Physics 10154 - Exam #1c

Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. (30 pts) Adam starts driving from Austin and heads North at a speed of 65 miles/hour toward Waco, which is 120 miles North. Bob starts driving at the same time from Fort Worth and heads South at a speed of 77 miles/hour toward Waco, which is 95 miles South. How far North or South of Waco do the drivers pass one another?

$|\Delta x_A| = 65t$

$|\Delta x_B| = 77t$

$\Delta x_{TOT} = 120 + 95 = 215$

$|\Delta x_A| + |\Delta x_B| = 215$

$65t + 77t = 215$

$t = \frac{215}{142} = 1.514\ hr$

$\Delta x_A = 65t = 98.4\ mi$, which is

22 miles South of Waco

2. (30 pts) A ball is kicked from ground level at an angle of 25° above the horizontal. It hits the ground again 3.3 seconds after it was kicked. How far away does the ball land?

X	Y
$\Delta x = ?$	$\Delta y = 0$
$V_{0x} = V_0 \cos 25$	$V_{0y} = V_0 \sin 25$
$V_x = V_0 \cos 25$	$V_y = ?$
$a_x = 0$	$a_y = -9.8$
$t = 3.3$	$t = 3.3$

$$\Delta y = V_{0y} t + \frac{1}{2} a_y t^2$$

$$0 = (V_0 \sin 25)(3.3) - 4.9(3.3)^2$$

$$V_0 \sin 25 = 4.9(3.3)$$

$$V_0 = 38.26 \text{ m/s}$$

$$V_{0x} = 34.68 \text{ m/s}$$

$$\Delta x = V_{0x} t = (34.68)(3.3) = \boxed{110 \text{ m}}$$

15

3. (40 pts) A ball at ground level is fired up a 15 meter long ramp inclined at 38° above the horizontal with an initial speed of 21 m/s. While on the ramp, the ball slows down at a rate of 3.5 m/s^2. When the ball leaves the ramp, it is in free fall until it returns to ground level.

What is the magnitude and direction of the ball's final velocity just before it hits the ground?

On ramp

$\Delta s = 15$
$v_0 = 21$
$v = ?$
$a = -3.5$
$t = ?$

$v^2 = v_0^2 + 2a\Delta s$

$v^2 = (21)^2 + 2(-3.5)(15)$

$v = 18.3 \text{ m/s}$

$v_x = 18.3\cos 38$
$= 14.44 \text{ m/s}$

$v_y = 18.3\sin 38$
$= 11.27 \text{ m/s}$

$\Delta y = \Delta s(\sin 38^\circ)$
$= 9.23 \text{ m}$

Falling: $v_{0x} = 14.44 \text{ m/s} = v_x$

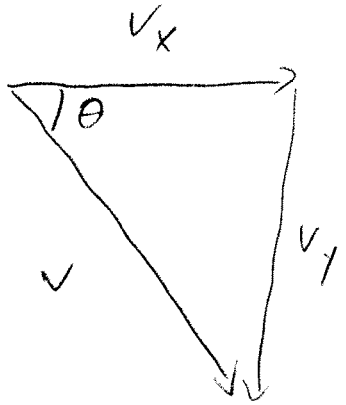
v

$\Delta y = -9.23$
$v_{0y} = 11.27$
$v_y = ?$
$a_y = -9.8$
$t = ?$

$v_y^2 = v_{0y}^2 + 2a_y\Delta y$

$v_y^2 = (11.27)^2 + 2(-9.8)(-9.23)$
$= \pm 17.55$

$v_y = -17.55$



$|v| = \sqrt{14.44^2 + 17.55^2}$
$= \boxed{23 \text{ m/s}}$

$\theta = \tan^{-1}\left(\frac{17.55}{14.44}\right) = \boxed{51^\circ \text{ below } +x}$