SPH3U UNIVERSITY PHYSICS

KINEMATICS

- Acceleration (P.21-25)

Acceleration

Whether we move by the power of our own legs, or by a train, plane, or car, we seldom move at a constant velocity. Either the speed changes or the direction changes. When the speed or direction of an object changes, the object is accelerating. ***Acceleration*** *is the rate of change of velocity. However, few objects undergo uniform acceleration. Instead, their velocity changes in a non-uniform way. Average acceleration is a more useful quantity.*

Acceleration

ACCELERATION

- rate of change of velocity per unit time
- vector quantity

NOTE!

*If the object is slowing down, we sometimes call this "****deceleration****."*

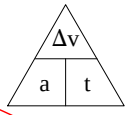
Acceleration

*The **average acceleration**, or $\vec{a}_{avg}$, of an object in motion is the total change in the velocity divided by the total elapsed time. The SI unit for acceleration is metres per second per second (m/s/s).*

Average Acceleration

AVERAGE ACCELERATION

$$\vec{a}_{avg} = \frac{\Delta\vec{v}}{\Delta t} = \frac{v_f - v_i}{\Delta t}$$



where $\vec{a}_{avg}$ is the average acceleration (m/s/s or m/s^2)
$\Delta\vec{v}$ is the change in velocity (m/s)
Δt is the time interval (s)

NOTE!
Sometimes 1 and 2 are used as the subscripts instead of i and f.

Average Acceleration

PRACTICE

1. A motorbike starting from rest and undergoing uniform acceleration reaches a velocity of 21.0 m/s[N] in 8.4 s. Find its average acceleration.

   $a_{avg} = 2.5\ m/s^2[N]$

Average Acceleration

PRACTICE

2. A cyclist, travelling initially at 14 m/s[S], brakes smoothly and stops in 4.0 s. What is the cyclist's average acceleration?

a_{avg} = -3.5 m/s²[S] or 3.5 m/s²[N]

-[S] = +[N]

Average Acceleration

PRACTICE

3. When a hockey player hits a hockey puck with his stick, the velocity of the puck changes from 8.0 m/s[N] to 10.0 m/s[S] over a time interval of 0.050 s. What is the average acceleration of the puck?

a_{avg} = 360 m/s²[S]

Average Acceleration

PRACTICE

4. A racehorse takes 2.70 s to accelerate from a trot to a gallop. If the horse's initial velocity is 3.61 m/s[E] and it experiences an acceleration of 2.77 m/s²[E], what is the racehorse's final velocity when it gallops?

v_f = 11.1 m/s[E]

✔ Check Your Learning

TEXTBOOK

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