College of Engineering, Pune

F.Y. B.Tech

CE-101, Engineering Mechanics

Date : 02/05/2009 Timing : 10:00am – 1:00pm

Academic Year : 2008- 09 Max. Marks : 100 (Weightage 50%)

Spring Semester

Instructions:

1. **All questions are compulsory**
2. **Use of non-programmable calculator is allowed**
3. **Mobile phones are strictly prohibited in the Exam Room**

Q.1 a) The Figure 1a shows a truss of 8m span and loaded as shown. Find the forces in all the members of the truss using method of joints. **(08)**

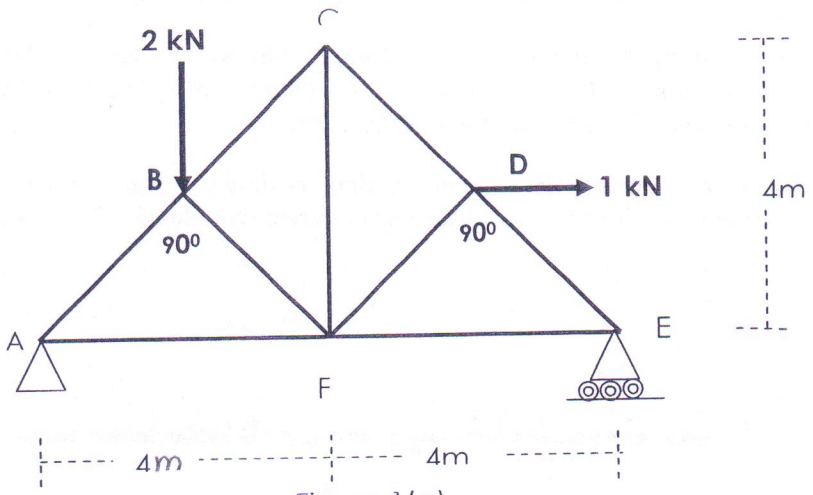

Figure 1(a)

b) A bar of length 1 m resting against smooth surfaces has its ends A and B constrained to move horizontally and vertically as shown in figure 1b. The end A moves with constant velocity of 5 m/sec horizontally. Find a) the angular velocity of the bar AB and b) the velocity of end B at the instant when the axis of the bar makes an angle 30^0 with the horizontal. **(04)**

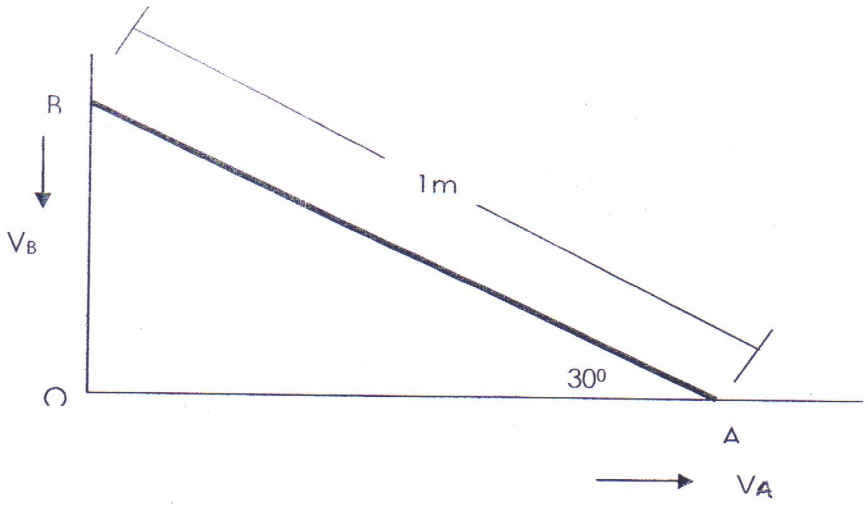

Figure 1(b)

c) A shot is fired with a velocity of 30 meters per second from a point 15 meters in front of a vertical wall 6 meters high. Find the angle of projection, to the horizontal, to enable the shot just to clear the top of the wall. **(08)**

Q.2 a) The brakes of a train reduce its speed from 60 km/hr to 20 km/hr, while it runs 200 m. Assuming that there exists constant retarding force, find i) how much further the train will run before coming to rest and ii) how much time will it take to stop. **(08)**

b) What do you mean by Simple Harmonic Motion? The amplitude of a body moving in a simple harmonic motion is 0.6 m and its period of oscillation is 2.4 seconds. What would be its speed at 0.5 second after it has passed the middle position? **(04)**

c) Find the reactions of a beam ABC carrying loading as shown in figure 2 (c). The size of beam is 300 mm x 400 mm and made up of reinforced concrete with density 25 kN/m^3 **(08)**

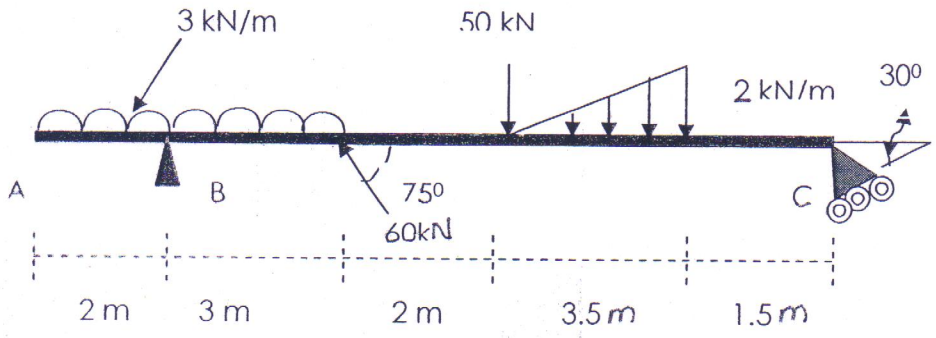

Figure 2(c)

Q.3 a) For the structure loaded and supported as shown in figure 3 (a), find the horizontal and vertical components of the pin force at B as they act upon member CD. **(08)**

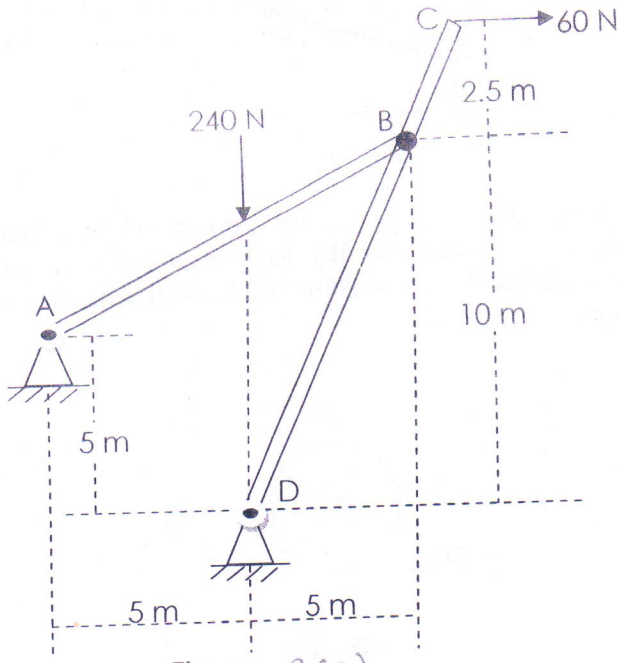

Figure 3(a)

b) The plane curvilinear motion of a particle is defined by $r = 2t+10$ and $\theta = 5t^2 - 6t$, where r is in meters, θ is in radians and t is in seconds. At the instant when $t = 2$ sec. determine the magnitudes of velocity, acceleration and the radius of curvature of the path. **(06)**

c) A 10 kg block rests on the horizontal surface as shown in figure 3(c). The spring, which is not attached to the block, has a stiffness $k = 500$ N/m and initially compressed 0.2 m from C to A. After the block is released from rest at A, determine its velocity when it passes point D. The coefficient of kinetic friction between the block and the plane is 0.2. **(06)**

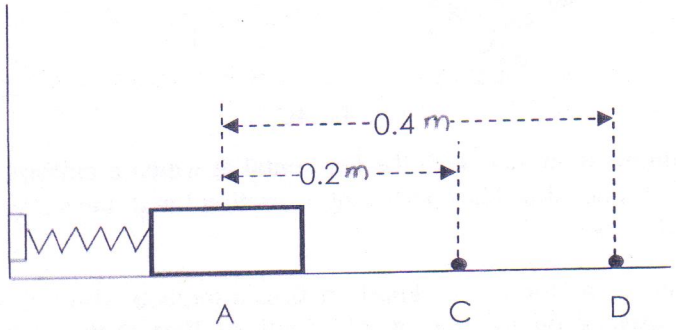

Figure 3(c)

Q.4a) The coefficient of friction between block B and block A are $\mu_s = 0.12$ and $\mu_k = 0.10$ and coefficient of friction between block A and incline are $\mu_s = 0.24$ and $\mu_k = 0.20$. The masses of block A and block B are 10 kg and 5 kg respectively. Knowing that the system is released from the rest in the position shown (Fig 4a) determine (i) Acceleration of block A; (ii) The velocity of B relative to A at $t = 0.5$ second. **(08)**

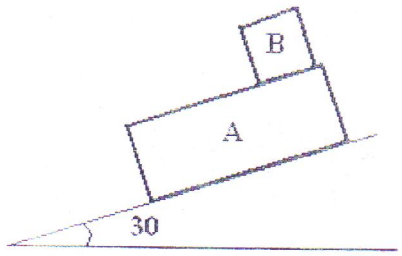

Fig 4a

(b) A 0.54 kg ball A is moving with a velocity V_A when it is struck by a 1kg ball B which has a velocity V_B of magnitude $V_B = 5.5$ m/s (Fig 4b). Knowing that the velocity of ball B is zero after impact and that the coefficient of restitution is 0.8, determine the velocity of ball A (i) before impact (ii) after impact. **(04)**

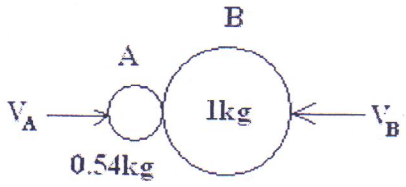

Fig 4b

c) A vertical force **P** is applied to the linkage at B (Fig. 4c). The constant of the spring is 2000 N/m, and the spring is unstretched when AB and BC are horizontal. Neglecting the weight of the linkage, determine **using principle of virtual work**, the magnitude of **P** so that $\theta = 25^\circ$, when the system in equilibrium. **(08)**

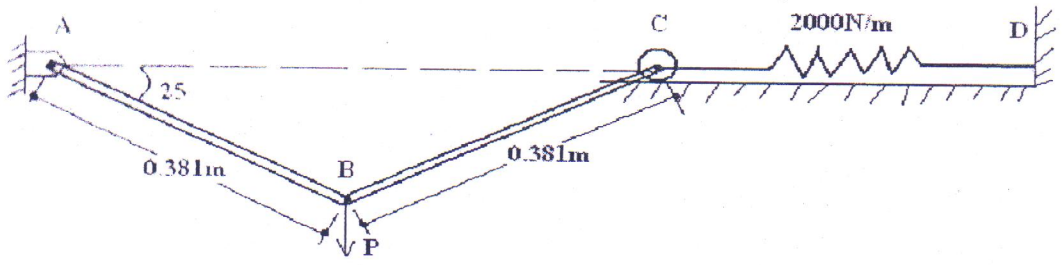

Fig 4c

Q.5 a) Determine the minimum angle ɵ with the horizontal at which a uniform plank may be placed against a will and still not slip. The coefficient of friction for all the surfaces in contact is ט and weight of the plank is W. **(06)**

b) A battle ship is heading North at 45 kmph. It fires a torpedo with a velocity of 200 m/s at a stationary object situated on the line of 30° South of East at the instant of firing. In what direction should the torpedo be shot so as to hit the target. **(06)**

c) A ball of mass 1 kg is dropped on the floor from a height of 5 m. After striking the floor it rebounds to a height of 3 m. Find the impulse of the force on the ball during its contact with the floor. Assuming the contact to last for 1/50 second, find the average force exerted by the floor on the wall. **(08)**