

NATIONAL EXAMINATION - MAY 2014

- 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 OF 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.

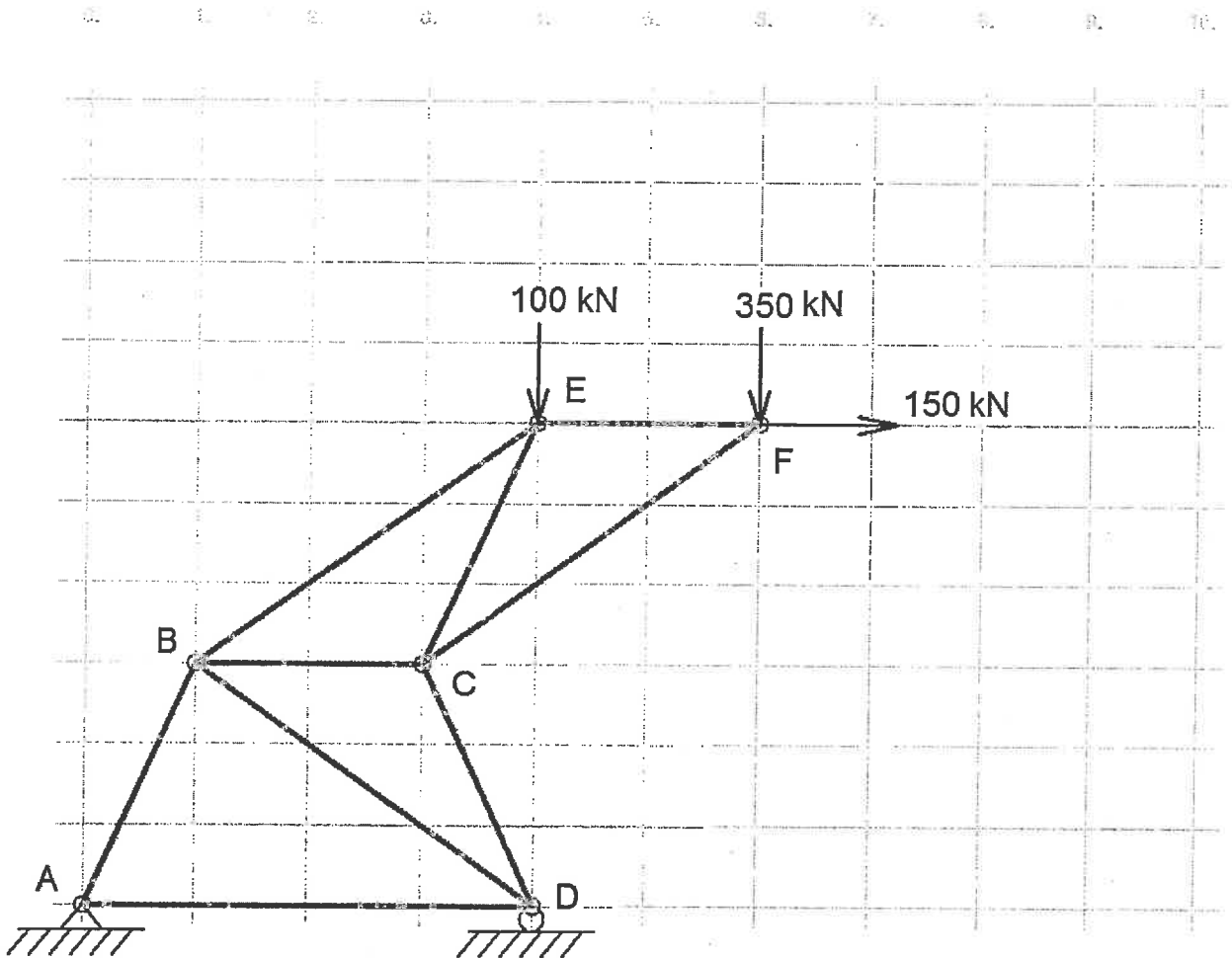


FIGURE 1.

II. ( 20 Marks )

The action of the roll clamp is controlled by the two hydraulic cylinders shown in figure 2. In order to hold firmly the paper roll, a vertical 1000 pound force is applied at the top of the roll arm CAF. Knowing that the weight of the paper roll is 4500 lb, determine:

- the force exerted by each cylinder, and
- the force exerted at C on arm BCEH.

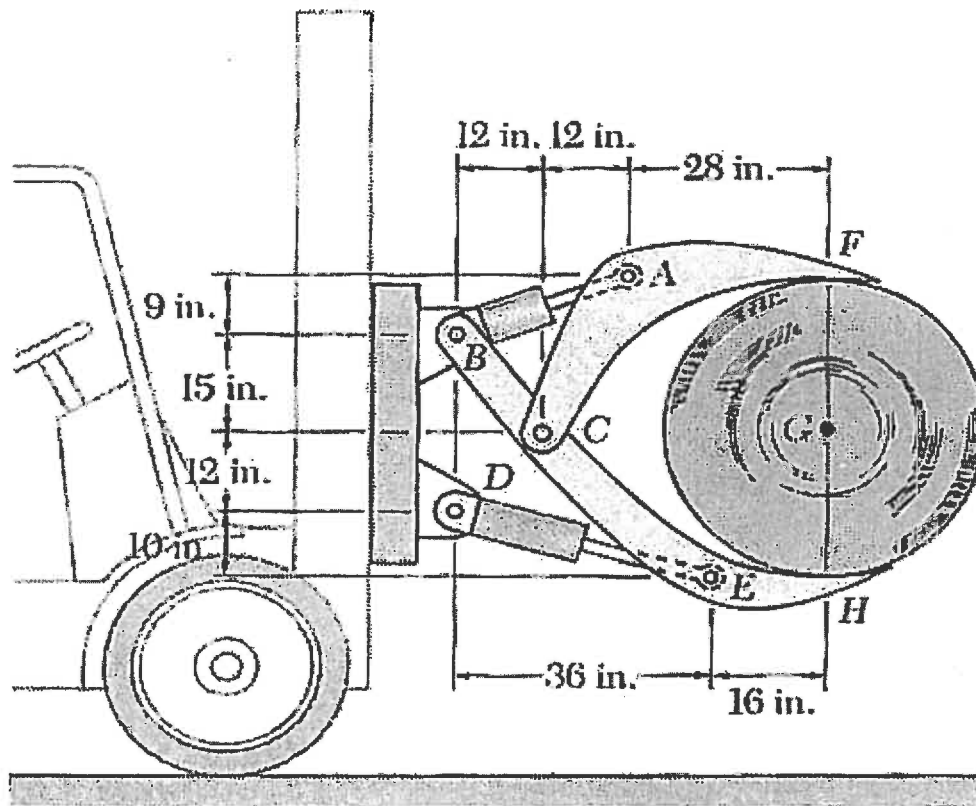


FIGURE 2

III. (THIS QUESTION CONTAINS 2 PARTS FOR A TOTAL OF 20 MARKS)

PART A. (10 Marks)

The movable bracket, shown in figure 3A may be placed at any height on the 3 in. diameter pipe. If the coefficient of static friction between the pipe and the bracket is 0.25, determine the minimum distance  $x$  at which the load  $W$  can be supported. Neglect the weight of the bracket.

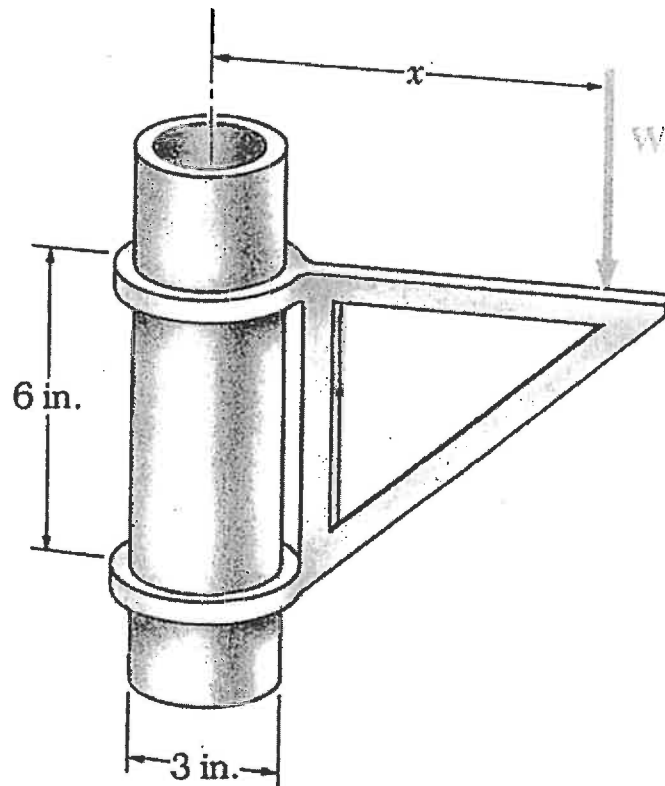


FIGURE 3A

QUESTION 3 PART B, CONTINUED ON NEXT PAGE

PART B. (10 Marks)

Locate the X, Y and Z co-ordinates of the centre of gravity for the machine element shown in figure 3B. Both holes are of 1 in. diameter.

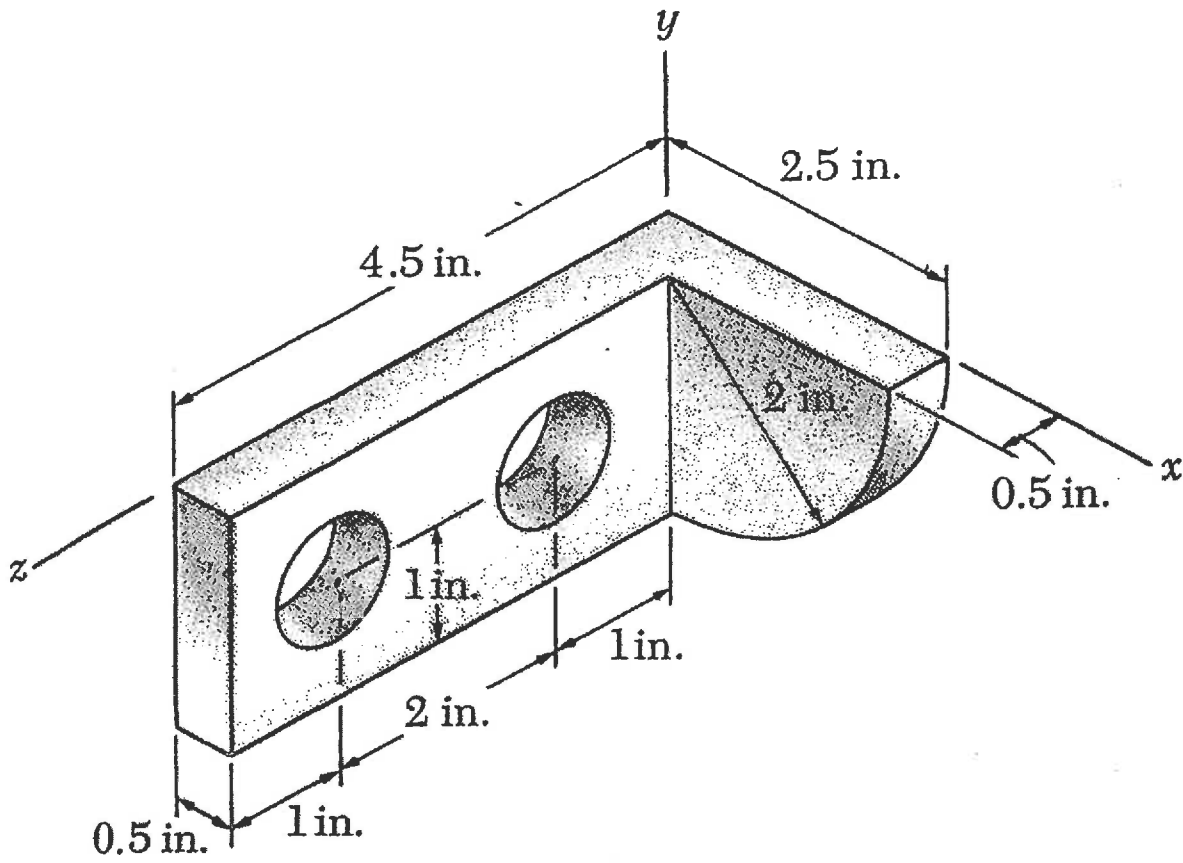


FIGURE 3B

**PART B - DYNAMICS**  
(ANSWER ANY 2 OF THE 3 QUESTIONS)

IV. (20 Marks)

Car A was travelling due north through an intersection when it was hit broadside by car B which was travelling due east. While both drivers admitted having ignored the four-way stop signs at the intersection, each claimed he was driving at the 35 mi/hr speed limit and that the other was travelling much faster. Knowing that car A weighs 2000 lb, car B 3600 lb, and that the inspection of the scene of the accident showed that as a result of the impact the two cars stuck together and skidded in a direction 40 degrees north of east, determine;

- a) which of the two cars was actually travelling at 35 mi/hr, and,
- b) how fast the other car was moving.

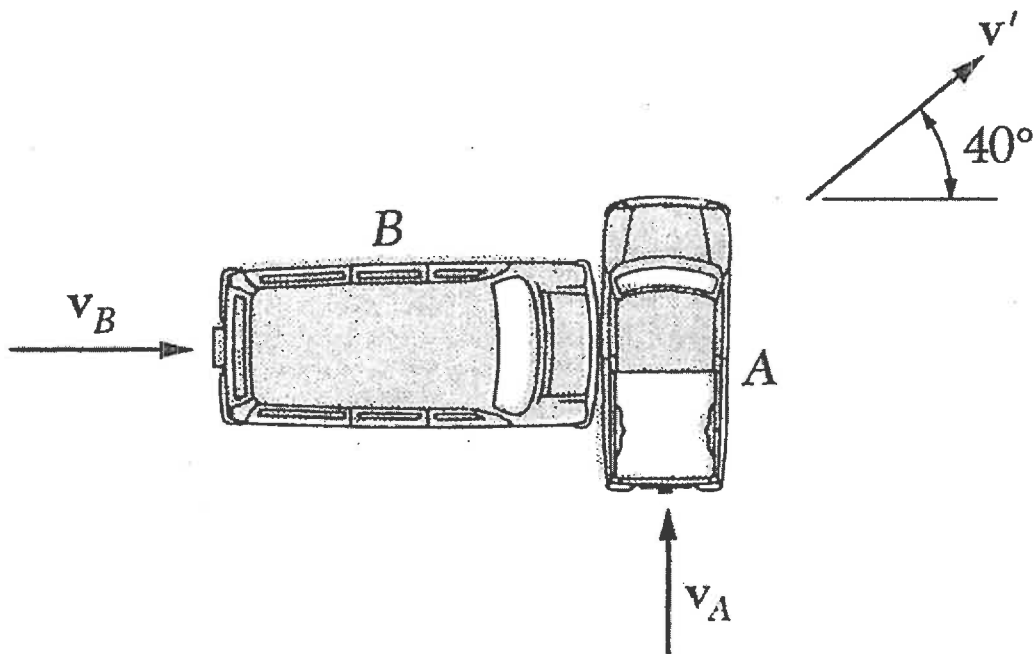


FIGURE 4.

V. ( 20 marks )

The two blocks shown in figure 5 are originally at rest. Neglecting the masses of the pulleys and the effect of friction in the pulleys and between block A and the incline, determine, using work and energy methods;

- a) the velocity of block A after it has moved through 5 ft., and,
- b) the tension in the cable.

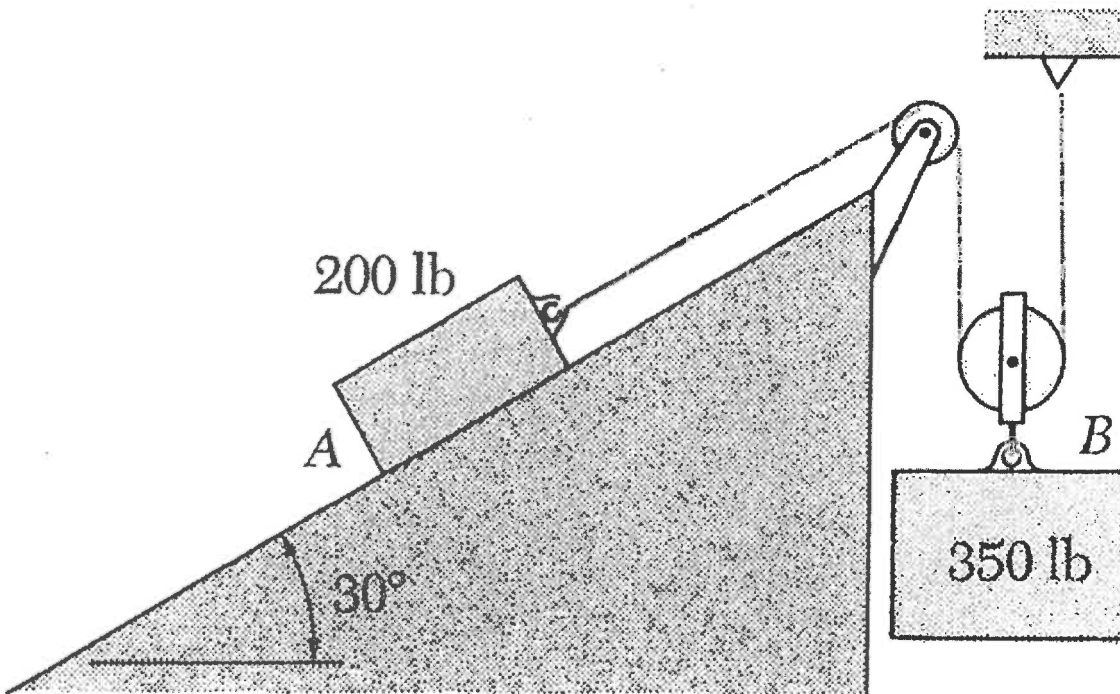


FIGURE 5.

VI. ( 20 marks )

Two 5 kg thin uniform disks are attached to the 8 kg rod ab as shown in figure 6. Knowing that the constant of the spring is 4 kN/m and that the disks roll without sliding, determine the frequency of vibration of the system.

Note: for a uniform thin disk:  $I_{\text{disk}} = \frac{1}{2} mr^2$

and for simple harmonic motion:  $v_m = p x_m^2$

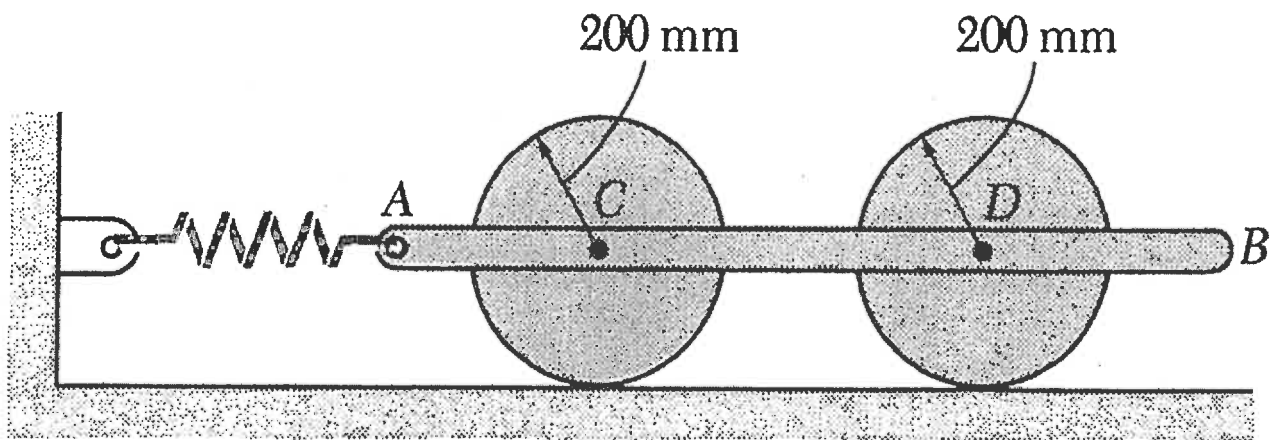


FIGURE 6.