Acceleration & Position

Calculations: Guided Practice

A car is initially traveling 20 m/s [E]. It then accelerates to 32 m/s [E] in 3.5 seconds.

a) Calculate the average acceleration.

$\vec{v}_0 = 20\ m/s\ [E]$ $\quad \vec{a} = ?$

$\vec{v}_f = 32\ m/s\ [E]$ $\quad \vec{a} = \frac{\vec{v}_f - \vec{v}_0}{t}$

$t = 3.5\ s$ $\quad \vec{a} = \frac{32 - 20}{3.5} = \frac{12}{3.5} = 3.43\ m/s^2$

b) Calculate the position of the car at the end of the acceleration.

Reread question and set up the frame of reference and coordinate system

W,- E,+

Frame of reference is relative to the road or a stationary observer outside of the car - this will most often be the case.

Reread question and list known/wanted quantities - include any previously calculate values but only use them if necessary

$\vec{v}_0 = 20\ m/s\ [E]$ $\quad \vec{d}_f = ?$

$\vec{v}_f = 32\ m/s\ [E]$ $\quad \vec{d}_0 = 0\ m$ ← if no information is given $\vec{d}_0 = 0\ m$

$t = 3.5\ s$

$\vec{a} = 3.43\ m/s^2\ [E]$

Check for a formula using only the known and wanted quantities

Two choices! Which one is more mathematically simple to use?

Think about what we are solving for, then decide.

$$\vec{d}_f = \vec{d}_o + \vec{v}_o t + \frac{1}{2}\vec{a}t^2 \qquad \vec{v}_f{}^2 = \vec{v}_o{}^2 + 2\vec{a}(\vec{d}_f - \vec{d}_o)$$

Substitute values and solve for the unknown

$\vec{d}_f = 0 + (20)(3.5) + \frac{1}{2}(3.43)(3.5)^2$

$= 70 + 21$

$\vec{d}_f = 91\ m$

Check answer conceptually - does its value and direction make sense?

...and now Changing Direction

including how to approach a multi-step problem

The wind changes the velocity of a glider from 25 m/s [E] to 25 m/s [W] in 10 seconds. Calculate the final position.

Reread question and set up the frame of reference and coordinate system

W,- E,+

Reread question and list known/wanted quantities relative to positive direction

$\vec{v}_o = 25\ m/s\ [E]$ $\vec{d}_f = ?$

$\vec{v}_f = -25\ m/s\ [E]$ $\vec{d}_o = 0m$

$t = 10s$

Check for a formula using only the known and wanted quantities

error - does not compute

No such formula available :(

Check for a formula that is close, but maybe missing one or two values

Yep → $\vec{d}_f = \vec{d}_o + \vec{v}_o t + \frac{1}{2}\vec{a}t^2$

Check for a formula(s) that solves for a(the) missing value(s) using known quantities

right here $\vec{a} = \frac{\vec{v}_f - \vec{v}_o}{t}$

Substitute values and solve for the unknown

$\vec{a} = \frac{-25-25}{10} = \frac{-50}{10} = -5\ m/s^2$

Use that value and solve for the unknown in a main (first) equation

$\vec{d}_f = 0 + (25)(10) + \frac{1}{2}(-5)(10)^2$

$\vec{d}_f = 250 + (-250)$

$\vec{d}_f = 0m$

Check answer conceptually - does its value and direction make sense?

Attachments

moving-man_all.jar