80. At maximum height, the y-component of a projectile's velocity vanishes, so the given 10 m/s is the (constant) x-component of velocity.

(a) Using v_{0y} to denote the y-velocity 1.0 s before reaching the maximum height, then (with $v_y = 0$) the equation $v_y = v_{0y} - gt$ leads to $v_{0y} = 9.8$ m/s. The magnitude of the velocity vector at that moment (also known as the *speed*) is therefore

$$\sqrt{v_x^2 + {v_{0y}}^2} = \sqrt{10^2 + 9.8^2} = 14 \text{ m/s} .$$

(b) It is clear from the symmetry of the problem that the speed is the same 1.0 s after reaching the top, as it was 1.0 s before (14 m/s again). This may be verified by using $v_y = v_{0y} - gt$ again but now "starting the clock" at the highest point so that $v_{0y} = 0$ (and $t = 1.0$ s). This leads to $v_y = -9.8$ m/s and ultimately to $\sqrt{10^2 + (-18)^2} = 14$ m/s.

(c) With v_{0y} denoting the y-component of velocity one second before the top of the trajectory – as in part (a) – then we have $y = 0 = y_0 + v_{0y}t - \frac{1}{2}gt^2$ where $t = 1.0$ s. This yields $y_0 = -4.9$ m. Alternatively, Eq. 2-18 could have been used, with $v_y = 0$ to the same end. The x_0 value more simply results from $x = 0 = x_0 + (10\,\text{m/s})(1.0\,\text{s})$. Thus, the coordinates (in meters) of the projectile one second before reaching maximum height is $(-10, -4.9)$.

(d) It is clear from symmetry that the coordinate one second after the maximum height is reached is $(10, -4.9)$ (in meters). But this can be verified by considering $t = 0$ at the top and using $y - y_0 = v_{0y}t - \frac{1}{2}gt^2$ where $y_0 = v_{0y} = 0$ and $t = 1$ s. And by using $x - x_0 = (10\,\text{m/s})(1.0\,\text{s})$ where $x_0 = 0$. Thus, $x = 10$ m and $y = -4.9$ m is obtained.