Name: STANFORD Date:

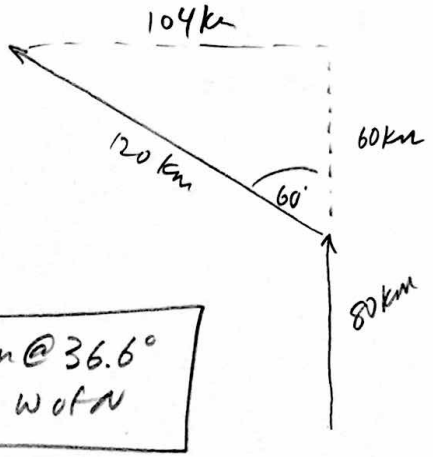
NV College Physics – quiz, chapter 4

Answer all questions and circle or box your answer. Draw diagrams and show all work!

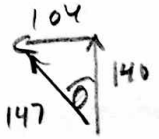
1. An airplane takes off from a runway and flies due north for 80km. The pilot then changes course and flies at an angle of 60° west of north for a distance of 120km.

a) How much further north does the plane end up? 140km

b) How much further west? 104km



c) what is the plane's displacement for the whole journey?



$\theta = \tan^{-1}\left(\frac{104}{140}\right) = 36.6°$

174km @ 36.6° W of N

2. A particle's **velocity** is given by the equation

$v(t) = (8t-9t^2)i + (5-4t)j$

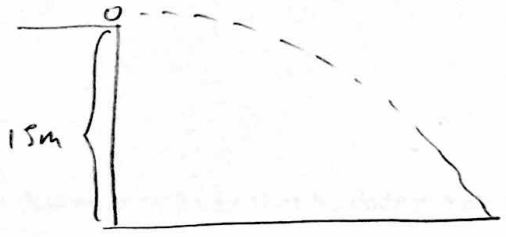
a) Find the equation for the particles acceleration, a(t). $\vec{a}(t) = \frac{d\vec{v}}{dt} = (8-18t)\hat{i} - 4\hat{j}$

b) Find the general equation for particle's displacement, r(t).

$\vec{r}(t) = \int \vec{v}(t)\,dt = (4t^2 - 3t^3 + C)\hat{i} + (5t - 2t^2 + C)\hat{j}$

3. A cannonball at the top of a castle wall is fired horizontally from a height of 15m. It strikes the ground a distance of 560m from the wall. Assume the ground is perfectly level.

a) how long is the cannonball in the air before it hits the ground? $t = 1.75s$



b) What was the initial velocity of the cannonball? 320 m/s

X-DIR

$a = 0$

$V_0 = V = \frac{\Delta x}{t}$

$= \frac{560}{1.75} = 320\ m/s$

Y-DIR

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

$\Delta y = -15m$

$V_0 = 0$

$\Delta y = \frac{1}{2} a t^2$

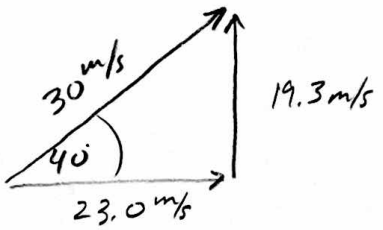
$-15 = -4.9 t^2$

$t = 1.75s$

4. A trick-or-treater out on Halloween night throws a rotten egg at their neighbor's house which is 65m away. The egg is thrown with an initial velocity of 30m/s at an angle of 40° above horizontal.

a) What is the initial horizontal velocity of the egg?

$23.0\ m/s$



b) how long does it take to reach the house?

X-DIR

$v = 23\ m/s$

$\Delta x = 65m$

$t = \frac{\Delta x}{v} = \frac{65}{23} = 2.83s$

c) How high up on the wall does it strike the house?

Y-DIR

$v_0 = 19.3\ m/s$

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

$t = 2.83s$

$\Delta y = (19.3)(2.83) - (4.9)(2.83)^2$

$54.6 - 39.2 = 15.4m$

5. A racecar is heading around a circular turn in the racetrack. At one moment the driver is heading north at 40m/s while turning to his left. The radius of the turn is 80m.

a) what is the acceleration of the driver at that moment? Include the direction!

$a_c = \frac{40^2}{80} = 20\ m/s^2$ west

b) If the driver is traveling at the same speed, how big would the radius have to be so that he does not exceed and acceleration of $10m/s^2$?

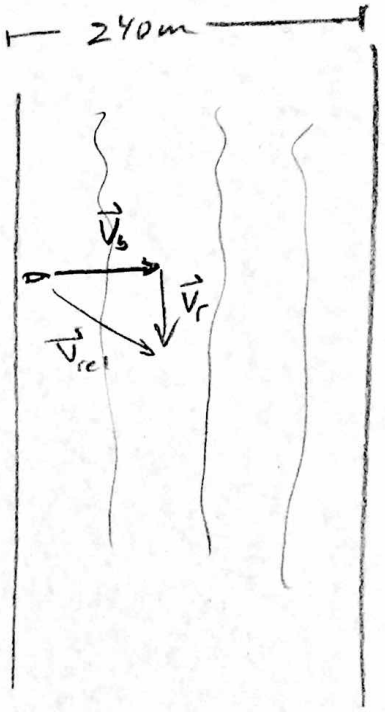
$a_c = 10 = \frac{40^2}{r}$

$r = 160m$

5. A boat is heading eastward (it is pointing to the east) as it crosses a river that is running southward. The river is 240m wide and the banks are parallel. It takes 80 seconds to cross the river and the captain finds that he is 96m downstream when he reaches the far side.

a) What is the speed of the boat relative to the water?

$$|\vec{V}_b| = \frac{240m}{80s} = 3m/s$$



b) what is the speed of the water relative to an observer on shore?

$$|\vec{V}_r| = \frac{96m}{80s} = 1.2\ m/s$$

c) At what angle should the captain have steered the boat so that it followed a straight path across the river going directly to the east?

$$\theta = \sin^{-1}\left(\frac{1.2}{3}\right)$$

$\theta = 23.6°$ North of East