$\vec{P} = 2i + 6j \Rightarrow P(2, 6)$

$V \cdot P = 2 \times 2 + 3 \times 6 = 4 + 18 \Rightarrow V \cdot P = 22$

$P \cdot U = 2 \times -3 + 6 \times 1 = -6 + 6 \Rightarrow P \cdot U = 0$

Examples

Given the vectors;
$V = 2i + j$ and $U = 4i + 2j$.
Show that V and U are parallel vectors.

Solution

Method A

- Scalar multiple approach.

$V = 2i + j \quad U = 4i + 2j \Rightarrow U = 2(2i + j)$
Now substitute V in $2i + j$ in U

$\Rightarrow \underline{U = 2V}$ U is a scalar multiple of V, Hence U and V are parallel.

Method B

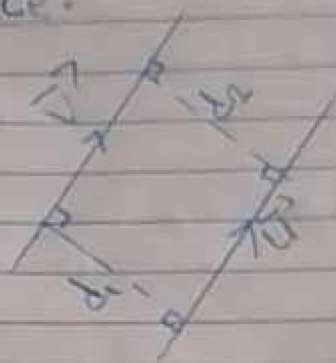
- The dot product approach

$V = 2i + j \quad U = 4i + 2j$
Apply the formula
$(a, b) \cdot (-d, c) = 0$ $\quad V = ai + bj$
$a = 2, b = 1$
$V \cdot U = (2, 1) \cdot (-2, 4)$ $\quad U = 4i + 2j$
$= 2 \times -2 + 1 \times 4$ $\quad c = 4, d = 2$

$= -4 + 4 = 0 \quad V \cdot U = 0$
Hence V and U are parallel

- The perpendicular distance between the two vector is always equal at any given instance.

$d_1 = d_2$ if the vectors $\vec{V}$ and $\vec{U}$ are parallel.



Calculation of Dot Product

To easily Calculate dot (•) product of two vectors, always express the vectors in Coordinates form.
The i-component always comes before the j-component.

Examples: Calculate the dot product of the following vectors:

1) $\vec{V} = 2i + 3j$, $\vec{U} = -3i + j$, $\vec{P} = 2i + 6j$
Find $V \cdot U$, $V \cdot P$, $P \cdot U$.

Solution

For vector dot product, for

$$(a, b) \cdot (c, d) = a \times c + b \times d$$
$$= ac + bd.$$

a) $\vec{V} = 2i + 3j \Rightarrow V(2, 3)$

$\vec{U} = -3i + j \Rightarrow U(-3, 1)$

$$V \cdot U = 2 \times -3 + 3 \times 1$$
$$= -6 + 3 \Rightarrow \underline{V \cdot U = -3}$$

Question N°
Write on both side of this paper

Examples; determine the directions of the following vectors.

a) $\overrightarrow{OA} = 3i$ b) $\overrightarrow{OB} = \sqrt{5}j$ c) $\overrightarrow{OP} = -5i$
d) $\overrightarrow{ON} = -15j$

SOLUTION

a) $\overrightarrow{OA} = 3i$, $\overrightarrow{OA}$ lies along the positive i-axis Direction $= 0°$

b) $\overrightarrow{OB} = \sqrt{5}j$; $\overrightarrow{OB}$ lies along the positive j-axis, Direction is $90°$

c) $\overrightarrow{OP} = -5i$; $\overrightarrow{OP}$ lies along the negative i-axis, Direction is $180°$

d) $\overrightarrow{ON} = -15j$; $\overrightarrow{ON}$ lies along the Negative j-axis. Direction $= -90°$.

PARALLEL VECTORS

Two or more vectors are parallel if the following condition holds.

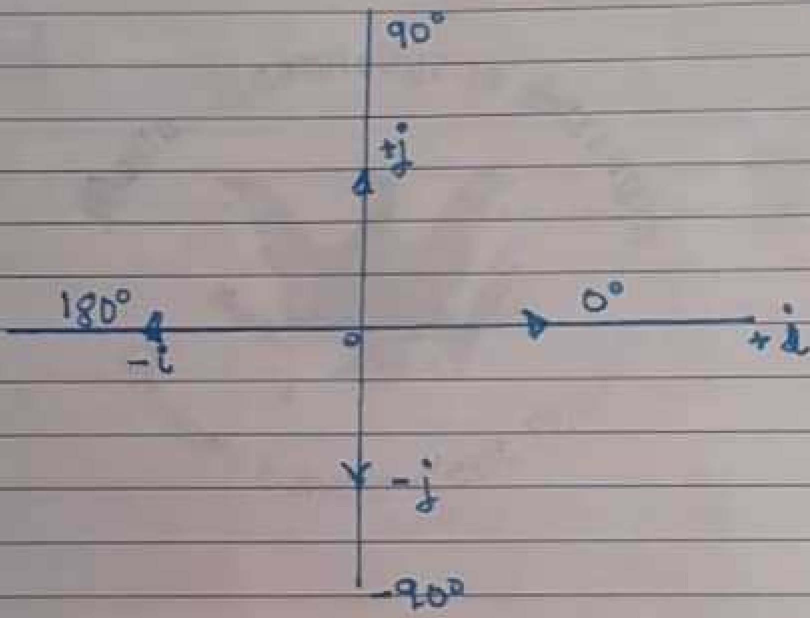
- One is a scalar multiple of the other.
- They must have the same direction vector.
- $(a, b) \cdot (-d, c) = 0$ ie the dot product of the vectors equals zero

The product $(a, b) \cdot (-d, c)$ is called the dot product because of the dot $(\cdot)$ between.

STANDARD DIRECTIONS OF VECTORS

They are standard because the vectors have fixed directions no matter the magnitude of the vector.

The Diagram below Summarizes the theory above.



- Vectors that lie along the positive i-axis has direction of 0°
- Vectors that lie along the positive j-axis has direction as 90°.
- Vectors that lie along the Negative i-axis has direction as 180°
- Vectors that lie along the Negative j-axis has -90° as direction.

From the above analysis the direction of a Vector lies in the Range $-180° < \theta \leq 180°$ OR $]-180°, 180°]$

P₁