NATIONAL EXAMINATION - MAY 2003

- STATICS AND DYNAMICS -

(98-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, a **Casio FX-991** or a **Sharp EL-540**.

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. Any **FOUR** questions completed will constitute a complete paper, and only four will be marked.

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. Total marks 80.

I. (20 marks)

Determine the forces acting on the pins, ***a, b, c, d, e,*** and ***f*** of the frame shown in figure 1. Each of the pulleys has a mass of 75 kg and the mass of the members and the cable may be neglected. Assume that the pulleys are frictionless.

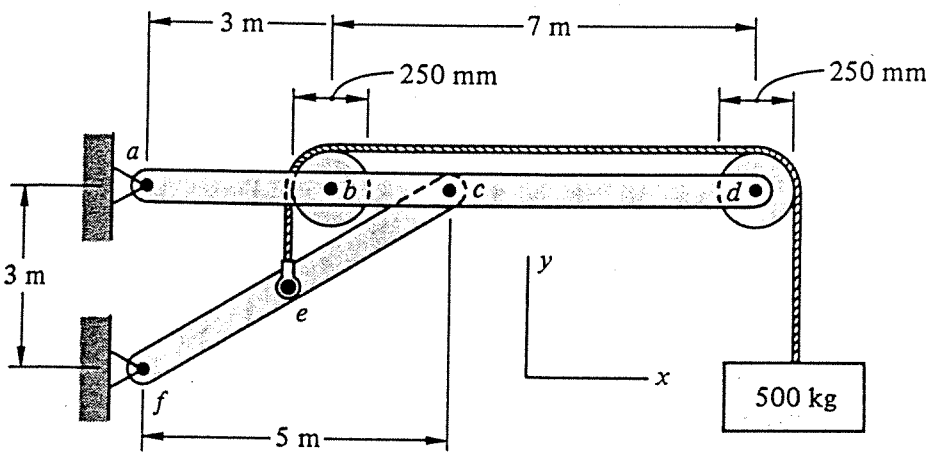

FIGURE 1.

II. (20 marks)

At time $t = 0$ seconds vehicle ***B*** just passes beneath the overpass and vehicle ***A*** is 1000 feet from the structure. At this instant $v_A = 51.3$ ft/sec and vehicle ***A*** starts to accelerate at a rate of 4 ft/sec^2, while vehicle ***B*** continues at a constant speed of 80.7 ft/sec. Determine the relative displacement, velocity and acceleration of vehicle ***A*** with respect to vehicle ***B*** at the time that vehicle ***A*** crosses the overpass.

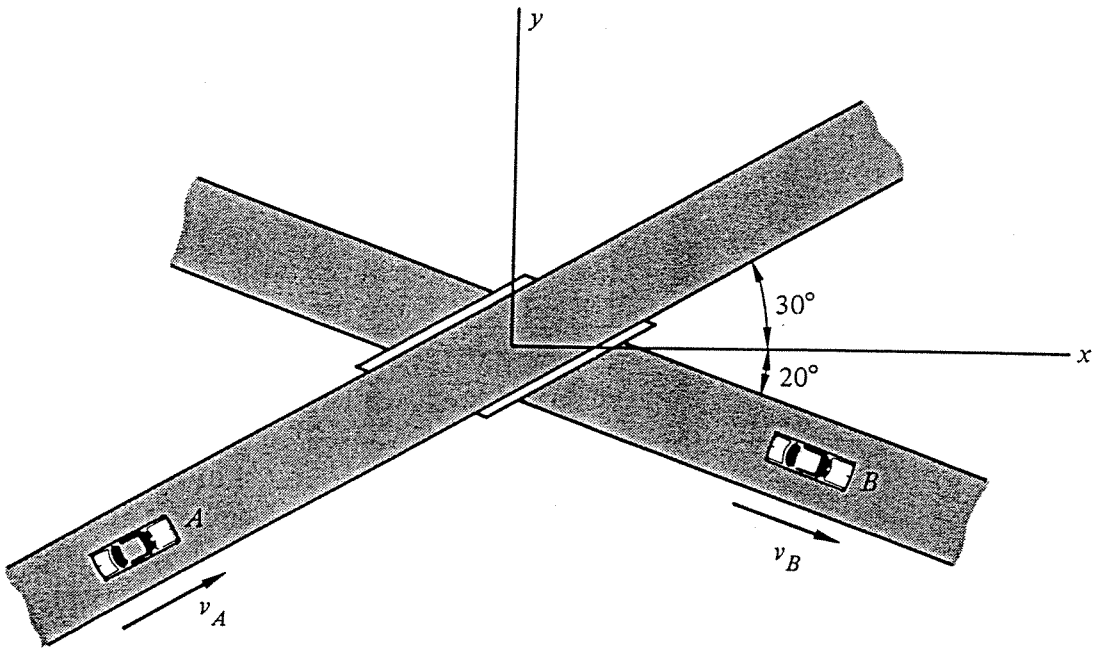

FIGURE 2.

III. (20 marks)

Block ***B*** in figure 3 is initially at rest, and the plane surface is assumed to be frictionless. Block ***A*** has an initial velocity of 5 m/s in the direction shown.

a) If the impact is assumed to be elastic, determine, the velocities of the blocks after impact and the distance between the two blocks 2 seconds after impact.

b) If a coefficient of restitution of 0.2 is assumed, determine, the velocities of the blocks after impact and the distance between the two blocks 2 seconds after impact.

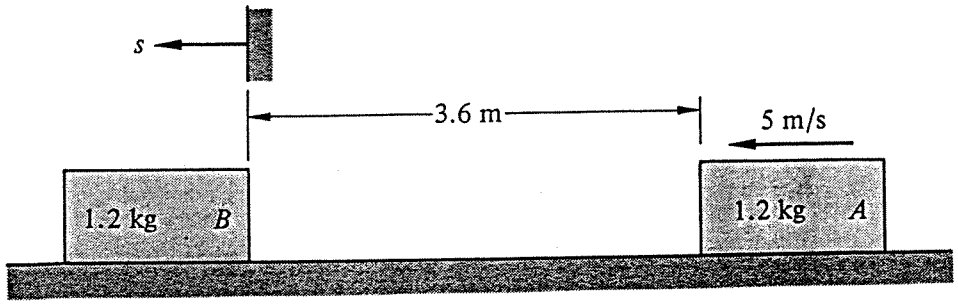

FIGURE 3.

IV. (20 Marks)

The system shown in figure 4 is initially at rest. A second block of mass 3.5 kg is attached to block ***B***. **Using energy methods** determine the angular velocity of the pulley when block ***A*** has moved through a distance of 1.75 m.
NOTE: Neglect the mass of the pulley and any friction between the cables and the pulley.

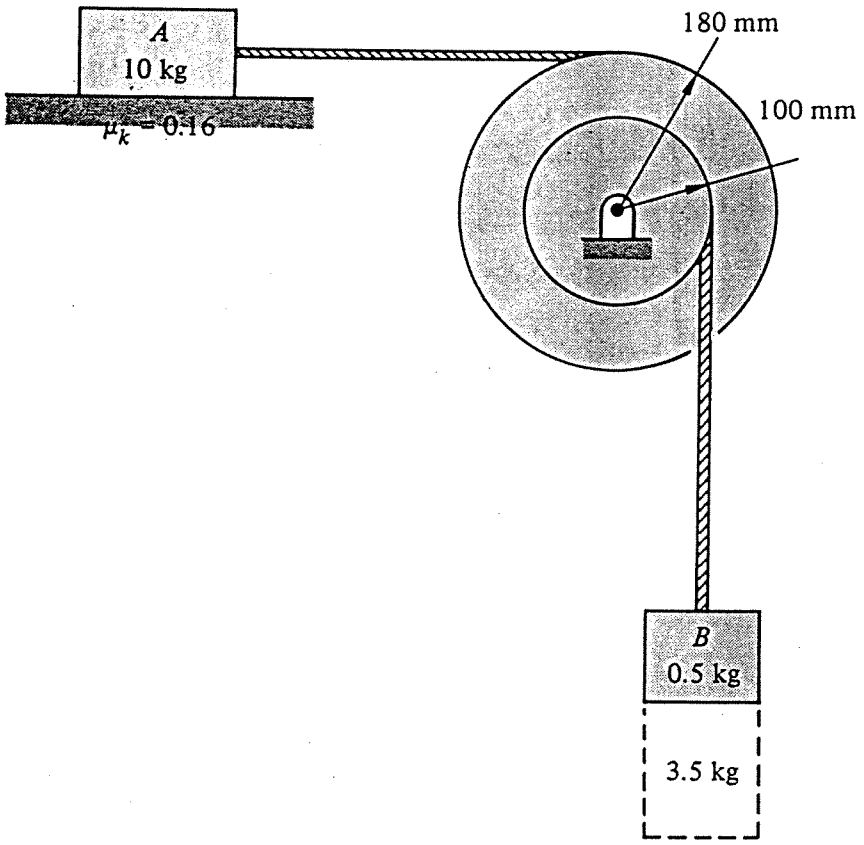

FIGURE 4.

V. (20 Marks)

Figure 5 illustrates a model of a piston cylinder and crank arrangement for an internal combustion engine. When the piston is in the position shown in the figure, it has a downward velocity of 4.572 m/sec. Determine the corresponding angular velocity of the crank *bc*.

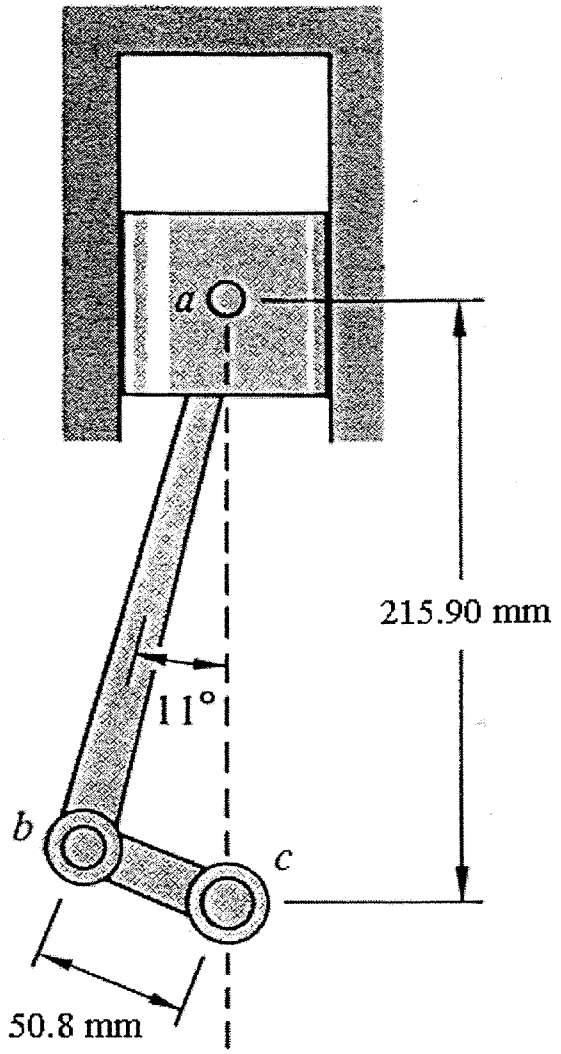

FIGURE 5.

VI. (TOTAL 20 MARKS CONTAINS 2 PARTS)

PART A. (10 Marks)

Block ***A*** has a weight of 50 N, and block ***B*** weighs 100 N. In the position shown in figure 6A sliding motion is impending. Determine the value of the coefficient of static friction between block ***B*** and the inclined surface if the contacting surfaces of block ***A*** and the plane are assumed to be frictionless.

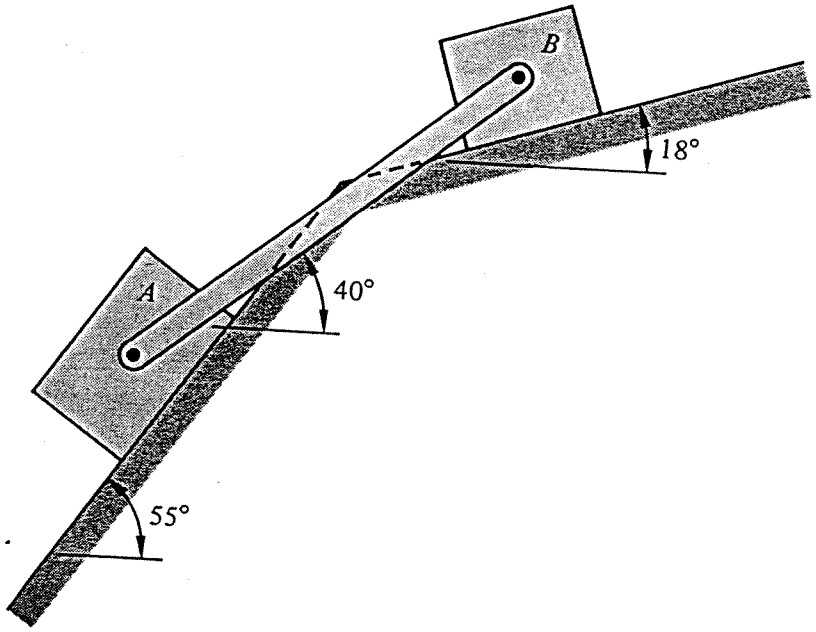

FIGURE 6A.

VI. PART B. (10 Marks)

In figure 6B, block ***A*** weighs 25 N and block ***B*** weighs 18 N. The static coefficient of friction between all surfaces is 0.11. Determine the value of ***P*** which will cause impending motion of block ***B*** in the upward direction.

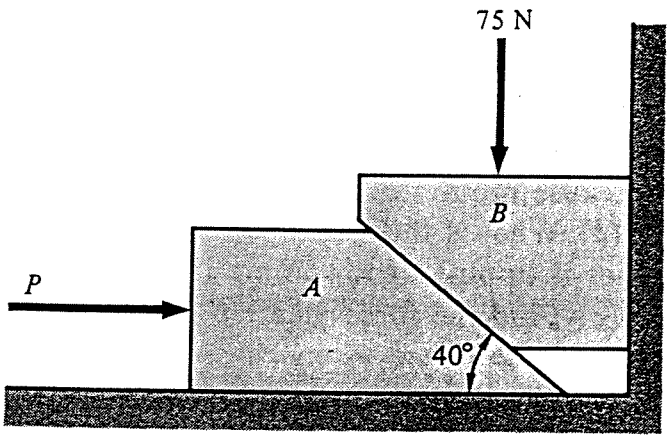

FIGURE 6B