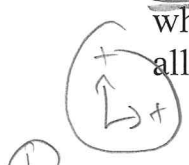
_____ / 19 Name: Anne Sics .

SPH3U 2-D & Projectile Motion Quiz

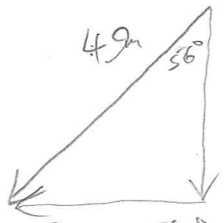
Remember to show all of your work and circle your final answer. Don't forget units and directions!
You may write your answers on this page or separate sheets of paper and staple all pages together before handing in.

1. A bird flies 38 m [N27^{0}E], then 24 m [S18^{0}E], then 49 m [S56^{0}W] in 15 s. Find the bird's:
   a) Total distance traveled. [1]
   b) Resultant displacement. [5]
   c) Average speed. [1]
   d) Average velocity. [1]

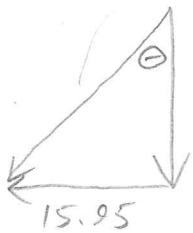
2. Your teacher uses his 6-iron and hits a golf ball from an elevated tee box so that it leaves the ground with a speed of 45 m/s at 34° above the horizon. Of course, the ball lands right in the hole, which is a vertical distance of 12 m below the tee box. (No big deal, he gets holes-in-one all the time…) Determine each of the following values:
   a) How far away, horizontally, is the hole from the tee box? [4]
   b) What is the maximum height of the ball above the hole? [2]
   c) What is the impact velocity of the ball as it lands in the hole? [3]
   d) To really show off his sharp-shootin' ability, your teacher hits a second identical golf shot, and then takes out a gun and shoots a bullet so that it hits the ball at the moment it returns back down to his eye level. If your teacher's eye level is 1.7 m above the ground, and there is a 2.0 s time delay between hitting the ball and shooting the bullet, what is the speed of the bullet? (Hint: You can assume that the bullet does not drop at all in the vertical axis during its motion.) [2]



(1) b)



				Total
In x	$+38 \sin 27°$ $= +17.25$	$+24 \sin 18°$ $= +7.42$	$-49 \sin 56°$ $= -40.62$	-15.95
In y	$+38 \cos 27°$ $= +33.86$	$-24 \cos 18°$ $= -22.83$	$-49 \cos 56°$ $= -27.40$	-16.37



$\Delta\vec{d} = \sqrt{15.95^2 + 16.37^2}$

$= 22.86\text{ m}$

$\theta = \tan^{-1}\left(\frac{15.95}{16.37}\right)$

$= 44.2°$

$\therefore \Delta\vec{d}_R = 22.9\text{ m}\ [S44°W]$

a) $d = 38\text{m} + 24\text{m} + 49\text{m}$

$d = 111\text{ m}$

c) $v_{av} = \frac{d}{\Delta t}$

$= \frac{111\text{ m}}{15\text{ s}}$

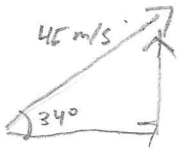
$v_{av} = 7.4\ \frac{\text{m}}{\text{s}}$

d) $\vec{v}_{av} = \frac{\Delta\vec{d}}{\Delta t}$

$= \frac{22.9\text{m}\ [S44°W]}{15\text{ s}}$

$\therefore \vec{v}_{av} = 1.5\ \frac{\text{m}}{\text{s}}\ [S44°$

2.



$V_{iy} = 45 \sin 34°$ ✓ $\quad V_{iy} = 25.2$ m/s

$V_x = 45 \cos 34°$ ✓ $\quad V_x = 37.3$ m/s

a) in the y

$V_i = 25.2$ m/s
$V_2 = NA$
$a = -9.8 m/s^2$
$\Delta d = -12$ m
$\Delta t = ?$

$\Delta d = V_i \Delta t + \frac{1}{2} a \Delta t^2$

$0 = \frac{1}{2} a t^2 + V_i t - d$

$0 = \frac{1}{2}(-9.8) t^2 + 25.2 t - (-12)$

$0 = -4.9 t^2 + 25.2 t + 12$

$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$t = \frac{-25.2 \pm \sqrt{25.2^2 - 4(-4.9)(12)}}{2(-4.9)}$ ✓

$t =$ 5.58 s, ~~-0.439 s~~

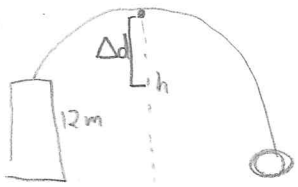
in the x

$V_x = 37.3$ m/s
$\Delta t = 5.58$ s
$\Delta d_x = ?$

$V_x = \frac{\Delta d_x}{\Delta t}$ ✓

$\Delta d_x = V_x \Delta t$
$\Delta d_x = (5.58)(37.3)$
$\therefore \Delta d_x = 208$ m

b)



In y

$V_i = 25.2$ m/s
$V_2 = 0$ m/s
$a = -9.8 m/s^2$
$\Delta d_y = ?$
$\Delta t = NA$

$V_2^2 = V_i^2 + 2a \Delta d_y$

$\Delta d_y = \frac{V_2^2 - V_i^2}{2a}$

$\Delta d_y = \frac{-(25.2)^2}{2(-9.8)}$ ✓

$\Delta d_y = 32.4$ m

32.4 m + 12 m = 44.4 m

∴ max height is 44.4 m ✓

c) In y

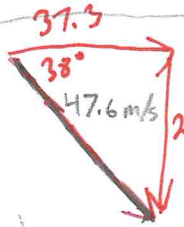
$V_i = 25.2$ m/s
$V_2 = ?$
$a = -9.8 m/s^2$
$\Delta d = -12$ m
$\Delta t = NA$

$V_2^2 = V_i^2 + 2a \Delta d$

$V_2 = \sqrt{V_i^2 + 2a \Delta d}$

$V_2 = \pm\sqrt{25.2^2 + 2(-9.8)(-12)}$ ✓

$V_2 = -29.5$ m/s



$a^2 + b^2 = c^2$

$c = \sqrt{a^2 + b^2}$

$c = \sqrt{37.3^2 + 29.5^2}$ ✓

$c = 47.6$ m/s

$\theta = \tan^{-1}\left(\frac{29.5}{37.3}\right)$

$\theta = 38°$ ✓

$\therefore \vec{V}_{impact} = 47.6$ m/s [38° below horizon]

d) In y (ball)

$V_1 = 25.2$ m/s
$V_2 = NA$
$a = -9.8$ m/s^2
$\Delta d_y = 1.7$ m
$\Delta t = ?$

$\Delta d = V_1 \Delta t + \frac{1}{2} a \Delta t^2$

$0 = \frac{1}{2} a t^2 + V_1 t - d$

$0 = \frac{1}{2}(-9.8)t^2 + 25.2t - 1.7$

$0 = -4.9t^2 + 25.2t - 1.7$

$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$t = \frac{-25.2 \pm \sqrt{25.2^2 - 4(-4.9)(-1.7)}}{2(-4.9)}$

$t = 5.07$ s ✓½ ~~0.068 s~~

In x (ball)

$V_x = 37.3$ m/s
$\Delta t = 5.07$ s
$\Delta d_x = ?$

$V_x = \frac{\Delta d_x}{\Delta t}$

$\Delta d_x = V_x \Delta t$ ✓½

$\Delta d_x = (5.07)(37.3)$

$\Delta d_x = 189$ m

In x (bullet)

$V_{av} = ?$
$\Delta d_x = 189$ m
$\Delta t = 5.07 - 2$ ✓½
$= 3.07$ s

$V_{av} = \frac{\Delta d_x}{\Delta t}$

$V_{av} = \frac{189}{3.07}$ ✓½

$\therefore V_{av} = 61.6$ m/s [fwd]