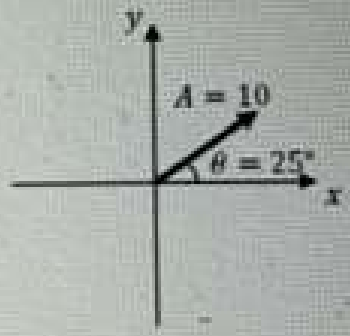
PHY 121 Homework Assignment 1

Dr. MacDonald
ASU Spring 2019
Due: Wednesday, January 16th 2019, in class
Points: 60 (10 per problem)

Problem 1:
Using dimensional analysis, construct a constant, with units of length *only*, out of *all three* of the following fundamental constants of Nature: $\hbar$, G, and c. Here, $\hbar$ is Planck's constant, which has dimensions of $[M][L]^2[T]^{-1}$, G is Newton's gravitational constant, which has dimensions of $[M]^{-1}[L]^3[T]^{-2}$, and c is the speed of light, with dimensions $[L][T]^{-1}$.

Problem 2:
How many hairs do you have on your head? *Do not Google the answer! Use knowledge you already have to make a good estimation of the answer. You must be within the right order of magnitude to receive full credit.*

Problem 3:
Consider the vector $\vec{A}$ shown in the figure, with magnitude given by $A = 10$, that makes an angle of $\theta = 25°$ with the x-axis.



(a) Find a vector, $\vec{B}$, such that $\vec{A} + \vec{B} = 0$. What is the magnitude of $\vec{B}$? Carefully sketch both $\vec{A}$ and $\vec{B}$, making sure they are proportional.
(b) Find a *unit* vector, $\hat{u}$, such that $\vec{A} \cdot \hat{u} = 0$.
(c) Let $\vec{V} = 5\,\hat{x} - 7\,\hat{y}$. Compute $\vec{A} \times \vec{V}$ and $\vec{V} \times \vec{A}$. Compare your answers; does this make sense?

Problem 4: *Problem 1.62 in Young & Freedman*
A plane leaves the airport in Galisteo and flies 170 km at 68.0° east of north; then it changes direction to fly 230 km at 36.0° south of east, after which it makes an immediate emergency landing in a pasture. When the airport sends out a rescue crew, in which direction and how far should this crew fly to go directly to this plane?

Problem 5: *Problem 1.76 in Young & Freedman*
Ricardo and Jane are standing under a tree in the middle of a pasture. An argument ensues, and they walk away in different directions. Ricardo walks 26.0 m in a direction 60.0° west of north. Jane walks 16.0 m in a direction 30.0° south of west. They then stop and turn to face each other.
(a) What is the distance between them?
(b) In what direction should Ricardo walk to go directly toward Jane?