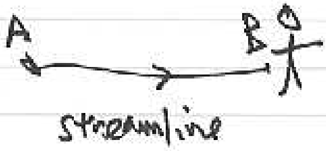
Math 324 Problem 14 Solution 25 March 2004

Use Bernoulli's theorem

$$\tfrac{1}{2}\rho V_A^2 + \rho U_A + P_A = \tfrac{1}{2}\rho V_B^2 + \rho U_B + P_B$$

to estimate the force the wind exerts on you.



Assume the streamline is horizontal, so that $\rho U_A = \rho U_B$ (gravitational potential energy unchanged)

and assume $V_B = 0$ (wind comes to a stop on you).

Then $P_B - P_A = \tfrac{1}{2}\rho V_A^2$.

Also the force on you is $P_B A - P_A A$ where A is your (frontal) surface area, and P_A = atmospheric pressure is also the pressure on your back, in the lee of the wind. Since $V_A = 20$ mph $\doteq 9$ m/s and $\rho \doteq 1$ kg/m^3, we have $P_B - P_A \doteq 40$ N/m^2.

If (my) frontal area is about 0.5 m^2, the net force on me due to pressure ($P_B A$ on the front, $P_A A$ on the back) is about 20 N, which is the weight of about 2 kg, or about 4 pounds. This seems about right in common sense terms.