SEAT No._____ No. of Printed Pages : 2

[992]

SARDAR PATEL UNIVERSITY
B.Sc.(SEMESTER-V) EXAMINATION-2020
December 31, 2020, Thursday
2:00 p.m. to 4:00 p.m.
US05CMTH06 (Mechanics I)

Maximum Marks: 70

Q.1 Write the correct option of the following multiple choice questions. [10]

(1) Dimension of force is .....
(a) $ML^2T^{-2}$ (b) $MLT^{-2}$ (c) $MLT^{-1}$ (d) $ML^2T$

(2) 1 ft = .....cms
(a) 30 (b) 30.38 (c) 30.48 (d) 12

(3) The point of concurrence of the altitudes of a triangle is called the ..... of a triangle.
(a) Centroid (b) Circum center (c) Orthocenter (d) In center

(4) If we push a body by a rod then the force exerted is called .....
(a) tension (b) moment (c) weight (d) thrust

(5) A unit of power is .....
(a) horsepower (b) dyne (c) erg (d) pound

(6) $V(A) =$ .....
(a) $-W(A, A_0)$ (b) $W(A_0, A)$ (c) $W(A, A_0)$ (d) $(A, A_0)$

(7) There is only ..... mass center of the system .
(a) four (b) three (c) two (d) one

(8) Tension of suspension bridge is given by $T =$ .....
(a) $H^2 + w_0^2x^2$ (b) $\sqrt{H^2 - w_0^2x^2}$ (c) $\sqrt{H^2 + w_0^2x^2}$ (d) $\sqrt{H + w_0^2x^2}$

(9) If a particle moves in a plane with constant speed then $\angle(\bar{a}, \bar{v}) =$ .....
(a) $\pi$ (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{4}$ (d) 0

(10) Radial component of acceleration of a particle moving in a plane is .....
(a) $\ddot{r} + r\,\dot{\theta}^2$ (b) $\ddot{r} - r\,\dot{\theta}$ (c) $\dot{r} - r\,\dot{\theta}^2$ (d) $\ddot{r} - r\,\dot{\theta}^2$

Q.2 Do as directed. [08]

(1) Any vector has a unique directed segment is called ..... vector.
(2) **True or False?**
The region in which different events occurs is called Event.
(3) **True or False?**
If $F$ is the force acting on a particle, the necessary and sufficient condition for equilibrium is $F = 0$.
(4) A branch of mechanics which deals with the equilibrium of systems at rest is known as .....
(5) The vector sum of forces in a couple is .....
(6) **True or False?**
$\bar{F} = -\nabla V$.
(7) **True or False?**
Normal component of acceleration is $\frac{v^2}{\rho}$
(8) Intrinsic equation of catenary is $s =$ .....

Q.3 Answer the following in short. (Attempt any 10) [20]

(1) Define: Rigid body and Force.
(2) Explain addition of a vectors by triangle.
(3) Define: Mass and Weight.
(4) Define: moment of vector about a point.
(5) State theorem of Varignon.
(6) Define: Couple and Arm of couple.
(7) When a particle is said to be in equilibrium?
(8) State Newton's law of gravitational.
(9) Define: Linear moment and Mass center.
(10) Define: Suspension bridge.
(11) In usual notation prove that $s^2 = y^2 + 2cy$
(12) Define hodograph.

Q.4 Answer the following questions. (Attempt any 4) [32]

(1) In usual notation prove that $\nabla V = \frac{\partial V}{\partial x}\,\bar{i} + \frac{\partial V}{\partial y}\,\bar{j} + \frac{\partial V}{\partial z}\,\bar{k}$ .
(2) If two forces of magnitude $P$ and $Q$ act at an inclination $\theta$ to each other then prove that magnitude of resultant $R$ is given by $R^2 = P^2 + Q^2 + 2PQ\cos\theta$. Also find its direction.
(3) State and prove Lamy's theorem.
(4) A door of weight $w$, height $2a$, width $2b$ is hanged at top and bottom. If the reaction at upper hinge has no vertical component, find the components of reaction at both hinge, assume that the weight of the door acts at it's center. Determine this reaction for a door of weight 34.5 $lbwt$ and measuring $6ft\ 10in$ by $3ft\ 2in$.
(5) State and prove sufficient conditions for the equilibrium of a rigid body movable parallel to a fixed plane.
(6) Find the center of gravity of the area bounded by the curve $x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$ in the first quadrant.
(7) Derive differential equation of suspension bridge. Also show that it represent the equation of parabola and find its tension.
(8) Obtain the general equation of common catenary in the form $y = c(\cosh\frac{x}{c} - 1)$. Hence prove that $y = c(\cosh\frac{x}{c})$.