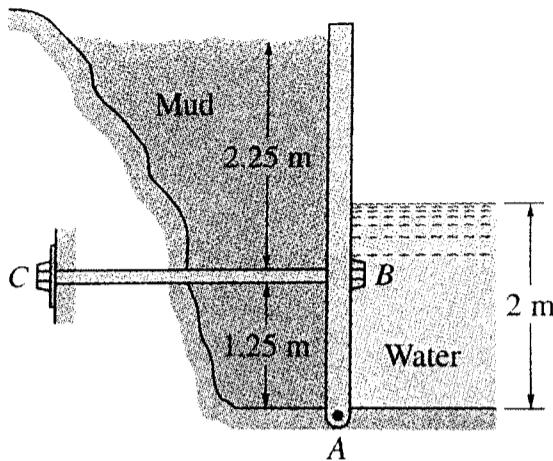
3. For the aluminium truss shown below:
  (a) Determine the forces in members DE and DL, and indicate if they are in tension or compression.
  (b) Member DE has a square hollow cross-section, as shown below. If the load factor for axial tension is 1.9 and the yield stress for aluminium is 207 MP, determine the thickness, t, of the required cross-section. The section wall thickness is available in 2 mm increments.
  (c) What is the elongation of member DE, as determined above? The modulus of elasticity for aluminium is 69,000 MPa.
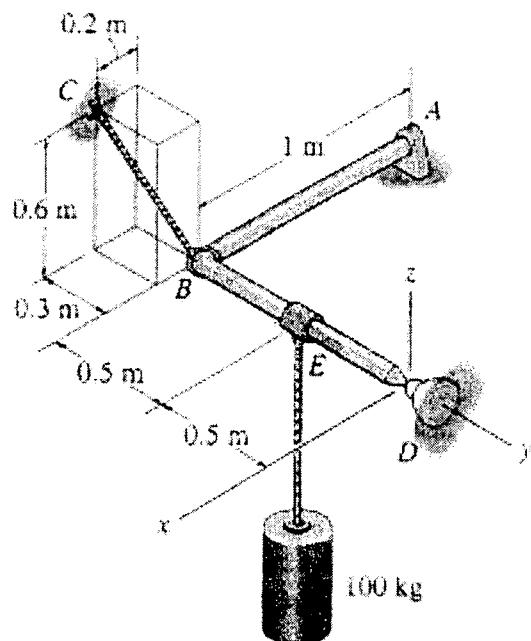

Cross-Section of Member DE

4. The vertical retaining wall that restrains liquid mud is supported by a continuous pin at A and by equally spaced (perpendicular to the page) horizontal anchor bolts BC which are embedded in bedrock at C. Determine the maximum safe spacing of the anchor bolts if the maximum allowable tension force in each bolt is 90 kN and the load factor for bolts in tension is 2.25. The density of liquid mud is 1,760 kg/m^3 and that of water is 1,000 kg/m^3.

5. The weightless bent rod $ABED$ is supported by a journal bearing at A, by a ball-and-socket at D and by cable BC. The rod is free to move at A in a direction parallel to the x-axis. Determine the tension in cable BC.