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GNG 1105 – ENGINEERING MECHANICS

Supplemental Examination
February, 2011.

Time: 3 hrs.

Profs. Skaff, Van Blaeren and Flores-Vera.

Closed Book Examination. Programmable calculators are not allowed.

Free-body diagrams must be drawn wherever appropriate.

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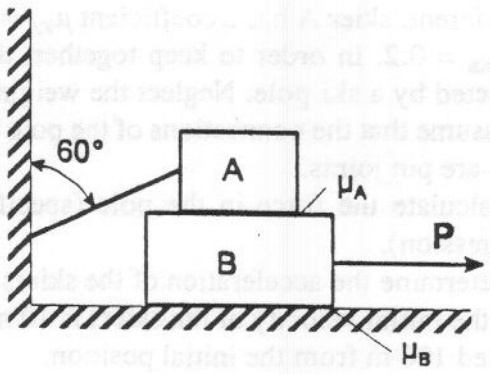
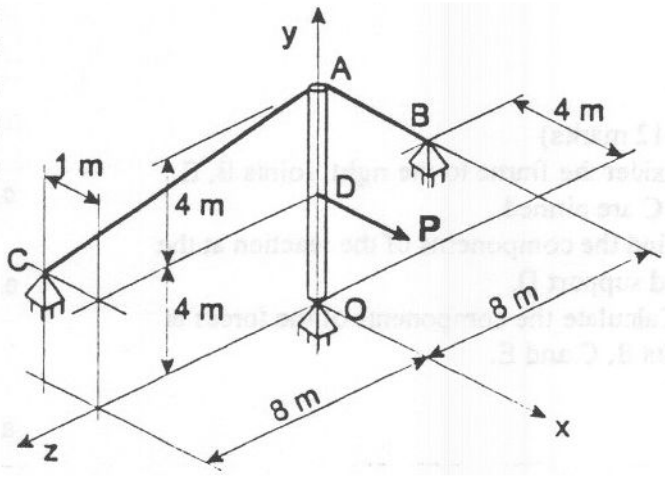
1. **(12 marks) Block A in the sketch has a mass of 20 kg and is attached to the wall by means of a cord at an angle of 60° to the vertical, while Block B has a mass of 40 kg. The static friction coefficient between A and B is μ_{SA} = 0.2, while the static friction coefficient between B and the floor is μ_{SB} = 0.3. Determine the minimum force P required to cause Block B to slide.**



2. (12 marks) A mast is supported by a frictionless ball and socket joint at O and by two cables AB and AC. Determine the tensions in the two cables if the applied load P = 20 kN. Point B lies in the x-z plane, while point C lies 4 m above the x-z plane.



3. (12 marks) The sketch shows a pin-jointed truss, loaded with a single force **P** as shown.

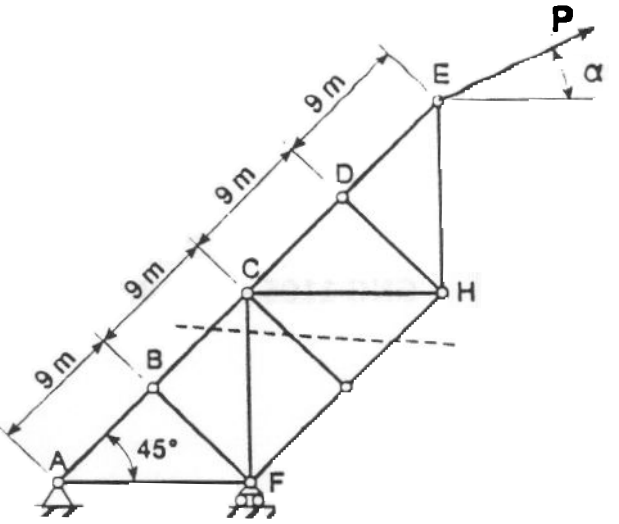
(a) Identify all zero-force members.

(b) If the force in member GH is 0.6 kN in compression, and the force in member BC is 4.8 kN in tension, calculate the values of P and the angle α. **Hint**: use a section that cuts members BC, CF, CG and GH.

Trigonometric identities:

$\sin(\theta \pm \phi) = \sin\theta\cos\phi \pm \cos\theta\sin\phi$

$\cos(\theta \pm \phi) = \cos\theta\cos\phi \mp \sin\theta\sin\phi$

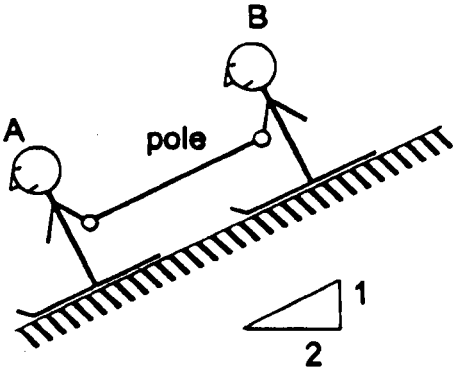


4. (12 marks) Two skiers, A and B, are skiing down a 1:2 slope. Skier A has a mass of 60 kg and B a mass of 80 kg. Owing to differences in ski wax, the friction coefficients are different: skier A has a coefficient $\mu_{kA} = 0.1$, while B has $\mu_{kB} = 0.2$. In order to keep together, the skiers are connected by a ski pole. Neglect the weight of the pole, and assume that the connections of the pole to the skiers' hands are pin joints.

(a) Calculate the force in the pole (specify tension or compression).

(b) Determine the acceleration of the skiers.

(c) If the initial velocity of the skiers is 10 m/s, determine the velocity of the skiers after they have traveled 100 m from the initial position.

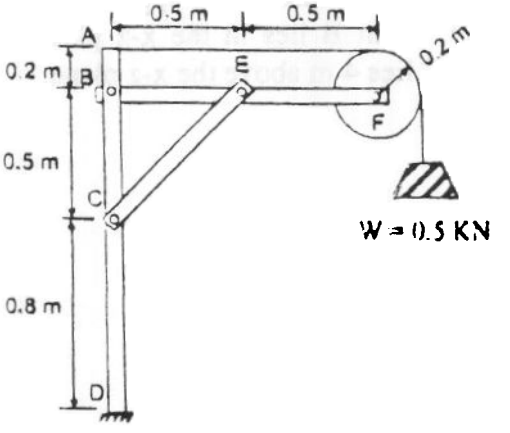


5. (12 marks)

Consider the frame to the right. Joints B, E and C are pinned.

a) Find the components of the reaction at the fixed support D.

b) Calculate the components of the forces at joints B, C and E.



Answers to the problems of the Supplemental Examination of GNG1105 (FALL'2010) – Supplemental Examination Date: February 2011.

Problem 1: P=228.62 N

Problem 2: Tab = 24 kN and Tac = 18 kN

Problem 3:

a) Zero-force member are : BF, CG and DH.
b) P = 3.91 kN and alfa =40.60 degrees.

Problem 4:

a) P = 30.60 N (T)
b) a = 3 m/s2
c) v = 26.50 m/s

Problem 5:

a) Md = 0,50 kN.m (ccw); Dx = 0 and Dy = 0.50 kN
b) Bx = 0.50 kN; By = 0.51 kN and Fec = 1.43 kN in direction of the two-force member EC.