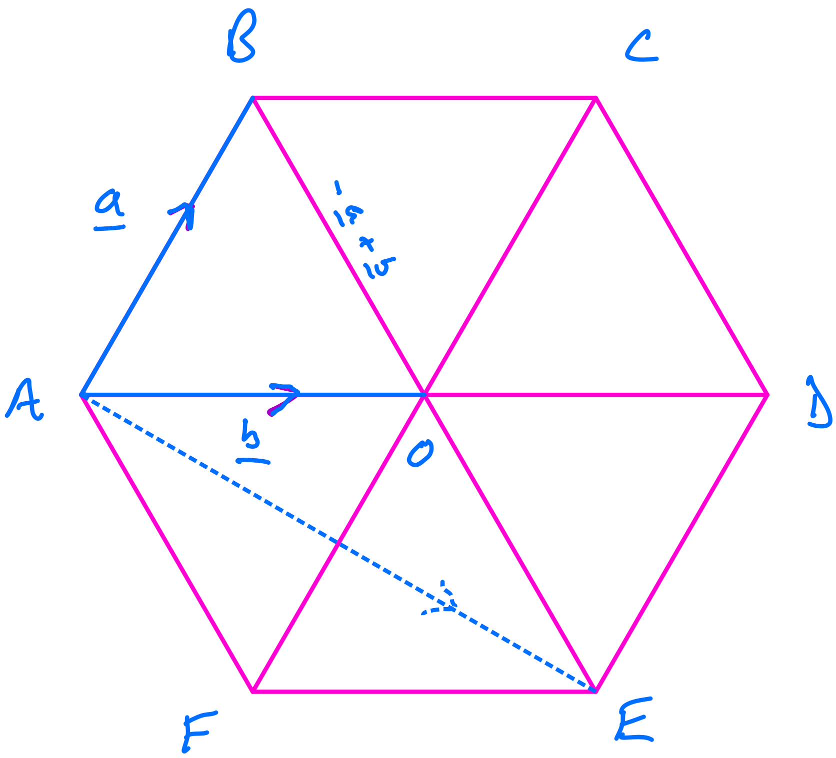
Vectors in Geometry



$$\overrightarrow{BO} = \overrightarrow{BA} + \overrightarrow{AO}$$
$$= -\underline{a} + \underline{b}$$

$$\overrightarrow{AB} = \underline{a} \qquad \overrightarrow{AO} = \underline{b} \qquad \overrightarrow{BO} = -\underline{a} + \underline{b}$$
$$\overrightarrow{FO} = \underline{a} \qquad \overrightarrow{FE} = \underline{b} \qquad \overrightarrow{CD} = -\underline{a} + \underline{b}$$
$$\overrightarrow{OC} = \underline{a} \qquad \overrightarrow{OD} = \underline{b} \qquad \overrightarrow{OE} = -\underline{a} + \underline{b}$$
$$\overrightarrow{ED} = \underline{a} \qquad \overrightarrow{BC} = \underline{b} \qquad \overrightarrow{AF} = -\underline{a} + \underline{b}$$

Further Examples

$$\overrightarrow{AE} = \overrightarrow{AF} + \overrightarrow{FE}$$
$$= -\underline{a} + \underline{b} + \underline{b} = 2\underline{b} - \underline{a}$$

$$\overrightarrow{AE} = \overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CD} + \overrightarrow{DE}$$
$$= \underline{a} + \underline{b} - \underline{a} + \underline{b} - \underline{a}$$
$$= 2\underline{b} - \underline{a}$$

Any continuous route around the diagram from A to E will give the same answer

Try ABODE

$$\overrightarrow{AE} = \overrightarrow{AB} + \overrightarrow{BO} + \overrightarrow{OD} + \overrightarrow{DE}$$
$$= \underline{a} - \underline{a} + \underline{b} + \underline{b} - \underline{a}$$
$$= 2\underline{b} - \underline{a}$$

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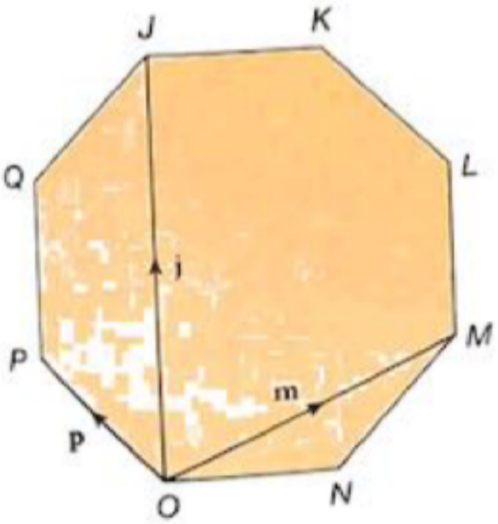
3 *JKLMNOPQ* is a regular octagon.

$\overrightarrow{OJ} = \mathbf{j}$ $\overrightarrow{OM} = \mathbf{m}$ $\overrightarrow{OP} = \mathbf{p}$



Write all the vectors that are equa

a $\mathbf{j}$ b $\mathbf{m}$

c $\mathbf{p}$ d $-\mathbf{j}$

e $-\mathbf{m}$ f $-\mathbf{p}$

a) Equal to $\underline{j}$

$\overrightarrow{NK}$

b) Equal to $\underline{m}$

$\overrightarrow{QK}$

c) Equal to $\underline{p}$

$\overrightarrow{LK}$

d) Equal to $-\underline{j}$

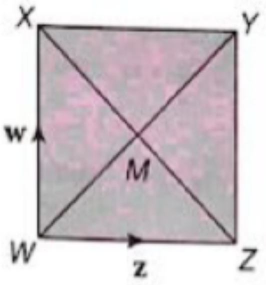
$\overrightarrow{KN}$

e) Equal to $-\underline{m}$

$\overrightarrow{KQ}$

f Equal to $-\underline{p}$
$\overrightarrow{KL}$

1 $WXYZ$ is a square.
The diagonals WY and XZ intersect at M.
$\overrightarrow{WX} = \mathbf{w}$ and $\overrightarrow{WZ} = \mathbf{z}$.
Write these vectors in terms of $\mathbf{w}$ and $\mathbf{z}$.



a $\overrightarrow{XY}$ b $\overrightarrow{WY}$ c $\overrightarrow{WM}$
d $\overrightarrow{MY}$ e $\overrightarrow{MX}$ f $\overrightarrow{XM}$

a) $\overrightarrow{XY} = \underline{z}$

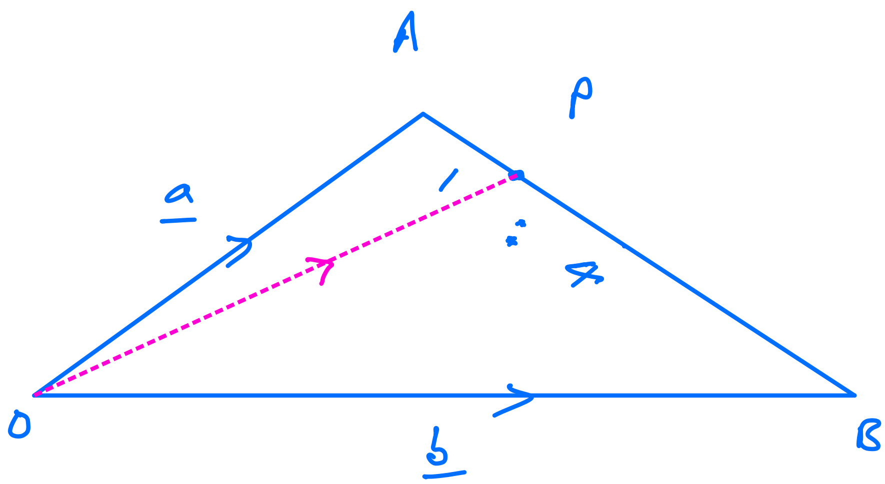
b) $\overrightarrow{WY} = \underline{w} + \underline{z}$

c) $\overrightarrow{WM} = \frac{1}{2}\overrightarrow{WY} = \frac{1}{2}(\underline{w} + \underline{z})$

d) $\overrightarrow{MY} = \frac{1}{2}\overrightarrow{WY} = \frac{1}{2}(\underline{w} + \underline{z})$

e) $\overrightarrow{ZX} = -\underline{z} + \underline{w}$, $\overrightarrow{MX} = \frac{1}{2}\overrightarrow{ZX} = \frac{1}{2}(-\underline{z} + \underline{w})$

f) $\overrightarrow{XM} = -\overrightarrow{MX} = -\frac{1}{2}(-\underline{z} + \underline{w})$ or $\frac{1}{2}(\underline{z} - \underline{w})$



Find $\overrightarrow{AB}$

$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$
$= -\underline{a} + \underline{b}$

P divides AB in the ratio 1:4
$\overrightarrow{AP} : \overrightarrow{PB} = 1:4$

Find $\overrightarrow{OP}$

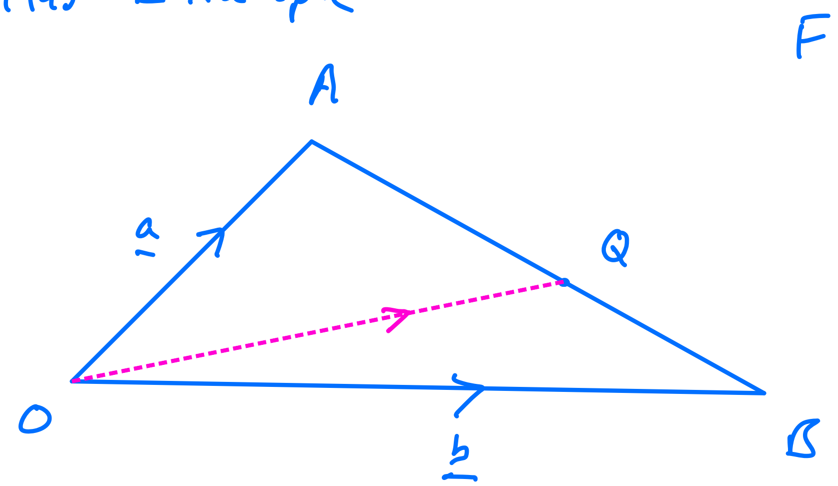
$\overrightarrow{OP} = \overrightarrow{OA} + \overrightarrow{AP}$
$= \overrightarrow{OA} + \frac{1}{5}\overrightarrow{AB}$

$= \underline{a} + \frac{1}{5}(-\underline{a} + \underline{b})$

$= \underline{a} - \frac{1}{5}\underline{a} + \frac{1}{5}\underline{b}$

$= \frac{4}{5}\underline{a} + \frac{1}{5}\underline{b}$

Similar Example



Q divides AB in the ratio 4 : 3

$\vec{AQ} : \vec{QB} = 4 : 3$

i) Find $\vec{AB}$

$\vec{AB} = \vec{AO} + \vec{OB}$

$= -\underline{a} + \underline{b}$

4 + 3 = 7 parts

ii) Find $\vec{OQ}$

$\vec{OQ} = \vec{OA} + \vec{AQ}$

$= \vec{OA} + \frac{4}{7}\vec{AB}$

$= \underline{a} + \frac{4}{7}(-\underline{a} + \underline{b})$

$= \underline{a} - \frac{4}{7}\underline{a} + \frac{4}{7}\underline{b}$

$\vec{OQ} = \frac{3}{7}\underline{a} + \frac{4}{7}\underline{b}$