The Panda Math Tutor

www.thepandamathtutor.com

Vectors and Transformations

Solutions & Answer Key

Full worked solutions, marking scheme & answer key

IGCSE Mathematics

The Panda Math Tutor

Prepared by

Nikolas Agisilaou

Companion to the *Student Worksheet*

Contents

4 Part IV — Complete Solutions **2**
4.1 Solutions — Vectors and Column Vectors . . . 2
4.2 Solutions — Magnitude of a Vector . . . 4
4.3 Solutions — Vector Operations . . . 5
4.4 Solutions — Position Vectors and Vector Geometry . . . 7
4.5 Solutions — Translations . . . 9
4.6 Solutions — Reflections . . . 10
4.7 Solutions — Rotations . . . 12
4.8 Solutions — Enlargements . . . 13
4.9 Solutions — Combined Transformations . . . 15
4.10 Solutions — Mixed Review . . . 17
4.11 Marking Scheme — Examination-Style Practice . . . 19

5 Part V — Common Mistakes & Learning Tips **22**

6 Part VI — Final Answer Key **23**

The Panda Math Tutor

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.

The Panda Math Tutor

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

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

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

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

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

Adding the first two componentwise:

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

This is the Triangle Law: travelling $A \to B$ then $B \to C$ 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.

The Panda Math Tutor

Preview ends here

22 more pages are in the full pack.

Vectors and Transformations — Solutions — €9.99

Buy the pack and the complete PDF lands in your inbox.

Personal study use only — please don't resell or share.