Exam.Code:0906
Sub. Code: 6253

2063
B.E. (Mechanical Engineering)
Second Semester
MEC-201: Rigid Body Dynamics

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt <u>five</u> questions in all, including Question No. I which is compulsory and selecting two questions from each Part.

x-x-x

Q1a)Differentiate between inertial and non-inertial frame of reference.

b)Differentiate between conservative and non - conservative forces. Also give examples of conservative and non-conservative forces.

c)What is the work done on a rigid body subjected to couple moment M during
i)Translation ii)Rotation

d)What is torque - free motion.

e)Differentiate between damped and undamped vibrations.

(10)

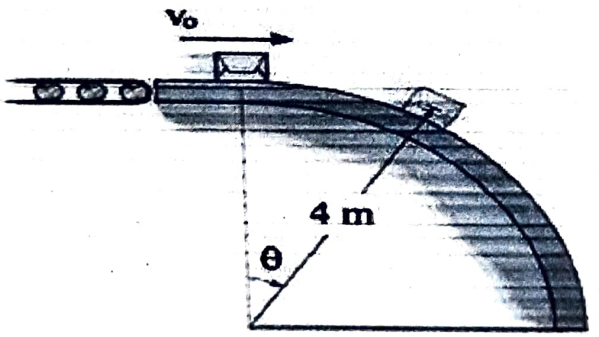
<u>Part-A</u>

Q2a)Derive the relation for acceleration of particle in polar co-ordinates. (5)

b)A particle is projected just to clear two walls. The first one is at height of 'a' and is at a distance of 'b' from the point of projection. The second one is at height of 'b' and is at a distance of 'a' from the point of projection. Prove that angle of projection and range is given by:
$\tan \alpha = (a^2 + ab + b^2)/ab$, $R = (a^2 + ab + b^2)/(a + b)$ (5)

Q3a)Prove that escape velocity (Ve) of a satellite is equal to $(2GM_e/r_o)^{1/2}$ where G is gravitational constant, M_e is the mass of earth and r_o is the initial distance of satellite from center of the earth. (5)

b)Packages having mass of 12 kg are delivered from a conveyor to a smooth circular ramp with the velocity of V_o=2.8 m/s as shown in figure below .If the radius of the ramp is 4 m, determine the angle $\theta=\theta_{max}$ at which the package begins to leave the surface using principle of work and energy. (5)



P.T.O

(2x10)

x-x-x

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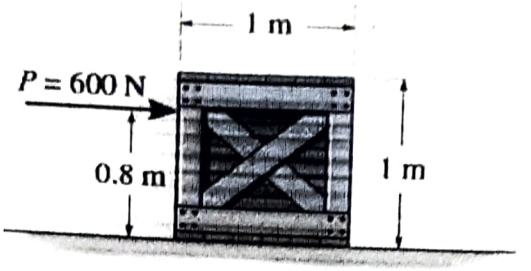
Q4a) A ball of mass m collides with another identical ball at rest and has elastic collision. Show that if the collision is not head on, the two balls move at 90° after the collision. **(5)**

b)Explain general plane motion with an example. **(3)**

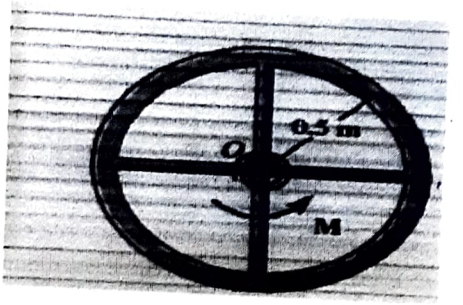
c)What is instantaneous centre. How it can be located **(2)**

Part-B

Q5a) A uniform 50 kg crate rests on a horizontal surface for which the coefficient of kinetic friction is $\mu_K = 0.2$. Determine the acceleration if a force P = 600 N is applied to the crate as shown in figure below. **(5)**



b)The wheel is made from a 5-kg thin ring and two 2-kg slender rods as shown in figure below. If the torsional spring attached to the wheel's center has a stiffness k =2 N. m /rad and the wheel is rotated until the torque M =25 N .m is developed, determine the maximum angular velocity of the wheel if it is released from rest. **(5)**



Q6a) Derive the relation for coefficient of restitution in an eccentric impact. **(5)**

b)What are forced vibrations. Write the differential equation of motion for viscous damped forced vibrations. **(3)**

c)Explain the significance of critical damping. **(2)**

Q7a) Show that finite rotations cannot be classified as vectors. **(3)**

b)Write Euler's equations of motion for three dimensional kinetics of rigid body **(3)**

c)Explain briefly : A)Product of inertia B)Gyroscopic motion (2+2)