

13. We use  $v_m = \omega x_m = 2\pi f x_m$ , where the frequency is  $180/(60\text{ s}) = 3.0\text{ Hz}$  and the amplitude is half the stroke, or  $x_m = 0.38\text{ m}$ . Thus,  $v_m = 2\pi(3.0\text{ Hz})(0.38\text{ m}) = 7.2\text{ m/s}$ .