

Projectile Motion Worksheet Answer Key

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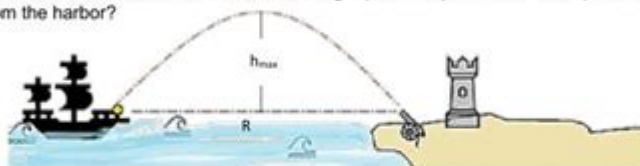
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Projectile Motion Worksheet

Directions: Solve the following word problems by filling-in the boxes with the correct answers.

1. A pirate ship, docked at sea a certain distance from the harbor, attacks a fort. The fort retaliates by firing cannonballs at a speed of 82 m/s at an angle of 27° above the horizontal. The cannonballs land on the target pirate ship. How far is the pirate ship from the harbor?



Given: $v_i =$ _____ m/s $\theta_i =$ _____ ° $g =$ _____ m/s²

Find: t_R and R

Solution:
$$t_R = \frac{2v_i \sin \theta_i}{g}$$
$$= \frac{2 \left(\frac{m}{s} \right) \sin(\quad \text{°})}{\frac{m}{s^2}}$$

$t_R =$ _____ s

$t_R =$ _____ s

$$R = \frac{v_i^2 \sin 2\theta_i}{g}$$
$$= \frac{\left(\frac{m}{s} \right)^2 \sin 2(\quad \text{°})}{\frac{m}{s^2}}$$

$R =$ _____ m

$R =$ _____ m

2. A baseball batter hits the ball that flies off at a speed of 40.0 m/s at an angle of 35.0° above the horizontal. An outfielder just catches the ball such that the distance of the ball from the ground when it was hit is the same as the distance of the ball from the ground when it was caught. (a) How far is the outfielder from the batter when he caught the ball? (b) How long did it take the outfielder to catch the ball (from the moment the ball was hit)?



LIVEWORKSHEETS

Projectile Motion Worksheet Answer Key: Your Guide to Mastering Physics

Are you struggling with projectile motion problems? Feeling overwhelmed by the calculations and formulas? You're not alone! Projectile motion can be a tricky concept in physics, but with the right resources and understanding, you can master it. This comprehensive guide provides you with a detailed look at projectile motion, complete with a sample worksheet and its corresponding answer key. We'll break down the key concepts and provide you with the tools to confidently solve any projectile motion problem. Forget the frustration - let's unlock the secrets to projectile motion together!

Understanding Projectile Motion: The Fundamentals

Projectile motion describes the path of an object launched into the air, influenced only by gravity (we'll ignore air resistance for simplicity in this context). Understanding this motion relies on grasping two crucial independent components: horizontal and vertical motion.

Horizontal Motion: In the absence of air resistance, the horizontal velocity of a projectile remains constant throughout its flight. This means it travels at a consistent speed in the x-direction.

Vertical Motion: Gravity significantly impacts vertical motion. The vertical velocity changes constantly due to the downward acceleration of gravity (approximately 9.8 m/s^2 on Earth). This means the object's upward speed decreases until it reaches its highest point (apex), then increases as it falls back down.

Key Formulas for Projectile Motion Calculations

Several key formulas are essential for solving projectile motion problems. These equations allow us to calculate various aspects of the projectile's trajectory, including:

Horizontal Distance (Range): This calculation depends on the initial horizontal velocity and time of flight. The formula is typically expressed as: $\text{Range} = v_{0x} t$, where v_{0x} is the initial horizontal velocity and t is the total time of flight.

Time of Flight: This is the total time the projectile spends in the air. It's determined by the initial vertical velocity and the acceleration due to gravity. The formula is often represented as: $t = (2 v_{0y}) / g$, where v_{0y} is the initial vertical velocity and g is the acceleration due to gravity.

Maximum Height: The highest point the projectile reaches is determined by the initial vertical velocity and gravity's effect. The formula is typically: $h_{\text{max}} = (v_{0y})^2 / (2 g)$

Velocity Components: At any point in the projectile's trajectory, the velocity can be broken down into its horizontal (v_x) and vertical (v_y) components. These components can be calculated using trigonometric functions if the initial velocity and launch angle are known.

Sample Projectile Motion Worksheet & Answer Key

Let's work through a sample projectile motion worksheet to solidify our understanding. Below is a simplified example:

Worksheet:

1. A ball is thrown horizontally from a cliff 20 meters high with an initial velocity of 15 m/s.

Calculate:

- a. The time it takes to hit the ground.
- b. The horizontal distance it travels before hitting the ground.
- c. The final vertical velocity just before impact.

2. A projectile is launched at an angle of 30 degrees above the horizontal with an initial velocity of 20 m/s. Calculate:

- a. The initial horizontal and vertical velocity components.
- b. The maximum height reached by the projectile.
- c. The total time of flight.
- d. The horizontal range of the projectile.

Answer Key:

Problem 1:

- a. Using the vertical motion equation ($h = v_{0y}t + 0.5gt^2$), where $h = 20\text{m}$, $v_{0y} = 0\text{ m/s}$ (horizontal launch), and $g = 9.8\text{ m/s}^2$, we solve for $t \approx 2.02\text{ seconds}$.
- b. Horizontal distance = $v_{0x} t = 15\text{ m/s} \cdot 2.02\text{ s} \approx 30.3\text{ meters}$.
- c. Final vertical velocity (v_y) using $v_y = v_{0y} + gt = 0 + (9.8\text{ m/s}^2)(2.02\text{ s}) \approx 19.8\text{ m/s}$

Problem 2:

- a. $v_{0x} = 20\text{ m/s} \cos(30^\circ) \approx 17.32\text{ m/s}$; $v_{0y} = 20\text{ m/s} \sin(30^\circ) = 10\text{ m/s}$
- b. $h_{\text{max}} = (v_{0y})^2 / (2g) = (10\text{ m/s})^2 / (2 \cdot 9.8\text{ m/s}^2) \approx 5.1\text{ meters}$
- c. $t = (2 v_{0y}) / g = (2 \cdot 10\text{ m/s}) / 9.8\text{ m/s}^2 \approx 2.04\text{ seconds}$
- d. Range = $v_{0x} t = 17.32\text{ m/s} \cdot 2.04\text{ s} \approx 35.3\text{ meters}$

Advanced Projectile Motion Concepts

While this covers the basics, advanced concepts like air resistance, projectile motion on inclined planes, and the effect of different gravitational fields add complexity. These require more advanced mathematical techniques and are often explored in higher-level physics courses.

Conclusion

Mastering projectile motion involves understanding the fundamental principles of horizontal and vertical motion and applying the appropriate formulas. By practicing with worksheets and working through example problems, you can build confidence and accuracy in solving these types of physics problems. Remember to break down the problem into its components, carefully choose the right equations, and always double-check your calculations. This guide, along with the provided worksheet and answer key, will serve as a valuable resource in your journey to conquer projectile motion.

Frequently Asked Questions (FAQs)

1. What is the difference between a projectile and an object in freefall? A projectile has an initial velocity, while an object in freefall only experiences the acceleration due to gravity.
2. Does air resistance affect projectile motion? Yes, air resistance opposes the motion of a projectile, reducing its range and altering its trajectory. Our calculations here assume negligible air resistance for simplicity.
3. How do I handle projectile motion problems with angles other than 0 or 90 degrees? Resolve the initial velocity into its horizontal and vertical components using trigonometry (sine and cosine functions).
4. Why is gravity considered a constant in these calculations? We typically assume a constant gravitational acceleration near the Earth's surface. This approximation is valid for relatively short projectile flights.
5. Are there online calculators or simulators for projectile motion? Yes, many online resources offer calculators and simulations that can help visualize and solve projectile motion problems. These can be valuable tools for understanding the concepts.

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