

NAME:  
STUDENT'S NUMBER:

GNG1100 E - ENGINEERING MECHANICS

Mid-term Examination  
February 10, 2006  
Professor Y. Haddad

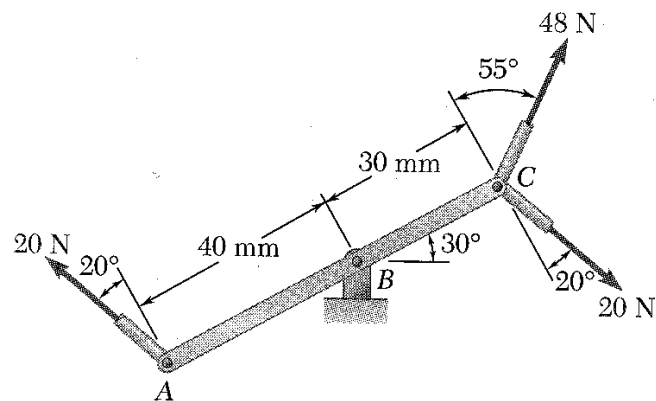
Duration: 90 minutes  
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**CLOSED BOOK. Only Non-programmable calculators are allowed. Write your solutions on this document. Answer only two problems. Full mark is 30.**

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- 1) **(15 points)** Three control rods rigidly welded to a lever  $ABC$ . The formed rigid body is exerted upon by the forces shown.
- (a) Replace the three forces with an equivalent force-couple system at  $B$ . **(6 points)**
  - (b) Determine the single force which is equivalent to the force-couple system obtained in part (a) above, and obtain its point of application on the lever. **(6 points)**
  - (c) Determine the force-couple system that could be applied at point  $C$  to keep the lever at rest **(3 points)**



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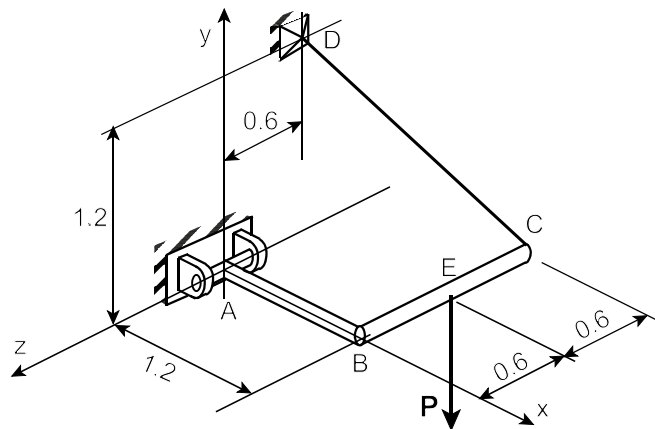
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2. **(17 points)** The sketch shows a bar ABC made of two uniform rods AB and BC, each of mass of 10 kg. As shown in the figure, the bar ABC lies in the x-z plane, with AB parallel to the x-axis and BC parallel to the z-axis. Bar ABC is supported by a hinge at A and by a cable CD, while support points A and D lie in the y-z plane. The bar is loaded by a force  $P = 5 \text{ kN}$  acting at point E. A tension force of 20 kN is assumed to develop in the cable. All dimensions are in meters.
- (a) Express all forces in a vectorial form **(4 points)**
  - (b) Determine the resultant force (in a vectorial form) of all forces **(2 points)**
  - (c) Determine the moment about A of each of the forces acting on the bar **(8 points)**
  - (d) Determine the moment resultant (in a vectorial form) of all forces **(3 points)**



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3. **(13 points)** A rectangular steel plate of weight  $W$  is held in the horizontal position by three cables as shown in the figure. The force in each cable is 100 N. All dimensions are in mm.
- (a) Express the forces acting on A in a vectorial form **(5 points)**
- (b) Assuming that the weight  $W$  can be expressed by the sum of the vertical components of the tensions in the three cables, what would be the resultant of all forces acting on A? **(5 points)**
- (c) Determine the force-couple system acting at point O and equivalent to the system of forces acting on A **(3 points)**

