NATIONAL EXAMINATION - DECEMBER 2009

- 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. Squared paper will be provided, on request of the candidate, as an aid in the conducting of graphical solutions, if that is the method of solution preferred.

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

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

6. All questions are of equal value.

7. 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)

I. (20 Marks)
Using the method of joints determine magnitude of the force in each of the members for the truss shown in figure 1. For each, state if the member is in tension or compression.

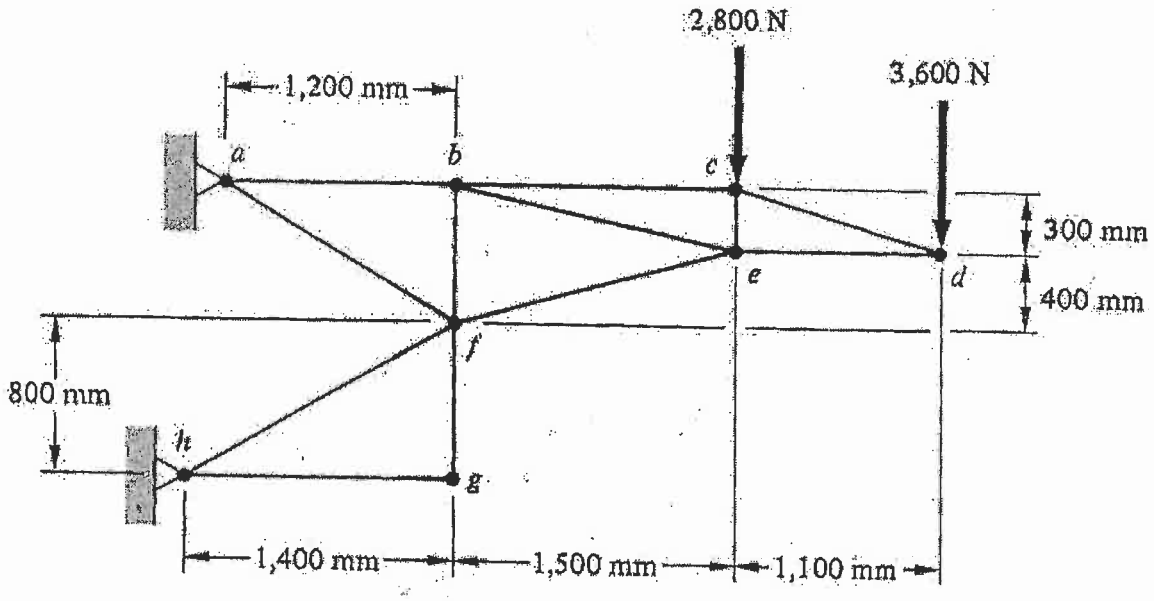

FIGURE 1.

II. (20 Marks)

A 360 pound force acts on corner ***b*** of the hinged vertical plate as shown in figure 2. The link ***ce*** has ball joints at both ends. Using ***cartesian vector methods*** determine the force in the link and the total forces acting on each hinge pin.

NOTE: Assume that only hinge ***a*** can resist forces in the z direction and that the weight of the plate can be neglected.

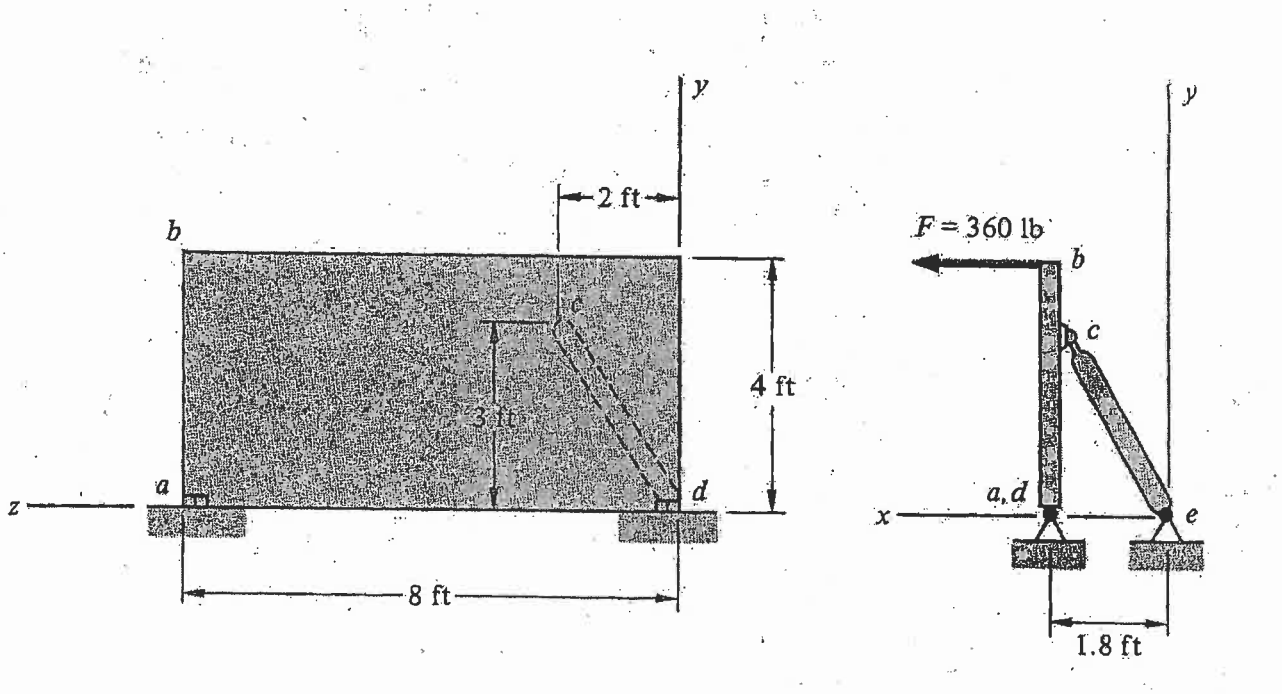

FIGURE 2.

III. For the assembly shown in figure 3, braking forces are applied to a rotor assembly made up of a 700 mm diameter disc and a 300 mm diameter disc which rotate together. Determine;

a) the forces acting on the hinge pins at ***a*** and ***b***, and

b) the value of ***Mo*** for which the rotor assembly's motion is impending.

NOTE: The mass of the rotor assembly and links and the curvature of the brake pads can be neglected.

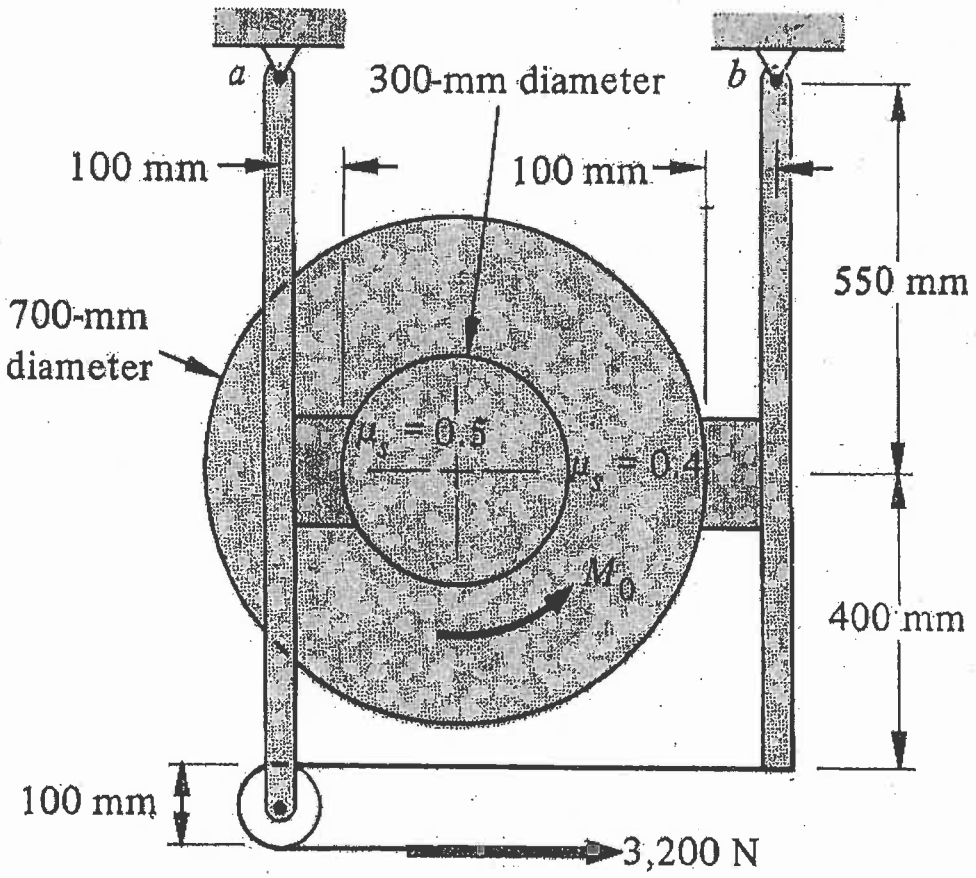

FIGURE 3.

PART B - DYNAMICS
(ANSWER ANY 2 0F THE 3 QUESTIONS)

IV. (20 Marks)

A particle travels clockwise along a circular track, as shown in figure 4, with a constant tangential acceleration $a_t = 0.28\ m/s^2$. The particle starts from rest at point a.

a) Determine the x and y components of the velocity of the particle when it first reaches point b.

b) Find the magnitude and direction of the acceleration when the particle first reaches point b. Clearly illustrate the direction of the acceleration and its components with a vector diagram.

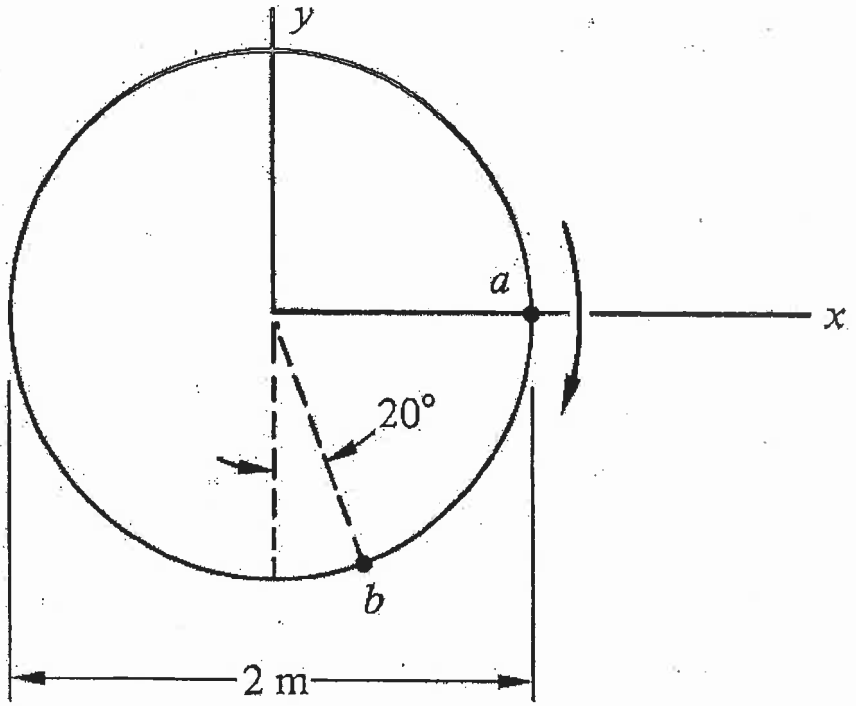

FIGURE 4.

V. (20 Marks)

Figure 5 shows a system of pulleys and weights. The cable is assumed not to slip on the pulleys. Determine the acceleration of the weights ***A*** and ***B***, the tensile forces in the cable and the hinge pin forces at ***a*** and ***b***, when the system is released from rest.

NOTE: The mass moments of the pulleys are: $I_C = 0.005$ kg-m^2 and $I_D = 0.010$ kg-m^2.
HINT: The tensile force in the cable is not equal over its full length.

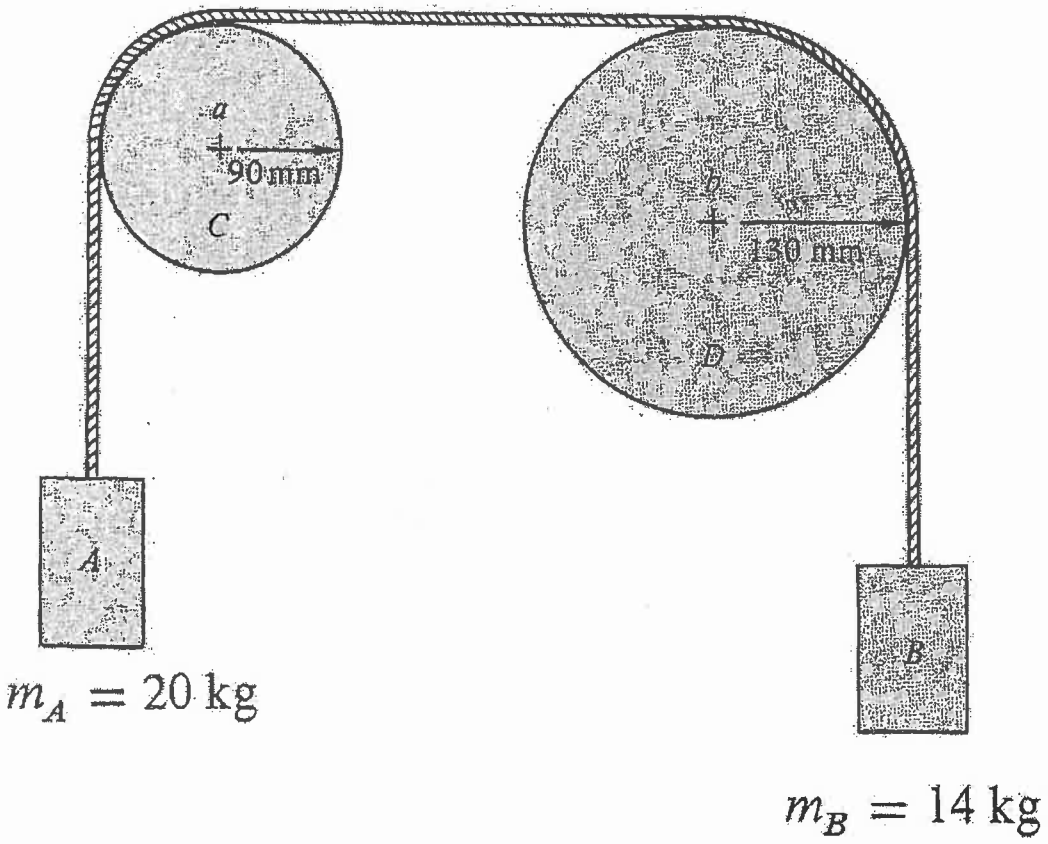

FIGURE 5.

VI. (20 Marks)

The blocks shown in figure 6 are initially at rest. Using work-energy methods determine the velocity of the blocks after they have travelled a distance of 2 metres. **The mass of block *B* is 160 kg.**

NOTE: Assume the pulley to be frictionless and the cable inextensible.

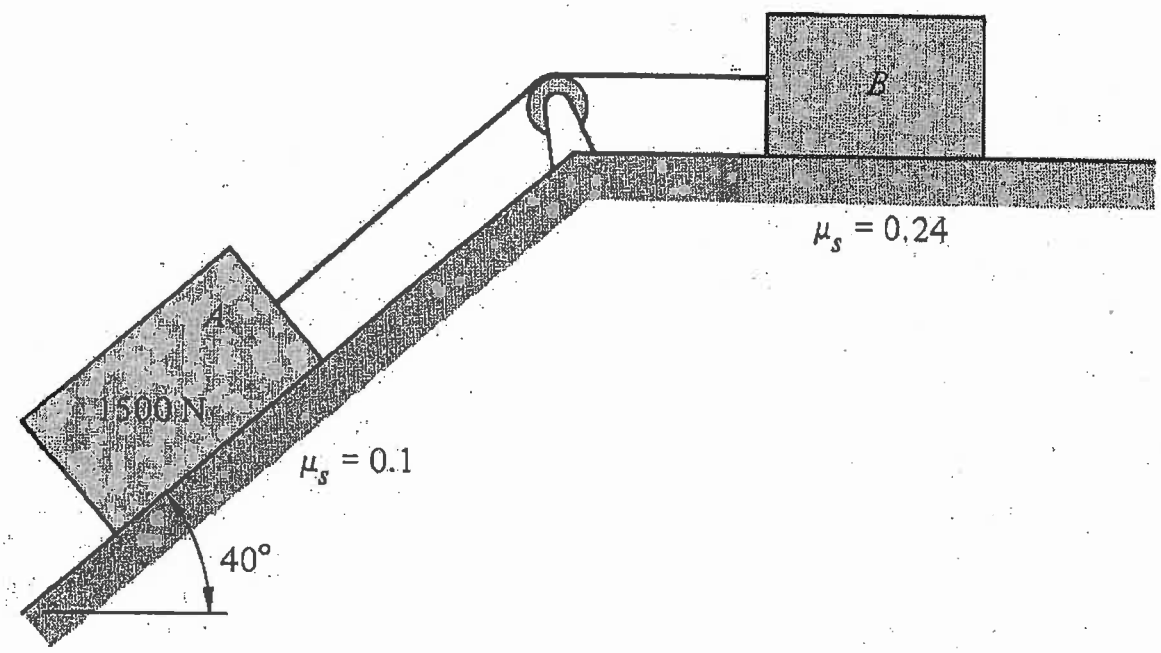

FIGURE 6.