Motion in Two Dimension

1. A particle is moving in a plane with velocity given by $\vec{u} = u_0\hat{i} + (a\omega\cos\omega t)\hat{j}$ where $\hat{i}, \hat{j}$ are unit vectors along *x* and *y* axes respectively. The trajectory of the particle if the particle starts from origin at *t* = 0 will be

(a) $y = a\sin\left(\frac{\omega x}{u_0}\right)$ (b) $y = a\cos\left(\frac{\omega x}{u_0}\right)$ (c) $y = \tan x$ (d) $y = \cos tx$

2. Two paper screens (*A*) and (*B*) are separated by a distance of 100 *m*. A bullet pierces (*A*) and (*B*) the hole in (*B*) is 10 *cm* below the hole is (*A*). If the bullet is travelling horizontally at the time of hitting (*A*). Then velocity of the bullet at (*A*) is

(a) 100 *m*/*sec* (b) 200 *m*/*sec* (c) 600 *m*/*sec* (d) 700 *m*/*sec*

3. A particle is thrown upward with a speed *u* at an angle θ with the horizontal. When the particle makes an angle ϕ with the horizontal, its speed changes to *v*, then

(a) $v = u\cos\theta\cos\phi$ (b) $v = u\cos\theta\sec\phi$ (c) $v = u\cos\theta$ (d) $v = u\sec\theta\cos\phi$

4. A particle is projected with a speed $2\sqrt{gh}$ so that it clears two walls of equal height *h* which are at a distance 2*h* from each other. The time taken by the particle to pass between the two walls is

(a) $\sqrt{\frac{2h}{g}}$ (b) $\frac{2h}{g}$ (c) $\sqrt{2}\frac{h}{g}$ (d) $2\sqrt{\frac{h}{g}}$

5. A projectile is thrown in the upward direction making an angle of 60° with the horizontal direction with a velocity of 147 ms^{-1}. Then the time after which its inclination with the horizontal is 45° is

(a) 15 *s* (b) 10.98 *s* (c) 5.49 *s* (d) 2.745 *s*

6. A projectile has a maximum range of 16 *km*. At the highest point of its motion, it explodes into two equal masses. One mass drops vertically downwards the horizontal distance covered by the other mass from the time of explosion is

(a) 8 *km* (b) 16 *km* (c) 24 *km* (d) 32 *km*

7. Two projectiles *A* and *B* thrown with velocities *v* and $\frac{v}{2}$ have the same range. If *B* is thrown at an angle of 15° to the horizontal, *A* must have been thrown at an angle

(a) $\sin^{-1}\left(\frac{1}{16}\right)$ (b) $\sin^{-1}\left(\frac{1}{4}\right)$ (c) $2\sin^{-1}\left(\frac{1}{4}\right)$ (d) $\frac{1}{2}\sin^{-1}\left(\frac{1}{8}\right)$

8. A ball is projected from the ground at a speed of 10 m/s making angle 30° with the horizontal. Another ball is simultaneously released from a point on the vertical line along the maximum height of the projectile. Both the balls collide at the maximum height of the projectile. What was the initial height of the second ball

(a) 1.0 *m* (b) 1.25 *m* (c) 2.0 *m* (d) 2.5 *m*

9. A ball is thrown up with a given angle to the horizontal. Then the total change of momentum by the instant it returns to the ground is equal to

(a) Acceleration due to gravity × total time of flight (b) Weight of the ball × half the time of flight

(c) Weight of the ball × total time of flight (d) None of these

10. An aeroplane is moving in a horizontal circle with a uniform speed of 141 *km*/*hr*. Change in its velocity in one fourth revolution, from its initial direction will be

(a) 100 *km*/*hr* at an angle of 90° (b) 141 *km*/*hr* at an angle of 135°

(c) 200 *km*/*hr* at an angle of 135° (d) Zero

11. A particle of mass m_1 is fastened to one end of a string and one of m_2 to the middle point, the other end of the string being fastened to a fixed point on a smooth horizontal table. The particles are then projected, so that the two portions of the string are always in the same straight line and describes horizontal circles. Find the ratio of tensions in the two parts of the string

(a) $\frac{m_1}{m_1 + m_2}$ (b) $\frac{m_1 + m_2}{m_1}$ (c) $\frac{2m_1 + m_2}{2m_1}$ (d) $\frac{2m_1}{m_1 + m_2}$

12. A toy cart is tied to the end of an unstretched string of length *a*. When revolved, thy toy cart moves in a horizontal circle of radius $2a$ with a time period *T*. Now the toy cart is speeded up until it moves in a horizontal circle of radius $3a$ with a period T'. If Hooke's law holds, then

(a) $T' = T$ (b) $T' = (3/2)T$ (c) $T' = (\sqrt{3}/2)T$ (d) $T' = \sqrt{(3/2)}\,T$

13. In the above question, what is the reaction at the wheels

(a) 13450 *N* (b) 26900 *N* (c) 6725 *N* (d) 40350 *N*

14. Two masses *M* and *m* are attached to a vertical axis by weightless threads of combined length *L*. They are set in rotational motion in a horizontal plane about this axis with constant angular velocity ω. If the tensions in the threads are the same during motion, the distance of *M* from the axis is

(a) $\frac{Ml}{M+m}$ (b) $\frac{ml}{M+m}$ (c) $\frac{M+m}{M}l$ (d) $\frac{M+m}{m}l$

15. The angular velocity of earth about its axis of rotation is

(a) $2\pi/(60\times60\times24)$ rad/sec (b) $2\pi/(60\times60)$ rad/sec

(c) $2\pi/60$ rad/sec (d) $2\pi/(365\times24\times60\times60)$ rad/sec