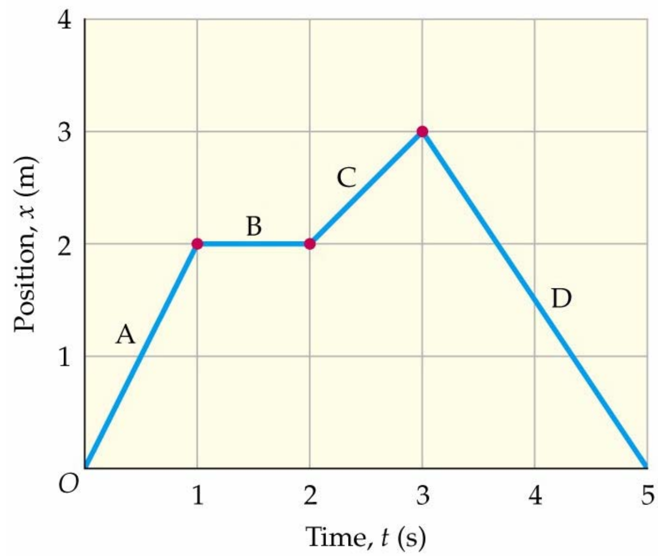
**Physics 151 Class Exercise: Kinematics Graphs - KEY**

1. An expectant father paces back and forth producing the potison-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 C.

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).

Segment A:

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

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

Segment B:

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

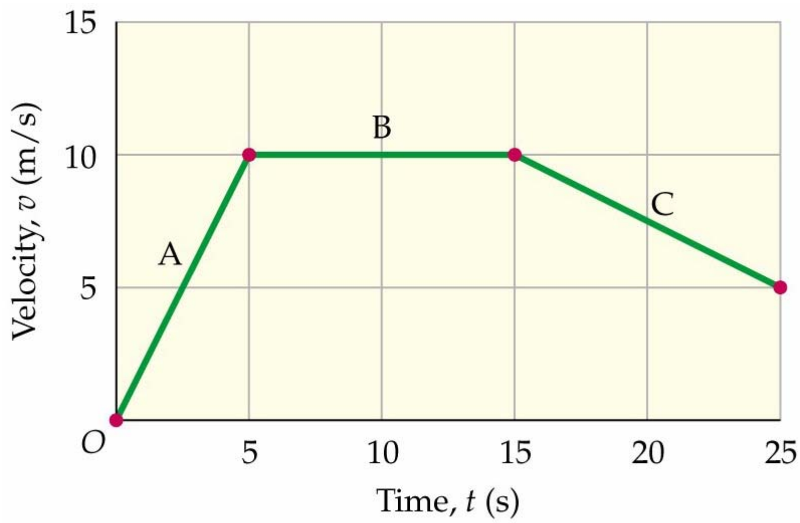
Segment C:

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

Segment D:

$$v_D = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{0\,m - 3\,m}{5\,s - 3\,s} = -1.5\frac{m}{s}$$

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.

$$A = \frac{1}{2}bh = \frac{1}{2}(5\,s)\left(10\frac{m}{s}\right) = 25\,m$$

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:

$$x = \bar{v}t = \left(5\frac{m}{s}\right)(5\,s) = 25\,m$$

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:

$$x = \bar{v}t = \left(10\frac{m}{s}\right)(10\,s) = 100\,m$$

Segment C:

$$x = \bar{v}t = \left(7.5\frac{m}{s}\right)(10\,s) = 75\,m$$

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