The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Mechanical Engineering

081

Study Programme	Bachelor of Science Honours in Engineering
Name of the Examination	Final Examination
Course Code and Title	**DMX3302 Engineering Mechanics**
Academic Year	2022/2023
Date	06th February 2024
Time	1330 – 1630 hrs
Duration	**03 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Six (6)** questions in **Four (4)** pages.
3. **Answer All questions.**
4. This is a Closed Book Test (CBT).
5. Answers should be in clear handwriting.

QUESTION 01 (20 marks)

The slender bar has a mass **m** and a length **L** (Figure Q1). When the system undergoes oscillatory motion it is observed the displacement at point B as x(t).

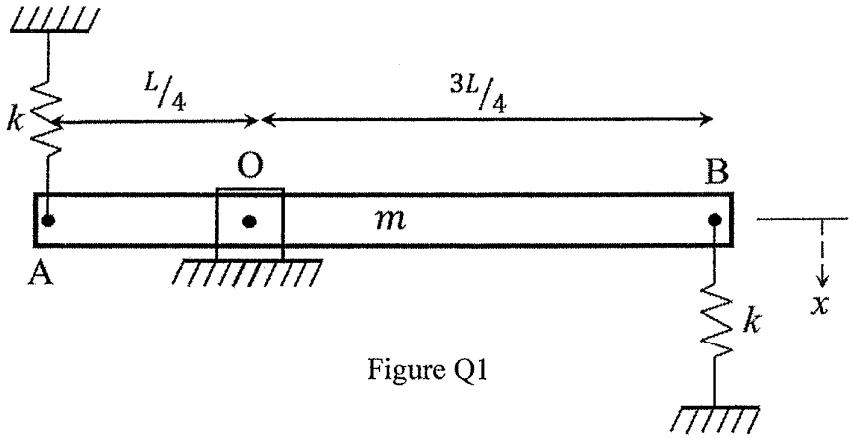


Figure Q1

a) Draw the freebody diagram of the system and mark all the forces acting on it when point B has moved **x** distance downword from the equlibrium position as shown in Figure Q1.

b) Derive the governing equation for the motion at point B.

c) If the mass $m = 15$ kg , length $L = 2.6$ m and spring constant $k = 1.26 \times 10^4$ N/m compute the natural frequency of the system.

d) At time $t = 0$ the initial displacment and velocity at point B was measured as $x_0 = 1.2$ mm and $\dot{x}_0 = 54$ mm/s find the equation of motion at point B as $x(t) = A \sin(\omega_n t + \varphi)$.

QUESTION 02 (20 marks)

Beam AB is supported by a pin support at A and roller support at B as in the Figure Q2. A linearly varying distributed load (0 kN/m to 1.6 kN/m) is applied between C and D. A point load of 4.2 kN is applied at point F as shown in Figure Q2.

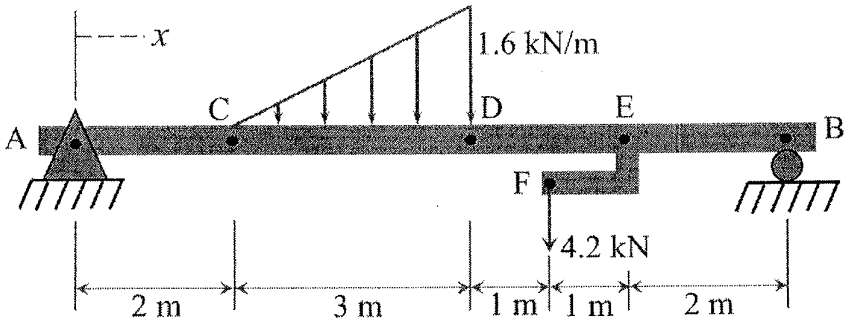


Figure Q2

a) Change the line of action of 4.2 kN froce from point F to point E.
b) Draw the free body diagram for beam AB.
c) Find the reactions at point A and at point B.
d) Find expressions of bending moment and shear force between AC, CD, DE and EB.
e) Draw the bending moment and shear force diagrams for the beam AB

QUESTION 03 (15 marks)

Two disks A and B have masses $m_A = 3$ kg and $m_B = 2$ kg. Their initial velocities are $(V_A)_1 = 4$ m/s and $(V_B)_1 = 6$ m/s as shown in Figure Q3, just before they collide. If the coefficient of restitution is e = 0.5, determine the speeds of disks just after impact.

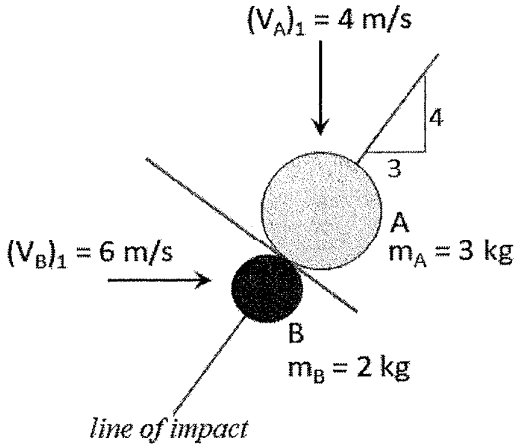


Figure Q3

QUESTION 04 (15 marks)

The welded tubular frame is secured to the horizontal x-y plane by a ball-and-socket joint at A and receives support from the loose-fitting ring at point B. An external load of 2-kN load is applied at point E parallel to y direction. The frame is kept under equilibrium by the tension cable CD. Weight of the frame can be neglected when compared with the applied load.

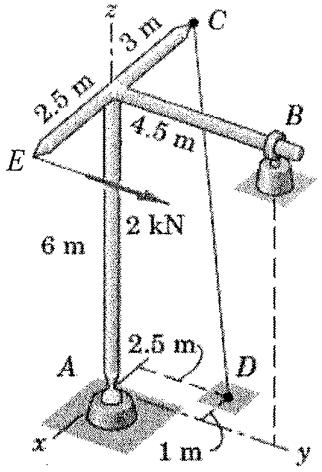


Figure Q3

a) Draw the free body diagram for the frame and clearly mark all the forces acting on it.
b) Express the external 2 kN load and the tension T in cable CD as vector forces.
c) Compute the vector moment $\mathbf{M}_A$ of tension **T** about point A.
d) Find the moment of tension **T** about line AB. (component of the moment along AB)
e) If the tension $\mathbf{T} = (0.833\,\mathbf{i} + 1.042\,\mathbf{j} - 2.50\,\mathbf{k})$ kN write the moment balance $\Sigma\mathbf{M}_A = 0$ about point A for the frame.

QUESTION 05 (15 marks)

The three flat blocks are positioned on the 30° inclined plane as shown in Figure Q5, and a force P parallel to the incline is applied to the middle block. The upper block is prevented from moving by a wire which attaches it to the fixed support. The coefficient of static friction for each of the three (03) pairs of mating surfaces are as shown in Figure Q5. Determine the maximum value which P may have, before any slipping takes place.

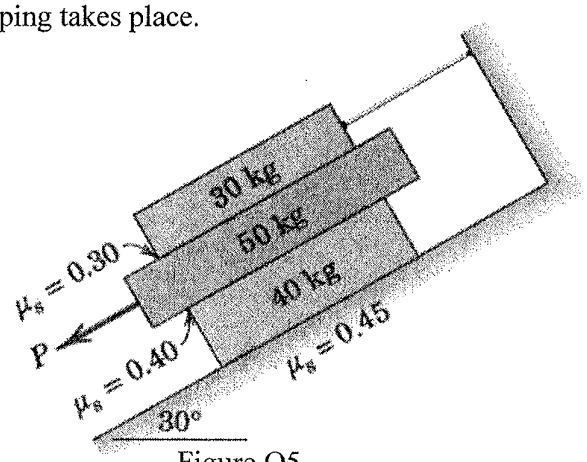


Figure Q5

QUESTION 06 (15 marks)

The uniform slender rod AC (Figure Q6)has a mass **m** and length **L**. It is hinged at point B using a pin joint and is free to rotate about point B. The rod is released from rest when $\theta = 0$ (the rod is horizontal), find the reaction force exerted on the rod by pin B when $\theta = 90°$ (the rod is vertical).

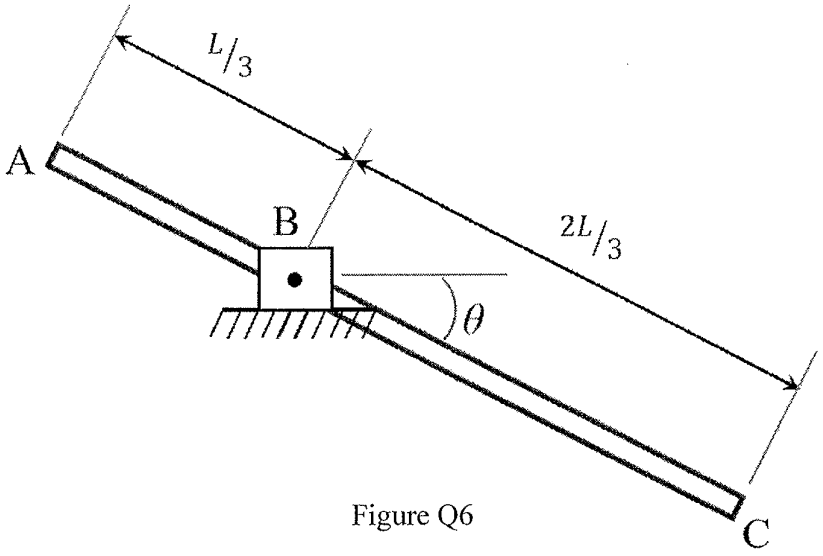


Figure Q6

End of Question Paper