[26] SEAT No.________ No. of Printed Pages : 04

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SARDAR PATEL UNIVERSITY

BSc Sem V Examination

Mathematics

US05CMTH06-Mechanics-I

Date : 12-04-2019 **Time : 10-00 AM TO 1-00 PM**

12-04-2019, Friday

Q. 1 Answer the following by selecting correct choice from the options. **(10)**

1. The region in which different events occur is called________.
   - A. Space
   - B. Event
   - C. Particle
   - D. Time

2. If O is the orthocentre of a ΔABC then $m\angle BOC =$_______
   - A. $180 - \angle A$
   - B. $2m\angle A$
   - C. $90 + \frac{A}{2}$
   - D. None

3. $\frac{ds}{dt} =$ ________
   - A. a
   - B. v
   - C. p
   - D. None

4. The point of concurrence of the medians of a triangle is called_______
   - A. Orthocentre
   - B. Circumcentre
   - C. Incentre
   - D. Centroid

5. The mass centre of the area in the first quadrant of the curve $x^2 + y^2 = a^2$.
   - A. $\left(\frac{4a}{3\pi}, \frac{4a}{3\pi}\right)$
   - B. $\left(\frac{3a}{4\pi}, \frac{3a}{4\pi}\right)$
   - C. $\left(\frac{4a}{\pi}, \frac{4a}{\pi}\right)$
   - D. $\left(\frac{4a}{3\pi}, \frac{a}{3\pi}\right)$

6. The radial component of acceleration vector is ______
   - A. $\dot{r} - r\dot{\theta}^2$
   - B. $\dot{r}$
   - C. $\ddot{r} - r\dot{\theta}^2$
   - D. $\frac{1}{r}\frac{d}{dt}(r^2\theta)$

(P.T.O.)

7. If F is a force acting on a particle then the necessary and sufficient condition for equilibrium is ________

A. $F = 0$
B. $F < 0$
C. $F > 0$
D. $F \neq 0$

8. Intrinsic equation for a common catenary is ________

A. $S = tan\theta$
B. $S = c\ tan\theta$
C. $S^2 = c\ tan\theta$
D. $S = c\ ^2tan\theta$

9. If $\angle(\bar{P}, \bar{Q}) = \frac{\pi}{2}$, and R is the resultant of $\bar{R}$ then $R^2 =$ ________.

A. $P^2 + Q^2$
B. $(P + Q)^2$
C. $P^2 - Q^2$
D. $(P - Q)^2$

10. The vector sum of forces in a couple is ______

A. 0
B. 1
C. 2
D. Equal

Q. 2 Answer any TEN. **(20)**

1) Explain gradient vector.

2) If $V = x^2 + y^2 + z^2 + yz + y$. At what point in the space vector $gradV$ is parallel to X-axis?

3) If the plane is $V = x^2 + y^2$, then find components of $gradV$ at point $(1, 0)$ in the direction making an angle 45° with X-axis.

4) Three forces acting at a point are in equilibrium. If the angle between first and second is 90°,second and third is 120°, then find out the proportion of forces.

5) Define internal and external forces.

6) Explain moment of a vector about a line.

7) Define conservative system.

8) Define centre of gravity.

9) State Newton's law of gravitation.

10) Define the terms: (i) common catenary (ii)span

11) A particle moves in a plane with constant speed. Prove that it's acceleration is perpendicular to the velocity.

12) In usual notations prove tha t $s^2 = y^2 + 2cy$.

Q. 3 (a) State and prove Law of Parallelogram of two forces. (5)

(b) What curves are described by a particle moving in accordance with the equation $\bar{r} = b\ cospt\ \hat{\imath} + c\ sinpt\ \hat{\jmath}$? where p, c and b are constants and $\hat{\imath}, \hat{\jmath}$ are fixed unit vectors perpendicular to one another. Also prove that the direction of acceleration is towards origin. (5)

OR

Q.3 (a) A particle is moving in a straight line as subject to resistance which produces the retardation kv^3, where v is velocity and k is contant. Showthat v and t are given by the equations. $(i)\ \ v = \frac{u}{1+kux}$ $\quad (ii)\ \ t = \frac{kx^2}{2} + \frac{x}{u}$. (5)

(b) Forces of magnitudes 3, 4 and 5 $lbwt.$ act at a point in the direction parallel to the sides of equilateral triangle taken in order. Find their resultant force. (5)

Q.4 (a) State and prove theorem of polygon of forces. (5)

(b) Three forces $\bar{P}, \bar{Q}$ and $\bar{R}$ acting at a point are in equilibrium and angle between $\bar{P}$ and $\bar{Q}$ is double of the angle between $\bar{P}$, and $\bar{R}$. Prove that $R^2 = Q(Q - P)$. (5)

OR

Q. 4(a) State and prove theorem of Varignon. (5)

(b) If O is the orthocenter of ΔABC. Forces $\bar{P}, \bar{Q}$ and $\bar{R}$ are acting along $\overline{OA}, \overline{OB}$ and $\overline{OC}$ are in equilibrium. If $BC = a, CA = b, AB = c$ then show that $P : Q : R = a : b : c$ (5)

Q. 5 (a) Explain the principal of virtual work. (5)

(b) In usual notations prove that $\delta W = X\ \delta x + Y\ \delta y + Z\ \delta z$. (5)

OR

Q. 5 (a) State and prove Pappu's theorem for a plane curve. (5)

(b) Prove that the mass center of the system exists and it is unique. (5)

(P.T.O)

Q.6 (a) Derive general formula for the flexible cable hanging freely. **(6)**

(b) In usual notations, prove that $s = c \sinh\left(\frac{x}{c}\right)$. **(4)**

OR

Q.6 (a) Define hodograph and derive the hodograph for a particle moving in a circle with constant speed. **(5)**

(b) Obtain tangential and normal component of velocity and acceleration of a particle moving in a plane. **(5)**

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