NATIONAL EXAMINATION - MAY 2010

- 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**.

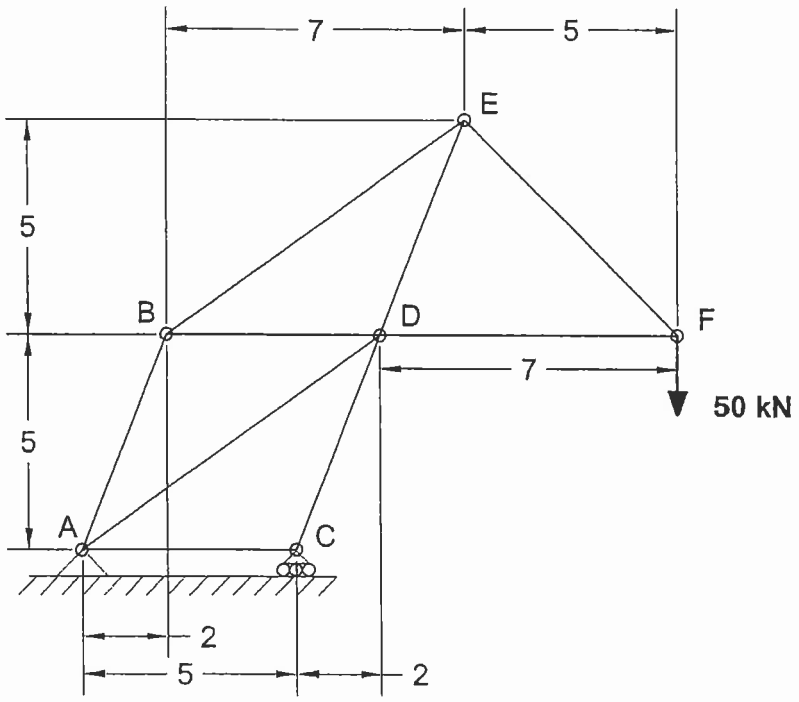
6. All questions are of equal value.

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)

Determine the force in each member of the truss shown and state whether each member is in tension or compression.



ALL DIMENSIONS IN METRES

FIGURE 1.

II. (20 Marks Total)

NOTE: THIS QUESTION HAS TWO PARTS

(**PART A**. 10 Marks)

A. While inserting a cylindrical part into the circular hole, the robot exerts a 90 N force on the part as shown in figure 2A. Determine;
a) the moment about points A, B, and C of the force which the part exerts on the robot.
b) the components of the force which the part exerts on the robot along axes parallel and perpendicular to arms AB and BC.

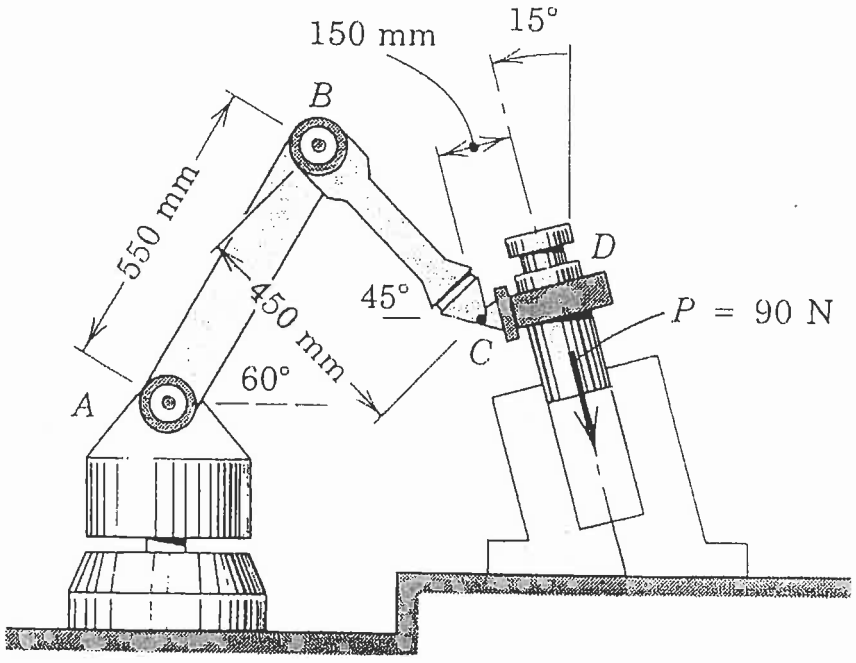


FIGURE 2A.

II. (**PART B.** - 10 MARKS)

B. The four wheel drive tractor shown in figure 2B has a mass of 20×10^3 kg with its centre of mass at G. Determine the load **P** which the tractor can pull at a constant speed of 5 km/hr up the 15 percent grade if the kinetic coefficient of friction between the wheels and the incline is, $\mu_{kinetic} = 0.80$. Also determine the **total** normal reaction N_B under the rear pair of wheels at B.

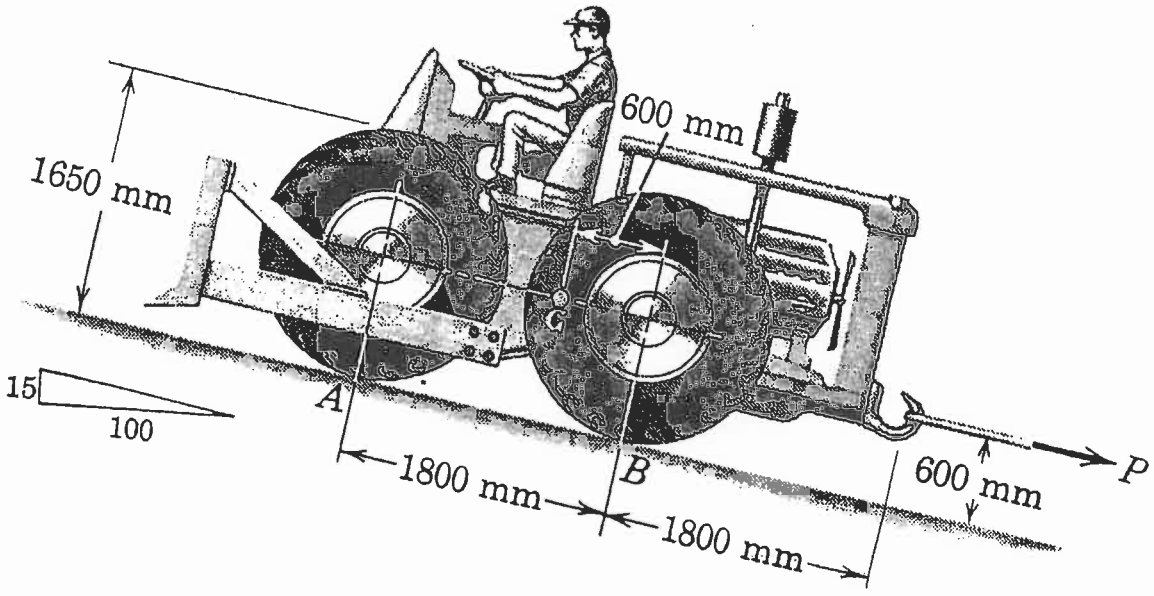


FIGURE 2B.

III. (20 Marks Total)

NOTE: THIS QUESTION HAS TWO PARTS

(**PART A**. 10 Marks)

A. Determine the moment of inertia and radius of gyration of the shaded area, shown in figure 3A, with respect to the x-axis.

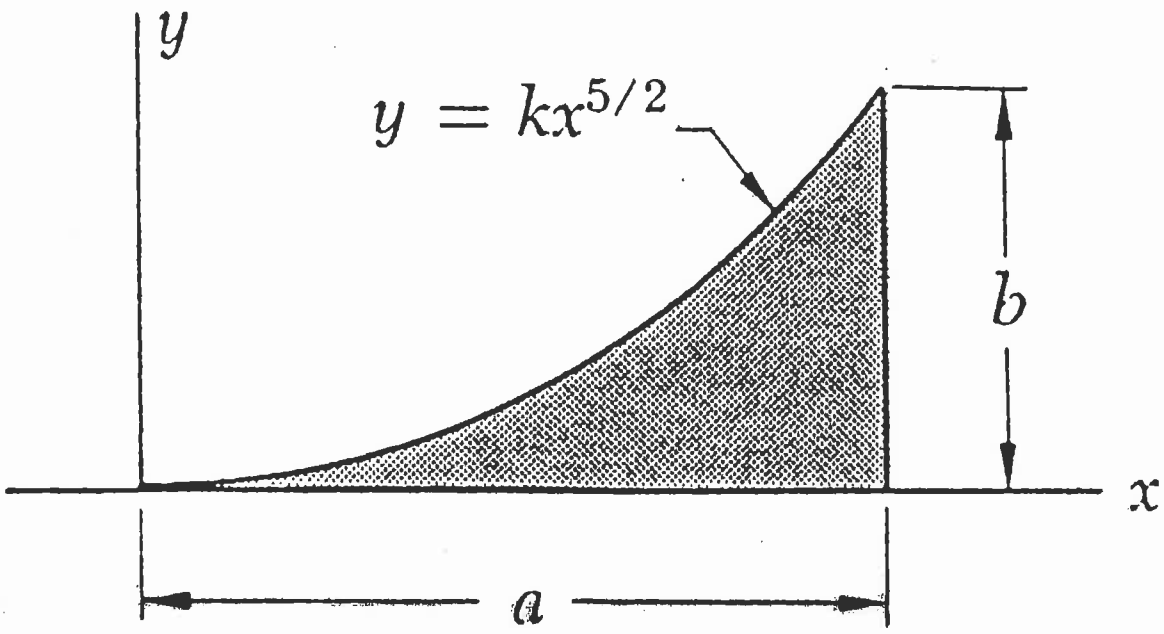


FIGURE 3A.

III. (**PART B.** - 10 MARKS)

B. The strength of a W14 × 38 rolled steel beam is increased by attaching a 9 × 3/4 inch plate to its upper flange as shown in figure 3B. Determine the moment of inertia and the radius of gyration of the composite section with respect to a horizontal axis through its centroid C .

NOTE: Area of W14 × 38 section is 11.20 in^2 and its centroidal moment of inertia about the horizontal axis is, I_{xx} = 385 in^4.

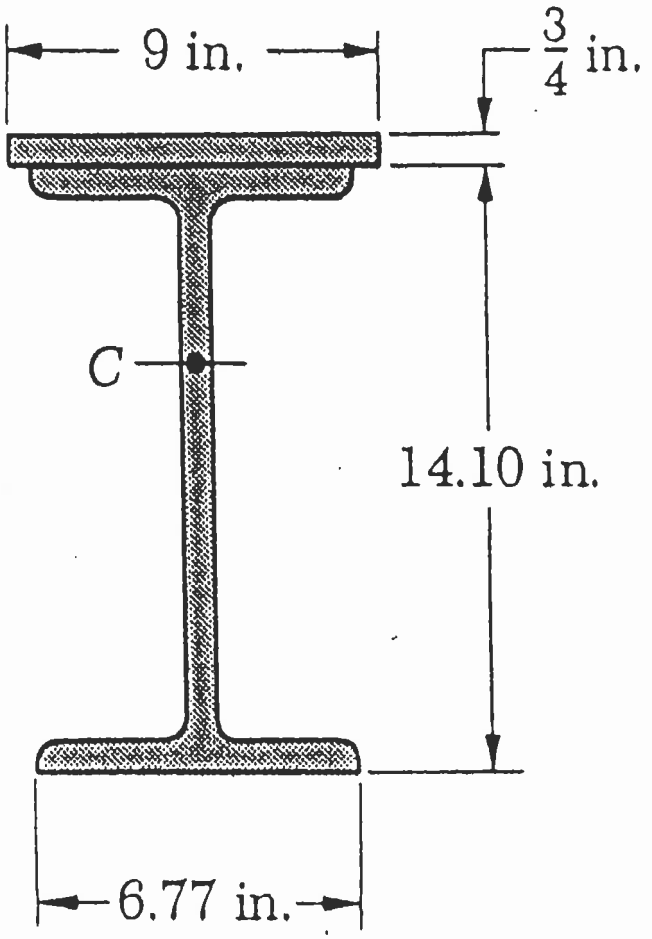


FIGURE 3B

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

IV. (20 Marks)

Crank AB, shown in figure 4, has a constant angular velocity of 200 revolutions per minute counterclockwise. Determine the magnitude and direction of the velocity of the collar D when $\theta = 60^{\circ}$.

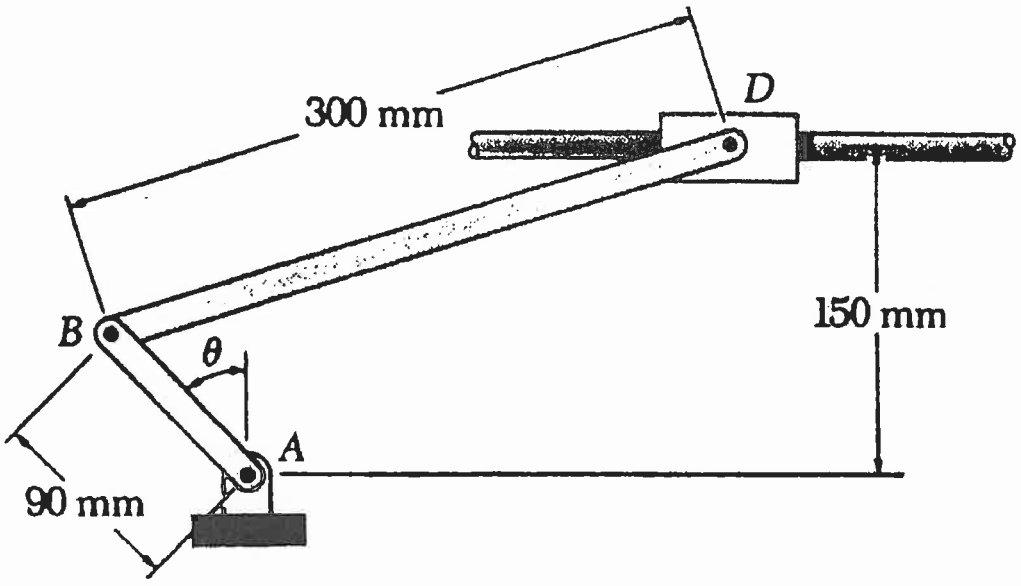


FIGURE 4.

V. (20 marks)

Block B, which has a mass of 0.6 kg rests on the edge of a table, as shown in figure 5. A second block (block A) which has a mass of 0.4 kg moves to the right with a velocity v_A. Block A strikes block B and causes the trajectory shown in figure 5. Assuming that the table is frictionless and that the coefficient of restitution for the impact is 0.95, determine,

a) the initial velocity (v_A) of block A, and

b) the final velocity (v_A') of block A after the impact.

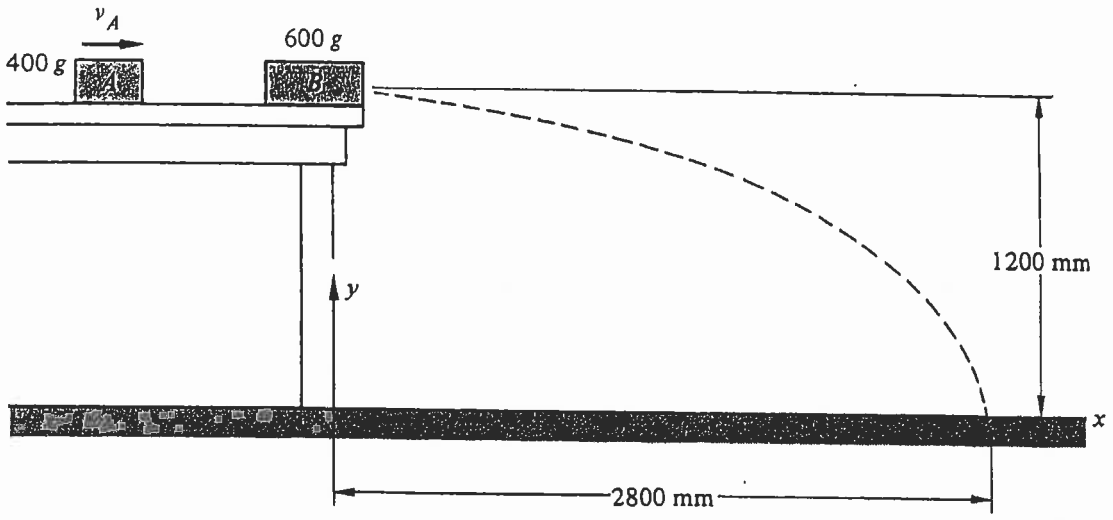


FIGURE 5.

VI. (20 marks)

A constant force ***P*** of magnitude 178 Newtons is applied to the initially stationary block which has a mass of 27 kilograms as shown in figure 6. When the block has travelled a distance of 3.65 metres up the incline, the force is removed and the block continues to move. Using Energy methods, determine the velocity of the block when it passes back downward through its initial position.

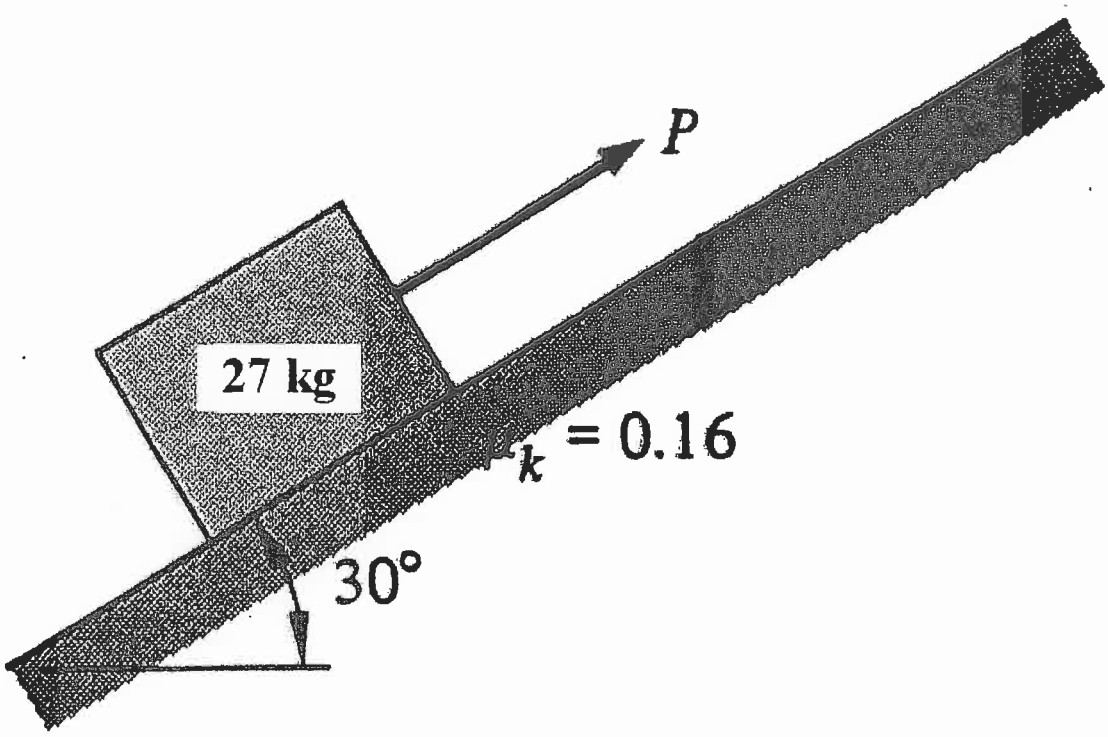


FIGURE 6.