

**INDIAN MARITIME UNIVERSITY**  
(A Central University, Government of India)  
End Semester Examinations- June-July 2019  
**Semester – I**  
**B.Tech (Marine Engineering)**  
**Engineering Mechanics – I (UG11T3105)**

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Date: 18-07-2019  
Time: 3 Hrs

Maximum Marks: 100  
Pass Marks: 50

**PART A**

**Question – 1 is compulsory (10 X 3 = 30 Marks)**

Q.1

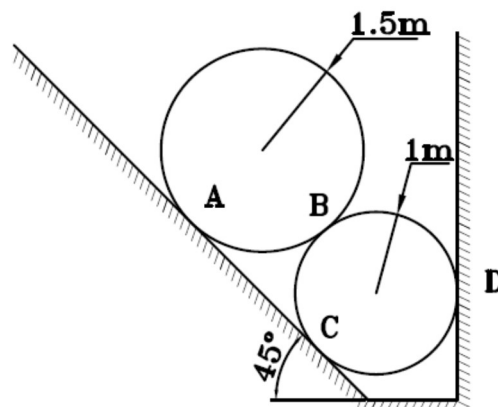
- a) State and explain Parallelogram law of forces.
- b) List the assumptions made for solving a truss.
- c) State the principle of virtual work.
- d) Derive the relationship between the mechanical advantage, velocity ratio and efficiency for lifting machine.
- e) Explain Pappus – Guldinus theorems.
- f) What is moment of inertia and radius of gyration?
- g) State and explain parallel axis theorem for moment inertia.
- h) State D 'Alembert's principle.
- i) What is a projectile? Give an example of projectile.
- j) Calculate the angular acceleration of the flywheel which starts from rest, and gets up a speed of 180 rpm in 3 minutes.

**PART B**

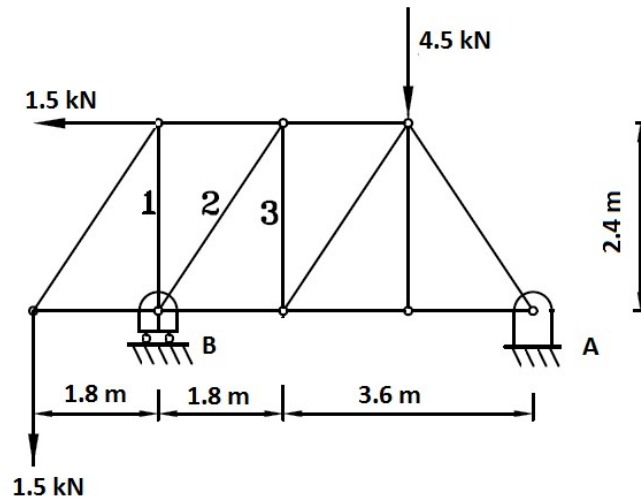
**(Answer any five questions from question no. 2 to 8)**

(5 X 14 = 70)

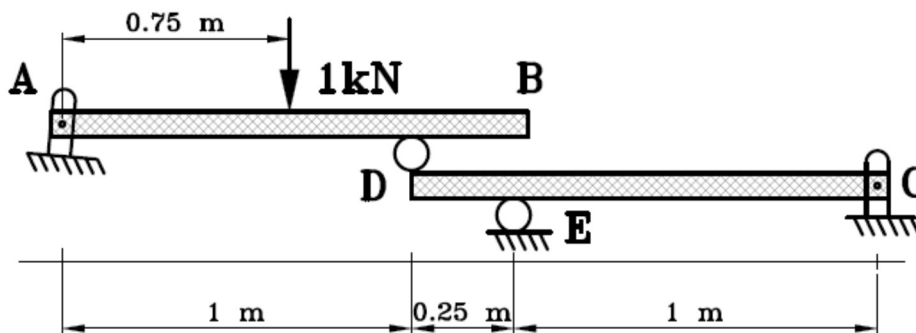
- Q.2) Two smooth cylinders are placed in a channel as shown in figure. Their respective diameters are indicated in the figure. The weight of the smaller cylinder is  $W$  and that of the larger cylinder is  $3W$ . Determine contact forces at points A, B, C and D. Take  $W = 10\text{kN}$ . (14marks)



- Q.3) Determine, by the method of sections, the axial force in each of the bars 1, 2 and 3 of the plane truss shown in figure. (14marks)

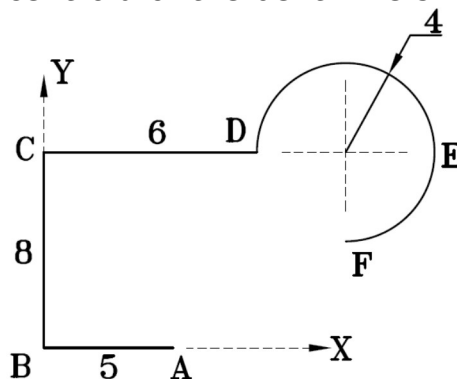


- Q.4) a) Two beams AB and CD are arranged and supported as shown in figure. Using the principle of virtual work, determine the reaction at support E if a load of 1kN acts at 0.75m away from support A. (7marks)

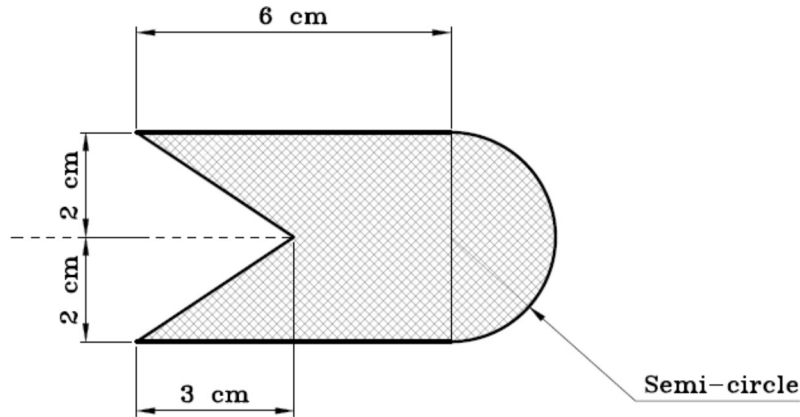


- b) In a certain weight lifting machine, an effort of 15N can lift a load of 300N and effort of 20N can lift a load of 500N. Find the law of machine. Find the effort required to lift a load of 880N. What is the maximum mechanical advantage and maximum efficiency. Velocity ratio for the lifting machine is 50. (7marks)

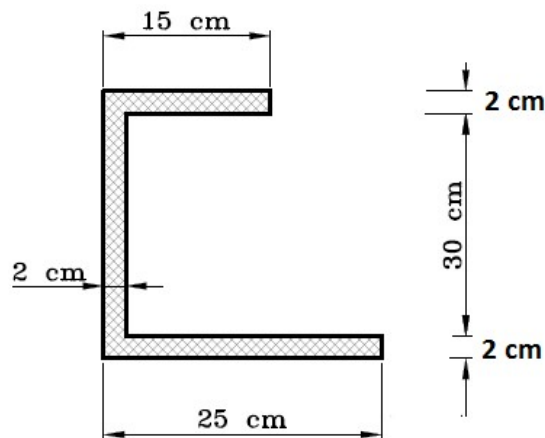
- Q.5) a) Find the centroid of the bent wire shown in figure. All dimensions are in cm. (7marks)



b) Determine the centroid of the composite section shown in figure. (7marks)

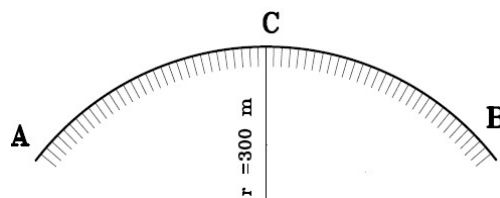


Q.6) Find the moment of inertia of the channel section about the centroidal axes. (14marks)

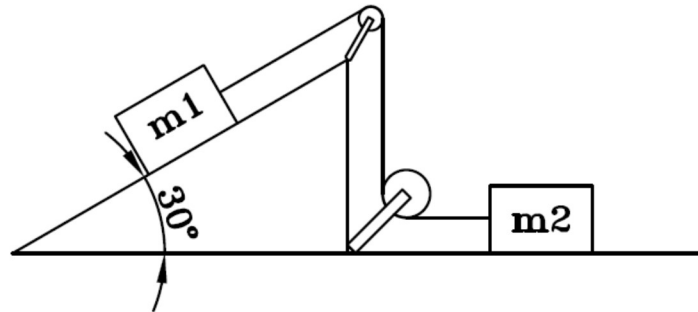


Q.7) a) A ball is thrown upwards from the top of a building with an initial velocity of 20m/s and at angle of  $30^\circ$  with the horizontal. The height of the building from the ground level is 25 m. Determine i) horizontal distance it will travel before striking the ground ii) Maximum height reached by the ball above the ground level. (7marks)

b) A motorcycle and rider of total weight  $W = 2225 \text{ N}$  travel in a vertical plane with constant speed  $v = 72 \text{ kmph}$  along the circular curve AB of radius  $r = 300\text{m}$ , as shown in figure Find the reaction  $R$  exerted on the motorcycle by the track as it passes the crest C of the curve. (7 marks)



- Q.8) a) Determine the tension in the string and acceleration of the system shown in the figure if  $m_1=2\text{kg}$ ,  $m_2= 1\text{kg}$ ,  $\theta=30^\circ$  and  $\mu=0.2$  for all contact surfaces. Assume the pulleys are mass less and friction less and string is inextensible. (7marks)



- b) A block of 10 kg mass slides down an inclined plane with a slope angle of  $35^\circ$ . It is stopped by a spring of stiffness  $1\text{kN/m}$ . If the block slides down 5m before hitting the spring then determine maximum compression of the spring. The coefficient of friction between the block and the inclined plane is 0.15. (7marks)

