NATIONAL EXAMINATION - MAY 2011

- STATICS AND DYNAMICS -

(04-BS-3)

3 HOURS' DURATION

Notes:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer-paper a clear statement of any assumption made.

2. This is a **"CLOSED BOOK"** examination. However, candidates may bring **ONE 8½"×11" sheet** of self-prepared notes. Candidates may use one of two calculators, the **Casio** or a **Sharp** approved models.

3. Candidates are required to complete **2 questions from PART A** and **2 questions from PART B**.

4. If more than four questions are presented for assessment then only the **first four undeleted solutions encountered will be marked.**

5. All questions are of equal value.

6. **Hand in examination question paper and self-prepared note sheet (formula sheet) with solution booklet.**

PART A - STATICS

(ANSWER ANY 2 0F THE 3 QUESTIONS)

1. (20 Marks)

   Determine the magnitude and sense of the forces in all of the members for the truss shown in figure 1.

   NOTE: Each grid division represents a distance of one metre.

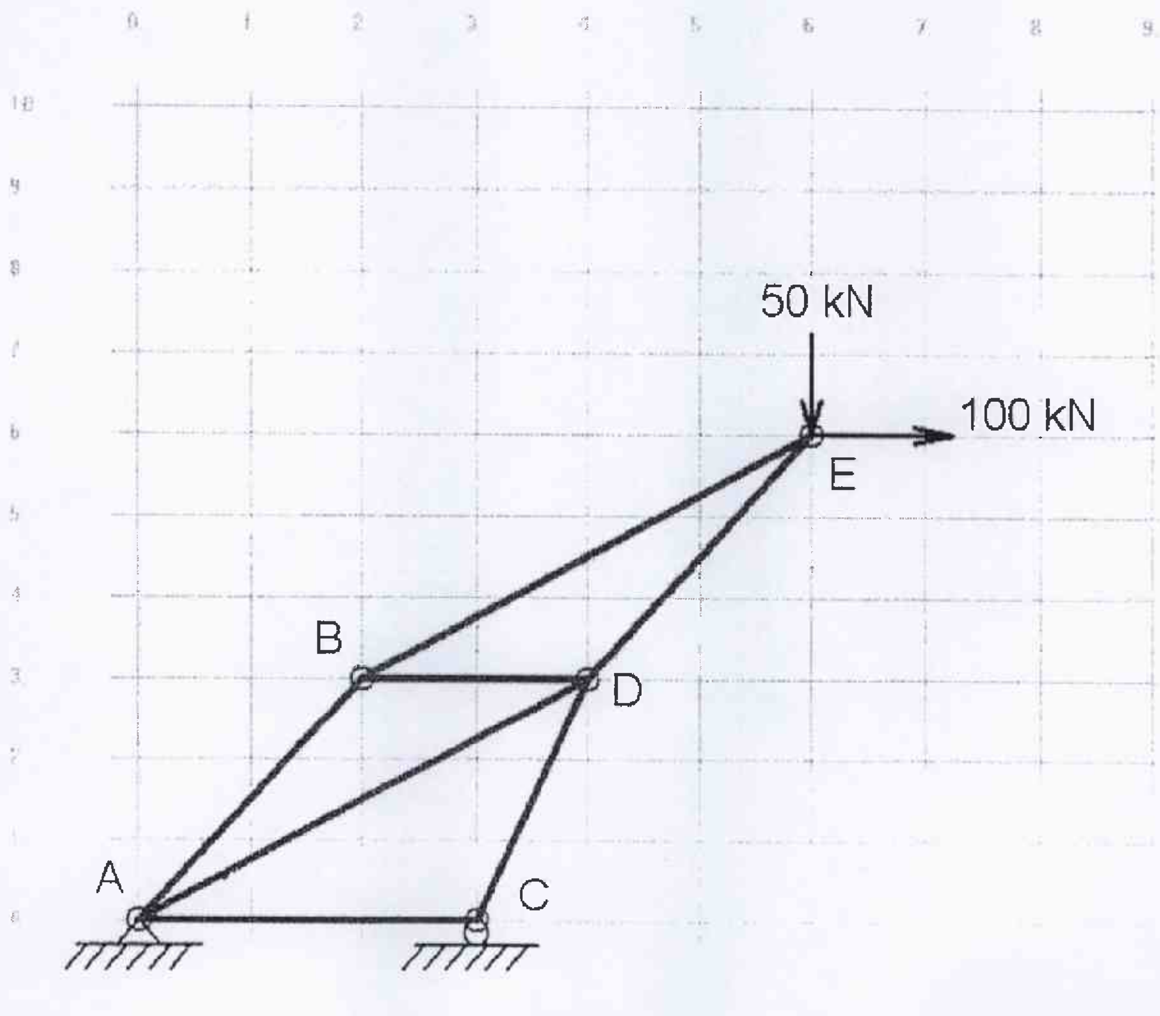

FIGURE 1.

2. (20 Marks)
A rigid, weightless boom supports a load, as shown in figure 2. The boom is hinged to move in the ***x-y*** plane only. Using ***cartesian vector methods***;

a) Find the tensile force in the length of cable between the point ***a*** on the boom and point ***b*** on the wall.
b) Determine the value of the component of the hinge force which prevents the motion of the boom in the z direction

NOTE: Use the origin of the x,y,z co-ordinate axes at point ***O*** as shown in the figure.

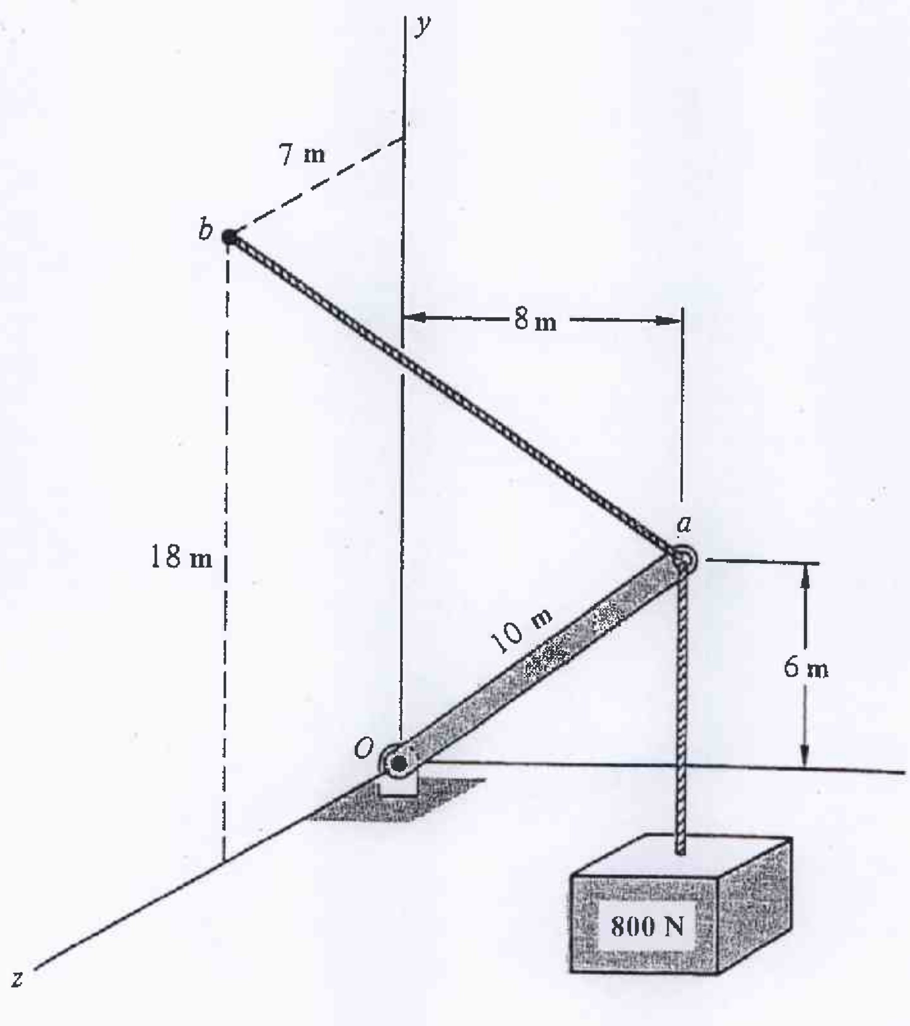

FIGURE 2.

3. (20 Marks)

Block A has a mass of 185 kg, and block B has a mass of 65 kg. Block *C* rests on block ***B*** as shown in figure 3. Determine the minimum value of the mass of block *C* in order to maintain the equilibrium position shown in the figure. The static co-efficient of friction between Block *A* and the inclined plane is **0.15** and the static co-efficient of friction between Block ***B*** and the horizontal plane is **0.18**

NOTE: Neglect the weight of the link.

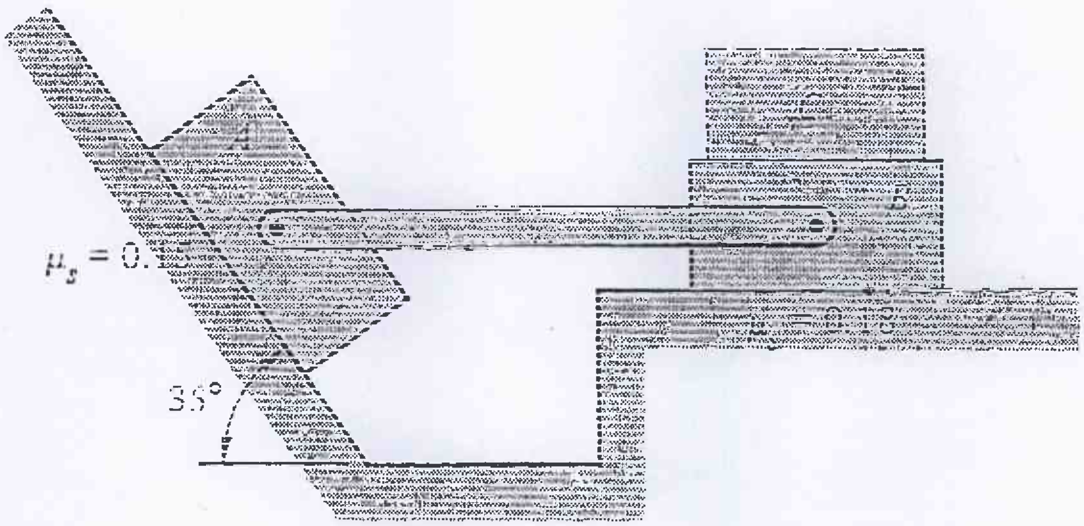

FIGURE 3

PART B - DYNAMICS

(ANSWER ANY 2 0F THE 3 QUESTIONS)

4. (20 Marks)

A homogeneous cylinder is released from rest at position ***a*** in figure 4. It rolls without sliding until it reaches position ***b***. Length b-c of the inclined plane is coated with a lubricant and for purposes of this problem, the co-efficient of friction on this section of the inclined plane can be considered to be zero. Using energy methods determine;

a) the cylinder's angular velocity, and the velocity of the cylinder's centre, when the cylinder reaches position ***b*** on the inclined plane.

b) the cylinder's angular velocity, and the velocity of the cylinder's centre, when the cylinder reaches position ***c*** on the inclined plane.

NOTE: For a homogeneous cylinder the mass moment of inertia about its centre is:

$$Io = \frac{1}{2}mr^2$$

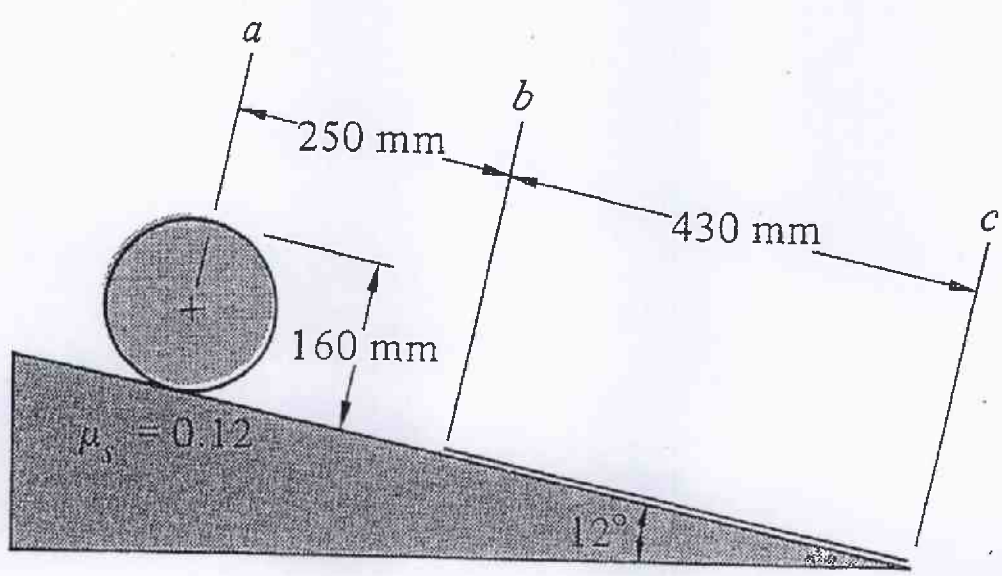

FIGURE 4.

5. (20 Marks)

A homogeneous disk A has a mass of 10 kg and is connected to a uniform rod AB which has a mass of 5 kg. If the assembly is released from rest at the position shown in the figure ($\theta = 60°$), determine the angular velocity of the rod when $\theta = 0°$.

Note: Assume the disk rolls without slipping. Also neglect the mass of the collar at B and any friction between the collar and the guide rod.

The moment of inertia about the centroid of a slender rod: $I = \frac{1}{12} m\, l^2$

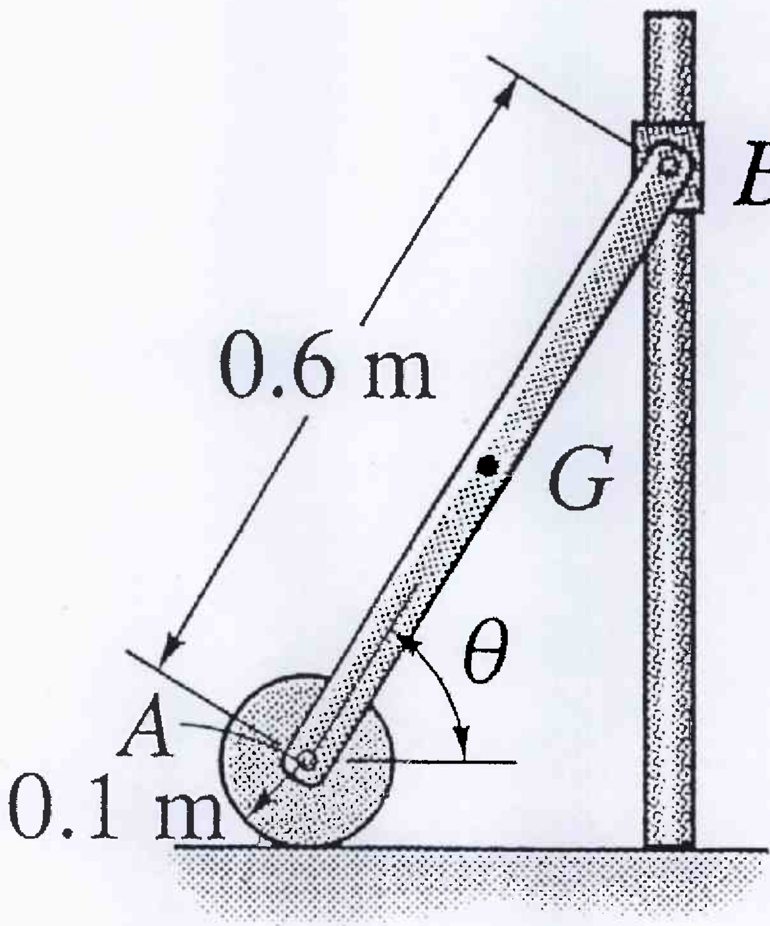

FIGURE 5.

6. (20 Marks)

A ball which has a mass of 3 kg and negligible size has an initial velocity of 15 m/s at point A, in the figure shown. If the inclined surface from A to B has negligible friction, determine;

a) the horizontal distance d, that is the distance from point C to D, where the ball hits the horizontal surface.

b) the velocity at which the ball strikes the surface at point D.

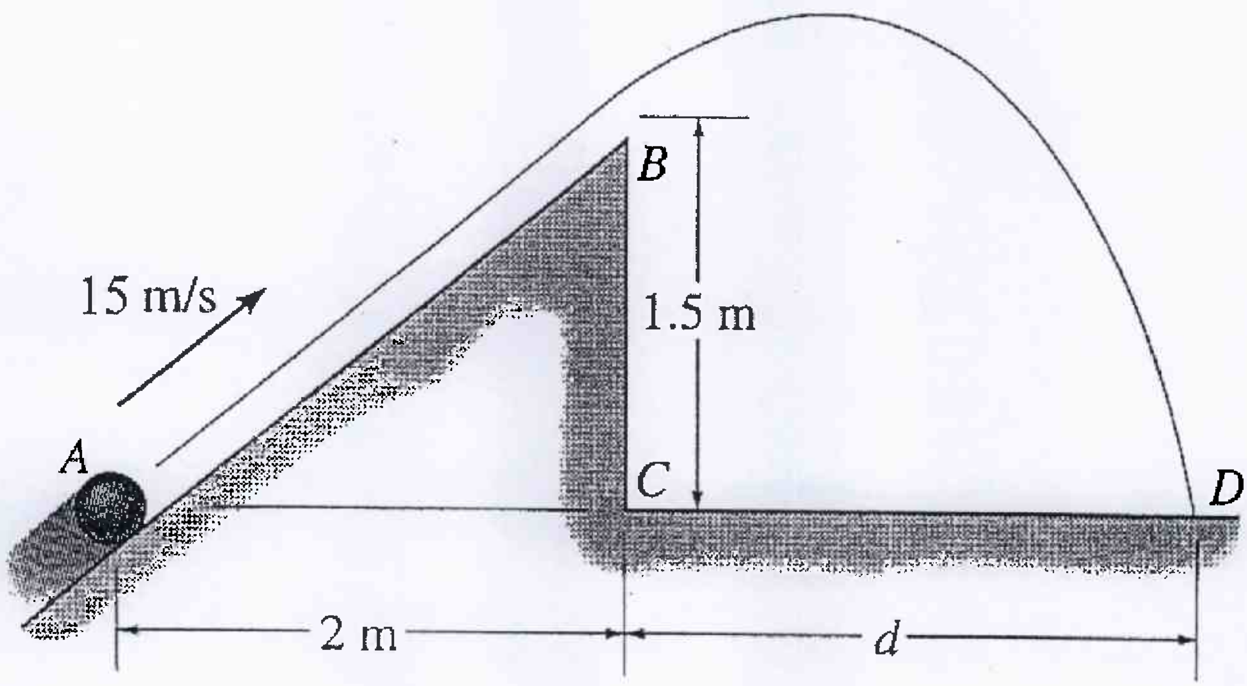

FIGURE 6.