NATIONAL EXAMINATION - MAY 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 formulae only.The formula sheet must be submitted with the solution booklet. Candidates may use one of two calculators, the **Casio** or a **Sharp** approved models.

3. Squared paper will be provided, 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. Figure 1 shows a machine part which is clamped in a vise (at the x, y, z origin). An inclined hole is to be drilled in the end of the part, as shown. The drill exerts a force of 40 N, and a couple of 3 N.m, on the part.The sense of the couple is clockwise when viewed from the lower right side of the figure. Using ***cartesian vector methods***, find the force-moment system exerted by the vise (at the origin) on the part during the drilling operation. Illustrate the force-moment system on a clearly labelled diagram with axes.

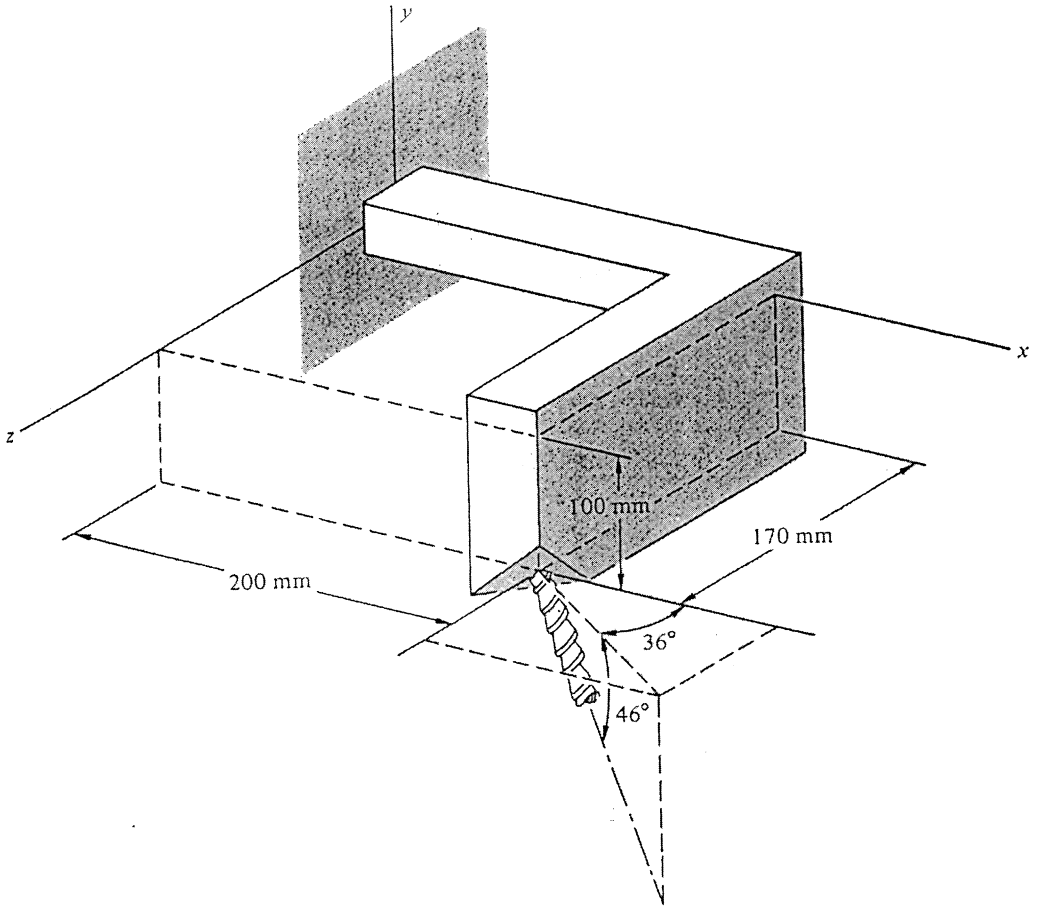


FIGURE 1.

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

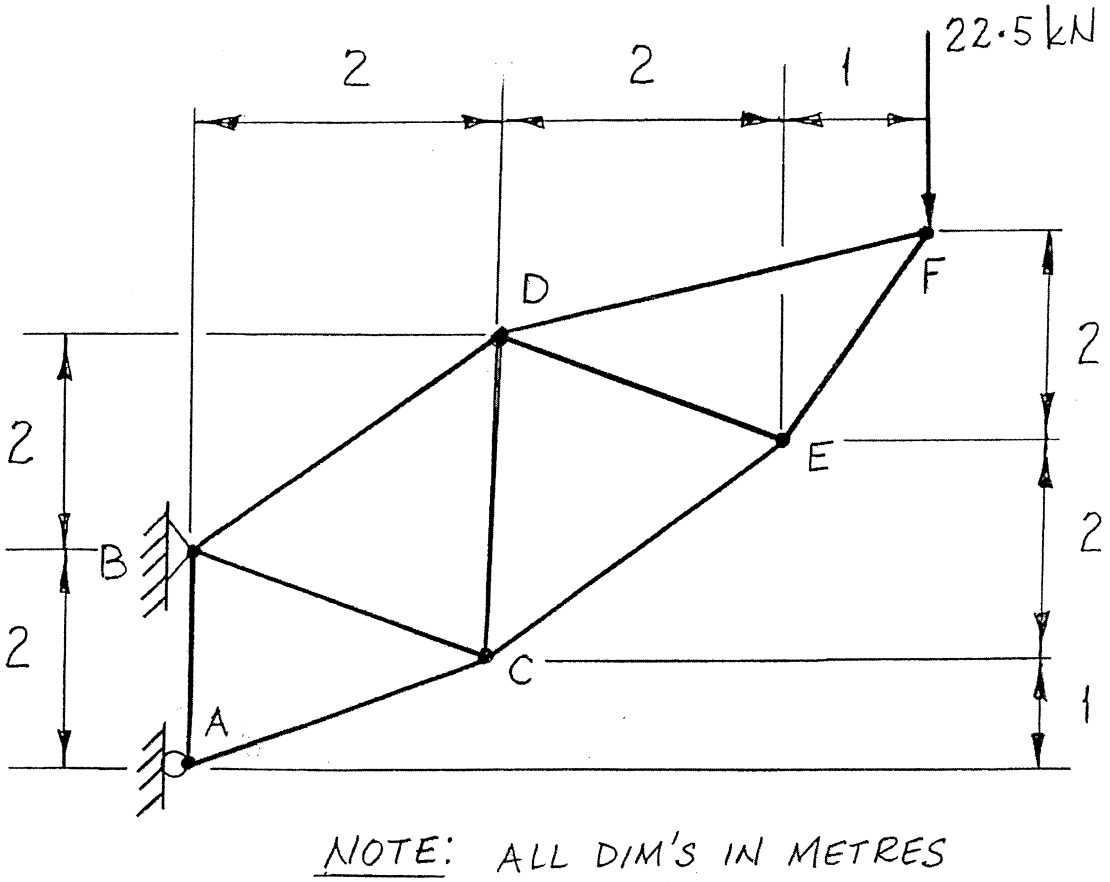


FIGURE 2.

III. The link in figure 3 is weightless. Block A weighs 100 N, and block B weighs 350 N. The coefficient of static friction between block A and B is $\mu_s = 0.15$, and between block B and the inclined surface $\mu_s = 0.2$.

A) For what range of values of P will the block B remain in the equilibrium position shown?
B) Find the corresponding range of values of the force in the link.

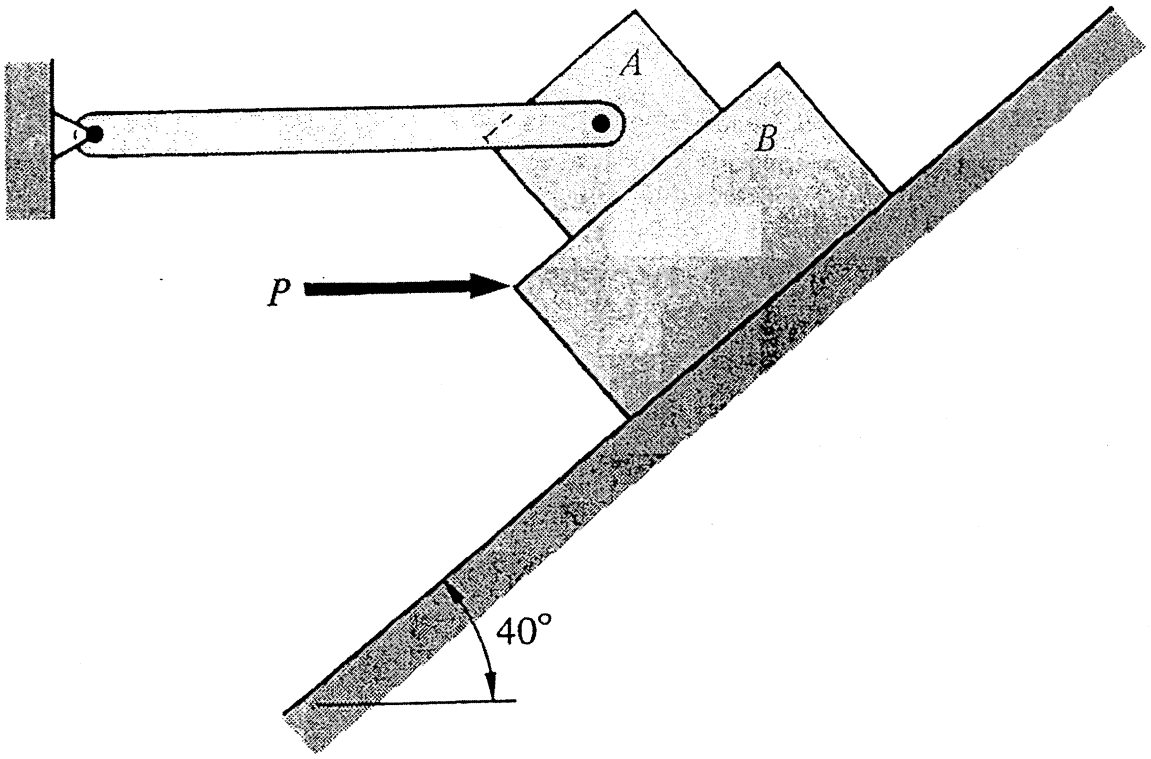
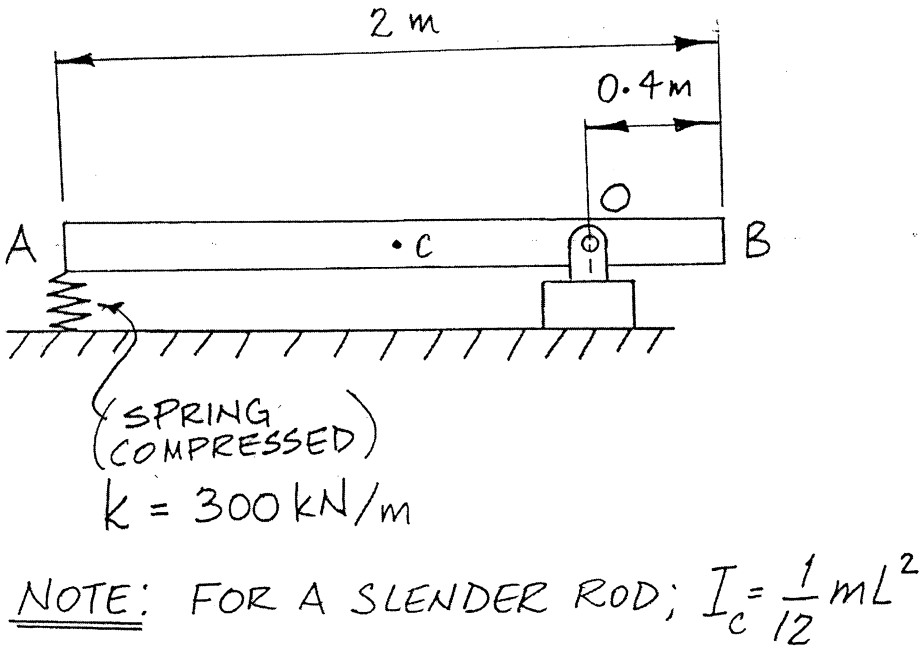


FIGURE 3.

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. At the instant shown in figure 5, block ***B*** is released with zero initial velocity. The velocity of block , v_A is constant, and the blocks collide at a position 20 inches from the original position of block ***B***. The impact is assumed to be elastic. Block ***A*** weighs 10 lb_f and block ***B*** weighs 12 lb_f.

A) Find the velocities of the blocks after impact.
B) Find the value of the impulse.

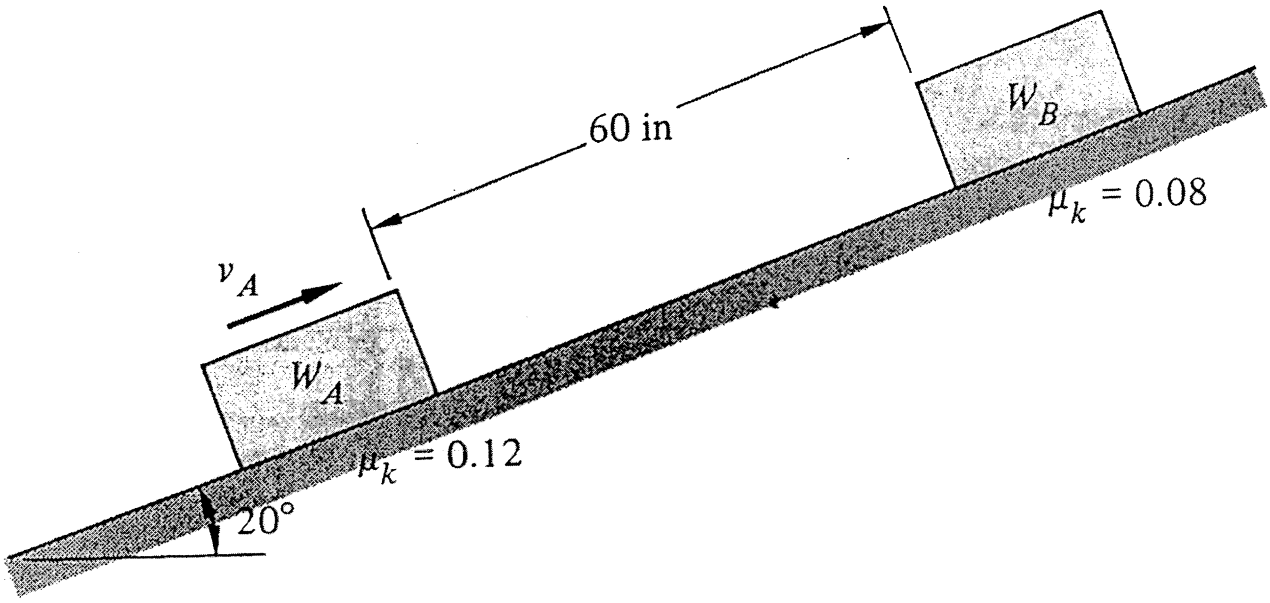


FIGURE 5.

VI. Figure 6 shows a plane frictionless sliding mechanism. Slider block A moves to the left with a constant velocity of 4 m/sec. Neglecting the masses of the blocks and the link, determine;

A) the angular velocity of the link AB.

B) the velocity of the slider block B.

C) the magnitude, direction, and the sense of the velocity of point "a" on the link.

and

D)iIllustrate the velocities of the blocks and the velocity of point "a" on a clearly labelled diagram.

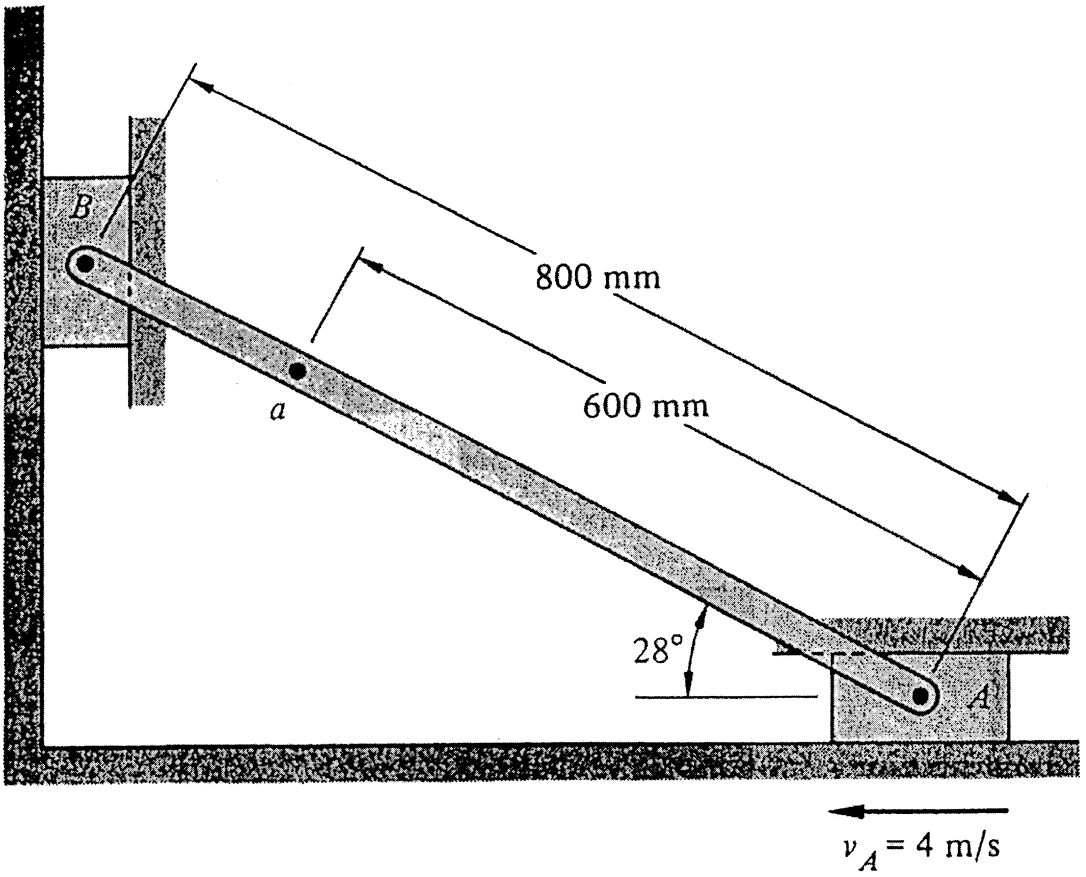


FIGURE 6.