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BME-016

B.Tech. Mechanical Engineering (Computer Integrated Manufacturing) / B.Tech. Aerospace Engineering (BTAE)

Term-End Examination

December, 2014

01585

BME-016 : ENGINEERING MECHANICS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any* ***five*** *questions. Use of scientific calculator (non-programmable) is allowed.*

1. (a) A smooth sphere weighing 1000 N is resting on two planes in which one is vertical and other is inclined by 30° to the vertical. Determine reaction at the supports. 7

(b) Two blocks, A weighing 60 N and B weighing 100 N are resting on a rough horizontal surface. Both the blocks are connected by a string. The coefficient of friction between block A and ground is 0·28 and that between block B and the ground is 0·22. A force P is applied at block B to move these blocks. The inclination of force P is 30° to the horizontal. Find minimum value of force P and tension in the string. 7

2. (a) Find area moment of inertia about an axis passing through the centroid and parallel to the diameter of the semicircle. The area is shown in Fig. 1. *6*

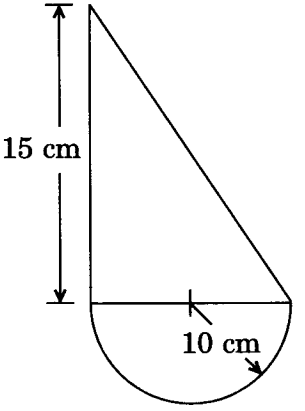

Fig. 1

(b) Analyse the truss shown in Fig. 2. *8*

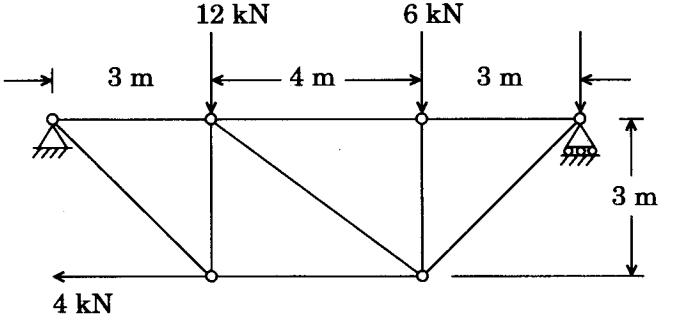

Fig. 2

3. (a) Determine the resultant of the coplanar concurrent force system shown in Fig. 3. *5*

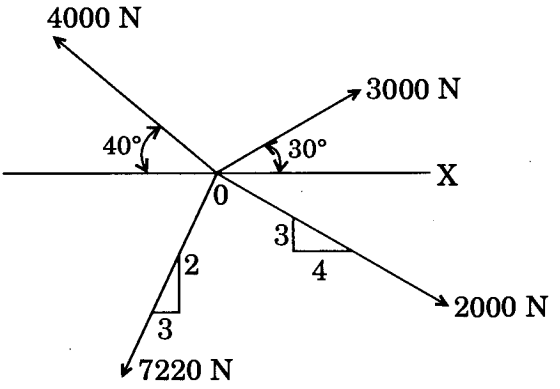

Fig. 3

(b) A flat plate shown in Fig. 4 is subjected to coplanar force system. The inscribed grid with each square having a length of 1 m locates each force. Determine the resultant and its x and y intercepts. *9*

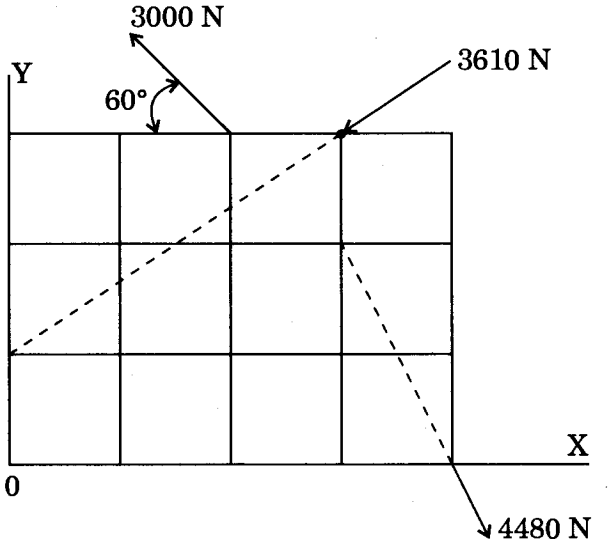

Fig. 4

4. (a) Two blocks A and B are connected by a horizontal rod and are supported on two rough planes as shown in Fig. 5. If weight of block B is 3000 N and coefficients of friction of blocks A and B are 0·25 and 0·35 respectively, find the least weight of block A for which equilibrium can exist. *8*

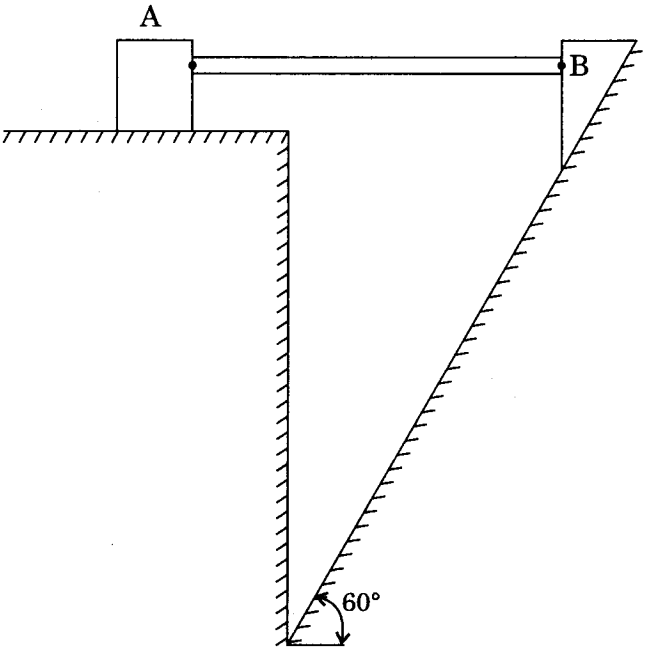

Fig. 5

(b) Determine centroid of the plane lamina shown in Fig. 6. *6*

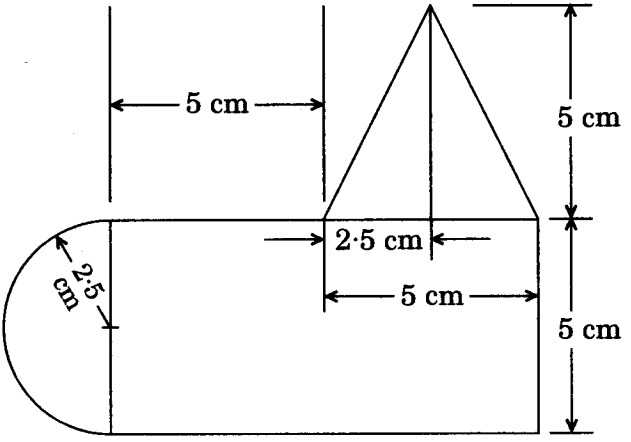

Fig. 6

5. (a) The equation of motion of a particle moving on a circular path, whose radius is 300 m, is given by

$$s = 18t + 3t^2 - 2t^3$$

where 's' is total distance covered from the starting point in meters at the end of 't' seconds.

Determine

(i) the velocity and acceleration at start.

(ii) the time when the particle reaches its maximum speed in the positive direction.

(iii) the maximum speed. *9*

(b) A man having mass 65 kg dives into a swimming pool from a tower of height 19·6 m. He was found to go down in water by 2 m. Find the average resistance of water. Neglect the resistance of air. *5*

6. (a) A locomotive along with train weighs 200 tonnes. The tractive resistance is 98 N/tonne of weight of the train. On a grade of 1 in 120 the train can achieve maximum speed of 30 kmph.

Determine

(i) the power of locomotive in kW.

(ii) the maximum speed the train can attain on straight level track with same tractive resistance. *8*

(b) An elevator weighs 2500 kg and moves with constant acceleration. Starting from rest, it travels 35 metres during 10 seconds. Determine the cable tension when lift is moving up and down. *6*

7. (a) Determine the tension in the string and acceleration of blocks A and B which weigh 150 kg and 50 kg respectively. Neglect friction in pulleys and their weights. The system is shown in Fig. 7 *6*

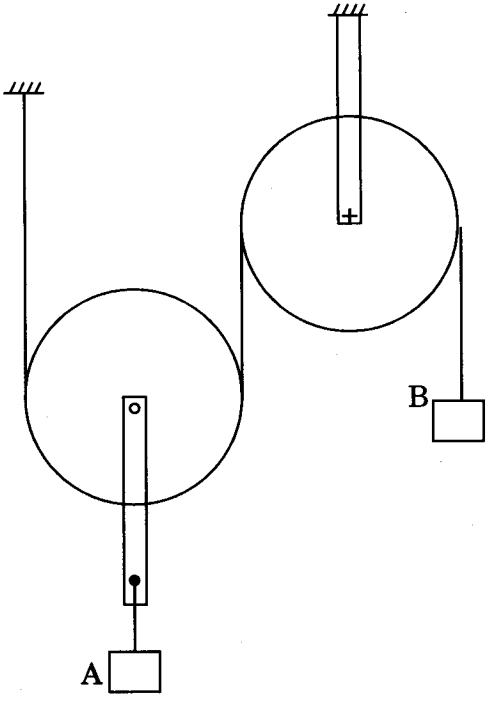

Fig. 7

(b) A cage weighing 3000 kg is raised by a rope one end of which is wrapped round a drum 120 cm in diameter and weighing 735 kg. Drum has radius of gyration equal to 35 cm. The drum is rotated by an electric motor which exerts a constant torque equal to 40000 Nm. If rope is tight when the drum begins to rotate, determine

(i) the acceleration of cage.

(ii) the tension in rope.

(iii) the time required to raise the cage by 20 m from the ground.

Neglect friction and mass of rope. *8*

8. (a) A body A weighing 10 kg moves at a speed of 9 m/s towards right. Another body B weighing 20 kg moves with velocity of 3 m/s towards left. These two bodies collide with each other. Find the velocity of A and B after impact. The coefficient of restitution is 0·6. *7*

(b) A projectile is fired from the top of a cliff 90 m high with a velocity 500 m/s directed at 45° to the horizontal. Find the range on a horizontal plane through the base of the cliff. *7*
