

SPH3U

UNIVERSITY PHYSICS

KINEMATICS

☛ Acceleration-Time Graphs
(P.31-35)

Acceleration-Time Graphs

An **acceleration-time graph** is a graph that describes the acceleration of an object over time (acceleration on the y-axis and time on the x-axis). The following diagram shows an acceleration-time graph for a cheetah. (Did you know that cheetahs can accelerate at rates greater than 10 m/s^2 while most sports cars accelerate at $\sim 7.2 \text{ m/s}^2$.)

Acceleration v. Time for Motion with Uniform Acceleration

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Acceleration-Time Graphs

You learned earlier how to find the displacement of an object by determining the area under a velocity-time graph. In a similar fashion,

The area under an acceleration-time graph gives the change in velocity of the object.

Acceleration v. Time for Motion with Uniform Acceleration

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Acceleration-Time Graphs

PRACTICE

1. What is the change in velocity of the cheetah between 0 and 5.0 s?

$\Delta v = \text{area} = 20 \text{ m/s[W]}$ (area = lw = (5.0 s)(4.0 m/s[W]))

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Acceleration-Time Graphs

PRACTICE

2. What is the cheetah's final velocity?

If the initial velocity of the cheetah is zero, the final velocity of the cheetah would be 20 m/s[W]. If the initial velocity of the cheetah is 5.0 m/s[W], the final velocity of the cheetah would be 25 m/s[W]. However, the graph does not tell us what the initial and final velocities are – it just tells us the change in velocity that occurs in the time interval.

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Acceleration-Time Graphs

ACCELERATION-TIME GRAPH (a-t)

- graph that describes the acceleration (y-axis) of an object wrt time (x-axis)
- area under graph = change in velocity of object

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Comparing Graphs of Linear Motion

Graphical analysis is one of the most powerful analytical tools available to physicists. In studying the motion of objects, analyzing position-time, velocity-time, and acceleration-time graphs can help us gain insight into real-life events such as the motion of the cheetah.

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Graphs of Motion

RECALL! ⇐ the "area" is **cumulative!**

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Graphs of Motion

PRACTICE

3. With the aid of the graphic you just noted, complete the following chart by adding a check mark (✓) in each column that applies.

How do you determine ...	Given a ...	Read info from graph	Take the slope	Find the area	Can't do
position	d-t graph	✓			
position	v-t graph			✓	
position	a-t graph				✓
velocity	d-t graph		✓		
velocity	v-t graph	✓			
velocity	a-t graph			✓	
acceleration	d-t graph				✓
acceleration	v-t graph		✓		
acceleration	a-t graph	✓			


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 **Graphs of Motion**


PRACTICE

4. For each of the described motions, what would the corresponding d-t, v-t, and a-t graphs look like?

(a) an object moves to the right at a constant speed




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 **Graphs of Motion**


PRACTICE

4. For each of the described motions, what would the corresponding d-t, v-t, and a-t graphs look like?

(b) an object moves to the left at a constant speed




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 **Graphs of Motion**


PRACTICE

4. For each of the described motions, what would the corresponding d-t, v-t, and a-t graphs look like?

(c) an object speeds up as it moves to the right

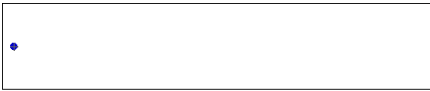


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 **Graphs of Motion**

PRACTICE

4. For each of the described motions, what would the corresponding d-t, v-t, and a-t graphs look like?
(d) an object slows down as it moves to the right

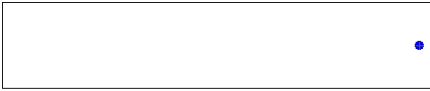


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 **Graphs of Motion**

PRACTICE

4. For each of the described motions, what would the corresponding d-t, v-t, and a-t graphs look like?
(e) an object speeds up as it moves to the left

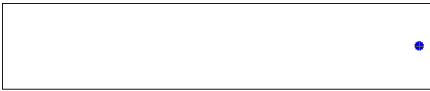


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 **Graphs of Motion**

PRACTICE




4. For each of the described motions, what would the corresponding d-t, v-t, and a-t graphs look like?
(f) an object slows down as it moves to the left



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 **Check Your Learning**

WIKI (KINEMATICS)

-  3U1 - WS#4 (d-t, v-t & a-t Relationships)
-  3U1 - WS#5 (d-t, v-t & a-t Graphs)
-  3U1 - ASG#1 (Acceleration Due to Gravity)

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