Homework Sample: Physics Numerical Problem

Topic: Calculate the Final Velocity of an Object in Free Fall

Grade Level: 10th Grade

Subject Area: Physics

Specific Instructions: Use the kinematic equations to solve for the final velocity of an object in free fall. Show all calculations and explain the steps.

Keywords to Include: Free fall, final velocity, kinematic equations, acceleration due to gravity

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Problem Statement:

An object is dropped from a height of 45 meters. Calculate the final velocity of the object just before it hits the ground. Assume there is no air resistance and use the acceleration due to gravity $g=9.8 \, \text{m/s}^2$ $g = 9.8 \, \text{m/s}^2$ $g=9.8 m/s2$.

Solution:

To solve for the final velocity (v_f v_f) of an object in free fall, we can use the following kinematic equation:

$$v_f^2 = v_i^2 + 2gh \quad v_f^2 = v_i^2 + 2gh \quad v_f^2 = v_i^2 + 2gh$$

where:

- v_f v_f = final velocity
- v_i v_i = initial velocity (0 m/s, since the object is dropped)
- g g = acceleration due to gravity (9.8 m/s²)
- h h = height (45 meters)

Step-by-Step Calculation:

1. **Identify the values:**
   - Initial velocity (v_i v_i) = 0 m/s
   - Acceleration due to gravity (g g) = 9.8 m/s²
   - Height (h h) = 45 meters
2. **Substitute the values into the equation:** $v_f^2 = 0^2 + 2 \times 9.8 \, \text{m/s}^2 \times 45 \, \text{m}$ $v_f^2 = 0^2 + 2 \times 9.8 \, \text{m/s}^2 \times 45 \, \text{m}$ $v_f^2 = 0^2 + 2 \times 9.8 m/s2 \times 45 m$
3. **Perform the multiplication:** $v_f^2 = 2 \times 9.8 \times 45$ $v_f^2 = 2 \times 9.8 \times 45$ $v_f^2 = 2 \times 9.8 \times 45$ $v_f^2 = 882 \, \text{m}^2/\text{s}^2$ $v_f^2 = 882 \, \text{m}^2/\text{s}^2$ $v_f^2 = 882 m2/s2$

4. **Calculate the final velocity:** $v_f = \sqrt{882}$ $v_f \approx 29.7 \, \text{m/s}$

Answer:

The final velocity of the object just before it hits the ground is approximately $29.7 \, \text{m/s}$.

Explanation:

To find the final velocity of an object in free fall, we use the kinematic equation that relates the final velocity, initial velocity, acceleration, and displacement. Since the object is dropped (initial velocity = 0) and only the acceleration due to gravity acts on it, we calculate the final velocity by substituting the known values into the equation and solving for v_f. The result shows the speed of the object just before impact.