

Exercise walk-through

4.4.4

Coordinate Geometry

AQA · GCSE · Mathematics

28. Vectors and transformation geometry · Foundation

Vectors and transformation geometry · Foundation

With $a=(4,1)$ and $b=(1,3)$, $a+b=(5,4)$ and $2a-b=(7,-1)$. From $A=(1,2)$ to $B=(5,5)$, $AB=(4,3)$ and its length is 5. Write each 2D vector as a column with the horizontal component above the vertical component: the translation AB has top entry 4 and bottom entry 3. A negative horizontal entry moves left; a negative vertical entry moves down. Drawing b from the head of a gives the head-to-tail diagram for $a+b$. Subtracting b adds its opposite $-b$.

86. Geometric reasoning on coordinate axes · Foundation

Geometric reasoning on coordinate axes · Foundation

For $A=(1,2)$, $B=(5,2)$, $C=(5,5)$, $D=(1,5)$, $AB=4$ and $BC=3$. AB is horizontal, BC vertical, so they are perpendicular; opposite sides have matching directions and lengths, establishing a rectangle. Diagonal AC has length $\sqrt{(4^2+3^2)}=5$. Its midpoint is $((1+5)/2, (2+5)/2)=(3,3.5)$. Diagonal BD has the same midpoint, confirming that the diagonals bisect each other. A translation by $(2,-1)$ sends A to $(3,1)$ and C to $(7,4)$, preserving the diagonal length. A square would additionally need adjacent side lengths equal; these lengths 4 and 3 exclude it.

176. Vector geometry and midpoint arguments · Higher

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Let $OA=a$ and $OB=b$, with M midpoint of OA and N midpoint of OB . Then $OM=a/2$ and $ON=b/2$, so $MN=b/2-a/2=(b-a)/2=AB/2$. Thus MN is parallel to AB and half as long. For $a=(4,2), b=(2,6)$, $M=(2,1), N=(1,3)$, $AB=(-2,4)$ and $MN=(-1,2)$, verifying the general result. In parallelogram $OACB$ with $OC=a+b$, the midpoint of OC is $(a+b)/2$; the midpoint of AB is the same, so the diagonals bisect each other. If $AP=3AB/2$, P lies on line AB beyond B ; if $AP=AB/2$, P is its midpoint. A parallel vector at another location alone does not prove three specified points collinear.

Exercises 2.1·2.3

2.1 (Foundation) Find AB for $A=(1,2)$, $B=(5,2)$.

2.2 (Foundation) Find AC for $A=(1,2)$, $C=(5,5)$.

2.3 (Foundation) Find the x-coordinate of the midpoint of AC.

3 Exam-style questions

Exercises 2.1·2.3

2.1 (Foundation) Find AB for $A=(1,2)$, $B=(5,2)$.

2.1 Same y: horizontal distance $|5-1|=4$.

2.2 (Foundation) Find AC for $A=(1,2)$, $C=(5,5)$.

2.2 Pythagoras gives $\sqrt{4^2+3^2}=5$.

2.3 (Foundation) Find the x-coordinate of the midpoint of AC.

3 Exam-style questions

2.3 Average the x-coordinates: $(1+5)/2=3$.

Exercise 3.1

3.1 Decide whether this claim is true. Justify with a concrete calculation or counterexample: Every quadrilateral with two equal diagonals is a square.

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3.1 False. A 3 by 4 rectangle has two diagonals of length 5 but unequal adjacent sides, so it is not a square.

Local review guidance: show the chosen method; give the checked result; explain the condition or failed shortcut. This is authored classroom guidance.