COLLEGE OF ENGINEERING PUNE
End Semester Exam 2009-2010 (I SEM.)
Engineering Mechanics (CE 101)

Programme : First year B. Tech
Duration: 180 minutes
Time: 10 am to 1 pm

Date: 30-11-2009
Max. Marks: 100
Total pages: 5

Instructions:

1) **Answer any five questions.**
2) **Figures to the right indicate full marks.**
3) **Use of non-programmable calculator is allowed.**
4) **Assume suitable data if required.**

Q 1a Three loads are applied as shown to a light beam supported by cables attached at B and D. Knowing that the maximum allowable tension in each cable is 12 kN and neglecting the weight of the beam, determine the range of values of Q for which the loading is safe when P = 5 kN. (10)

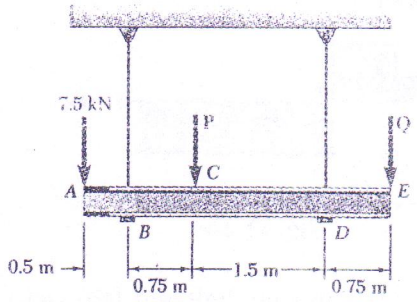


Fig. Q 1a

Q 1b Determine whether the block shown is in equilibrium and find the magnitude and direction of the friction force when θ = 30° and P = 200 N. (10)

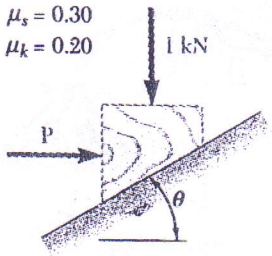


Fig. Q 1b

Q.2a Find the magnitude and direction of the resultant of the two forces shown knowing that P = 500 N and Q = 600 N. (8)

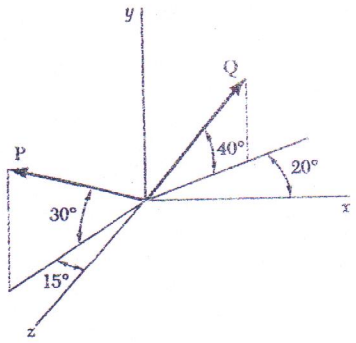


Fig. Q 2a

Q.2b A particle moves in a straight line with the acceleration shown in the figure. Knowing that its start from the origin with v_0 = -18 m/s, (a) plot the v-t and x-t curves for $0 < t < 20$ s, (b) determine its velocity, its position, and the total distance traveled after 12 seconds. (12)

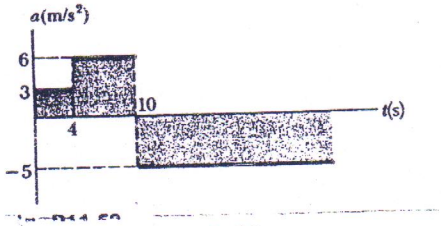


Fig. Q 2b

Q.3a Sand is discharged at A from a conveyer belt and falls onto the top of a stockpile at B. Knowing that the conveyer belt forms an angle $\alpha = 20°$ with the horizontal, determine the speed v_0 of the belt. (10)

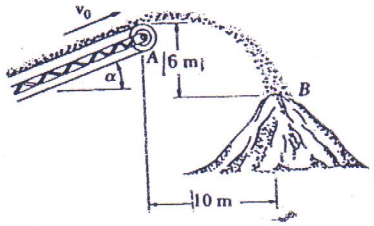


Fig. Q 3a

Q.3b Knowing that block A moves down to the left with a constant velocity of 80 mm/sec, determine (*a*) the velocity of block B, (*b*) the change in position of block A relative to block b, which takes place in 4 seconds. (10)

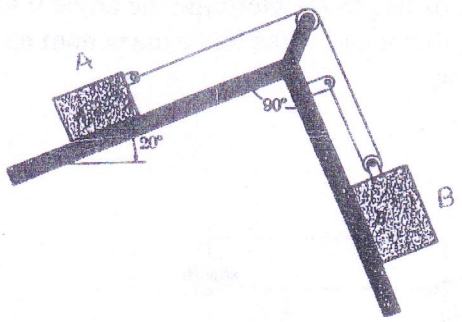


Fig. Q 3b

Q.4a A nozzle discharges a stream of water in the direction shown with an initial velocity of 7.5 m/s. Determine the radius of curvature of the stream (*a*) as it leaves the nozzle, (*b*) at the maximum height of the stream. (10)

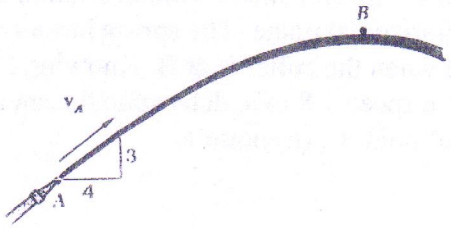


Fig. Q 4a

Q.4b The rotation of rod *OA* about *O* is defined by the relation $\theta = 2t^2$, where θ is expressed in radians and t in seconds. Collar *B* slides along the rod in such away that its distance from *O* is $r = 60t^2 - 20t^3$, where r is expressed in millimeters and t in seconds. When t =1 s, determine, (*a*) the velocity of the collar, (*b*) the total acceleration of the collar. (10)

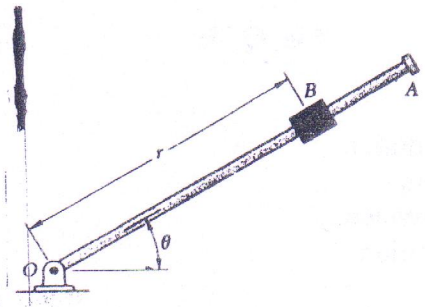


Fig. Q 4b

Q.5a A bag is gently pushed off the top of a wall at A and swings in a vertical plane at the end of a rope of length l. Determine the angle θ for which the rope will break, knowing that it can withstand a maximum tension equal to twice the weight of the bag. (10)

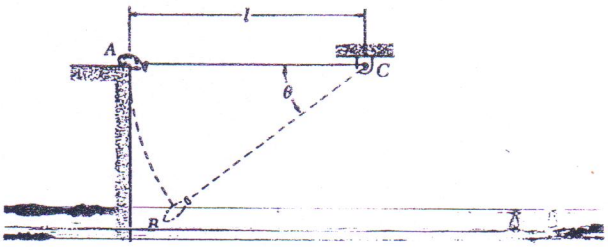


Fig. Q 5a

Q.5b A 1 kg collar is attached to a spring and slides without friction along a circular rod which lies in a horizontal plane. The spring has a constant k = 250 N/m and is undeformed when the collar is at B. Knowing that the collar passes through point D with a speed 1.8 m/s, determine the speed of the collar as it passes through (*a*) point C, (*b*) point B. (10)

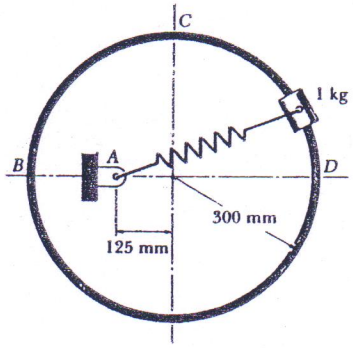


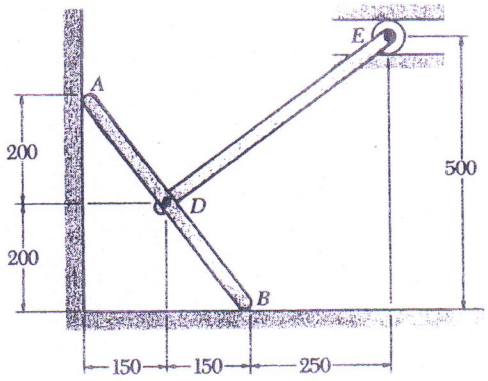
Fig. Q 5b

Q 6a Define the following: (4)

1. Coefficient of restitution
2. Angular momentum
3. Natural Circular frequency
4. Period of free vibration

Q 6b Derive the work energy principle for a particle from Newton's second law. (6)

Q. 6c Two 500 mm rods are pin connected at D as shown, knowing that B moves to the left with a constant velocity of 360 mm/s, determine at the instant shown (*a*) the angular velocity of each rod , (*b*) the velocity of E. (10)



Dimensions in mm

Fig. Q 6c