Honors Physics Test - Ch. 2b, Freefall - 10-02-02 - Mr. Ward

Name WARD ____ o

1. (11 pts) Daler Mehndi throws a salami straight up at 37.5 m/s. How high does it go above the release point?

$\Delta y =$ ___ m

$V_{iy} = 37.5 \frac{m}{s}$

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

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

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

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

$= \frac{-(37.5 \frac{m}{s})^2}{2(-9.8 \frac{m}{s^2})}$

$\boxed{\Delta y = 71.7 \text{ m}}$

2. (11 pts) A vicious squirrel throws an acorn straight down from a 15.0 m high tree at 8.25 m/s. How long does it take to hit?

$t =$ ___ s

$\Delta y = -15.0 \text{ m}$

$V_{iy} = -8.25 \frac{m}{s}$

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

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

$V_{fy}^2 = (-8.25 \frac{m}{s})^2 + 2(-9.8 \frac{m}{s^2})(-15.0 \text{ m})$

$\underline{V_{fy} = -19.0 \frac{m}{s}}$

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

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

$= \frac{-19.0 \frac{m}{s} - (-8.25 \frac{m}{s})}{-9.8 \frac{m}{s^2}}$

$\boxed{t = 1.10 \text{ s}}$

OR

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

$-15 = -8.25t - 4.9t^2$

$\boxed{t = 1.10 \text{ s}}, -2.78 \text{ s}$

3. (11 pts) An angry bricklayer throws a brick up onto the roof of a 12.5 m high building at 25.0 m/s. Just as it it lands on the roof of the building, what is its velocity? Draw a well-labeled diagram.

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

$\Delta y = 12.5 m$

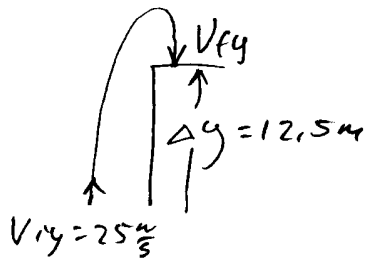
$V_{iy} = 25.0 \frac{m}{s}$

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

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

$V_{fy}^2 = (25 \frac{m}{s})^2 + 2(-9.8 \frac{m}{s^2})(12.5 m)$

$\boxed{V_{fy} = -19.5 \frac{m}{s}}$



4. (11 pts) A terrorist shot-putter throws the shot straight down from a 325 m high building at 12.0 m/s. What is its velocity when it hits the ground?

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

$\Delta y = -325 m$

$V_{iy} = -12.0 \frac{m}{s}$

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

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

$V_{fy}^2 = (-12 \frac{m}{s})^2 + 2(-9.8 \frac{m}{s^2})(-325 m)$

$\boxed{V_{fy} = -80.7 \frac{m}{s}}$

5. (6 pts) A lunar lander is using its engine to hover motionless above the surface of the moon at the altitude of 1000 m. The commander then shuts the engine down and allows the lander to free fall with the lunar acceleration of 1.61 m/s^2 until it is 285 m above the surface. At this point he fires the engine which is capable of producing a constant upward acceleration of 4.00 m/s^2. The engine burns continually until the lander lands. At what velocity will the lander hit the moon? Draw a well-labeled diagram.

$V_{fy_1} = \_\_\_\_ \frac{m}{s}$

$y_i = 1000 m$

$y_f = 285 m$

$a = -1.61 \frac{m}{s^2}$

$V_{iy_1} = 0 \frac{m}{s}$

$\Delta y = y_f - y_i$

$= 285 m - 1000 m$

$\Delta y = -715 m$

$V_{fy_1}^2 = \cancel{V_{iy_1}^2}^{\,0} + 2a\Delta y$

$V_{fy_1}^2 = 2(-1.61 \frac{m}{s^2})(-715 m)$

$V_{fy_1} = -48.0 \frac{m}{s}$

$V_{i1} = 0$ $y_{i1} = 1000 m$

$a_1 = -1.61 \frac{m}{s^2}$

$V_{2i} = V_{1f} = -\frac{m}{s}$ $y_{f1} = 285 m = y_{i2}$

$a_2 = +4.0 \frac{m}{s^2}$

$V_{2f} = \_\_ \frac{m}{s}$ $y_{f2} = 0 m$

$V_{fy_2} = \_\_\_\_ \frac{m}{s^2}$

$V_{iy_2} = -47.8 \frac{m}{s}$

$a = +4.0 \frac{m}{s^2}$

$\Delta y = -285 m$

$V_{fy_2}^2 = V_{iy_2}^2 + 2a\Delta y$

$V_{fy_2}^2 = (-48.0 \frac{m}{s})^2 + 2(4.0 \frac{m}{s^2})(-285 m)$

$\boxed{V_{fy_2} = -4.90 \frac{m}{s}}$

EC (5 pts, 52.5 max) In problem 1, what are the two times (after it is thrown) the salami is 30 m above the ground?

$t = \_\_\_\_ s$

$\Delta y = 30 m$

$V_{iy} = 37.5 \frac{m}{s}$

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

$\Delta y = V_{iy} t + \frac{1}{2} a t^2$

$30 = 37.5 t - 4.9 t^2$

$\boxed{t = 0.908 s, 6.75 s}$

EC (5 pts, 52.5 max) In problem 5, how long does the landing take from 1000 m to the surface?

$t = \_\_\_\_ s$

$V_{iy_1} = 0 \frac{m}{s}$

$V_{fy_1} = -47.8 \frac{m}{s}$

$\Delta y = -715 m$

$V_{iy_2} = -48.0 \frac{m}{s}$

$V_{fy_2} = -4.90 \frac{m}{s}$

$\Delta y = -285 m$

$\Delta y = \frac{1}{2}(V_{fy_1} + \cancel{V_{iy_1}}) t$

$t_1 = \frac{2\Delta y_1}{V_{fy_1}}$

$= \frac{2(-715 m)}{-48.0 \frac{m}{s}}$

$t_1 = 29.8 s$

$t_2 = \frac{2\Delta y_2}{V_{fy_2} + V_{iy_2}}$

$= \frac{2(-285 m)}{-4.90 \frac{m}{s} - 48.0 \frac{m}{s}}$

$t_2 = 10.8 s$

$t_T = t_1 + t_2$

$= 29.8 s + 10.8 s$

$\boxed{t_T = 40.6 s}$