66. (a) Ignoring air friction amounts to assuming that the ball has the same speed v when it returns to its original height.

$$K_i = K_f = \frac{1}{2}mv^2 = \frac{1}{2}(0.050\,\text{kg})(16\,\text{m/s})^2 = 6.4 \text{ J} .$$

(b) The momentum at the moment it is thrown (taking $+y$ upward) is

$$|\vec{p}_i| = |\vec{p}_f| = mv = (0.050\,\text{kg})(16\,\text{m/s}) = 0.80 \text{ kg·m/s} .$$

The vector $\vec{p}_i$ is $\theta = 30°$ above the horizontal, while $\vec{p}_f$ is $30°$ below the horizontal (since the vertical component is now downward). We note for later reference that the magnitude of the change in momentum is

$$|\Delta\vec{p}| = |\vec{p}_f - \vec{p}_i| = 2mv\sin\theta = 0.80 \text{ kg·m/s}$$

and $\Delta\vec{p}$ points vertically downward.

(c) The time of flight for the ball is $t = 2v_i \sin\theta/g$, thus

$$mgt = mg\left(\frac{2v\sin\theta}{g}\right) = 2mv\sin\theta = 2p_i\sin\theta = 0.80 \text{ kg·m/s}$$

which (recalling our result in part (b)) illustrates the relation $|\Delta p| = Ft$ where $F = mg$.