SARDAR PATEL UNIVERSITY
BSc (V Sem.) Examination
Monday, 25 November 2013
10.30 am – 1.30 pm
US05CMTH06 – Mathematics
Mechanics I

Total Marks: 70

Note: Figures to the right indicates full marks.

Q.1   Answer the following by selecting the correct choice from the given options.   [10]

(1)   _____ is s scalar quantity.
   (a) velocity   (b) acceleration
   (c) speed   (d) force

(2)   Mass of a particle is denoted by _____.
   (a) M   (b) m   (c) p   (d) w

(3)   Dimension of velocity is _____.
   (a) $M^1 L^1 T^1$ (b) $M^0 L^1 T^1$
   (c) $M^1 L^1 T^{-1}$ (d) $M^0 L^1 T^{-1}$

(4)   If a system of particles is in equilibrium, then _____ = 0.
   (a) $\sum X_i$ (b) $\sum y_i$ (c) $\sum x_i$ (d) $\sum (x_i + y_i)$

(5) $\vec{P} \times \vec{Q}$ = _____.
   (a) $\vec{Q} \times \vec{P}$ (b) $-\vec{Q} \times \vec{P}$ (c) $\vec{P} + \vec{Q}$ (d) $\vec{Q} + \vec{P}$

(6)   Potential Energy is denoted by _____.
   (a) P. E.   (b) T   (c) V   (d) E

(7)   Virtual work is _____.
   (a) real   (b) constant   (c) zero   (d) imaginary

(8)   The radial component of velocity is _____.
   (a) $\dot{r}$ (b) $r\dot{\theta}$ (c) $\dot{r}\theta$ (d) r

(9)   Intrinsic equation of a common catenary is _____.
   (a) $S^2 = c \tan \theta$ (b) $S = c^2 \tan \theta$
   (c) $S = c \tan \theta$ (d) $S = \tan \theta$

(10) $\sqrt{\dot{x}^2 + \dot{y}^2}$ = _____.
   (a) v (b) a   (c) $\sqrt{v}$ (d) $\sqrt{a}$

Q.2   Answer the following in short. (Attempt Any Ten)   [20]
   (1)   Explain addition of vectors by triangle.
   (2)   Define: Vector with appropriate illustrations.
   (3)   Define: Equal Vectors
   (4)   When a particle is said to be in equilibrium?
   (5)   Define: Moment of a Vector about a line.
   (6)   Define: Equipollent system of forces.
   (7)   Describe the forces which do not work.
   (8)   Define: Conservative System.
   (9)   State the principle of virtual work.
   (10) Explain the term: Hodograph.
   (11) For a catenary prove that $S^2 = y^2 + 2yc$.
   (12) Define: Instantaneous Centre

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Q.3

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

(b) If $V = x^2 + y^2 + z^2 + xy + x$, at what point in the space grad. V is parallel to z-axis. [05]

OR

Q.3

(a) Show that the component of grad. V in any direction is the rate of change of V in that direction. [05]

(b) Two forces acting in opposite directions on a particle have a resultant of 34 lbwt. If they act at right angles to each other their resultant would have a magnitude of 50 lbwt. Find the magnitude of these forces. [05]

Q.4

(a) State and prove Lamy's theorem. [05]

(b) In usual notations prove that $M = xy - yx$. [05]

OR

Q.4

(a) State and prove theorem of triangle of forces. [05]

(b) Find the condition for the equilibrium of a body. [05]

Q.5 Show that there exists mass centre of a system of particles and it is unique. [10]

OR

Q.5 Show that the potential inside a thin spherical cell is constant. [10]

Q.6

(a) Derive the general formula for the cable hanging freely. [05]

(b) Find the tangential and normal components of velocity and acceleration of a moving particle along the curve. [05]

OR

Q.6

(a) Show that the equation of Suspension bridge represents a parabola. [05]

(b) A uniform cable hanging across two smooth pegs at the same height. The ends hanging down vertically. If the free ends are each 12 feet long and tangent to the catenary at each peg makes an angle of 60° with the horizontal. Find the total length of the cable. [05]

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