NATIONAL EXAMINATION - MAY 2018

04-BS-3, STATICS AND DYNAMICS

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. **The 8½"×11" sheet of self-prepared notes MUST be submitted along with the examination paper and the answer booklet.**

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

I. The pipe and cable assembly supports the plate, as shown in figure 1. Using ***cartesian vector methods***, Determine the tensions in the cables and the components of reaction acting on the smooth collar at *A* necessary to hold the sign of weight **220 N** in equilibrium. The center of gravity for the sign is at *G*.
All dimensions shown are metres.

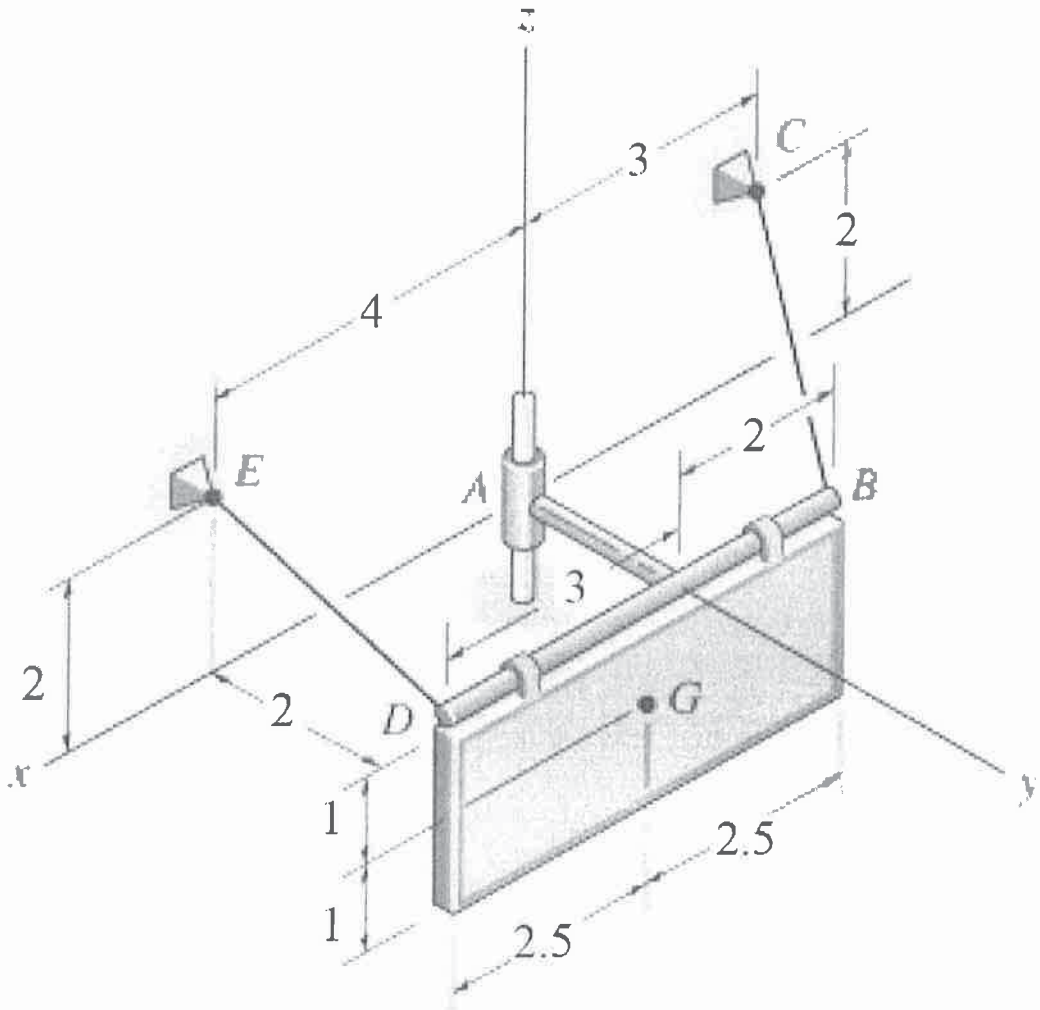

FIGURE 1.

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

NOTE: Each division on the grid shown represents 1 metre.

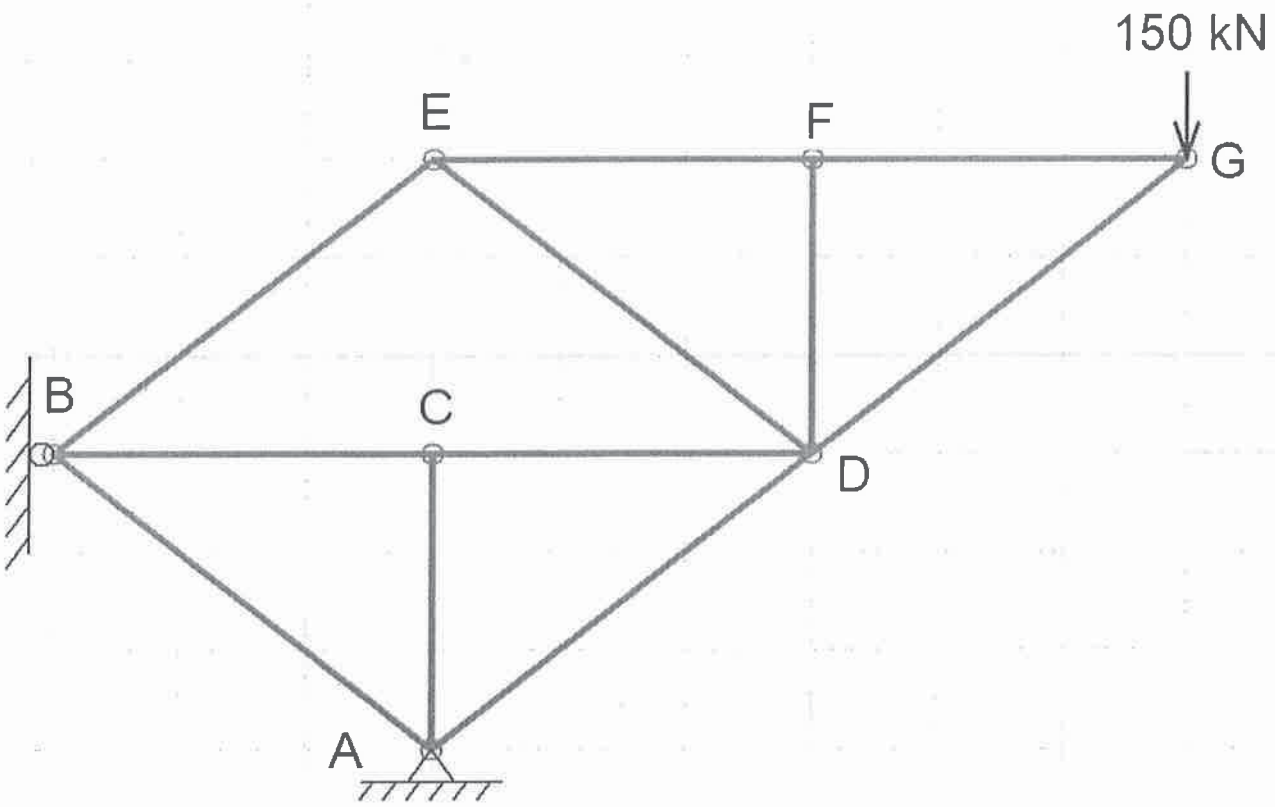

FIGURE 2.

III. A cable that is attached to the 40-kg plate ***B***, passes over a fixed cylindrical rod at ***C***, and is attached to the block at ***A***. Using the coefficients of static friction shown; determine the smallest mass of block ***A*** so that it will prevent sliding motion of *B* down the plane.

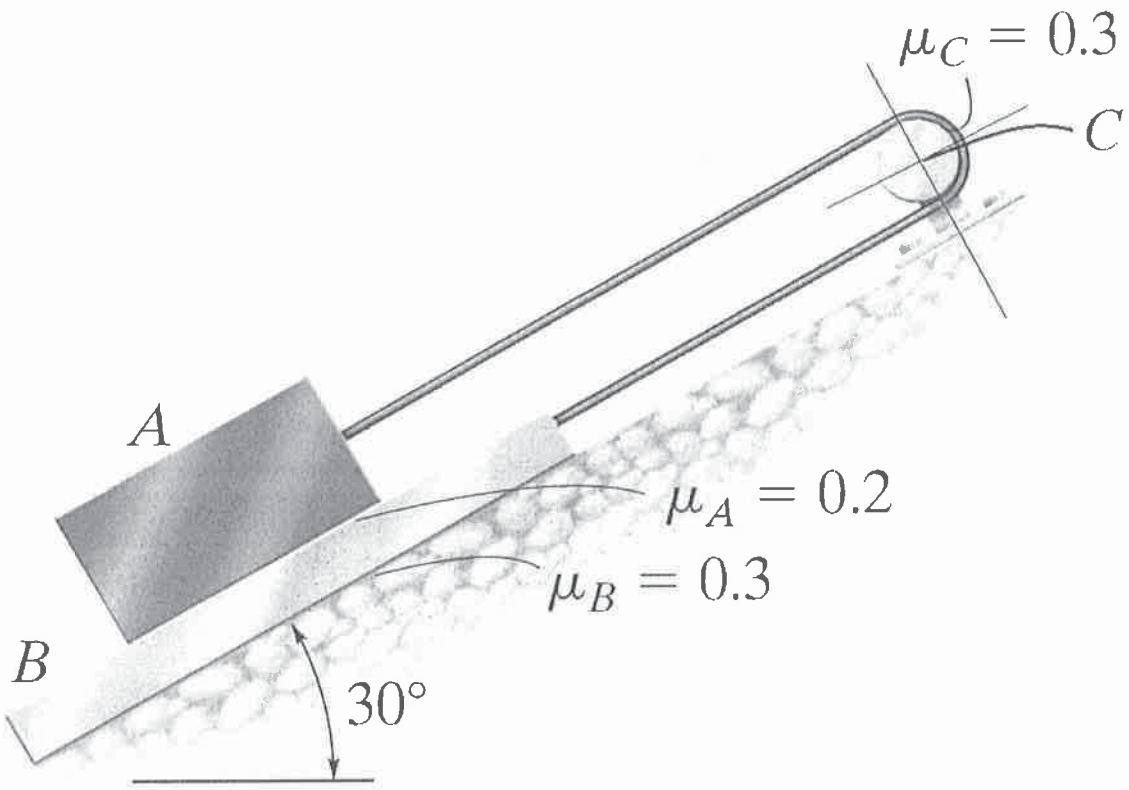

FIGURE 3.

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

IV. At the instant shown, cars ***A*** and ***B*** are traveling at velocities of 50 m/s and 30 m/s, respectively. If ***A*** is increasing its speed at 4 m/s^2, whereas the speed of ***B*** is decreasing at 3 m/s^2, determine the velocity and acceleration of ***B*** with respect to ***A***. The radius of curvature at ***B*** is $\rho_B = 200$ m.

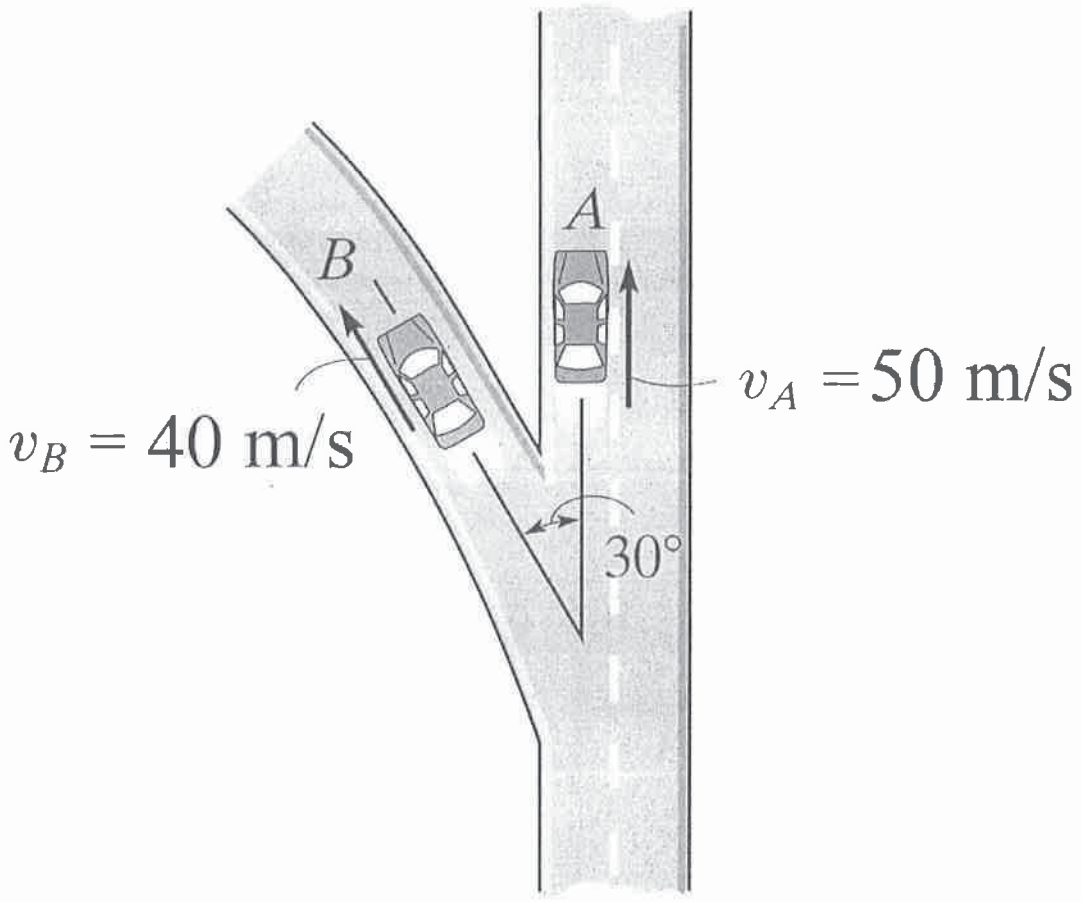

FIGURE 4

V. A 10-kg block A is released from rest 2.5 m above the 5-kg plate ***P***, which can slide freely along the smooth vertical guides *BC* and *DE*.

a) Determine the velocity of the block and plate just after impact. The coefficient of restitution between the block and the plate is $e = 0.75$

b) Find the maximum compression of the spring due to impact. The spring has a stiffness of $k = 1600$ N/m.

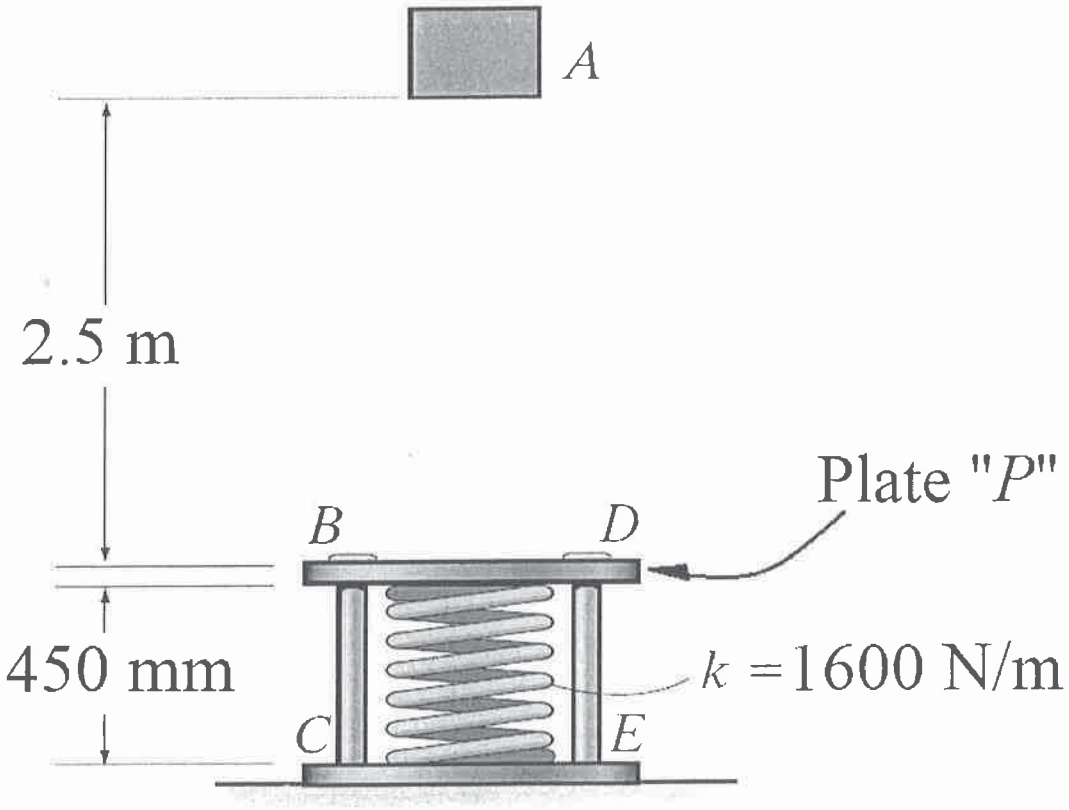

FIGURE 5.

VI. The slider block C moves at 10 m/s down the inclined groove. Determine the angular velocities of links AB and BC, at the instant shown.

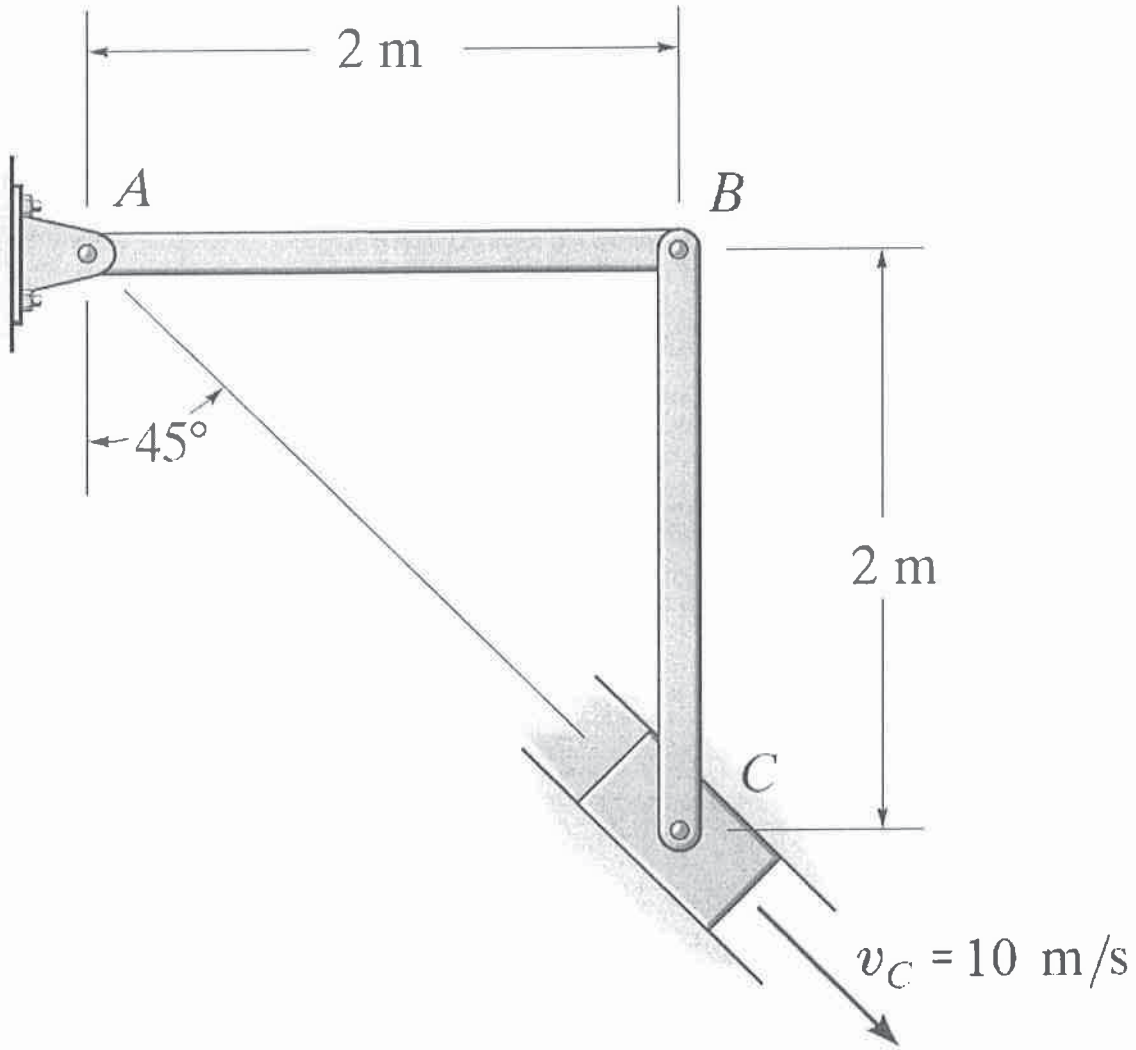

FIGURE 6.