3.2 Motion With Constant Acceleration

STANDARDS

3.1 I can interpret and analyze the motion of an object moving with constant acceleration.

3.2 Motion with Constant Acceleration

STANDARDS

Remember...

\[ t \cdot a_{av} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i} \]

Constant-Acceleration Equation of Motion: Velocity as a Function of Time

\[ v_x = v_{xo} + a_x t \]

\[ v_f = v_o + at \]

Constant-Acceleration Equations of Motion

Position as a Function of Time

\[ x = x_o + v_{xo} t + \frac{1}{2} a_x t^2 \]

\[ x_f = x_o + v_{o} t + \frac{1}{2} at^2 \]

Review

Average Acceleration

\[ \bar{a}_{av} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i} \]

Positive and Negative Acceleration

EXAMPLE: How Fast?

A plane is being accelerated uniformly from rest at the rate of 5.0 m/s² for 8.5 s. What final velocity does it attain?

\[ a = 5.0 \text{ m/s}^2 \]
\[ \Delta t = 8.5 \text{ s} \]
\[ v_0 = 0 \]
\[ x_0 = 0 \]

\[ v_f = v_0 + at \]

\[ v_f = (5.0 \text{ m/s})(8.5 \text{ s}) \]

\[ v_f = 42 \text{ m/s} \]

EXAMPLE: How Far?

An automobile starts at rest and speeds up at 3.5 m/s² after the traffic light turns green. How far will it have gone after 5.5 s?

\[ a = 3.5 \text{ m/s}^2 \]
\[ \Delta t = 5.5 \text{ s} \]
\[ v_0 = 0 \]
\[ x_0 = 0 \]

\[ x = x_o + v_{o} t + \frac{1}{2} at^2 \]

\[ x = \frac{1}{2} at^2 = \frac{1}{2}(3.5 \text{ m/s}^2)(5.5 \text{ s})^2 \]

\[ x = 53 \text{ m} \]
3.2 Motion With Constant Acceleration

Constant-Acceleration Equations of Motion

Velocity as a Function of Position

\[ v^2 = v_0^2 + 2a(x-x_0) \]

\[ v_f^2 = v_0^2 + 2a(\Delta x) \]

\[ \Delta x = \frac{v_f^2 - v_0^2}{2a} \]

Example

A drag racer starts from rest and accelerates at 7.40 m/s\(^2\). How fast is it moving after it has gone 20.0 m?

\[ \Delta x = 20.0 \text{ m} \]

\[ v_0 = 0 \]

\[ v_f = ? \]

\[ v_f = \sqrt{2a\Delta x} \]

\[ v_f = \sqrt{2(7.40 \text{ m/s}^2)(20.0 \text{ m})} \]

\[ v_f = 17.2 \text{ m/s} \]

Driving At Night

A park ranger driving on a back country road suddenly sees a deer "frozen" in the headlights. The ranger, who is driving at 11.4 m/s, immediately applies the brakes and slows with an acceleration of 3.80 m/s\(^2\).

Can you have an acceleration when the velocity is zero?

Driving At Night

If the deer is 20.0 m from the ranger's vehicle when the brakes are applied, will he hit the deer?

Driving At Night

How much time is needed for the ranger's vehicle to stop?

\[ v = v_0 + at \]
3.2 Motion With Constant Acceleration

1. Unit 3 Problems (5-9)
2. WORKSHEET