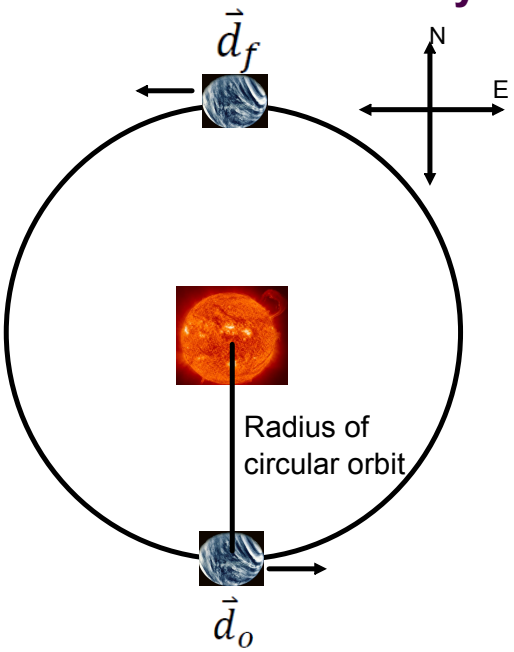
Guided Displacement and Velocity Problems

Note how we approach physics problems using the handbook

2 a) Calculate the average velocity, in m/s, of Venus the instant it has traveled half of its circular orbit around the Sun.

Sketch a diagram → ***Determine quantities needed***

Create a coordinate system



$\vec{v}_{avg} = \frac{\vec{d}}{t}$ required

$\vec{d}$ = ? t = ?

Use learned & prior knowledge

$\vec{d}$ = change in position

$\vec{d}$ = diameter of circle

t = time to change position

t = ½ a Venus year (seconds)

Obtain values from handbook

Venus distance from Sun, the radius = 108 million km, so diameter is 216 million km.

$\vec{d}$ = 216 x 10^6 km [N] → (x 10^3 m/km) $\vec{d}$ = 216 x 10^9 m [N]

t = ½ x 225 days x 24 h/day x 60 min/h x 60 s/min

t = 9.72 x 10^6 s

Complete Problem

$$\vec{v}_{avg} = \frac{\vec{d}}{t}$$

$$\vec{v}_{avg} = \frac{216 \times 10^9 \text{ m [N]}}{9.72 \times 10^6 \text{ s}}$$

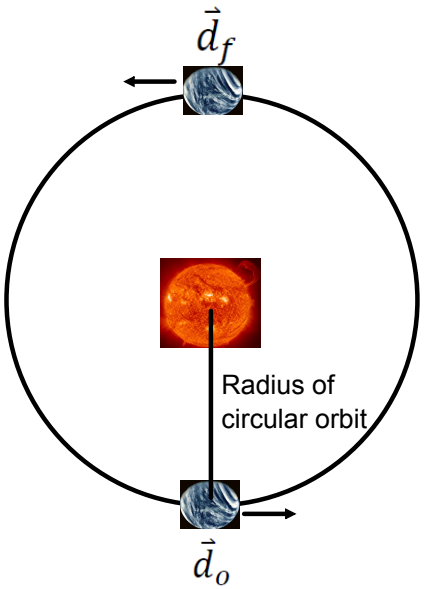
$$\vec{v}_{avg} = 2.22 \times 10^4 \text{ m/s [N]}$$

Guided Displacement and Velocity Problems

Note how we approach physics problems using the handbook

2 b) Calculate the average speed, in m/s, of Venus the instant it has traveled half of its circular orbit around the Sun.

Sketch a diagram → ***Determine quantities needed***



$v_{sp} = \frac{d}{t}$ > required

d = ? t = ?

Use learned & prior knowledge

d = length of path

d = ½ circumference of circle

t = time to travel distance

t = ½ a Venus year (seconds)

Obtain values from handbook

Venus distance from Sun, the radius = 108 million km

d = ½ x 2πr, where r = 108 x 10^6 km x 10^3 m/km = 108 x 10^9 m

d = (3.14)(108 x 10^9 m)

d = 3.39 x 10^{11} m

t = ½ x 225 days x 24 h/day x 60 min/h x 60 s/min

t = 9.72 x 10^6 s

Complete Problem

$$v_{sp} = \frac{d}{t}$$

$$v_{sp} = \frac{3.39 \times 10^{11} \text{ m}}{9.72 \times 10^6 \text{ s}}$$

$$v_{sp} = 3.49 \times 10^4 \text{ m/s}$$

17. A soccer ball is kicked 25 m [E], then 15 m [E], 8 m [W], and finally 12 m [E]. All this takes place in 45 seconds. Calculate the average speed and velocity of the ball. (v_{sp} = 1.3 m/s; v_{avg} = +0.98 m/s [E])

$$v_{sp} = \frac{d}{t}$$

$$d = 25 + 15 + 8 + 12 = 60\text{m}$$

$$v_{sp} = \frac{60\text{m}}{45\text{s}} = \boxed{1.3\text{m/s}}$$

$-$ W ⟵⟶ E $+$

$$\vec{v}_{avg} = \frac{\vec{d}}{t} \; ; \; \vec{d} = 25 + 15 - 8 + 12 = 44$$

(west)

$$\vec{v}_{avg} = \frac{44\text{m}}{45\text{s}} = \boxed{0.98\text{m/s}}$$

16. A car drives 12 m/s [S] for 5.0 seconds, then 18 m/s [N] for 9.0 seconds, and finally 15 m/s [S] for 11 seconds. Calculate the average speed and average velocity. (v_{sp} = 15.5 m/s; v_{avg} = -2.5 m/s or 2.5 m/s [S])

$v_{sp} = \frac{d}{t}$ ← add dist. for each trip

N +

S −

Calculate each trip:

$d_1 = 12 m/s \times 5s = 60m$ [S]

$d_2 = 18 m/s \times 9s = 162m$ [N]

$d_3 = 15 m/s \times 11s = 165m$ [S]

total distance, $d = 60 + 162 + 165$

$= 387m$

total time, $t = 5 + 9 + 11 = 25s$

$v_{sp} = \frac{d}{t} = \frac{387m}{25s} = \boxed{15.5 m/s}$

$\vec{v}_{avg} = \frac{\vec{d}}{t}$

$\vec{d} = -60 + 162 - 165 = -63m$

$t = 25s$

$\vec{v}_{avg} = \frac{-63}{25} = \boxed{-2.5 m/s}$