

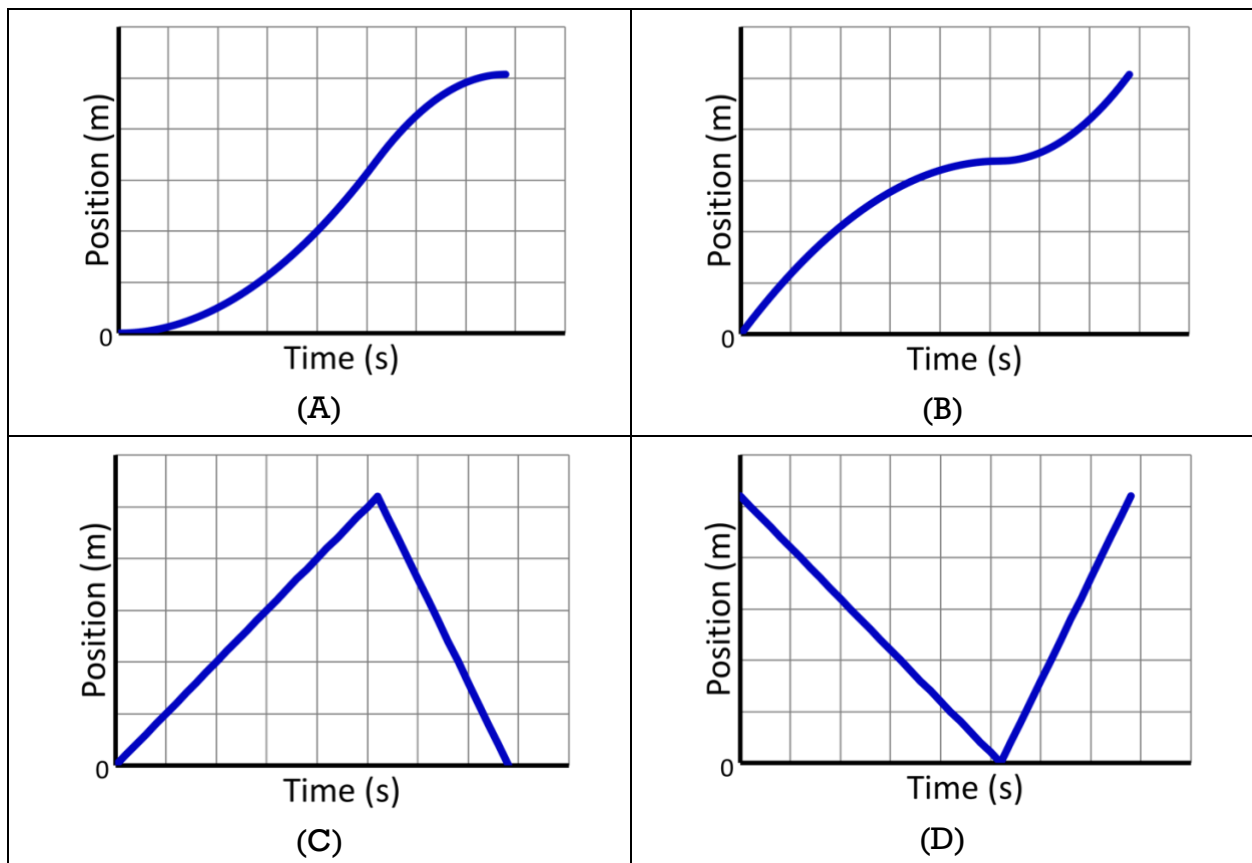
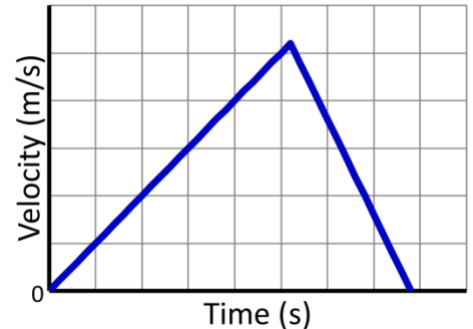


Flipping Physics Lecture Notes:
Motion Graphs - AP Physics 1: Kinematics Review Supplement
<http://www.flippingphysics.com/ap1-kinematics-motion-graphs.html>

This lesson is a part of my AP Physics 1 Ultimate Review Packet. Please consider signing up for access to the whole Review Packet at www.UltimateReviewPacket.com!

I can pretty much **guarantee** you will have problems where you have to interpret position, velocity, and acceleration as functions of time graphs. For example:

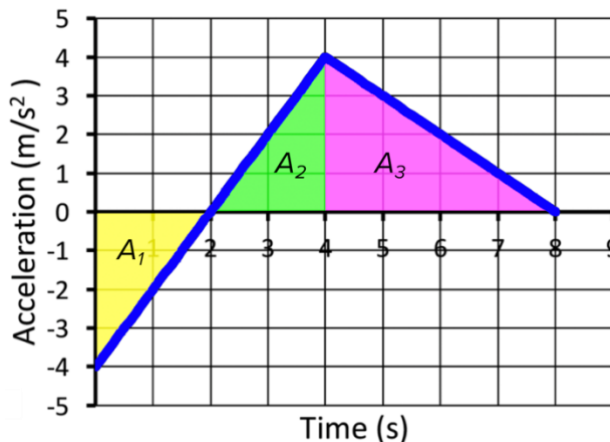
1) You slam your foot down on the accelerator pedal in your car causing it to speed up with a uniform acceleration. After a few seconds, you take your foot off the accelerator pedal and immediately slam it down on the brake pedal, causing your car to slow down with a uniform acceleration. Your velocity as a function of time graph is shown. Which graph could correctly show your position as a function of time?



*The key to remember here is that the slope of a position vs. time graph is velocity. The initial velocity is zero, therefore, the initial **slope** of the position vs. time graph needs to be zero. The only graph which shows that is choice (A). The correct answer is (A).*

2) The graph shows the acceleration of a particle with respect to time. Assuming the velocity of the particle at $t = 0$ seconds is -10 m/s, which of the following is the velocity of the particle at $t = 8$ seconds?

- (A) -2 m/s
- (B) 8 m/s
- (C) 6 m/s
- (D) 18 m/s



The area “under” an acceleration as a function of time graph is change in velocity, however, remember that area under the time axis is negative and area above the time axis is positive.

The area “under” the curve from 0 to 2 seconds and 2 to 4 seconds are of equal magnitude, however, from 0 to 2 seconds the area is negative and from 2-4 seconds the area is positive. In other words, those two areas cancel one another out. Therefore, the only area “under” the curve we need to calculate is from 4 to 8 seconds.

$$A_1 + A_2 = 0$$

$$\text{Area "Under" Curve} = A_3 = \frac{1}{2}bh = \frac{1}{2}(8s - 4s)\left(4\frac{m}{s^2}\right) = 8\frac{m}{s}$$

$$\Rightarrow 8\frac{m}{s} = \Delta v = v_f - v_i = v_f - (-10) = v_f + 10 \Rightarrow v_f = 8 - 10 = -2\frac{m}{s}$$

Correct answer is (A).

Just so you know, the basic concept that:

- the slope of a position versus time graph is velocity,
- the slope of a velocity versus time graph is acceleration,
- the area¹ “under” a velocity versus time graph is change in position,
- the area “under” an acceleration versus time graph is change in velocity,

Will be combined with other topics later in the AP Physics 1 curriculum. 😊

¹ Technically this is the *signed area* or the total area above the horizontal axis minus the total area below the horizontal axis.