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

Programme: F. Y. B. Tech.
Duration: 180 minutes
Time: 10-00 am to 1-00 pm

Date: 04-05-2010
Max. Marks: 100

Instructions :

1) **Answer all 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 The period of vibration of the system shown is observed to be o.2 s. After the spring of constant k_2 = 3.5 kN/m is removed and block A is connected to the spring of constant k_1, the period is observed to be 0.12 s. Determine (10)

1. the constant k_1 of the remaining spring,
2. the weight of block A.

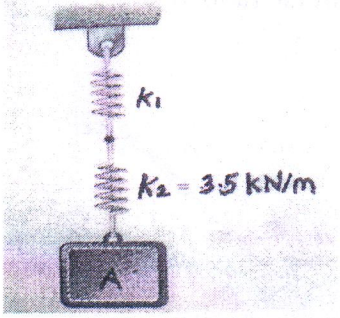

Fig. Q.1a

Q.1b Draw the mathematical model of a damped SDOF system subjected to a force P sin (Ωt) and obtain the equation of motion for the same. (4)

Q.1c Find the period of oscillation for a simple pendulum of length 2 m. Derive the formula you use. (6)

Q.2a Determine the reactions at supports A, B and C for the beam shown in figure using the principle of virtual work. At D there is an internal hinge. (8)

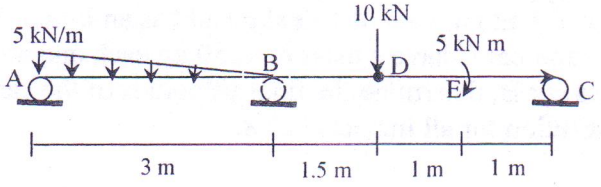

Fig. Q.2a

Q.2b If the maximum tension in the cable ABCD is 15 kN, determine (8)

1. the distance h_B
2. the distance h_C

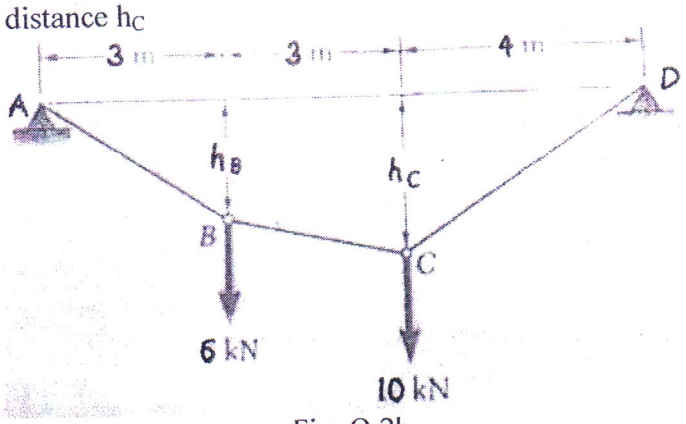

Fig. Q.2b

Q.3a A crate of weight W_1 is held in equilibrium on a ramp by a counterweight W_2, which is connected to the crate by a light rope that passes over a frictionless pulley as shown in figure. The coefficient of static friction between the crate and the ramp is $\mu_s = 0.30$. By the principle of virtual work, determine the range of the ratio W_2 / W_1 for which the crate is in equilibrium. (8)

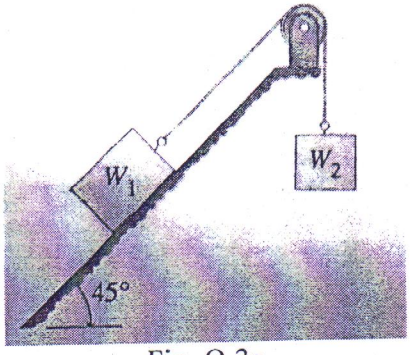

Fig. Q.3a

Q.3b State true or false giving reasons. (No marks if reason is not given.) (8)

1. It is possible to have relative velocity $V_{A/B} = V_{B/A}$.
2. For a body in rectilinear translation the velocities of different particles are different.
3. Friction force is a conservative force.
4. Natural period of vibration does not depend on mass of the body.

Q.4a In figure shown, car A has a mass of 1500 kg and has an initial velocity of 40 km /h. If car B and car C have a mass of 1250 kg each and are at rest when car A strikes car B, determine the final velocities of the cars if the coefficient of restitution for all impacts is 0.8. (8)

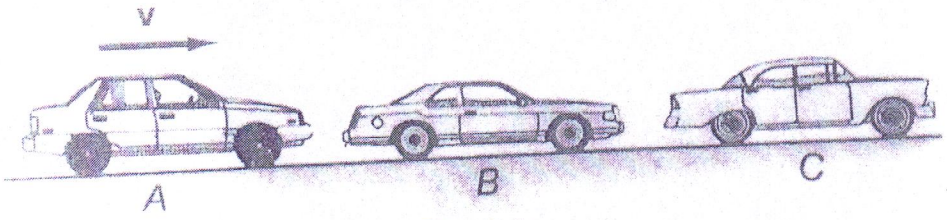

Fig. Q.4a

Q.4b Rod OA rotates about O in a horizontal plane. The motion of the 200 g collar B is defined by the relation $r = 250 + 150\sin \pi t$ and $\theta = \pi (4 t^2 - 8 t)$, where r is expressed in mm, t in seconds and θ in radians. Determine the radial and transverse components of the force exerted on the collar when $t = 0$ s. (8)

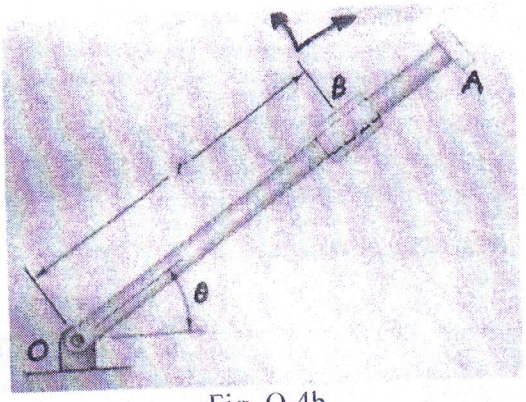

Fig. Q.4b

Q.5a A 6 kg block which can slide on a horizontal surface is acted upon by a force P which varies in magnitude as shown. If the coefficient of friction between the block and the surface are $\mu_s = 0.60$ and $\mu_k = 0.45$ and the block is initially at rest, determine the velocity of the block at $t = 5$ s and the maximum velocity of the block. (8)

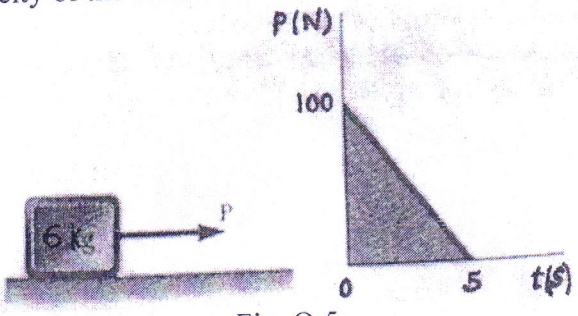

Fig. Q.5a

Q.5b A body A is released from a condition of rest on a frictionless circular surface. The body then moves on a horizontal surface CD whose dynamic coefficient of friction with the body $\mu_k = 0.20$. A spring having a spring constant K = 900 N/m is positioned at C as shown in the figure. How much will the spring be compressed? The body has a mass of 5 kg. (8)

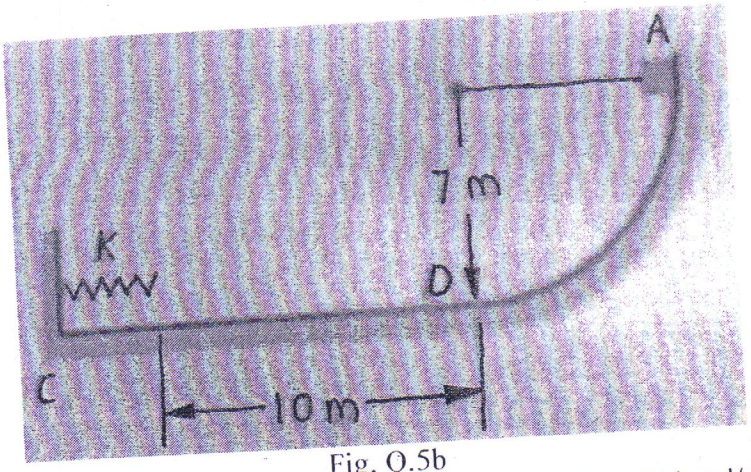

Fig. Q.5b

Q.6a Arm OB of the linkage has a clockwise angular velocity of 10 rad/s in the position shown where $\theta = 45^0$. Determine the velocity of A, the velocity of D and the angular velocity of link AB for the position shown. (8)

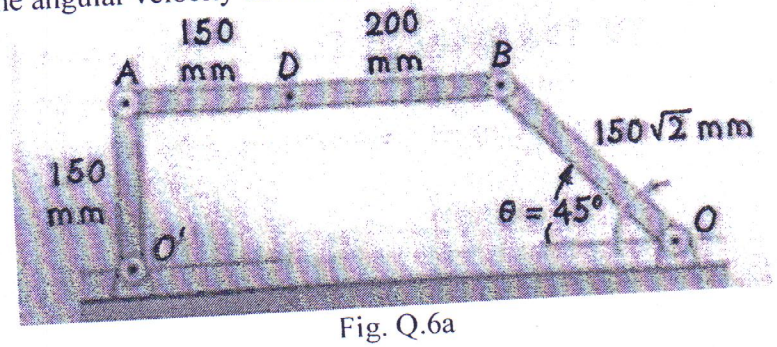

Fig. Q.6a

Q.6b In the accompanying figure, pulley A has a radius of 600 mm, and pulley B has a radius of 400 mm. An inextensible cable rotates both pulleys without slipping as the block C is moved. If the initial velocity of C is 1000 mm/s downward and the block is accelerated at a constant rate of 100 mm/s^2 in the direction shown, determine the initial acceleration of point D on pulley A and the acceleration of point D after 8 s. (8)

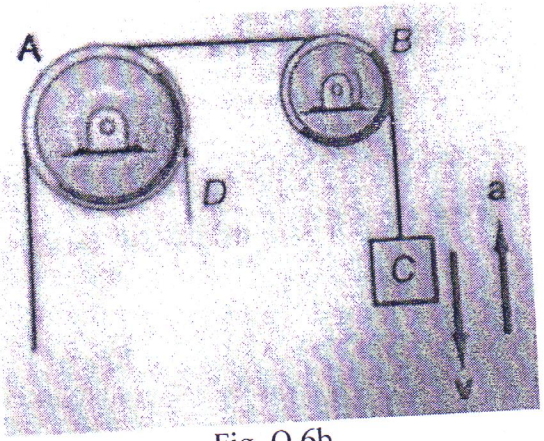

Fig. Q.6b