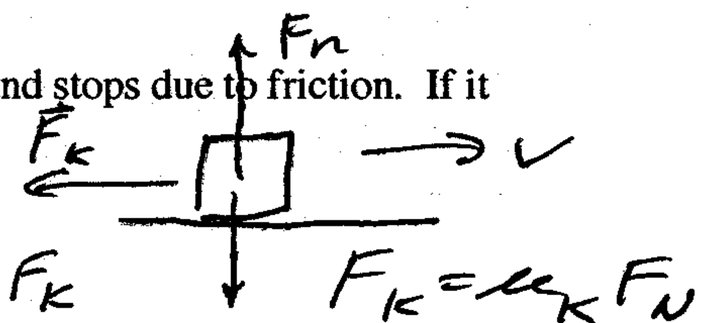
7. A ball is thrown from the top of a building, straight up, at 15 m/s. It hits the ground 6.0 s later. How tall is the building?

$y - y_0 = v_{0y}t - \frac{1}{2}gt^2 = (15\ m/s)(6.0\ s) - \frac{1}{2}(9.8\ m/s^2)(6.0\ s)^2$

$y - y_0 = -86.4\ m$

86 m tall

8. A 22.0 kg mass initially moving at 12.0 m/s on a horizontal surface slows and stops due to friction. If it travels 45.0 m before stopping, what is the coefficient of static friction?




need a $v_f^2 - v_0^2 = 2a(x - x_0)$

$a = \frac{-v_0^2}{2(x - x_0)} = -1.6\ m/s^2$ NII $ma = -F_k$ $F_k = \mu_k F_N$

$= -\mu_k mg$

So $a = -\mu_k g$ $\mu_k = -\frac{a}{g} = 0.16$

9. A cannon is aimed at an angle of 30 degrees above the horizontal and fires a shell at 550 m/s. How far away will the shell land if it lands at the same height it started at (neglect friction)?

Time $v_{yf} - v_{yi} = -gt$ $v_{yf} = -v_{yi}$ $\rightarrow t = \frac{2v_{yi}}{g} = \frac{2v_0 \sin\theta_0}{g} = 56\ s$

horizontal distance $R = v_x t = v_0 \cos 30° t$

$R = 26.7\ km$

10. How long will the cannon shell from problem 9 be in the air before landing?

11. I want to throw a marker into a trash can which is 4.5 m away horizontally and 1.5 m below my hand. If I throw the marker at an angle of 30 degrees above the horizontal, what speed should I throw it at to hit the trash can?

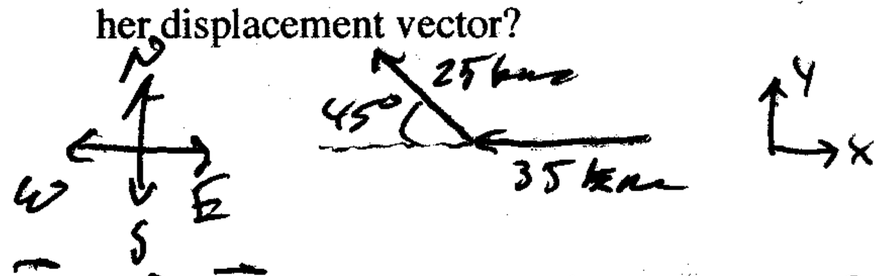
$y - y_0 = -1.5\ m = v_{0y}t - \frac{1}{2}gt^2$, $v_{0x}t = 4.5\ m$

So $t = \frac{4.5\ m}{v_0 \cos 30°} = 5.20\ m/v_0$ and $v_{0y} = v_0 \sin 30° = v_0/2$

So $-1.5\ m = \frac{v_0}{2}\frac{5.20\ m}{v_0} - \frac{1}{2}(9.8\ m/s^2)\frac{(5.20\ m)^2}{v_0^2}$ or $4.1\ m = \frac{132\ m^3/s^2}{v_0^2}$

$v_0 = \sqrt{\frac{132\ m^3/s^2}{4.1\ m}} = 5.7\ m/s$

12. Sue travels 35 km west, then 25 km northwest (at a 45 degree angle to west). What is the magnitude of her displacement vector?




$\vec{A} = 35\ km\ W$

$B_W = (25\ km)\cos 45° = 17.7\ km$ west component

$B_N = (25\ km)\sin 45° = 17.7\ km$ North

$\vec{C} = \vec{A} + \vec{B}$ $C_W = A_W + B_W = 35\ km + 17.7\ km = 52.7\ km$ $C_N = 17.7\ km$

$|\vec{C}| = \sqrt{(52.7)^2 + (17.7)^2}\ km = 55.6\ km$

13. Referring to problem 12, what angle does Sue's displacement vector make with respect to west?


$\alpha = \tan^{-1}\left(\frac{17.7}{52.7}\right) = 18.6°$