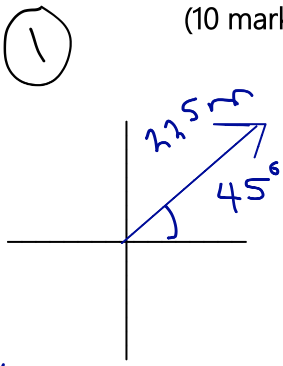
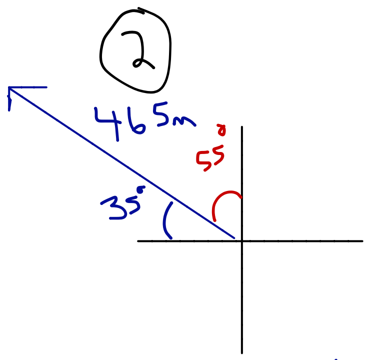
1. In a race, a boat travels a distance of 225m [E 45^0 N] and then makes a turn and travels a distance of 465 m [N 55^0 W] to the finish line. The trip takes 27 s. Using the component method determine the displacement of the boat. Determine the average velocity of the boat.

(10 marks)





$$v_{avg} = \frac{\text{displacement}}{\text{time}} = \frac{\Delta \vec{d}}{\Delta t}$$

x_1: $225m(\cos 45^\circ) = 159.1\,m\,[E]$

y_1: $225(\sin 45^\circ) = 159.1\,m\,[N]$

x_2: $465m(\cos 35^\circ) = 380.9\,m\,[W]$

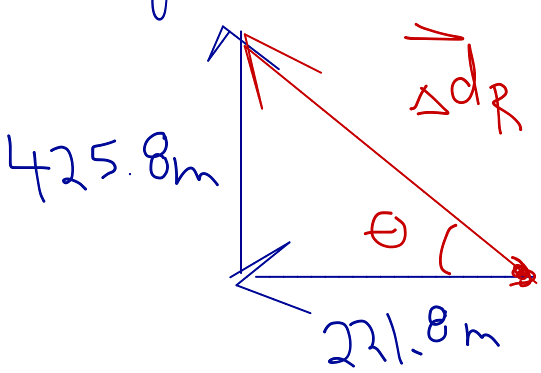
y_2: $465m(\sin 35^\circ) = 266.7\,m\,[N]$

$\Delta \vec{d}_x = 380.9\,m\,[W] - 159.1\,m\,[W]$

$\Delta \vec{d}_x = 221.8\,m\,[W]$

$\Delta \vec{d}_y = 159.1\,m\,[N] + 266.7\,m\,[N]$

$\Delta \vec{d}_y = 425.8\,m\,[N]$



$|\Delta \vec{d}_R| = \sqrt{(221.8)^2 + (425.8)^2}$

$= \sqrt{230{,}501}$

$|\Delta \vec{d}_R| = 480\,m$

$\tan\theta = \frac{425.8}{221.8}$

$\theta = \tan^{-1}\left(425.8/221.8\right)$

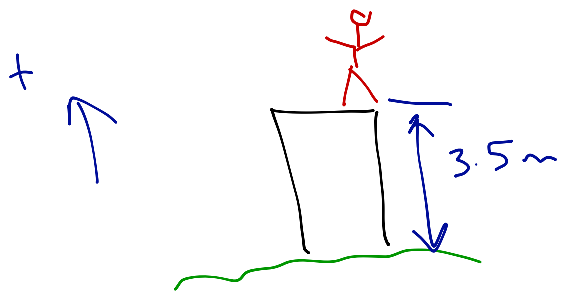
$\theta = 62^0$

$\therefore \Delta \vec{d}_R = 480\,m\,[W\,62^\circ N]$

$\vec{v}_{avg} = \frac{480\,m\,[W\,62^\circ N]}{27\,s}$

$\vec{v}_{avg} = 18\,m/s\,[W\,62^\circ N]$

2. After surviving his "fall" off the school roof another disgruntled Physics student pushes Mr. Neave off the top of the bleachers at the football field. The bleachers are 3.5 m high and Mr. Neave falls straight down. Ignore air resistance. Calculate how long it takes Mr. Neave to hit the ground and the speed he hits the ground at. **(10 marks)**



Given: $a = -9.8\ m/s^2$

$v_1 = 0\ m/s$

$\Delta d_y = -3.5\ m$

RTF: Δt = time

V_2 = Velocity when I hit the ground.

Analysis: Big 5

① $v_2^2 = v_1^2 + 2a\Delta d$

② $V_2 = V_1 + a\Delta t$

Steps

$$V_2^2 = 0 + 2\left(-9.8\ \frac{m}{s^2}\right)(-3.5\ m)$$

$$V_2^2 = 68.6\ \frac{m^2}{s^2}$$

$$V_2 = \sqrt{68.6\ m^2/s^2}$$

$$V_2 = 8.28\ m/s\ [\downarrow]$$

$$V_2 = 8.3\ m/s\ [\downarrow]$$

Δt

$$v_2 = v_1 + a\Delta t$$

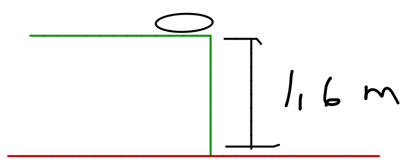
$$-8.28\,\frac{m}{s} = 0\,\frac{m}{s} - 9.8\,\frac{m}{s^2}\,\Delta t$$

$$-8.28\,\frac{m}{s} = -9.8\,\frac{m}{s^2}\,\Delta t$$

$$\Delta t = \frac{-8.28\ m/s}{-9.8\ m/s^2}$$

$$\Delta t = 0.84\ s$$

3. Physics students are performing an experiment and slide a hockey puck off a horizontal desk that is 1.6 metres high. The initial speed of the hockey puck is 2.5 m/s.
   a) Determine how long it takes the hockey puck to hit the ground
   b) Determine the horizontal displacement of the hockey puck
   c) Determine the final velocity (include the angle) at which the hockey puck hits the ground



x

$v_x = 2.5\,m/s$

y

$v_{iy} = 0\,m/s$

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

$\Delta d_y = -1,6\,m$

Analysis

y/

$v_f^2 = v_i^2 + 2a\Delta d$

$v_f = v_i + a\Delta t$

$\Delta t_y = \Delta t_x$

$v_f^2 = 0\,m/s + 2\left(-9,8\,\frac{m}{s^2}\right)(-1.6\,m)$

$v_f^2 = 31,36\,m^2/s^2$

$v_{fy} = 5,6\,m/s\ [\downarrow]$

$v_{fy} = v_{iy} + a\Delta t$

$-5.6\,m/s = 0 + \left(-9.8\,\frac{m}{s^2}\right)\Delta t$

$\Delta t = \frac{-5,6\,m/s}{-9.8\,m/s^2}$

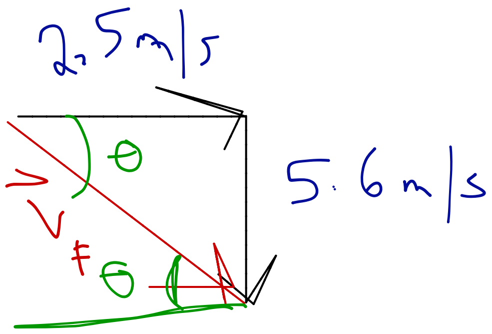
$\Delta t = 0,57\,s$

$v_x = \frac{\Delta d_x}{\Delta t_x}$

$\Delta d_x = v_x \Delta t$

$= \left(2,5\,\frac{m}{s}\right)(0.57\,s)$

$\Delta d_x = 1.4\,m\ [\rightarrow]$



$|\vec{v}_f| = \sqrt{2,5^2 + 5,6^2}$

$|\vec{v}_f| = 6.1\,m/s$

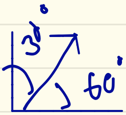
$\tan\theta = \frac{5.6}{2.5}$

$\theta = \tan^{-1}(5.6/2,5)$

$\theta = 66°$

$\therefore \vec{v}_f = 6,1\,m/s\ [66°\text{ from Horizontal}]$

Pg 90 # 8

11 m/s 

Δt to max height?

@ max height $v_y = 0$

$V_2 = 0$

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

$V_1 = 11\ m/s(\sin 60°)$

$= 9.53\ m/s$

$V_2 = V_1 + a\Delta t$

$0\frac{m}{s} = 9.53\frac{m}{s} - 9.8\frac{m}{s^2}\Delta t$

$\Delta t = \frac{-9.53\frac{m}{s}}{-9.8\ m/s^2}$

$\Delta t = 0.97s$

Pg 494 #68

$m = 0{,}35\ g = 0.00035\ kg$
$\ell = 33\ cm = 0{,}33\ m$

$f = 196\ Hz$

RTF:
v = speed of wave
μ = linear density
F_T = tension on string

Analysis
$v = f\lambda$

$\mu = \frac{m}{\ell}$

$v = \sqrt{\frac{F_T}{\mu}}$

$$\mu = \frac{m}{\ell} = \frac{0.00035\ kg}{0.33\ m}$$

$$\mu = 0{,}00106\ kg/m$$