

1. Given: $v_0 = 0, g = 10 \text{ m/s}^2, v = 70 \times \text{km/h} = 70 \times \frac{1000 \text{ m}}{3600 \text{ s}} = 19.4 \text{ m/s}$

Find: t .

Solution: We select downward as the positive y .

$$v = v_0 + gt \text{ or } 19.4 \text{ m/s} = 0 + (10 \text{ m/s}^2)t, \text{ which leads to } t = \boxed{2 \text{ s}}.$$

2. Given: $t = 3.00 \text{ s}, v_0 = 0, g = 10 \text{ m/s}^2$.

Find: y .

$$\text{Solution: } y = v_0t + \frac{1}{2}gt^2 = \frac{1}{2}(10 \text{ m/s}^2)(3.00 \text{ s})^2 = \boxed{44.1 \text{ m}}.$$

3. Given: $y = 380 \text{ m}, v_0 = 0, g = 10 \text{ m/s}^2$

Find: t, v .

Solution: It is easier to calculate the final velocity and then find time to avoid the use of a quadratic equation.

$$v^2 = v_0^2 + 2gh = 2(10 \text{ m/s}^2)(380 \text{ m}) = 7600 \text{ m/s}^2, \text{ which means } v = \boxed{87 \text{ m/s}}.$$

$$v = v_0 + gt \text{ or } 87 \text{ m/s} = 0 + (10 \text{ m/s}^2)t, \text{ which means } t = \boxed{8.7 \text{ s}}.$$

4. Given: $t = 3.3 \text{ s}, v = 0, g = 10 \text{ m/s}^2$.

Find: v_0, h .

Solution: When Alex catches the ball, we have $y = 0$. Thus,

$$0 = v_0t + \frac{1}{2}gt^2 \text{ which means } v_0 = -\frac{1}{2}gt = (0.5)(10 \text{ m/s}^2)(3.3 \text{ s}) = \boxed{16.5 \text{ m/s}}$$

Since Alex caught the ball after 3.3 second, it takes the ball 1.65 seconds to reach the top. Thus,

$$h = v_0t + \frac{1}{2}gt^2 = (16.5 \text{ m/s})(1.65 \text{ s}) + (0.5)(-10 \text{ m/s}^2)(1.65^2) = \boxed{13.6 \text{ m}}.$$

5. Given: $v_0 = -5.50 \text{ m/s}, h = 105 \text{ m}$

Find: t .

Solution: We select downward as the positive y .

$$105 \text{ m} = (-5.50 \text{ m/s})t + (0.5)(10 \text{ m/s}^2)t^2$$

$$\text{Solve for } t, \text{ we have } t = \boxed{5.23 \text{ s}}.$$

6. Given: $v_0 = -12.0 \text{ m/s}, h = 75.0 \text{ m}$.

(a) $75.0 \text{ m} = (-12.0 \text{ m/s})t + (0.5)(10 \text{ m/s}^2)t^2$. Solve for t , we have $t = \boxed{5.32 \text{ s}}$.

(b) $y = 89.7 \text{ m}$

7. (a) $v_0 = 25.2 \text{ m/s}$

(b) $y = 32.3 \text{ m}$

(c) $t = 1.35 \text{ s}$

(d) $t = 3.80 \text{ s}$



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Problem Set 2.1 - Falling Objects Solutions

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8. D. $v = v_0 + at = 4.0 \text{ m/s} + (-10 \text{ m/s}^2)(1 \text{ s}) = -6 \text{ m/s}$. Since the value is negative, it is downward.
9. D. $v = v_0 + at = 18 \text{ m/s} + (10 \text{ m/s}^2)(2 \text{ s}) = 38 \text{ m/s}$.
10. B. The resistance will reduce the downward velocity of the falling object until it reaches 0.