$i$**,** $j$ **and** $k$ **notation**

In 2D you were previously introduced to $i=\left(\begin{matrix}1\\0 \end{matrix}\right)$ and $j=\left(\begin{matrix}0\\1\end{matrix}\right)$ as unit vectors in each of the $x$ and $y$ directions.

It meant for example that $\left(\begin{matrix}8\\-2\end{matrix}\right)$ could be written as $8i-2j$since $8\left(\begin{matrix}1\\0 \end{matrix}\right)-2\left(\begin{matrix}0\\1\end{matrix}\right)=\left(\begin{matrix}8\\-2\end{matrix}\right)$

Unsurprisingly, **in 3D:**

$$i=\left(\begin{matrix}1\\0\\0\end{matrix}\right), j=\left(\begin{matrix}0\\1\\0\end{matrix}\right), k=\left(\begin{matrix}0\\0\\1\end{matrix}\right)$$

**Quickfire Questions**

1. Put in $i,j,k$ notation:

$$\left(\begin{matrix}1\\2\\3\end{matrix}\right)=$$

$$\left(\begin{matrix}3\\0\\-1\end{matrix}\right)=$$

1. Write as a column vector:

$$4j+k=$$

$$i-j=$$

1. If $A\left(1,2,3\right), B\left(4,0,-1\right)$ then

$$\vec{AB}=$$

1. If $a=\left(\begin{matrix}2\\3\\4\end{matrix}\right)$ and $b=\left(\begin{matrix}0\\-1\\3\end{matrix}\right)$ then $3a+2b=$

**Examples**

1. Find the magnitude of $a=2i-j+4k$ and hence find $\hat{a}$, the unit vector in the direction of $a$.
2. If $a=\left(\begin{matrix}2\\-3\\5\end{matrix}\right)$ and $b=\left(\begin{matrix}4\\-2\\0 \end{matrix}\right)$ is $2a-3b$ parallel to $4i-5k$?

**Angles between vectors and an axis**

How could you work out the angle between a vector and the $x$-axis?



* **The angle between** $a=\left(\begin{matrix}x\\y\\z\end{matrix}\right)$ **and the** $x$**-axis is:**

$$\cos(θ\_{x})=\frac{x}{\left|a\right|}$$

**and similarly for the** $y$ **and** $z$ **axes.**

[Textbook] **Find the angles that the vector** $a=2i-3j-k$ **makes with each of the positive coordinate axis.**

***Test Your Understanding***

[Textbook] **The points** $A$ **and** $B$ **have position vectors** $4i+2j+7k$ **and**

$3i+4j-k$ **relative to a fixed origin,** $O$**. Find** $\vec{AB}$ **and show that** $ΔOAB$ **is isosceles.**

**(a) Find the angle that the vector** $a=2i+j+k$ **makes with the** $x$**-axis.**

**(b) By similarly considering the angle that** $b=i+3j+2k$ **makes with the** $x$**-axis, determine the area of** $OAB$ **where** $\vec{OA}=a$ **and** $\vec{OB}=b$**. (Hint: draw a diagram)**

Ex 12B p.341-343