NATIONAL EXAMINATION - DECEMBER 2010

- 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.

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)

1. (20 Marks)
Determine the magnitude and sense of the forces in all of the members for the structure shown in figure 1. The mass of the members, cable and pulley may be neglected. Assume that the pulley is frictionless.

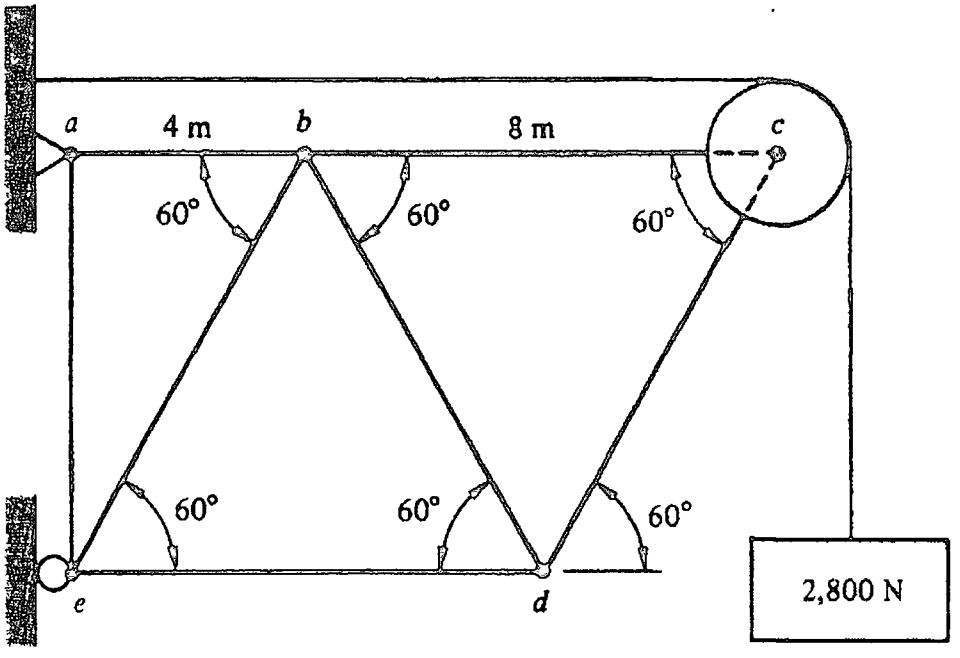


FIGURE 1.

2. (20 Marks)

A uniform pipe cover of radius $r = 240$ mm and mass 60 kg is held in a horizontal position by the cable CD. Assuming that the bearing at B does not exert any force in the z direction, determine the tension in the cable **and** the reactions at A and B using ***cartesian vector methods.***

NOTE: Use the origin of the x,y,z co-ordinate axes at point B as shown in the figure.

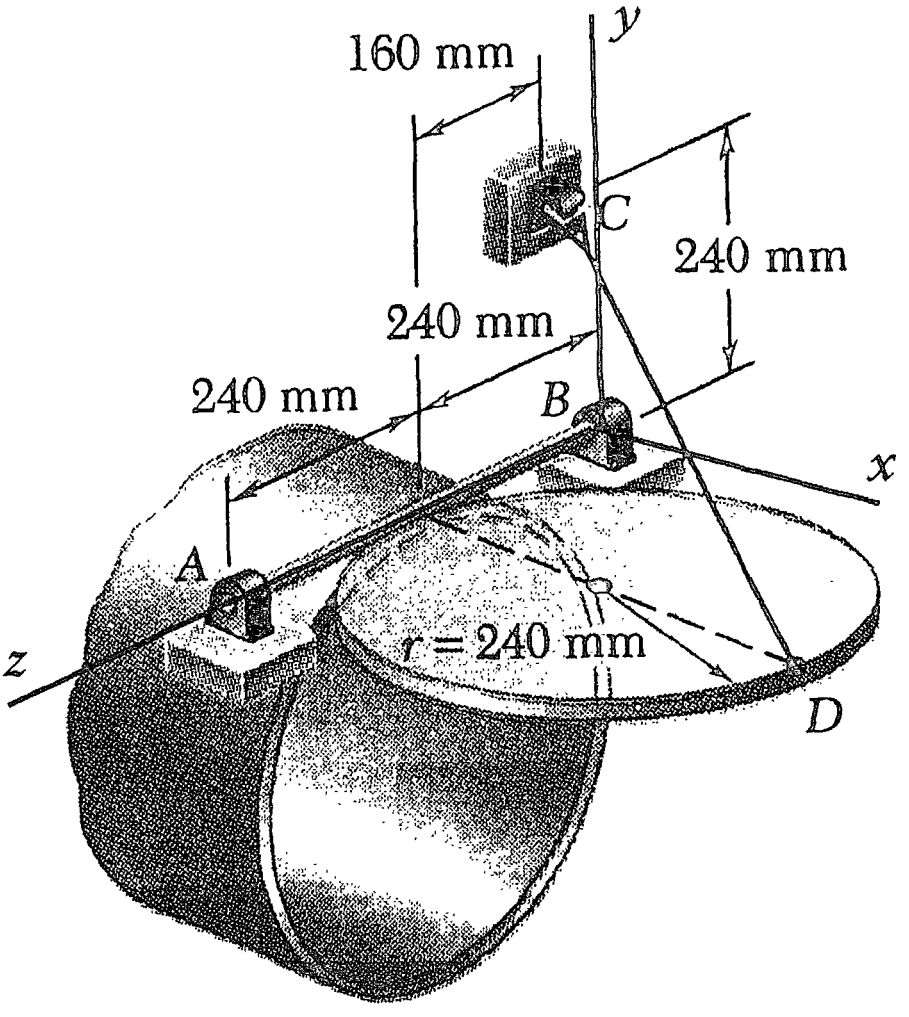


FIGURE 2.

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

PART 3A. (10 Marks)

Determine the centroidal coordinates of the area bounded by the straight line and parabolic curve shown in figure 6 A. **Note:** Dimensions are in metres.

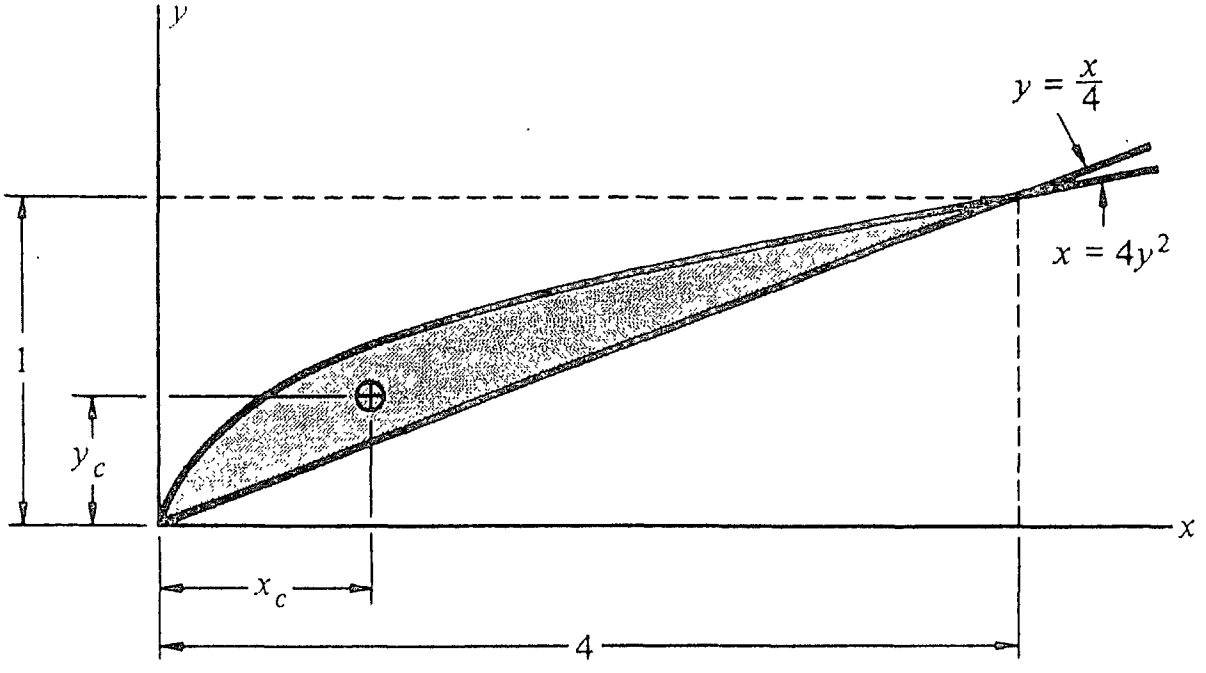


FIGURE 3A.

QUESTION 3 PART B, CONTINUED ON NEXT PAGE

PART 3B. (10 Marks)

Figure 3B shows the cross section of a precast concrete floor beam. Determine the moment of inertia and radius of gyration about the horizontal centroidal axis of the cross section.

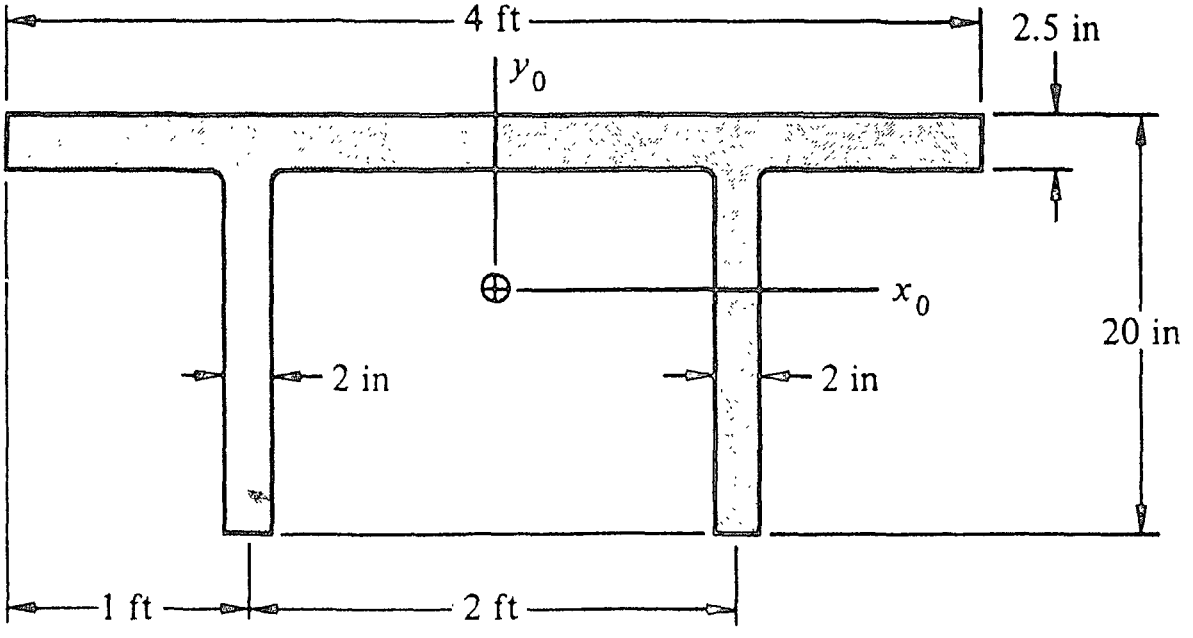


FIGURE 3B.

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

4. (20 Marks)

A spring is used to stop a package with a mass of 68 kg which is moving down a 20 degree incline. The spring has a constant of k = 26.28 kN/m and is held by cables so that it is initially compressed 101.6 mm. Knowing that the velocity of the package is 3.048 m/sec when it is 9.144 m from the spring, determine the maximum additional deformation of the spring in bringing the package to rest. Neglect any frictional effects.

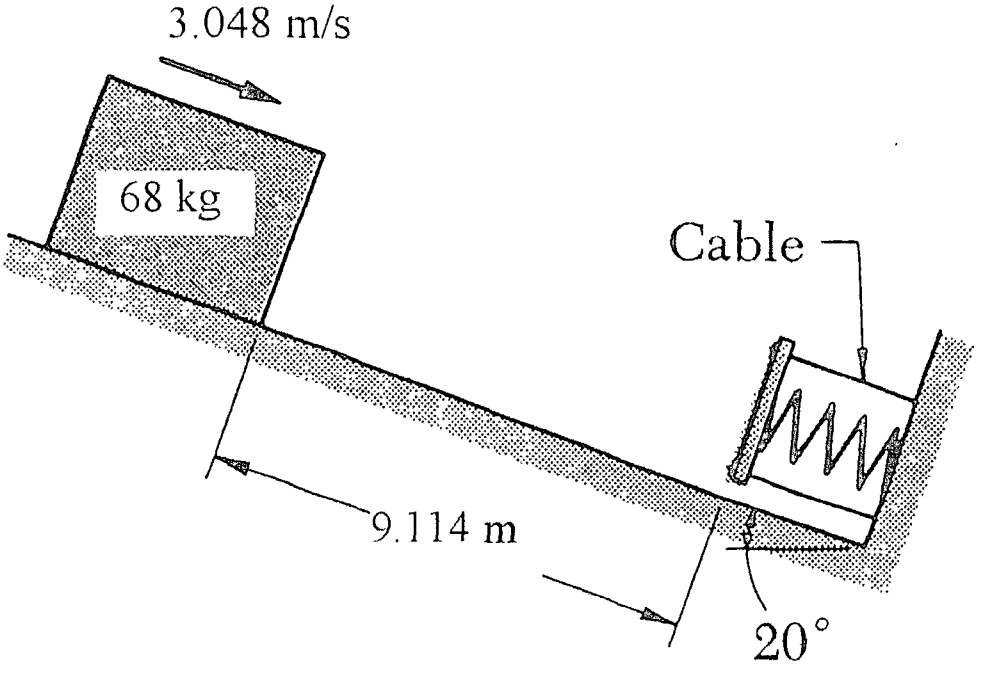


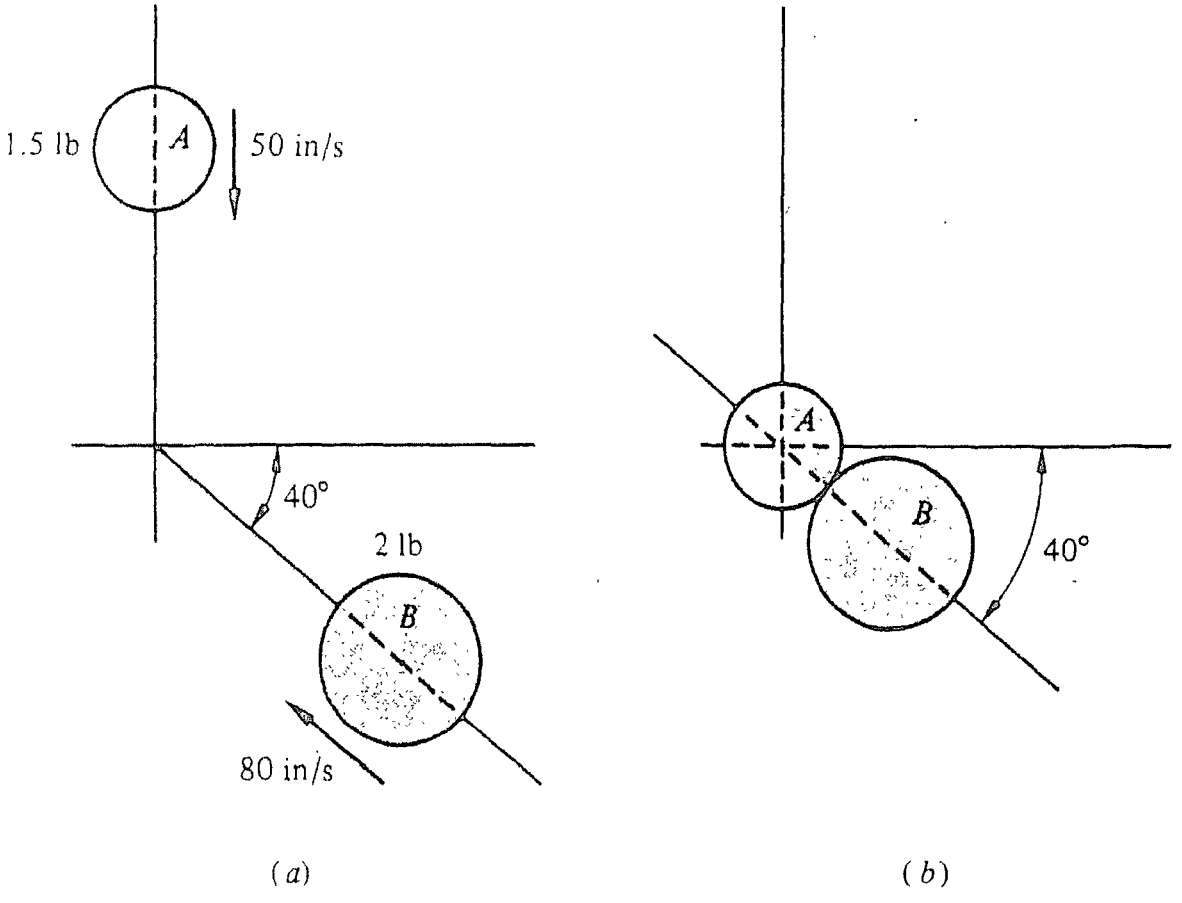
FIGURE 4.

5. (20 Marks)

Two spheres approach each other with constant velocities along rectilinear paths, as shown in figure 5 (a). Sphere A weighs 1.5 lb_f and sphere B weighs 2 lb_f. The coefficient of restitution is assumed to be 0.85. The impact configuration is shown in figure 5 (b) Determine;

a) the magnitudes and directions of the velocities of the two spheres after impact.

b) The percent loss of energy.



(*a*) (*b*)

FIGURE 5.

6. (20 Marks)

The system of blocks in figure 6, are released from rest at time $t = 0$. The coefficient of kinetic friction on all contacting surfaces is $\mu_k = 0.08$. Determine the magnitude, direction, and sense of the relative acceleration of block ***A*** with respect to block ***B***. Block ***A*** weighs 60 lb_f and block ***B*** weighs 125 lb_f. Assume that the pulley is frictionless.

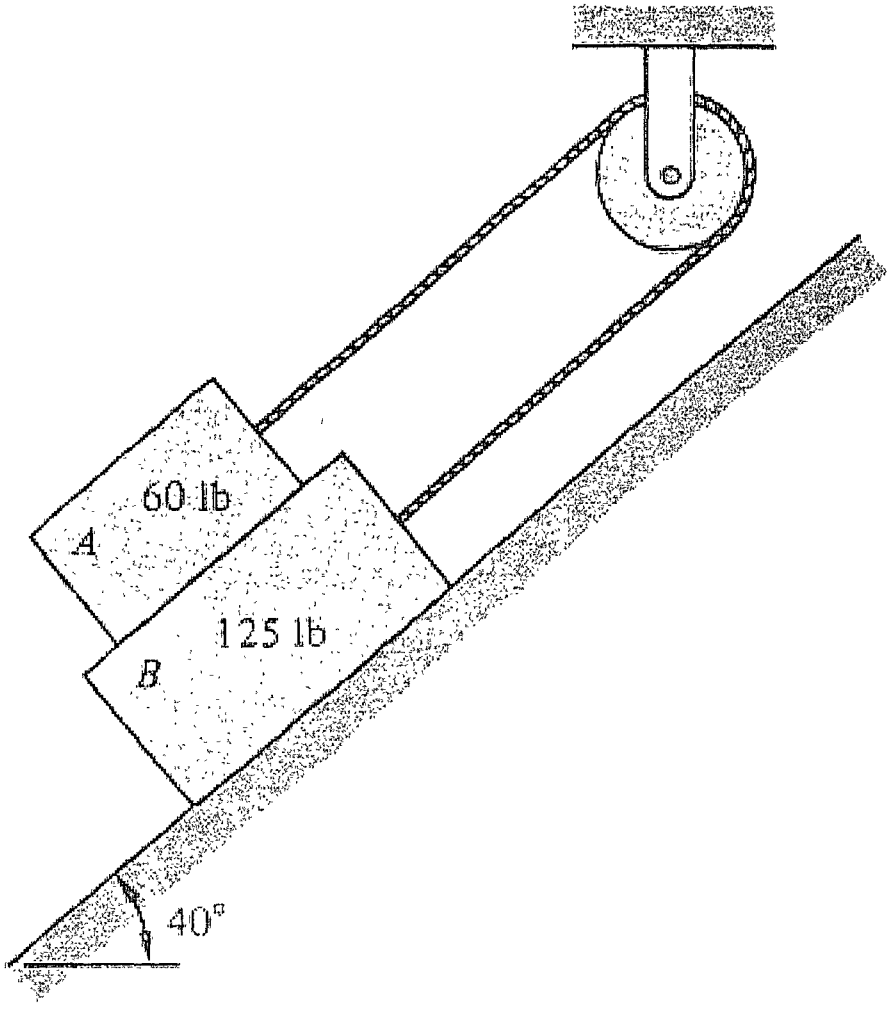


FIGURE 6.