Defining Acceleration

Answer the following from pg 384-385 in your textbook

1. Define *acceleration*.

The rate of change in speed.

2. Give the formula for acceleration. Define each term of the formula (what is Δt? etc.)

$\vec{a}_{av} = \frac{\Delta v}{\Delta t}$

$\vec{a}_{av}$ is: average acceleration
$\Delta \vec{v}$ is: change in velocity
Δt is: chang in time

3. Define *constant acceleration*.

When the same change in speed occurs in each equal interval of time.

4. Define *average acceleration*.

The avergge rate of change in speed of an object.

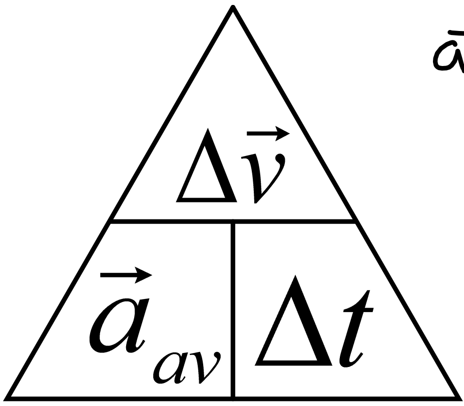
5. What are the units for acceleration? How would you say it aloud?

m/s/s or m/s² or km/h/s

meters per second per second
meters per second squared
kilometers per hour per second

6. Copy sample problem 1 from page 385, including the question.

Feb 25-11:03 AM



$$\vec{a}_{av} = \frac{\Delta\vec{v}}{\Delta t}$$

$$\Delta t = \frac{\Delta\vec{v}}{\vec{a}_{av}}$$

$$\Delta v = \vec{a}_{av} \times \Delta t$$

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It takes Mr. Grimmer's Cruze 6.0 seconds to speed up to +90.0km/h. What is the average acceleration of his car?

$\Delta t = 6.0\,s$

$\Delta \vec{v} = +90.0\,km/h$

$\vec{a}_{av} = ?$

$\vec{a}_{av} = \frac{\Delta \vec{v}}{\Delta t} = \frac{+90\,km/h}{6.0\,s}$

$= +15\,km/h/s$

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1. A skateboarder rolls down a hill and changes his velocity from rest to +1.9 m/s. If the average acceleration down the hill is +0.40m/s/s, for how long was the skateboarder on the hill?

$\Delta v = +1.9\,m/s$

$a_{av} = +0.40\,m/s/s$

$\Delta t = ?$

$\Delta t = \frac{\Delta \vec{v}}{\vec{a}_{av}} = \frac{+1.9\,m/s}{0.40\,m/s/s} = 4.75\,s \rightarrow 4.8\,s$

The skateboarder was on the hill for 4.8s

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2. A cyclist changes her velocity by -5.0 m/s in a time of 4.5 s. What is her acceleration?

$\Delta\vec{v} = -5.0\,m/s$
$\Delta t = 4.5\,s$
$\vec{a}_{av} = ?$

$a_{av} = \frac{\Delta\vec{v}}{\Delta t} = \frac{-5.0\,m/s}{4.5\,s} = -1.1\,m/s/s$

Her acceleration is -1.1 m/s/s.

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3. A roller coaster car accelerates at +8.0 m/s/s for 4.0 s. What is the change in velocity of the roller coaster?

$\vec{a}_{av} = +8.0\,m/s/s$
$\Delta t = 4.0\,s$
$\Delta\vec{v} = ?$

$\Delta v = a_{av} \times \Delta t$
$= +8.0\,m/s/\cancel{s} \times 4.0\,\cancel{s}$
$= 32\,m/s$

The change in velocity is +32 m/s.

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4. A downhill skier moving -2.5 m/s accelerates to -20.0 m/s in a time of 3.8 s. Calculate the average acceleration of the skier.

$\Delta \vec{v} = -17.5 m/s$

$\Delta t = 3.8 s$

$\vec{a_{av}} = ?$

$a_{av} = \frac{\Delta v}{\Delta t} = \frac{-17.5 m/s}{3.8 s} = 4.6 m/s/s$

The average acceleration of the skier is 4.6m/s/s.

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$$\vec{a}_{av} = \frac{\Delta \vec{v}}{\Delta t}$$

expanded out becomes . . .

$$\vec{a_{av}} = \frac{V_f - V_i}{\Delta t}$$

Where V_f = final speed

V_i = initial speed

$V_f = (a_{av} \cdot \Delta t) + v_i$

$V_i = V_f - (a_{av} \cdot \Delta t)$

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1. The bike path passes over a small bridge designed to carry cyclists over a busy street. At the bottom of the ramp leading up to the bridge, Kirsten is riding at 5.6 m/s. When she reaches the top of the ramp, she is travelling at 1.8 m/s. If it takes her 28 s to ride up the ramp, what is her acceleration?

$\vec{V}_i = 5.6 m/s$
$\vec{V}_f = 1.8 m/s$
$\Delta t = 28 s$
$\vec{a}_{av} = ?$

$$a_{av} = \frac{V_f - V_i}{\Delta t} = \frac{1.8 m/s - 5.6 m/s}{28 s} = \frac{-3.8 m/s}{28 s} = -0.14 m/s/s$$

Her average acceleration is -0.14 m/s/s.

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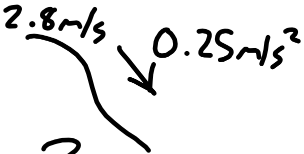
2. Brad starts down the ramp on the other side of the bridge, travelling at a speed of 2.8 m/s, and then accelerates at 0.25 m/s² for 18 s. What is his speed at the bottom of the ramp?



$V_f = ?$
$V_i = 2.8 m/s$
$a_{av} = 0.25 m/s^2$
$\Delta t = 18 s$

$$V_f = \vec{a}_{av} \cdot \Delta t + V_i$$
$$= 0.25 m/s/s \times 18 s + 2.8 m/s$$
$$= 4.5 m/s + 2.8 m/s$$
$$= 7.3 m/s$$

The speed at the bottom is 7.3 m/s

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3. At the bottom of the ramp, Brad hits a patch of loose gravel and wipes out. Kirsten applies her brakes quickly to avoid hitting him. She is travelling at 6.5 m/s when she applies the brakes and she accelerates at -2.6 m/s². How long (time) does it take her to stop?

$V_i = 6.5 m/s$
$a_{av} = -2.6 m/s^2$
$V_f = 0.0 m/s$
$\Delta t = ?$

$$\Delta t = \frac{v_f - v_i}{a_{av}} = \frac{0 m/s - 6.5 m/s}{-2.6 m/s^2} = \frac{-6.5 m/s}{-2.6 m/s/s} = 2.5 s$$

It takes Kirsten 2.5s to stop.

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4. Kirsten and Brad coast down a long hill that leads into the river valley. They accelerate at 0.12 m/s² for 85 s and are travelling at 12.5 m/s at the bottom of the hill. What was their initial velocity?

$V_i = ?$
$V_F = 12.5 m/s$
$a_{av} = 0.12 m/s^2$
$\Delta t = 85 s$

$$V_i = V_f - a_{av} \times \Delta t$$
$$= 12.5 m/s - 0.12 m/s/s \cdot 85 s$$
$$= 12.5 m/s - 10.2 m/s$$
$$= 2.3 m/s$$

Their initial velocity was 2.3 m/s

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More Practice:

Pg. 388-389 Q. 8-11

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