St. Francis Institute of Technology (Engg. College)

Prelims

Academic Year 2019-2020

Branch: Common to all | Year: FE Semester: I

Subject: Engineering Mechanics | Time: 10:00am-01:00pm

Date: 13-11-2019 | No. of Pages: 04

Marks: 80 Marks

Instructions: Candidates should read carefully the instructions printed on the question paper and on the cover of the Answer Book, which is provided for their use.

Note the following instructions.

1. All questions are compulsory, however there are internal choices.
2. Draw neat diagrams wherever possible.
3. Write everything in ink (no pencil) only.
4. Assume data, if missing, with justification.
5. **Question No.1 is compulsory**
6. **Question no. 2 to question no. 6 Attempt any 3 questions**

Q.1. Attempt any five. **Marks**

a. Six forces acting on a particle. Determine the magnitude and direction of the resultant of the force system as shown in Figure 1 **5M**

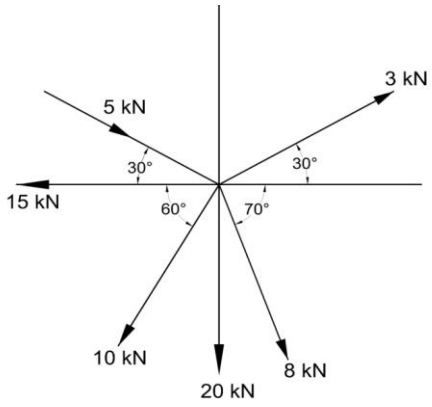

Figure 1

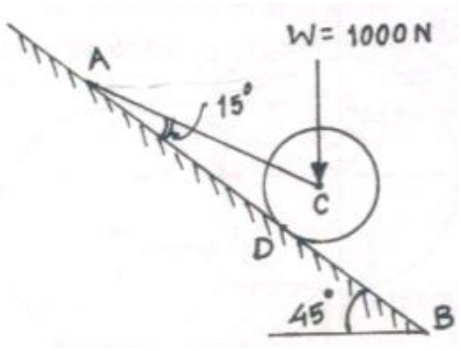

Figure 2

b. Find the tension in the string AC as shown in Figure 2. **5M**

c. The equation of motion of a particle moving in a straight line is given by $S = 18t + 3t^2 - 2t^3$ where s is in meter and t is in sec. Find (i) Velocity and acceleration at start. (ii) Time when particle reaches its maximum velocity. (iii) Maximum velocity of the particle. **5M**

d. The 550 N box rest on a horizontal plane for which the coefficient of kinetic friction μ_k= 0.32. If the box is subjected to a 400 N towing force as shown Figure 3, find the velocity of the box in 4 seconds starting from the rest. **5M**

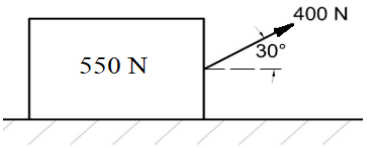

Figure 3

e. A ball is dropped on to a smooth horizontal floor from a height of 4m. On the 2nd bounce it attains a height of 2.25m. Find coefficient of restitution between the ball and floor. **5M**

Q.2

a. Locate the Centroid of the plane lamina shown in the Figure 4. **8M**

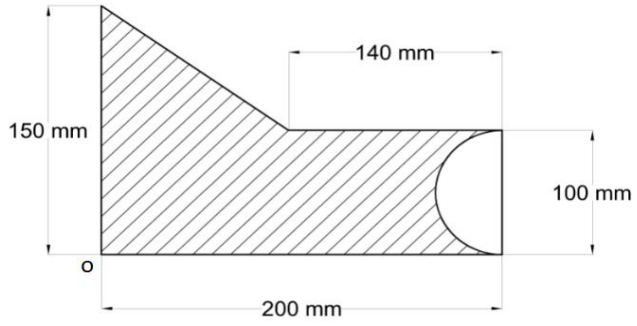

Figure 4

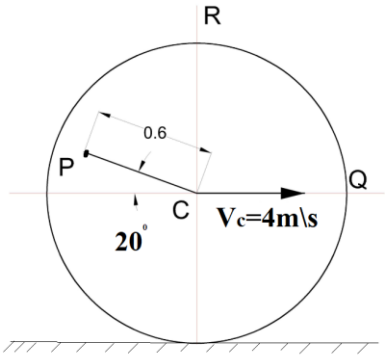

Figure 5

b. Three forces F_1, F_2 and F_3 act at the origin O. F_1 = 70 N acting along OA, where A (2, 1, 3). F_2 = 80N acting along OB, where B (-1, 2, 0). F_3 = 100 N acting along OC, where C (4, -1, 5). Find the resultant of these concurrent forces. **6M**

c. A wheel of 2 m diameter rolls without slipping on a flat surface. The Centre of the wheel is moving with a velocity of 4 m/s towards right. Determine the angular velocity of the wheel and velocity of P, Q and R shown on wheel. Refer Figure 5. **6M**

Q.3

a. A beam AB as shown in Figure 6 is supported by a roller at A and hinged at B. Find the support reactions at point A and B. **8M**

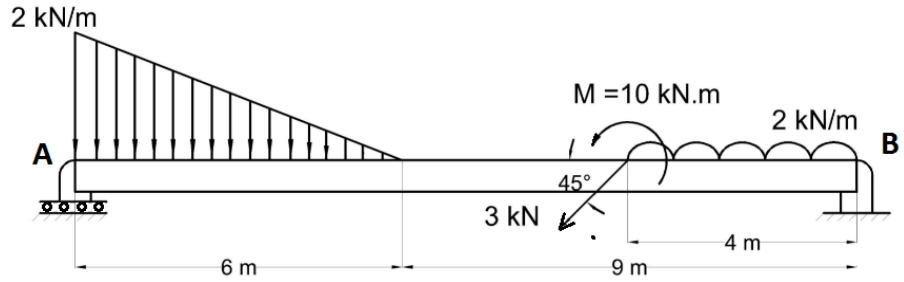

Figure 6

b. Find the value of θ if the block A and B placed as shown in the Figure 7 have impending motion. Weight of A=200N, B=200N, μ for all surfaces= 0.25. **8M**

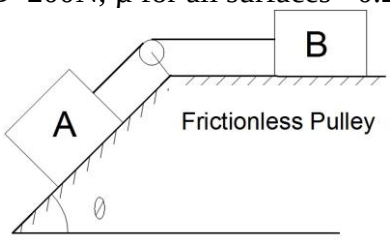

Figure 7

c. Derive the General equation of Projectile motion. **4M**

Q.4

a. Two cylinders each of diameter 100 mm and weighing 200N are placed as shown in Figure 8. Assuming that all contact surfaces are smooth find the reactions at A, B and C. **8M**

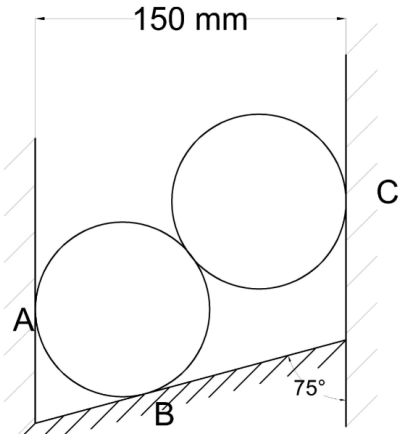

Figure 8

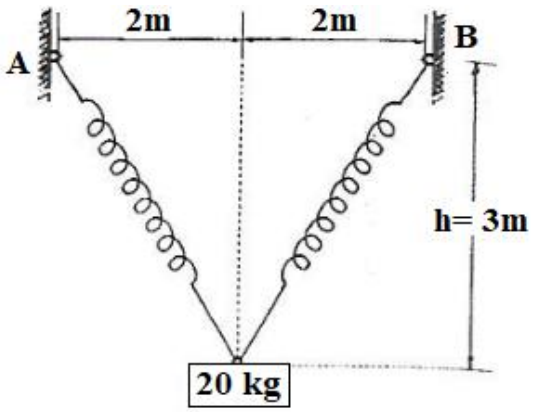

Figure 9

b. The cylinder has a mass of 20kg and is released from rest when h = 0. Determine its speed when h = 3m. The springs each have an un-stretched length of 2m. Refer Figure 9. **6M**

c. Two masses of 60N and 30 N are positioned over frictionless and massless pulley as shown in Figure 10. If the 60 N mass is released from rest, find the speed at which the 60 N. mass will hit the ground. **6M**

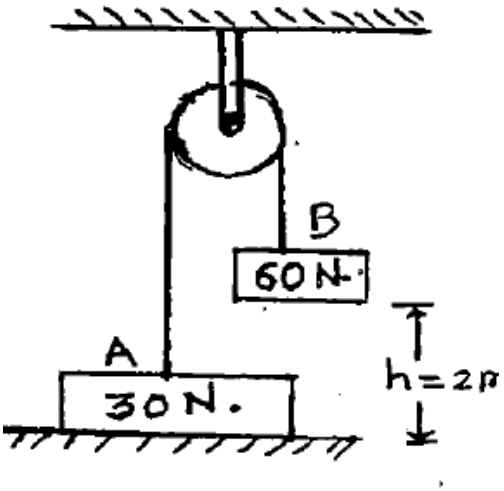

Figure 10

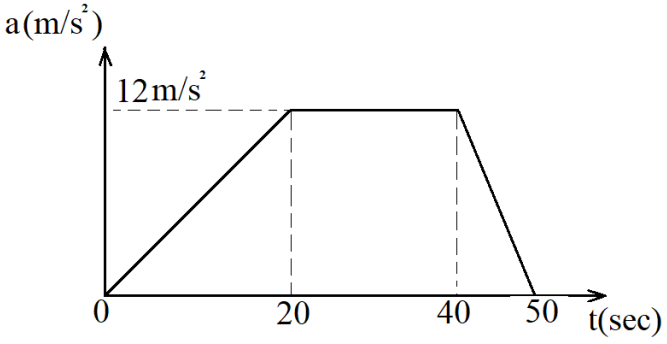

Figure 11

Q.5

a. Figure 11 shows a diagram of acceleration versus time for a particle moving along X – axis, plot (a) the velocity time diagram (b) the displacement time diagram. Find the speed and distance covered by the particle after 50 second. Also find the maximum speed attained by the particle. **6M**

b. A ladder of length 7m rest against a wall as shown in Figure 12. Assuming that the coefficient of static friction is zero at B. Determine smallest value of μ_S at A for which equilibrium is maintained **6M**

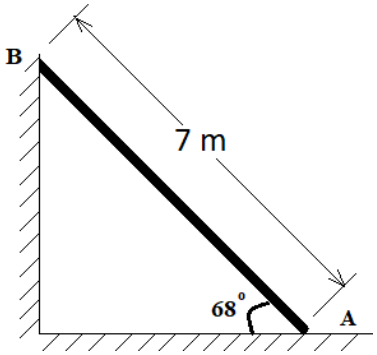

Figure 12

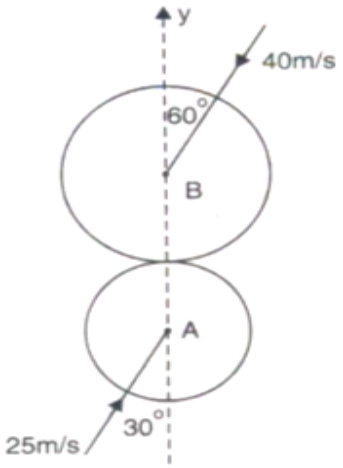

Figure 13

c. Two smooth balls A (mass 3 kg) and B (mass 4kg) are moving with velocities 25 m/s and 40 m/s respectively. Before impact, the directions of velocity of two balls are 30 and 60 degrees with the line joining the centers as shown in Figure 13. If e = 0.8, find the magnitude and direction of velocities of the balls after impact. **8M**

Q.6

a. A slider crank mechanism is shown in Figure 14. The crank OA rotates anticlockwise at 100 rad/s. Find the angular velocity of rod AB and the velocity of the slider at B. **6M**

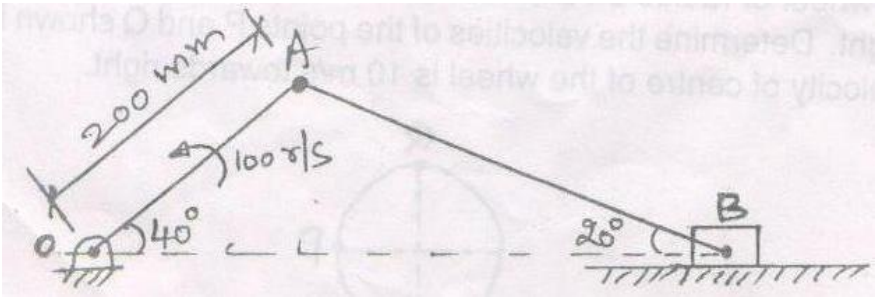

Figure 14

b. For a given system, find the resultant and its point of application w.r.t. point O on the x axis (x-intercept). Force along CA = 100N, along OD=150N, along ED=150N, along OE =100N. a clockwise moment of 5000N-cm is also acting at the point O. (Refer Figure 15) **6M**

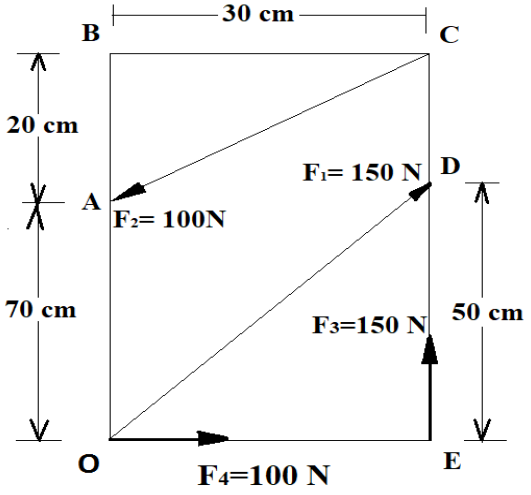

Figure 15

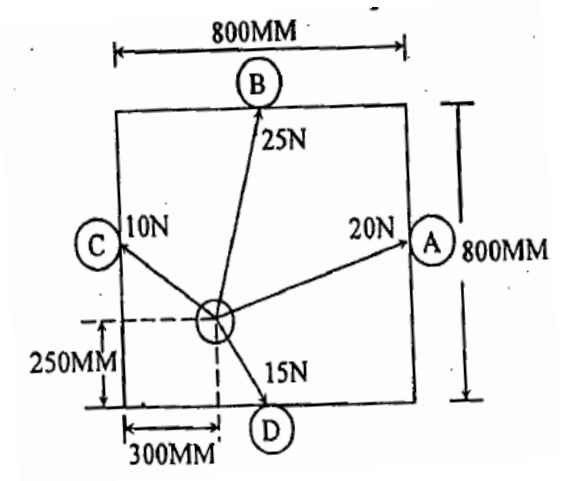

Figure 16

c. The striker of carom board is being pulled by 4 players as shown in Figure 16. The players are sitting exactly at the centre of the four sides. Determine the resultant force in magnitude and direction. **8M**