Faculté de génie
Génie mécanique

uOttawa
L'Université canadienne
Canada's university

Faculty of Engineering
Mechanical Engineering

GNG 1100 - ENGINEERING MECHANICS

Final Examination
12 December 2006
Profs. Hallett and Skaff

Time: 3 hours

Closed Book. Non-programmable calculators only allowed. Free-body diagrams must be drawn wherever appropriate. Marks will be deducted for missing or incorrect free-body diagrams.

At the end of the exam, when time is up, **stop working and close your exam booklet**. Do not move or speak until all exams have been picked up and the proctor tells you that you may leave.

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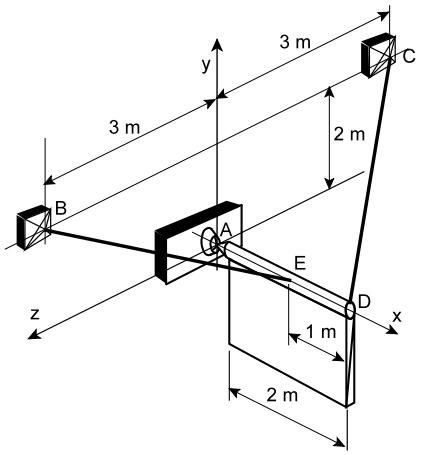
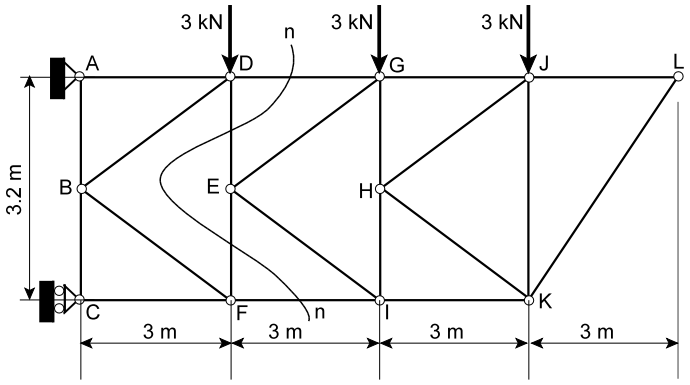
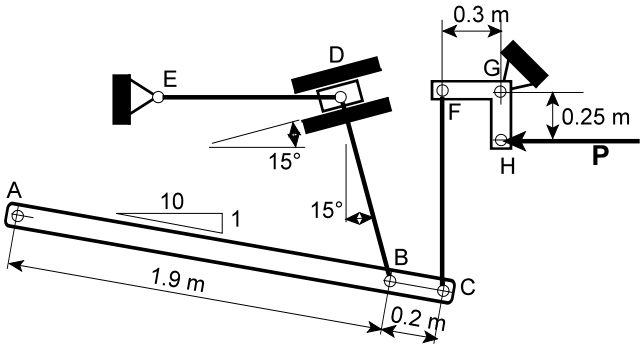
1. (12 marks total) A sign weighing 1.2 kN is supported by a ball and socket joint at point A and by two cables EB and DC.
(a) (4 marks) Write the forces in cables EB and DC as vector components.
(b) (8 marks) Determine the forces in cables EB and DC.



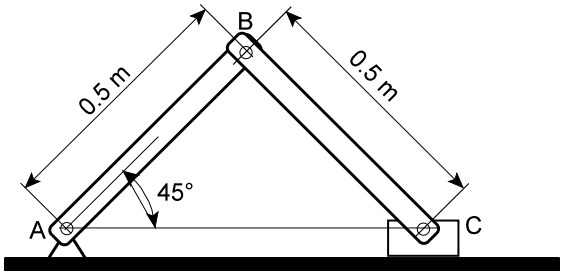
2. (8 marks total) The sketch shows a pin-jointed truss loaded by three 3 kN forces as shown.
(a) (2 marks) Identify all zero-force members in the truss.
(b) (6 marks) Determine the forces in members DG and FI, using the method of sections with the section taken along the line n - n. State whether these members are in tension or compression. **Note:** Use the method of sections - a method of joints solution will get a mark of zero (0).



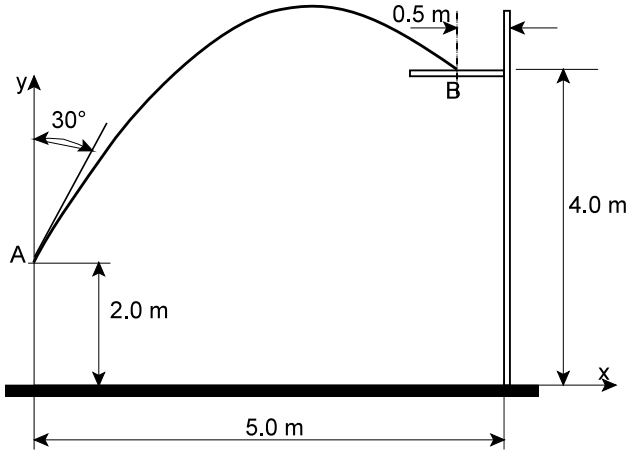
3. (12 marks) The sketch shows a mechanism which is used to exert a horizontal force P = 2.4 kN. D is a frictionless slide, while ED is a horizontal link, FC is a vertical link, and DB is also a link. Arm FG of the bellcrank FGH is horizontal, while GH is vertical. Determine the reactions at point A required to keep the system in equilibrium. All joints are pinned, and you may neglect the weights of all parts.



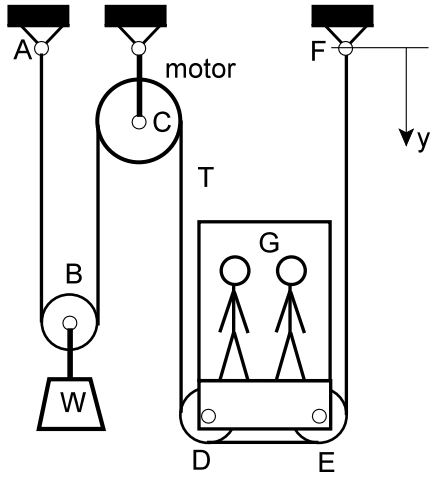
4. (12 marks) Two bars AB and BC each weigh 50 N, the weight being uniformly distributed along the length of the bar. The bars are connected to each other, to a support at A and to a slide at C by pin joints. Assuming the slide to be of negligible weight, determine the coefficient of static friction at C if slipping impends.



5. (6 marks) A ball is thrown upwards at an angle of 30° to the vertical and passes through a hoop at the location shown. Determine the initial velocity of the ball. The gravitational acceleration is g = 9.80 m/s^2.



6. (10 marks total) The sketch shows - in simplified form - the glassed-in elevator in the SITE building. A cable anchored at points A and F supports the elevator through pulleys D and E underneath the elevator cage, while the pulley B supports a counterweight W. These pulleys are all frictionless. The cable is driven by an electric motor which drives a drum at C around which the cable passes. The elevator with passengers has a mass of 1500 kg, and it is accelerating upwards at a rate of 3 m/s^2.



(a) (5 marks) Determine the tension T in the part of the cable extending from C through D and E to F.

(b) (3 marks) Determine the acceleration of the counterweight.

(c) (2 marks) If the initial velocity of the elevator cage is 0 m/s, determine the velocity of the counterweight with respect to the cage after 1 s.

Total marks for this paper: 60