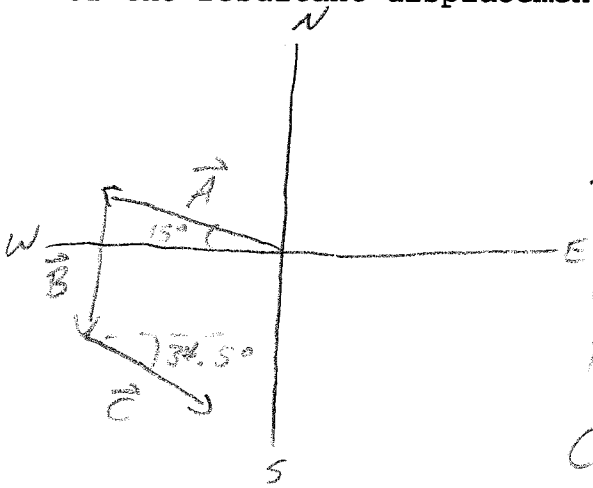
Physics 10154 - Quiz #3B

Please clearly indicate (with a box) your answers to the following problems. SHOW ALL WORK. If I cannot see how you arrived at an answer to a problem, you will lose points.

1. (40 pts) An airplane travels 233 miles in a direction 15.0° North of West, then 122 miles due South, then 145 miles in a direction 34.5° South of East. What is the magnitude and direction of the resultant displacement?



$A_x = -233 \cos 15^\circ = -225$

$A_y = 233 \sin 15^\circ = 60.3$

$B_x = 0$

$B_y = -122$

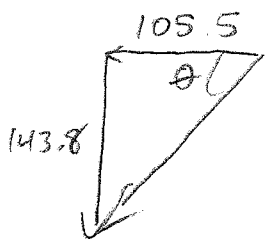
$C_x = 145 \cos 34.5^\circ = 119.5$

$C_y = -145 \sin 34.5^\circ = -82.1$

$R_x = -225 + 0 + 119.5 = -105.5$

$R_y = 60.3 - 122 - 82.1 = -143.8$

$|R| = \sqrt{(-105.5)^2 + (-143.8)^2} = \boxed{178 \text{ miles}}$



$\theta = \tan^{-1}\left(\frac{143.8}{105.5}\right) = \boxed{53.7^\circ \text{ S of W}}$

2. (60 pts) A model rocket starts at rest and accelerates up a 2.50 meter ramp (angled 65.0° above the horizontal) with an acceleration of 145 m/s². After it leaves the launching ramp, the rocket is in free-fall.

a) How long is the rocket in the air? (from moment it leaves ramp) You can assume that "ground level" is the bottom of the ramp.

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

Part 1

$\Delta s = 2.50\ m$

$V_0 = 0$

$V = ?$

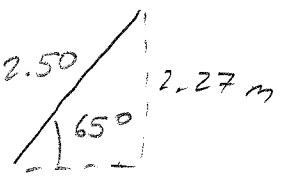
$a = 145\ m/s^2$

$t = ?$

$V^2 = V_0^2 + 2a\Delta s$

$V^2 = 0 + 2(145)(2.5)$

$V = 26.9\ m/s$



Part 2

$\Delta y = -2.27\ m$

$V_{0y} = 26.9 \sin 65° = 24.4$

$V_{0x} = V_x = 26.9 \cos 65°$

$= 11.4\ m/s$

$V_y = ?$

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

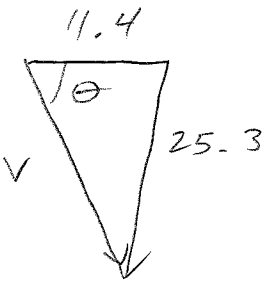
$t = ?$

$V_y = -25.3\ m/s$

$V_y^2 = V_{0y}^2 + 2a\Delta y$

$V_y^2 = (24.4)^2 + 2(-9.8)(-2.27)$

$V_y = -25.3\ m/s$



$|\vec{V}| = \sqrt{(11.4)^2 + (-25.3)^2}$

$= 27.7\ m/s$

$\theta = \tan^{-1}\left(\frac{25.3}{11.4}\right) = 65.7°$ below $+x$

$V_y = V_{0y} + a_y t$

$-25.3 = 24.4 - 9.8t$

$t = \frac{-49.7}{-9.8} = 5.07\ s$