SCALAR $\rightarrow$ ONLY MAGNITUDE

VECTOR $(a_1, a_2, a_3 \dots a_n)$

MATRIX $A$ ELEMENT $a_{ij}$

$$\underline{v} = (v_1 \; v_2 \dots v_n)$$

$$\underline{v}^T = \begin{pmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{pmatrix}$$

MATRIX MULTIPLICATION

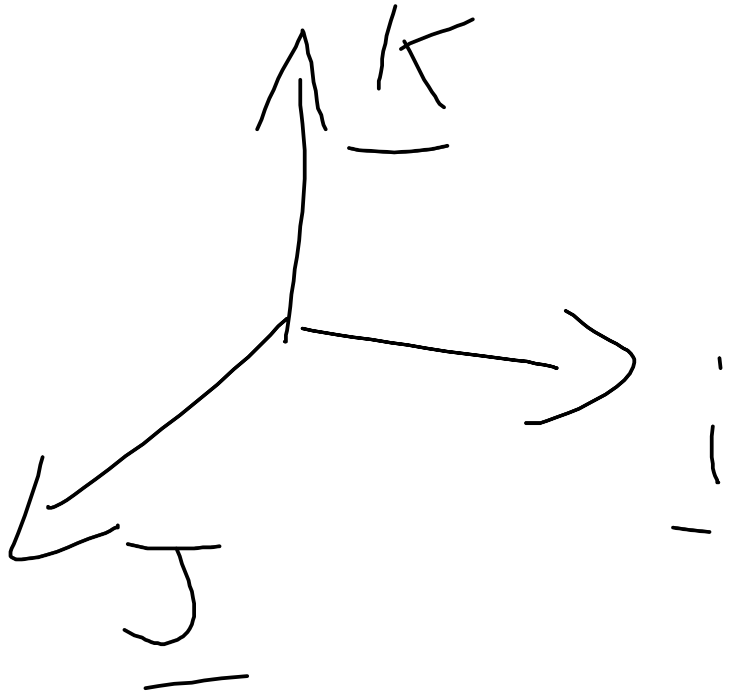
$$\begin{pmatrix} a_{11} \; a_{1i} \dots \\ \\ \end{pmatrix} \begin{pmatrix} b_{11} & b_{i1} & - \\ & - & \\ & - & \end{pmatrix} = \begin{pmatrix} \cancel{a} \\ \\ \end{pmatrix}$$

$$(v_1 \ \ldots \ v_m) \times \begin{pmatrix} u_1 \\ \vdots \\ u_m \end{pmatrix} = v_1 u_1 + v_2 u_2 + \ldots \ldots$$

$$\begin{pmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{pmatrix} (u_1 \ \ldots \ u_m) = \begin{pmatrix} v_1 u_1 & v_1 u_2 \\ v_2 u_1 & \ldots \\ & \vdots \\ & \ldots \end{pmatrix}$$

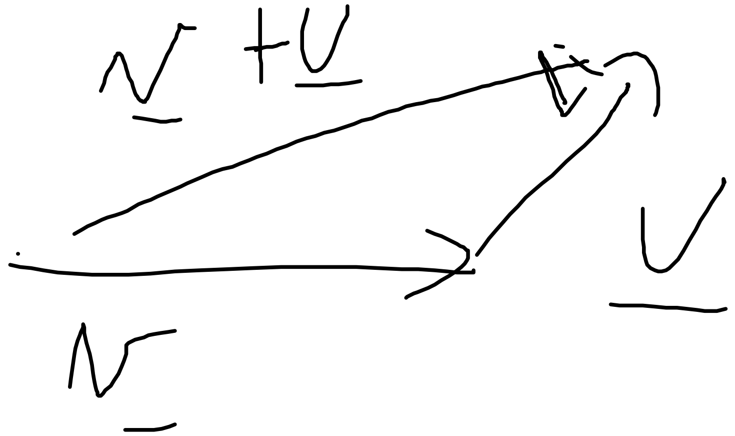
VECTORS IN PHYSICS:

NEED A BASIS




$\underline{r} = x\,\underline{i} + y\,\underline{j} + z\,\underline{k}$

VECTOR SUM



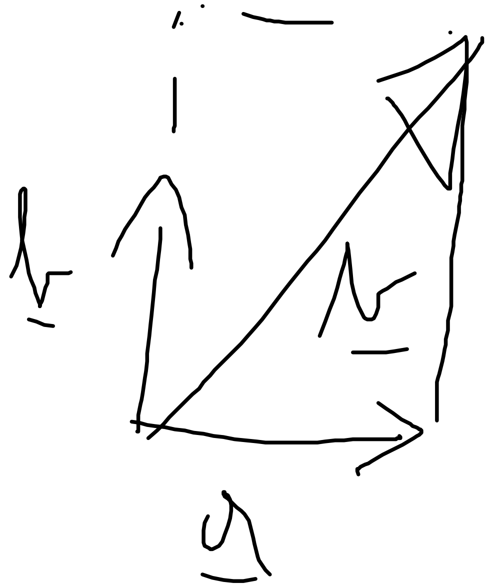

USUALLY AXES ORTHOGONAL, BUT.

SUPPOSE

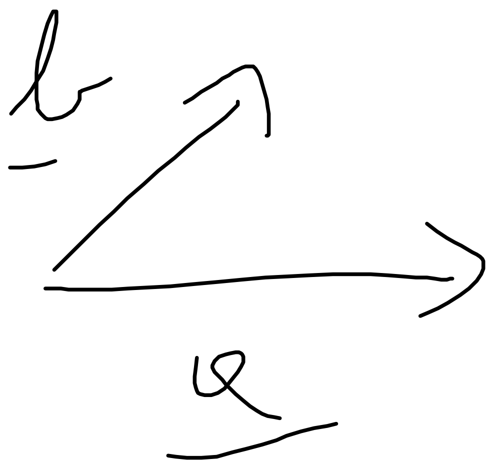

TAKE VECTOR

$\underline{v}(1,2)$

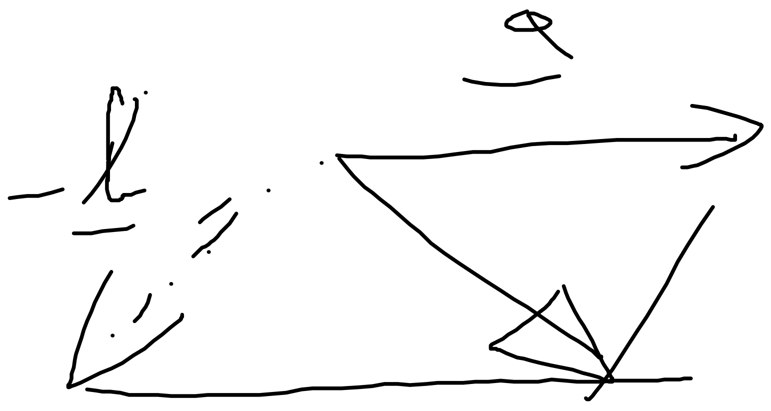
FOR ORTHONORMAL CHOICE



# SUBTRACTING VECTORS




$\underline{a} - \underline{b} \rightarrow$




$\underline{r} = x\underline{i} + y\underline{j} + z\underline{k}$

$\underline{s} = a\underline{i} + b\underline{j} + c\underline{k}$

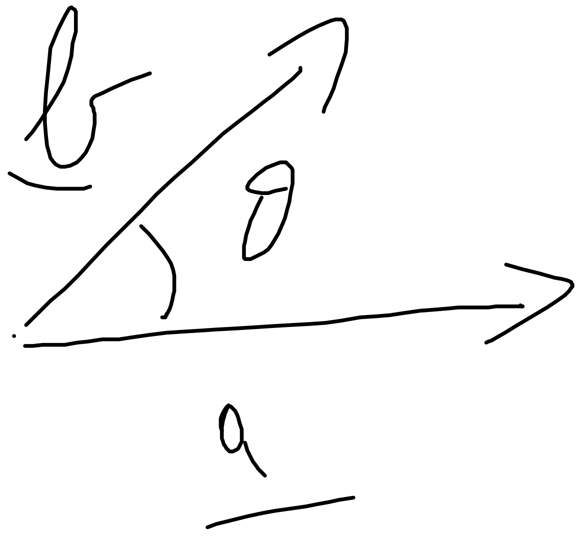
SCALAR PRODUCT $= \underline{r} \cdot \underline{s} = ax + by + cz$

MAGNITUDE OF VECTOR $= \sqrt{\underline{v} \cdot \underline{v}}$

FOR ORTHONORMAL BASIS

$\underline{i}\cdot\underline{j} = 0 = \underline{i}\cdot\underline{k} = \underline{j}\cdot\underline{k}$ ORTHOGONAL

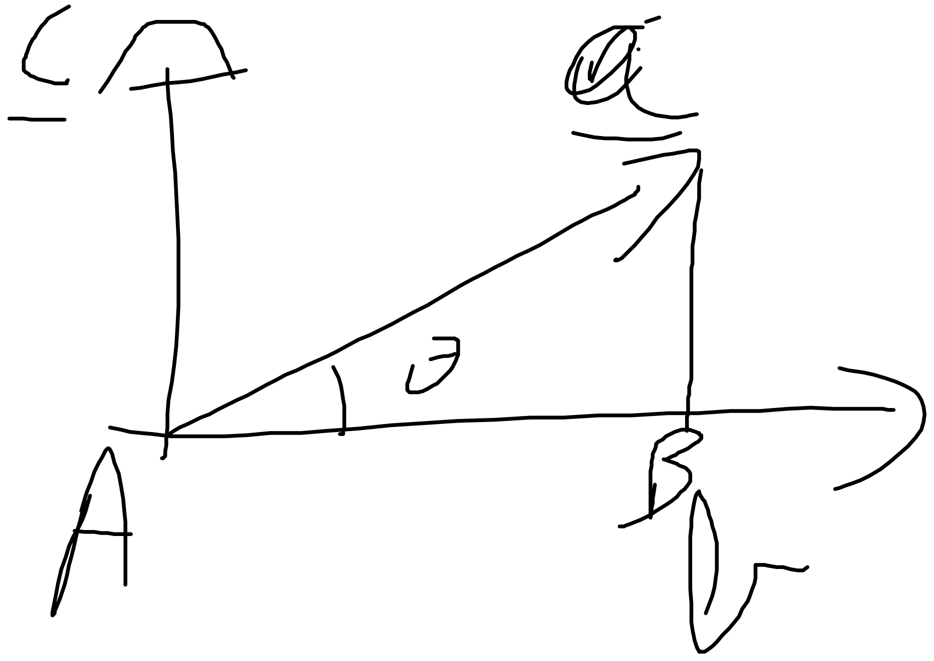
$\underline{i}\cdot\underline{i} = |\underline{i}|^2 = \underline{j}\cdot\underline{j} = |\underline{j}|^2 = |\underline{k}|^2 = \underline{1}$ NORMALISED




$\underline{a}\cdot\underline{b} = |\underline{a}||\underline{b}|\cos\theta$

$\underline{b}\cdot\underline{a} = |\underline{b}||\underline{a}|\cos|-\theta| = \underline{a}\cdot\underline{b}$

# PROJECTIONS




$$\cos\theta = \frac{AB}{|\underline{a}|}$$

$$AB = |a| \cos\theta$$

$$\underline{a} \cdot \underline{b} = |a||b| \cos\theta$$

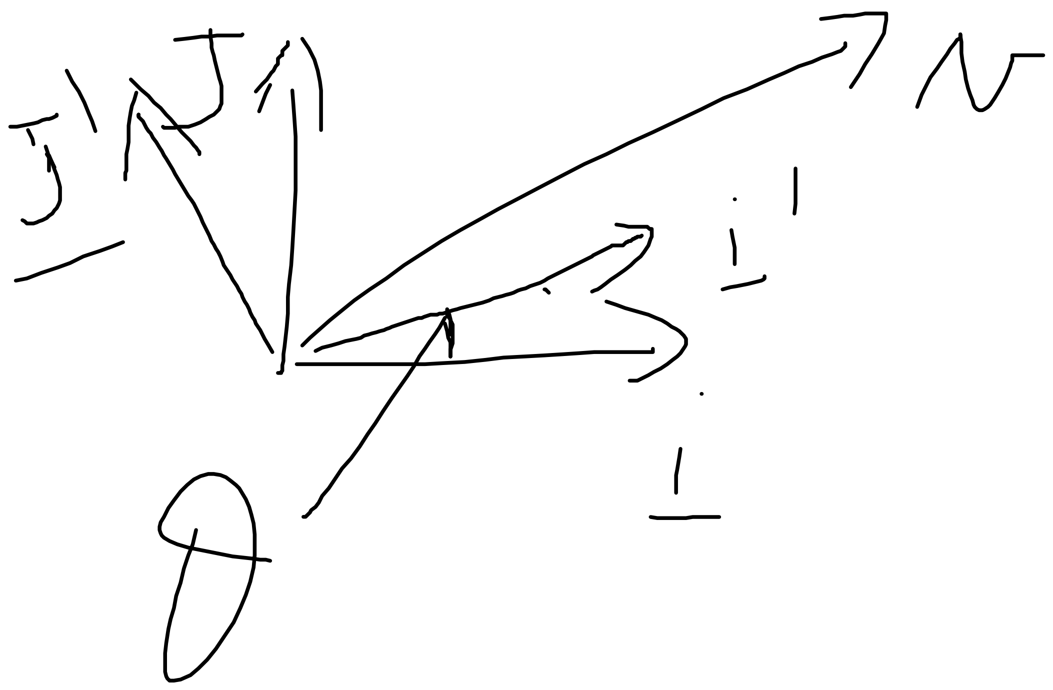
DIVIDE BY $|b|$

$$\underline{a} \cdot \hat{b} = |a| \cos\theta$$

$\hat{b}$ = UNIT VECTOR OF DIRECTION B

→ PROJECTION OF $\underline{a}$ ALONG DIRECTION $\hat{b}$ → $\underline{a} \cdot \hat{b}$

# BASIS TRANSFORMATION




$$\underline{i}' = x_1 \underline{i} + y_1 \underline{j}$$

WE KNOW

$$x_1 = \cos\theta \qquad y_1 = \sin\theta$$

$$\begin{cases} \underline{i}' = \cos\theta\, \underline{i} + \sin\theta\, \underline{j} \\ \underline{j}' = -\sin\theta\, \underline{i} + \cos\theta\, \underline{j} \end{cases}$$