****Invariant Points

Draw as many coordinate grids and diagrams as you need to in your book.

**Question 1**

A triangle has vertices $A (2, 2)$, $B (5, 2)$ and $C (2, 6)$.

For each of the transformations below, write down the letter(s) of any vertices that are invariant.

a) Rotation $180°$ about the point $B$.

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b) Enlargement by scale factor $3$, centre $(2, 2)$.

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c) Reflection in the line $x=2$.

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d) Reflection in the line $y=x$.

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**Question 2**

A triangle has vertices $A (-3, 6)$, $B (-3, -1)$ and $C (4, 6)$.

For each of the transformations below, write down the letter(s) of any vertices that are invariant.

a) Rotation $180°$ about the point $(-3, 6)$.

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b) Enlargement by scale factor $\frac{1}{2}$, centre $(4, 6)$.

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c) Reflection in the line $x=4$.

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d) Reflection in the line $y=x+2$.

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**Question 3**

A triangle has vertices $P (-2, 1)$, $Q (2, 1)$ and $R (2, 4)$.

* David says, “if $PQR$ is reflected in the line $x=-2$ there is one invariant point”.
* Yash says, “if $PQR$ is reflected in the line $y=1$ there are two invariant points”.
* Suzie says, “if $PQR$ is reflected in the line $x=2$ there are two vertices that are invariant”.

Which student is incorrect? You must explain your answer.

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**Question 4**

A quadrilateral has vertices $A (-5, -2)$, $B (-3, -1)$, $C (-3, -3)$ and $D (-5, -4)$.

* $ABCD$ is reflected in the line $x=-1$,
* followed by a reflection in the line $y=-x$,
* followed by a rotation of $180°$ about $(-1, -1)$.

Which of the vertices are invariant?

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**Question 5**

A triangle has vertices $X (-1, 0)$, $Y (1, 0)$ and $Z (1, 1)$.

$XYZ$ is rotated of $180°$ about $(-1, 2)$ and then translated by the vector $\left(\begin{matrix}2\\-4\end{matrix}\right)$.

Write down the coordinates of the invariant point.

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**Question 6**

A square has vertices $A (1, 4)$, $B (3, 4)$, $C (3, 2)$ and $D (1, 2)$.

Square $ABCD$ is transformed by a combined transformation of a reflection in the line $x=-1$ followed by a rotation.

Under the combined transformation, two vertices of the square $ABCD$ are invariant.

Describe fully one possible rotation.

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**Question 7**

A quadrilateral has vertices $A (2, 5)$, $B (3, 3)$, $C (2, 1)$ and $D (1, 3)$.

Describe the transformation given:

a) Points $A$ and $C$ are invariant. $B$ maps onto $D$ and $D$ maps onto $B$.

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b) Points $B$ and $D$ are invariant. $A$ maps onto $C$ and $C$ maps onto $A$.

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