Projectile Motion Worksheet (Case 2)

Name: Key

Mod: _____

Date: _____

Directions: Answer the following questions below using the projectile motion equations. List all variables and show your work. Circle your final answer with the correct units.

1. A football is kicked with an initial velocity of 25 m/s at an angle of 45-degrees with the horizontal. Determine the time of flight, the horizontal distance, and the peak height of the football.

$t_{range} = \frac{-2V_i \sin\theta}{g} = -\frac{2(25\,m/s \sin 45)}{-9.8\,m/s^2}$ $t_{range} = 3.61\,sec$

$R = -\frac{V_i^2 \sin 2\theta}{g} = -\frac{(25\,m/s)^2 \sin(2 \cdot 45)}{(-9.8\,m/s^2)}$ $R = 63.78\,m$

$y_{max} = -\frac{(V_i \sin\theta)^2}{2g} = -\frac{(25\,m/s \sin 45)^2}{2 \cdot 9.8\,m/s^2}$ $y_{max} = 15.94\,m$

2. A long jumper leaves the ground with an initial velocity of 12 m/s at an angle of 28-degrees above the horizontal. Determine the time of flight, the horizontal distance, and the peak height of the long-jumper.

$t_{range} = -\frac{2V_i \sin\theta}{g} = -\frac{2(12\,m/s \sin 28^\circ)}{-9.8\,m/s^2}$ $t_{range} = 1.15\,sec$

$R = -\frac{V_i^2 \sin 2\theta}{g} = -\frac{(12\,m/s)^2 \sin(2 \cdot 28)}{-9.8\,m/s^2}$ $Range = 12.18\,m$

$y_{max} = -\frac{(V_i \sin\theta)^2}{2g} = -\frac{(12\,m/s \sin 28)^2}{2(-9.8\,m/s^2)}$ $y_{max} = 1.62\,m$

3. A hunter aims his bow and arrow 5 degrees above the horizontal and releases the bow. The arrow leaves the bow with a velocity of 120 ft/s towards a deer on the other side of a field. What is the range of the arrow?

$\frac{120\,ft}{1\,sec} \times \frac{12\,in}{1\,ft} \times \frac{2.54\,cm}{1\,in} \times \frac{1\,m}{100\,cm} = 36.58\,m/s$

$R = -\frac{V_i^2 \sin 2\theta}{g} = -\frac{(36.58\,m/s)^2 \sin(2 \cdot 5)}{-9.8\,m/s^2} = 23.71\,m$

4. An arrow is fired into the sky at an angle of 55 degrees to the horizontal. It lands down field with a range of 77.35 meters. What is the initial velocity of the arrow?

$R = \frac{-V_i^2 \sin 2\theta}{g}$

$V_i = \sqrt{\frac{-Rg}{\sin 2\theta}} = \sqrt{\frac{-(77.35m)(-9.8\,m/s^2)}{\sin(2 \cdot 55)}} = 28.40\,m/s$

5. A golf player hits a golf ball with an initial velocity of 83.0m/s at 40 degrees. How long did it take to reach maximum height? How far did the ball travel?

$t_{max\ height} = -\frac{v_i \sin\theta}{g}$ $\quad$ $\text{Range} = -\frac{v_i^2 \sin 2\theta}{g}$

$= -\frac{(83\ m/s \sin 40)}{-9.8\ m/s^2}$ $\quad$ $= -\frac{(83\ m/s)^2 \sin(2 \cdot 40)}{-9.8\ m/s^2}$

$t_{max\ height} = 5.44$ sec $\quad$ Range $= 692.28$ m

6. A football is kicked at an angle 37.0° with an unknown initial velocity and lands 45.0 meters down field
   a. Find the max height of the football.
   b. The time to reach maximum height.
   c. The time in air before striking the ground.

$\text{Range} = -\frac{v_i^2 \sin 2\theta}{g}$

$v_i = \sqrt{\frac{-Rg}{\sin 2\theta}}$

$= \sqrt{\frac{45\ m(9.8\ m/s^2)}{\sin(2 \cdot 37)}}$

$v_i = 21.42\ m/s$

a), $y_{max} = -\frac{(v_i \sin\theta)^2}{2g}$

$= -\frac{(21.42\ m/s \sin 37°)^2}{2(-9.8\ m/s^2)}$

$y_{max} = 8.48$ m

b), $t_{max\ height} = -\frac{v_i \sin\theta}{g}$

$= -\frac{21.42 \sin 37}{-9.8\ m/s^2}$

$t_{max\ height} = 1.32$ sec

c). $t_{range} = -\frac{2 v_i \sin\theta}{g}$

$= -\frac{2(21.42 \sin 37)}{-9.8\ m/s^2}$

$t_{range} = 2.63$ sec