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SARDAR PATEL UNIVERSITY

B.Sc. Sem-5 Examinaton 2018

Subject: Mechanics-I

Time: 10:00AM-1:00PM

Subject Code: US05CMTH06

Date: 03/11/2018 (Saturday)

Total Marks: 70

Q.1 CHOOSE THE ANSWER APPROPRIATE FROM THE FOLLOWING: (10)

1. Magnitude of gradient vector is ________.
   (A) $\frac{dv}{dn}$ (B) $\frac{dF}{dn}$ (C) $\frac{da}{dn}$ (D) None
2. Any vector has a unique directed segment is called ________.
   (A) Bound vector (B) Sliding vector (C) Unit vector (D) None
3. 1 mile= ________.
   (A) 1.6 meter (B) 16 meter (C) 1.6 decimeter (D) None
4. If F is the force acting on a particle, the necessary and sufficient condition for equilibrium is ________.
   (A) F>0 (B) F<0 (C) F=0 (D) None
5. Let F(X, Y, Z) be force acting at P(x, y, z) then its moment along line perpendicular to XY-plane at point O is given by ________.
   (A) Xy+Yx (B) yX-xY (C) xY-yX (D) None
6. $V(A) =$ ________.
   (A) $W(A_0,A)$ (B) $W(A_0,A_0)$ (C) $W(A)+W(A_0)$ (D) None
7. The rate of working is called ________.
   (A) power (B) couple (C) arm of couple (D) None
8. 1 horse power = ________.
   (A) $5.50\ ftlb\sec^{-1}$ (B) $550\ ftlb\sec^{-1}$ (C) $55.5\ ftlb\sec^{-1}$ (D) None
9. The differential equation of suspension bridge represent the ________.
   (A) Hyperbola (B) Ellipse (C) Parabola (D) None
10. In common catenary the weight per unit length of the chain is ________.
    (A) equal (B) unequal (C) symmetrical (D) None

Q.2 ATTEMPT ANY TEN: (20)

1. Define: (1) Free vector, (2) Rigid body.
2. State Newtonian laws of motion.
3. If $V = 2x^2y$, then find component of $grad\,V$ at point $(2,0)$ in the direction making angle 45° with Y-axis.
4. If O is orthocenter of ΔABC, forces $\overline{P}, \overline{Q}, \overline{R}$ acting along $\overline{OA}, \overline{OB}, \overline{OC}$ respectively are in equilibrium, then show that $P:Q:R = a:b:c$.
5. Define: (1) Internal forces, (2) External forces.
6. State the theorem of triangle of forces.
7. Define: (1) Arm of couple, (2) Moment of couple.
8. In usual notations show that $\delta W = X\delta x + Y\delta y + Z\delta z$.
9. Define: (1) Linear moment, (2) Mass center.
10. In usual notations prove that $s^2 = y^2 + 2cy$.
11. In usual notations prove that $c^2 + s^2 = y^2$.
12. Define: (1) Catenary, (2) Common catenary.

(P.T.O)

Q.3

(A) State and prove equations of motion of a particle moving in a straight line. (05)

(B) The resultant force of $\overline{P}$ and $\overline{Q}$ is $\overline{R}$; if $\overline{R}$ is doubled then $\overline{Q}$ is doubled and if $\overline{Q}$ is reversed then $\overline{R}$ is again double. Show that $P:Q:R=\sqrt{2}:\sqrt{3}:\sqrt{2}$ (05)

OR

(C) Show that $v=\dfrac{u}{1+Kux}$, using Kv^3 as the retardation, where K is a constant, u is initial velocity and v is velocity. (05)

(D) Show that $KS=\dfrac{1}{m-1}\{\dfrac{1}{v^{m-1}}-\dfrac{1}{u^{m-1}}\}$, using Kv^{m+1} as the retardation, where K is a constant, u is initial velocity and v is velocity. (05)

Q.4

(A) State and prove Lamy's theorem. (05)

(B) A body of mass 140 lbwt is suspended by two strings of length 5 ft. and 12 ft. and there ends by a rod of length 13ft. Find tension in the strings. (05)

OR

(C) State and prove theorem of Varignon. (05)

(D) Forces P, Q, & R acting at a point are in equilibrium and the angle between P & Q is double of that of P & R then $R^2=Q(Q-P)$. (05)

Q.5

(A) Prove that Mass center of the system exist and it's unique. (05)

(B) State and prove principal of virtual work. (05)

OR

(C) In usual notations prove that $\delta W=X\delta a+Y\delta b+N\delta\theta$. (05)

(D) Find the mass center of the area in the first quadrant bounded by $\dfrac{x^2}{a^2}+\dfrac{y^2}{b^2}=1$. (05)

Q.6

(A) Obtain general equation of common catenary in the form of $y=c\left[\cosh(\frac{x}{c})-1\right]$ and show that $y=c(\cosh\frac{x}{c})$ (05)

(B) Derive the differential equation of suspension bridge. Also, show that it represent the equation of parabola. (05)

OR

(C) For a cable in contact with smooth curve, in usual notations show that $N=\dfrac{T}{\rho}$, where N is normal reaction, T is tension and ρ is the radius of curvature for cable in contact with smooth curve. (05)

(D) A uniform chain A, B of length l hangs in the same horizontal line so that the tension is n-times that at the lowest point. Show that the $span\ AB$ must be $\dfrac{l}{\sqrt{n^2-1}}\log[n+\sqrt{n^2-1}]$. (05)

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