Physics Notes

by

Nada Saab, Ph.D.

http://nhsaab.weebly.com

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Chapter 2. Velocity and Acceleration

2.5 Equations for Motion with Uniform Acceleration;(P2.2F)

Three equations for motion with uniform acceleration are:

Equations for Motion with Uniform Acceleration
$\vec{v}_2 = \vec{v}_1 + \vec{a}\,\Delta t$
$\Delta\vec{d} = \vec{v}_1\,\Delta t + \frac{1}{2}\,\vec{a}\,(\Delta t)^2$
$\Delta\vec{d} = \frac{(\vec{v}_2 - \vec{v}_1)}{2}\,\Delta t$
If the motion is a straight line, the vector notation may be omitted and positive and negative signs used instead.

- $\vec{a}$ represents the object's uniform acceleration

- **Δ**t represents the time interval over which the object's velocity changed

- $\vec{v2}$ represents the object's final velocity at the end of the time interval
- $\vec{v1}$ represents the object's initial velocity at the beginning of the time interval

<u>What to do?</u>

1. Study sample problem below.
2. Do practice exercises numbers 1, 2, 3.
3. Show your work and submit.
4. Answers are shown below (in blue) to verify your work.
5. When submitting, write the section number, Example:

   Section 2.5 (Equations of Uniform Acceleration) Exercises numbers 1, 2, 3.

***Sample Problems*:**

1. A ball rolling down the hill at 4.0 m/s accelerates at 2.0 m/s^2. What is its velocity 5.0 s later?

To solve motion problems with this type, it helps to summarize the given information in algebraic form. this summary is show below

$$v_1 = 4.0 \text{ m/s}$$
$$a = 2.0 \text{ m/s}^2$$
$$\Delta t = 5.0 \text{ s}$$
$$v_2 = ?$$

To solve the problem, we can use one of the equation for uniform acceleration. It must contain v_2 as the only variable for which the value is not know.

$$v_2 = v_1 + a\ \Delta t$$

Substituting the values into this equation yields

$$\begin{aligned} v_2 &= 4.0 \text{ m/s} + (2.0 \text{ m/s}^2)(5.0 \text{ s}) \\ &= 4.0 \text{ m/s} + 10 \text{ m/s} \\ &= 14 \text{ m/s} \end{aligned}$$

The ball reaches a velocity of 14 m/s in 5.0 s.

2.A car traveling at 10 m/s accelerates at 4.0 m/s^2 for 8.0 s. What is its displacement during this intervals?

$$v_1 = 10 \text{ m/s}$$
$$a = 4.0 \text{ m/s}^2$$
$$\Delta t = 8.0 \text{ s}$$
$$\Delta d = ?$$
$$\Delta d = v_1 \Delta t + \frac{1}{2} a (\Delta t)^2$$
$$= (10 \text{ m/s})(8.0 \text{ s}) + \frac{1}{2} (4.0 \text{ m/s}^2)(8.0 \text{ s})^2$$
$$= 80 \text{ m} + (2.0 \text{ m/s}^2)(64 \text{ s}^2)$$
$$= 80 \text{ m} + 128 \text{ m}$$
$$= 208 \text{ m, or } 2.1 \times 10^2 \text{ m}$$

The car's displacement for 8.0 s is 2.1x 10^2 m.

Practice Exercises.

1. A horse running at 4.0 m/s accelerates uniformly to a velocity of 18 m/s in 4.0 s. What is its displacement during the 4.0 s time interval?

3.A car acquires a velocity of 32 m/s by accelerating at 4.0 m/s^2 for 5.0 s. What was its initial velocity?

3. A ball falling from rest is located at 45 m below its starting point 3.0 s later. Assuming that its acceleration is uniform, what is its value?

Answers;

1. 44 m
2.12 m/s
3.10 m/s^2