Chapter 1 of Tipler & Mosca, sections 6-7
Vectors

6. Vector: magnitude and direction. $\vec{A}$

magnitude $|\vec{A}|$ **or just** A

$\vec{A} = \vec{B}$ **means both magnitude and direction are equal.**

7. General properties.

a.) Addition (subtraction)

examples

associative: $\vec{A} + (\vec{B} + \vec{C}) = (\vec{A} + \vec{B}) + \vec{C}$

b.) Multiplication by a scalar

c.) Components:

i) In some direction (along some other vector, for example)

ii) Along coordinate axes (illustrate)

d.) Unit vectors

$\hat{A} = \vec{A}/A$. **Magnitude is 1, dimensionless**

unit coordinate vectors, $\hat{i}, \hat{j}, \hat{k}$

e.) Given, A_x, A_y, A_z **– the components, then**

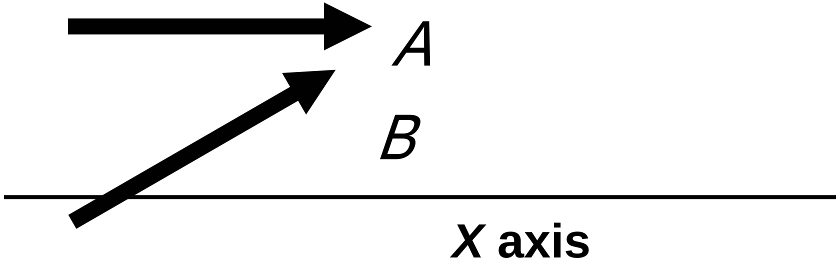
$$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$$

$\vec{A}$ and $\vec{B}$ are each 2.00 m in magnitude

$\vec{A}$ is parallel to the x-axis and

$\vec{B}$ is at 30º to the x-axis

$\vec{C} = \vec{A} + \vec{B}$



The magnitude of $\vec{C}$ is

A. 4.15 m
B. 2.15 m
C. 3.86 m
D. 1.86 m

(Clicker question on vector addition)

Chapter 3
Motion in Two and Three dimensions

1. Displacement, Velocity, and Acceleration.

a.) **Position vector**. (tails go at the origin)

b.) **Displacement vector:** $\Delta\hat{r} = \vec{r}_2 - \vec{r}_1$

illustrate

c.) **Velocity vector:**

i) $\vec{v}_{\text{av}} = \dfrac{\Delta\vec{r}}{\Delta t}$

which is similar to 1-dim case.
Direction carried by $\Delta\hat{r} = \vec{r}_2 - \vec{r}_1$

ii) $\vec{v} = \lim\limits_{\Delta t \to 0} \dfrac{\Delta\vec{r}}{\Delta t} = \dfrac{d\vec{r}}{dt}$

which means components are

$$v_x = \frac{dx}{dt}, v_y = \frac{dy}{dt}, v_z = \frac{dz}{dt}$$

(often $v_z = 0$ – then we have 2 dim motion)

d.) **examples**

e.) **Relative velocity** $\vec{V}_{pB} = \vec{V}_{pA} + \vec{V}_{AB}$

convention is V_{cd} is velocity of "c" in system "d" -- examples

f.) **Acceleration vectors**

$$\vec{a}_{av} = \frac{\Delta\vec{v}}{\Delta t}$$ **average acceleration**

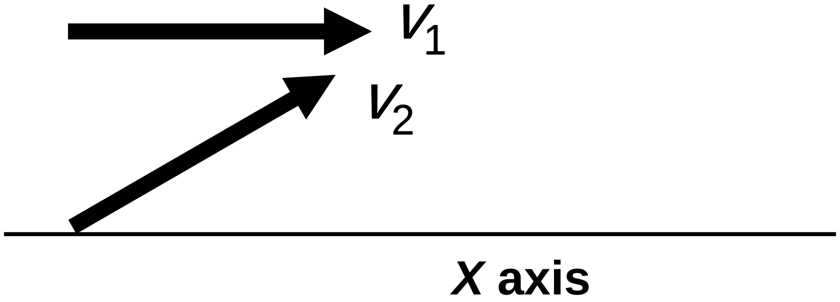
and

$$\vec{a} = \lim_{\Delta t \to 0} \frac{\Delta\vec{v}}{\Delta t} = \frac{d\vec{v}}{dt}$$ **instantaneous accel.**

Note that $\Delta\vec{V}$ will have a non-zero value if just the direction of $\vec{V}$ changes. The magnitude does not have to change.

g.) **Examples, clicker question**

the velocities of a particle at t_1 and t_2 ,
$\vec{v}_1$ and $\vec{v}_2$ are each 2.00 m/s in magnitude.
$\vec{v}_1$ is parallel to the x-axis at t=0 and
$\vec{v}_2$ is at 30º to the x-axis at t=2.00 s.



The magnitude of $\vec{a}_{av}$ is

A. 0.00 m/s²
B. 1.04 m/s²
C. 0.52 m/s²
D. 1.86 m/s²