

NATIONAL EXAMINATION - DECEMBER 2013

- 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.

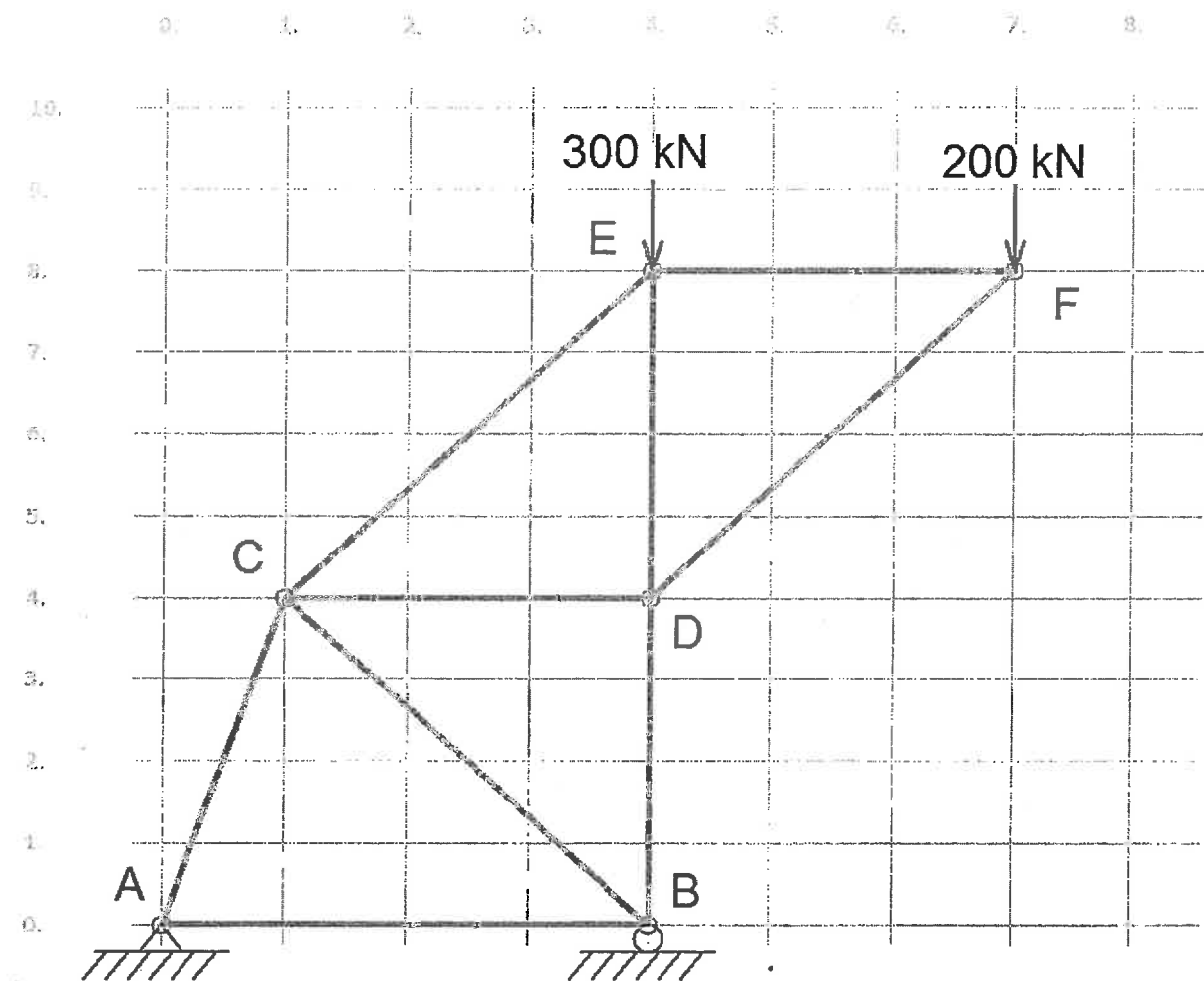


FIGURE 1.

II. (20 Marks)

The circular door shown in figure 2, has a weight of  $65 \text{ lb}_f$  and a centre of gravity at  $G$ . Using **cartesian vector methods**, determine the  $x, y, z$  components of the reaction at the hinge  $A$  and the force acting along strut  $CB$  required to hold the door in equilibrium if the angle  $\theta = 45^\circ$ .

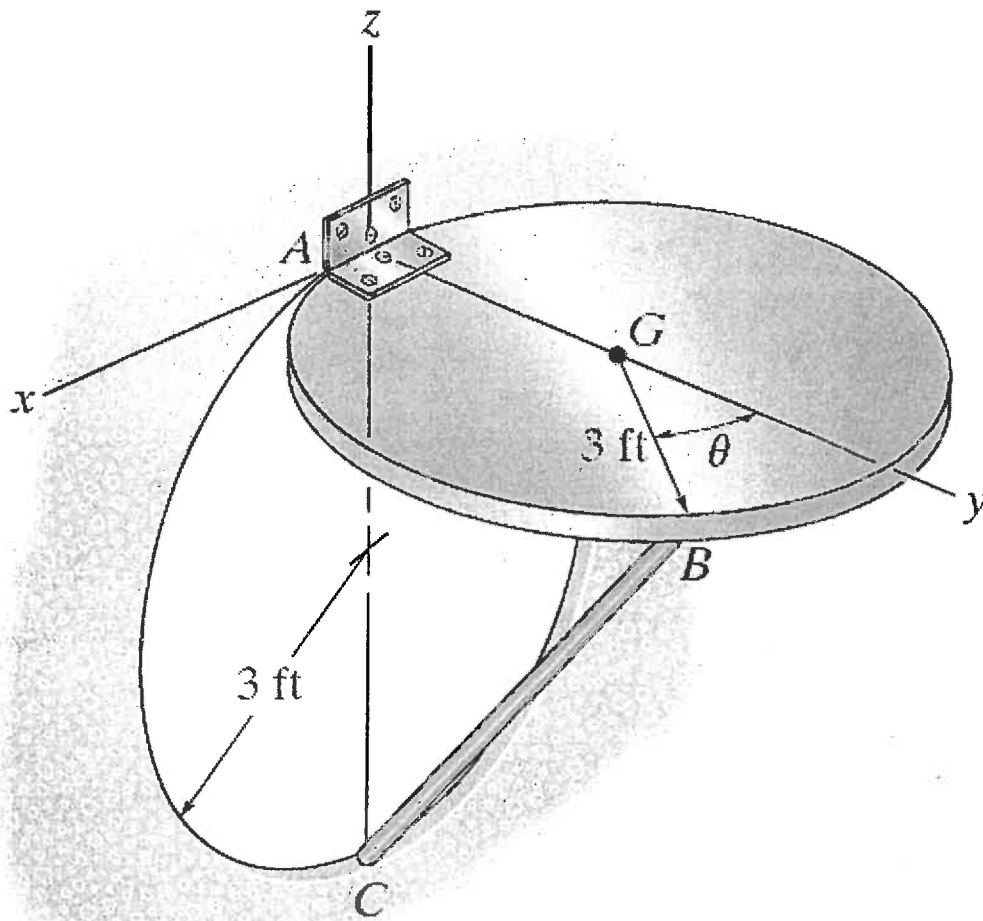


FIGURE 2

III. ( 20 Marks )

The uniform beam which weighs 50 N is supported by the rope which is attached to the end of the beam, wraps over the rough peg, and is then connected to the 100 N block. If the coefficient of static friction between the beam and the block, and between the rope and the peg, is  $\mu_s = 0.4$ , determine the maximum distance that the block can be placed from A and still remain in equilibrium. Assume the block will not tip.

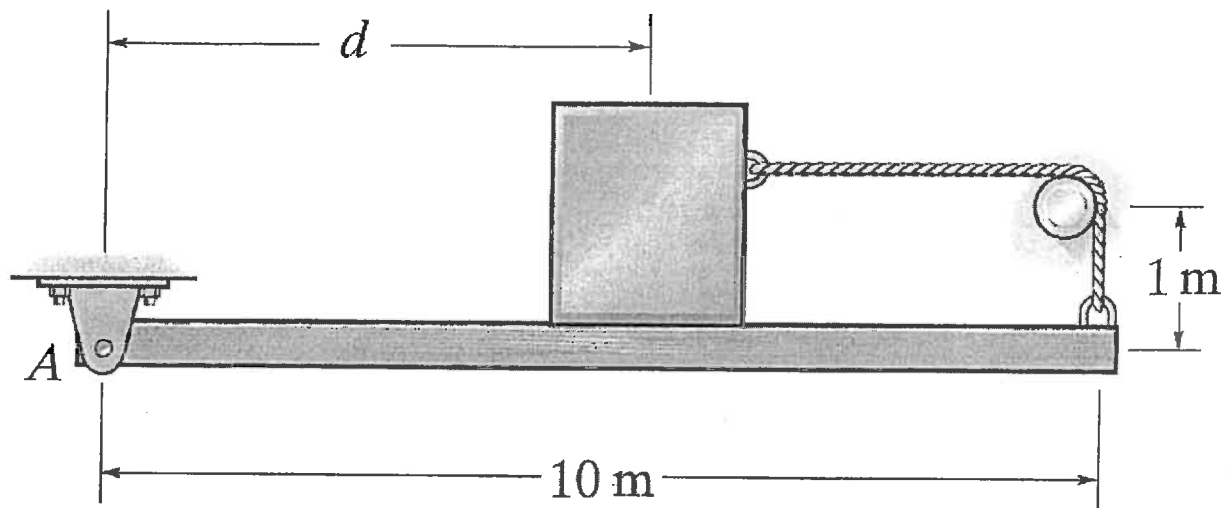


FIGURE 3

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

IV. (20 Marks)

The crate has a mass of 175 kg and rests on a surface for which the coefficients of static and kinetic friction are  $\mu_k = 0.3$  and  $\mu_s = 0.2$ , respectively. If the motor  $M$  supplies a cable force of  $F = (8t^2 + 20)$ , where  $t$  is in seconds, determine the power output developed by the motor when  $t = 5$  seconds.

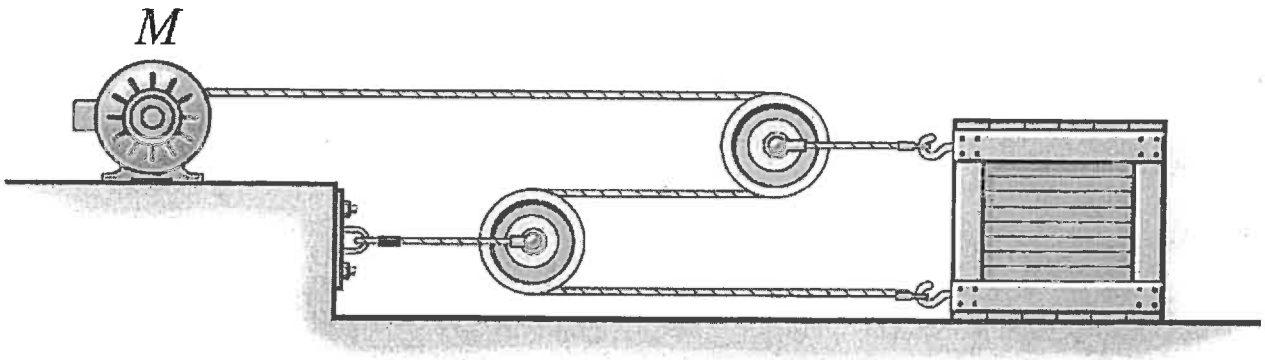


FIGURE 4.

V. (20 marks)

A horizontal force of  $P = 45$  Newtons is applied to block A, as shown in figure 5. Neglecting friction determine the acceleration of block B.

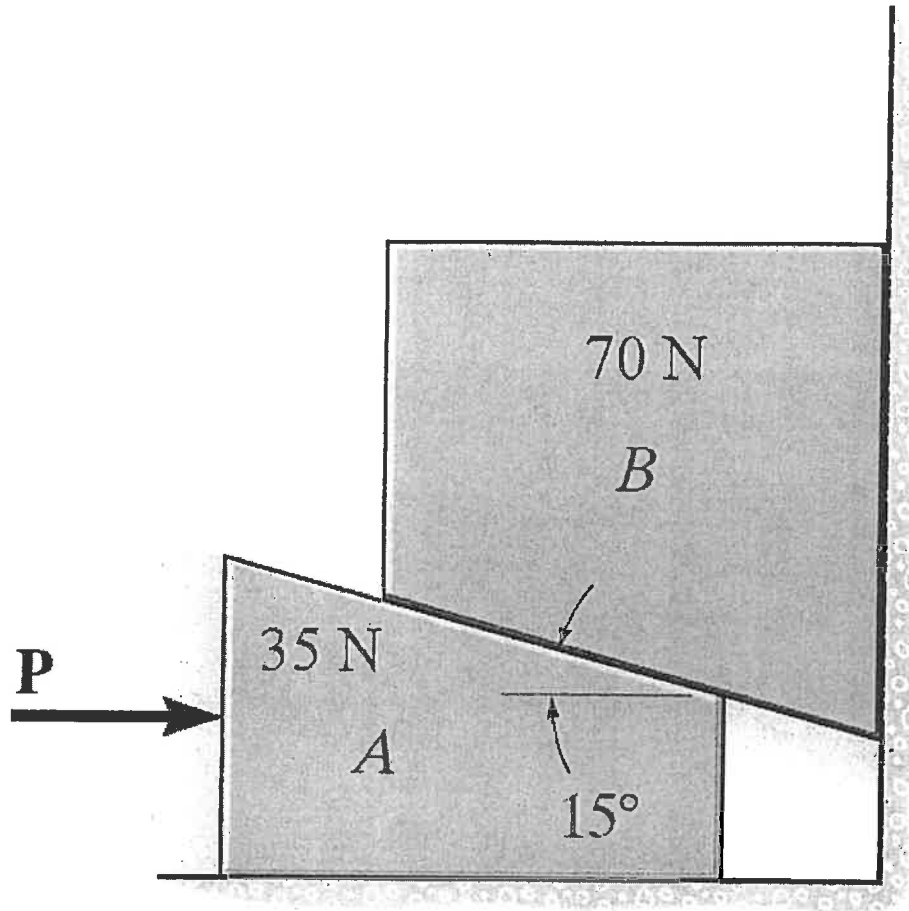


FIGURE 5.

VI. ( 20 marks )

A 5-kg projectile travels with a horizontal velocity of 700 m/s before it explodes and breaks into two fragments *A* and *B* of mass 2 kg and 3 kg, respectively. If the fragments travel along the parabolic trajectories as shown in figure 6, determine the magnitude of velocity of each fragment just after the explosion and the horizontal distance  $d_A$  where segment *A* strikes the ground at *C*.

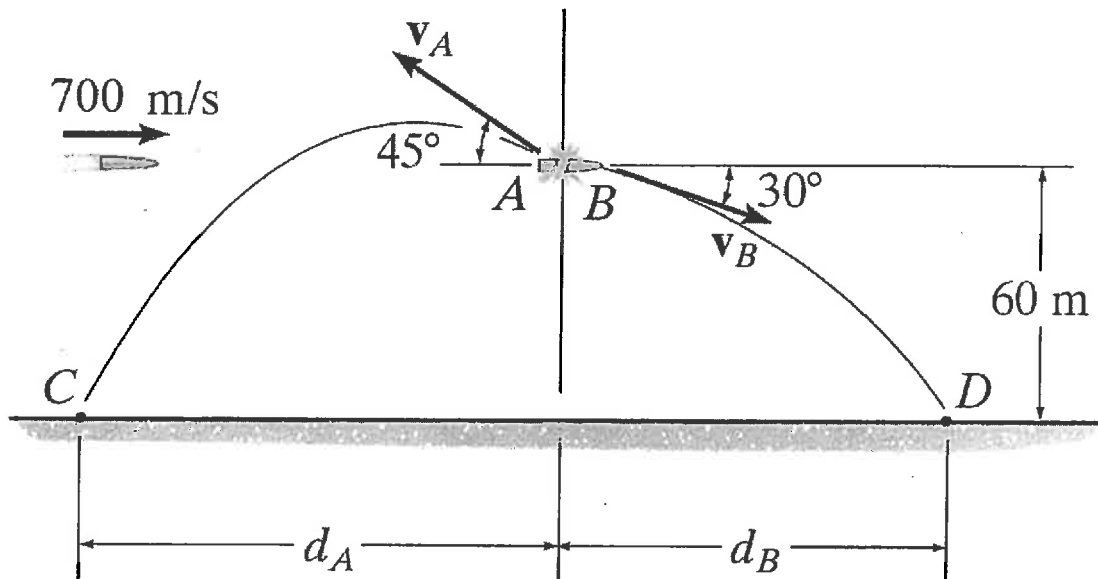


FIGURE 6.

