A batter hits a pitched ball whose center is 40 ft above the ground so that its angle of projection is 45° and its range is 350 ft. The ball will be a home run if it clears a 24 ft high fence that is 320 ft away from home plate. Will the ball clear the fence? If so, by how much?

Okay, the book authors confused themselves here - to get the answer in the back of the book, you have to take the 350 ft as being not the range as they defined it, but the distance along the ground.

I'll do this both ways:

1. \[ 350 \text{ ft} = \text{range} \] (as defined in text Sect. 4.6)

We need to know how high the ball is when it is 320 ft from home base and to get this we'll need the velocity \( v_0 \) of the ball:

\[
R = \frac{v_0^2 \sin 2\theta_0}{g} \quad \Rightarrow \quad v_0 = \sqrt{\frac{gR}{\sin 2\theta_0}}
\]

\[
= \sqrt{\frac{(350 \text{ ft})(320 \text{ ft})}{(32 \text{ ft})(45^\circ)}}
\]

\[
= \sqrt{350 \times 320} \times \frac{1}{32 \times \sin 45^\circ}
\]

\[
v_0 = 105.8 \text{ ft/s}
\]

Now use the trajectory formula:

\[
y = x \tan \theta_0 - \frac{gx^2}{2(v_0 \cos \theta_0)^2}
\]

\[
y = (320 \text{ ft})(\tan 45^\circ) - \frac{(32 \text{ ft/s})^2(320 \text{ ft})^2}{2 (105.8 \text{ ft/s} \cos 45^\circ)^2}
\]

\[
= 320 \text{ ft} - 292.7 \text{ ft}
\]

\[
= 27.3 \text{ ft}
\]

But the ball started 4 ft above the ground, so height of ball = 4 ft + 27.3 ft = 31.3 ft above ground it easily clears the 24 ft high fence.

Home Run!