NATIONAL EXAMINATION - DECEMBER 2016

- 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.

PART A - STATICS
(ANSWER ANY 2 0F THE 3 QUESTIONS)

I. Three cables are attached to a bracket, as shown in figure 1. Using ***cartesian vector methods***, replace the forces exerted by the cables with an equivalent force-moment system at A. Illustrate the system using a clearly labelled diagram with axes.

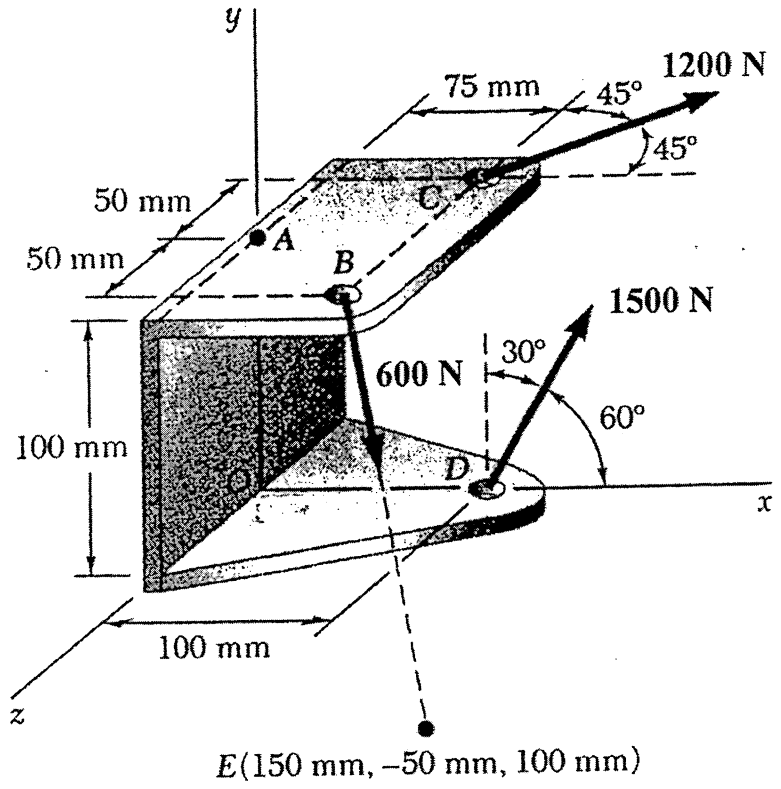


FIGURE 1.

II. Determine the magnitude and sense of the forces in all of the members for the structure shown in figure 2.

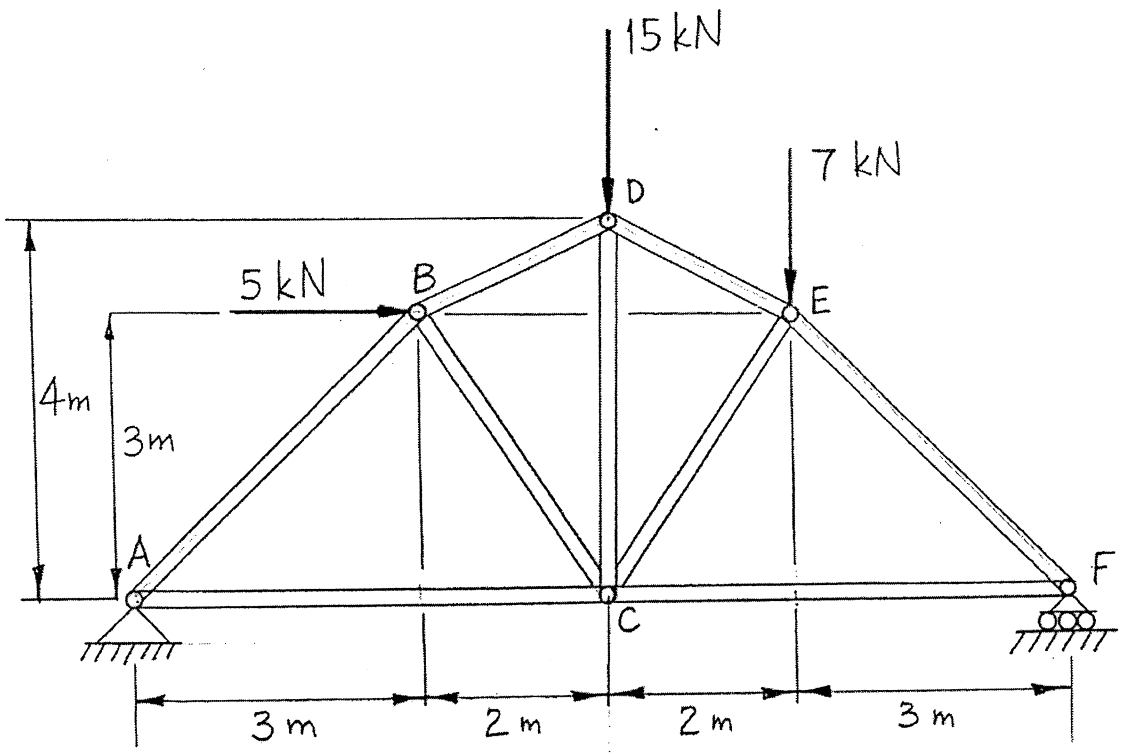


FIGURE 2.

III. Determine the range of values for the weight **A** that will result in the equilibrium of the system shown in figure 3.
NOTE: The pulley is assumed to be frictionless and the cable is inextensible and has negligible mass.

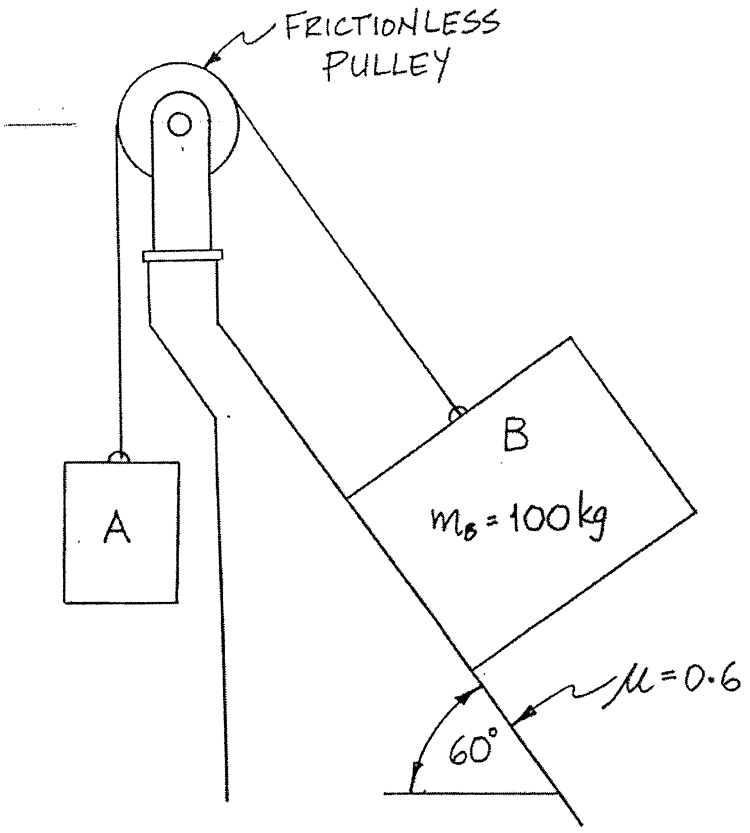
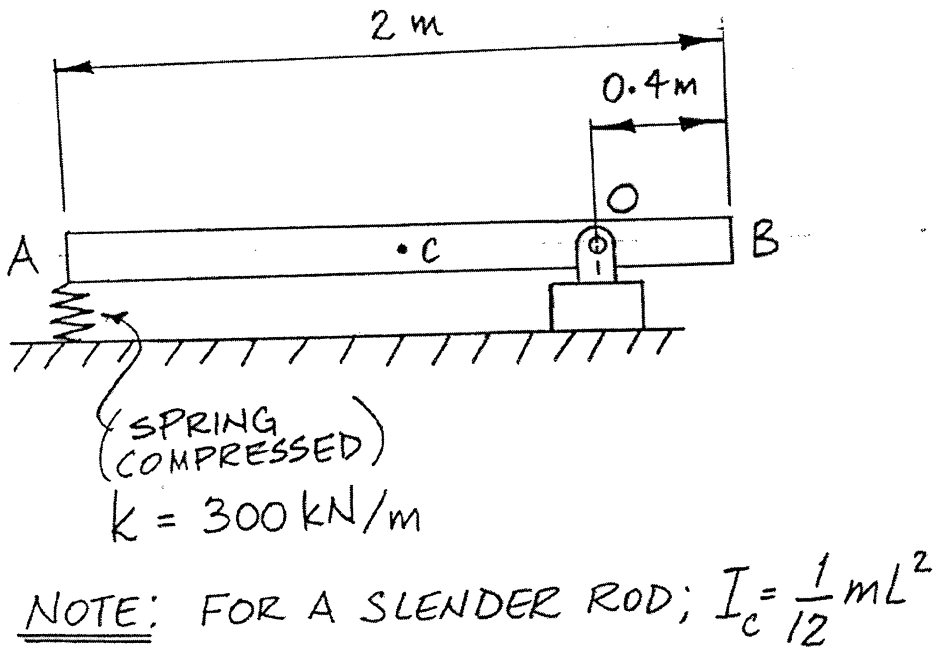


FIGURE 3.

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

IV. A 15 kg slender rod AB is 2 m long and is pivoted about point **O** which is 0.4 m from end **B**. End A of the rod is pressed against a spring of constant k = 300 kN/m until the spring is compressed 25 mm. The rod is then in a horizontal position, as shown in figure 4. If the rod is released from this position, determine the rod's angular velocity and the reaction forces at the pivot **O** as the rod passes through a vertical position.



NOTE: FOR A SLENDER ROD; $I_c = \frac{1}{12} mL^2$

FIGURE 4.

V. Two identical frictionless spheres are shown in figure 5 just prior to impact. The magnitude and directions of their velocities are also indicated in the figure. Determine the magnitude and direction of the velocity of each sphere after the impact if the coefficient of restitution is assumed to be $e = 0.90$.

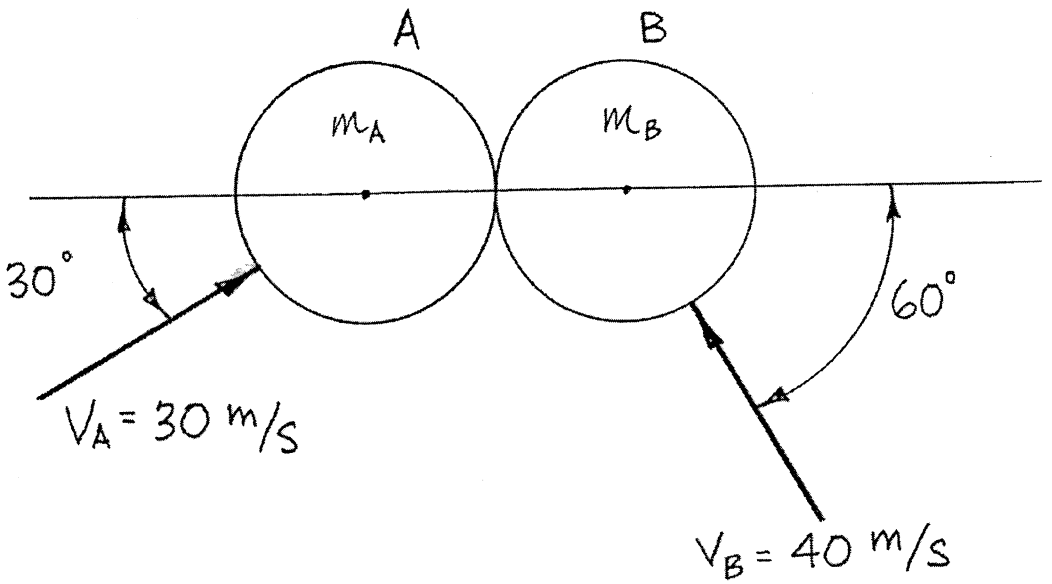


FIGURE 5.

VI. (Note: Parts A and B of this question have equal value.)

The linkage system in figure 6 is dimensioned as follows;

$a = b = 3$ ft, $c = 4$ ft, and $d = 8$ ft.

A) In the position shown, link ***AB*** has an angular velocity $\omega_{AB} = 10$ rad/s CCW. Determine the angular velocities of links ***BD*** and ***DE*** and the velocity v_D of the pin at ***D***.

B) In the position shown, link ***AB*** has an angular velocity of $\omega_{AB} = 10$ rad/s CCW and an angular acceleration $\alpha_{AB} = 12$ rad/s CCW. Determine the angular accelerations of links ***BD*** and ***DE*** and the angular acceleration α_D of the pin at ***D***.

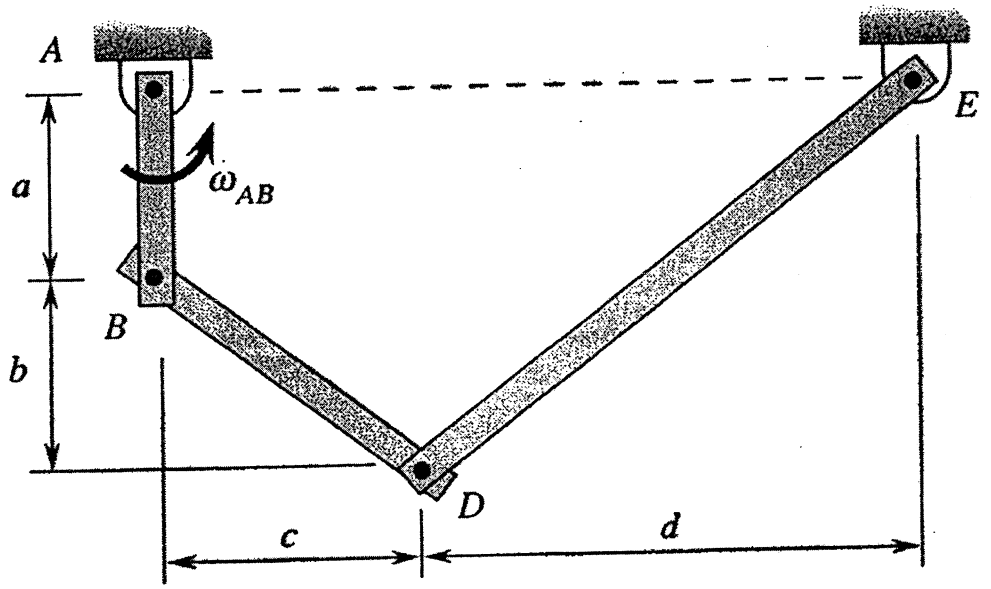


FIGURE 6.