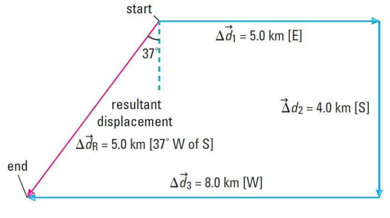
SPH3U UNIVERSITY PHYSICS

KINEMATICS

☞ Motion With Uniform Acceleration (P.36-39)

5 Key Equations for Uniform Acceleration

Graphical analysis is an important tool for physicists to use to solve problems. Sometimes, however, we have enough information to allow us to solve problems algebraically.



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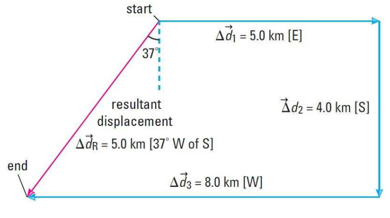
5 Key Equations for Uniform Acceleration

NOTE!

Algebraic methods tend to be quicker and more convenient than graphical analysis.



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5 Key Equations for Uniform Acceleration

As such, there are five key equations for motion with uniform (constant) acceleration.

- $\Delta\vec{d} = \left(\frac{\vec{v}_f + \vec{v}_i}{2}\right)\Delta t$
- $\Delta\vec{d} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2$
- $\Delta\vec{d} = \vec{v}_f\Delta t - \frac{1}{2}\vec{a}\Delta t^2$
- $\vec{v}_f = \vec{v}_i + \vec{a}\Delta t$
- $\vec{v}_f^{\,2} = \vec{v}_i^{\,2} + 2\vec{a}\Delta\vec{d}$

NOTE!
To make these equations somewhat easier to use, the Δ and vector notations are sometimes omitted. However, their meanings are retained.

Kinematics Formulas Summary

UNIFORM MOTION (a=0)

- $v = \frac{d}{t}$

*This can **only** be used when the acceleration is zero!*

NON-UNIFORM MOTION (a ≠ 0)

- $d = \left(\frac{v_i + v_f}{2}\right)t$
- $d = v_i t + \frac{1}{2}at^2$
- $d = v_f t - \frac{1}{2}at^2$
- $v_f = v_i + at$
- $v_f^2 = v_i^2 + 2ad$

where d is the displacement (m)
t is the time interval (s)
v is the velocity (m/s) ☞ *i = initial & f = final*
a is the acceleration (m/s/s or m/s²)

NOTE!
Sometimes 1 and 2 are used as the subscripts instead of i and f.

Uniform Acceleration Problems

PRACTICE

1. A sports car approaches an on-ramp at a velocity of 20.0 m/s[E]. If the car accelerates at a rate of 3.2 m/s²[E] for 5.0 s, what is the displacement of the car?

   d = 140 m[E]

Uniform Acceleration Problems

PRACTICE

2. A sailboat accelerates uniformly from 6.0 m/s[N] to 8.0 m/s[N] at a rate of 0.50 m/s²[N]. What is the displacement of the boat?

   d = 28 m[N]

Uniform Acceleration Problems

PRACTICE

3. A football player initially at rest accelerates uniformly as she runs down the field, travelling 17 m[E] in 3.8 s. What is her final velocity?

   v_f = 8.9 m/s[E]

Uniform Acceleration Problems

PRACTICE

4. A dart is thrown at a target that is supported by a wooden backstop. It strikes the backstop with an initial velocity of 37 m/s[E]. The dart comes to rest in 0.050 s.
   (a) What is the acceleration of the dart?
   (b) How far does the dart penetrate into the backstop?

   (a) a = -740 m/s²[E] or 740 m/s² [W]
   (b) d = 0.93 m[E]

✔ Check Your Learning

TEXTBOOK
P.39 Q.1-6

WIKI (KINEMATICS)
✎.... 3U1 - QUIZ#2 (Motion in 1D – Part 2)