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GNG 1105 – Engineering Mechanics

Final Examination — Duration: **3 hours**

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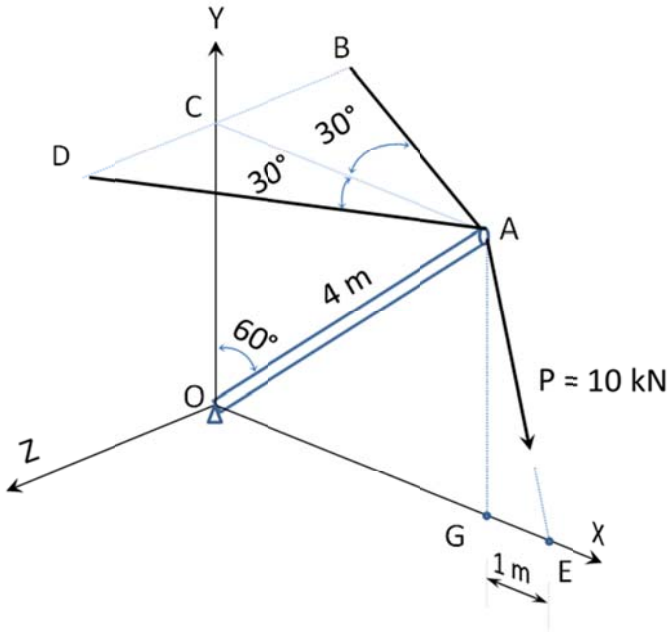
Closed Book Examination. Programmable calculators are not allowed.

Free-body diagrams must be drawn wherever applicable.

Problem 1. (14/60)

Load ***P*** = 10kN is supported by rod ***OA*** and cables ***AB*** and ***AD*** as shown in the diagram. Rod OA lies in the ***xy*** plane and the force in it is along its longitudinal axis. Cables ***AB*** and ***AD*** lie in a plane parallel to the ***xz*** plane. Rod ***OA*** is supported by a ball and socket joint at ***O***. Rod ***OA*** is of negligible weight.

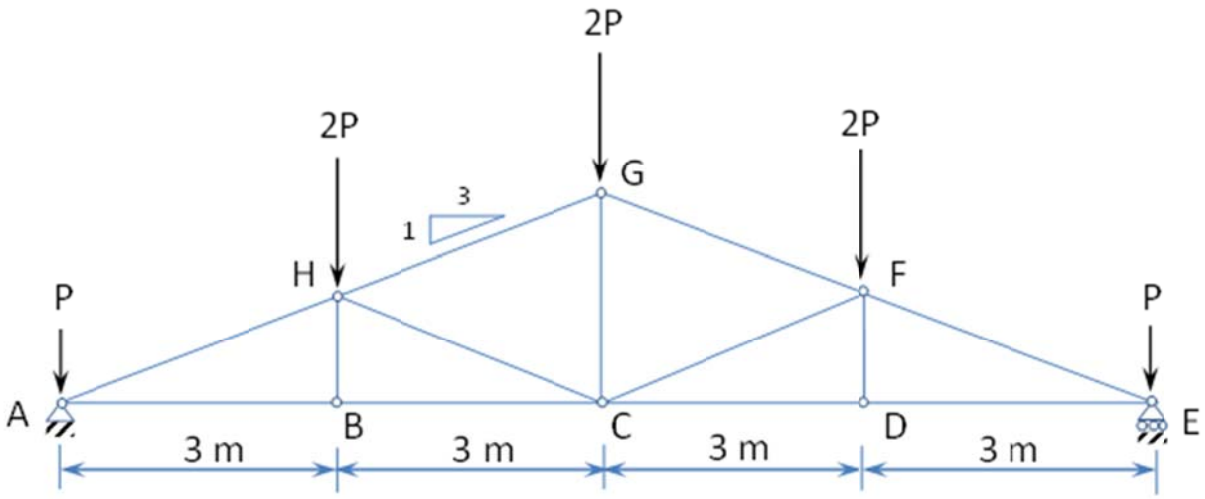


a) Write the forces in rod ***OA***, cables ***AB*** and ***AD*** and the force ***P*** in **vector form**.
b) Determine the magnitudes of the force in rod ***OA*** and the tensions in cables ***AB*** and ***AD***.

Problem 2. (12/60)

The sketch shows a standard Howe roof truss. It is subjected to a snow loading which results in ***P*** = 1.5 kN. The support at ***A*** is a pin joint and that at ***E*** is a roller. Determine:

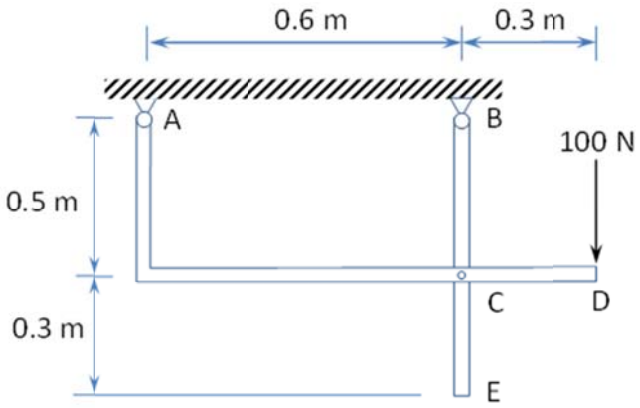
a) The reactions at the supports.
b) The forces in members ***BC***, ***HC*** and ***HG***, by the **method of sections**, stating whether each is in tension or compression.



Problem 3. (12/60)

The sketch to the right shows a frame which is supported by pin joints at ***A*** and ***B***. The two members (***ACD*** & ***BCE***) are joined by a pin at ***C***.
Note: Members ***ACD*** and **BCE** are continuous.

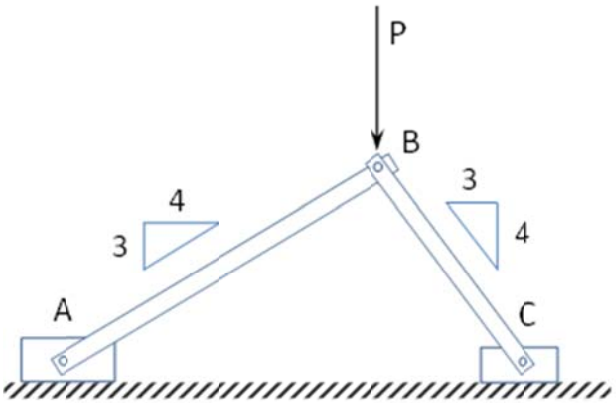
Determine the reactions at ***A*** and ***B***.



Problem 4. (12/60)

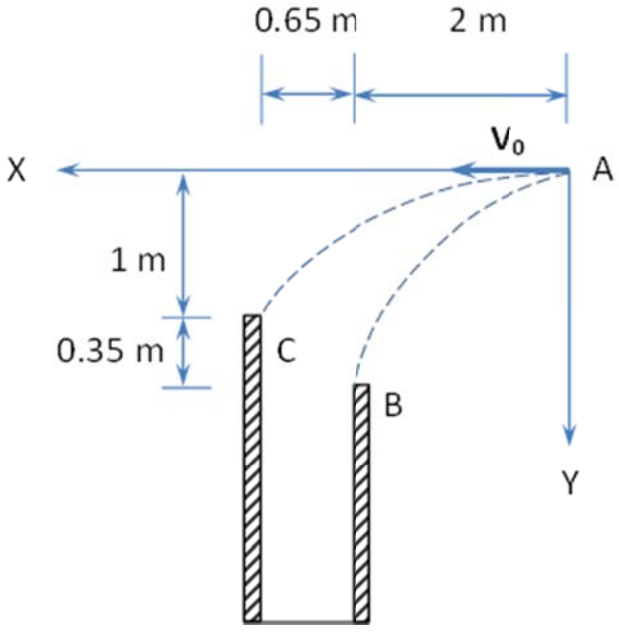
Block ***A*** weighs ***200N*** and block ***C*** weighs ***120N***. The coefficient of static friction between each block and the horizontal surface is $\mu_s = 0.3$.
Bars ***AB*** and ***BC*** are of negligible weight. The applied force ***P*** is vertical and all joints are pinned.

a) Write the force in ***BA*** and that in ***BC*** as functions of ***P***.
   Hint: you may take point ***B*** as a free-body diagram.
b) Find the magnitude of the applied load ***P*** for which motion will be impending.
   Hint: assume that slipping impends at ***C*** but not at ***A***.
c) Verify that slipping does not occur at ***A***.



Problem 5. (10/60)

Sand is discharged at ***A*** from a horizontal conveyor belt with an initial velocity V_o. Determine the range of values of V_0 for which the sand will enter the vertical chute down (*i.e.* between ***B*** and ***C***).



<u>Useful Equations:</u>

$$x = x_0 + vt$$
$$v = v_0 + at$$
$$x = x_0 + v_0 t + \frac{1}{2}at^2$$
$$v^2 = v_0^2 + 2a(x - x_0)$$

$$\bar{F} = m\bar{a}$$
$$\sum \bar{F} = m\bar{a}$$