**Physics 200** **Problem set #3**

$M_{Sarge}$=100kg g = 10 m/s$^2$

**1**. After his escapades in Antarctica, Green Sarge is traveling back to Green fairgrounds in a light plane. His airspeed is 100 km/hour. Although the Green fairgrounds is 200 km due north, Sarge turns the plane 20 degrees east of north. Sarge pulls the plane over Green fairgrounds after exactly 2 hours.

a) What is the vector wind velocity?

**2**. Sarge buzzes the fairway once before jumping. He maintains his speed but makes as fast a circle, horizontally, as he can without blacking out. Blackout for Sarge occurs at around 9 times the acceleration due to gravity.

a) What is the fastest speed at which he can cut a 200m-radius path?

**3**. Sarge finally spots his drop zone, the Ferris Wheel of Green Superiority, directly below him. He jumps out backwards hard enough that when he exits the plane, he has zero velocity relative to the ground. Air resistance provides an upward force proportional to his downward velocity. Terminal velocity of the Sarge is 80m/s.

a) What is the drag force as a function of v, the downward velocity?
b) How fast is he going 2 s after jumping?
c) How far does Sarge fall in 20 s?

Sarge deploys his parachute 100 m above the drop zone, which provides drag force that is 8x as high as his body did.

d) What is Sarge's velocity as a function of time?
e) How fast does he impact his DZ (numerical solution/approximation required)?

**4**. Sarge lands, goes to the 8$^{th}$ Annual Green Propaganda carnival, and gets onto the Ferris wheel. It has a 30-meter radius and completes 10 complete revolutions every minute.

a) What is the acceleration of Sarge at the highest point?
b) What is the acceleration of Sarge at the lowest point?

**5**. While on the bottom of the Ferris wheel rotation, Sarge sees two holes blow out of the walls of the 'box' in which he is sitting. He then hears the distinctive 'crack' of a 7.62-mm SVD Dragunov sniper rifle. Knowing that the muzzle velocity of a Dragunov is about 800 m/s, and that the wall of the 'box' wouldn't slow it down, he makes a few calculations. The holes are aligned exactly on the left and right (they're just in front of his knees on the side walls of the box). He also knows the velocity of the Ferris wheel at the bottom of its rotation (question 4).

a) What direction was the bullet fired from, relative to Sarge?