F.E. (Semester – I) (Revised in 2016 – 2017) Examination,
November/December 2017
ENGINEERING MECHANICS

Duration : 3 Hours | Total Marks : 100

Instructions: *1) Attempt **two** questions from Part – **A**, **two** questions from Part – **B** and **one** question from Part – **C**.*
*2) Figures to the **right** indicate **full** marks.*
*3) Make suitable assumptions **wherever** necessary.*

PART – A

1. a) A uniform wheel of 600 mm diameter, weighing 5 KN rests against a rigid rectangular block of 150 mm height as shown in figure (fig. Q1 a). Find the least pull required just to turn the wheel over corner 'A' of the block. Also find the reaction of the block. All contact surfaces are smooth. **10**

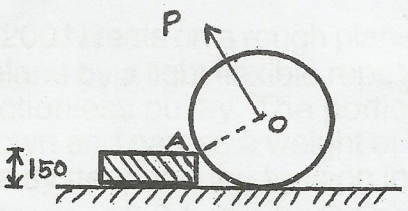
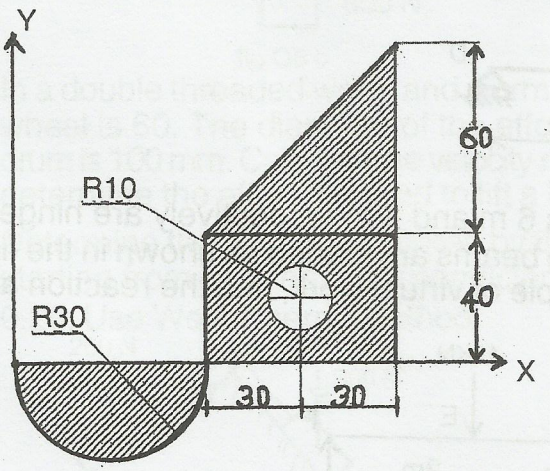


fig Q1 a

b) Determine the position of the centroid of the shaded area with respect to the X and Y axis marked on the figure (fig Q.1 b). **10**

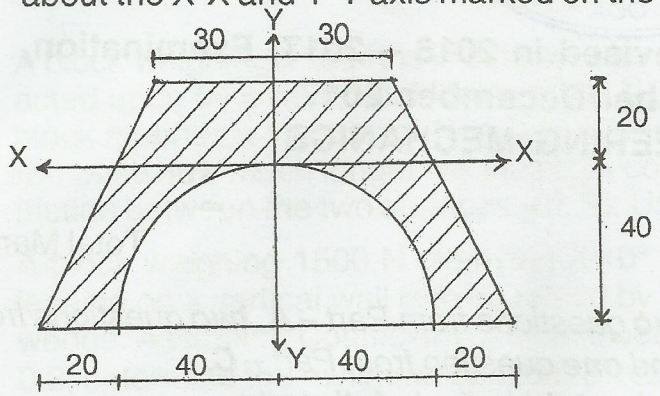


All dimensions are in cms

fig Q1 b

P.T.O.

2. a) Calculate the moment of inertia and radius of gyration of the shaded area about the X-X and Y-Y axis marked on the figure (fig. Q2a). **14**



All dimensions are in mm
fig Q2 a

b) Three cylinders A, B and C weighing 100 N each and 80 mm in diameter are placed in a channel of 180 mm width as shown in figure below (fig Q2 b). Draw a neat labelled free body diagram for all the cylinders clearly showing the forces and reactions. **6**

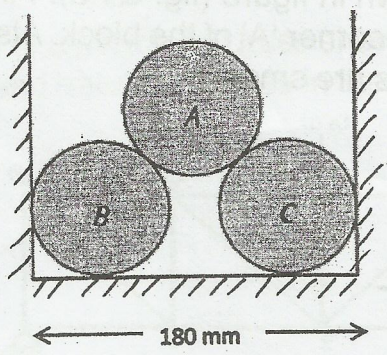


fig Q2 b

3. a) A beam A-B of span 6 m is loaded as shown in the figure below. (fig Q3 a.). Determine the reactions at A and D. **10**

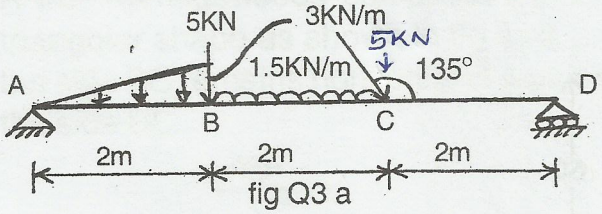


fig Q3 a

b) Two beams AD and DF of spans 6 m and 4 m respectively are hinged at C and supported at A, D and F. The beams are loaded as shown in the figure below (fig Q3 b); using the principle of virtual work, find the reaction at D. **10**

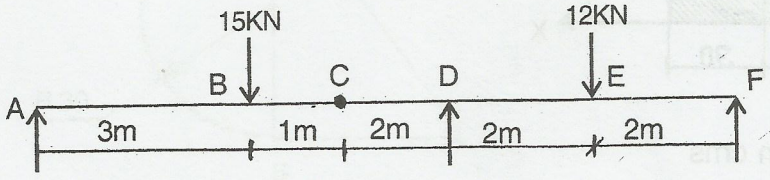


fig Q3 b

PART – B

4. a) Find the forces in all the members of the plane frame shown (fig Q4 a). Tabulate the results. **10**

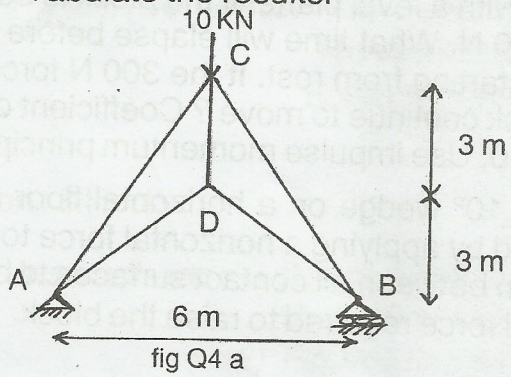


fig Q4 a

b) A body resting on a rough horizontal plane required a pull of 180 N inclined at 30° to the plane just to move it. It was found that a push of 220 N inclined at 30° to the plane just moved the body. Determine the weight of the body and the coefficient of friction between the body and horizontal surface. **10**

5. a) In a weight lifting machine an effort of 40 N can lift a load of 1000 N and an effort of 55 N can lift a load of 1500 N. Find the law of the machine, also find the maximum mechanical advantage and maximum efficiency. Velocity ratio of the machine is 48. **10**

b) A body weighing 1200 N rests on a rough plane inclined at 12° to the horizontal, it is pulled up the plane by a light flexible rope running parallel to the plane and passing over a frictionless pulley. The portion of the rope beyond the pulley hangs vertically down and carries a weight of 800 N at its end. Determine the acceleration of the system and the tension in the rope. Coefficient of friction for all contact surfaces is 0.2 (refer fig Q 5b). Use D' Alembert's principle. **10**

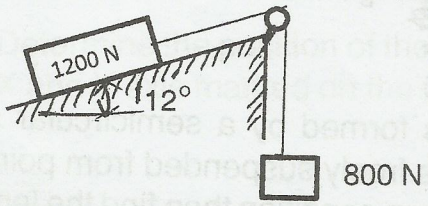


fig Q5 b

6. a) In a double threaded worm and worm wheel, the number of teeth on the worm wheel is 60. The diameter of the effort wheel is 250 mm and that of the load drum is 100 mm. Calculate the velocity ratio. If the efficiency of the machine is 50%, determine the effort required to lift a load of 300 N. **10**

b) Determine the distance covered by the system to attain a velocity of 3 m/sec starting from rest. Assume coefficient of friction for all contact surfaces as 0.20, Use Work Energy method. **10**

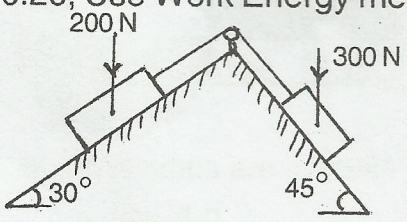


fig Q6 b

PART – C

7. a) A block weighing 1500 N is in contact with a level plane, if the block is being acted upon by a horizontal force of 300 N. What time will elapse before the block reaches a velocity of 16 m/sec starting from rest. It the 300 N force is removed how much longer will the block continue to move ? Coefficient of friction between the two surfaces = 0.10, Use impulse momentum principle. **8**

b) A block weighing 1500 N overlying a 10° wedge on a horizontal floor and leaning on a vertical wall is to be raised by applying a horizontal force to the wedge. Assuming Coefficient of friction between all contact surfaces to be 0.3, determine the minimum horizontal force required to raise the block. **12**

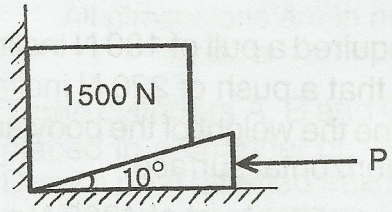


fig Q7 b

8. a) For a pin jointed truss shown in the figure (fig Q8a), determine the magnitude and nature of forces in the members DE, EI and IH. **10**

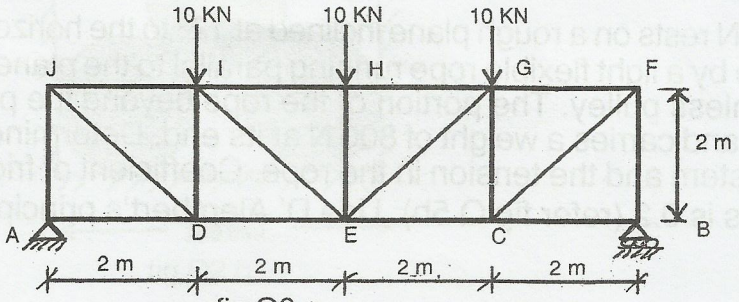


fig Q8 a

b) A thin homogeneous composite plate is formed by a semicircular and a triangular shape as shown in fig Q. 8 b, is freely suspended from point A. If the side BC remains horizontal in equilibrium condition then find the length of the side BC. **10**

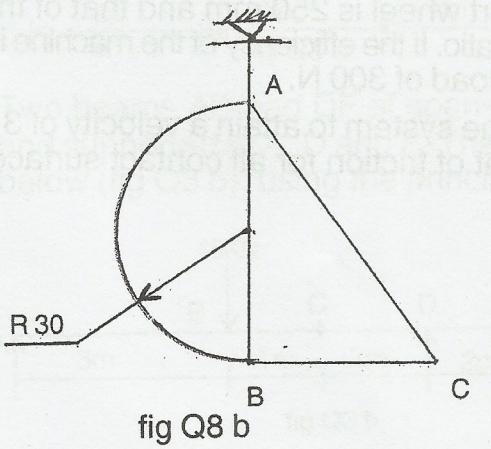


fig Q8 b