90. (a) At the point of maximum height, where $y = 140$ m, the vertical component of velocity vanishes but the horizontal component remains what it was when it was launched (if we neglect air friction). Its kinetic energy at that moment is

$$K = \frac{1}{2}(0.55\,\mathrm{kg})v_x^2 \ .$$

Also, its potential energy (with the reference level chosen at the level of the cliff edge) at that moment is $U = mgy = 755$ J. Thus, by mechanical energy conservation,

$$K = K_i - U = 1550 - 755 \quad \Longrightarrow \quad v_x = \sqrt{\frac{2(1550 - 755)}{0.55}}$$

which yields $v_x = 54$ m/s.

(b) As mentioned $v_x = v_{i\,x}$ so that the initial kinetic energy

$$K_i = \frac{1}{2}m\left(v_{i\,x}^2 + v_{i\,y}^2\right)$$

can be used to find $v_{i\,y}$. We obtain $v_{i\,y} = 52$ m/s.

(c) Applying Eq. 2-16 to the vertical direction (with $+y$ upward), we have

$$\begin{aligned} v_y^2 &= v_{i\,y}^2 - 2g\Delta y \\ 65^2 &= 52^2 - 2(9.8)\Delta y \end{aligned}$$

which yields $\Delta y = -76$ m. The minus sign tells us it is below its launch point.