| NEET | Class – 11th | Topic – Projectile Motion |
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Q1. A ball is projected with a speed of 20 m/s at an angle of 30° to the horizontal. Find the time of flight. (Take $g = 10\ m/s^2$)

**Solution.** Time of flight $T = (2u \sin\theta)/g$

$= (2 \times 20 \times \sin 30°)/10$

$= (40 \times 0.5)/10 = 20/10 = 2\ s$

Q2. A projectile is thrown with a velocity of 40 m/s making an angle of 60° with the horizontal. Find the maximum height.

**Solution.** Maximum height $H = (u^2 \sin^2\theta)/(2g)$

$= (40)^2 \times (\sin 60°)^2 / (2 \times 10)$

$= 1600 \times (0.866)^2 / 20 \approx 1600 \times 0.75 / 20 = 1200/20 = 60\ m$

Q3. A cricket ball is hit at 25 m/s at an angle of 45°. Find its horizontal range.

**Solution.** Range $R = (u^2 \sin 2\theta)/g$

$= 25^2 \times \sin 90° / 10 = 625 \times 1 / 10 = 62.5\ m$

Q4. A projectile is launched at a speed of 20 m/s and covers a horizontal range of 34.6 m. Find the angle of projection. (Take $g = 9.8\ m/s^2$)

**Solution.** Range $R = (u^2 \sin 2\theta)/g$

$34.6 = 400 \times \sin 2\theta / 9.8$

$\sin 2\theta = (34.6 \times 9.8) / 400 \approx 0.8477$

$2\theta = \sin^{-1}(0.8477) \approx 58°$

$\theta \approx 29°$

Q5. A projectile is projected with a speed of 30 m/s at 45°. Find:

(a) Maximum height

(b) Time of flight

**Solution.** (a) $H = (u^2 \sin^2\theta)/(2g) = (30)^2 \times (\sin 45°)^2 / (2 \times 10)$

$= 900 \times 0.5 / 20 = 22.5$ m

(b) $T = (2u \sin\theta)/g = 2 \times 30 \times \sin 45° / 10$

$= 60 \times 0.707 / 10 \approx 4.24$ s

Q6. A projectile reaches a maximum height of 20 m and covers a horizontal distance of 80 m. Find the angle of projection.

**Solution.** $H = (u^2 \sin^2\theta)/(2g)$, $R = (u^2 \sin 2\theta)/g$

Dividing: $H/R = (\sin^2\theta)/(2 \sin 2\theta)$

$20/80 = \sin^2\theta / (2 \times 2 \sin\theta \cos\theta) = \sin\theta / 4\cos\theta$

$\Rightarrow \tan\theta = 1 \Rightarrow \theta = 45°$

Q7. A projectile is thrown at 30° and covers a range R. To get maximum possible range 2R, at what angle should it be projected?

**Solution.** Maximum range occurs when $\theta = 45°$.

Hence, to get 2R, angle should be 45°.

Q8. What factors affect the horizontal range of a projectile?

**Solution.** The range depends on:

- Initial speed (u): Greater u, greater range.
- Angle of projection (θ): Maximum range at 45°.
- Acceleration due to gravity (g): Range $\propto 1/g$

Q9. Why does the time of flight increase with increase in angle of projection?

**Solution.** Time of flight $T = (2u \sin\theta)/g$

As θ increases from 0° to 90°, sinθ increases, thus increasing time of flight.

Q10. Two projectiles are fired at complementary angles (e.g., 30° and 60°) with the same speed. Compare their ranges.

**Solution.** Range $R = (u^2 \sin 2\theta)/g$

Since $\sin(2\theta) = \sin(2(90°-\theta)) = \sin(2\theta)$, both projectiles cover the same range.