28. We place the reference position for evaluating gravitational potential energy at the relaxed position of the spring. We use x for the spring's compression, measured positively downwards (so $x > 0$ means it is compressed).

(a) With $x = 0.190$ m, Eq. 7-26 gives $W_s = -\frac{1}{2}kx^2 = -7.22$ J for the work done by the spring force. Using Newton's third law, we conclude the work done on the spring is 7.22 J.

(b) As noted above, $W_s = -7.22$ J.

(c) Energy conservation leads to

$$\begin{aligned} K_i + U_i &= K_f + U_f \\ mgh_0 &= -mgx + \frac{1}{2}kx^2 \end{aligned}$$

which (with $m = 0.700$ kg) yields $h_0 = 0.862$ m.

(d) With a new value for the height $h_0' = 2h_0 = 1.72$ m, we solve for a new value of x using the quadratic formula (taking its positive root so that $x > 0$).

$$mgh_0' = -mgx + \frac{1}{2}kx^2 \implies x = \frac{mg + \sqrt{(mg)^2 + 2mgkh_0'}}{k}$$

which yields $x = 0.261$ m.