Angle Projectiles Problems – Answer Key

Solve these problems using \( g = -9.80 \, \text{m/s}^2 \). Show all your work.

1. A projectile is launched from the origin with an initial velocity of 35 m/s, +55 degrees above the horizontal. Where on the x axis should the target be placed?

\[
V_{ix} = V_i \cos 55 = 20 \, \text{m/s}
\]
\[
V_{iy} = V_i \sin 55 = 29 \, \text{m/s}
\]

\[
\begin{align*}
0 &= -4.9t^2 + 29t \\
X_f &= 20 \, \text{m/s} (5.85 \, \text{s}) = 120 \, \text{m}
\end{align*}
\]

\[
t = 0 \, \text{s}, \ 5.85 \, \text{s}
\]

2. A projectile is launched from the origin with an initial velocity of 50 m/s, +65 degrees above the horizontal. It hits a target 60 m high. What is the x-coordinate of the target?

\[
V_{ix} = V_i \cos 65 = 21 \, \text{m/s}
\]
\[
V_{iy} = V_i \sin 65 = 45 \, \text{m/s}
\]

\[
\begin{align*}
0 &= -4.9t^2 + 45t - 60 \\
&= 21 \, \text{m/s} \times 1.6 \, \text{s} = 34 \, \text{m}
\end{align*}
\]

\[
t = 1.6 \, \text{s}, \ 7.6 \, \text{s}
\]

3. A projectile is launched from the origin with an initial velocity of 60 m/s, +60 degrees above the horizontal. If the target’s x-coordinate is 80 m, what is the y-coordinate?

\[
V_{ix} = V_i \cos 60 = 30 \, \text{m/s}
\]
\[
V_{iy} = V_i \sin 60 = 52 \, \text{m/s}
\]

\[
\begin{align*}
t &= \frac{X_f}{V_{ix}} = 2.7 \, \text{s} \\
Y_f &= 100 \, \text{m}
\end{align*}
\]
4. A projectile is launched from a cliff that is 70 m high. The initial velocity of the projectile is 60 m/s, 0 degrees (launched horizontally). How far from the base of the cliff should the target be placed?

\[ Y_f = y_i + V_{iy}t + \frac{1}{2}gt^2 \quad X_f = x_i + V_{ix}t \]

\[ t = 3.8 \text{ s} \quad X_f = 230 \text{ m} \]

5. A projectile is launched from a cliff that is 65 m high with an initial velocity of 35 m/s at -40 degrees (below the horizontal). How far from the base of the cliff should the target be?

\[ V_{ix} = V_i \cos 40 = 27 \text{ m/s} \]
\[ V_{iy} = V_i \sin 40 = -23 \text{ m/s} \]

\[ Y_f = y_i + V_{iy}t + \frac{1}{2}gt^2 \quad X_f = x_i + V_{ix}t \]

\[ 0 = 4.9t^2 + 23t - 65 \quad = 27 \text{ m/s}(2.0 \text{ s}) \]

\[ t = 2.0 \text{ s}, -6.6 \text{ s} \quad = 54 \text{ m} \]

6. A projectile is launched from a cliff that is 100 m high with an initial velocity of 30 m/s, -30 degrees (below the horizontal). Point P is 70 m from the base of the cliff. How far above point P should the target be?

\[ V_{ix} = V_i \cos 30 = 26 \text{ m/s} \]
\[ V_{iy} = V_i \sin 30 = -15 \text{ m/s} \]

\[ X_f = x_i + V_{ix}t \quad Y_f = y_i + V_{iy}t + \frac{1}{2}gt^2 \]

\[ t = 2.7 \text{ s} \quad = -75 \text{ m} \]

so target should be 25 m above point P.