85. (a) Using the same coordinate system assumed in Eq. 4-21, we obtain the time of flight

$$t = \frac{\Delta x}{v_0 \cos\theta_0} = \frac{20}{15\cos 35^\circ} = 1.63 \text{ s} .$$

(b) At that moment, its height of above the ground (taking $y_0 = 0$) is

$$y = (v_0 \sin\theta_0)\, t - \frac{1}{2} g t^2 = 1.02 \text{ m} .$$

Thus, the ball is 18 cm below the center of the circle; since the circle radius is 15 cm, we see that it misses it altogether.

(c) The horizontal component of velocity (at $t = 1.63$ s) is the same as initially:

$$v_x = v_{0x} = v_0 \cos\theta_0 = 15\cos 35^\circ = 12.3 \text{ m/s} .$$

The vertical component is given by Eq. 4-23:

$$v_y = v_0 \sin\theta_0 - gt = 15\sin 35^\circ - (9.8)(1.63) = -7.3 \text{ m/s} .$$

Thus, the magnitude of its speed at impact is $\sqrt{v_x^2 + v_y^2} = 14.3$ m/s.

(d) As we saw in the previous part, the sign of v_y is negative, implying that it is now heading down (after reaching its max height).