Science 20 Unit B - Physics

Finding Displacement in Accelerated Motion

Sep 18-9:00 PM

POS Checklist

☐ compare and contrast displacement in uniform motion and uniformly accelerated motion, using the following relationships $\Delta\vec{d} = \vec{v}_i\Delta t + \frac{1}{2}\vec{a}\Delta t^2$ and $\Delta\vec{d} = \frac{(\vec{v}_i + \vec{v}_f)}{2}\Delta t$.

Jan 27-8:32 AM

Where's the Acceleration?

Which of these situations is uniform motion and which is accelerated motion?

http://www.youtube.com/watch?v=Ug75diEyiA0

1. **A car increases its speed from rest to 15 m/s.**
2. **A ball is dropped from 40 m.**
3. **A runner jogs at 13 km/h.**

Sep 18-9:08 PM

Finding Displacement

For uniform motion, we find displacement using:

$$\vec{v} = \frac{\vec{d}}{t}$$ **rearranged for $\vec{d}$:** $\vec{d} = \vec{v}t$

However, $\vec{d} = \vec{v}t$ will not work to find displacement where there is acceleration!

For this, we need a new equation for finding displacement.

Sep 18-9:09 PM

Two New Equations for displacement:

Eqn 1:

$$\vec{d} = \frac{(\vec{v}_f + \vec{v}_i)t}{2}$$

- Use this equation when there is accelerated motion but you do not know the acceleration.

Jan 27-8:35 AM

ex) A puma moves with a velocity of 3.00 m/s E and accelerates constantly. If the velocity after 4.70 s is 15 m/s E, what is the displacement of the object?

Ans:

Sep 18-9:27 PM

ex) A driver accelerates constantly to a velocity of 7.5 m/s during 4.5 s. The driver's displacement is 19 m [E]. What is the v_i?

Ans:

Sep 18-9:30 PM

Two New Equations for displacement:

Eqn 2:

$$\vec{d} = \vec{v}_i t + 1/2 \vec{a} t^2$$

Use this equation to find displacement if initial velocity, time and acceleration are known.

Mar 19-7:48 AM

Remember:

Kinematics and Dynamics Formulas

$v = \frac{\Delta d}{\Delta t}$ — v = average speed (m/s)

$\vec{v} = \frac{\Delta \vec{d}}{\Delta t}$ — $\vec{v}$ = average velocity (m/s)

$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$ — d = distance (m); $\vec{d}$ = displacement (m); t = time elapsed (s); $\vec{a}$ = acceleration (m/s^2)

$\vec{F}_{net} = m\vec{a}$ — $\vec{F}$ = force (kg·m/s^2 or N)

$\vec{F}_{net} = \vec{F}_a + \vec{F}_f$ — $\vec{F}_{net}$ = net force (N); $\vec{F}_a$ = applied force (N); $\vec{F}_f$ = force of friction (N)

$W = F\Delta d$ — F = magnitude of a force (N); m = mass (kg); W = work (N·m or J)

$P = \frac{W}{t}$ — P = power (J/s or W)

$\Delta \vec{d} = \vec{v}_i \Delta t + \frac{1}{2}\vec{a}(\Delta t)^2$

$\Delta \vec{d} = \frac{\vec{v}_i + \vec{v}_f}{2} \Delta t$

All of these equations, along with units and variables, appear in your data booklet.

Mar 19-7:50 AM

ex) A biker passes a lightpost at the top of a hill traveling at 4.5 m/s. She accelerates down the hill at a constant rate of 0.40 m/s² for 12.0 s. How far down the hill did she move?

Ans:

Jan 27-8:53 AM

ex) A sheep starts from rest and accelerates at a constant rate 3.15 m/s² forward for 28.65 s. What is the displacement during this time?

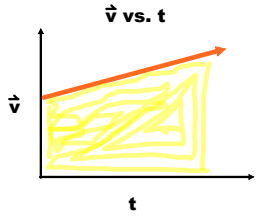
Secret Sheep Thing

Ans: 1.29 x 10^3 m forwards.

Sep 18-10:12 PM

Finding Displacement from a Graph

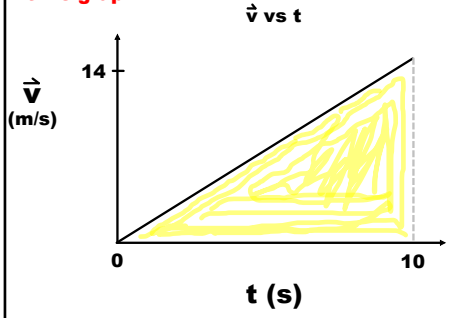
It is also possible to find displacement from a velcity vs. time graph.



The area under a $\vec{v}$ vs. t graph gives displacement.

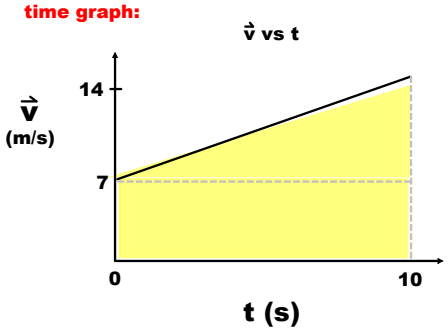
Mar 19-7:54 AM

ex) Determine the displacement using this velocity vs. time graph:



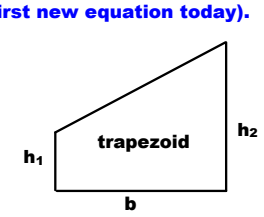
Mar 19-7:56 AM

ex) Determine the displacement using this velocity vs. time graph:

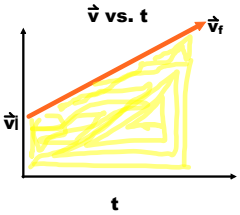


Mar 19-8:00 AM

Note: another way of finding this area is to use the formula for area of a trapezoid (which is the same as our first new equation today).



$A_{trapezoid} = \frac{(h_1 + h_2)b}{2}$



$\vec{d} = \frac{(\vec{v}_f + \vec{v}_i)t}{2}$

Jan 27-8:44 AM

Review:

$\vec{d} = \vec{v}t$ — Use only when there is no acceleration (constant velocity).

$\vec{d} = \frac{(\vec{v}_f + \vec{v}_i)t}{2}$ — Use when this is accelerated motion.

$\vec{d} = \vec{v}_i t + 1/2\vec{a}t^2$

Mar 19-7:38 AM

HW: Finding Displacement UA (first 5 problems)

Sep 18-10:28 PM

Mar 19-7:38 AM