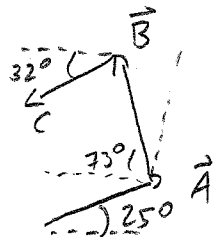
Physics 10154 - Exam #3B

Each problem is worth 50 points. 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. A car drives 33 miles in a direction 25° North of East, then 65 miles in a direction 17° West of North and finally 27 miles in a direction 32° South of West.

Find the magnitude and direction of the car's total displacement.



$A_x = 33 \cos 25 = 29.9$

$A_y = 33 \sin 25 = 13.9$

$B_x = -65 \cos 73 = -19.0$

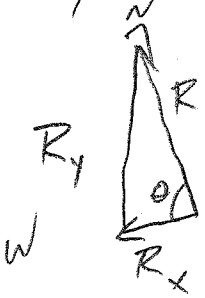
$B_y = 65 \sin 73 = 62.2$

$C_x = -27 \cos 32 = -22.9$

$C_y = -27 \sin 32 = -14.3$

$R_x = 29.9 - 19.0 - 22.9 = -12.0$

$R_y = 13.9 + 62.2 - 14.3 = 61.8$



$|\vec{R}| = \sqrt{12^2 + 61.8^2} = \boxed{63 \text{ miles}}$

$\theta = \tan^{-1}\left(\frac{61.8}{12}\right) = \boxed{79° \text{ N of W}}$

2. A rocket is launched from rest and accelerates for 4.0 seconds at a rate of 46 meters/sec^2 in a straight line, 75° above the horizontal. After that initial 4.0 seconds, the engines cut out and the rocket is in free fall. Assuming it hits the ground at the same elevation from which it was launched, what is the total horizontal displacement from the launch point to the point at which it impacts the ground?

Part 1

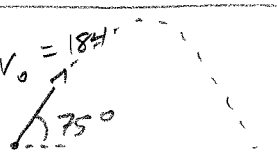
$\Delta s = ?$
$v_0 = 0$
$v = ?$
$a = 46\ m/s^2$
$t = 4.0\ s$

$\Delta s = v_0 t + \frac{1}{2} a t^2$
$= 0 + 23(4)^2 = 368\ m$

$\Delta x = 368 \cos 75 = 95.2$ save for later

$v = v_0 + at$
$= 0 + (46)(4) = 184\ m/s$

Part 2



$\Delta y = -368 \sin 75$
$= -355.46$

$\Delta x = ?$
$v_{0x} = 184 \cos 75 = 47.6$
$v_x = 47.6$
$a_x = 0$
$t =$

$\Delta y = -355.46$
$v_{0y} = 184 \sin 75 = 177.73\ m/s$
$v_y = ?$
$a_y = -9.8\ m/s^2$
$t = ?$

Find t: $\Delta y = v_{0y} t + \frac{1}{2} a t^2$

$-355.46 = 177.73t - 4.9t^2$

$4.9t^2 - 177.73t - 355.46 = 0$

$t = \dfrac{177.73 \pm \sqrt{(177.73)^2 - 4(4.9)(-355.46)}}{9.8} = 18.1 \pm 20$

$= 38.1\ s$

$\Delta x = (47.6)(38.1) = 1813.6$

$\Delta x_{TOT} = 1813.6 + 95.2 = \boxed{1900\ m}$