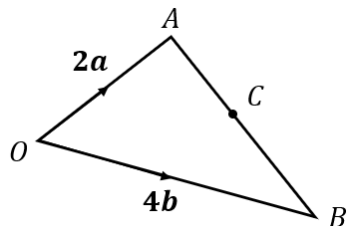# Vectors and Midpoints

(a)

In the triangle OAB, $\overrightarrow{OA} = 2\boldsymbol{a}$ and $\overrightarrow{OB} = 4\boldsymbol{b}$. C is the midpoint of the line AB.

Express the following in terms of $\boldsymbol{a}$ and $\boldsymbol{b}$:

(a) $\overrightarrow{AB}$ $-2\boldsymbol{a} + 4\boldsymbol{b}$

(b) $\overrightarrow{BA}$ $2\boldsymbol{a} - 4\boldsymbol{b}$

(c) $\overrightarrow{AC}$ $-\boldsymbol{a} + 2\boldsymbol{b}$

(d) $\overrightarrow{BC}$ $\boldsymbol{a} - 2\boldsymbol{b}$

(e) $\overrightarrow{OC}$ $\boldsymbol{a} + 2\boldsymbol{b}$

(f) $\overrightarrow{CO}$ $-\boldsymbol{a} - 2\boldsymbol{b}$

(b)

$OABC$ is a trapezium, where $\overrightarrow{OA} = \boldsymbol{a}$ and $\overrightarrow{AB} = \boldsymbol{b}$. D is the midpoint of BC and $\overrightarrow{OC} = 2\overrightarrow{AB}$.
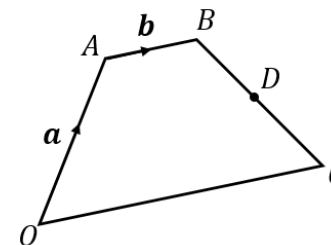
Express the following in terms of $\boldsymbol{a}$ and $\boldsymbol{b}$:

(a) $\overrightarrow{OC}$ $2\boldsymbol{b}$

(b) $\overrightarrow{CB}$ $\boldsymbol{a} - \boldsymbol{b}$

(c) $\overrightarrow{BC}$ $-\boldsymbol{a} + \boldsymbol{b}$

(d) $\overrightarrow{BD}$ $-\frac{1}{2}\boldsymbol{a} + \frac{1}{2}\boldsymbol{b}$

(e) $\overrightarrow{AD}$ $-\frac{1}{2}\boldsymbol{a} + \frac{3}{2}\boldsymbol{b}$

(f) $\overrightarrow{DO}$ $-\frac{1}{2}\boldsymbol{a} - \frac{3}{2}\boldsymbol{b}$

(c)

In the parallelogram $OABC$, $\overrightarrow{OA} = \boldsymbol{a}$ and $\overrightarrow{OC} = \boldsymbol{c}$.
X is the midpoint of the line OB.
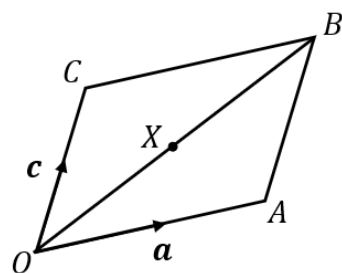
Express the following in terms of $\boldsymbol{a}$ and $\boldsymbol{c}$:

(a) $\overrightarrow{CB}$ $\boldsymbol{a}$

(b) $\overrightarrow{BA}$ $-\boldsymbol{c}$

(c) $\overrightarrow{OB}$ $\boldsymbol{a} + \boldsymbol{c}$

(d) $\overrightarrow{XB}$ $\frac{1}{2}\boldsymbol{a} + \frac{1}{2}\boldsymbol{c}$

(e) $\overrightarrow{XC}$ $-\frac{1}{2}\boldsymbol{a} + \frac{1}{2}\boldsymbol{c}$

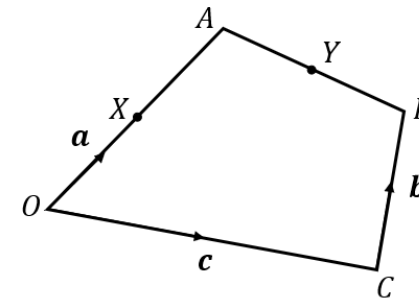(f) $\overrightarrow{AX}$ $-\frac{1}{2}\boldsymbol{a} + \frac{1}{2}\boldsymbol{c}$

What do the answers to (e) and (f) tell us about the points C, X and A? CXA is a straight line where X is the midpoint

(d)

$OABC$ is a quadrilateral.
$\overrightarrow{OX} = \boldsymbol{a}$, $\overrightarrow{OC} = \boldsymbol{c}$ and $\overrightarrow{CB} = \boldsymbol{b}$.
X is the midpoint of OA and Y is the midpoint of AB.

Express the following in terms of $\boldsymbol{a}, \boldsymbol{b}$ and $\boldsymbol{c}$:

(a) $\overrightarrow{OA}$ $2\boldsymbol{a}$

(b) $\overrightarrow{OB}$ $\boldsymbol{b} + \boldsymbol{c}$

(c) $\overrightarrow{CA}$ $2\boldsymbol{a} - \boldsymbol{c}$

(d) $\overrightarrow{AB}$ $-2\boldsymbol{a} + \boldsymbol{b} + \boldsymbol{c}$

(e) $\overrightarrow{AY}$ $-\boldsymbol{a} + \frac{1}{2}\boldsymbol{b} + \frac{1}{2}\boldsymbol{c}$

(f) $\overrightarrow{XY}$ $\frac{1}{2}\boldsymbol{b} + \frac{1}{2}\boldsymbol{c}$

What do the answers to (b) and (f) tell us about vectors $\overrightarrow{OB}$ and $\overrightarrow{XY}$? $\overrightarrow{OB}$ and $\overrightarrow{XY}$ are parallel