Quiz 2
Phys 220
Fall 2013

Names: Solution

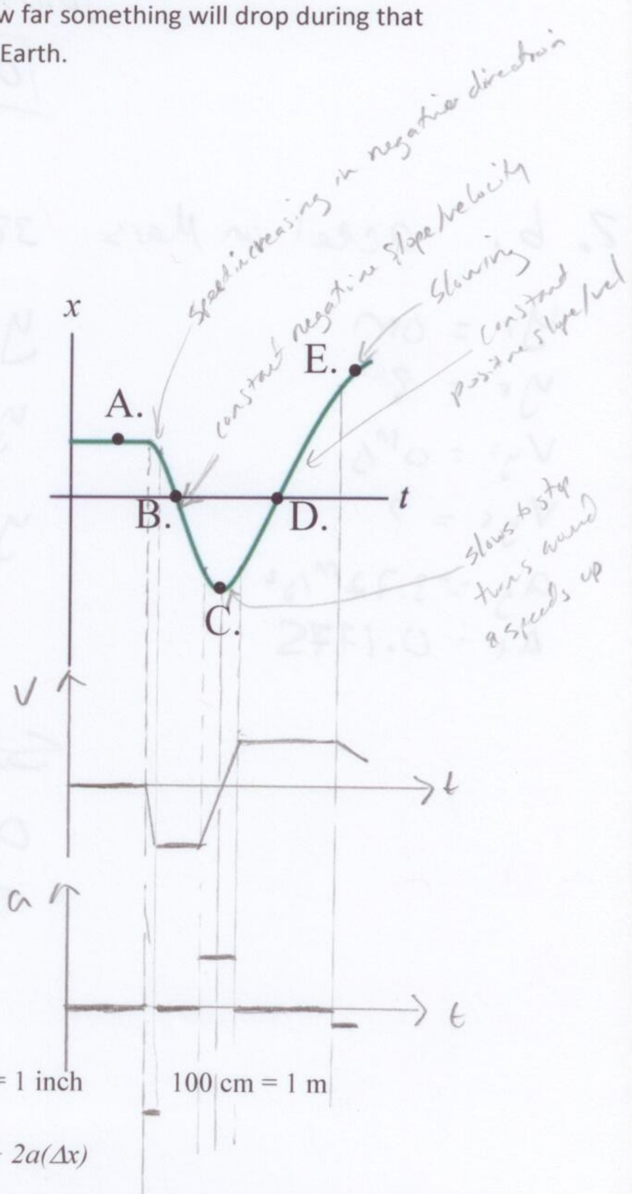
Be sure to show work or support your answer for every problem.

1. Yesterday in class we found that the typical reaction time was around 0.20 seconds. This isn't enough time to catch a 6 inch falling object so the text suggests betting your friend they can't catch a $20 bill. But we know air resistance would cause you to lose that bet! On Mars there's no atmosphere so a $20 bill wouldn't have the air resistance problem it would here on Earth. So "Would it be a safe bet on Mars?"
   a. Determine the reaction time on Earth for catching a bill which is ~6 inches in length. Use -9.8 m/s^2 for the acceleration due to Earth's gravity.
   b. Use the reaction time you found in a. to calculate how far something will drop during that time on Mars. The gravity on Mars is 38% of that on Earth.

See next page

2. The figure to the right shows a position-versus-time graph. At which lettered point or points is the object
   a. Moving the fastest? B
   b. Moving to the left? B
   c. Stationary A, C
   d. Slowing down? E
   e. Turning around? C

3. Draw the velocity-versus-time and acceleration-versus-time graphs directly below the position-versus-time graph.
   Be sure that the three graphs correspond (use a dotted line to show where points of interest line up.



$v = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{\Delta t}$ $a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t}$ 2.54 cm = 1 inch 100 cm = 1 m

$x_f = x_i + v_i\Delta t + \frac{1}{2} a(\Delta t)^2$ $v_f = v_i + at$ $v_f^2 = v_i^2 + 2a(\Delta x)$

1\. a. 6 inches $\left(\frac{2.54\,cm}{1\,inch}\right) = 15.24\,cm \left(\frac{1\,m}{100\,cm}\right) = 0.1524\,m$

Givens

$y_i = 0.1524\,m$ } could also use: $y_i = 0\,m$, $y_f = -0.1524\,m$

$y_f = 0\,m$

$v_{yi} = 0\,m/s$

$v_{yf} = ?$

$a_y = -9.8\,m/s^2$

$\Delta t = ?$

need Δt

$y_f = y_i + v_{yi}\Delta t + \frac{1}{2}a_y \Delta t^2$

$0 = 0.1524\,m + 0\,m/s\,\Delta t + \frac{1}{2}(-9.8\,m/s^2)\Delta t^2$

$-0.1524\,m = \frac{1}{2}(-9.8\,m/s^2)\Delta t^2$

$\frac{-0.1524\,m}{-4.9\,m/s^2} = \Delta t^2$

$\sqrt{0.031475\,s^2} = \Delta t = 0.1775$

$\boxed{0.18\,s = \Delta t}$

2\. b. accel on Mars $38\% \cdot -9.8\,m/s^2 = 3.72\,m/s^2$

$y_i = 0\,m$

$y_f = ?$

$v_{yi} = 0\,m/s$

$v_{yf} = ?$

$a_y = -3.72\,m/s^2$

$\Delta t = 0.1775$

$y_f = y_i + v_{yi}\Delta t + \frac{1}{2}a_y\Delta t^2$

$y_f = 0\,m + 0\,m/s(0.1775) + \frac{1}{2}(-3.72\,m/s^2)(0.1775)^2$

$y_f = 0 + 0 + {-0.0583\,m}$

$= -0.058\,m$ or $-5.8\,cm$

Something drops 5.8 cm on Mars in 0.1775 or

$5.8\,cm\left(\frac{1\,inch}{2.54\,cm}\right) = $ 2.3 inches

So it's not a safe bet!

It only falls 2.3 inches in the same time that a dollar falls 6 inches on Earth!

4. A ball is thrown straight up from the ground at a rate of 29.4 m/s and falls into a hole 10.0 m below where it starts.
   a. What is its velocity the instant before it hits the bottom of the hole?
   b. How long does it take from release for the ball to pass its original position on the way down?
   c. What is the ball's maximum height?
   d. What is the ball's velocity and acceleration at its maximum height?

↑ 29.4 m/s

a. $y_i = 0\,m$
$y_f = -10.0\,m$
$V_{yi} = 29.4\,m/s$
$V_{yf} = ?$
$a_y = -9.8\,m/s^2$
$\Delta t = ?$

$V_{yf}^2 = V_i^2 + 2a_y\Delta y$
$V_{yf}^2 = (29.4\,m/s)^2 + 2(-9.8\,m/s^2)(-10.0\,m)$
$= \pm 32.6\,m/s$
$-32.6\,m/s = V_{yf}$

b. $y_i = 0\,m$
$y_f = 0\,m$
$V_{yi} = 29.4\,m/s$
$V_{yf} = ?$
$a_y = -9.8\,m/s^2$
$\Delta t = ?$

$y_f = y_i + V_{yi}\Delta t + \frac{1}{2}a_y\Delta t^2$
$0 = 0 + 29.4\,m/s\,\Delta t + \frac{1}{2}(-9.8\,m/s^2)\Delta t^2$
$29.4\,m/s = 4.9\,m/s^2\,\Delta t$
$6.00\,s = \Delta t$

c. $y_i = 0\,m$
$y_f = ?$
$V_i = 29.4\,m/s$
$V_{yf} = 0\,m$
$a_y = -9.8\,m/s^2$
$\Delta t = ?$

$V_{yf}^2 = V_i^2 + 2a_y\Delta y$
$0 = (29.4\,m/s)^2 + 2(-9.8\,m/s^2)\Delta y$
$44.1\,m = \Delta y$

d. Velocity $= 0\,m/s$ at the max height (turning around)
acceleration $= -9.8\,m/s^2$ (gravity always acts.)
If $a = 0$, then the ball will just float since $v = 0$ and $a = 0$ means v is not changing.