College of Engineering Pune

(CE 101) Engineering Mechanics

F. Y. B. Tech. (Semester-II)

End-Semester Examination

Year: 2011-12
Time: 9.00 am to 12 noon.

Date: 11th May 2012
Max. Marks: 100

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Assume suitable data wherever required and state it clearly.

Q.1 Fig.Q.1 shows a compound beam. Determine the reactions developed at support **A** and support **D** by using virtual work principle. (10)

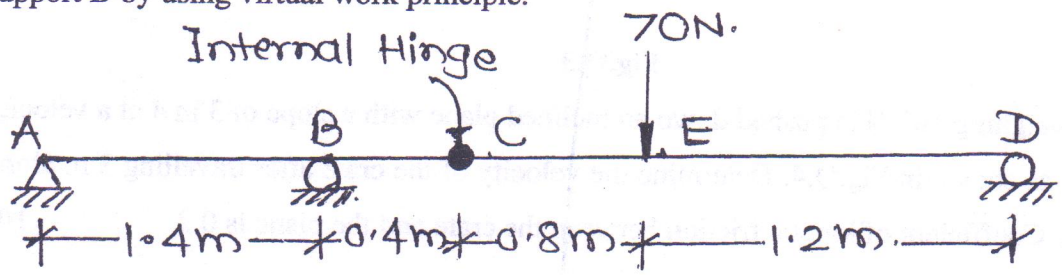


Fig.Q.1

Q.2 Determine the product moment of inertia of the area shown in Fig.Q.2 with respect to *x-x* and *y-y* axes. (10)

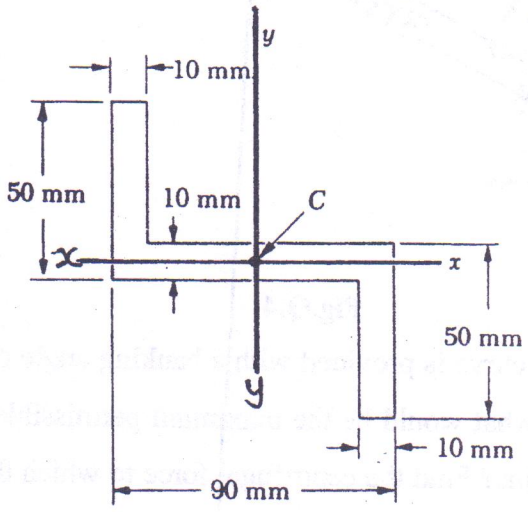


Fig.Q.2

Q.3 After rolling down a 20^0 incline, a sphere has a velocity v_0 at point **A**, as shown in Fig.Q.3. Determine the range of values of v_0 for which the sphere will enter the horizontal pipe.

(10)

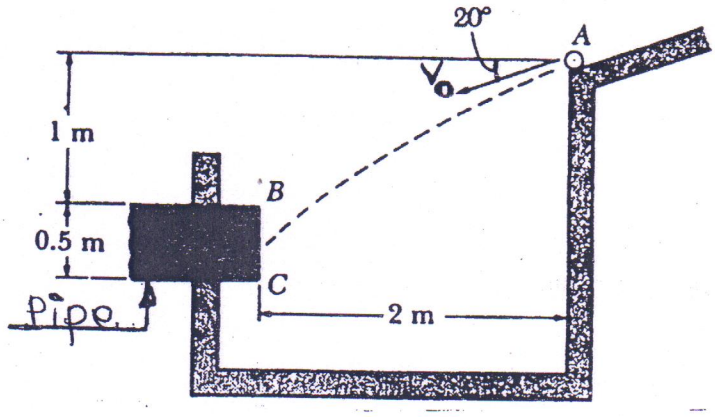


Fig.Q.3

Q.4 A crate weighing 100 N is pushed down an inclined plane with a slope of 3 in 4 at a velocity of 6 m/s, as shown in Fig.Q.4. Determine the velocity of the crate after travelling 3 m along the plane. Coefficient of kinetic friction between the crate and the plane is 0.2. (10)

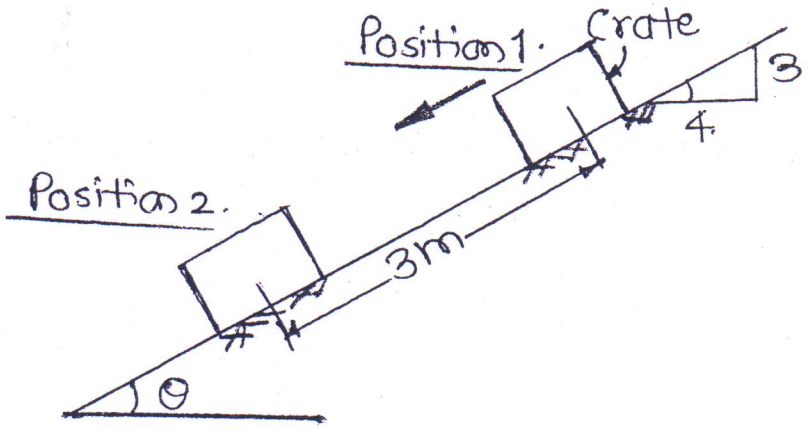
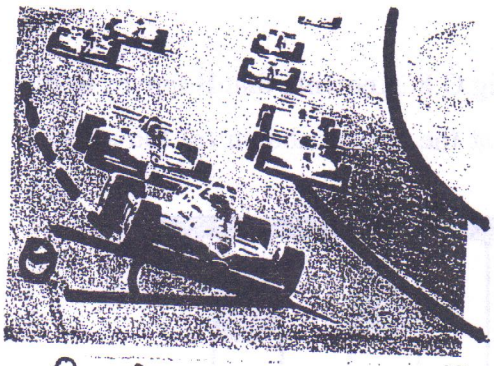


Fig.Q.4

Q.5 A racing track with a steep curve is provided with a banking angle of $\theta = 30^0$. If the mass of the racing cars is 500 kg, what would be the maximum permissible speed that the cars can run on a curve of 80 m radius? Find the centrifugal force to which the driver is subjected to, while driving. What should be the banking angle θ, if a speed of 100 kmph is to be achieved on this curve? Refer Fig.Q.5. (10)



Racing Track and Racing cars.

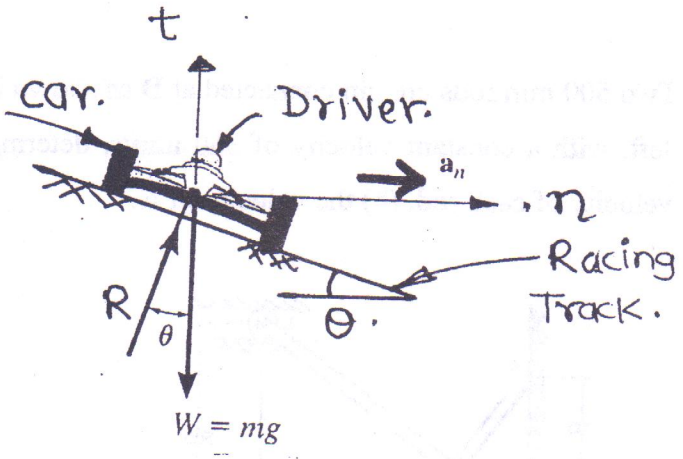


Fig.Q.5

Q.6 Two identical cars **B** and **C** are at rest on a loading dock with their brakes released. Car **A** of the same model, which has been pushed by dock workers, hits car **B** with a velocity of 1.5 m/s, causing a series of collisions among the three cars. Assuming the coefficient of restitution $e = 0.50$ between **A** and **B**; and $e = 1.00$ between **B** and **C**, determine the velocity of each car after all collisions have taken place. Refer Fig.Q.6. (10)

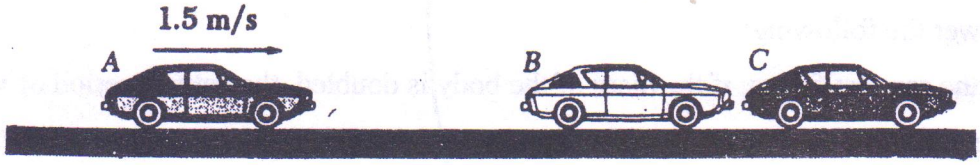


Fig.Q.6

Q.7 A 3 kg collar is initially at rest. It is acted upon by the force Q which varies as shown in Fig.Q.7. Knowing that the coefficient of kinetic friction between the rod and the collar is 0.25, determine the maximum velocity reached by the collar and the corresponding time. Also find the time at which the collar comes to rest. (10)

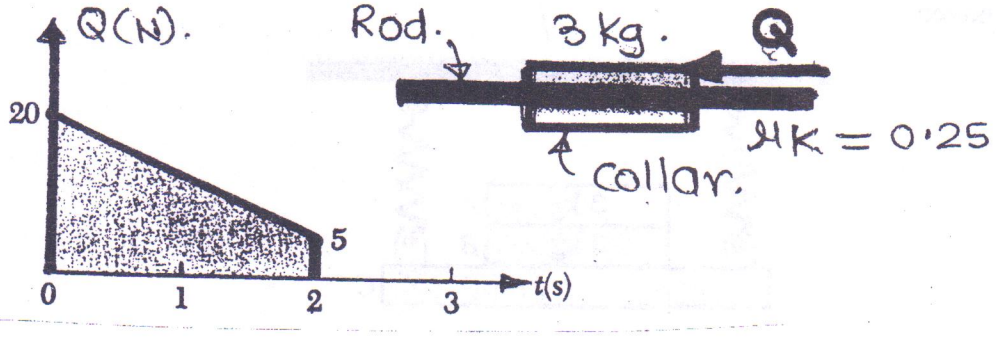


Fig.Q.7

Q.8 Two 500 mm rods are pin connected at **D** as shown in Fig.Q.8. 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)

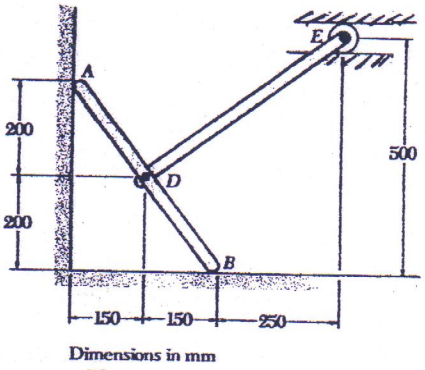


Fig.Q.8

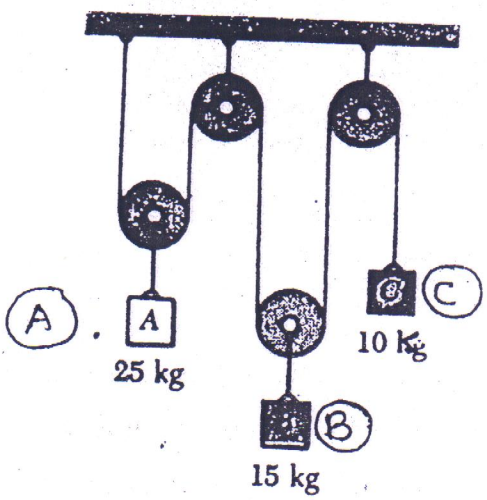


Fig.Q.9

Q.9 The system of pulleys shown in Fig.Q.9 is released from rest. Assuming that the pulleys are frictionless and are of negligible mass, determine the acceleration of each block. (10)

Q.10 (a) Answer the following:

(i) For the same stiffness, if the mass of the body is doubled, the natural period of vibration is reduced to half. State true or false giving reason. (1)

(ii) Define stiffness. (1)

(iii) Draw a mathematical model of a single degree of freedom system for damped forced vibrations. Write the dynamic equation of motion and explain each term. (3)

Q.10 (b) The period of vibration of the system shown in Fig.Q.10 (b) is observed to be 0.8 s. If the block **A** is removed, the period is observed to be 0.7s. Determine the mass of block **C**. Also determine the period of vibration when both blocks **A** and **B** have been removed. (5)

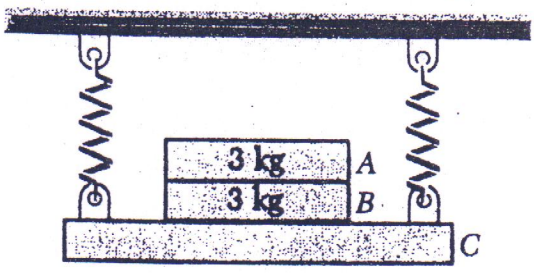


Fig. Q.10(b).