GNG 1100 - ENGINEERING MECHANICS

Final Examination — Time: 3 hours
17 December 2004 —
Profs. Hallett and Skaff

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.

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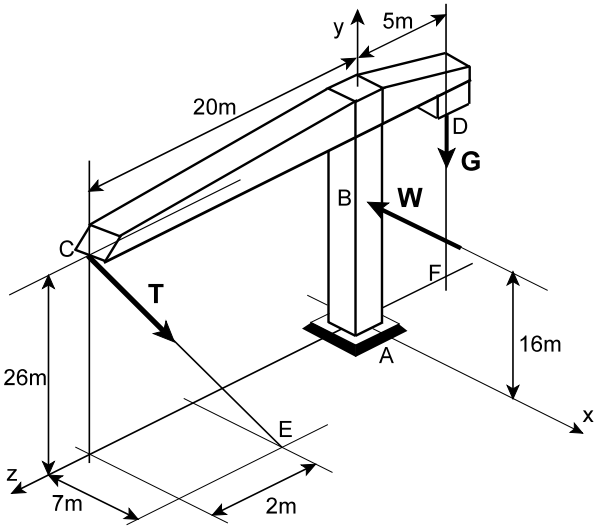
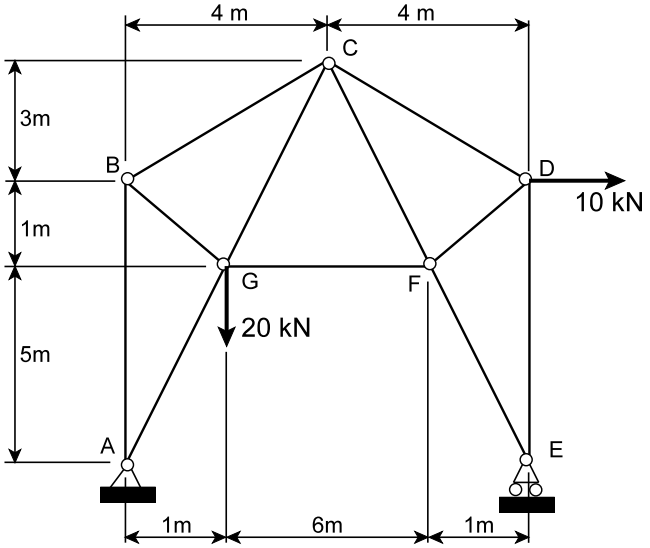
1. The sketch shows a tower crane subjected to three forces: the load T = 5.4 kN, the wind load W = 2.0 kN, and the counterweight G = 50 kN. The crane is held up by a fixed support (fixed connection to the ground) at point A.
(a) (3 marks) Write force **T** as vector components.
(b) (8 marks) Determine the reactions at the base of the crane (point A).



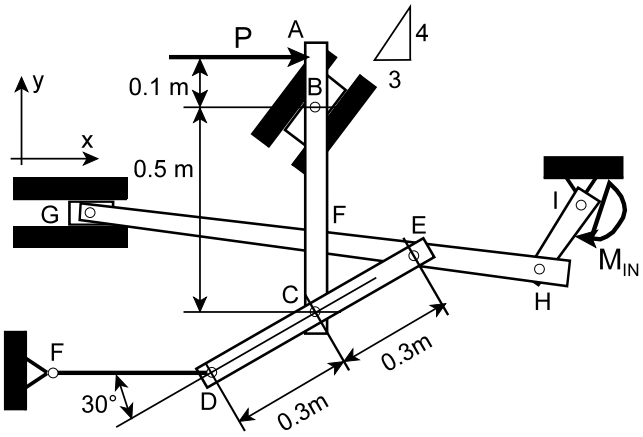
2. (12 marks) The sketch shows a truss loaded by two forces. Determine the forces in members CD, CF and GF using the method of sections, stating whether each is in tension or compression. All joints are frictionless pins. **Note**: a method of joints solution will be given a mark of zero (0).



3. In the linkage shown in the sketch, member ABC is vertical and link FD is horizontal. All joints are pinned, and B and G are attached to frictionless slides. There is no connection between the two members at point F. A force **P** is applied to point A and a couple $\mathbf{M}_{IN}$ to point I.

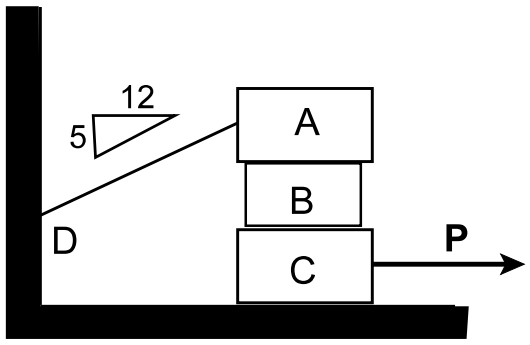
(a) (4 marks) Draw free-body diagrams of all parts of this linkage. Identify all two-force members.

(b) (10 marks) If the horizontal force P = 2 kN, determine all forces on member DCE. **Hint**: note that it is only necessary to analyze members ABC and DCE.

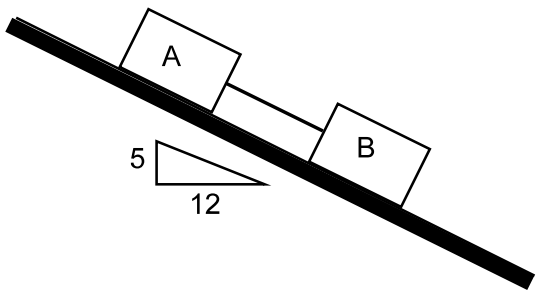


4. (a) (9 marks) Three blocks, each of weight 10 N, are stacked as shown, and the top block is connected to the wall by a cord. The coefficient of static friction between all surfaces is $\mu_S = 0.40$. Determine the force P required for motion of block C to be impending. **Hint**: assume that block B doesn't slip on block C, and take B and C together as a single free-body.

(b) (4 marks) Prove that B does not slip on C.



5. (10 marks) Two blocks connected by a light cord are sliding down an incline. Block A has a mass of 5 kg and a coefficient of kinetic friction $\mu_{KA} = 0.2$, while block B has a mass of 2 kg and a coefficient of kinetic friction $\mu_{KB} = 0.1$. The blocks have an initial velocity of 0, and at time t = 0 they have just started to move. Determine the acceleration of the blocks and the tension in the cord.



Total marks for this paper: 60