101. (a) With $v_0 = 6.3$ m/s and $R = 0.40$ m, Eq. 4-26 gives

$$\sin 2\theta_0 = \frac{gR}{v_0^2} = 0.0988 \ .$$

Because $\sin(\phi) = \sin(180^\circ - \phi)$, there are two roots of the above equation:

$$2\theta_0 = \sin^{-1}(0.0988) = 5.7^\circ \quad \text{and} \quad 174.3^\circ \ .$$

Therefore, the two possible launch angles that will hit the target (in the absence of air friction and related effects) are $\theta_0 = 2.8^\circ$ and $\theta_0 = 87.1^\circ$. But the juggler is trying to achieve a visual effect by having a relatively high trajectory for the balls, so $\theta_0 = 87.1^\circ$ is the result he should choose.

(b) We do not show the graph here. It would be very much like the higher parabola shown in Fig. 4-51.

(c) , (d) and (e) The problem requests that the student work with his graphs, here, but we – for doublechecking purposes – use Eq. 4-26 to calculate $R - 0.40$ m for $\theta_0 - 87.1^\circ = -2^\circ, -1^\circ, 1^\circ$, and $2^\circ$. We obtain the respective values (in meters) $0.28, 0.14, -0.14$, and $-0.28$.