4.) (12 pts) Find the magnitude and direction of the resultant of four displacements:

1 2 3 4

{ 3.50*i* + 4.00*j* } m, { -6.00*i* - 8.50j) m, { -1.5*j* } m, and { 4.5*i* } m.

1.) find total displacement

2.) Find r

3.) Find θ

$$
\begin{array}{r}
3.5\hat{i} + 4\hat{j} \\
-6\hat{i} - 8.5\hat{j} \\
-1.5\hat{j} \\
+ \quad 4.5i \quad \\
\hline
2\hat{i} - 6\hat{j}
\end{array}
$$

$$r = \sqrt{i^2 + j^2} = \sqrt{(2)^2 + (-6)^2}$$

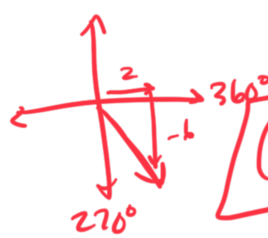
$$\sqrt{4 + 36} = \sqrt{40}$$

$$\sqrt{4} \quad \sqrt{10} = 2\sqrt{10}$$

$$\theta = \tan^{-1}\left(\frac{y}{x}\right)$$

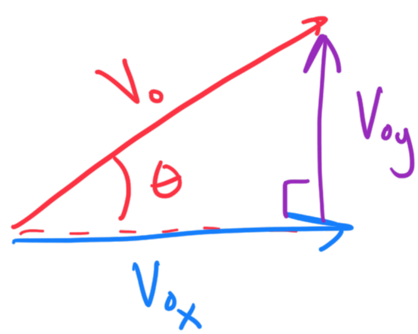
$$\tan^{-1}\left(-\frac{6}{2}\right) = -71.6^\circ$$

$$360 + (-71.6^\circ) = 288.4^\circ$$



$$\boxed{(2\sqrt{10}, 288.4^\circ)}$$

5.) (6 pts) Using angle measure θ and initial velocity, find the component vectors for velocity in the x and y direction. Draw the appropriate diagram (using triangle).

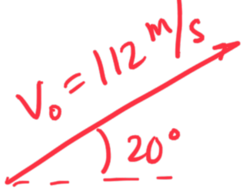


$$V_{ox} = V_o \cos\theta$$

$$V_{oy} = V_o \sin\theta$$

6.) (18 pts, 6 pts) Danger! In an effort to thwart a nefarious battalion of possums, Tampy hurls an assortment of toiletry products from his protective maxi-pad. In one instance, he throws an unravelling roll of double ply Charmin toilet paper with a velocity of 112 m/s at an angle of 20° above the horizontal.

a) Find the horizontal and vertical velocities.



horizontal $V_{0x} = V_0 \cos\theta$

$112 \cos 20° = \boxed{105.3\ m/s}$

vertical $V_{0y} = V_0 \sin\theta$

$112 \sin 20° = \boxed{38.3\ m/s}$

b) Estimate the total time of flight for the charmin.

Have to show the equation.

$y = \cancel{y_0}^{0} + V_{0y} t - 4.9t^2$

$0 = (112 \sin 20)t - 4.9t^2$

$+4.9t^2 \qquad +4.9t$

$\dfrac{4.9t^2}{4.9t} = \dfrac{112 \sin 20\, \cancel{t}}{4.9\cancel{t}}$

$t = \dfrac{112 \sin 20}{4.9} = \boxed{7.8s}$

c) Estimate the distance the toilet paper travels from the maxi-pad.

$X_f = \cancel{X_0}^{0} + V_{0x} t$

$(112 \cos 20)(7.8s) = \boxed{821\ m}$

7.) (12 pts, 6 pts) Undeterred by the quilted softness, the mischievous marsupials continue their bombardment. Frantically, Tampy begins to throw more toiletries.

a) If Tampy can throw Charmin at a maximum velocity of 138 m/s, what is the maximum horizontal distance he can expect to volley it?

$\theta = 45°$

1.) Time of flight

2.) Distance

$y = \cancel{y_0}^{0} + v_{oy}t - 4.9t^2$

$[0 = (138 \sin 45)t - 4.9t^2]$

$+4.9t^2 \qquad +4.9t^2$

$\frac{4.9t^2}{4.9t} = \frac{(138 \sin 45)\cancel{t}}{4.9\cancel{t}}$

$t = 19.9\,s$

$x_f = x_0 + v_{ox}t$

$(138 \cos 45)(19.9)$

$\boxed{1942m}$

b) With squirrels now flying overhead, what is the maximum height Tampy could launch a roll based on the previous maximum velocity (138 m/s) and a trajectory of 70° above the horizontal?

At max height, vel = 0

$v_f = v_0 + at$

$0 = (138 \sin 70) - 9.8t$

$+9.8t \qquad +9.8t$

$\frac{9.8t}{9.8} = \frac{138 \sin 70}{9.8}$

$t = 13.2\,s$

$y = y_0 + v_{oy}t - 4.9t^2$

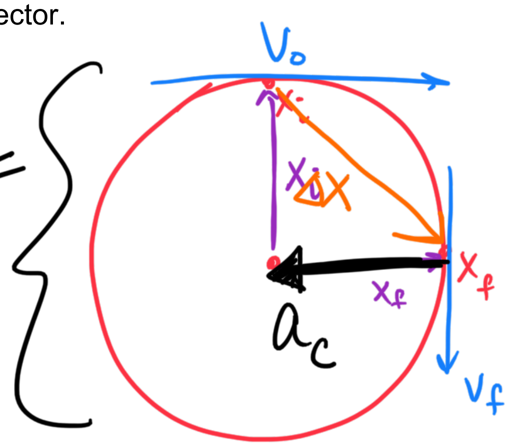
$(138 \sin 70)(13.2) - 4.9(13.2)^2$

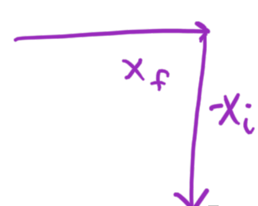
$\boxed{858\,m}$

8.) (6 pts) Draw a free body diagram displaying the motion of an object along a uniform circular path. Include θ, r_i, and v. Define centripetal acceleration and include the appropriate vector.

$\Delta x = x_f - x_i$

memorize





9.) (6 pts) The possums have breached the perimeter! Valiantly, Tampy tries to fend them off, swinging a ~~1.35 kg~~ half used dove bar on a 2.80 m long piece of used ~~piece~~ of dental floss. Find the centripetal acceleration of the dove bar if he is swinging it at 72.0 m/s?

r

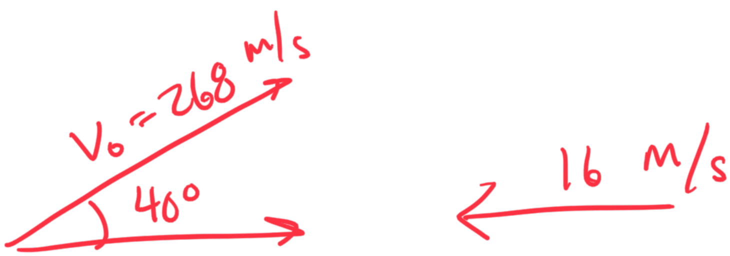
$$a_c = \frac{v^2}{r} = \frac{(72.0\,m/s)^2}{2.80\,m} = \boxed{1851\ m/s^2}$$

10.) (12 pts, 6 pts each) The possums refuse to play dead. With squirrels raining down from above, Tampy resigns himself and begrudgingly executes trash can protocols. The control center rumbles as walls shift and rockets emerge. This maxi-pad has wings.

a) The maxi-pad launches at a velocity of 268 m/s at an angle of 40° above the horizontal. Find the resulting horizontal velocity if the wind is blowing against the ship at 16 m/s.

$x \rightarrow \cos$

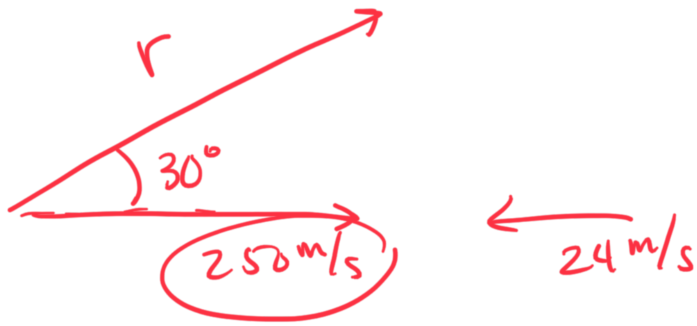
$y \rightarrow \sin$



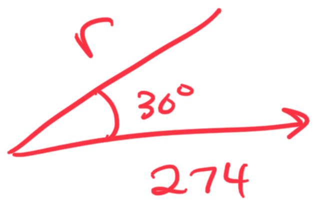
V_x

$$268 \cos 40 - 16 = \boxed{189\ m/s}$$

b) At what velocity will the maxi-pad need to travel at an angle of 30° above the horizontal to reach 250 m/s with a 24 m/s head wind?



$250 + 24 = 274$



$V_x = r\cos\theta$

$$\frac{274}{\cos 30} = \frac{r\cos 30}{\cos 30}$$

$$r = \frac{274}{\cos 30} = \boxed{316 \text{ m/s}}$$