68. For each rate, we use distance $d = vt$ and convert to SI using 0.0254 cm = 1 inch (from which we derive the factors appearing in the computations below).

(a) The total distance d comes from summing

$$\begin{aligned} d_1 &= \left(120\,\frac{\text{steps}}{\text{min}}\right)\left(\frac{0.762\,\text{m/step}}{60\,\text{s/min}}\right)(5\,\text{s}) = 7.62\,\text{m} \\ d_2 &= \left(120\,\frac{\text{steps}}{\text{min}}\right)\left(\frac{0.381\,\text{m/step}}{60\,\text{s/min}}\right)(5\,\text{s}) = 3.81\,\text{m} \\ d_3 &= \left(180\,\frac{\text{steps}}{\text{min}}\right)\left(\frac{0.914\,\text{m/step}}{60\,\text{s/min}}\right)(5\,\text{s}) = 13.72\,\text{m} \\ d_4 &= \left(180\,\frac{\text{steps}}{\text{min}}\right)\left(\frac{0.457\,\text{m/step}}{60\,\text{s/min}}\right)(5\,\text{s}) = 6.86\,\text{m} \end{aligned}$$

so that $d = d_1 + d_2 + d_3 + d_4 = 32$ m.

(b) Average velocity is computed using Eq. 2-2: $v_{\text{avg}} = 32/20 = 1.6$ m/s, where we have used the fact that the total time is 20 s.

(c) The total time t comes from summing

$$\begin{aligned} t_1 &= \frac{8\,\text{m}}{\left(120\,\frac{\text{steps}}{\text{min}}\right)\left(\frac{0.762\,\text{m/step}}{60\,\text{s/min}}\right)} = 5.25\,\text{s} \\ t_2 &= \frac{8\,\text{m}}{\left(120\,\frac{\text{steps}}{\text{min}}\right)\left(\frac{0.381\,\text{m/step}}{60\,\text{s/min}}\right)} = 10.5\,\text{s} \\ t_3 &= \frac{8\,\text{m}}{\left(180\,\frac{\text{steps}}{\text{min}}\right)\left(\frac{0.914\,\text{m/step}}{60\,\text{s/min}}\right)} = 2.92\,\text{s} \\ t_4 &= \frac{8\,\text{m}}{\left(180\,\frac{\text{steps}}{\text{min}}\right)\left(\frac{0.457\,\text{m/step}}{60\,\text{s/min}}\right)} = 5.83\,\text{s} \end{aligned}$$

so that $t = t_1 + t_2 + t_3 + t_4 = 24.5$ s.

(d) Average velocity is computed using Eq. 2-2: $v_{\text{avg}} = 32/24.5 = 1.3$ m/s, where we have used the fact that the total distance is $4(8) = 32$ m.