PROJECTILE MOTION

1. A particle is thrown with velocity u making an angle θ with the vertical. It just crosses the top of two poles each of height h after 1 s and 3 s respectively. The maximum height of projectile is:
   (a) 9.8 m **(b)** 19.6 m (c) 39.2 m (d) 4.9 m
2. From the top of a tower of height 40 m, a ball is projected upwards with a speed of 20 m/s at an angle of elevation of 30°. Then the ratio of the total time taken by the ball to hit the ground to its time of flight is: (Take g = 10 m/s^2):
   (a) 2: 1 (b) 3: 1 (c) 3: 2 (d) 4: 1
3. A person can throw a ball to a maximum horizontal distance of 100 m. With the same speed how much high above the ground can he throw the same ball?
   (a) 50 m (b) 100 m (c) 150 m (d) 200 m
4. A ball of mass m is projected horizontally with a velocity u from the top of a tower of height h and it reaches the ground at a distance R from the foot of the tower. If a second body of mass 2m is projected horizontally from the top of a tower of height 2h, it reaches the ground at a distance 2R from the foot of the tower. The horizontal velocity of the second body is:
   (a) u **(b)** $\sqrt{2}$u (c) 2u (d) u/2
5. The maximum range of a projectile fired with some initial velocity is found to be 400 metre, in the absence of wind and air resistance. The maximum height reached by this projectile is:
   (a) 200 metre (b) 50 metre **(c)** 100 metre (d) 400 metre
6. A projectile is given an initial velocity of $2\hat{\imath} + 4\hat{\jmath}$. The cartesian equation of its path is (g = 10 m/s^2):
   (a) y = 5x — x^2 **(b)** 4y = 8x — 5x^2 (c) y = x — 5x^2 (d) y = 2x — 5x^2
7. A ball is thrown from a point with a speed u at an angle of projection θ. From the same point and at the same instant a person starts running with a constant speed u/2 to catch the ball. If the person is able to catch the ball, what should be the angle of projection?
   (a) 60° (b) 30° (c) 45° (d) Data insufficient
8. A particle is projected at an angle of 60° above the horizontal with a speed of 10 m/s. After some time the direction of its velocity makes an angle of 30° above the horizontal. The speed of the particle at this instant is:
   (a) $5\sqrt{3}$ m/s (b) 5 m/s (c) $5/\sqrt{3}$ m/s **(d)** $10/\sqrt{3}$ m/s
9. A projectile is projected with initial velocity $(4\hat{\imath} + 6\hat{\jmath})$ m/s. If g = 10 m/s^2, then horizontal range is:
   (a) 4.8 m (b) 9.6 m (c) 19.2 m (d) 14.0 m
10. Two balls are projected making angles of 30° and 45° respectively with the horizontal. If both have same velocity at the highest point of their path, then the ratio of their horizontal ranges is:
    (a) 1 : $\sqrt{3}$ (b) $\sqrt{3}$: 2 (c) 1 : 3 (d) 1: 5
11. The equation of motion of a projectile are given by x = 6t metre and 2y = 16t - 9.8t^2 metre. The angle of projection is:
    (a) $sin^{-1}\left(\frac{3}{5}\right)$ (b) $sin^{-1}\left(\frac{3}{4}\right)$ **(c)** $sin^{-1}\left(\frac{4}{5}\right)$ (d) $cos^{-1}\left(\frac{3}{4}\right)$
12. A ball of mass m is thrown vertically upwards. Another ball of mass 2m is thrown at an angle θ with the vertical. Both of them stay in air for the same period of time. The heights attained by the two are in the ratio:
    (a) 1 : 2cos θ **(b)** 1 : 1 (b) 2 : cos θ (d) 1 : 2

13. Two stones are projected with the same speed but making different angles with the horizontal. Their horizontal ranges are equal. The angle of projection of one is π/3 and the maximum height reached by it is 102 m. Then the maximum height reached by the other is:
    (a) 34 m (b) 44 m (c) 54 (d) 64
14. A ball is thrown from a point at different angles with same speed u and has same range in both cases. If h_1 and h_2 are the heights attained in the two cases, then ($h_1 + h_2$) will be:
    (a) $\frac{u^2}{g}$ (b) $\frac{3u^2}{2g}$ (c) $\frac{2u^2}{g}$ **(d)** $\frac{u^2}{2g}$
15. A projectile is fired at an angle of 60° with the horizontal. Angle of elevation of the projectile at its highest point as seen from the point of projection, is:
    (a) $tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (b) $tan^{-1}\left(\frac{2}{\sqrt{3}}\right)$ (c) $tan^{-1}\left(\frac{1}{2}\right)$ (d) $tan^{-1}\left(\frac{3}{2}\right)$
16. A particle is projected from a horizontal plane with a velocity of 6 m/s at an angle θ. At highest point its velocity is found to be $3\sqrt{3}$ m/s. Its range will be (g= 10 m/s^2):
    (a) 4.8 m (b) $3.6\sqrt{3}$ m **(c)** $1.8\sqrt{3}$ m (d) 2.8 m
17. A particle is thrown with a speed u at an angle θ to the horizontal. When the particle makes an angle α with the horizontal, its speed changes to v. Then:
    (a) v = u cosθ (b) v = u cos θ cos α **(c)** v = u cosθ/cosα (d) v = u cosα/ cos θ
18. A body is projected such that its potential energy at the top is (3/4) th of its initial kinetic energy. What is the angle of projection with the horizontal?
    (a) 30° (b) 45° (c) 60° (d) 90°
19. When the angle of projection is 75°, a ball falls 20 m short of the target. When the angle of projection is 45°, it falls 20 m ahead of the target. Both are projected from the same point with the same speed in the same direction, the distance of the target from the point of projection is:
    (a) 20 m (b) 30 m **(c)** 60 m (d) 80 m
20. Two paper screens A and B are separated by a distance of 200 m. A bullet pierces A and then B. The hole in B is 40 cm below the hole in A. If the bullet is travelling horizontally at the time of hitting A, then the velocity of the bullet at A is:
    (a) 700 m/s (b) 500 m/s (c) 300 m/s (d) 200 m/s
21. If the angles of projection of a projectile with same initial velocity exceed or fall short of 45° by equal amount α, then the ratio of horizontal ranges is:
    (a) 1 : 1 (b) 1: 3 (c) 1 : 4 (d) 1 : 2