

NATIONAL EXAMINATION - DECEMBER 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 OF 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.

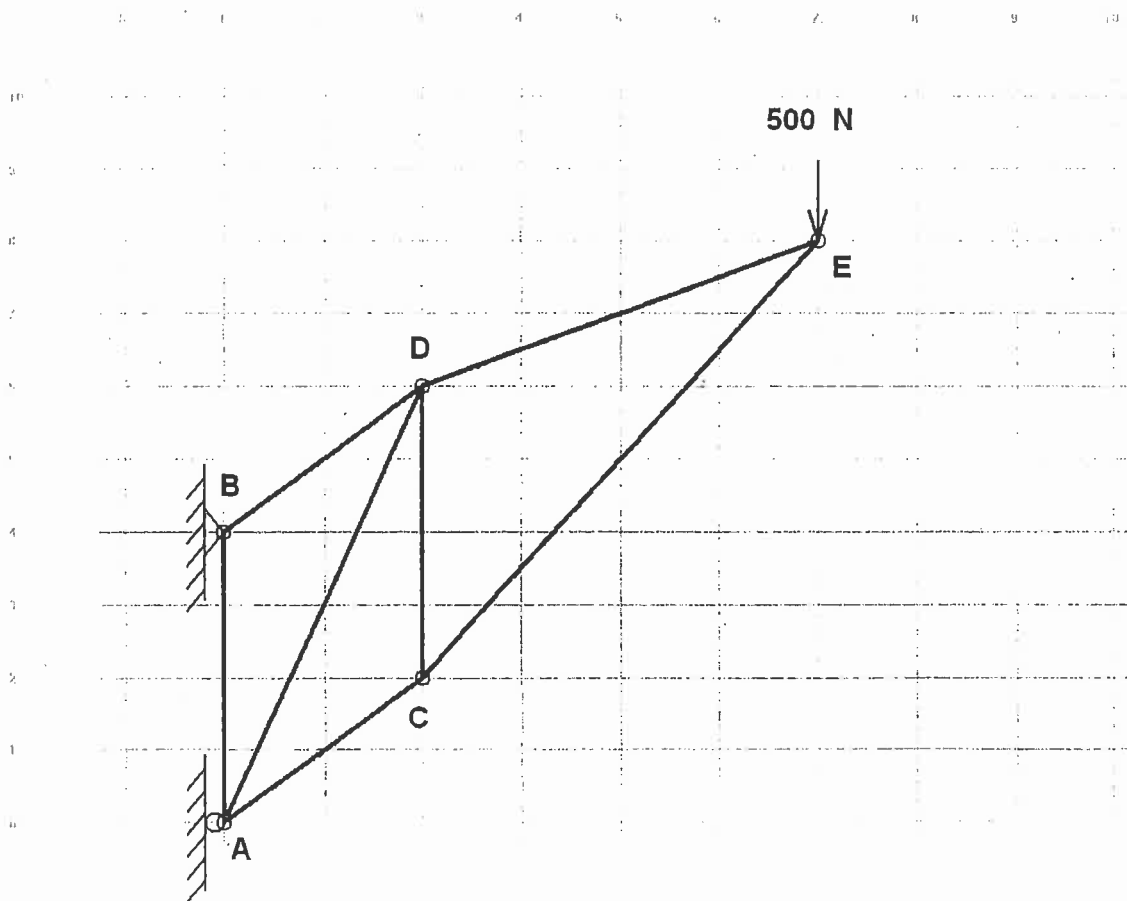


FIGURE 1.

2. (20 Marks)

The circular door, shown in figure 2, has a weight of 60 lb, and a centre of gravity at G . Using *cartesian vector methods* determine the x , y , and z components of the reaction force at the hinge A and the force acting along the strut CB to maintain the equilibrium position shown. The angle $\theta = 30^\circ$.

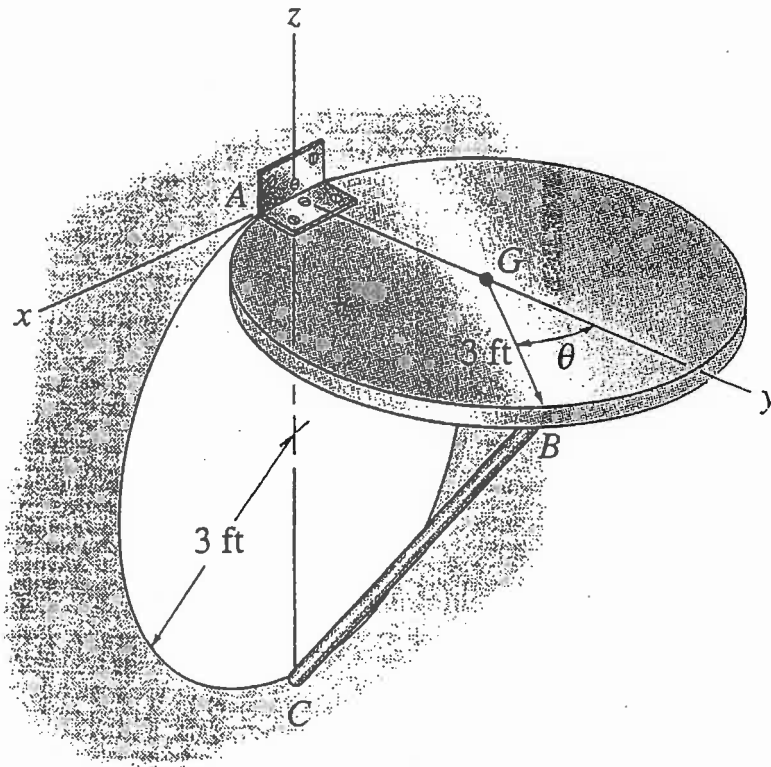


FIGURE 2.

3. (20 Marks)

Two blocks *A* and *B*, each having a mass of 5 kg, are connected by the linkage as shown in figure 3. If the coefficient of static friction at the contacting surfaces is $\mu_s = 0.5$, determine the largest vertical force *P* that may be applied to the pin *C* of the linkage without causing the blocks to move.

NOTE: Neglect the mass of the links.

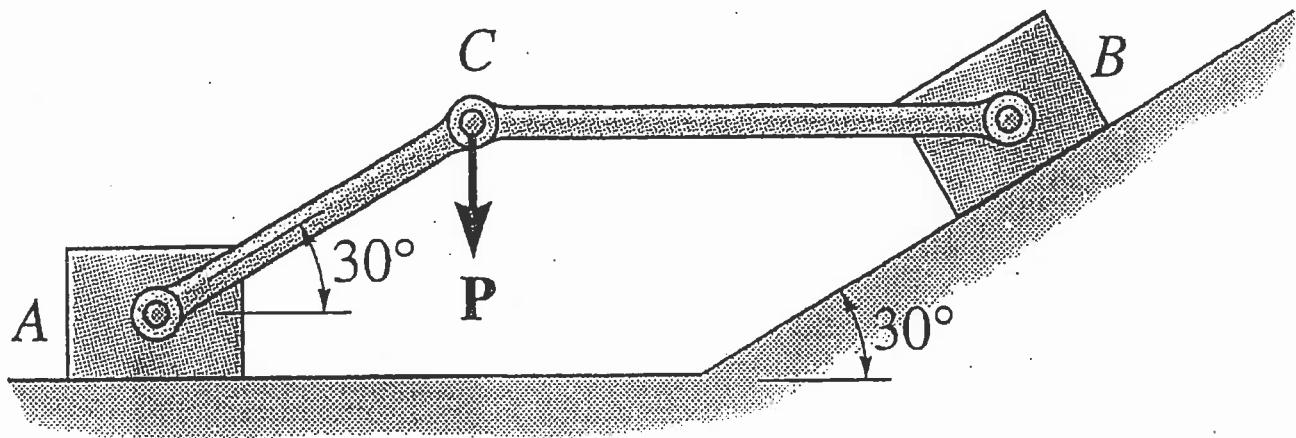


FIGURE 3

PART B - DYNAMICS
(ANSWER ANY 2 OF THE 3 QUESTIONS)

4. (20 Marks)

In the assembly shown in figure 3, the motor on the right draws in the cable at C with a constant velocity of $v_C = 4 \text{ m/s}$. The motor attached to the cable D draws in the cable D with a constant acceleration of $a_D = 6 \text{ m/s}^2$.

If $v_D = 0$ when $t = 0$, determine,

a) the time required for block A to rise 3 metres, and

b) the relative velocity of block A with respect to block B when block A has risen the 3 metres.

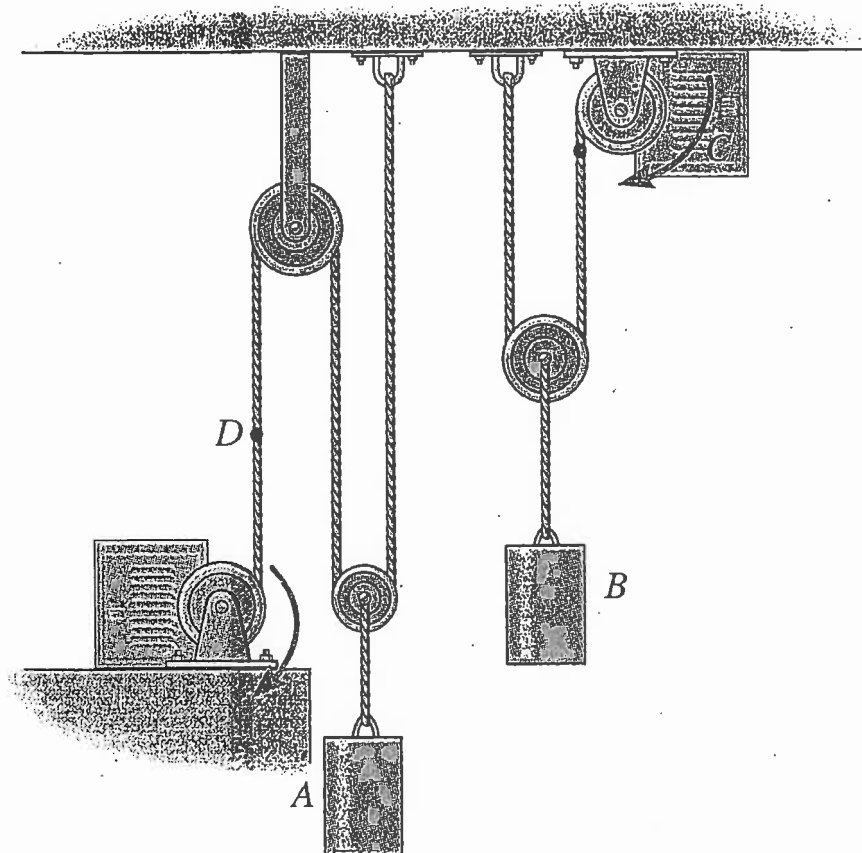


FIGURE 4.

5. (20 Marks)

A ball which has a mass of 2 kg is thrown at the suspended block B with a velocity of 6 m/s. Block B has a mass of 20 kg and is initially stationary. If the time of impact between the ball and the block is 0.005 seconds, determine the average normal force exerted on the block during this time.

NOTE: Assume the coefficient of restitution to be $e = 0.8$

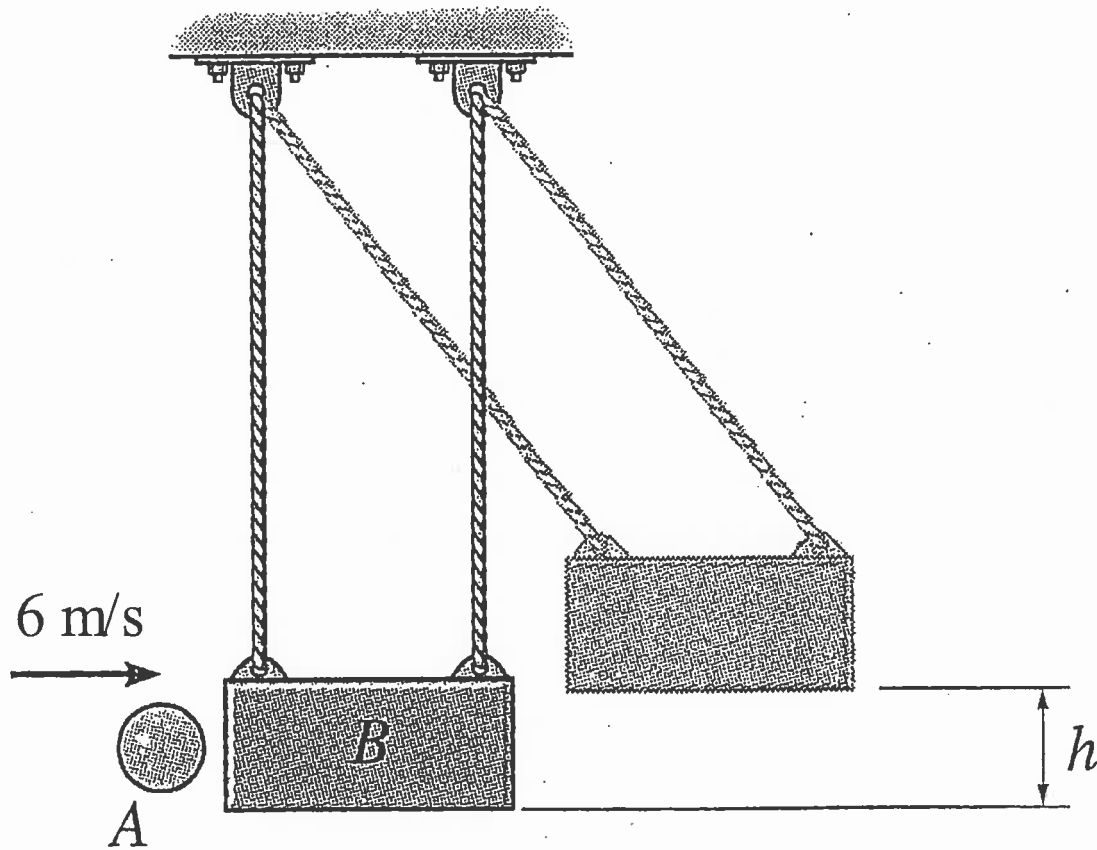


FIGURE 5.

6. (20 Marks)

At a given instant, blocks *A* and *B* have the positions as shown in figure 6. At this instant in time block *A* has the velocity and deceleration shown. Determine the acceleration of block *B* and the angular acceleration of the link at this instant.

NOTE: All contacting surfaces are assumed to be frictionless.

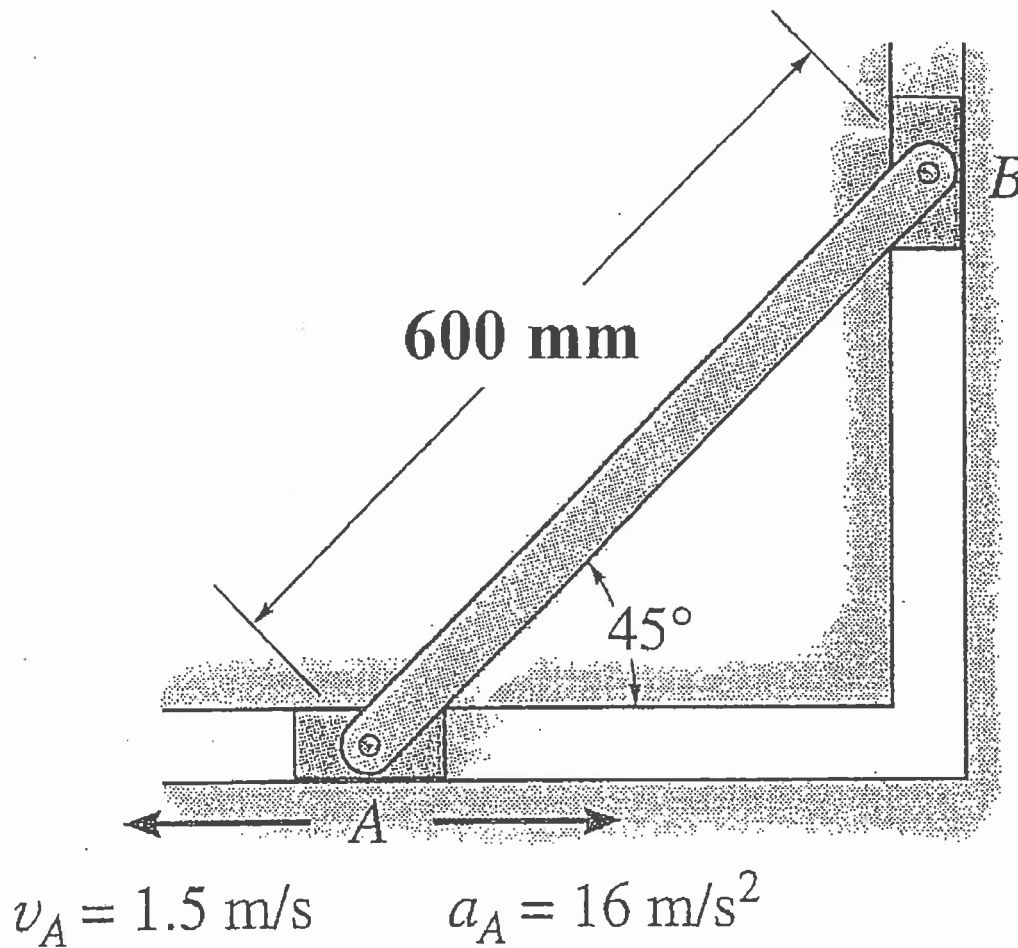


FIGURE 6.