Horizontal projection

1. **A): If a bomb is dropped from an aero plane moving horizontally with constant velocity then the bomb appears to move along a vertical straight line for the pilot of the plane.**

   R): Horizontal component of velocity of the bomb remains const and same as the velocity of the plane during the motion under gravity.

   1) Both (A) and (R) are true and (R) is the correct explanation of (A).

   2) Both (A) and (R) are true and (R) is not the correct explanation of (A).

   3) (A) is true but (R) is false.

   4) (A) is false but (R) is true.

2. **A): Time taken by the bomb to reach the ground from a moving aero plane depends on height of aero plane only.**

   R): Horizontal component of velocity of bomb remains constant and vertical component of velocity of bomb changes due to gravity.

   1) Both (A) and (R) are true and (R) is the correct explanation of (A).

   2) Both (A) and (R) are true and (R) is not the correct explanation of (A).

   3) (A) is true but (R) is false.

   4) (A) is false but (R) is true.

3. **A): For a body projected horizontally from the top of a tower, the velocity on reaching the ground depends both on velocity of projection and height of the tower.**

   R): For a projectile velocity varies both in horizontal and vertical directions.

   1) Both (A) and (R) are true and (R) is the correct explanation of (A).

   (2) Both (A) and (R) are true and (R) is not the correct explanation of (A).

   (3) (A) is true but (R) is false.

   (4) (A) is false but (R) is true.

4. (A): For a horizontal projectile and freely falling body from same height time of flight is same but velocity on reaching the bottom are different.

(R): For both the horizontal projectile and freely falling body initial velocity in vertical direction are zero but they posses different initial horizontal velocities.

(1) Both (A) and (R) are true and (R) is the correct explanation of (A).

(2) Both (A) and (R) are true and (R) is not the correct explanation of (A).

(3) (A) is true but (R) is false.

(4) (A) is false but (R) is true.

5. A body is projected horizontally from a height of 78.4 m with a velocity 10 ms^{-1}. Its velocity after 3 seconds is _ [g = 10 ms^{-2}] (Take direction of projection on $\vec{i}$ and vertically upward direction on $\vec{j}$).

1) $10\hat{i}-30\hat{j}$ 2) $10\hat{i}+30\hat{j}$ 3) $20\hat{i}-30\hat{j}$ 4) $10\hat{i}+10\sqrt{3}\hat{j}$

6. In the above problem angle made by velocity vector with x axis after 4 seconds is $\tan^{-1}$

1) 3 2) 4 3) 5 4) 6

7. A stone is thrown horizontally with velocity g ms^{-1} from the top of a tower of height g meter. The velocity with which it hits the ground is (in ms^{-1})

1) g 2) 2g 3) $\sqrt{3g}$ 4) 4g

8. A body is thrown horizontally from the top of a tower. It reaches the ground after 4s at an angle 45° to the ground. The velocity of projection is

1) 9.8 ms^{-1} 2) 19.6 ms^{-1} 3) 29.4 ms^{-1} 4) 39.2 ms^{-1}

9. Two cliffs of heights 120m and 100.4m are separated by a horizontal distance of 16m. If a car has to reach from the first cliff to the second, the horizontal velocity of the car should be

1) 16 ms^{-1} 2) 4 ms^{-1} 3) 2 ms^{-1} 4) 8 ms^{-1}

10. An aero plane flying horizontally at an altitude of 490m with a speed of 180 kmph drops a bomb. The horizontal distance at which it hits the ground is

1) 500 m 2) 1000 m 3) 250 m 4) 50 m

11. A ball is projected horizontally from the top of a building 19.6 m high. If the line joining the point of projection to the point where it hits the ground makes an angle of 45° to the horizontal, the initial velocity of the ball is

1) 4.9 ms^{-1} 2) 9.8 ms^{-1} 3) 19.6 ms^{-1} 4) 14.7 ms^{-1}

12. At a certain height a body at rest explodes into two equal fragments with one fragment receiving a horizontal velocity of 10 ms^{-1}. The time interval after the explosion for which the velocity vectors of the two fragments become perpendicular to each other is ($g=10ms^{-2}$)

1) 1s 2) 2 s 3) 1.5 s 4) 1.75 s

13. At a certain height a shell at rest explodes into two equal fragments. One of the fragments receives a horizontal velocity u. The time interval after which, the velocity vectors will be inclined at 120° to each other is

1) $\frac{u}{\sqrt{3}g}$ 2) $\frac{\sqrt{3}u}{g}$ 3) $\frac{2u}{\sqrt{3}g}$ 4) $\frac{u}{2\sqrt{3}g}$

14. A bomb at rest at the summit of a cliff breaks into two equal fragments. One of the fragments attains a horizontal velocity of 20 $\sqrt{3}$ ms^{-1}. The horizontal distance between the two fragments, when their displacement vectors is inclined at 60° relative to each other is ($g = 10ms^{-2}$)

1) $40\sqrt{3}\,m$ 2) $80\sqrt{3}\,m$ 3) $120\sqrt{3}\,m$ 4) $480\sqrt{3}\,m$

15. An aero plane is flying horizontally with a speed of 600km/hr at a height of 1960m. When it is vertically above the point A on the ground, a body is dropped from it. The body strikes the ground at point B. Calculate the distance AB

1) 3.33km 2) 33.3 km 3) 3.33m 4) 6.66 km

16. A body is thrown horizontally from the top of a tower of height 5 *m*. It touches the ground at a distance of 10 *m* from the foot of the tower. The initial velocity of the body is (g = 10 ms^{-2})

(1) 2.5 ms^{-1} (2) 5 ms^{-1}

(3) 10 ms^{-1} (4) 20 ms^{-1}

17. An aeroplane moving horizontally with a speed of 720 *km/h* drops a food pocket, while flying at a height of 396.9 *m*. The time taken by a food pocket to reach the ground and its horizontal range is (Take g = 9.8 m/sec^2)

(1) 3 *sec* and 2000 *m* (2) 5 *sec* and 500 *m*

(3) 8 *sec* and 1500 *m* (4) 9 *sec* and 1800 *m*

18. A large number of bullets are fired in all directions with same speed v. What is the maximum area on the ground on which these bullets will spread?

(1) $\pi\frac{v^2}{g}$ (2) $\pi\frac{v^4}{g^2}$

(3) $\pi^2\frac{v^4}{g^2}$ (4) $\pi^2\frac{v^2}{g^2}$

19. A ball is projected horizontally with a speed 'v' from the top of a plane inclined at an angle with the horizontal. How far from the point of projection will be ball strike the plane?

1) $\frac{v^2}{g}$ 2) $\sqrt{2}\frac{v^2}{g}$ 3) $\frac{2v^2}{g}$ 4) $\sqrt{2}\left[\frac{2v^2}{g}\right]$

20. An inclined plane is making an angle with horizontal. A projectile is projected from the bottom of the plane with a speed u at an angle with horizontal then its range on the inclined plane is

1) $R = \frac{2u^2\sin(\alpha-\beta)\cos\alpha}{g\cos^2\beta}$ 2) $R = \frac{u^2\sin(\alpha-\beta)\cos\alpha}{g\cos^2\beta}$

3) $R = \frac{2u^2\sin(\alpha+\beta)\cos\alpha}{g\cos^2\beta}$ 4) $R = \frac{u^2\sin(\alpha+\beta)\cos\alpha}{g\cos^2\beta}$

Key

1) 1	**2) 2**	**3) 3**	**4) 1**	**5) 2**	**6) 2**	**7) 3**	**8) 3**	**9)4**
10) 1	**11) 2**	**12) 1**	**13) 1**	**14) 4**	**15) 1**	**16)3**	**17)4**	**18)2**
19) 4	**20) 1**							

Hints

5. $\vec{v} = \vec{u} + \vec{a}\,t \;= 10\vec{i} + 10\vec{j} \times 3 = 10\vec{i} + 30\vec{j}$

6. $Tan\theta = \dfrac{gt}{u}$

$\tan\theta = \dfrac{40}{10}$ $\qquad \theta = \tan^{-1} 4$

7. $v_y = \sqrt{2gh}$ $\qquad V_y = \sqrt{2g \times g} = g\sqrt{2}$

$v = \sqrt{g^2 + 2g^2}$ $\qquad = \sqrt{3}\,g$

8. $v_y = v_x$

$= 9.8 \times 4 = u$ $\qquad = 39.2$ m/s

9. $19.6 = \dfrac{1}{2} 9.8t^2$ $\qquad t = 2$

$x = u\,t$ $\qquad 16 = u \,.\, 2 \; u = 8$ m /s

10. $t = \sqrt{\dfrac{2 \times 490}{9.8}} = 10$ s

11. $\tan\theta = gt / 2u$

$gt = 2u$ $\qquad u = 9.8$ m/s

12. $t = \dfrac{\sqrt{u_1 u_2}}{g}$ $\qquad t = \dfrac{\sqrt{10 \times 10}}{10}$ t = 1 sec

13. $Tan\alpha_1 = \frac{V_y}{V_x} = \frac{gt}{u}$ $\quad Tan\alpha_2 = \frac{V_y}{V_x} = \frac{gt}{u}$

$Tan30^0 = \frac{gt}{u}$ $\quad \frac{1}{\sqrt{3}} = \frac{gt}{u}$

$t = \frac{u}{\sqrt{3}g}$

a) $t = \frac{\sqrt{u_1 u_2}}{g}\cot\left(\frac{\theta}{2}\right) = \frac{\sqrt{u^2}}{g}\cot\left(\frac{120}{2}\right)$

$= \frac{u}{g}\cot 60$

$t = \frac{u}{\sqrt{3}g}$

14. $Tan60 = \frac{h}{R}$ $\quad \sqrt{3} = \frac{1}{2}\frac{gt^2}{ut}$

$t = \frac{2\sqrt{3}u}{g} = \frac{2\sqrt{3}\times 20\times\sqrt{3}}{10}$ $\quad$ t = 12

$R = ut - 20\sqrt{3}\times 12 = 240\sqrt{3}$

$2R = 480\sqrt{3}$

15. The time taken by the body to reach the ground is

$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2\times 1960}{9.8}} = 20\sec.$

Distance AB = $600\times\frac{5}{18}\times 20 = 3.33km$

16. $S = u\times\sqrt{\frac{2h}{g}} \Rightarrow 10 = u\sqrt{2\times\frac{5}{10}} \Rightarrow u = 10\ m/s$

17. $t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2\times 396.9}{9.8}} \simeq 9\sec$ and $u = 720\ km/hr = 200\ m/s$

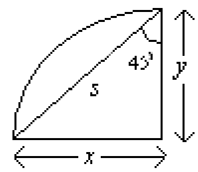
$\therefore R = u\times t = 200\times 9 = 1800\ m$

18. Area in which bullet will spread = πr^2

For maximum area, $r = R_{max} = \frac{v^2}{g}$ [when $\theta = 45°$]

Maximum area $\pi R_{max}^2 = \pi\left(\frac{v^2}{g}\right)^2 = \frac{\pi v^4}{g^2}$

19. $\tan 45^0 = \frac{x}{y} \Rightarrow x = y$



But $x = V\sqrt{\frac{2y}{g}}$

$s\cos 45^0 = x \Rightarrow s = \sqrt{2}x$