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?

45° for max distance

$4.9t^2 = (138 \sin 45°)t$

$\frac{4.9t}{4.9} = \frac{138 \sin 45°}{4.9}$

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

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

$+4.9t^2 \quad +4.9t^2$

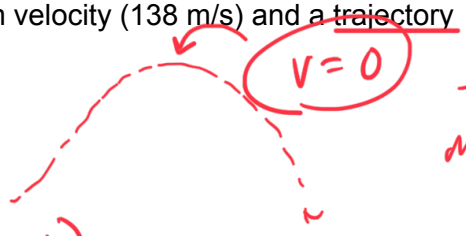
$t = \frac{138 \sin 45°}{4.9} = 19.9\,s$

$x_f = x_0^{0} + v_{ox}t$

$(138 \cos 45)(19.9)$

$= 1941.9\,m$

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?



time to max height $\frac{v_{oy}}{g}$

$v = v_0 + at$

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

$0 = 138 \sin 70° + (-9.8t)$

$+9.8t \quad +9.8t$

$9.8t = 138 \sin 70°$

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

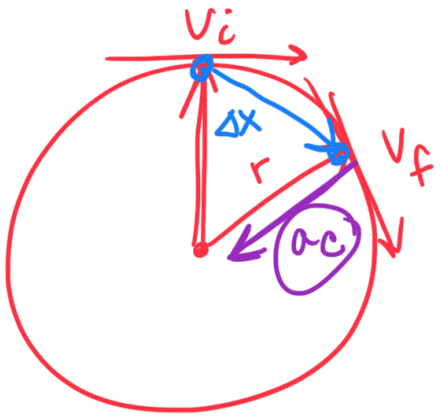
$t = \frac{138 \sin 70°}{9.8}$

$13.23\,s$

$(138 \sin 70°)(13.23) - 4.9(13.23)^2$

$858\,m$

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.

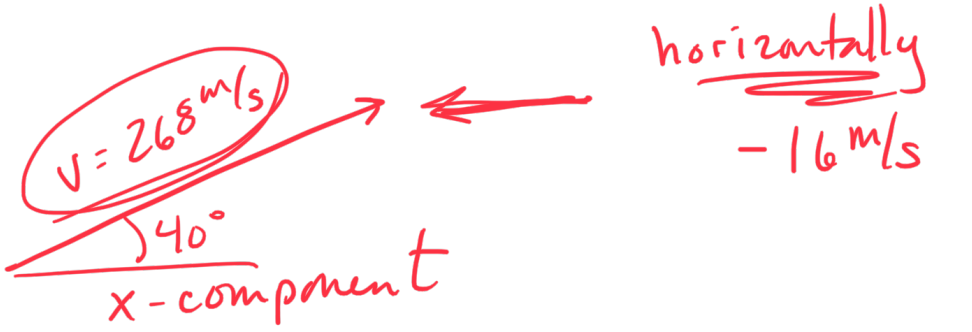


9.) (6 pts) The possums have breached the perimeter! Valiantly, Tampy tries to fend them off, swinging a 1.35 kg half used dove bar on a 2.80 m long piece of used [redacted] of dental floss. Find the centripetal acceleration of the dove bar if he is swinging it at 72.0 m/s?

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

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.

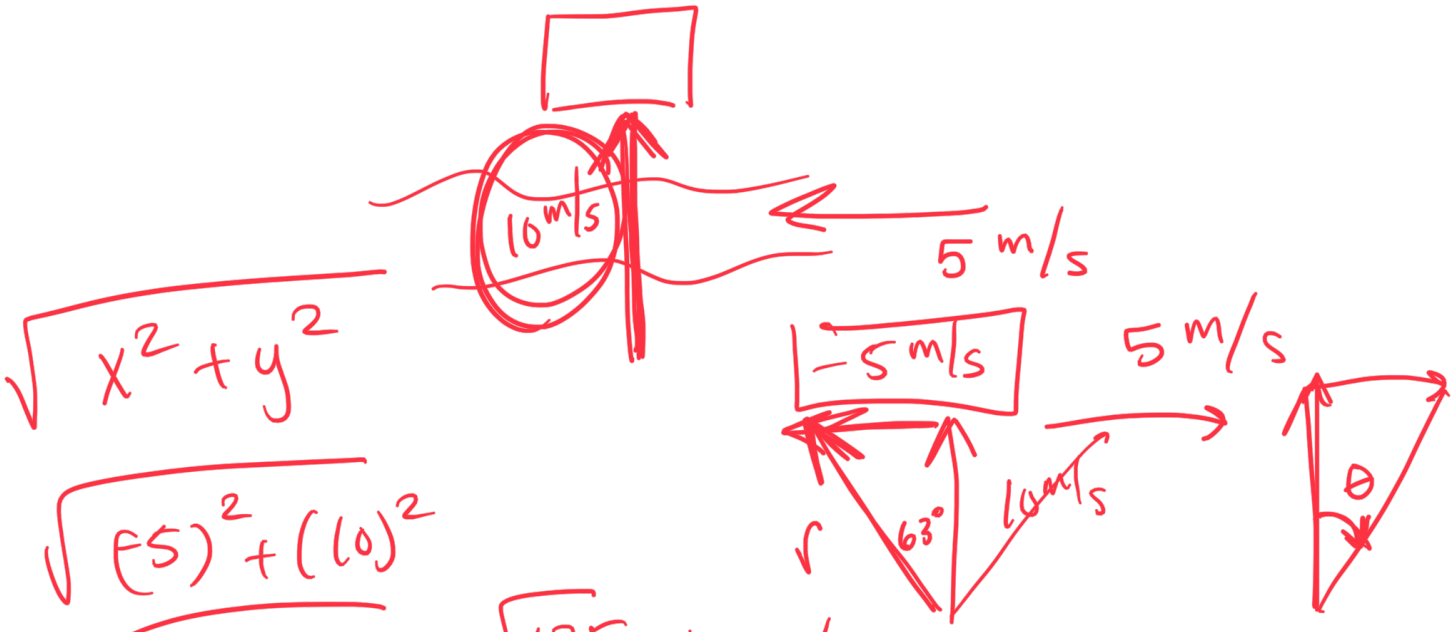
a) The maxi-pad launches at a velocity of 268 m/s at an angle of 40° above the horizontal. Find the resulting horizontal velocity if the wind is blowing against the ship at 16 m/s.



$$x = r\cos\theta$$

$$268\cos 40 - 16 = \boxed{189.3\ m/s}$$

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?



$\sqrt{x^2 + y^2}$

$\sqrt{(-5)^2 + (10)^2}$

$\sqrt{25 + 100} = \sqrt{125} = 11.2 \text{ m/s}$

$\theta = \tan^{-1}\frac{y}{x} = \tan^{-1}\left(\frac{10}{-5}\right) = -63^\circ$

$180 - 63^\circ = 117^\circ$

$11.2 \text{ m/s}, 117^\circ$

actual $\theta = \tan^{-1}\left(\frac{10}{5}\right)$

$= 63^\circ$

11.2 m/s, 63°