NATIONAL EXAMINATION - DECEMBER 2015

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

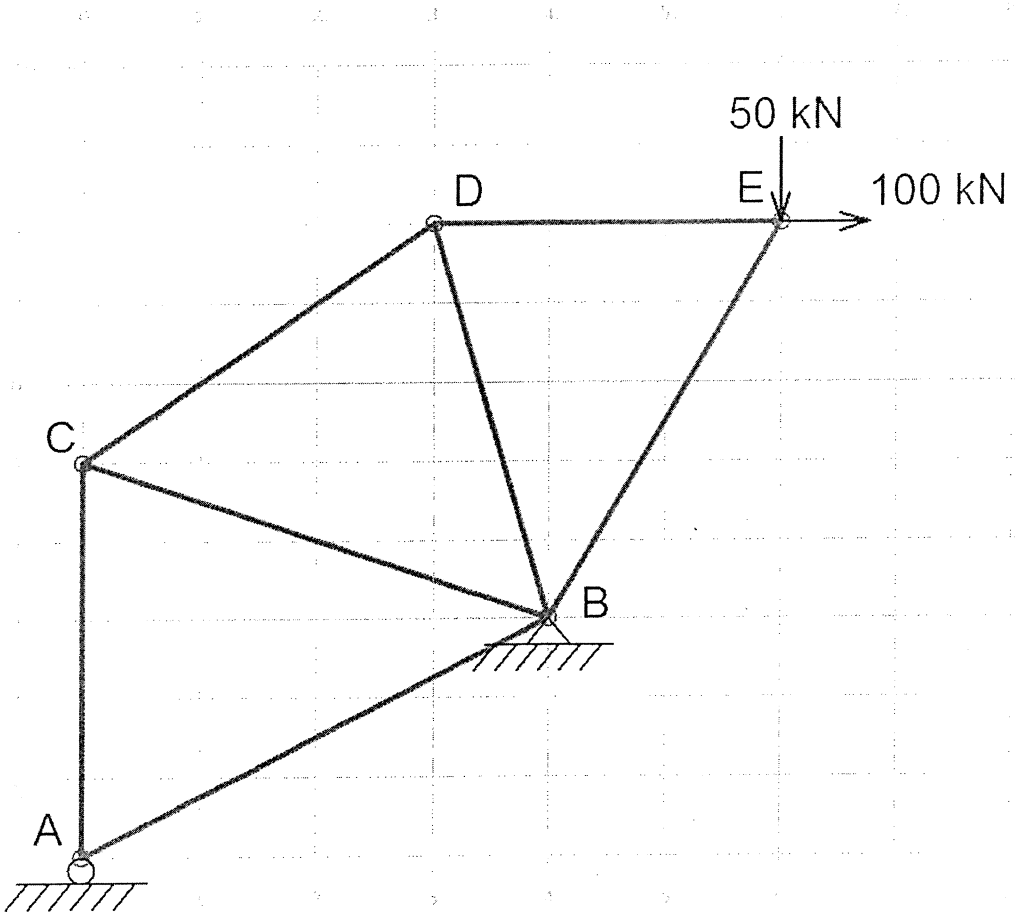

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FIGURE 1.

II. (20 Marks)

A 19.5-kN force is applied at point ***D*** of the 60 mm diameter cast-iron post as shown.

a) Using **Cartesian Vector Methods**, determine the equivalent force moment system which would act at point ***C*** which is in the centre of the post 100 mm up from the base.

b) Clearly draw and label the magnitudes and directions of the equivalent force moment system with the origin of the *x-y-z* axis located at point ***C***.

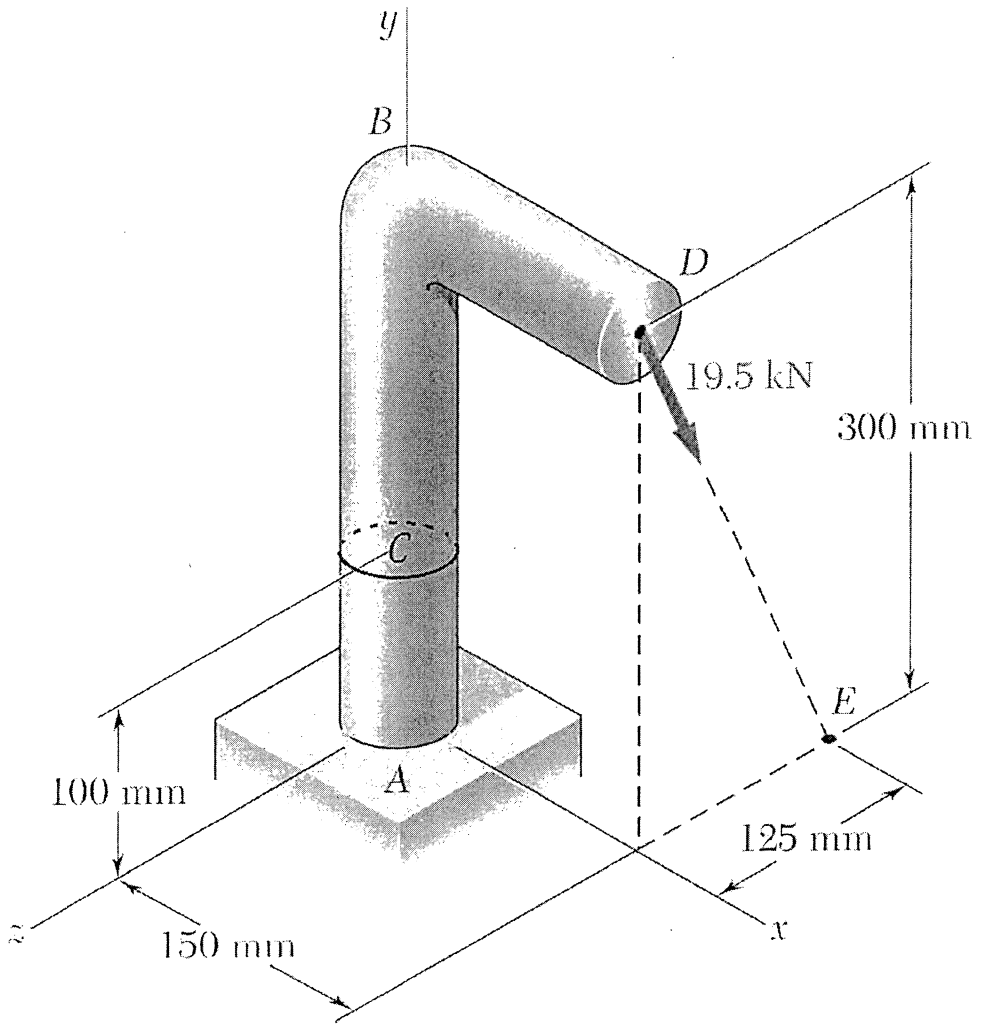

FIGURE 2

III. (20 MARKS)

Blocks *A* and *B* weigh 15.44 lb_f and 20 lb_f, respectively. Using the coefficients of static friction indicated, determine the largest vertical force P which can be applied to the cord without causing motion.

Do not neglect the friction of the rope which contacts the stationary pulleys at *C* and *D*.

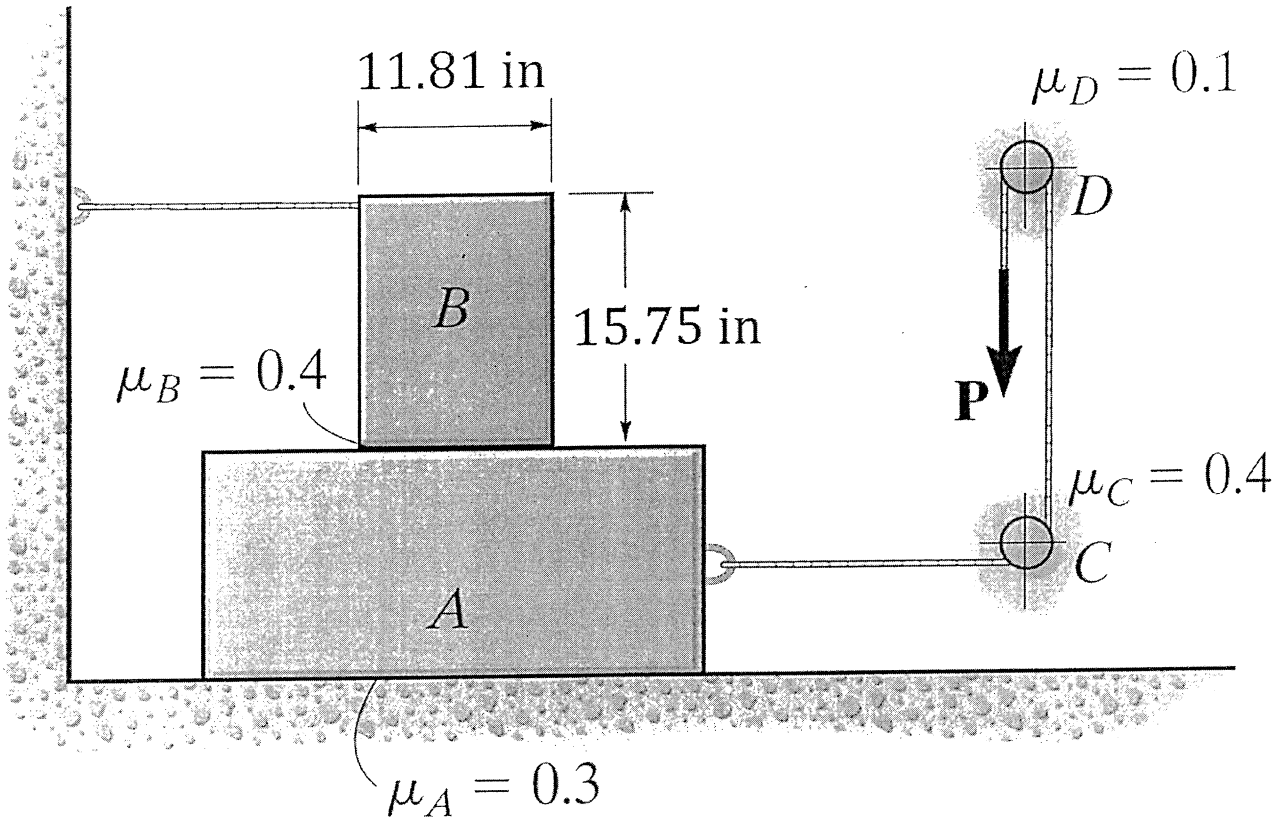

FIGURE 3.

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

IV. (20 Marks)

The crank member ***CB*** can oscillate about the pinned joint support at ***C*** within a limited arc distance. When ***CB*** oscillates it causes crank ***OA*** to oscillate about the pinned supported joint ***O***. When link ***CB*** is horizontal the link ***OA*** is vertical, as shown in the figure. In this position, the angular velocity of ***CB*** is 2 rad/sec counter clockwise. For this instant, determine;

a) the angular velocities of links ***OA*** and ***AB***, and

b) the angular accelerations of links ***OA*** and ***AB***.

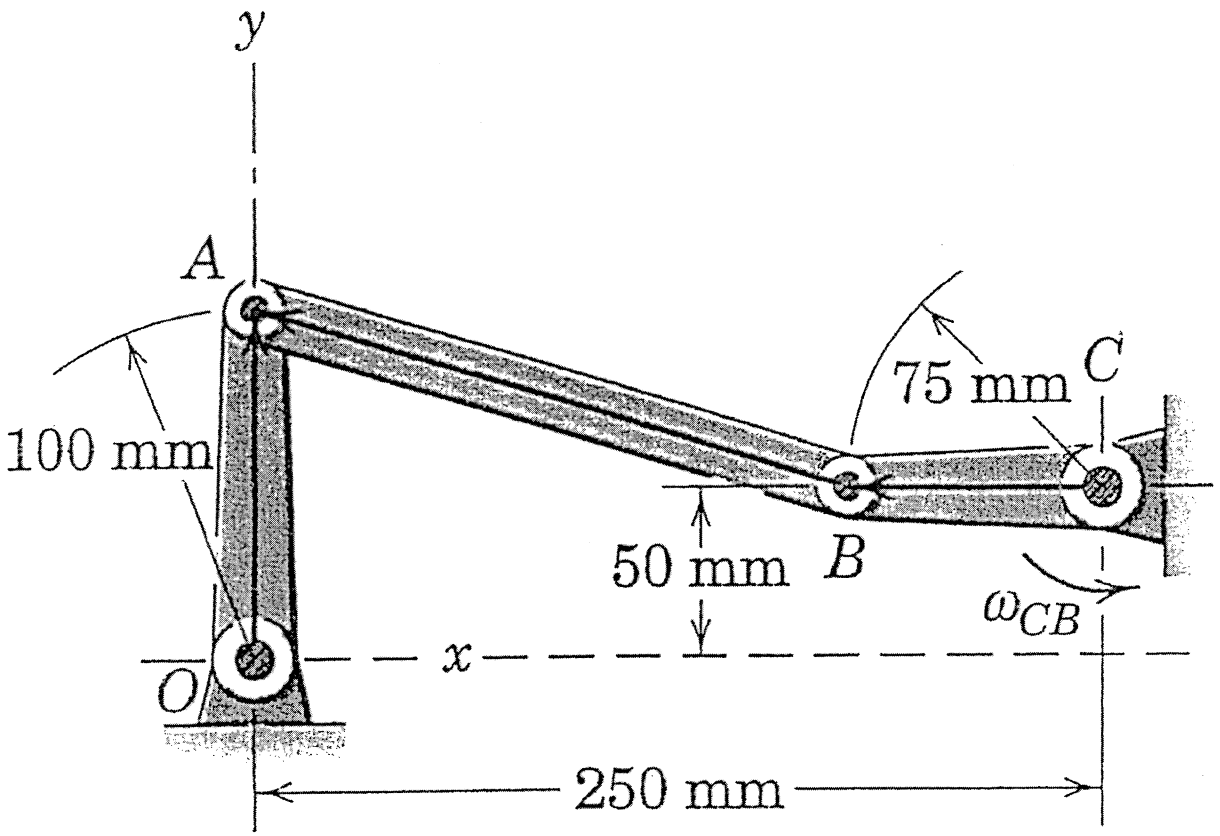

FIGURE 4.

V. (20 marks)

The cart shown has a mass of m = 10 kg and rides on a frictionless 20 degree inclined plane. In the position shown at x = 0, all three springs are unstretched and the cart is at rest. All three springs have the same spring constant of k = 125 N/m. Determine;

a) the speed of the cart when x = 50 mm,
b) the maximum displacement x_{max} of the cart, and
c) the final position of the cart after all oscillations cease.

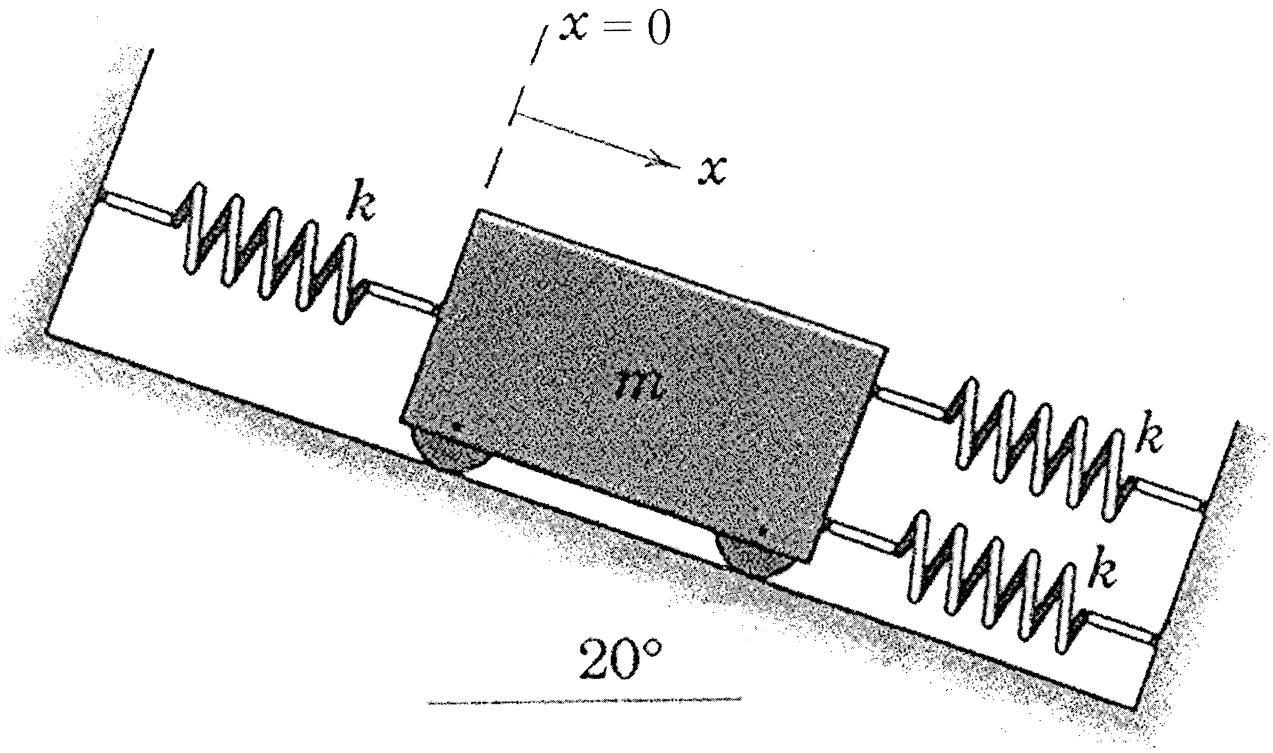

FIGURE 5.

VI. (20 marks)

A ball is released from position A and drops 0.75 m vertically downward and impacts the 20 degree inclined plane at position B. If the coefficient of restitution for the impact is e = 0.85, determine the distance L_{BC} as indicated in figure 6 below.

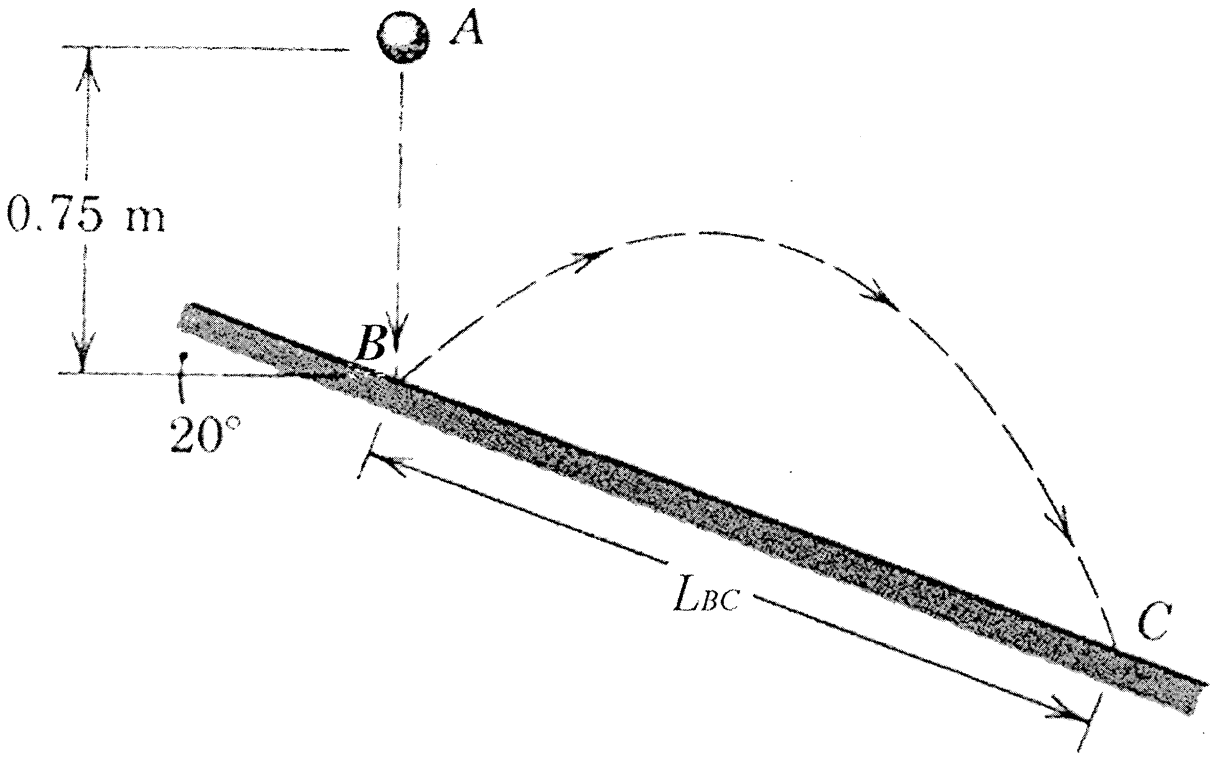

FIGURE 6.