MEGR 3121
Homework 1
Due: Friday Monday 8/29/05

Problem 1: Using the principal of *dimensional homogeneity* (the dimensions of all terms in an equation must be the same) to determine whether the following equations are possibly correct or not correct. Circle the correct response for each and show your work to explain your answers (see Lecture 1 Notes and Chapter 1 for review of units). **Notice that you can tell if an equation is wrong even if you know very little about it!**

(a) Total energy E of a moving particle of mass m, height x, and speed v.

$$E = \frac{1}{2}mv^2 + mgx$$

Circle one and justify in the space below.

Possibly Correct Not Correct

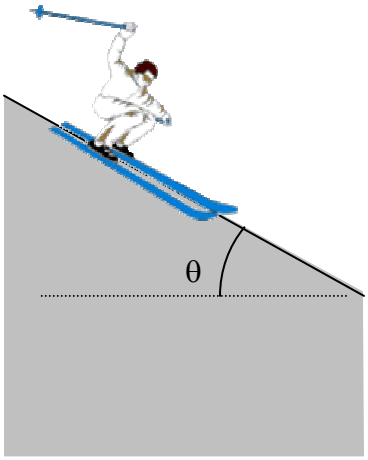
(b) Force on a particle moving with a speed v in a circle of radius R.

$$F = \frac{mv^2}{R^2}$$

Circle one and justify in the space below.

Possibly Correct Not Correct

(c) Maximum speed (so called terminal velocity) reached by a skier on a hill with a constant slope of θ radians. Neglecting air resistance the maximum speed of the skier is limited by the resistance of a very thin water film that forms under the skies due to melting of the ice/snow under pressure and friction. m is the skier's mass, g is the acceleration of gravity, A is the area of the bottom of the skies, h is the thickness of the water film (probably less than 20 micrometers), and η is the dynamic viscosity of the water.



$$V_{\max} = \frac{mgh\sin\theta}{\eta A}$$

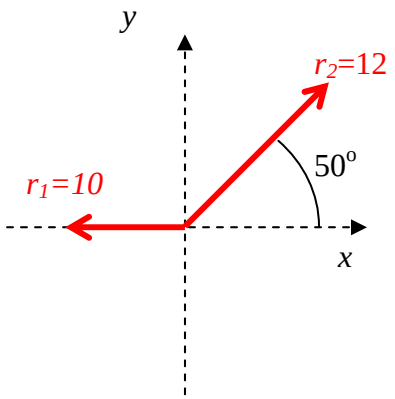
The units of dynamic viscosity are in units of stress multiplied by seconds (see http://www.fact-index.com/v/vi/viscosity.html).

Circle one and justify in the space below.

Possibly Correct Not Correct

Problem 2: This problem is a review of your skills in using vectors. If you are uncomfortable with the calculations here, you should plan to attend one of my vector review sessions (TBA). For the given vectors $\mathbf{r_1}$ and $\mathbf{r_2}$ determine the following:

(a) the sum of the magnitudes $r_1 + r_2$ (Note: In this class bold indicates vector quantities and non-bold represents scalar magnitudes or lengths.)
(b) the vector sum $\mathbf{r_1} + \mathbf{r_2}$
(c) the vector difference $\mathbf{r_1} - \mathbf{r_2}$
(d) the vector dot product $\mathbf{r_1} \cdot \mathbf{r_2}$
(e) the vector cross product $\mathbf{r_1} \times \mathbf{r_2}$



Problem 3: Textbook, Problem 2/1 on Page 31. (You will have to read ahead a little for this one…this is intentional.)