The Open University of Sri Lanka

Faculty of Engineering Technology
Department of Mechanical Engineering

Study Programme	Bachelor of Technology Honours in Engineering
Name of the Examination	Final Examination
Course Code and Title	**DMX3302 Engineering Mechanics**
Academic Year	2021
Date	18th January 2022
Time	0930 – 1230 hrs
Duration	**03 hours**

General Instructions

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

SECTION - A (ANSWER ALL QUESTIONS)

(1) The velocity of a particle is given by $\boldsymbol{v} = 16t^2\,\mathbf{i} + 4t^3\,\mathbf{j} + (5t + 2)\,\mathbf{k}$ m/s where t is in seconds. If the particle is at the origin when $t = 0$, determine the magnitude of the particle's acceleration when $t = 2$ s. Also, what is the x, y, z coordinate position of the particle at this instant (5 marks)

(2) Starting form rest the motorboat travels around the circular path with radius r = 40 m, at a speed $v = 0.4t^2$ m/s where t is in seconds. Find the magnitude of boats acceleration when t = 4s (5 marks)

(3) Determine the magnitude of the resultant force acting on a 5 kg particle at the instant $t = 2$ s, if the particle is moving along a horizontal path defined by equations $r = (2t + 10)$ m and $\theta = (1.5t^2 - 6t)$ rad, where $\boldsymbol{t}$ is in seconds. (5 marks)

(4) The 50-kg crate is pulled by the constant force P. If the crate P starts from rest and achieves a speed of in 5 s, determine the magnitude of P. The coefficient of kinetic friction between the crate and the ground is $\mu_k = 0.2$. (Fig. A4) (5 marks)

SECTION - B (ANSWER THREE QUESTIONS)

QUESTION 01 (20 marks)

(a) A rigid body is in equilibrium under several two-dimensional (co-planer) forces. State the equations of equilibrium. (5 marks)

(b) (15 marks)

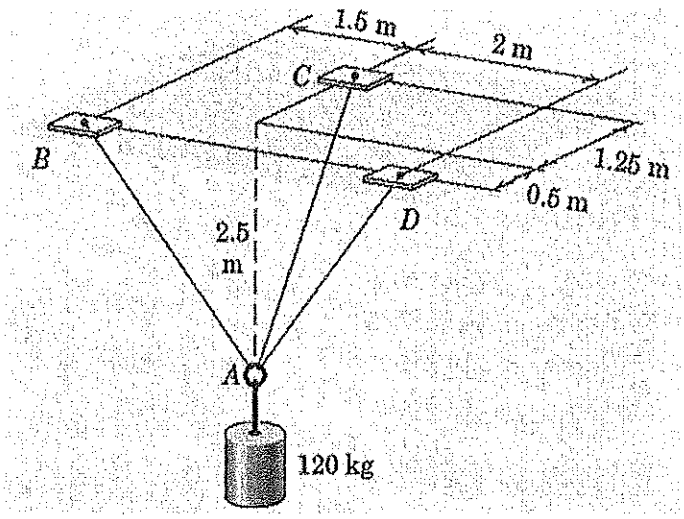

Fig. B1

Determine the tensions in cables AB, AC, and AD. (Fig. B1)

QUESTION 02 (20 marks)

(a) Mark the reaction forces at the supports if a beam is supported by (i) a roller support (ii) a pin joint and (iii) a fixed support.(consider the supports are for two dimensional systems). (5 marks)

(b) (15 marks)

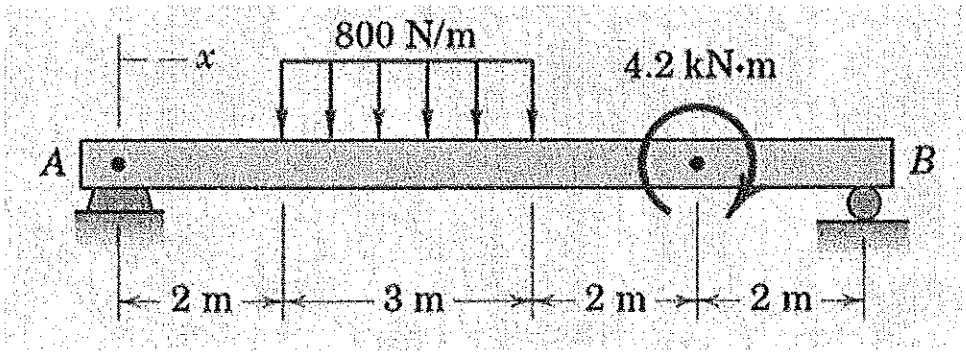

Fig. B2

Draw the shear force and bending moment diagrams for the beam loaded as shown in Fig. B2.

(i) Find the values of shear force and bending moment at x = 5 m.

(ii) Determine the maximum bending moment acting on the beam.

QUESTION 03 (20 marks)

(a) Explain the coefficient of restitution. What is the difference between an elastic impact and a plastic impact? (5 marks)

(b) (15 marks)

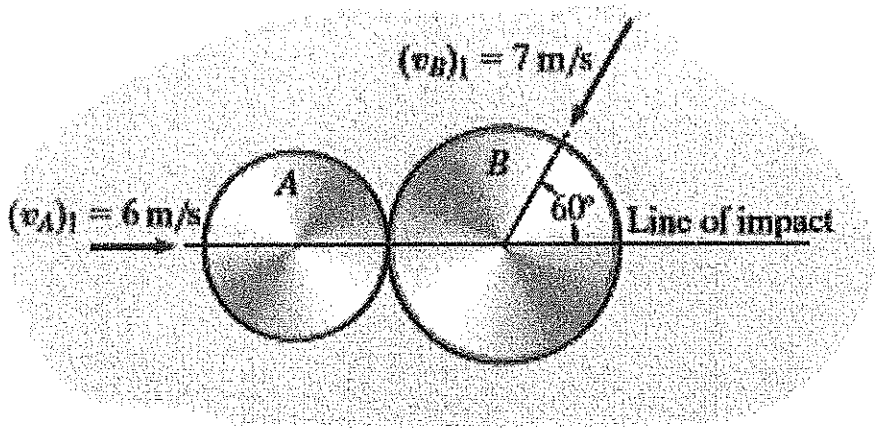

Fig. B3

The two disks A and B have a mass of 3 kg and 5 kg, respectively. If they collide with the initial velocities shown (Fig. B3), determine their velocities just after impact. The coefficient of restitution is e = 0.65.

QUESTION 04 (20 marks)

(a) Briefly explain about the (i) Centroid, (ii) First Moment and (iii) Second Moment of area. (5 marks)

(b) (15 marks)

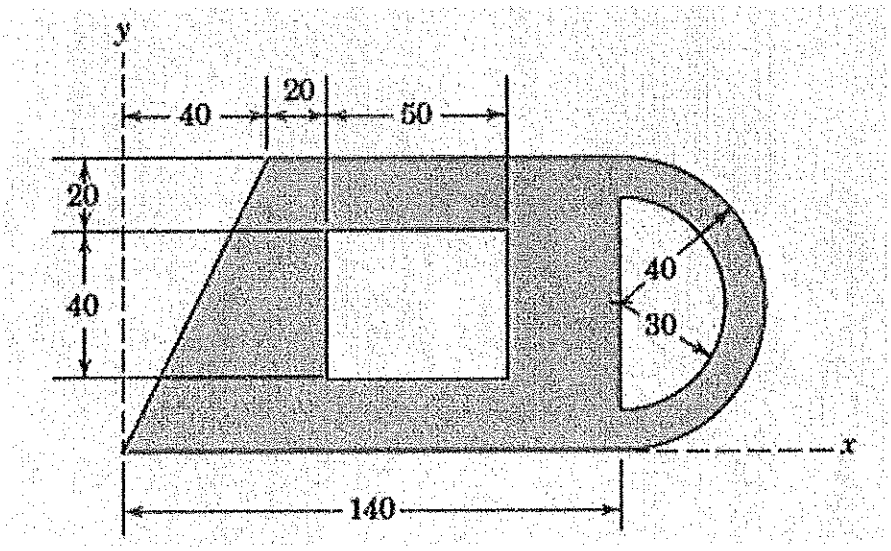

Fig B4

Determine the coordinates of the centroid of the shaded area given in Fig B4

QUESTION 05 (20 marks)

(a) A particles position is defined as $r\ \boldsymbol{e}_r$ in polar cordinates. Here $\boldsymbol{e}_r$ and $\boldsymbol{e}_\theta$ are the unit vectors along r and θ directions. Derive an expression for particles acceleration. (5 marks)

(b) (15 marks)

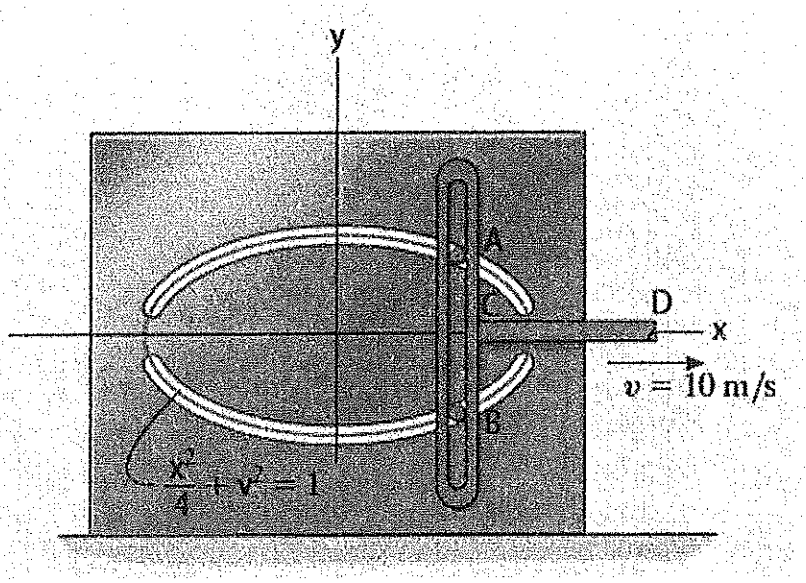

Fig. B5

Pegs A and B are restricted to move in the elliptical slots due to the motion of the slotted link (Fig. B5). If the link moves with a constant speed of 10 m/s, determine the magnitude of the velocity and acceleration of peg A when x = 1 m..

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