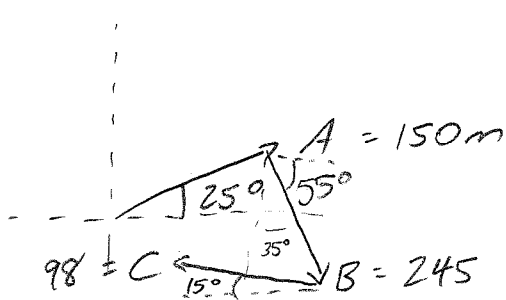


Physics 10154 - Exam #3D

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 treasure hunter following a map walks 150 meters in a direction 25° North of East, then 245 meters in a direction 35° East of South, and finally 98 meters in a direction 15° North of West.

What is the magnitude and direction of the total displacement?



$$\begin{aligned}A_x &= 150 \cos 25 = 135.9 \\A_y &= 150 \sin 25 = 63.4 \\B_x &= 245 \cos 55 = 140.5 \\B_y &= -245 \sin 55 = -200.7 \\C_x &= -98 \cos 15 = -94.7 \\C_y &= 98 \sin 15 = 25.4\end{aligned}$$

$$R_x = 135.9 + 140.5 - 94.7 = 181.7$$

$$R_y = 63.4 - 200.7 + 25.4 = -111.9$$

$$\begin{aligned}|\vec{R}| &= \sqrt{181.7^2 + 111.9^2} = 210 \text{ m} \\ \theta &= \tan^{-1}\left(\frac{111.9}{181.7}\right) = 32^\circ \text{ below } +x \\ &\quad \text{S of E}\end{aligned}$$

$$a = 2.57 \text{ m/s}^2$$

2. Starting from rest, a ball rolls 5.5 meters down a ramp angled 22° below the horizontal. The ball hits the ground 0.85 seconds after leaving the end of the ramp. How high is the bottom of the ramp above ground level?

$$\begin{aligned} \Delta s &= 5.5 \\ v_0 &= 0 \\ v &= ? \\ a &= 2.57 \text{ m/s}^2 \\ t &= ? \end{aligned}$$

$$\begin{aligned} v^2 &= v_0^2 + 2a\Delta s \\ &= 0^2 + 2(2.57)(5.5) \end{aligned}$$

$$v = 5.32 \text{ m/s}$$

$$v_x = 5.32 \cos 22^\circ = 4.93 \text{ m/s}$$

$$v_y = -5.32 \sin 22^\circ = -1.99 \text{ m/s}$$

Free-fall

$$\begin{aligned} \Delta y &= \\ v_{0y} &= -1.99 \text{ m/s} \\ v_y &= ? \\ a_y &= -9.8 \text{ m/s}^2 \\ t &= 0.85 \text{ s} \end{aligned}$$

$$\begin{aligned} \Delta y &= v_{0y}t + \frac{1}{2}a_yt^2 \\ &= (-1.99)(0.85) - 4.9(0.85)^2 \\ &= -5.2 \text{ m} \end{aligned}$$

5.2 m high