

Physics 10154 - Exam #2C

Answer the following two questions. Be sure to clearly indicate your answer with a circle or box. Show all work. If I cannot see how you arrived at an answer, I will deduct points!

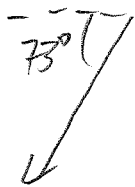
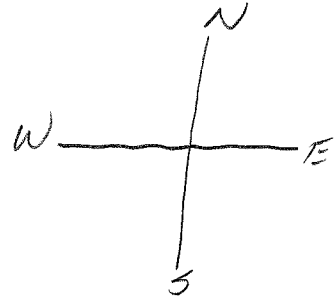
1. A hiker walks along three straight trails:

Trail #1 is 2.5 miles long, 17° West of South.

Trail #2 is 3.1 miles long, 22° South of East.

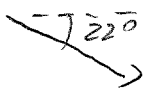
Trail #3 is 1.4 miles long, 63° North of West.

Find the magnitude and direction of the total displacement.



$$A_x = -2.5 \cos 73^\circ = -0.731$$

$$A_y = -2.5 \sin 73^\circ = -2.39$$



$$B_x = 3.1 \cos 22^\circ = 2.87$$

$$B_y = -3.1 \sin 22^\circ = -1.16$$

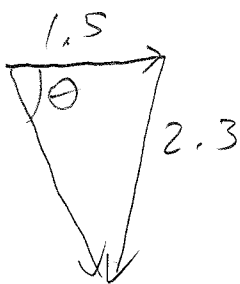


$$C_x = -1.4 \cos 63^\circ = -0.636$$

$$C_y = 1.4 \sin 63^\circ = 1.25$$

$$R_x = A_x + B_x + C_x = -0.731 + 2.87 - 0.636 = 1.50$$

$$R_y = A_y + B_y + C_y = -2.39 - 1.16 + 1.25 = -2.30$$



$$|\vec{R}| = \sqrt{1.5^2 + 2.3^2} = 2.7 \text{ miles}$$

$$\theta = \tan^{-1}\left(\frac{2.3}{1.5}\right) = 57^\circ \text{ S of E}$$

2. A rocket starts at rest and accelerates 27 meters/sec² at an angle of 71° above the horizontal until it reaches a vertical altitude of 350 meters above the ground. From there, the rocket is in free-fall. What is the total horizontal distance from the launching point to the point where the rocket hits the ground again?

Part 1

$$\Delta s = \frac{350}{\sin 71} = 370$$

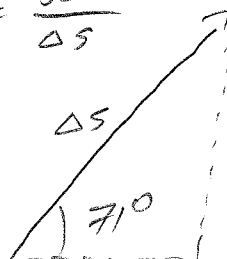
$$v_0 = 0$$

$$v = ?$$

$$a = 27 \text{ m/s}^2$$

$$t = ?$$

$$\sin 71 = \frac{350}{\Delta s}$$



350m

$$\tan 71^\circ = \frac{350}{x}$$

$$x = \frac{350}{\tan 71} = 121 \text{ m}$$

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

$$= 0^2 + 2(27)(370) \Rightarrow v = 141 \text{ m/s}$$

Part 2

$$\Delta x = ?$$

$$\Delta y = -350$$

$$v_{0x} = 141 \cos 71^\circ$$

$$v_{0y} = 141 \sin 71^\circ$$

$$v_x = 141 \cos 71^\circ$$

$$v_y = ?$$

$$a_x = 0$$

$$a_y = -9.8$$

$$t = ?$$

$$t = ?$$

Find t : $-350 = 133t - 4.9t^2$

$$4.9t^2 - 133t - 350 = 0$$

$$t = \frac{133 \pm \sqrt{133^2 - 4(4.9)(-350)}}{9.8} = 13.6 \pm 15.99$$

$$= 29.6 \text{ s}$$

$$\Delta x = (45.9)(29.6) = 1359$$

$$\Delta x_{\text{tot}} = 1359 + 121 = \boxed{1500 \text{ m}}$$

