determine angle θ at which equilibrium would be maintained in terms of P and M using the principle of virtual work. (3)

5.
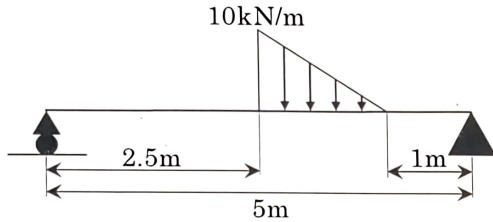
Compute the support reactions and draw SFD. Also, find the location of maximum bending moment. (5)

6. (a) An elevator cage weighing 500 kg is lifted or lowered using a wire rope. Starting from rest, it moves upwards with constant acceleration and acquires a velocity of 3 m/s within a distance of 3 m. Calculate tensile force in the cable during the accelerated motion using D'Alembert's principle (Use $g = 10$ m/s^2). (2)

   (b) Prove that complementary angles of projection give same range to the projectile if the velocity of projection remains same. (3)

Mar. 2022
B.Tech. (Civil) - III SEMESTER
Engineering Mechanics (ESC-202)

Time : 90 Minutes]   [Max. Marks : 25

Instructions :

1. *It is compulsory to answer all the questions (1 mark each) of Part-A in short.*

2. *Answer any three questions from Part-B in detail.*

3. *Different sub-parts of a question are to be attempted adjacent to each other.*

4. *Use of calculators is permitted.*

PART-A

1. (a) Name a physical quantity that possesses both magnitude and direction but is a scalar quantity and why? (1)

   (b) For a given set of two forces of 5N and 10N, what can be the maximum and minimum value of their resultants. (1)

   (c) Define the angle of friction. Also, write the expression for the same. (1)

(d) In the analysis by method of joints in planar trusses, what is the maximum number of unknowns that can be determined at a time? (1)

(e) In planar system, how many reactions does a hinged support provide? Name each. (1)

(f) What do you understand by the centroid and center of mass? List any condition in which the two won't coincide. (1)

(g) Define radius of gyration. (1)

(h) What do you understand by the principle of virtual work? (1)

(i) Give the relation between linear and angular velocity in a circular motion. (1)

(j) What do you understand by conservative and non-conservative forces? Give an example of each. (1)

PART-B

2. (a) State and prove Parallelogram Law of vector addition. (3)

(b) If two vectors to be added are equal in magnitude, find the angle between them such that the magnitude of their resultant is 1.5 times that of the individual vectors. (2)

3. (a) What is angle of repose? Show that its value is equal to the angle of static friction. (2)

(b) Derive mass moment of inertia of a rod of length L about the axis passing through one of its ends and perpendicular to the rod length. (3)

4. (a)

10kN
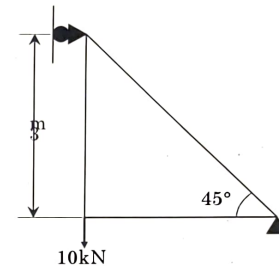
Analyze the truss given in the figure. (2)

(b)
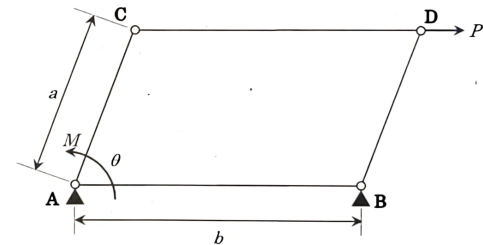
A parallel rule ABCD consists of four members connected by the frictionless pins as shown in the Figure. If link AB is fixed, a force P is applied at joint D along X-axis and a moment M is applied at joint A,