

Acceleration & Position

Calculations: Guided Practice

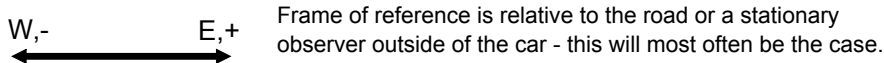
A car is initially traveling 20 m/s [E]. It then accelerates to 32 m/s [E] in 3.5 seconds.

a) Calculate the average acceleration.

$$\begin{aligned} \vec{v}_0 &= 20 \text{ m/s [E]} & \vec{a} &=? \\ \vec{v}_f &= 32 \text{ m/s [E]} & \vec{a} &= \frac{\vec{v}_f - \vec{v}_0}{t} \\ t &= 3.5 \text{ s} & \vec{a} &= \frac{32 - 20}{3.5} = \frac{12}{3.5} = \underline{3.43 \text{ m/s}^2} \end{aligned}$$

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



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

$$\begin{aligned} \vec{v}_0 &= 20 \text{ m/s [E]} & \vec{d}_f &=? \\ \vec{v}_f &= 32 \text{ m/s [E]} & \vec{d}_0 &= 0 \text{ m} \\ t &= 3.5 \text{ s} & & \\ \vec{a} &= 3.43 \text{ m/s}^2 \text{ [E]} & & \end{aligned}$$

if no information is given $d_0 = 0 \text{ m}$

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.

$$\vec{d}_f = \vec{d}_0 + \vec{v}_0 t + \frac{1}{2} \vec{a} t^2 \quad \left| \quad \vec{v}_f^2 = \vec{v}_0^2 + 2\vec{a}(\vec{d}_f - \vec{d}_0)\right.$$

Substitute values and solve for the unknown

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

$$= 70 + 21$$

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

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



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

$$\begin{aligned} v_0 &= 25 \text{ m/s [E]} & d_f &= ? \\ v_f &= -25 \text{ m/s [E]} & d_0 &= 0 \text{ m} \\ t &= 10 \text{ s} \end{aligned}$$

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 \rightarrow

$$\vec{d}_f = \vec{d}_0 + \vec{v}_0 t + \frac{1}{2} \vec{a} t^2$$

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

right here

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_0}{t}$$

Substitute values and solve for the unknown

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

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

$$\begin{aligned} \vec{d}_f &= 0 + (25)(10) + \frac{1}{2}(-5)(10)^2 \\ \vec{d}_f &= 250 + (-250) \\ \vec{d}_f &= 0 \text{ m} \end{aligned}$$

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

Attachments

moving-man_all.jar