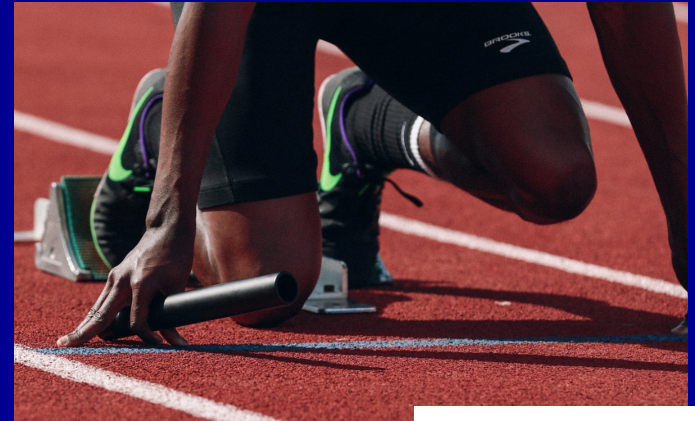


Accelerations in 1 and 2 Dimensions

- Acceleration in 1 dimension
- Units
- Graphing Motion With Constant Acceleration
 - Position-time, velocity-time and acceleration-time
- Constant Acceleration Equations
- Examples
- Acceleration in Two Dimensions
- Examples



$$a = \frac{v_f - v_i}{\Delta t}$$

$$d = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$d = \frac{1}{2} (v_i + v_f) \Delta t$$

$$v_f^2 = v_i^2 + 2a\Delta d$$

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Preview File

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- Some slides appear blank because they have been removed
- Student versions have portions of the text removed which is given in the teacher version and appear as _____ which the students are to fill in
- Other slides may have on them, this represents writing that has been removed on this sample

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Acceleration

- ---
- Velocity is a vector quantity therefore, acceleration is also a vector quantity
- Average acceleration, $\vec{a}_{av}$, is the change in velocity divided by the time interval for that change:

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t}$$

- where $\vec{v}_f$ is the final velocity, $\vec{v}_i$ is the initial velocity, and Δt is the time interval.
- Instantaneous acceleration is the acceleration at any particular instant —but often just referred to as acceleration

Acceleration Units

- What units do you end up with for acceleration?

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t} = \frac{\text{m/s}}{\text{s}} = \text{m/s}^2$$

- _____

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Check Your Understanding

A motorcyclist travelling at 23 m/s [N] applies the brakes, producing an average acceleration of 7.2 m/s² [S]. What is the motorcyclist's velocity after 2.5 s?

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{\Delta t}$$

Check Your Understanding

1. Is it possible to have acceleration when the velocity is zero? If “no,” explain.
2. Is it possible to have an eastward velocity with a westward acceleration? If “no,” explain why not. If “yes,” give an example.
3. A flock of robins is migrating southward. Describe the flock’s motion at instants when its acceleration is (a) positive, (b) negative, and (c) zero. Take the southward direction as positive.

Check Your Understanding

A track runner, starting from rest, reaches a velocity of 9.3 m/s [fwd] in 3.9 s . Determine the runner's average acceleration.



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Check Your Understanding

The fastest of all fish is the sailfish. If a sailfish accelerates at a rate of 14 (km/h)/s [fwd] for 4.7 s from its initial velocity of 42 km/h [fwd], what is its final velocity in km/h and m/s ?



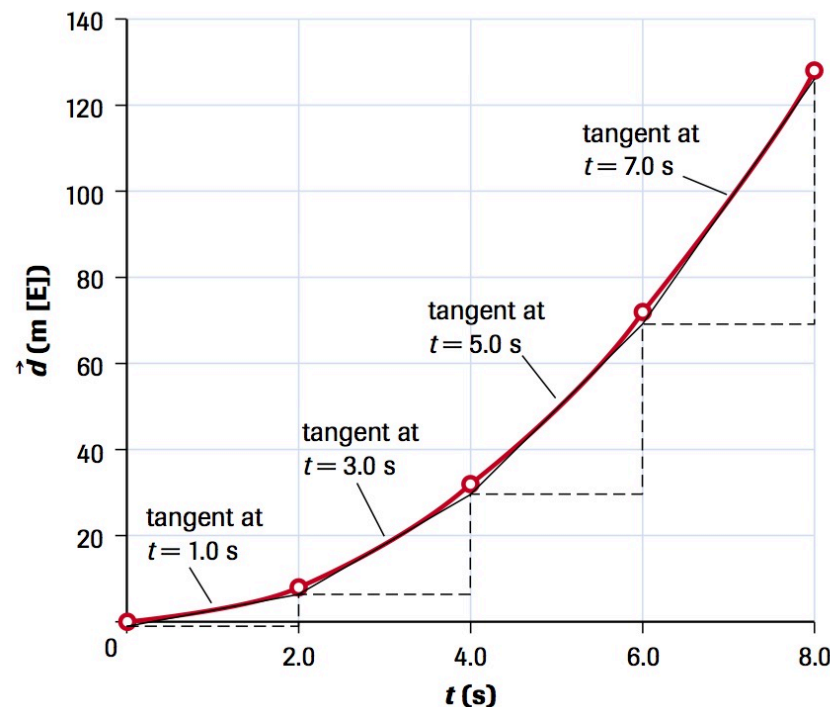
Check Your Understanding

An arrow strikes a target in an archery tournament. The arrow undergoes an average acceleration of $1.37 \times 10^3 \text{ m/s}^2$ [W] in $3.12 \times 10^{-2} \text{ s}$ then stops. Determine the velocity of the arrow when it hits the target.



Graphing Motion with Constant Acceleration

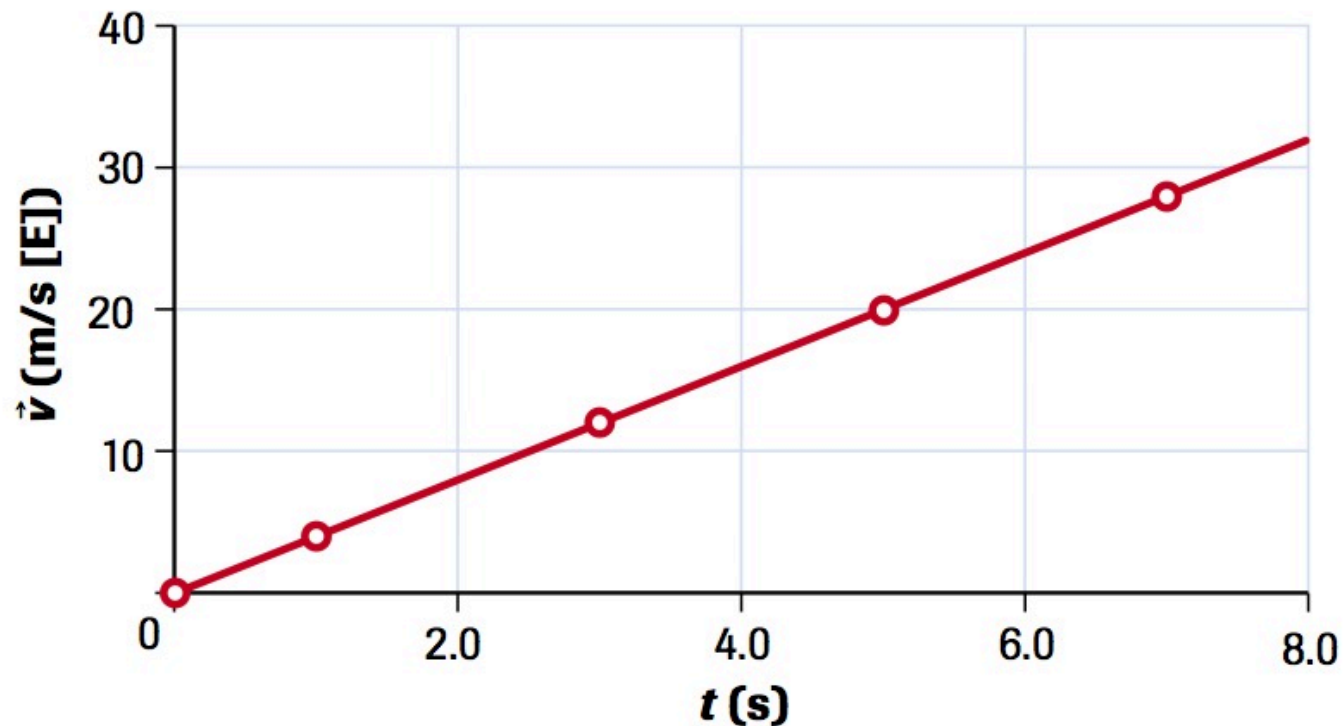
- A speedboat accelerates uniformly from rest for 8.0 s, with a displacement of 128 m [E] over that time interval. See the position-time graph below



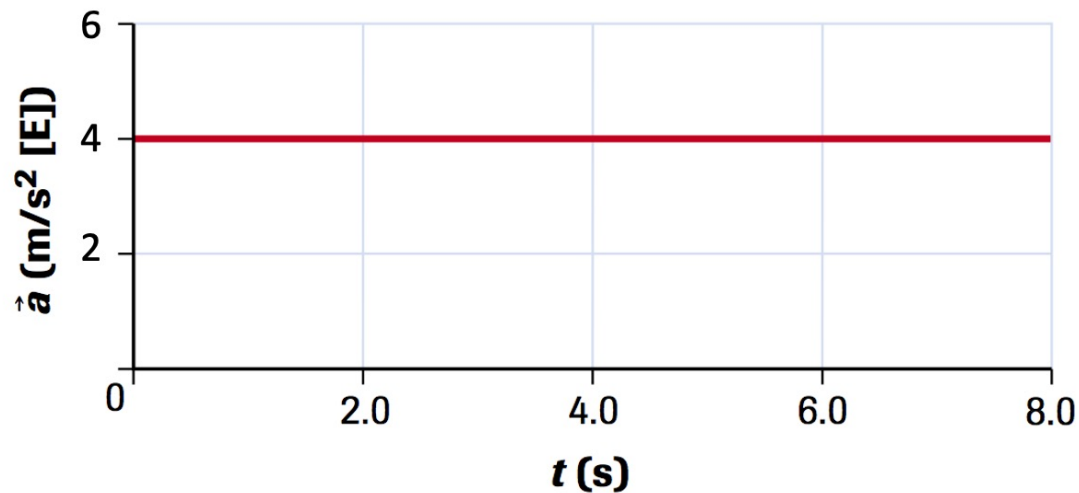
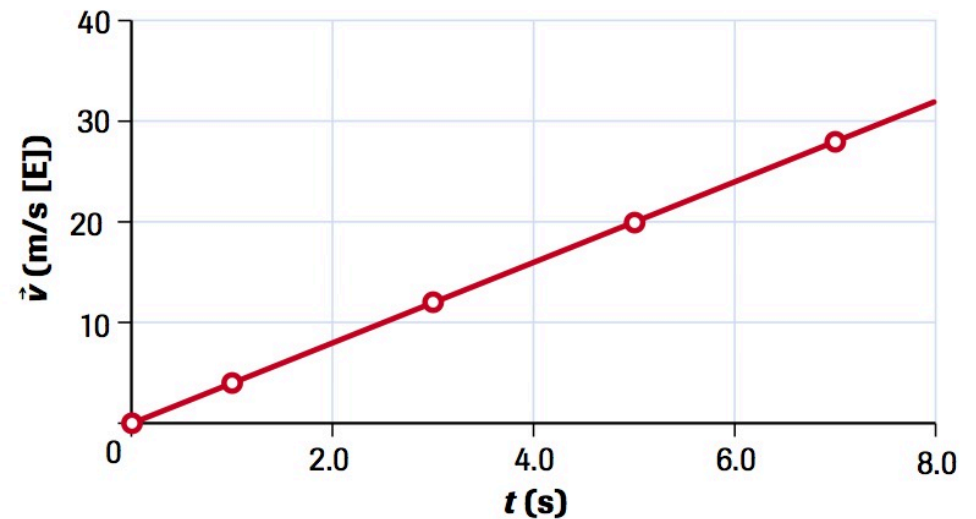
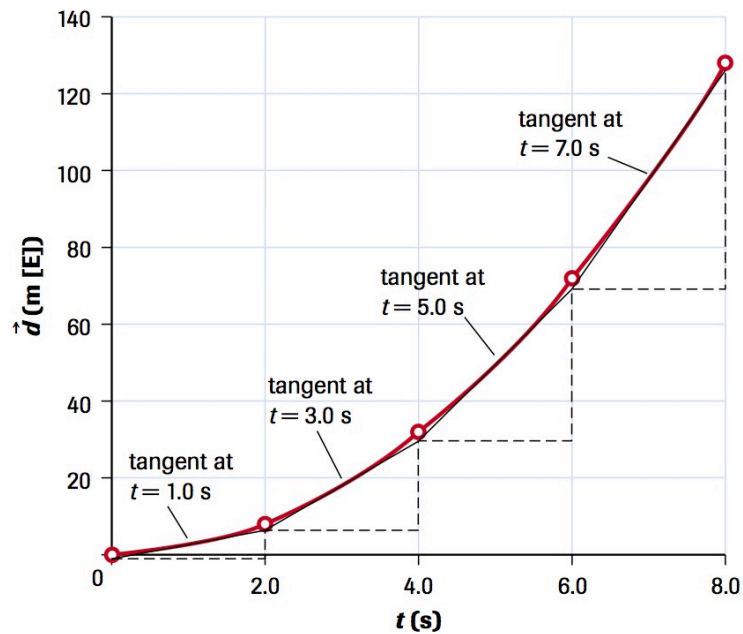
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- The acceleration can be determined from the slope of the line on the v-t graph which is $\frac{\Delta \vec{v}}{\Delta t}$

-



P-T, V-T and A-T Graphs



What the graphs tell us

- The area under the line on a velocity-time graph indicates the change in position over the time interval
- The area under the line on an acceleration-time graph _____

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Constant Acceleration Equations

Use these equations to solve motion problems involving acceleration, displacement, time and velocity.

$$a = \frac{v_f - v_i}{\Delta t}$$

$$d = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$d = \frac{1}{2} (v_i + v_f) \Delta t$$

$$v_f^2 = v_i^2 + 2a\Delta d$$

$$\Delta d = v_f \Delta t - \frac{1}{2} a (\Delta t)^2$$

Solving Equations

- Whenever you are faced with a word problem, the first thing you need to do is determine what is given and what is unknown including all units. By doing this you will prevent a lot of mistakes.
- You must also stipulate your positive direction horizontally and vertically

Check Your Understanding

A motorcyclist, travelling initially at 12 m/s [W], changes gears and speeds up for 3.5 s with a constant acceleration of 5.1 m/s^2 [W]. What is the motorcyclist's displacement over this time interval?

- 1) Determine your Given(s) and Unknown(s) as well as positive direction

← +

Check Your Understanding

A motorcyclist, travelling initially at 12 m/s [W], changes gears and speeds up for 3.5 s with a constant acceleration of 5.1 m/s² [W].

What is the motorcyclist's displacement over this time interval?

$$V_i = 12 \text{ m/s [W]}$$

$$t = 3.5 \text{ s}$$

$$a = 5.1 \text{ m/s}^2 \text{ [W]}$$

$$d = ?$$

2) Choose your equation and solve. Make sure you include your concluding statement

$$a = \frac{v_f - v_i}{\Delta t}$$

$$d = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$d = \frac{1}{2} (v_i + v_f) \Delta t$$

$$v_f^2 = v_i^2 + 2a\Delta d$$

$$\Delta d = v_f \Delta t - \frac{1}{2} a (\Delta t)^2$$

Check Your Understanding

1. A badminton shuttle is struck, giving it a horizontal velocity of 73 m/s [W] . Air resistance causes a constant acceleration of $18 \text{ m/s}^2 \text{ [E]}$. Determine its velocity after 1.6 s .
2. A baseball travelling horizontally at 41 m/s [S] is hit by a baseball bat, causing its
3. Upon leaving the starting block, a sprinter undergoes a constant acceleration of $2.3 \text{ m/s}^2 \text{ [fwd]}$ for 3.6 s . a) displacement and b) final velocity.
4. An electron travelling at $7.72 \times 10^7 \text{ m/s [E]}$ enters a force field that reduces its velocity to $2.46 \times 10^7 \text{ m/s [E]}$. The acceleration is constant and the displacement during the acceleration is 0.478 m [E] . Determine a) the electron's acceleration and b) the time interval over which the acceleration occurs.

Check Your Understanding

A badminton shuttle is struck, giving it a horizontal velocity of 73 m/s [W]. Air resistance causes a constant acceleration of 18 m/s^2 [E]. Determine its velocity after 1.6 s .



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Check Your Understanding

An electron travelling at 7.72×10^7 m/s [E] enters a force field that reduces its velocity to

Acceleration in Two Dimensions

Acceleration in two dimensions _____

Example: A car with a velocity of 25 m/s [E] changes its velocity to 25 m/s [S] in 15 s. Calculate the car's average acceleration.

Check Your Understanding

A car with a velocity of 25 m/s [E] changes its velocity to 25 m/s [S] in 15 s . Calculate the car's average acceleration.

Set [E] and [S] as positive

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Check Your Understanding

A child runs in a curved path from point A to B in 4.5 seconds. What is his average acceleration if his velocity at A is 1.8 m/s $[\text{E } 27^\circ \text{S}]$ and his velocity at B is 1.8 m/s $[\text{N } 15^\circ \text{E}]$