NATIONAL EXAMINATION - DECEMBER 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. Using ***cartesian vector methods***, determine the components of the reaction at the ball-and-socket joint at ***A*** and the tension in the supporting cables ***DB*** and ***DC***.

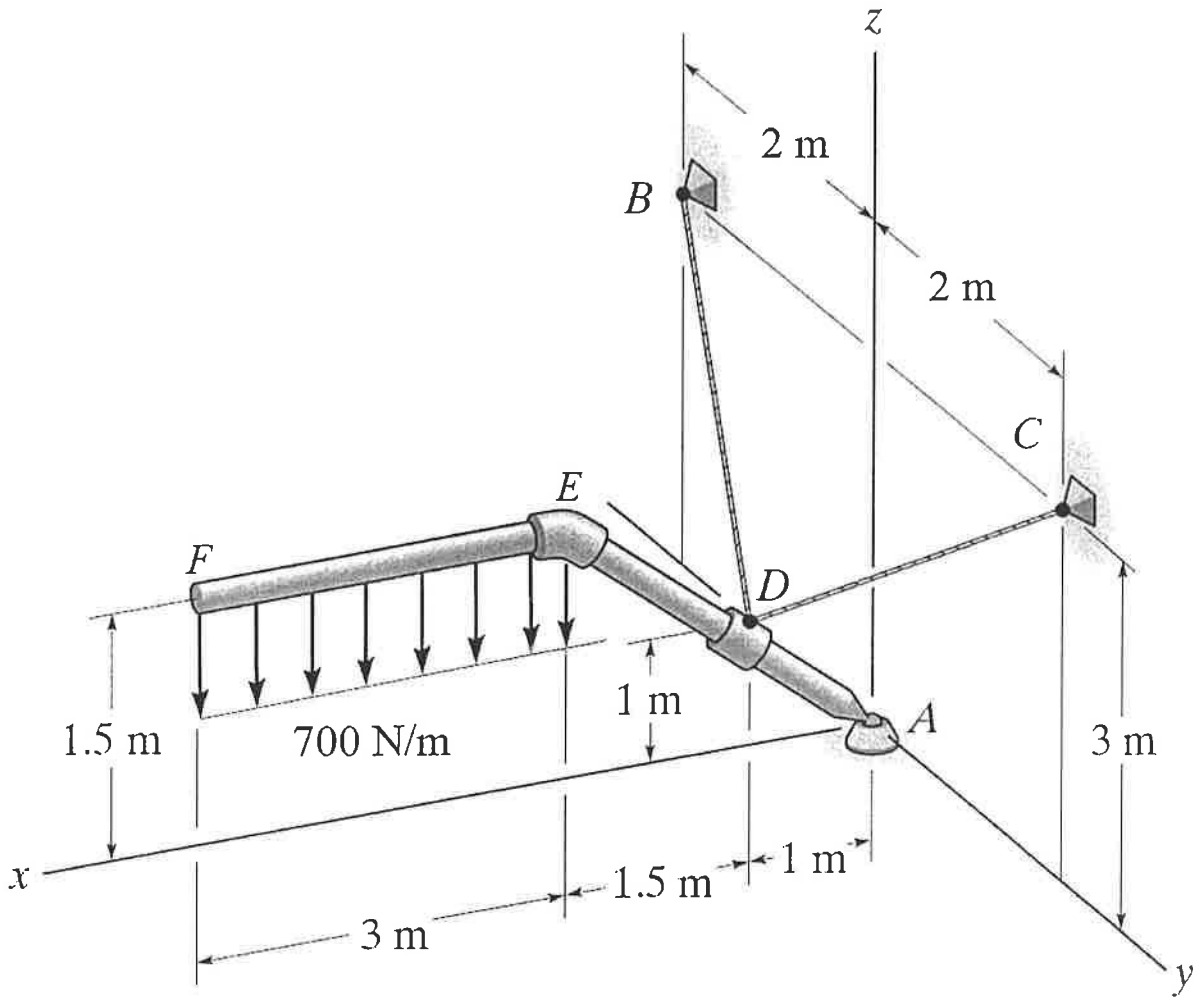

FIGURE 1.

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.

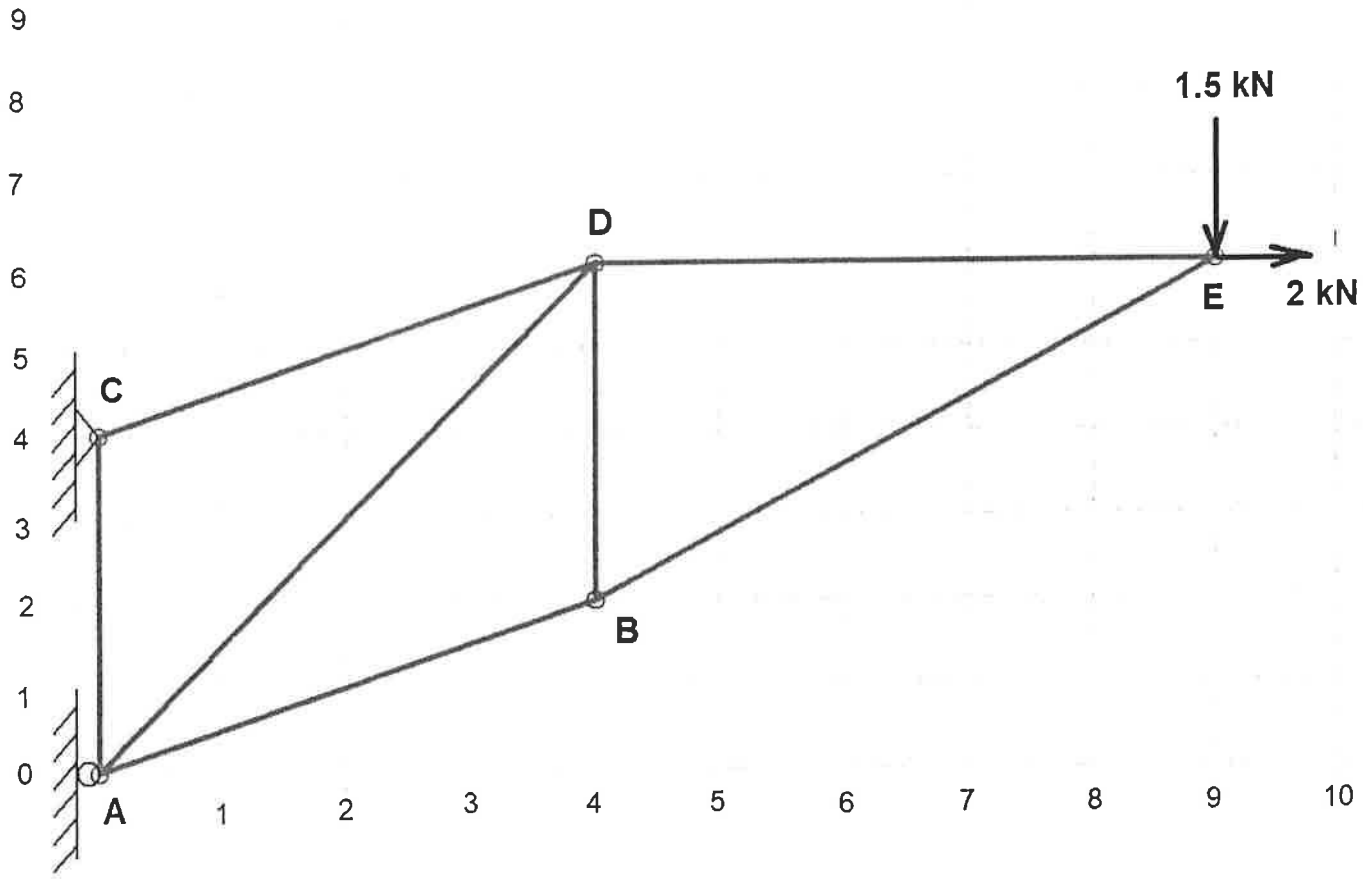

FIGURE 2.

III. A tong mechanism is used to lift a crate with a mass of 50-kg. The center of mass of the crate is at G. Determine the smallest coefficient of static friction at the surface between the crate and the gripping blocks at ***A*** and ***B*** so that the crate can be lifted.

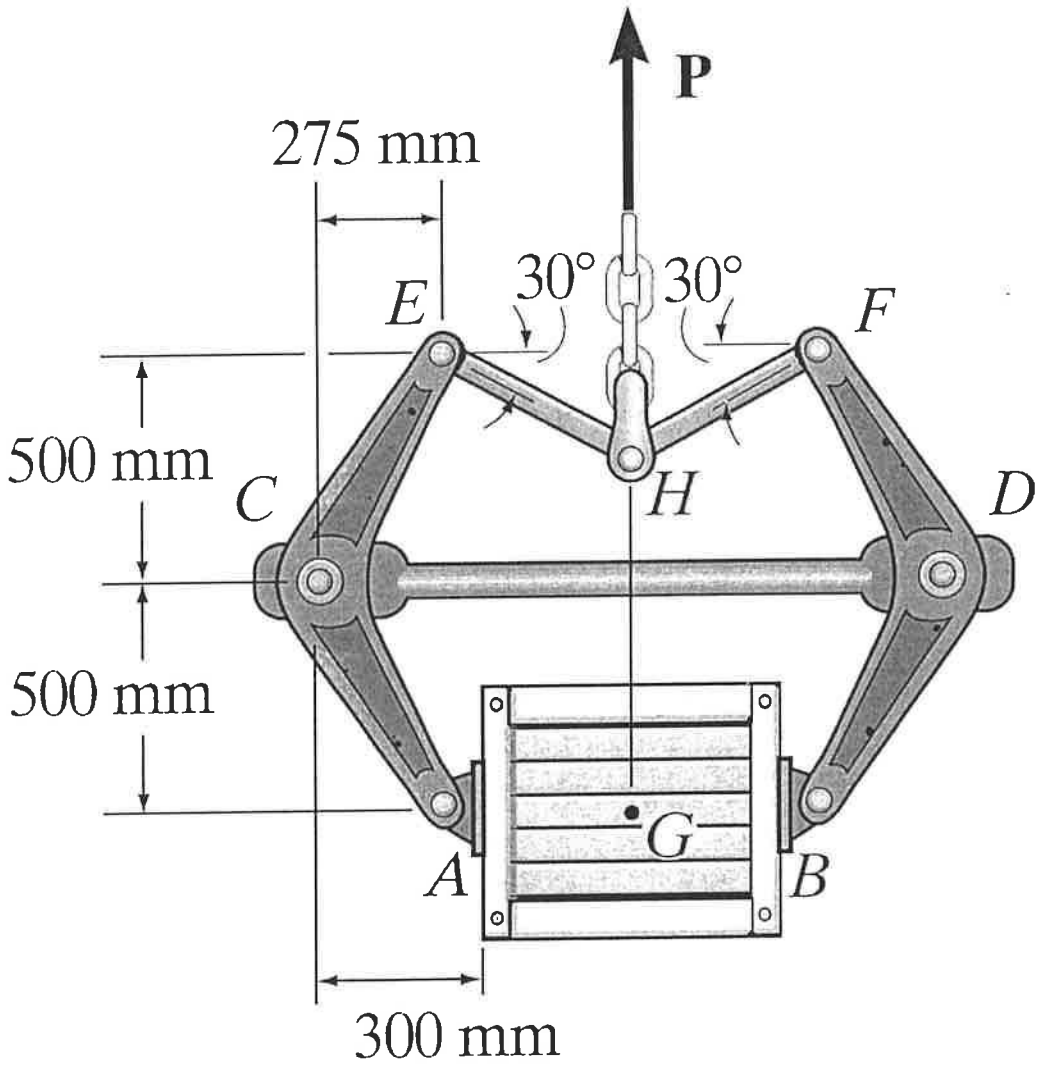

FIGURE 3.

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

IV. At the given position shown in figure 4, point *A* at the centre of the roller on the top of the bar has the velocity and acceleration shown.

Determine;
(a) the velocity and acceleration of point *B* at the centre of the roller and bottom of the link,
(b) the bar's angular velocity and angular acceleration at this instant.

NOTE: Neglect the mass of the link and the rollers.

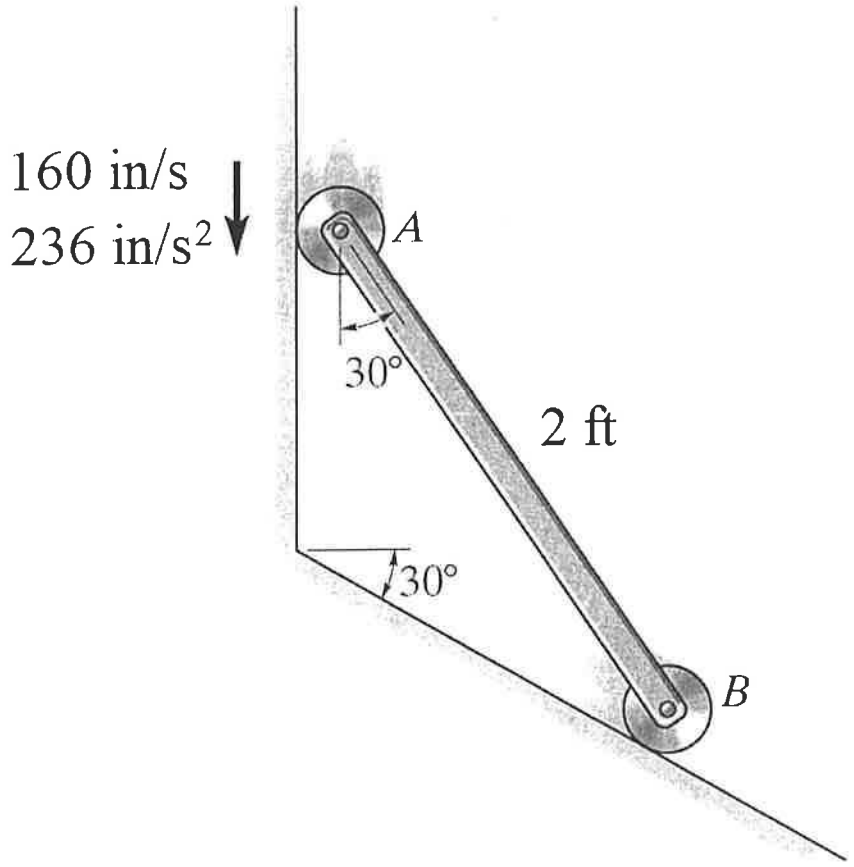

FIGURE 4

V. The pendulum shown in figure 5, consists of a 10-kg solid sphere attached to the free end of a 6-kg rod. If it is released from rest from a horizontal position, when $\theta_1 = 90°$, determine the angle θ_2 after the ball strikes the wall, rebounds, and the pendulum swings up to the point of momentary rest. The coefficient of restitution between the wall and the ball is $e = 0.6$.

NOTE:

The Mass Moment of Inertia for a Slender Rod about its *end* is: $Im = \frac{1}{3}mL^2$

The Mass Moment of Inertia for a Sphere about its *centre* is: $Im = \frac{2}{5}mR^2$

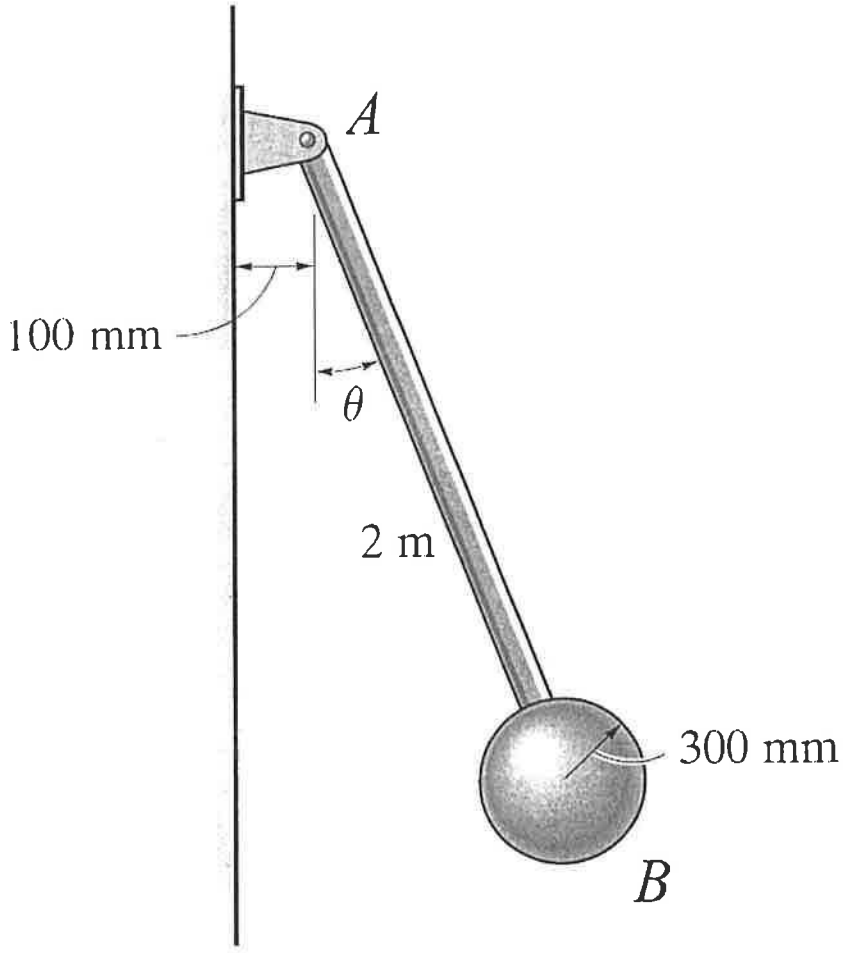

FIGURE 5.

VI. A 60-kg block has an initial velocity at point A down the ramp of $v_A = 2$ m/s, and the coefficient of kinetic friction along AC is $\mu_K = 0.2$.

(a) Determine the distance R where it strikes the ground at B.
(b) Determine the time it takes for the block to travel from A to B.

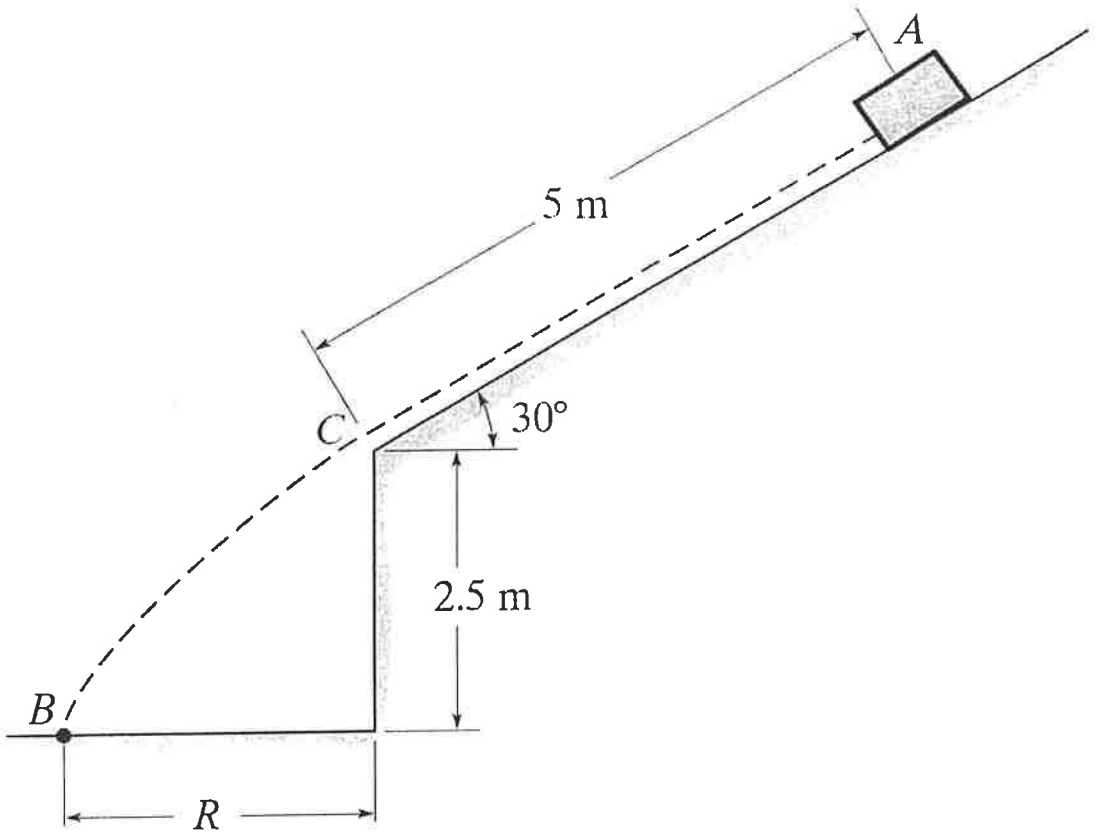

FIGURE 6.