

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)

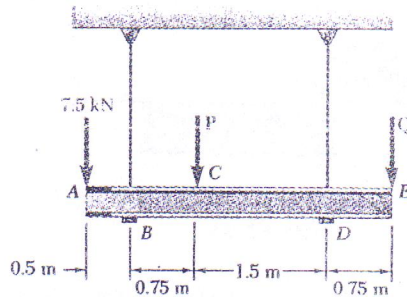


Fig. Q 1a

- Q 1b Determine whether the block shown is in equilibrium and find the magnitude and direction of the friction force when $\theta = 30^\circ$ and $P = 200$ N. (10)

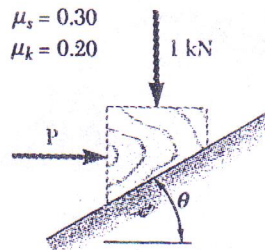


Fig. Q 1b

- 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)

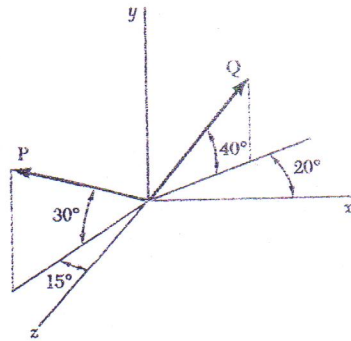


Fig. Q 2a

- Q.2b A particle moves in a straight line with the acceleration shown in the figure. (12)
 Knowing that it starts 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.

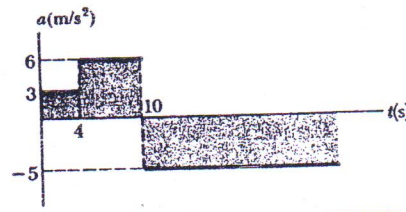


Fig. Q 2b

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

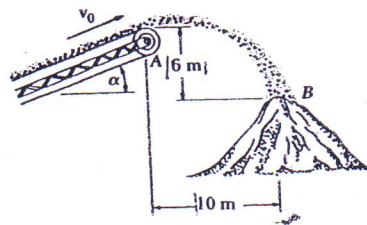


Fig. Q 3a

- 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)

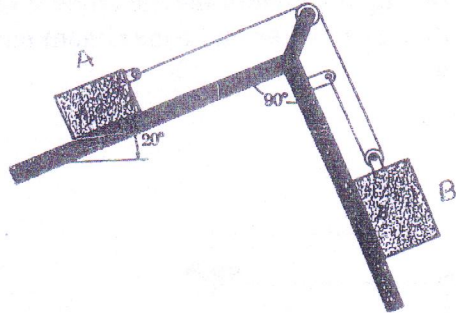


Fig. Q 3b

- 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)

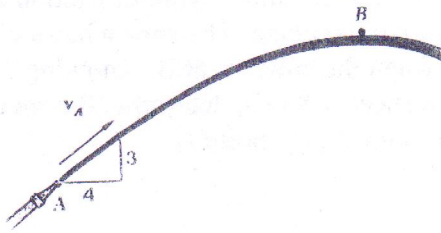


Fig. Q 4a

- 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 a way 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)

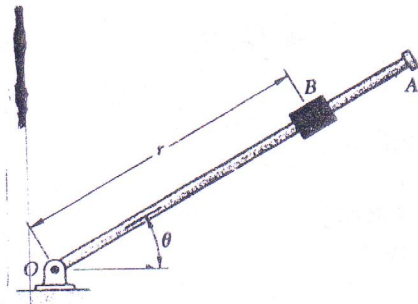


Fig. Q 4b

- 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)

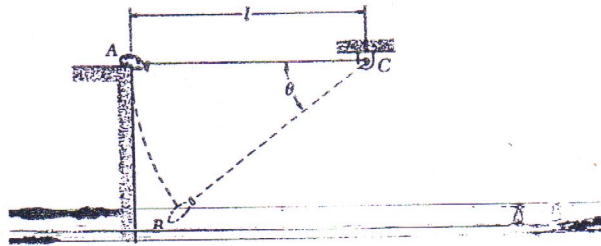


Fig. Q 5a

- 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 $k = 250 \text{ N/m}$ 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)

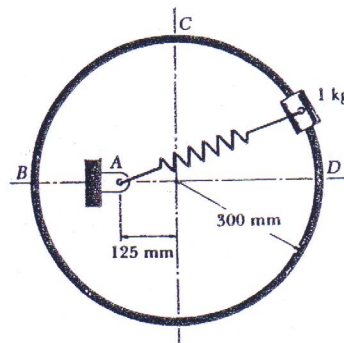


Fig. Q 5b

- 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)

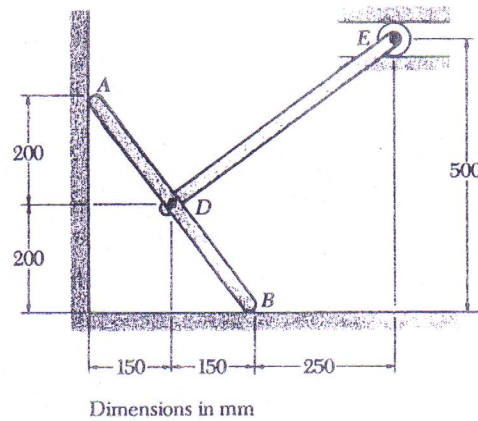


Fig. Q 6c