~~Fri~~ Mon: HW due by 5pm

Phys 111 Ex: 10, 12, 13, 14, 15, 16, 17, 18] Group ex: Monday.

~~Tues~~ Weds: Warm Up 2 (D2L)

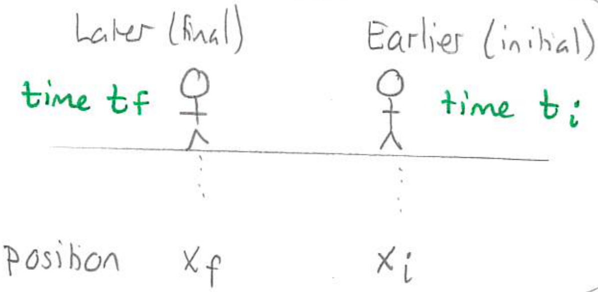
LABS!!

Math diagnostic: Above 30 – most get at least C
Below 30 – A very unlikely
Below 25 – C at best } slopes?...

Average velocity

Velocity quantifies the rate of change of position of a moving object. The definition involves:

Observe the object at two instants (earlier, later). Record positions and times



Displacement is the change in position

$$\Delta x = x_f - x_i$$

→ Average velocity between the instants is

$$V_{avg} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$

Quiz 1: Analysis

30%

$t_i = 0s$ $\quad t_f = 10s$

$x_i = 0m$ $\quad x_f = -30m$

$$V_{avg} = \frac{x_f - x_i}{t_f - t_i} = \frac{-30m - 0m}{10s - 0s} = -3.0s$$

Notes about average speed, average velocity:

1) average velocity and average speed are different. In the example above from 0s → 10s

average speed → rate at which distance is covered → speed = $\frac{50m}{10s}$ $= 5.0 m/s$

average velocity → rate at which position changes → $V_{avg} = \frac{-30m}{10s}$ $= -3.0 m/s$

different!

2) "average" is terminology referring to what happens over a time interval. It does not mean "take the average"

3) velocity has a sign

a) positive velocity → if the later location is right of earlier then $x_f > x_i \Rightarrow \Delta x > 0 \Rightarrow V_{avg} > 0$

V_{avg} positive ⇒ final location right of initial
displacement to right

b) negative velocity → if the later location is left of earlier then $x_f < x_i \Rightarrow \Delta x < 0 \Rightarrow V_{avg} < 0$

V_{avg} negative ⇒ final location left of initial
displacement to left.

Velocity, speed and displacement, distance

Knowing average velocity and time we can determine displacement

$$V_{avg} = \frac{\Delta x}{\Delta t} \quad \text{← solve for } \Delta x \quad \Rightarrow \quad V_{avg}\,\Delta t = \frac{\Delta x}{\Delta t}\,\Delta t$$

known (V_{avg}, Δt)

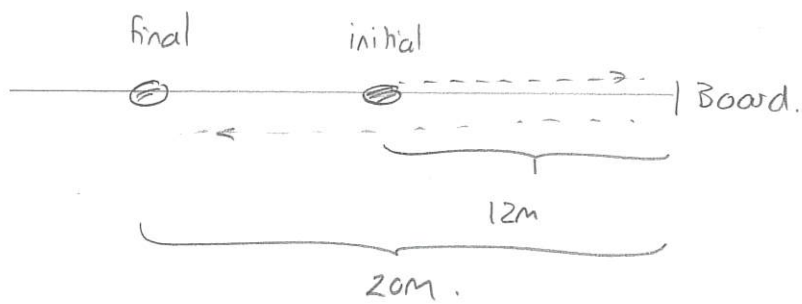
$$\Rightarrow \quad \Delta x = V_{avg}\,\Delta t$$

20 Hockey puck trip time

A hockey puck travels along a horizontal surface to the right for a distance of 12 m at speed 5.0 m/s. It hits a board and bounces to the left traveling a distance of 20 m at speed 4.0 m/s. Determine the total time for this trip. *(111F2023)*

Answer:

(1) DIAGRAM



(2) SCHEME: Two parts – 1) moving right → get time for this Δt_{first}

2) moving left → get time for this Δt_{second}

Total time $\Delta t = \Delta t_{first} + \Delta t_{second}$

(3) DO PARTS First part ⇒ moving right.

$$v_{avg} = \frac{\Delta x_{first}}{\Delta t_{first}} \Rightarrow 5.0\,m/s = \frac{12m}{\Delta t_{first}}$$

$$\Rightarrow 5.0\,m/s\, \Delta t_{first} = \frac{12m}{\cancel{\Delta t_{first}}} \cancel{\Delta t_{first}} \Rightarrow 5.0\,m/s\, \Delta t_{first} = 12m$$

$$\Rightarrow \Delta t_{first} = \frac{12m}{5.0\,m/s} = 2.4s.$$

Second part ⇒ moving left $v_{avg} \Delta t_{second} = \Delta x_{second}$

$$\Delta t_{second} = \frac{\Delta x_{second}}{v_{avg}} = \frac{-20m}{-4.0\,m/s} \text{ (moves left)} = 5.0s$$

(4) Combine $\Delta t = \Delta t_{first} + \Delta t_{second}$

$$= 2.4s + 5.0s = 7.4s$$

Metric system of units

Physics uses the metric system of units. For each type of quantity there is a basic unit and then other derived units using a standard scheme:

Basic measurement unit

↓

Derived units are multiples of basic units using factors of 10 or 1/10.

Examples

kilo unit = 1000 unit (prefix k)

milli unit = $\frac{1}{1000}$ unit (prefix m)

Length unit ≡ meter (m)

Examples:

1 kilometer = 1000 meter

1km = 1000m

---

1 centimeter = $\frac{1}{100}$ meter

1cm = 0.01m

100cm = 1.0m

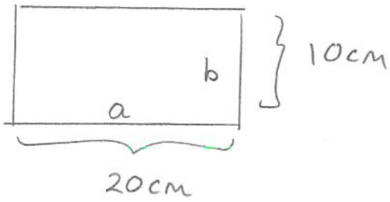
---

1 millimeter = $\frac{1}{1000}$ meter

1mm = 0.001m

1000mm = 1.0m

Warm Up 1



Area = ab

a = 20cm = 20cm × 0.01m = 0.20m

b = 10cm = 10cm × $\frac{1m}{100cm}$ = 0.10m

Area = 0.20m × 0.10m = 0.020m²

If we wanted this in square feet (ft^2) we need.

$1\,ft = 0.305\,m$

$a = 0.20\,m \times \frac{1\,ft}{0.305\,m} = 0.66\,ft$

$b = 0.10\,m \times \frac{1\,ft}{0.305\,m} = 0.33\,ft$

} Area $= 0.66\,ft \times 0.33\,f$

$= 0.22$ sq ft.

Scientific notation

A convenient way to represent the range of numbers encountered in physics is scientific notation. For example consider a flat microchip with dimensions 3.0mm and 5.0mm. Then to get the area in m^2

$a = 0.0030\,m$

$b = 0.0050\,m.$

} area $= ab = 0.0030\,m \times 0.0050\,m$

$= 0.000015\,m^2$

$= 1.5 \times 10^{-5}\,m^2$

The form $\square.\square\square \times 10^{\square}$ is scientific notation

Quiz 2

Warm Up 2