A ball is to be shot from level ground with a certain speed. The figure below shows the range $R$ it will have versus the launch angle $\theta_0$.

a) What is the launch speed?

According to the graph, the maximum range is 300 m. The maximum range is achieved when the projection angle is 45º. The equation for horizontal range yields

$$R_{\text{max}} = \frac{v_0^2}{g} \Rightarrow v_0 = \sqrt{(R_{\text{max}}g)} = 54.2 \text{ m/s}$$

b) The value of $\theta_0$ determines the flight time; let $t_{\text{max}}$ represent the maximum flight time. What is the least speed the ball will have during its flight if $\theta_0$ is chosen such that the flight time is 0.800 $t_{\text{max}}$?

When the ball comes back to the ground level, the vertical displacement is zero. The flight time is

$$0 = v_0 \sin \theta_0 t - \frac{1}{2} gt^2 \Rightarrow t = \frac{2v_0 \sin \theta_0}{g}$$

Since the sine function takes its maximum value (= 1) when $\theta$ is 90º. Thus the maximum flight time is

$$t_{\text{max}} = \frac{2v_0}{g}$$

Since we have to choose the projectile angle so that $t = 0.8t_{\text{max}}$, the angle is

$$2v_0 \sin \theta_0 / g = 0.8(2v_0 / g) \Rightarrow \sin \theta_0 = 0.8 \Rightarrow \theta_0 = 53.1^\circ$$

The speed of the ball is minimum at the peak of the projectile motion, where y component of the velocity is zero. Therefore, the least speed is

$$v_{\text{min}} = v_{0\text{y}} = v_0 \cos \theta_0 = 32.5 \text{ m/s}$$