

Total No. of Questions—6]

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[5151]-109

F.E. (Common) EXAMINATION, 2017

ENGINEERING MECHANICS

(2015 PATTERN)

Time : Two Hours

Maximum Marks : 50

- N.B.** :— (i) Attempt Q. 1 or Q. 2, Q. 3 or Q. 4 and Q. 5 or Q. 6.  
(ii) Neat diagram must be drawn wherever necessary.  
(iii) Figures to the right indicate full marks.  
(iv) Assume suitable data, if necessary and clearly state.  
(v) Use of cell phone is prohibited in the examination hall.  
(vi) Use of electronic pocket calculator is allowed.

1. (a) Determine the magnitude and direction of resultant with reference to point A for the force system as shown in Fig. 1 (a) if side of equilateral triangle is 1 m. [4]

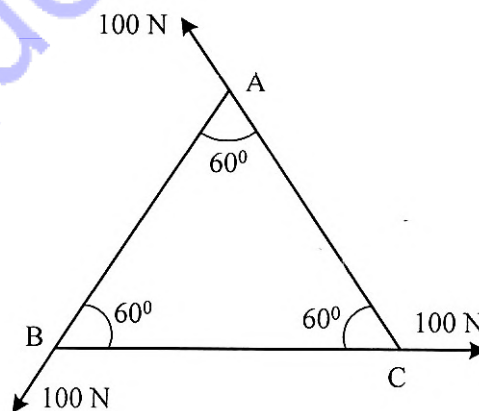
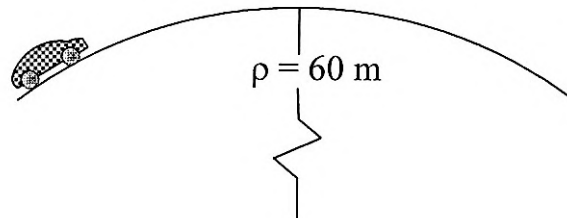


Fig. 1(a)

P.T.O.

- (b) If the crest of the hill has a radius of curvature  $r = 60$  m, determine the maximum constant speed at which the car can travel over it without leaving the surface of the road. The car has a weight of 17.5 kN. Refer Fig. 1 (b). [4]

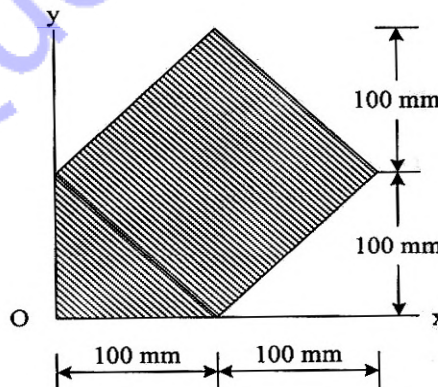


**Fig. 1(b)**

- (c) The acceleration of a particle as it moves along a straight line is given by  $a = (2t - 1)$  m/s<sup>2</sup>, where  $t$  is in seconds. If  $s = 1$  m and  $v = 2$  m/s when  $t = 0$ , determine the particle velocity and position when  $t = 6$  s. [4]
- (d) A tennis ball is dropped from a height 1600 mm and it rebounds to a height 1100 mm. Determine the coefficient of restitution. [4]

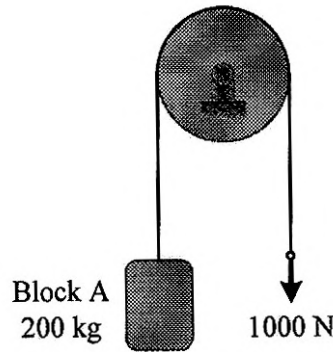
*Or*

2. (a) Determine the position of centroid of the shaded area with respect to origin O as shown in Fig. 2(a). [4]



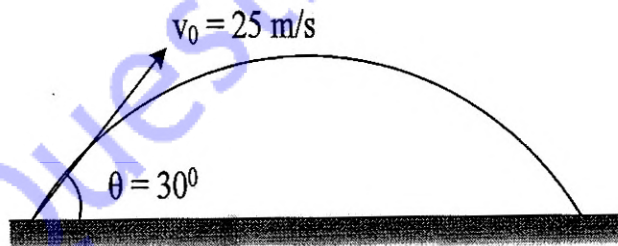
**Fig. 2(a)**

- (b) The system shown in Fig. 2(b) is initially at rest. Neglecting axle friction and mass of pulley, determine the acceleration of block A. [4]



**Fig. 2(b)**

- (c) A projectile is launched with a speed of  $V_0 = 25$  m/s at an angle of  $\theta = 30^\circ$  with horizontal as shown in Fig. 2(c). Determine the maximum distance travelled by projectile along horizontal and vertical direction. [4]



**Fig. 2(c)**

- (d) A ball has a mass of 30 kg is thrown upward with a speed of 15 m/s. Determine the time and distance travelled by the ball before stopping. Use impulse momentum principle. [4]

3. (a) A cylinder of mass 100 kg rest between the inclined plane as shown in Fig. 3(a) Determine the normal reaction at A and B. [6]

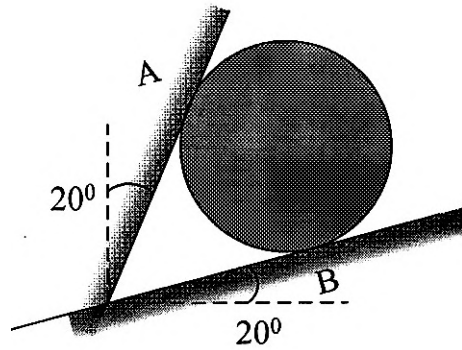


Fig. 3(a)

- (b) Four parallel bolting forces act on the rim of the circular cover plate as shown in fig. 3(b). If the resultant force 750 N is passing through (0.15 m, 0.1 m) from the origin O, determine the magnitude of forces  $P_1$  and  $P_2$ . [6]

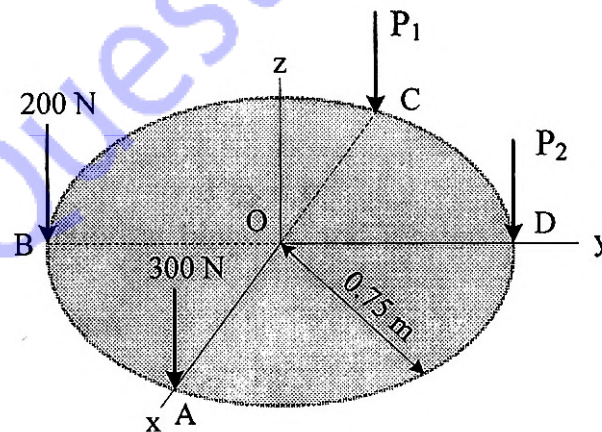
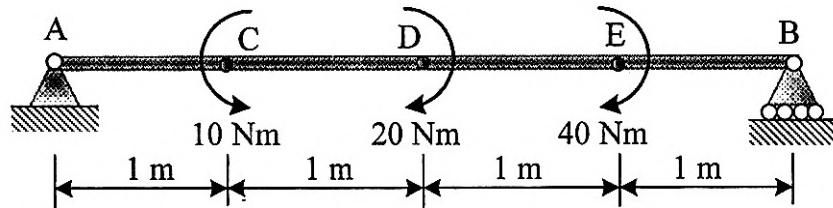


Fig. 3(b)

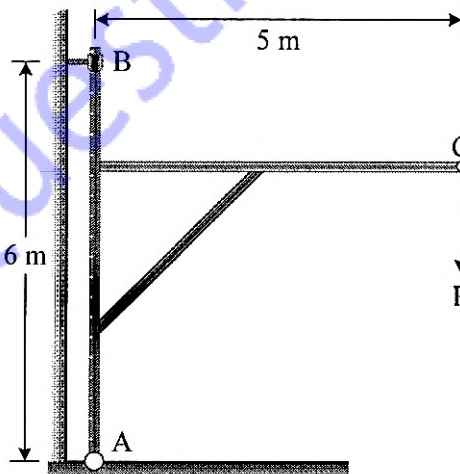
- (c) Determine reaction at A and B for the beam loaded and supported as shown in Fig. 3(c). Moments are act at point C, D and E. [5]



**Fig. 3(c)**

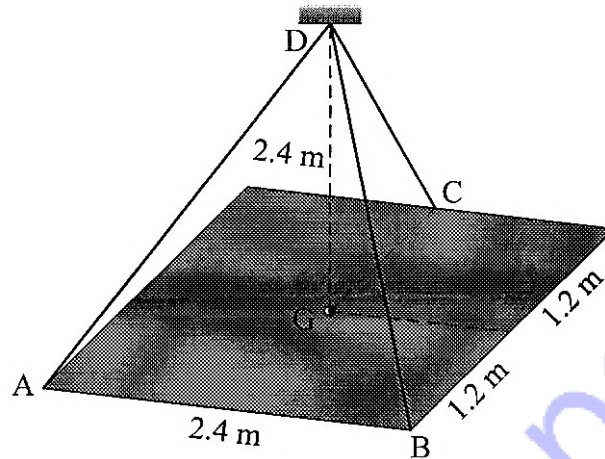
Or

4. (a) The wall crane is supported by smooth collar at B and pin at A as shown in Fig. 4(a). If the vertical component of reaction at A is 10 kN, determine the force P, normal reaction at B and tangential component of reaction at A. [6]



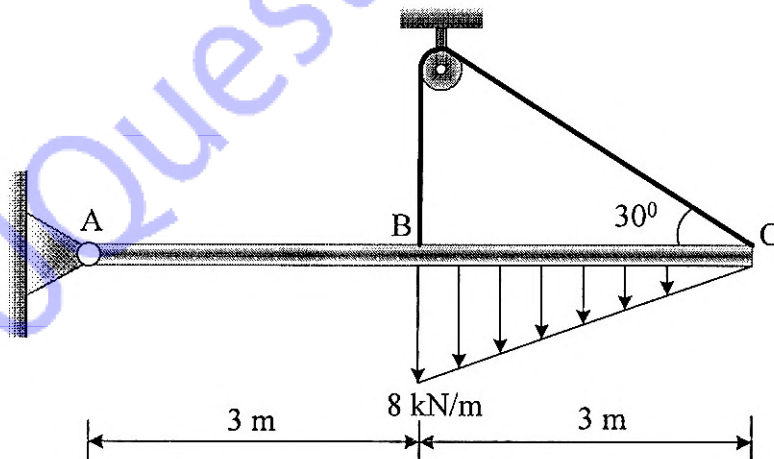
**Fig. 4(a)**

- (b) The square steel plate has a mass of 1800 kg with mass center  $G$  as shown in Fig. 4(b). Determine the tension in each cable so that the plate remains horizontal. [6]



**Fig. 4(b)**

- (c) Determine the component of reaction at hinge  $A$  and tension in the cable  $BC$  as shown in Fig. 4(c). [5]



**Fig. 4(c)**

5. (a) Determine the distance  $s$  to which the 90 kg painter can climb without causing the 4 m ladder to slip at its lower end A as shown in Fig. 5(a). The top of the 15 kg ladder has a small roller and at the ground the coefficient of static friction  $\mu_s = 0.25$ . The mass center of the painter is directly above its feet. [6]

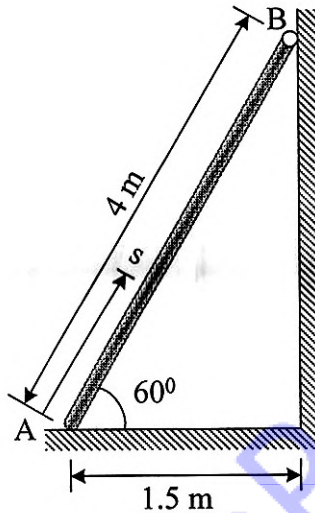


Fig. 5(a)

- (b) Determine support reaction and find the forces in magnitude and direction of the members AD, BD and BC of the simply supported truss as shown in Fig. 5(b) by method of section. Tabulate the result with magnitude and nature of force in the members. [6]

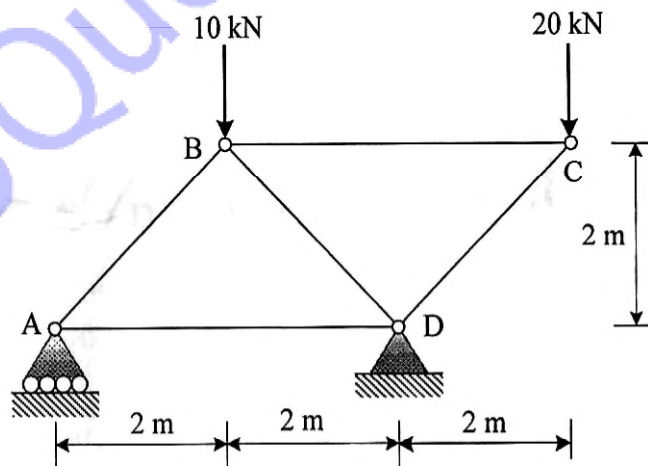
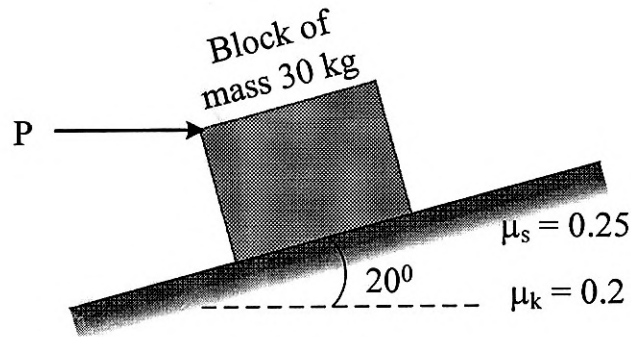


Fig. 5(b)

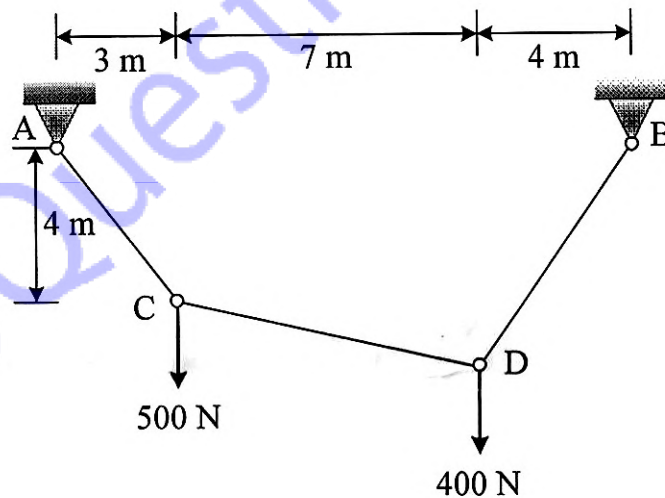
- (c) Determine the horizontal force  $P$  needed to just start moving the 30 kg block up the plane as shown in Fig. 5(c). Take  $\mu_s = 0.25$  and  $\mu_k = 0.2$ . [5]



**Fig. 5(c)**

Or

6. (a) The cable segment support the loading as shown in Fig. 6(a). Determine the support reaction and maximum tension in segment of cable. [6]



**Fig. 6(a)**



- (b) A chain having a weight of  $1.5 \text{ N/m}$  and a total length of  $10 \text{ m}$  is suspended over a peg  $P$  as shown in Fig. 6(b). If the coefficient of static friction between the peg and cord is  $\mu_s = 0.25$ , determine the largest length  $h$  which one side of the suspended cord can have without causing motion. Neglect the size of peg. [6]

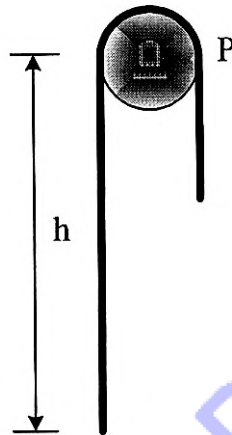


Fig. 6(b)

- (c) Determine the forces in the members of the truss loaded and supported as shown in the Fig. 6(c). Tabulate the result with magnitude and nature of force in the members. [5]

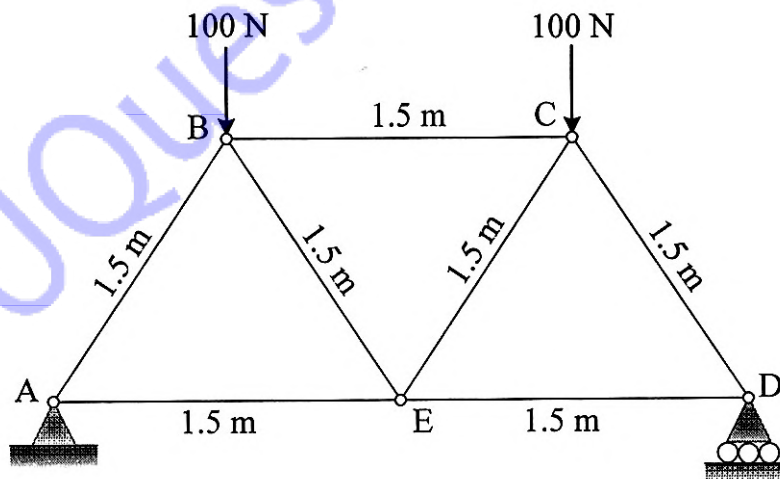


Fig. 6(c)