SOLUTIONS - 1 Phys 121

FORMULAE

Speed s is a scalar - it has magnitude only

$$s = \frac{\text{Distance travelled}}{\text{Time taken}} = \frac{d}{t}$$

d can NEVER

Displacement is a vector. It has both magnitude and direction.

$$\Delta \vec{x} = \vec{x}(t_2) - \vec{x}(t_1)$$

where t_2 is the final time and t_1 the initial time. If $x(t_2) < x(t_1)$ displacement is negative. If $x(t_2) > x(t_1)$ displacement is positive.

Velocity is a vector, it has both magnitude and direction. Average velocity between t_2 and t_1

$$\langle \vec{v} \rangle = \frac{\vec{x}(t_2) - x(t_1)}{(t_2 - t_1)}$$

Instantaneous velocity is obtained if $(t_2 - t_1) = \Delta t$ becomes very small ($\Delta t \to 0$) Then $\Delta \vec{x} \to 0$ and

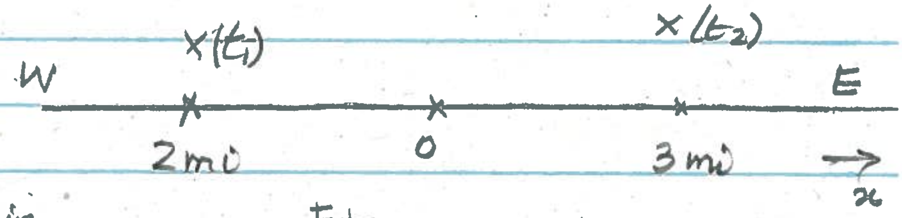
$$\vec{v} = \frac{\Delta \vec{x}}{\Delta t} \quad \Delta t \to 0.$$

Problems

1-7 Post office is at $x = 0$.

$t_1 = 12$ Noon

$t_2 = 12$ Noon $+ 30$ min



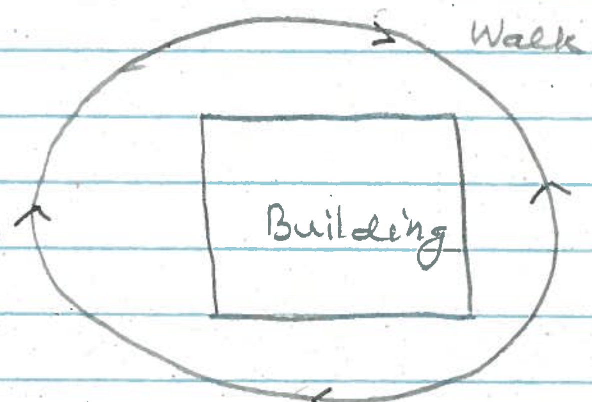
Figure

$$\Delta \vec{x} = \vec{x}(t_2) - \vec{x}(t_1) = +5\text{ mi due East.}$$

[Soon we will introduce unit ~~vectors~~ to write this more precisely].

1-8 Distance travelled $= 110$ m

time Elapsed $= 240$ s



$$S = \frac{110}{240} = 0.46\ \text{m/sec.}$$

1-12 $\vec{x}(t_1) = -12$ m , $x(t_2) = 3$ m

$t_2 - t_1 = \Delta t = 10$ s

$$\langle \vec{v} \rangle = \frac{3 - (-12)}{10} = 1.5\ \text{m/s along +ive } x.$$

1-13 $\langle \vec{v} \rangle = +0.35\,m/s$ along x.

$x(t_1) = 2.1m$

$\vec{x}(t_2) = 7.3m$

$\Delta \vec{x} = 5.2\,m$ along x.

$\Delta t = \frac{5.2}{0.35} = 14.86$ sec.

1-15 SI units $1\,ft = 30\,cm = 0.3\,m$, $1\,mi = 1.6\,km$.

(30.5cm more precise)

a. $8\,in = \frac{8}{12}\,ft = \frac{2}{3} \times 0.3 = 0.2\,m$.

b. $66\,ft/sec = (66 \times 0.3)\,m/s = 19.8\,m/s$

c. $60\,mph = \frac{60 \times 1.6 \times 10^3}{3600} = 26.7\,m/s$

1-17 $1\,mm$ per μs $= \frac{10^{-3}\,m}{10^{-6}\,s} = 10^3\,m/s$ → largest

$1\,km$ per ks $= \frac{10^3\,m}{10^3\,s} = 1\,m/s$. ← smallest

$1\,cm$ per ms $= \frac{10^{-2}\,m}{10^{-3}\,s} = 10\,m/s$

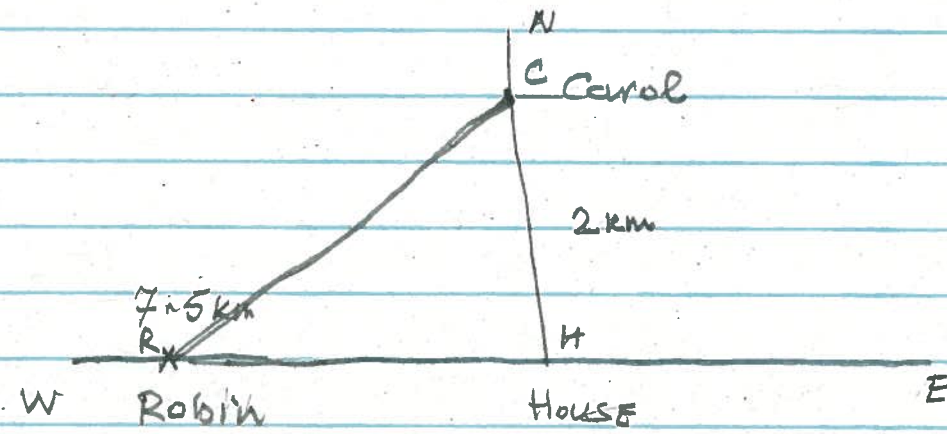
1-21 height of Empire State Bldg

$h = 1250\,ft$ $1\,ft = 0.3\,m$

$h = 1250 \times 0.3\,m = 375\,m = 3.75 \times 10^2\,m$

$(1250 \times 0.305\,m) = 381\,m = 3.81 \times 10^2\,m$

1-28

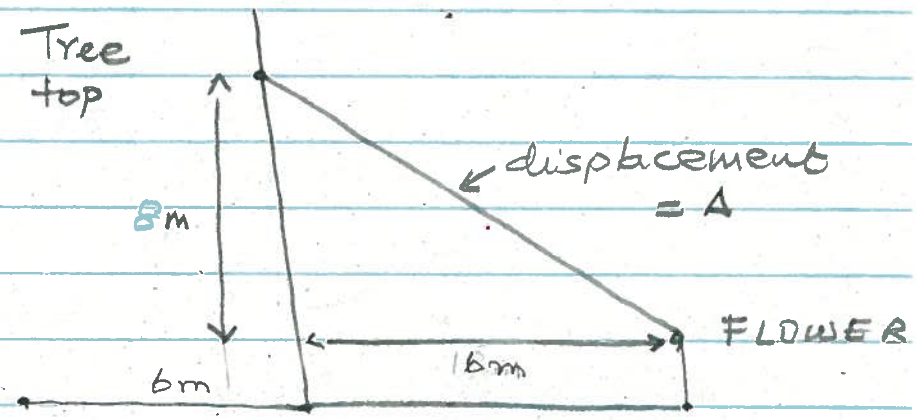


$$RC = \sqrt{(RH)^2 + (CH)^2} = \sqrt{4 + 56.25}\ km$$

$$= 7.76\ km$$

1-31

$$\Delta^2 = (8^2 + 6^2)\ m^2$$
$$= (64 + 36)\ m^2$$
$$\Delta = \sqrt{100}\ m$$
$$= 10\ m$$



1-33 Magnitude of displacement

$$d = \sqrt{50^2 + 90^2}$$
$$= 102.96\ m$$

Direction

$$\theta = \tan^{-1}\frac{90}{50} = 61^\circ$$