Description: Given a table of position versus time, identify graphs of an object's trajectory, velocity, and acceleration.

Constants | Periodic Table

Learning Goal:

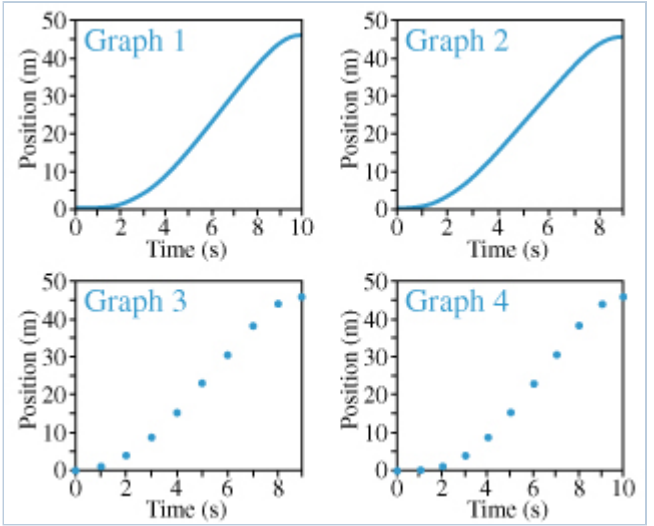
To understand how to graph position, velocity, and acceleration of an object starting with a table of positions vs. time.

The table shows the *x* coordinate of a moving object. The position is tabulated at 1-s intervals. The *x* coordinate is indicated below each time. You should make the simplification that the acceleration of the object is bounded and contains no spikes.

time (s)	0	1	2	3	4	5	6	7	8	9
x (m)	0	1	4	9	16	24	32	40	46	48

Part A

Which graph in best represents the function $x(t)$, describing the object's position vs. time?



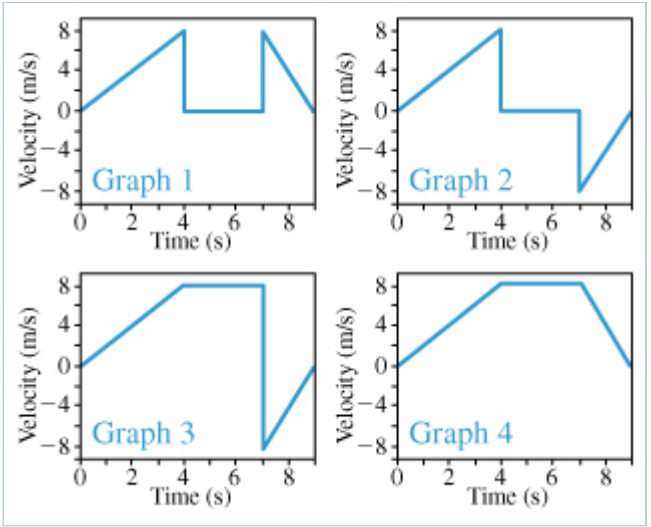
View Available Hint(s) (1)

ANSWER:

- Graph 1
- Graph 2
- Graph 3
- Graph 4

Part B

Which of the following graphs in best represents the function $v(t)$, describing the object's velocity as a function of time?



View Available Hint(s) (3)

ANSWER:

- Graph 1
- Graph 2
- Graph 3
- Graph 4

In principle, you could also just compute and plot the average velocity. The expression for the average velocity is

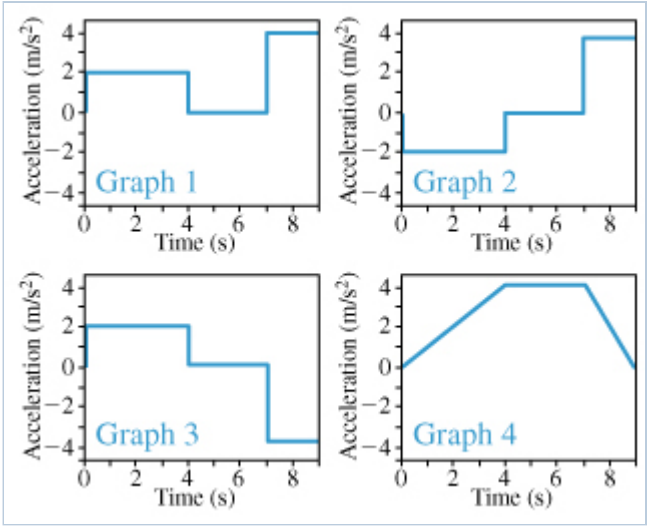
$$v_{\text{avg}}[t_1, t_2] = \frac{x(t_2) - x(t_1)}{t_2 - t_1}.$$

The notation $v_{\text{avg}}[t_1, t_2]$ emphasizes that this is not an instantaneous velocity, but rather an average over an interval. After you compute this, you must put a single point on the graph of velocity vs. time. The most accurate place to plot the average velocity is at the middle of the time interval over which the average was computed.

Also, you could work back and find the position from the velocity graph. The position of an object is the integral of its velocity. That is, the area under the graph of velocity vs. time from $t = 0$ up to time t must equal the position of the object at time t. Check that the correct velocity vs. time graph gives you the correct position according to this method.

Part C

Which of the following graphs in best represents the function $a(t)$, describing the acceleration of this object?



▸ **View Available Hint(s)** (3)

ANSWER:

- Graph 1
- Graph 2
- Graph 3
- Graph 4

In one dimension, a linear increase or decrease in the velocity of an object over a given time interval implies constant acceleration over that particular time interval. You can find the magnitude of the acceleration using the formula for average acceleration over a time interval:

$$a_{\text{avg}}[t_1, t_2] = \frac{v(t_2) - v(t_1)}{t_2 - t_1}.$$

When the acceleration is constant over an extended interval, you can choose any value of t_1 and t_2 within the interval to compute the average.