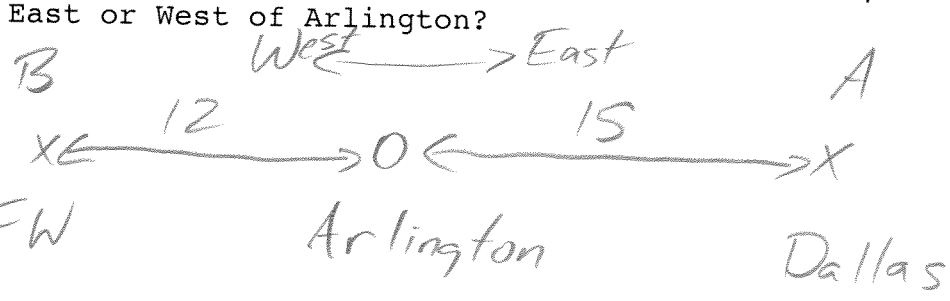
Physics 10154 - Exam #1b

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) Car A is driving due West at 45 miles/hour on I-30 starting from Dallas, 15 miles away from Arlington. Car B is driving due East at 41 miles/hour on I-30 starting from Fort Worth, 12 miles away from Arlington.

How far away from Arlington do the two cars meet, and do they meet East or West of Arlington?



$|\Delta x_A| = 45t$

$|\Delta x_B| = 41t$

$|\Delta x_A| + |\Delta x_B| = 27$

$86t = 27 \Rightarrow t = 0.314\ hr$

$\Delta x_B = (41)(.314) = 12.87\ mi$

so they meet | .87 mi East of Arlington |

2. (30 pts) A ball is thrown at an angle of 33° above the horizontal from ground level and reaches a maximum height of 12 meters above the ground.

a) For how many seconds is the ball in the air?
b) What is the initial speed of the ball?
c) How far (in meters) does the ball land from its starting point?

y (Total)

$\Delta y = 0$

$v_{oy} = v_0 \sin 33°$

$v_y = ?$

$a_y = -9.8$

$t = ?$

y (1st half)

$\Delta y = 12$

$v_{oy} = v_0 \sin 33°$

$v_y = 0$

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

$t = ?$

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

$0 = (v_{oy})^2 + 2(-9.8)(12)$

$v_{oy} = 15.3$

$\Delta y = v_y t - \frac{1}{2} a_y t^2$

$12 = 0 + 4.9t^2$

$t = 1.56\ s$

t_{TOT} should be 3.12 s

Use $v_{oy} = 15.3$ for total motion

$\Delta y = v_{oy} t + \frac{1}{2} a_y t^2$

$0 = 15.3t - 4.9t^2$

$0 = t(15.3 - 4.9t)$

a) $t = 0$, 3.1 s

b) $15.3 = v_0 \sin 33$

$v_0 = 28\ m/s$

c) $\Delta x = v_{ox} t + \frac{1}{2} a_x t^2$

$\Delta x = (28 \cos 33)(3.1)$

$= 74\ m$

3. (40 pts) A puck starts from rest and slides down a straight 2.2 meter long ramp angled 21° below the horizontal with an acceleration of 3.0 m/s^2. The end of the ramp is 12 meters above ground level.

a) For how many seconds is the puck in the air from the time it leaves the ramp until the time it hits the ground?

b) What is the magnitude and direction of the puck's final velocity the instant before it hits the ground?

On ramp

$\Delta s = 2.2$

$v_0 = 0$

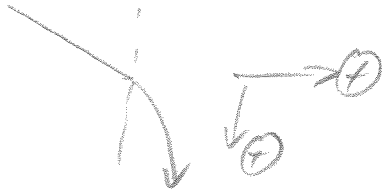
$v = ?$

$a = 3.0\ m/s^2$

$t = ?$

$v^2 = 0^2 + 2(3)(2.2)$

$v = 3.6\ m/s$



In Air

$\Delta x =$

$v_{0x} = 3.6\cos 21°$

$= 3.36$

$v_x = 3.36$

$a_x = 0$

$t = ?$

$\Delta y = +12$

$v_{0y} = +3.6\sin 21°$

$= 1.31$

$v_y = ?$

$a_y = +9.8$

$t = ?$

$v_y^2 = (1.31)^2 + 2(+9.8)(12$

$= 15.4\ m/s$

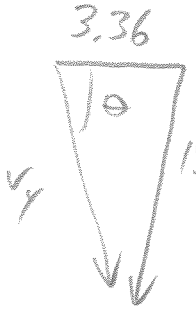
$v_y = v_{0y} + at$

$15.4 = 1.31 + 9.8t$

$t = 1.4\ s$

b) $v_x = 3.36$

$v_y = 15.4$



$|v_y| = \sqrt{3.36^2 + 15.4^2} = 16\ m/s$

$\theta = \tan^{-1}\left(\frac{15.4}{3.36}\right) = 78°$ below $+x$