Physics 200B, Assignment 3

1. Ch. 2 problem 58

ball flattens ~ 1 cm in bouncing, so it travels ~ 1 cm in going from $v = v_i$ to $v = 0$ (turning around)

to find acceleration, can use $v_{xf}^2 = v_{xi}^2 + 2a_x(x_f - x_i)$

if v_{xi} can be estimated

use "released at chest height" → free falls from height of ~ 1 m

so just before it hits the ground, the speed is

$$v_{xf}^2 = v_{xi}^2 + 2a_x(x_f - x_i)$$
$$= 0 + 2(9.8)(1) \Rightarrow v_{xf} = 4.4 \text{ m/s down}$$

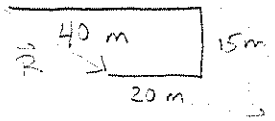
this is v_{xi} for bouncing – accelerates to $v_{xf} = 0$ in a distance of 0.01 m:

$$a_x = \frac{v_{xf}^2 - v_{xi}^2}{2(x_f - x_i)} = \frac{0 - (4.4 \text{ m/s})^2}{2(0.01 \text{ m})} = 980 \text{ m/s}^2 \sim 10^3 \text{ m/s}^2$$

2. Ch. 3 problem 14

start by assuming all right turns:

a)



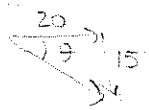
"how far away" $= \vec{r}_f - \vec{r}_i$

take $\vec{r}_i = 0$ (at origin)

$\vec{r}_f = 40\hat{i} - 15\hat{j} - 20\hat{i} = 20\hat{i} - 15\hat{j}$

$|\vec{R}| = |\vec{r}_f - \vec{r}_i| = \sqrt{(20)^2 + (-15)^2} = 25.0 \text{ m}$

b) angle

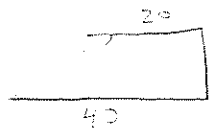


$\theta = \tan^{-1}(15/20) = 36.9°$ CW from +x $(-36.9°)$

(or 323.1° CCW from +x)

c) each turn can be either R or L – we did RR

if LL,



$\vec{R} = 20\hat{i} + 15\hat{j}$

distance is the same: 25.0 m

angle is 36.9° CCW from +x

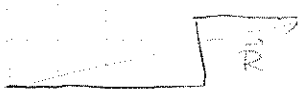
if RL,

$\vec{R} = 40\hat{i} - 15\hat{j} + 20\hat{i} = 60\hat{i} - 15\hat{j}$

distance $|\vec{R}| = 61.8$ m

angle $= \tan^{-1}(-15/60) = -14.0°$

if LR,



$\vec{R} = 60\hat{i} + 15\hat{j}$

$|\vec{R}| = 61.8$ m

angle $+14.0°$