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BME-016

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BACHELOR OF TECHNOLOGY IN MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING)
B.Tech. (AEROSPACE ENGINEERING) (BATE)

Term-End Examination

December, 2013

BME-016 : ENGINEERING MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt* ***any seven*** *questions. Use of calculator is* ***permitted.*** *All questions carry* ***equal*** *marks.*

1. (a) The resultant of the two forces, when they act at an angle of 60° is 14N. If the same forces are acting at right angles, their resultant is $\sqrt{136}$ N. Determine the magnitude of the two forces. **5+5**

(b) The resultant of four forces which are acting at a point 'O' as shown in figure 1, is acting along Y - axis. The magnitude of forces F_1, F_3 and F_4 are 10 kN,

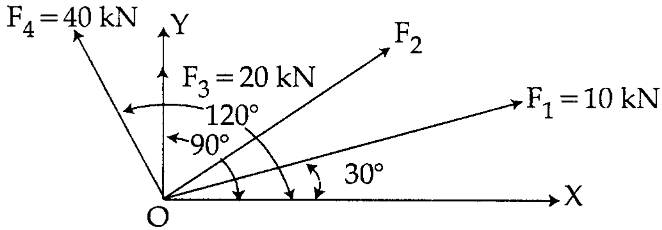

Fig. 1

20 kN, and 40 kN respectively. The angles made by 10 kN, 20 kN and 40 kN with x-axis are 30°, 90° and 120° respectively. Find the magnitude and direction of force F_2 if the resultant is 72 kN.

2. (a) In a first system of pulleys, there are 4 movable pulleys. If an effort of 100 N lifts a load of 1360 N, find : **5+5**

   (i) The effort wasted in friction

   (ii) The load wasted in friction

   (b) On a straight road, a smuggler's can passes a police station with a uniform velocity of 10m/s. After 10 seconds a police party follows in pursuit in a jeep with a uniform acceleration of $1 m/s^2$. Find the time necessary for the jeep to catch up with the smuggler's car.

3. (a) A 10 gm bullet is shot horizontally in a wooden block of mass 1 kg. The bullet gets embeded in the block and the block is displaced by 1 m on a rough horizontal table ($\mu = 0.2$). What was the velocity of the bullet ? **5+5**

   (b) A stone is thrown vertically upward with a velocity of 19.6 m/sec from the top of a tower 24.5 high. Calculate :

   (i) Time required for the stone to reach the ground,

   (ii) Velocity of the stone in its downward travel at the level of the point of projection, and

   (iii) The maximum height to which the stone will rise in its flight.

4. (a) An object of mass 5 kg is projected with a velocity of 20 m/s at an angle of 60° to the horizontal at the highest point of its path, the projectile explodes and breaks up into two fragments of masses 1 kg and 4 kg and these fragments separate horizontally. The explosion releases internal energy such that kinetic energy of the system at the highest point is doubled. Calculate the separation between two fragments when they reach the ground. 5+5

(b) Determine the forces in all the members of the truss as shown in figure 2.

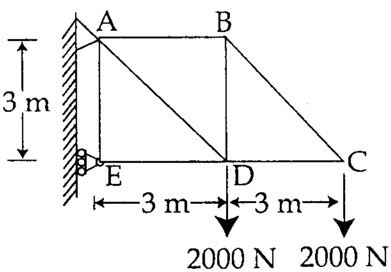

Fig. 2

5. (a) What is the least value of : 5+5

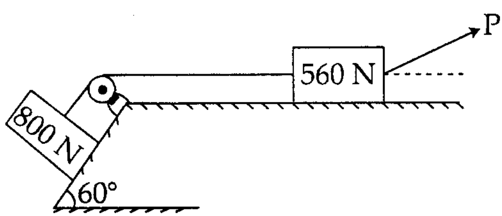

Fig. 3

'P' required to cause the motion to impend for the system as shown in figure 3. Assume co-efficient of friction on all contact surfaces as 0.2.

(b) Two cylinders of diameters 60 mm and 30 mm

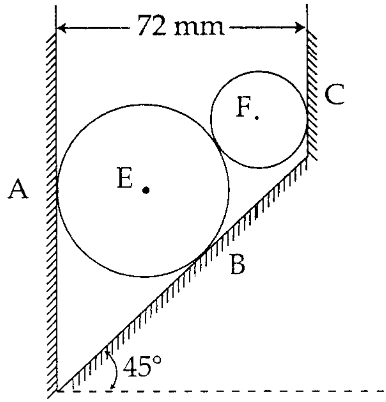

Fig. 4

Weighing 500N and 75N respectively are placed as shown in figure 4. Assuming all the contact surfaces to be smooth. Find the reaction at A, B and C.

6. (a) The acceleration of a particle moving along a straight line is : **5+5**

$a = 3v^{2/3}$

When $t = 3$sec, its displacement $s = 37.516$ m and velocity $v = 42.87$ m/s. Determine the displacement, velocity and acceleration when $t = 5$ sec.

(b) In a simple machine, with velocity ratio of 40, an effort of 200 N lifts a load of 2400 N and an effort of 240 N lifts a load of 3200 N. Find the law of the machine and calculate the load that can be lifted by an effort of 300 N. Also find :

(i) The effort lost in friction
(ii) The mechanical advantage
(iii) The efficiency
(iv) The frictional resistance

(v) The maximum efficiency of the machine

7. (a) Determine reactions at A and B for the beam loaded as shown in figure 5. **5+5**

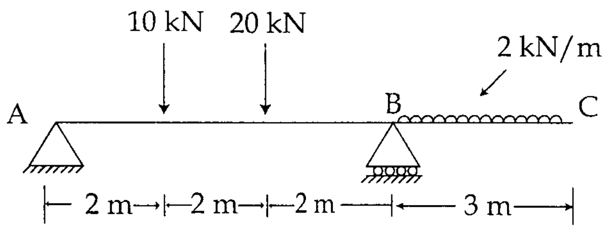

Fig. 5

(b) A particle is acted on by constant force $2\hat{i} + \hat{j} - \hat{k}$, $\hat{i} - 2\hat{j} + 3\hat{k}$ and $3\hat{i} + \hat{j} + 5\hat{k}$ is displaced from the point $\hat{i} + 2\hat{j} + 3\hat{k}$ to point $6\hat{i} + 3\hat{j} + \hat{k}$. Find the work done.

8. (a) Locate the centroid of the shaded area as shown in figure 6. **5+5**

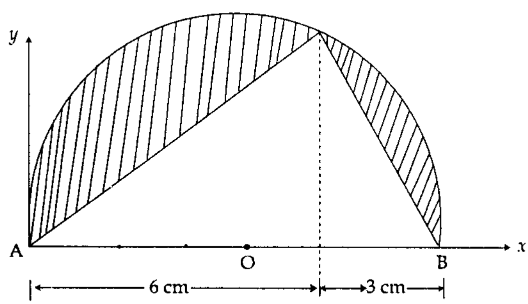

Fig 6.

(b) Determine the minimum value of force P required

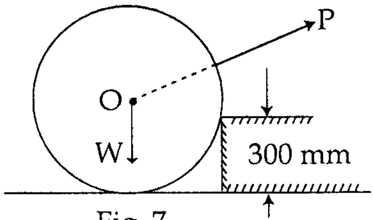

Fig. 7

Just to start the wheel over the step 300 mm high as shown in figure 7. The diameter of the wheel is 1.2 m and the weight is 800 N. Also find the direction of P.

9. (a) Given the vectors $P = 4\hat{i} - 2\hat{j} + P_z\hat{k}$, **5+5**

$Q = \hat{i} + 3\hat{j} - 5\hat{k}$, and $S = -6\hat{i} + 2\hat{j} - \hat{k}$,

determine the value of P_z for which the three vectors are co-planner.

(b) Two forces are acting at a point as shown in figure 8. Determine the magnitude and direction of the resultant.

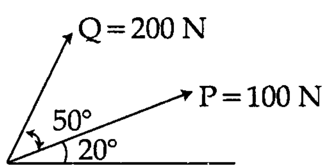

Fig. 8

10. (a) A train with total weight of 1000 tonnes is resting on an inclined track of 1 in 100 with tractive resistance of 5 N per kN. The train is pulled down wards by a locomotive with a constant pull of 5 tonnes. Assuming $g = 10 ms^{-2}$, calculate the power developed by the locomotive, after it has travelled a distance of 1 km. 5+5

(b) In railway yard, spring bumper with stiffness K is provided at the end of side track of track resistance 8 N per kN as shown in figure 9. The bumper spring has the total compressibility of 0.6 m. The stiffness of the spring is to be so designed that the wagon weight 50 kN travelling at a speed of $4 ms^{-1}$ down a slop of 1 in 50 at a distance of 40 m from the junction A and from A over on a horizontal track of 100 m before striking the bumper, find the spring stiffness K and the roll back distance of the wagon from the point of maximum compression. Assume $g = 10 ms^{-2}$.

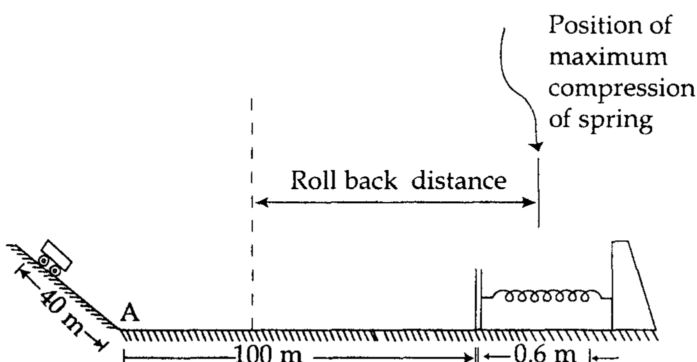

Fig. 9