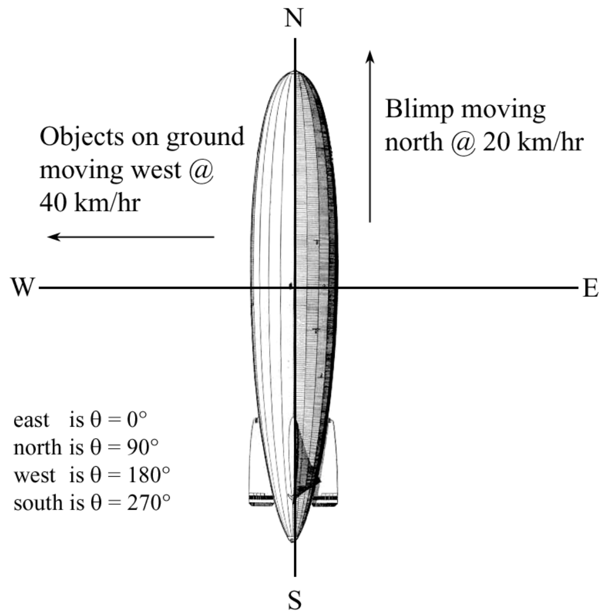
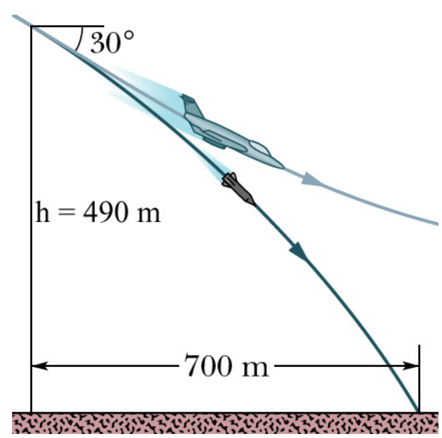
Quiz 1, Phyx 135-1, Fall 2009, Solutions

1) You are on a blimp. From your point of view, the blimp is moving at 20 km/hr due north through perfectly still air. However, when you look out the window, everything on the ground is moving due west at 40 km/hr relative to you. You deduce that the blimp is flying through a strong wind. If east is taken to be $\theta = 0$ as shown at right, from what angle is the wind blowing and what is its speed?



Solution: The blimp is moving 20 km/hr **N** relative to the air, but has no N-S motion relative to the ground, so the air must be moving 20 km/hr **S**. Objects on the ground seem to be moving west, so the wind must be blowing the blimp east at 40 km/hr. Since the wind is blowing to the south and east, it is coming from the NW quadrant. We have $\tan\theta = (-20/40)$, or $\theta = -26.6°$, according to my calculator. However, my calculator is a little dim-witted, and $-26.6°$ corresponds to the SE quadrant. To place the wind into the NW quadrant, I add 180° to get $\theta = 180° - 26.6° = 153.4°$ The wind speed is $[20^2 + 40^2]^{1/2} = 44.7$ km/hr.

2) A jet fighter streaks toward the ground at an angle of 30° below horizontal, as shown at right. It releases a bomb at a point that is 490 m above the ground and 700 m from the target. If the bomb was falling freely (no air friction) after it was released, what was the speed of the jet fighter when it released the bomb? (Hint: Just go ahead and use the equations. Don't let yourself be terrorized by a little algebra.)



Solution: We can set the coordinate origin at the place where the jet releases the bomb ($x_0 = y_0 = 0$). We will denote the jet's speed by S_J. The initial y-velocity of the bomb is then $v_y = S_J \sin(-30°) = -0.5\, S_J$, and its initial x-velocity is $v_x = S_J \cos(30°) = 0.866\, S_J$. We can solve for the bomb's motion using the "standard" equations: $y(t) = y_0 + v_y t - ½ gt^2$ and $x(t) = x_0 + v_x t$.

Substitution into the "standard" equations yields: $-490 = 0 - 0.5\, S_J\, t - ½\,(9.8)t^2$, and $700 = 0 + 0.866\, S_J\, t$. The second (x-axis) equation gives us $t = 808.3/S_J$, and substituting that into the first (y-axis) equation yields: $-490 = -(0.5\, S_J)(808.3/S_J) - ½(9.8)(808.3/S_J)^2$, or $-490 = -404.2 - 3{,}201{,}410 / S_J^2$, or $S_J = (3{,}201{,}410 / 85.5)^{1/2} = 193$ m/s.