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SARDAR PATEL UNIVERSITY

B.Sc.(SEMESTER-VI) EXAMINATION-2019

April 4, 2019, Thursday

10:00 a.m. to 1:00 p.m.

US06CMTH06 (Mechanics - 2)

Maximum Marks: 70

Q.1 Choose the correct option in the following questions, mention the correct option in the answerbook. [10]

(1) If V is the potential energy of particle then $\vec{F} =$ ....
(a) ∇V (b) $\nabla \cdot V$ (c) -∇V (d) $\nabla \times V$

(2) Unit of angular momentum is ....
(a) $gm \cdot cm/sec$ (b) $gm \cdot cm^2/sec^2$ (c) $gm \cdot cm^2/sec^{-2}$ (d) $gm^2 \cdot cm/sec^2$

(3) The rate of change of kinetic energy of a system = the rate of change of work done by ....
(a) external forces (b) internal forces (c) potential energy (d) both (a) & (b)

(4) The velocity of particle at any point of its trajectory is ....
(a) $\sqrt{u^2 - 2gh}$ (b) $\sqrt{u^2 + 2gh}$ (c) $\sqrt{2as - u^2}$ (d) None of these

(5) Maximum horizontal range of projectile is ....
(a) $\frac{v_0}{g}$ (b) $\frac{v_0^2}{g}$ (c) $\frac{v_0^2 \sin 2\alpha}{g}$ (d) $\frac{v_0^2 \sin \alpha}{2g}$

(6) The areal velocity is ....under the central force.
(a) 0 (b) constant (c) not constant (d) not possible

(7) Moment of inertia of hoop depends on .... of hoop.
(a) mass (b) length (c) radius (d) mass and radius

(8) For collision, $v_s =$ ....
(a) ev_a (b) v_a (c) $\frac{v_a}{e}$ (d) $\frac{e}{v_a}$

(9) Body is said to be perfectly inelastic if $e =$ ....
(a) -1 (b) 0 (c) 1 (d) 2

(10) The coefficient of restitution e is always ....
(a) 1 (b) ≥ 1 (c) < 2 (d) ≤ 1

Q.2 Answer the following in short. (Attempt any 10) [20]

(1) Define central force.

(2) State principle of conservation of energy for system of particle.

(3) Verify the principle of conservation of energy, if a particle of mass m falling vertically downward under the force of gravity.

(4) Find the angle α for which a particle covered the maximum horizontal range.

(5) If R is the horizontal range and H is the greatest height attained by the projectile for the given angle of projection then show that $2H + \frac{R^2}{8H}$ represents the maximum horizontal range.

(6) Find the time T of flight for projectile.

(7) Write Newton's law of gravitation.

(8) State the theorem of $KÖNIG$.

(9) Find the law of force towards the pole for the curve described by $au = e^{n\theta}$.

(10) Define impulsive force.

(11) Discuss the problem of collision of two spheres which are moving along the line joining their centers.

(12) Define the coefficient of restitution.

(P.T.O.)

Q.3

(a) State and prove D'Alembert's principle. [03]

(b) Prove that the rate of change of kinetic energy of system is equal to the rate of change of working of all the forces, external and internal. [04]

(c) State and prove principle of angular momentum of a system. [03]

OR

Q.3

(d) Obtain equation of motion of a particle in (1) cartesian form, (2) tangent and normal form and (3) polar form. [06]

(e) State and prove principle of angular momentum about a point. [04]

Q.4

(a) For projectile motion, prove that $gT^2 = 2R\tan\alpha$. [03]

(b) A shell is fired vertically upward with the velocity v_0. If resistance of air is $mgcv^2$, then show that the maximum height attain by the shell is $h = \frac{1}{2gc}log(1 + cv_0^2)$. [03]

(c) Obtain the equation of motion of a projectile with resistance in cartesian form and tangential & normal component form. [04]

OR

Q.4

(d) A particle is projected with velocity v_0 making an angle α with the horizontal axis. Obtain the equation of the projectile in the usual form. Also prove that it represents a parabola. [05]

(e) A gun mounted on hill of height h above a level plane. Show that if the resistance of air is neglected then the greatest horizontal range for given muzzle velocity v_0 is obtained by firing at an angle of elevation α such that $cosec^2\alpha = 2\left(1 + \frac{gh}{v_0^2}\right)$. [05]

Q.5

(a) In usual notations prove that $\frac{d^2u}{d\theta^2} + u = \frac{P}{h^2u^2}$. [05]

(b) Obtain equation of orbit described under a central force varying directly as the distance, in the form $\frac{x^2}{a^2} + \frac{y^2k^2}{v_0^2} = 1$, where v_0 is the initial velocity of the particle in the direction of y-axis and $(a, 0)$ is the initial position of particle. [05]

OR

Q.5

(c) State and prove the theorem of parallel axes. [05]

(d) Using theorem of perpendicular axes find moment of inertia of a circular disk of mass m and radius r about a diameter. [03]

(e) Find moment of inertia of a solid circular cylinder about its axis. [02]

Q.6

(a) Two sphere of masses m_1 and m_2 moving in a straight line collide to each other, the coefficient of restitution is e then find their velocities after collision. Also discuss the cases $e = 0, 1$ for $m_1 = m_2 = m$. [05]

(b) Define collision. If a sphere collides directly to an equal sphere which is at rest, then show that the fraction $\frac{1}{2}(1 - e^2)$ of the original kinetic energy is lost during the impact. [05]

OR

Q.6

(c) Define compound pendulum. Also find the equation of motion of compound pendulum. [05]

(d) A particle falls from height h on a horizontal plane and rebounds continuously. Show that the whole distance travelled by particle is $\frac{h(1+e^2)}{1-e^2}$ and whole time before it comes to rest is $\sqrt{\frac{2h}{g}}\left(\frac{1+e}{1-e}\right)$. [05]

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