F.E. (Semester – I) (Revised in 2016-17) Examination, Nov./Dec. 2018

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) Two bars AB and BC of lengths 1 m and 2 m weighing 150 N and 250 N respectively are rigidly joined at B and suspended by a string AO in figure Q. 1a) below. Determine the inclination 'θ' which bar BC makes with the horizontal, when the system is in equilibrium. **10**

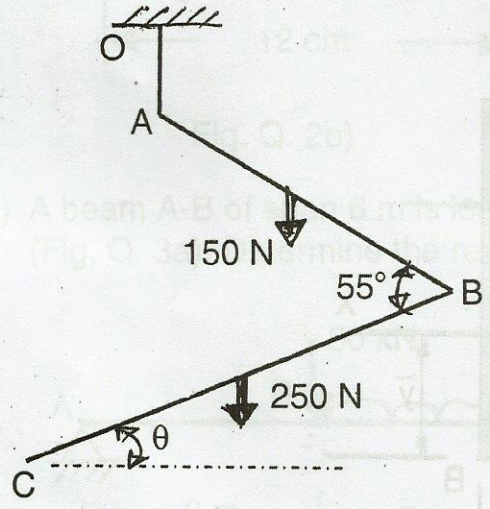

Fig. Q. 1a)

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

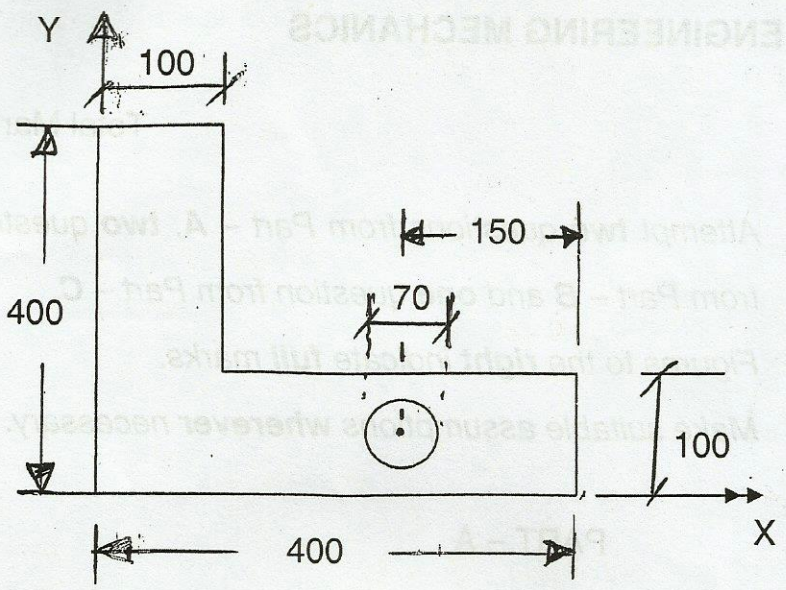

Fig. Q. 1 b)

2. a) Calculate the moment of inertia and radius of gyration of the shaded area about the centroidal X-X axis and axis AB marked on the figure (Fig. Q. 2a). **10**

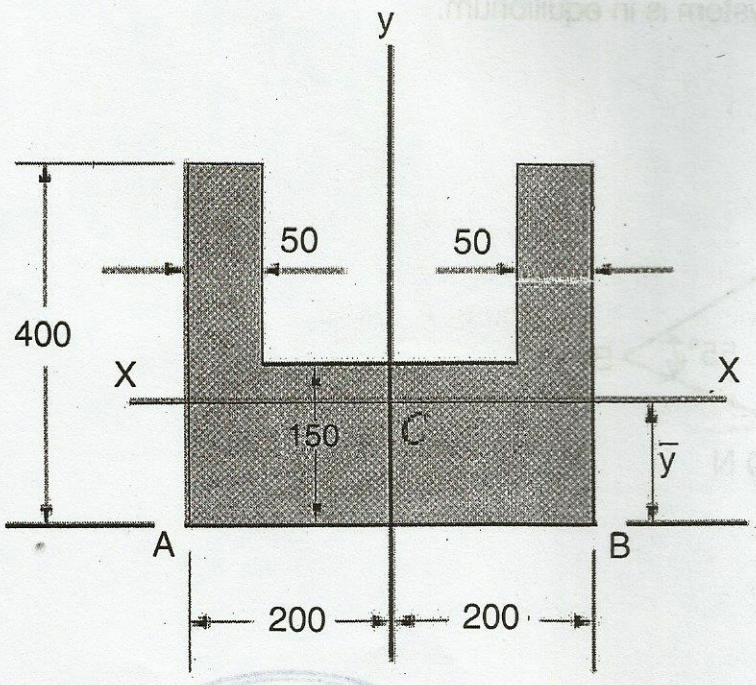

Fig. Q. 2a)

b) Three cylinders are piled up in a rectangular channel as shown in Fig. Q. 2b). Determine the reactions between the cylinder A and the vertical wall of the channel. **10**

Weight and radius of the cylinder are as follows :

$W_A = 150$ N $\quad r_A = 5$ cm

$W_B = 400$ N $\quad r_B = 7$ cm

$W_C = 200$ N $\quad r_C = 4$ cm

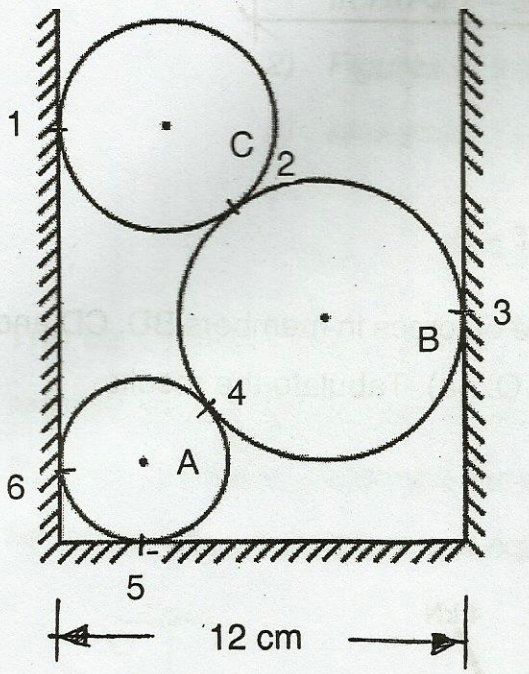

Fig. Q. 2b)

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

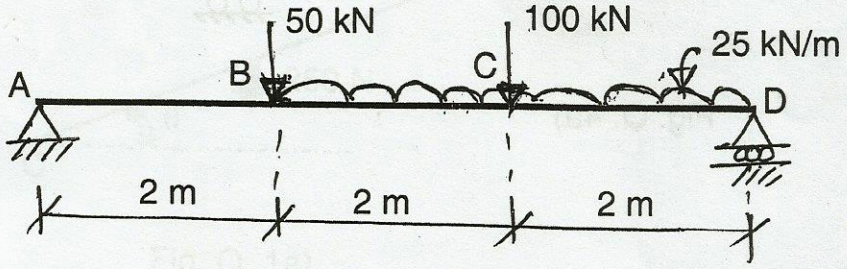

Fig. Q. 3a)

b) Two beams AC and CE of spans 7 m and 5 m respectively are hinged at D and supported at A, C and E. The beams are loaded as shown in the figure below (Fig. Q. 3b); using the principle of virtual work, find the reaction at C. **10**

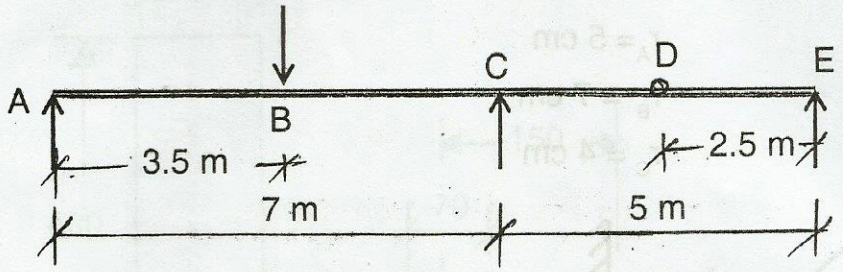

Fig. Q. 3b)

PART – B

4. a) Determine the magnitude and nature of forces in members BD, CD and CE of the truss as shown in figure (Fig. Q. 4a). Tabulate the results. **12**

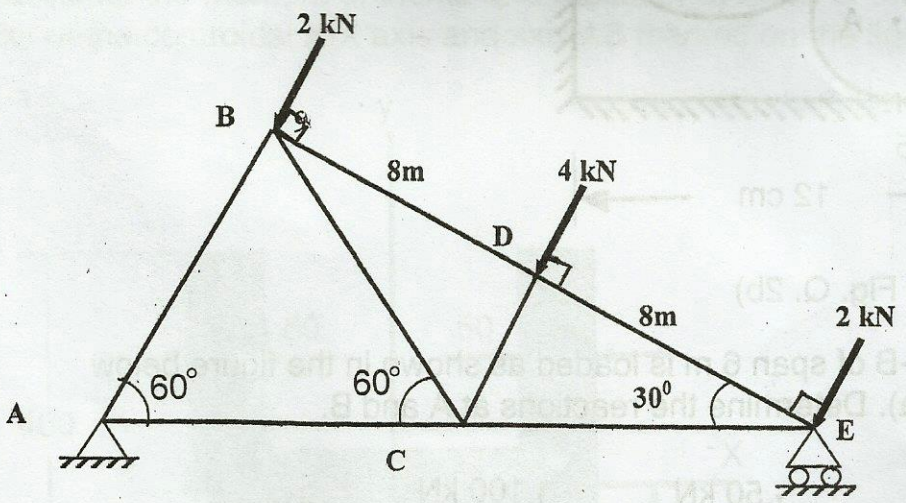

Fig. Q. 4a)

b) What should be the value of θ in Fig. Q. 4b) which will make the motion of 900 N block down the plane to impend ? The coefficient of friction for all contact surfaces is 0.25. **8**

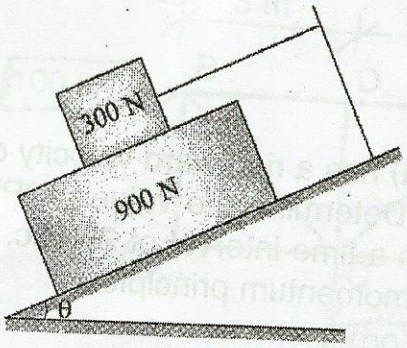

Fig. Q. 4b)

a) In a simple lifting machine, an effort of 40 N raised a load of 1.2 kN. What is the mechanical advantage ? Calculate its velocity ratio if the efficiency at this load is 75%. If by the same machine, a load of 2.1 kN is raised by an effort of 60 N, what is now its efficiency ? Also find the maximum mechanical advantage and maximum efficiency. What will be the effort required to raise a load of 5 kN ?

b) Two blocks of weight 850 N and 500 N are connected by a flexible but inextensible string and they move along a rough horizontal plane under the action of 150 N force as shown in the figure Q. 5b). If the coefficient of friction between all contact surfaces is 0.35, determine the acceleration of the weight and tension in the thread. Use D'Alembert's principle. **10**

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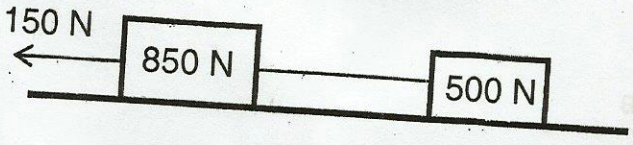

Fig. Q. 5b)

a) With the help of a neat sketch, derive an expression for velocity ratio of a differential wheel and axle. In terms of its efficiency, how does it compare with that of a simple wheel and axle. **10**

b) A block weighing 500 N is pushed up the plane by a 300 N force acting parallel to the plane. If the initial velocity of the body is 1.5 m/sec and coefficient of kinetic friction is 0.2, what velocity will the body have after moving 6m. **10**

PART – C

7. a) The system shown in the figure (Fig. Q. 7a) has a rightward velocity of 3.5 m/sec, just before a force "P" is applied. Determine the value of "P" that will give a leftward velocity of 5.5 m/sec in a time interval of 25 sec. Take coefficient of friction is 0.20. Use impulse momentum principle. **10**

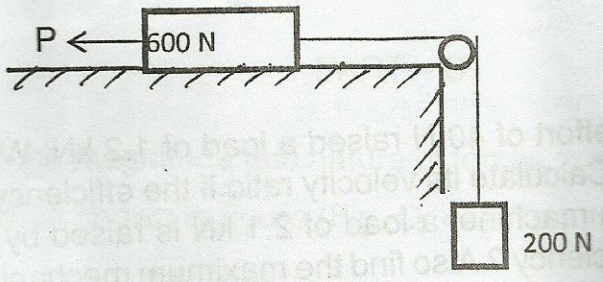

Fig. Q. 7a)

b) A ladder of length L rests against a wall, the angle of inclination being 45°. If the coefficient of friction between the ladder and the ground and that between ground and the wall is 0.45 each, what will be the maximum distance on ladder to which a man whose weight is 1.25 times the weight of ladder may ascend before the ladder begins to slip ? **1**

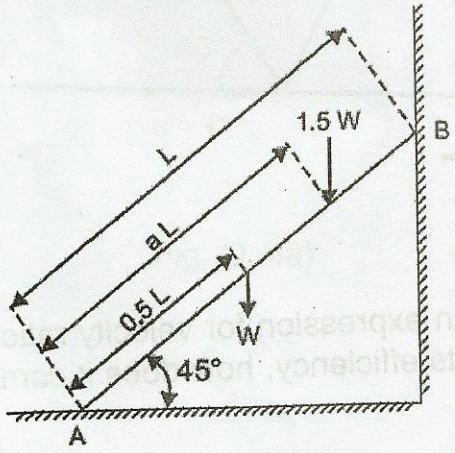

Fig. Q. 7b)

8. a) For a pin jointed truss shown in the figure (Fig. Q. 8a), determine the magnitude and nature of forces in all the members. Tabulate the results. **12**

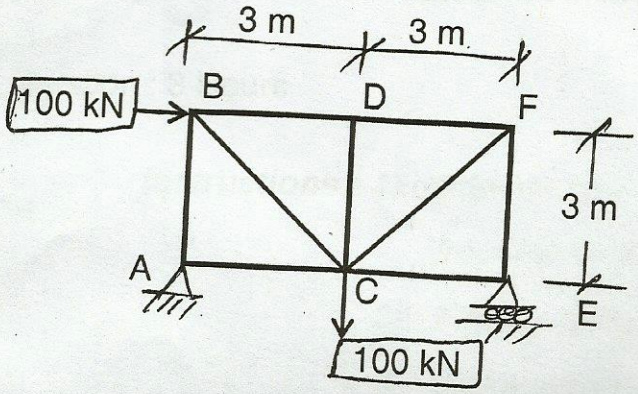

Fig. Q. 8a)

b) Two symmetrical sections whose cross-sectional area is the SAME, are shown in the figure Q. 8b). Calculate moment of inertia of the two sections about their centroidal axis. Which of the two sections will be economical for use as a beam section ? Justify your answer. **8**

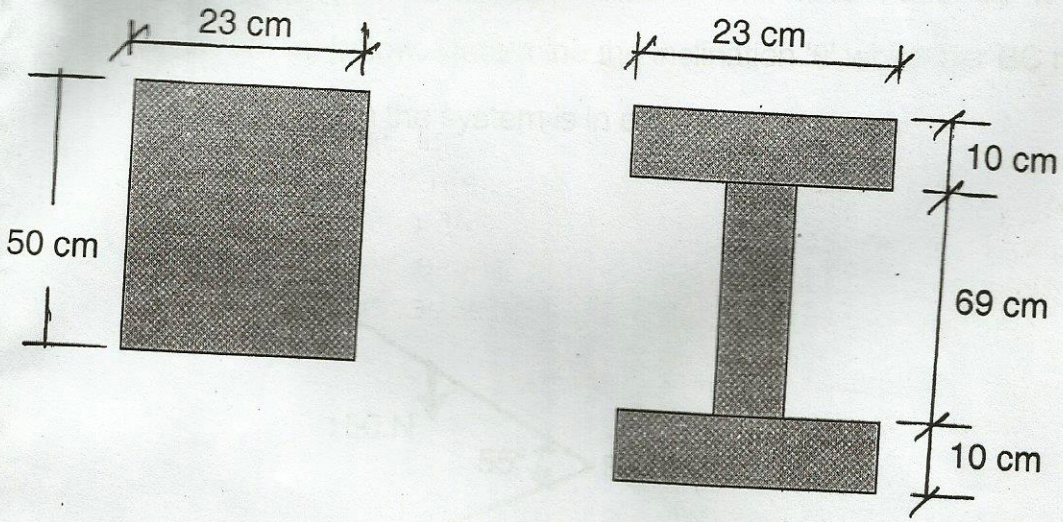

Fig. Q. 8b)