Worksheet #4

Physics – Mr. Hall

PROJECTILES

Name: _____

1. A plane is traveling 280 m/s at an altitude of 3050 m. One of its wheels falls off when it is directly over your house. (a) How long will it take for the wheel to hit the ground? (b) How far from your house will the wheel land?

a) $d_f = d_i + v_i t + \frac{1}{2} a t^2$
$3050\ m = 0\ m + 0\ m/s \cdot t + \frac{1}{2} (9.8\ m/s^2)\ t^2$
$3050\ m = 4.9\ m/s^2\ t^2$
$3050\ m/4.9\ m/s^2 = t^2$
$622.44897959\ s^2 = t^2$
$t = 24.9489274\ s =$ 24.9 s or 25 s

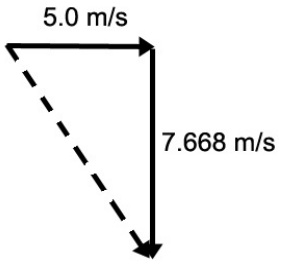
b) $d_f = d_i + v_i t + \frac{1}{2} a t^2$
$d_f = 0\ m + 280\ m/s\ (24.9489274\ s) + \frac{1}{2}\ (0\ m/s^2)\ (24.9489274\ s)^2$
$d_f = 280\ m/s\ (24.9489274\ s) = 6985.6996786\ m =$ 6990 m or 7.0×10^3 m

2. You're installing a 3.0-meter high diving board in your backyard. Your daughter likes to run off the diving board at a speed of 5.0 m/s. If the edge of the diving board is even with the edge of the pool, (a) how far from the edge of the pool would she land running off the new diving board? (b) What would her horizontal and vertical speeds be when she hit the water? (c) What would her total speed be when she hit the water?

a) $d_f = d_i + v_i t + \frac{1}{2} a t^2$
$3.0\ m = 0\ m + 0\ m/s \cdot t + \frac{1}{2} (9.8\ m/s^2)\ t^2$
$3.0\ m = 4.9\ m/s^2\ t^2$
$3.0\ m/4.9\ m/s^2 = t^2$
$0.612245\ s^2 = t^2$
$t = 0.7824608\ s$
$d_f = d_i + v_i t + \frac{1}{2} a t^2$
$d_f = 0\ m + 5.0\ m/s\ (0.7824608\ s) + \frac{1}{2}\ (0\ m/s^2)\ (0.7824608\ s)^2$
$d_f = 5.0\ m/s\ (0.7824608\ s) = 3.91230398\ m =$ 3.9 m

b) $v_{horiz} = 5.0\ m/s$ (horiz speed doesn't change)
$v_f = v_i + at = 0\ m/s + (9.8\ m/s^2)(0.7824608\ s) = 7.6681158\ m/s$
$v_{vert} = 7.7\ m/s$

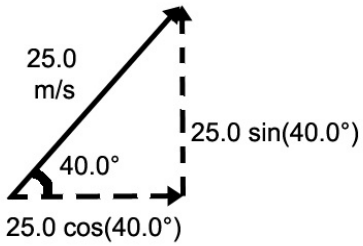
c) $v_{total}^2 = v_{horiz}^2 + v_{vert}^2$
$v_{total}^2 = (5.0\ m/s)^2 + (7.6681158\ m/s)^2 = 83.8\ m^2/s^2$
$v_{total} = 9.15423399\ m/s =$ 9.2 m/s



3. You throw a ball off of a 20.0 meter building at 25.0 m/s at an angle of 40.0°. What are the vertical and horizontal components of your velocity vector?

$v_{vert} = v \sin(40.0°)$
$= (25.0 \text{ m/s}) \sin(40.0°) = 16.06969 \text{ m/s} =$ **16.1 m/s**

$v_{horiz} = v \cos(40.0°)$
$= (25.0 \text{ m/s}) \cos(40.0°) = 19.151111 \text{ m/s} =$ **19.2 m/s**



4. Which of those two vector components determines how long the ball remains in the air? Find how long the ball remains in the air.

The **vertical component** determines how long the ball is in the air.

$v = v_i + at$
$-16.06969 \text{ m/s} = 16.06969 \text{ m/s} + (-9.8 \text{ m/s}^2)\, t$
$-32.13938 \text{ m/s} = (-9.8 \text{ m/s}^2)\, t$
$t = (-32.13938 \text{ m/s}) / (-9.8 \text{ m/s}^2) = 3.27952857 \text{ s} =$ **3.28 s**

5. Which of the vector components determines how far away from the building the ball will land? How far from the building does the ball land?

The **horizontal component** is used to determine how far away the ball will land.
(Note: Since the distance the ball travels from its starting point is determined by both the horizontal speed and the time in the air, the vertical component does also affect how far away the ball will land as it determines how long the ball is in the air. However, the direct component used in the distance formula is the horizontal speed.)

$d = d_i + v_i t + \frac{1}{2} a t^2$
$d = 0 \text{ m} + (19.151111 \text{ m/s})(3.27952857 \text{ s}) + \frac{1}{2} (0 \text{ m/s}^2)(3.27952857 \text{ s})^2 = 62.8066157 \text{ m} =$ **62.8 m**