1-DIMENSIONAL MOTION

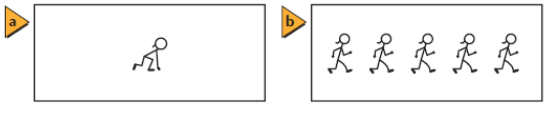
Ch 2

Objectives

- Relate velocity and acceleration to motion
- Create and interpret position-time, velocity-time and acceleration-time graphs
- Perform calculations with displacement, velocity, and acceleration
- Solve problems involving objects in free fall

Velocity

- Motion diagram



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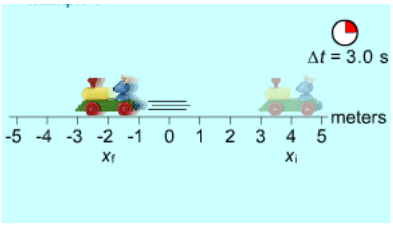
Average Velocity

- Average $\bar{v} = \frac{\Delta x}{\Delta t}$



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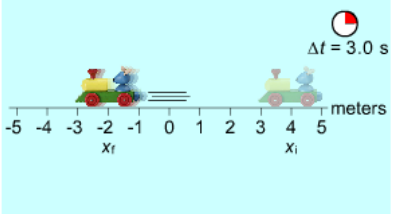
Sketch a position vs time graph



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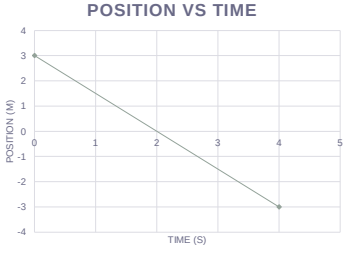
Average Velocity

- Calculate average v using equation.
- How does calculated v relate to graph?



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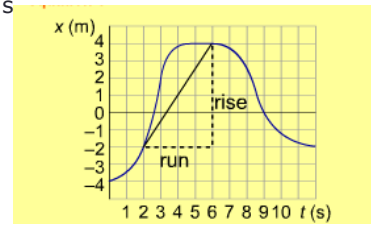
Average Velocity

- Average $\bar{v} = \frac{\Delta x}{\Delta t}$

Calculate average velocity from t = 2 s to t = 6 s



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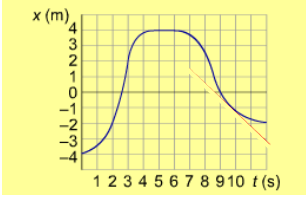
Instantaneous Velocity

- What is the velocity at exactly 9.5 s?



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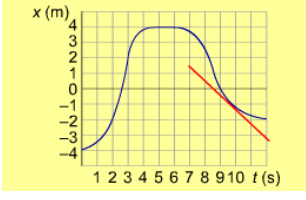
Instantaneous Velocity

- $v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$
- Tangent line



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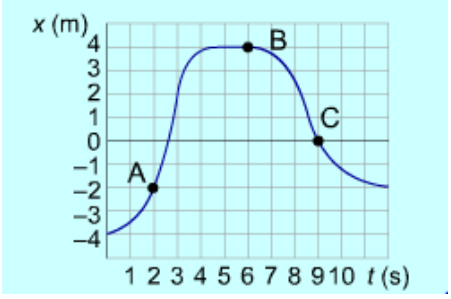

- Describe motion at A, B, C

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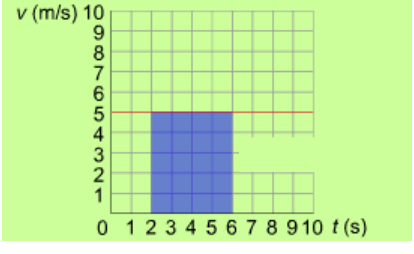
Velocity-time graph

- How far does the object travel from t = 2s to t = 6s?



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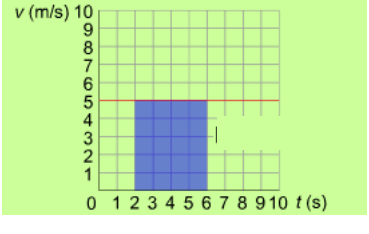
Velocity-time graph

- Use $\Delta v = \frac{\Delta x}{\Delta t}$
- Displacement = area under curve



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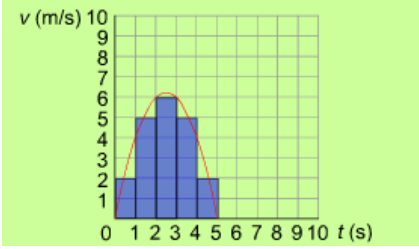
Velocity-time graph

- Displacement = area under curve



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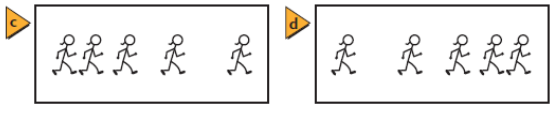
Acceleration

- Motion diagram



- Velocity?
- Acceleration?

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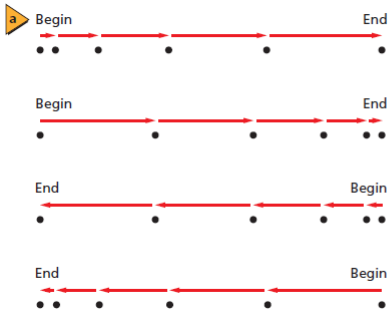
Acceleration



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Acceleration

- Acceleration—change in velocity
- $\bar{a} = \frac{\Delta v}{\Delta t}$

Type of *v*	**Sign of *a* needed to:**
+ v	Speed up:
	Slow down:
- v	Speed up:
	Slow down:

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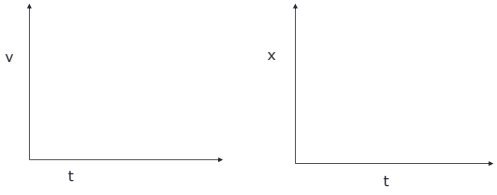
Positive vs Negative Acceleration

- Draw a sketch of v vs t and x vs t for positive acceleration



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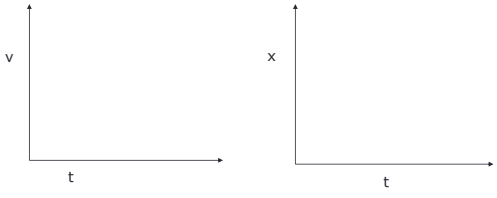
Positive vs Negative Acceleration

- Draw a sketch of v vs t and x vs t for negative acceleration



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- A ball rolls up a slanted driveway. It starts at 2.50 m/s, slows down for 5.00 s, stops for an instant, then rolls back down at an increasing speed.
  - What is the sign of the ball's velocity and acceleration as it rolls up the driveway? Down?
  - What is the magnitude of *a* as it rolls up the driveway? Down?
  - Draw a sketch of this v vs t graph.

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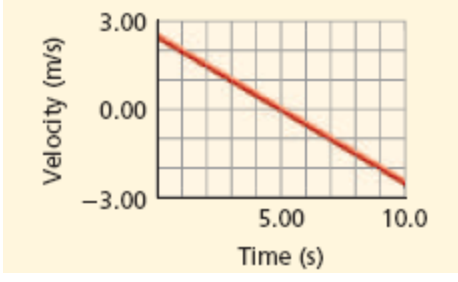

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Velocity vs time graph

- A car is traveling at 25 m/s and constantly decelerates for 50 seconds until it comes to a complete stop.
- Calculate the acceleration
- Draw a sketch of the v vs t graph

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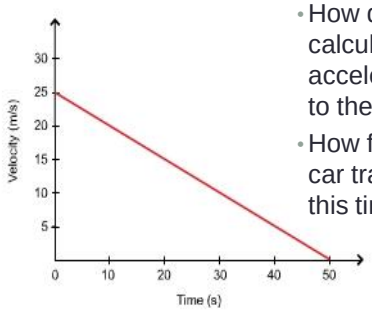
Velocity vs time graph



- How does the calculated acceleration relate to the graph?
- How far has the car traveled during this time?

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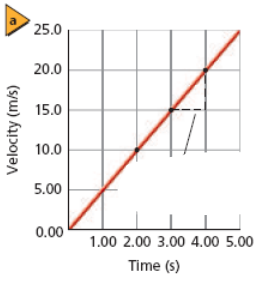
Velocity vs time graph



- Determine both the acceleration and displacement of the moving object described in the graph.

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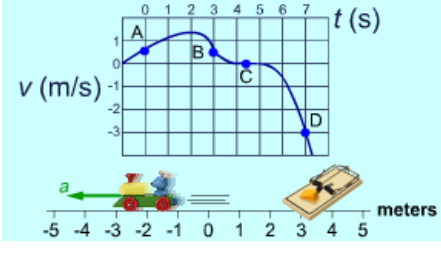
Acceleration and v vs t graph

- Average acceleration
- Instantaneous acceleration



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Motion equations with constant accel.

Equations
$v_f = v_i + at$
$\Delta x = v_i t + \frac{1}{2} at^2$
$v_f^2 = v_i^2 + 2 a\Delta x$
$\Delta x = ½(v_i + v_f)t$

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Problem set up (give it a try)

- Knowns
- Unknowns
- Equations
- Work
- Solution

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Practice questions

- A jet lands on an aircraft carrier at 63 m/s. What is the acceleration if it stops in 2.0 s?

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Practice questions

- A car initially traveling at 15.0 m/s accelerates at a constant rate of -2.00 m/s^2. If the car's final velocity is 10.0 m/s, how long was the period of acceleration?

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Practice questions

- A car moves at 25 m/s and coasts up a hill with a uniform acceleration of -1.5 m/s^2.
  - What is its displacement after 6.0 s?
  - What is its displacement after 9.0 s?

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Practice questions

- A plane starting at rest at one end of a runway undergoes a uniform acceleration of 4.8 m/s^2 for 15 s before takeoff.
  - What is its speed at takeoff?
  - How long must the runway be for the plane to be able to take off?

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Practice questions

- A car starts at rest and speeds up with an acceleration of 3.5 m/s^2. How far will the car have gone when it is traveling at 25 m/s?

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Practice questions

- Alice is jogging at a velocity of 2.50 m/s. If she accelerates at a constant -0.10 m/s^2, how fast will she be jogging after 10.0 m?

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Practice questions

- A car is traveling at 25.0 m/s when the driver sees a dog in the road. It takes the driver 0.90 s to react, then steps on the brakes and slows at 6.5 m/s^2. How far does the car go before it stops?

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More practice questions

- A driver of a car traveling at 15.0 m/s applies the brakes, causing an acceleration of -2.0 m/s^2.
  - How long does it take the car to accelerate to a final speed of 10.0 m/s?
  - How far has the car moved during the breaking period?

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More practice questions

- A car starts from rest and travels for 5.0 s with a unform acceleration of -1.5 m/s^2.
  - What is the final velocity of the car?
  - How far does the car travel during this period?

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Air Resistance

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Free Fall

- Acceleration due to gravity is constant

  $a = g = -9.80\ m/s^2$

- Moon Landing: hammer vs feather

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More practice questions

- Jill hits a softball from a height of 0.80 m and gives it an initial velocity of 7.5 m/s straight up.
  - How high will the ball go?
  - How long will it take the ball to reach maximum height?

40

More practice questions

- That crazy Bob doesn't look where he walks and topples right off the edge of the Grand Canyon.
  - If the canyon is 1200 m tall, how long will he be falling?
  - What will be his impact speed?

More practice questions

- Penelope hits a volleyball upward so its initial velocity is 6.0 m/s. If the ball starts 2.0 m above the floor, how long will it be in the air before it strikes the floor?