...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 resulting displacement.

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

$v_o = 25\ m/s\ [E]$ $d_o = 0\ m\ [E]$

$v_f = -25\ m/s\ [E]$ $d_f = ?$

$t = 10\ s$

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

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

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

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

$$d_f = 0 + (25)(10) + \tfrac{1}{2}(-5)(10)^2$$

$$= 250 + (-2.5)(100)$$

$$= 250 + (-250)$$

$$\boxed{d_f = 0\ m}$$

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

Suppose the previous question wanted to know the total distance covered (for fuel purposes for example). Pair and come up with a method to calculate the total distance (you do not actually have to perform the calculation).

Acceleration, Changing Direction and Distance

A car changes velocity from 25 m/s [E] to 25 m/s [W] in 10 seconds (to save time, a = -5.0 m/s^2 [E]). Calculate the total *distance* covered by the car.

Distance is a scalar. Total distance is calculated by adding up the distance traveled in each direction distance east + distance west

Calculate distance traveled eastward - east is positive

W,- E,+ *origin is starting point of car

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

Velocity at the point where direction changes is zero

$v_o = 25\ m/s\ [E]$ $a = -5.0\ m/s^2\ [E]$ $d_f = ?$

$v_f = 0\ m/s\ [E]$ $t = ?$ $d_o = 0m$

Check for a formula using only the known and wanted quantities

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

Hold on there bro, why not ? $\vec{d}_f = \vec{d}_o + \vec{v}_o t + \frac{1}{2}\vec{a}t^2$?

Substitute values and solve for the unknown

$(0)^2 = (25)^2 + 2(-5)(d_f - 0)$

$-625 = -10 d_f$

$d_f = 62.5m\ [E]$

Calculate distance traveled westward - west is positive ↖ dist. east

W,+ E,- *origin is point where direction changed

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

Velocity at the point where direction changes is zero

$v_o = 0\ m/s\ [E]$ $t = ?$ $a = -5\ m/s^2\ [E]$

$v_f = -25\ m/s\ [E]$ $d_o = 0m$ $d_f = ?$

Check for a formula using only the known and wanted quantities

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

Substitute values and solve for the unknown

$(-25)^2 = (0)^2 + 2(-5)(d_f - 0)$

$625 = -10 d_f \longrightarrow d_f = -62.5m\ [E]$

Calculate the total distance East West

$dist = (62.5m) + (62.5m)$

$d = 125m$

Problem Set Pg 8.

Attachments

moving-man_all.jar