

The Panda Math Tutor

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Vectors and Transformations

Solutions & Answer Key

Full worked solutions, marking scheme & answer key

IGCSE Mathematics

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Companion to the *Student Worksheet*

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Note

About this booklet. These are the complete solutions to every question in the *Vectors and Transformations — Student Worksheet*. Question numbers match exactly (V1–V6, MG1–MG7, VO1–VO7, PV1–PV7, T1–T6, R1–R6, RO1–RO7, E1–E7, C1–C6, the Mixed Review MR1–MR10, and the examination questions Q1–Q8). Each solution follows the notes’ reasoning pattern — identify what is given, state what is required, choose the method *and say why it fits*, work through it, then check. Depth is scaled to difficulty. Part V collects the common mistakes to watch for, and Part VI is a quick answer key for fast marking.

4 Part IV — Complete Solutions

Note

Each solution follows the same reasoning pattern used in the notes: identify what is given, decide what is required, choose the method *and say why it fits*, work through it, then check. Depth is scaled to difficulty — brief for basic questions, fuller for harder ones.

4.1 Solutions — Vectors and Column Vectors

Solution V1

Use *end – start*:

$$\overrightarrow{PQ} = \begin{pmatrix} 6 - 1 \\ 5 - 2 \end{pmatrix} = \begin{pmatrix} 5 \\ 3 \end{pmatrix}.$$

Check: from $(1, 2)$, move 5 right and 3 up, landing on $(6, 5)$. ✓

Solution V2

Reversing the arrow reverses the vector: $\overrightarrow{BA} = -\overrightarrow{AB}$.

$$\overrightarrow{BA} = \begin{pmatrix} -3 \\ 7 \end{pmatrix}.$$

The two vectors have the *same length* but point in *opposite directions*, so every component changes sign.

Solution V3

$$\overrightarrow{AB} = \begin{pmatrix} 3 - (-2) \\ -1 - 4 \end{pmatrix} = \begin{pmatrix} 5 \\ -5 \end{pmatrix}, \quad \overrightarrow{BA} = \begin{pmatrix} -2 - 3 \\ 4 - (-1) \end{pmatrix} = \begin{pmatrix} -5 \\ 5 \end{pmatrix}.$$

As expected, $\overrightarrow{BA} = -\overrightarrow{AB}$. ✓

Solution V4

Here the *start* and the *vector* are known, so add the vector to the start point:

$$D = (7 + (-4), 1 + 6) = (3, 7).$$

Check: $\overrightarrow{CD} = \begin{pmatrix} 3 - 7 \\ 7 - 1 \end{pmatrix} = \begin{pmatrix} -4 \\ 6 \end{pmatrix}$. ✓

Solution V5

$$\overrightarrow{AB} = \begin{pmatrix} 4 - 1 \\ -1 - 5 \end{pmatrix} = \begin{pmatrix} 3 \\ -6 \end{pmatrix}, \quad \overrightarrow{BC} = \begin{pmatrix} 9 - 4 \\ 7 - (-1) \end{pmatrix} = \begin{pmatrix} 5 \\ 8 \end{pmatrix},$$

$$\overrightarrow{AC} = \begin{pmatrix} 9 - 1 \\ 7 - 5 \end{pmatrix} = \begin{pmatrix} 8 \\ 2 \end{pmatrix}.$$

Adding the first two componentwise:

$$\overrightarrow{AB} + \overrightarrow{BC} = \begin{pmatrix} 3 + 5 \\ -6 + 8 \end{pmatrix} = \begin{pmatrix} 8 \\ 2 \end{pmatrix} = \overrightarrow{AC}. \quad \checkmark$$

This is the Triangle Law: travelling $A \rightarrow B$ then $B \rightarrow C$ has the same overall effect as going straight from A to C .

Solution V6

(a) $Q = P + \overrightarrow{PQ} = (-3 + 7, 2 + (-5)) = (4, -3).$

(b) $\overrightarrow{QR} = -2 \begin{pmatrix} 7 \\ -5 \end{pmatrix} = \begin{pmatrix} -14 \\ 10 \end{pmatrix}$, so

$$R = (4 + (-14), -3 + 10) = (-10, 7).$$

(c) $\overrightarrow{PR} = \begin{pmatrix} -10 - (-3) \\ 7 - 2 \end{pmatrix} = \begin{pmatrix} -7 \\ 5 \end{pmatrix} = - \begin{pmatrix} 7 \\ -5 \end{pmatrix} = -\overrightarrow{PQ}.$

Since $\overrightarrow{PR}$ and $\overrightarrow{PQ}$ have equal length but opposite direction, R and Q lie on opposite sides of P at the same distance from it. In other words, **P is the midpoint of QR .**

Preview ends here

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