UNIVERSITY OF TORONTO

Faculty of Applied Science and Engineering

CIV100F and APS160F – MECHANICS

Final Examination – Sections 1, 2, 3, 4, 5, 6, 7, 8 and Online

Thursday, 11th December 2014

Examiner: Staff in Civil Engineering

Time allowed: 1-½ hours

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

STUDENT NUMBER: _____ **DEPT. (ECE, Track One, etc.)**_____

CIRCLE YOUR SECTION AND THE NAME OF YOUR INSTRUCTOR:

1. Grasselli, Giovanni
2. Grasselli, Giovanni
3. Briggs, Scott
4. Mercan, Oya
5. Guner, Serhan
6. Kamaleddine, Fouad
7. Sun, Min
8. Packer, Jeffrey

Online. Seica, Michael

CIRCLE YOUR CALCULATOR TYPE:

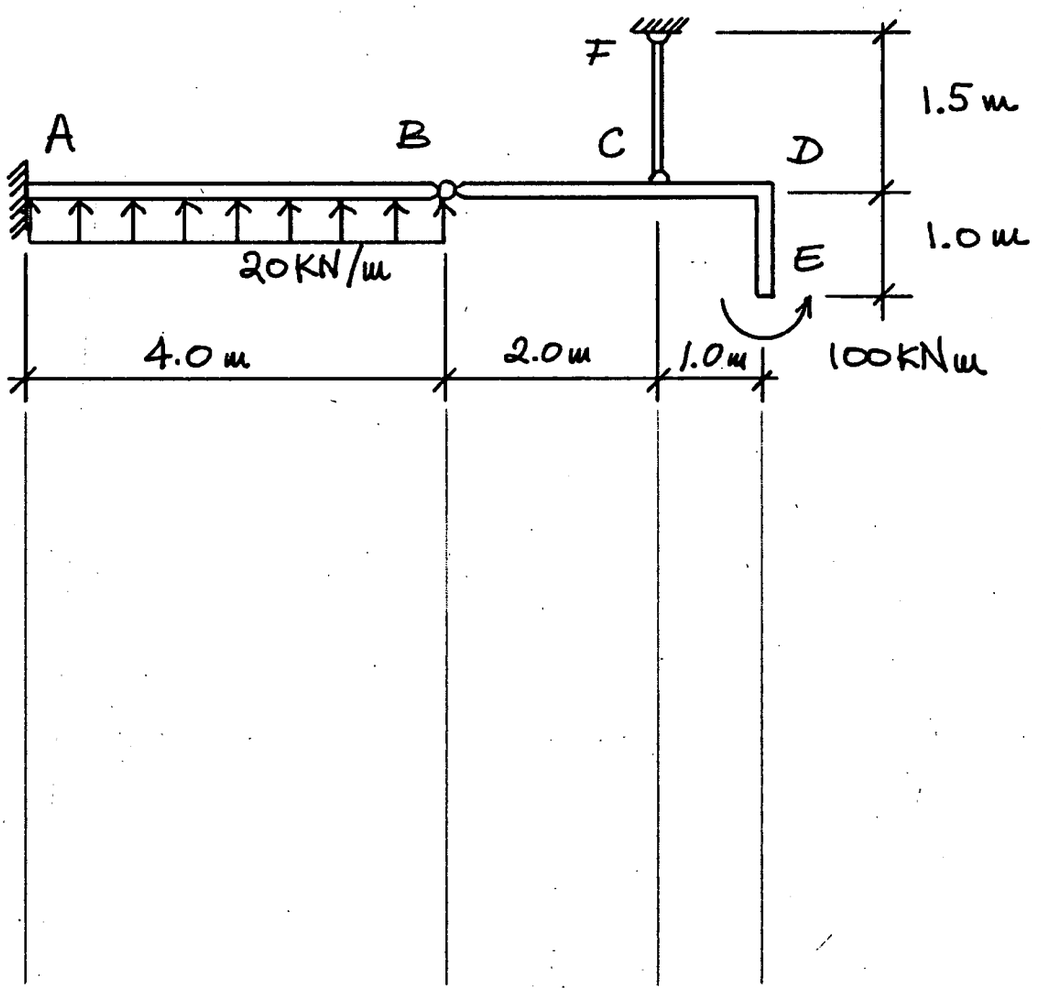
CASIO 991 **SHARP 520**

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 permitted 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.**

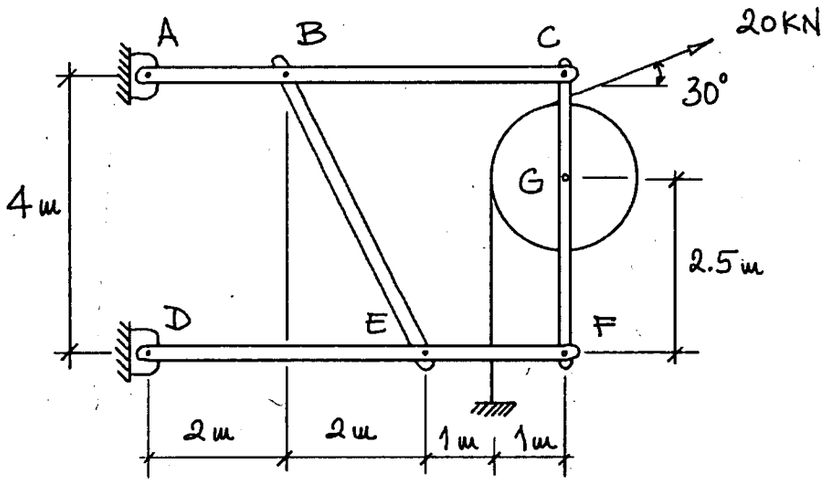
DO NOT WRITE IN THIS SPACE.

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

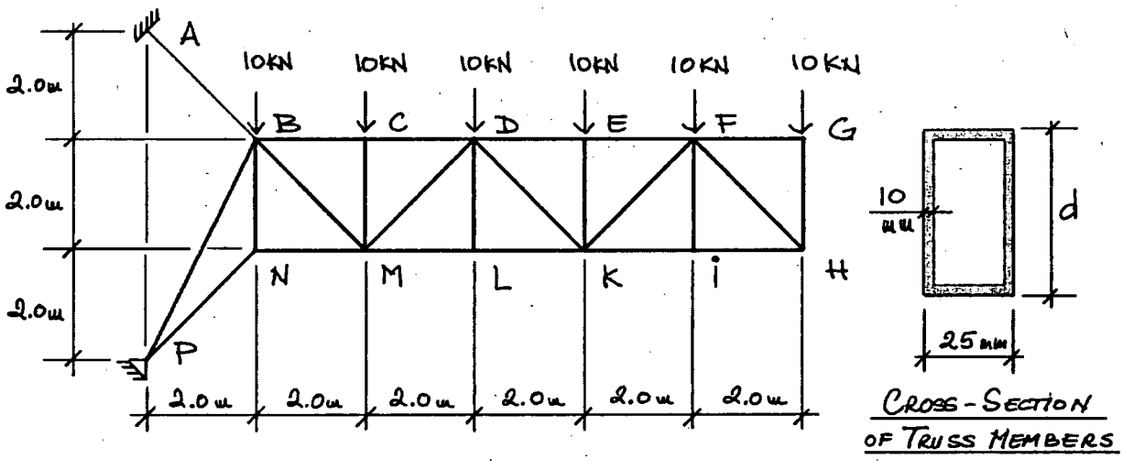
1. Draw the shear force and bending moment diagrams in the space reserved below for the beam *ABCD* shown, indicating the values at points *A*, *B*, *C* and *D*, as well as any potential local maxima or minima. The beam is fixed at *A*, has an internal pin at *B* and is supported by a vertical pin-ended hanger at point *C*. The only material available to construct this beam is flat steel plate with a thickness of 100 mm, which can be cut in strips of various widths, in multiples of 10 mm. Determine the cross-sectional dimensions of the beam having the least weight and express you final answer in terms of the 'Width x Height' (i.e. 'Horizontal x Vertical' dimensions) of the cross-section. The yield stress for the steel available is 300 MPa and the load factor for bending is 1.9.



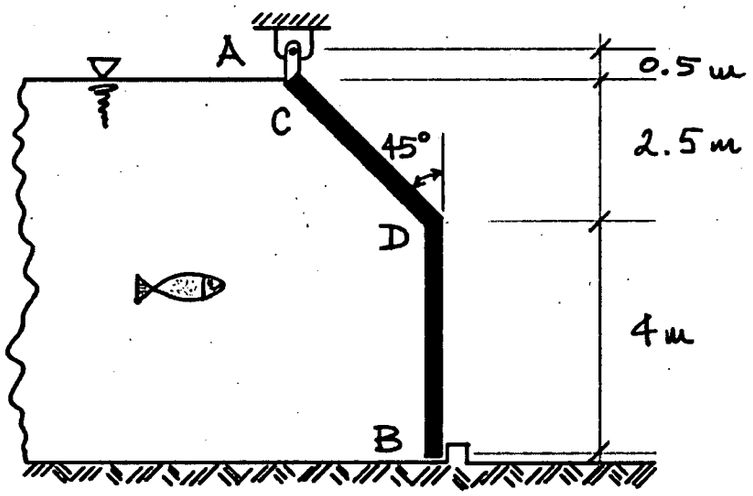
2. Determine the reaction components at *A* and *D* for this pin-connected frame. The cable passes behind the frame without touching it and the frictionless pulley is pinned to member *CF* at *G*.



3. The truss shown is supported by a pin at *P* and a diagonal cable *AB*, at *B*. Determine the force in members *BM*, *NM*, *CM* and *CD*, and indicate whether they are in tension or compression. Members *CD* and *BM* are to be constructed from the same-size rectangular box cross section (shown), which is fabricated from 10 mm thick welded steel plate that can be cut in 5 mm increments. Knowing that the yield stress for steel is 350 MPa, the load factor for axially loaded bars is 2.25 and the modulus of elasticity for steel is 200,000 MPa, determine dimension *d* for the required section. Also, what is the elongation of member BM?



4. A long, continuous steel gate, *BC*, restrains fresh water as shown and is supported by hinges at *A*, which are spaced at 8 metre equal intervals in the longitudinal direction of the gate, and a continuous stop at *B*. Determine the reaction components for a typical hinge at *A*, and at *B*.



5. The turnbuckle on cable *AD* is tightened until the magnitude of the *y*-component of the ball-and-socket reaction at *O* is 2,700 N. Determine the resulting force in cable *AD*. The mass of bar OAC is small and can be neglected.