UNIVERSITY OF TORONTO

Faculty of Applied Science and Engineering

CIV 100S – MECHANICS

Final Examination

18th April 2016

Examiner: Prof. Michael Seica

Time allowed: 2-½ hours

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

STUDENT NUMBER: _____

CIRCLE THE MODEL NUMBER OF YOUR CALCULATOR:

CASIO FX991 **SHARP EL520**

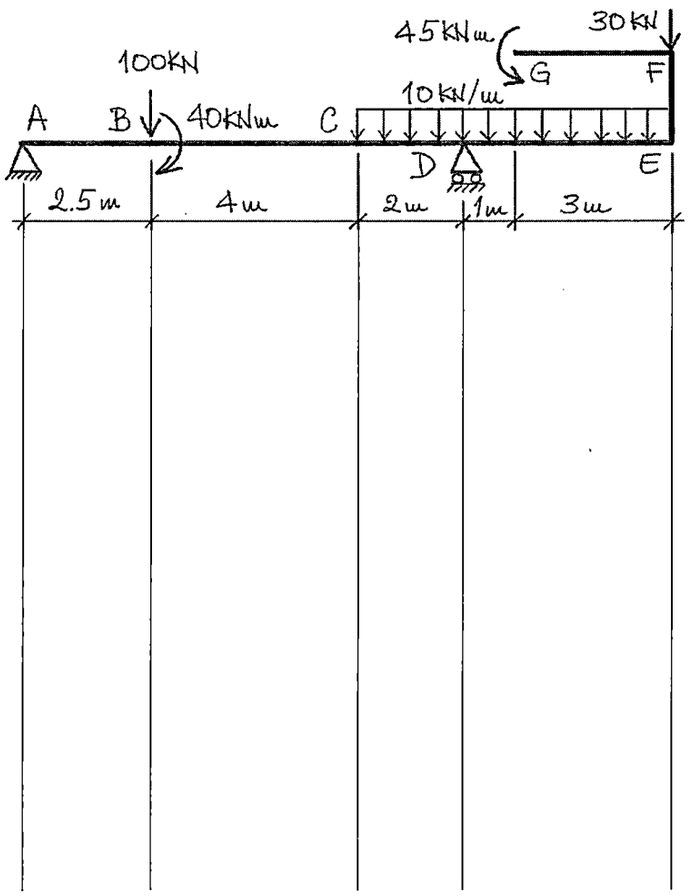
NOTES:
1. **Ensure that you have all 7 sheets of the examination paper. Page 7 is blank.**
2. **Answer <u>all</u> 5 (five) questions. The value of the questions is indicated below.**
3. **If you need more space for a question, please use the back of the preceding question. In all cases, please indicate 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 <u>not</u> remove the staple.**

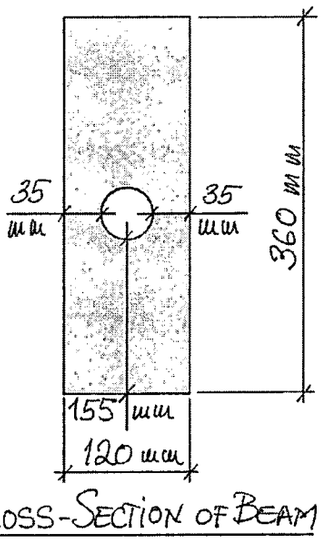
DO NOT WRITE IN THIS SPACE.

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

NAME: _____

1. The beam *ABCDE*, located in an existing structure, will be subject to the new, increased loads illustrated below. Member *EFG* is attached rigidly to the beam at *E*. You are required to:
(a) Draw the shear force and bending moment diagrams for the beam in the space reserved below, indicating the values at points *A*, *B*, *C*, *D* and *E*, as well as any potential local maxima or minima.
(b) The beam is made of a solid rectangular cross-section with a circular hole for electrical conduits, oriented as shown. The beam is constructed of Grade 6061-T4 aluminium with a yield stress of 110 MPa. Determine if the beam is safe to carry the new loads. The required load factor for flexure is 1.8. The second moment of area for circular areas is $\pi r^4/4$, where r is the radius of the area.

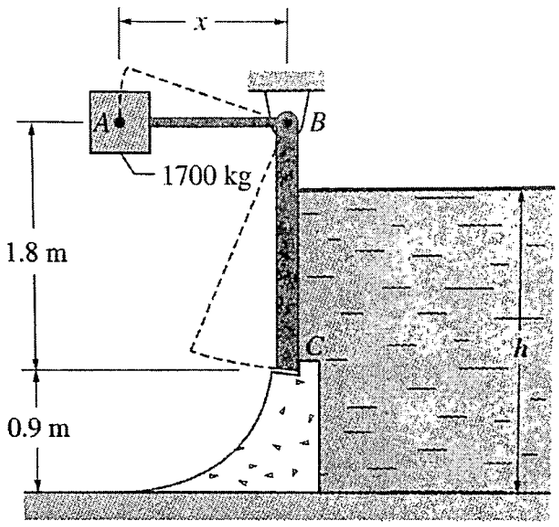




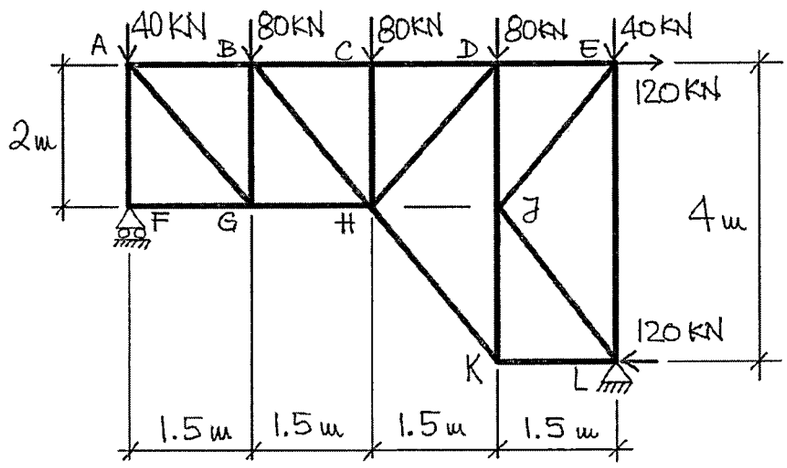
CROSS-SECTION OF BEAM

NAME: _____

2. The self-regulating, long floodgate ABC, pinned at B, is pressed against the lip of the spillway at C by the action of the weight at A. If, for safety considerations, the gate has to open when the fresh water level reaches a height $h = 1.8$ metres, determine the distance x, where the weight at A must be located. Neglect the weight of the gate.



3. The deep truss shown is supported by a pin at *L* and a roller at *F*. Indicate the zero-force members in the truss, if any.
(a) Determine the force in members *BC*, *CH*, *DH* and *HK*, and indicate whether they are in tension or compression.
(b) Member *EJ* has a tension force of 125 kN and is to be constructed from low-grade steel having a solid rectangular section of size *a* x *b*, where *b* is four times larger than *a*. The material can be fabricated in 5 mm increment sizes. Knowing that the yield stress for steel is 160 MPa, the load factor for axially loaded bars in tension is 2.0 and the modulus of elasticity for steel is 200,000 MPa, determine the dimensions for the required section. Also, determine the elongation of member *EJ*, as designed.



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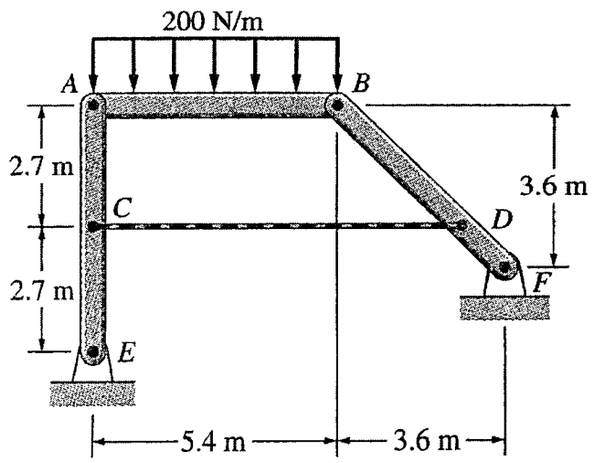
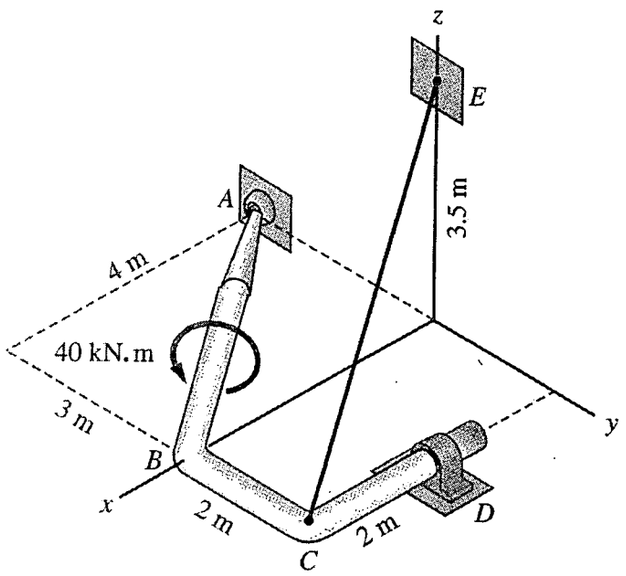
4. Neglecting the weight of the members in the frame shown, determine the force in cable *CD*.



5. The bent bar is supported by a ball-and-socket joint at A, a cable at C and a slider bearing at D. Determine the force in the cable due to the 40 kNm moment applied to bar AB, the direction of the moment vector being along AB. Neglect the weight of the bar.



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