1. An expectant father paces back and forth producing the position-versus-time graph shown here.
(a) Without performing a calculation indicate whether the father’s velocity is positive, negative, or zero on the segments of the graph labeled A, B, C, and D.

Segment A: **Positive**

Segment B: **Zero**

Segment C: **Positive**

Segment D: **Negative**

(b) Calculate the average velocity for each segment and show that your results verify your answers to part (a).

**Velocity is the slope of the position versus time graph**

Segment A:

\[ v_A = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{2m - 0m}{1s - 0s} = 2 \frac{m}{s} \]

Segment B:

\[ v_B = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{2m - 2m}{2s - 1s} = 0 \frac{m}{s} \]

Segment C:

\[ v_C = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{3m - 2m}{3s - 2s} = 1 \frac{m}{s} \]

Segment D:

\[ v_D = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{0m - 3m}{5s - 3s} = -1.5 \frac{m}{s} \]
2. A motorcycle moves according to the velocity-versus-time graph shown. Find the displacement of the motorcycle for each of the segments A, B, and C.

**Displacement is the area under the velocity versus time curve.**

Segment A:

One could use the formula for the area of a triangle.

\[
A = \frac{1}{2} \times b \times h = \frac{1}{2} \times (5 \text{ s}) \times \left( \frac{10 \text{ m}}{\text{s}} \right) = 25 \text{ m}
\]

or one could think about the average velocity during the time interval (0 to 5 s) which is 5 m/s. So the displacement is:

\[
x = \bar{v}t = \left( \frac{5 \text{ m}}{\text{s}} \right) (5 \text{ s}) = 25 \text{ m}
\]

Segment B:

Here both methods turn out to be the same. Whether one thinks about this as the area of a rectangle or the product of average velocity and time, one gets:

\[
x = \bar{v}t = \left( \frac{10 \text{ m}}{\text{s}} \right) (10 \text{ s}) = 100 \text{ m}
\]

Segment C:

\[
x = \bar{v}t = \left( 7.5 \frac{\text{ m}}{\text{s}} \right) (10 \text{ s}) = 75 \text{ m}
\]

or one could add the area of the triangle plus the area of the rectangle underneath the curve.