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final-exam-f6d53

#132 1 of 12

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, 14th December 2017

Examiner: Staff in Civil Engineering

Time allowed: 2-½ 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. Panesar, Daman
2. Saxe, Shoshanna
3. Mercan, Oya
4. Bruun, Edvard
5. El-Diraby, Tamer
6. Tousignant, Kyle
7. Xia, Kaiwen
8. Packer, Jeffrey

Online. Seica, Michael

CIRCLE YOUR CALCULATOR TYPE:

CASIO 991 **SHARP 520**

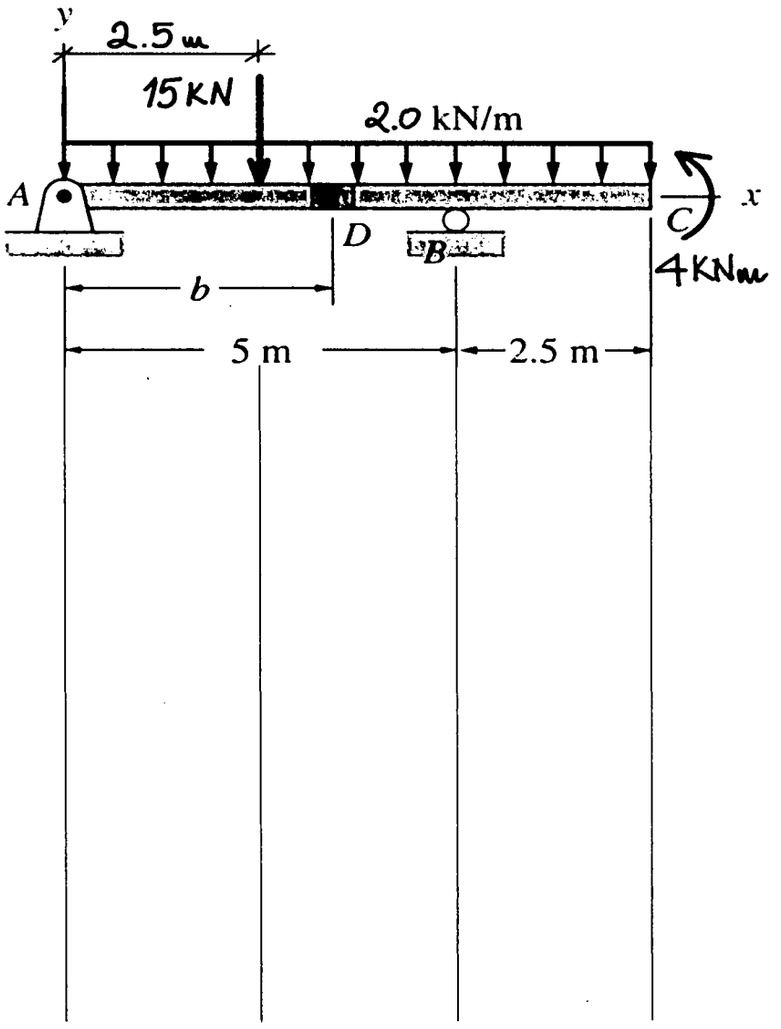
Notes:
1. **Ensure that you have all 12 pages of the examination paper. Page 12 is blank.**
2. **Answer all five questions. The value of the questions is indicated below.**
3. **If you need more space for a question, continue on the page indicated at the bottom.**
4. **The only calculators permitted 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 not remove the staple.**

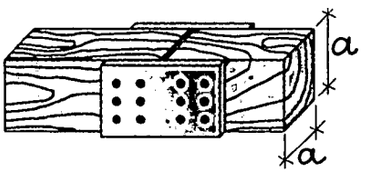
DO NOT WRITE IN THIS SPACE.

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

NAME: _____

1. The 7.5 m-long timber floor beam, having a square cross-section, is to be designed to carry the loads shown. Because only 5 m-long timbers are available, the beam is to be fabricated from two pieces connected together by a nailed joint, *D*. You are required to:
(a) In the space provided, draw the shear force and bending moment diagrams for the beam indicating the values at points *A*, *B*, and *C*, and any potential local maxima and minima;
(b) If wood has a strength of 30 MPa, in both tension and compression, determine the required size, *a*, for the beam such that it can safely carry the floor loads. The load factor for timber in bending is 1.67; and
(c) Determine the distance *b* for the most advantageous position of the joint D, knowing that nailed joints are strong in shear but weak in bending.





Detail of joint at *D*

Solution can be continued on Page 3

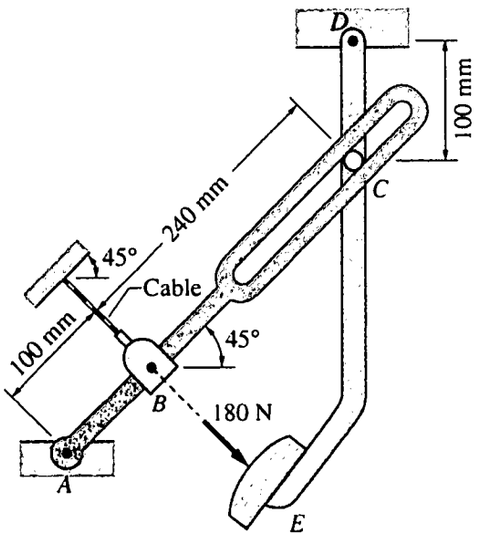
NAME: _____

Question 1 can be continued on this page.

Solution can be continued on Page 12

NAME: _____

2. Determine the tension in the cable at *B* when the 180 N force is applied to the pedal at *E*. Also, calculate the reaction force components at the pins at *A* and *D*. If the cable at *B* has a diameter of 7.0 mm and the yield stress of the cable material is 70 MPa, determine the actual load (safety) factor for the cable. In your opinion, is this a 'safe' design? In all your calculations, neglect friction and the mass of the components.



Solution can be continued on Page 5

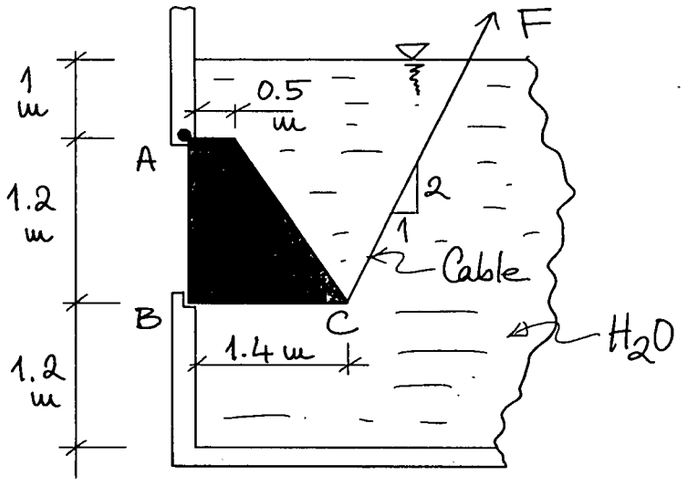
NAME: _____

Question 2 can be continued on this page.

Solution can be continued on Page 12

NAME: _____

3. The fresh water channel illustrated can be emptied by opening the 6,300 kg solid gate *ABC* (represented in cross-section). The gate is 5 m wide (into the paper), is pinned at *A*, rests against the vertical wall at *B* and can be operated by pulling on the cable attached to it at *C*. Determine the minimum magnitude of the force, F, required to open the gate.



Solution can be continued on Page 7

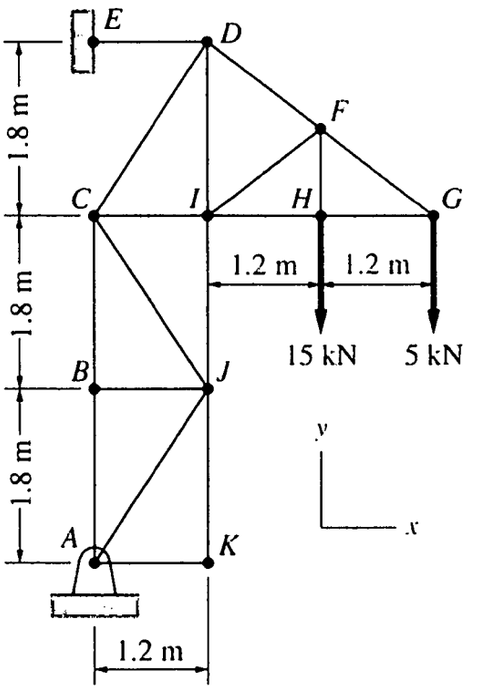
NAME: _____

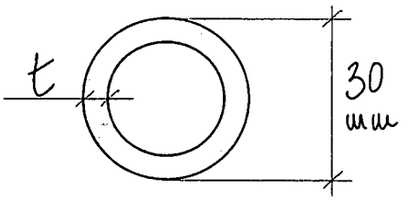
Question 3 can be continued on this page.

Solution can be continued on Page 12

NAME: _____

4. Determine the force in members *BC*, *CJ*, *DF*, *FH*, *HI* and state if the members are in tension or compression. Members *CJ*, *DF* and *FH* are to be fabricated using the same circular hollow section having an external diameter of 30 mm and a yield stress of 150 MPa. Knowing that the load factor for members in axial tension is 1.5, determine the minimum wall thickness of the cross-section, *t*, such that the three members are safe. The wall thickness can be selected in 0.5 mm increments. Also, what is the elongation of member *DF*? The modulus of elasticity for the material is 69,000 MPa.





Cross-Section of CJ, DF, FH

Solution can be continued on Page 9

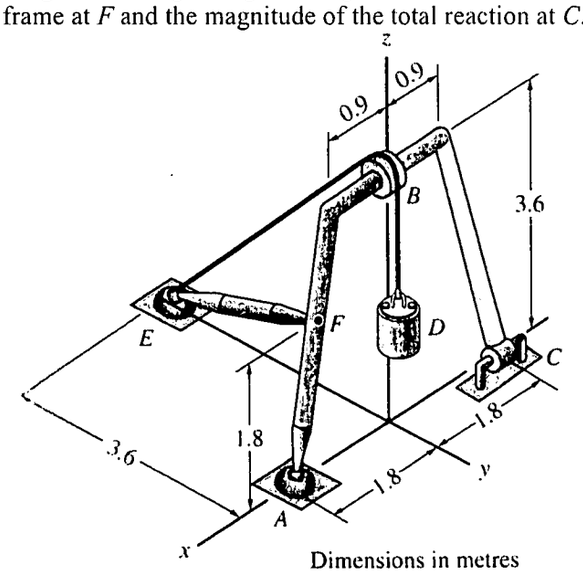
NAME: _____

Question 4 can be continued on this page.

Solution can be continued on Page 12

NAME: _____

5. The frame shown is supported by a ball-and-socket joint at *A* and a pin at *C*. (The pin is similar to a ball-and-socket joint that was modified to allow translation in the *x*-direction.) The strut *EF* has a ball-and-socket joint at each end. The cable *EBD* runs over a small frictionless pulley at *B* and carries a 2,700 N weight at *D*. Neglecting the weight of the members, determine the force exerted by member *EF* on the frame at *F* and the magnitude of the total reaction at *C*.



Dimensions in metres

Solution can be continued on Page 11

NAME: _____

Question 5 can be continued on this page.

Solution can be continued on Page 12

NAME: _____