(a) If $\alpha = 30°$ and $v_0 = 800$ m/ s, then the equations become $x = (800 \cos 30°)t = 400\sqrt{3}t$ and $y = (800 \sin 30°)t - \frac{1}{2}(9.8)t^2$ $= 400t - 4.9t^2$. $y = 0$ when $t = 0$ (when the gun is fired) and again when $t = \frac{400}{4.9} \approx 82$ s. Then $x = \left(400\sqrt{3}\right)\left(\frac{400}{4.9}\right) \approx 56557$ m, so the bullet hits the ground about 56 km from the gun. The formula for y is quadratic in t. To find the maximum y-value, we will complete the square:

$$y = -4.9\left(t^2 - \tfrac{400}{4.9}t\right) = -4.9\left[t^2 - \tfrac{400}{4.9}t + \left(\tfrac{200}{4.9}\right)^2\right] + \tfrac{200^2}{4.9}$$

$= -4.9\left(t - \frac{200}{4.9}\right)^2 + \frac{200^2}{4.9} \leq \frac{200^2}{4.9}$

with equality when $t = \frac{200}{4.9}$ s, so the maximum height attained is $\frac{200^2}{4.9} \approx 8163$ m.

(b) $x = (v_0 \cos\alpha)t \quad \Rightarrow \quad t = \dfrac{x}{v_0 \cos\alpha}$.

$y = (v_0 \sin\alpha)t - 4.9t^2 \quad \Rightarrow \quad y = (v_0 \sin\alpha)\dfrac{x}{v_0 \cos\alpha} - 4.9\left(\dfrac{x}{v_0 \cos\alpha}\right)^2 =$ $(\tan\alpha)x - \left(\dfrac{4.9}{v_0^2 \cos^2\alpha}\right)x^2$, which is the equation of a parabola (quadratic in x).