Honors Physics Test - Ch. 2 freefall - 10-02-08

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Follow all the rules. Double check your algebra and math.

1. (20 pts) A happy bricklayer throws a brick straight down from a tall building at 15 m/s. At 2.50 s later, how far has it fallen?

$t = 2.5\,s$
$a_y = -9.8\,\frac{m}{s^2}$
$v_{iy} = -15\,\frac{m}{s}$
$\Delta y = \_\_\_ m$

$\Delta y = v_{iy}t + \frac{1}{2}at^2$
$= -15\,\frac{m}{s}(2.5\,s) - 4.9\,\frac{m}{s^2}(2.5\,s)^2$
$\boxed{\Delta y = -68.1\,m}$

missing	
Δy	$v_{fy} = v_{iy} + a_y t$
v_f	$\Delta y = v_{iy}t + \frac{1}{2} a_y t^2$
t	$v_{fy}^2 = v_{iy}^2 + 2a\Delta y$
a	$\Delta y = \frac{1}{2}(v_{fy} + v_{iy})\, t$
v_{iy}	$\Delta y = v_{fy}t - \frac{1}{2} a_y t^2$

2. (15 pts) A pitcher throws a baseball up from the top of a 40 m high stadium at 35.0 m/s. (a) What is its velocity when it hits the ground? (b) How long does it take to get there?

$v_{iy} = 35\,\frac{m}{s}$
$\Delta y = -40\,m$
$a_y = -9.8\,\frac{m}{s^2}$
$v_{fy} = \_\_\_ \frac{m}{s}$

$v_{fy}^2 = v_{iy}^2 + 2a\Delta y$
$v_{fy} = \sqrt{(35\,\frac{m}{s})^2 + 2(-9.8\,\frac{m}{s^2})(-40\,m)}$

a) $\boxed{v_{fy} = -44.8\,\frac{m}{s}}$

$v_{fy} = v_{iy} + at$
$t = \frac{v_{fy} - v_{iy}}{a}$
$= \frac{-44.8\,\frac{m}{s} - 35\,\frac{m}{s}}{-9.8\,\frac{m}{s^2}}$

b) $\boxed{t = 8.14\,s}$

3. (10 pts) A noisy crow is 17 m above ground. (a) How fast would you have to throw an acorn so that it hit him at 25 m/s? (b) How long does it take to get there?

$\Delta y = 17m$

$V_{fy} = 25 \frac{m}{s}$

$a_y = -9.8 \frac{m}{s^2}$

$V_{iy} = \_\_ \frac{m}{s}$

$t = \_\_ s$

$V_{fy}^2 = V_{iy}^2 + 2a\Delta y$

$V_{iy} = \sqrt{V_{fy}^2 - 2a\Delta y}$

$= \sqrt{(25 \frac{m}{s})^2 - 2(-9.8 \frac{m}{s^2})(17m)}$

a) $\boxed{V_{iy} = 31.0 \frac{m}{s}}$

$V_{fy} = V_{iy} + at$

$t = \frac{V_{fy} - V_{iy}}{a}$

$= \frac{25 \frac{m}{s} - 31 \frac{m}{s}}{-9.8 \frac{m}{s^2}}$

b) $\boxed{t = 0.612 s}$

4. (5 pts) A rocket accelerates from rest upward at 4.5 m/s^2 for 2 minutes. Then its engines shut off and it coasts upward until it reaches a maximum altitude. (a) How fast was it going when the engines shut off? (b) What was the maximum altitude above ground that it reached?

$a_R = 4.5 \frac{m}{s^2}$

$t = 120 s$

$V_{iy} = 0 \frac{m}{s}$

$\Delta y_1 = \_\_ m$

$\Delta y_1 = \cancel{V_{iy}^0} t + \frac{1}{2} a t^2$

$= \frac{1}{2} (4.5 \frac{m}{s^2})(120 s)^2$

$\Delta y_1 = 3.24 \times 10^4 m$

$V_{fy_1} = \cancel{V_{iy}^0} + at$

$= 4.5 \frac{m}{s^2}(120 s)$

a) $\boxed{V_{fy_1} = 540 \frac{m}{s}}$

$\Delta y_T = \Delta y_1 + \Delta y_2$

$= 3.24 \times 10^4 m + 1.49 \times 10^4 m$

b) $\boxed{\Delta y_T = 4.73 \times 10^4 m}$

$a_y = -9.8 \frac{m}{s^2}$

$V_{iy_2} = 540 \frac{m}{s}$

$V_{fy_2} = 0 \frac{m}{s}$

$\Delta y_2 = \_\_ m$

$\cancel{V_{fy}^0}^2 = V_{iy}^2 + 2a\Delta y$

$\Delta y_2 = \frac{-V_{iy}^2}{2a}$

$= \frac{-(540 \frac{m}{s})^2}{2(-9.8 \frac{m}{s^2})}$

$\Delta y_2 = 1.49 \times 10^4 m$

(EC – easy) (2% extra) In problem 2, what are the two times the ball is 60 m above the ground?

$\Delta y = +20\ m$

$v_{iy} = 35\ \frac{m}{s}$

$a_y = -9.8\ \frac{m}{s^2}$

$t_1 = \_\_\_\ s$

$v_{fy}^2 = v_{iy}^2 + 2a\Delta y$

$v_{fy} = \sqrt{(35\frac{m}{s})^2 + 2(-9.8\frac{m}{s^2})(20m)}$

$v_{fy} = \pm 28.9\ \frac{m}{s}$

$v_{fy_1} = v_{iy_1} + at_1$

$t_1 = \frac{v_{fy_1} - v_{iy_1}}{a}$

$= \frac{28.9\frac{m}{s} - 35\frac{m}{s}}{-9.8\frac{m}{s^2}}$

a) $\boxed{t_1 = 0.622\ s}$

$v_{fy_2} = v_{iy_2} + at_2$

$t_2 = \frac{v_{fy_2} - v_{iy_2}}{a}$

$= \frac{-28.9\frac{m}{s} - 35\frac{m}{s}}{-9.8\frac{m}{s^2}}$

b) $\boxed{t_2 = 6.52\ s}$

(EC - harder) (5 % extra) A good diagram will help! A watermelon is dropped from 2070 m above ground. (a) If you shoot a gun straight up (from ground level) at the same time the melon is dropped, at what velocity will you need to fire the gun to hit the melon when it is 1380 m above ground? (b) At what time after the drop will the bullet hit it? (c) What is the velocity of the melon at the time of collision?

- 2070 m $\Delta y = -690\ m$
- 1380 m
- 0 m

$v_{iy_m} = 0\ \frac{m}{s}$

$\Delta y_m = -690\ m$

$a_y = -9.8\ \frac{m}{s^2}$

$t_m = \_\_\_\ s$

$\Delta y = \cancel{v_{iy}^{0}}t + \frac{1}{2}at^2$

$t = \sqrt{\frac{2\Delta y}{a}}$

$= \sqrt{\frac{2(-690m)}{-9.8\frac{m}{s^2}}}$

b) $\boxed{t = 11.9\ s}$

$v_{iy_m} = 0\ \frac{m}{s}$

$a_y = -9.8\ \frac{m}{s^2}$

$t = 11.9\ s$

$v_{fy} = \_\_\_\ \frac{m}{s}$

$v_{fy} = \cancel{v_{iy}^{0}} + at$

$= -9.8\frac{m}{s^2}(11.9\ s)$

c) $\boxed{v_{fy} = -117\ m}$

$v_{iy_b} = \_\_\_\ \frac{m}{s}$

$a_y = -9.8\ \frac{m}{s^2}$

$\Delta y_b = 1380\ m$

$t = 11.9\ s$

$\Delta y = v_{iy}t + \frac{1}{2}at^2$

$v_{iy} = \frac{\Delta y - \frac{1}{2}at^2}{t}$

$= \frac{1380m + 4.9\frac{m}{s^2}(11.9\ s)^2}{11.9\ s}$

a) $\boxed{v_{iy} = 174\ \frac{m}{s}}$