3.17 Transformations: Test Pack

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Translate point P(2, 3) by the vector (4, -1). Write down the coordinates of the image.

(Total for Question 1 is 1 mark)

2 Reflect the point A(-1, 4) in the y-axis. Give the coordinates of the reflected point.

(Total for Question 2 is 1 mark)

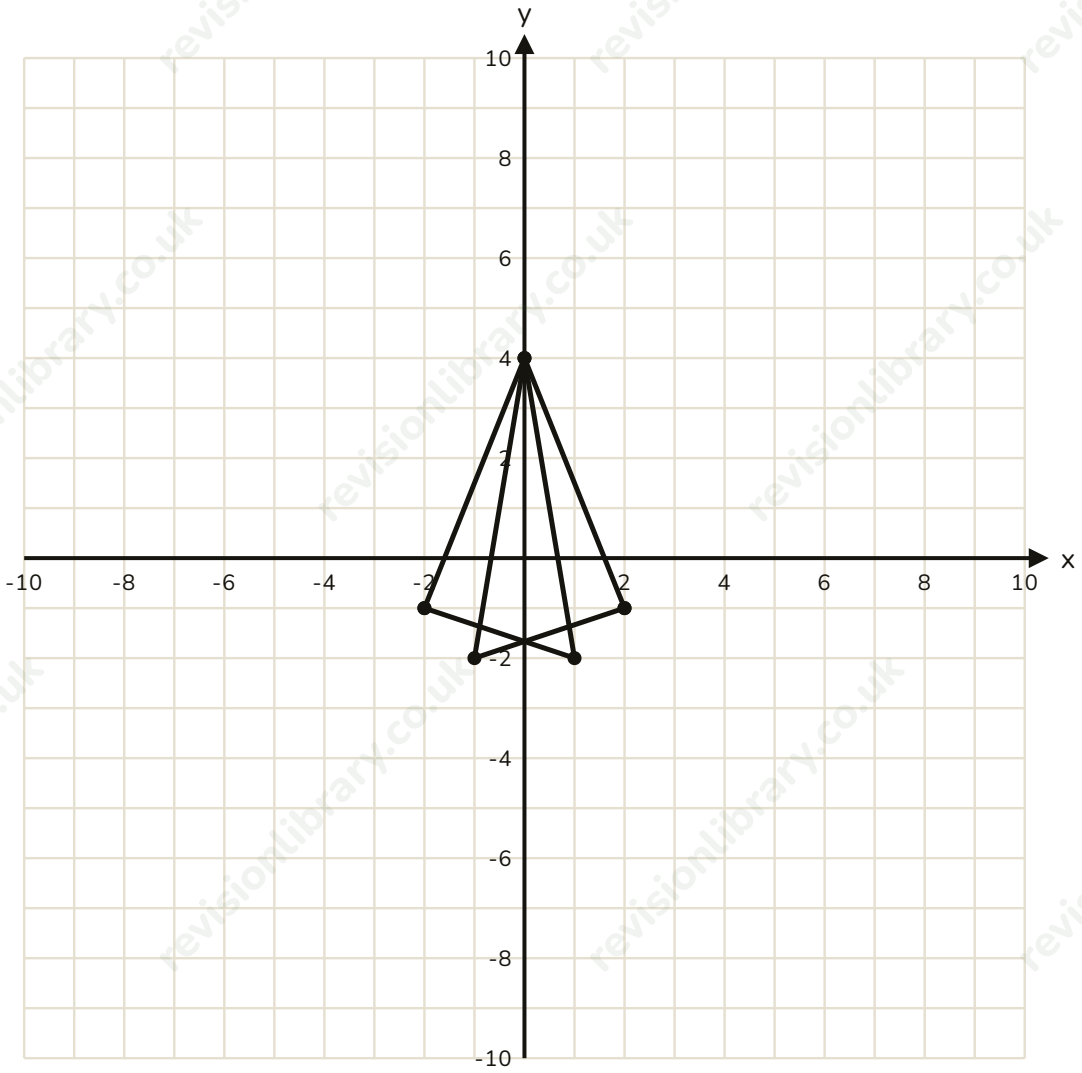
3 Point A has coordinates (2, 1). Under a translation, A is mapped to A' (8, 0).
Point B has coordinates (2, 5). Work out the coordinates of B' after the same translation, and describe the translation as a column vector in the form (x, y).

(Total for Question 3 is 3 marks)

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4 Triangle T has vertices at (-2, -1), (0, 4), (1, -2). Triangle U has vertices at (2, -1), (0, 4), (-1, -2).

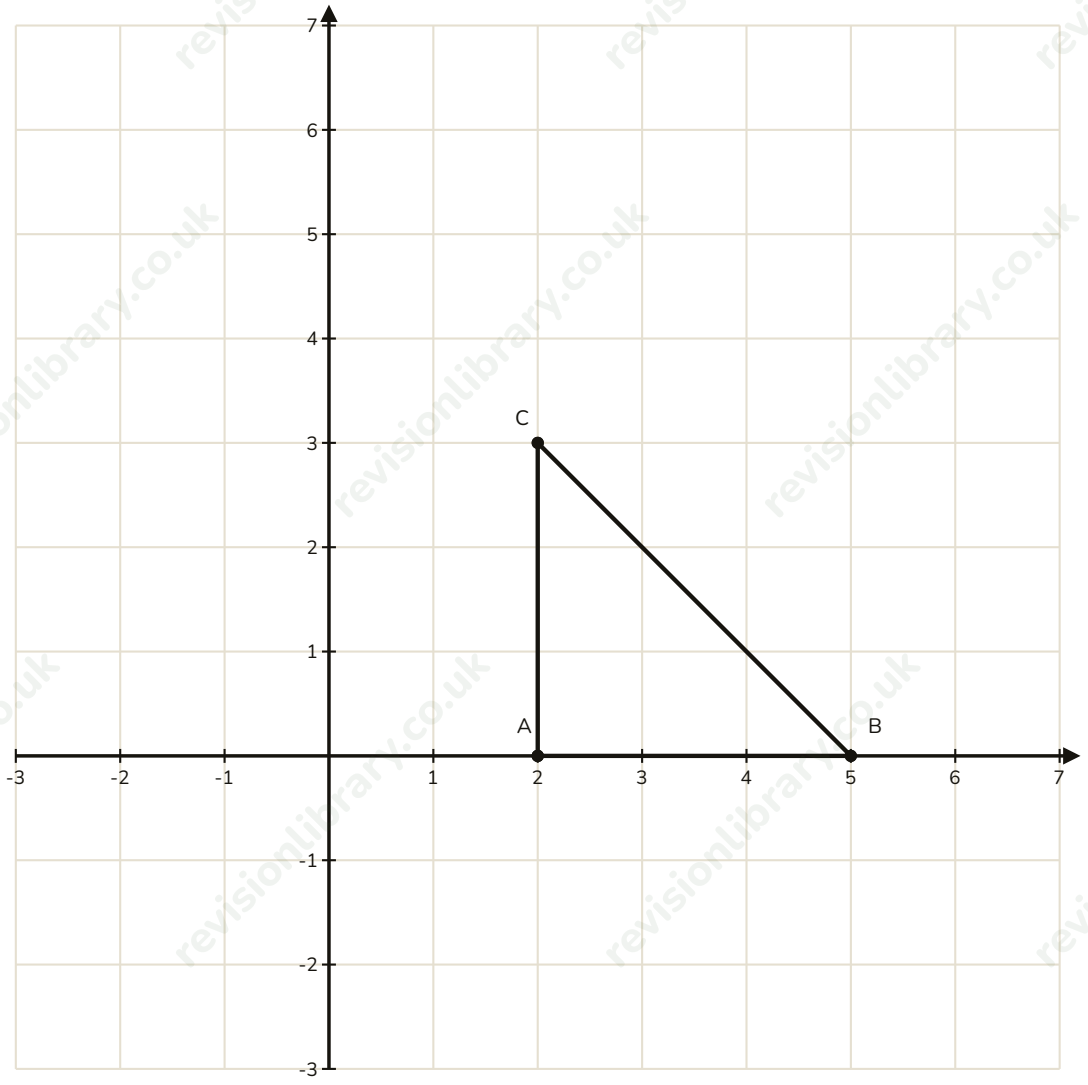
Describe fully the single transformation that maps T onto U.



(Total for Question 4 is 3 marks)

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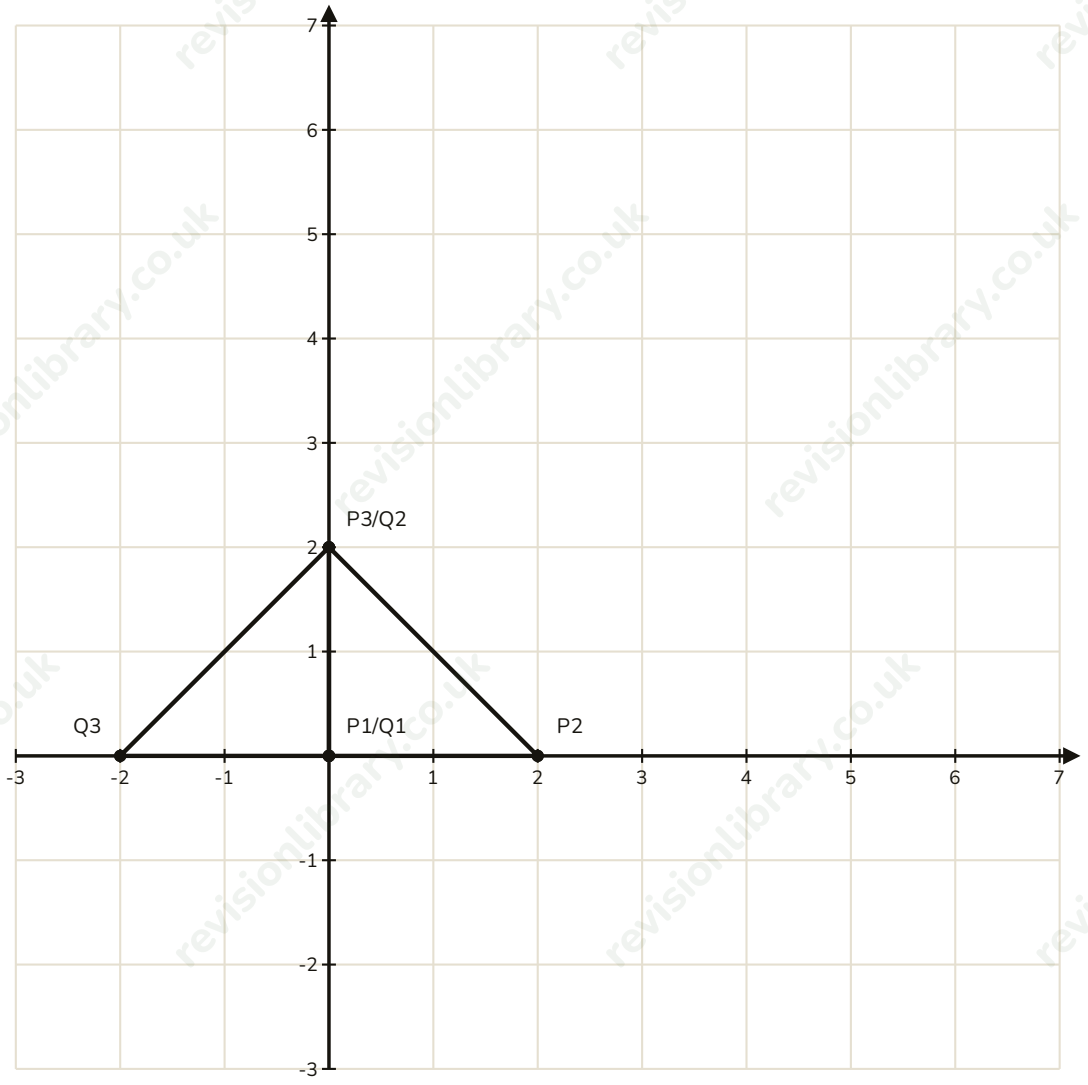
5 Triangle ABC has vertices A(2, 0), B(5, 0) and C(2, 3). First translate the triangle by the vector (-2, 1). Then reflect the translated triangle in the x-axis. Give the coordinates of the final image of point C only.



(Total for Question 5 is 4 marks)

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6 The shape P is a triangle with vertices (0, 0), (2, 0) and (0, 2). Describe fully the single transformation that maps P to the triangle Q with vertices (0, 0), (0, 2) and (-2, 0). Give the type of transformation, the centre or axis or vector, and the angle if needed.

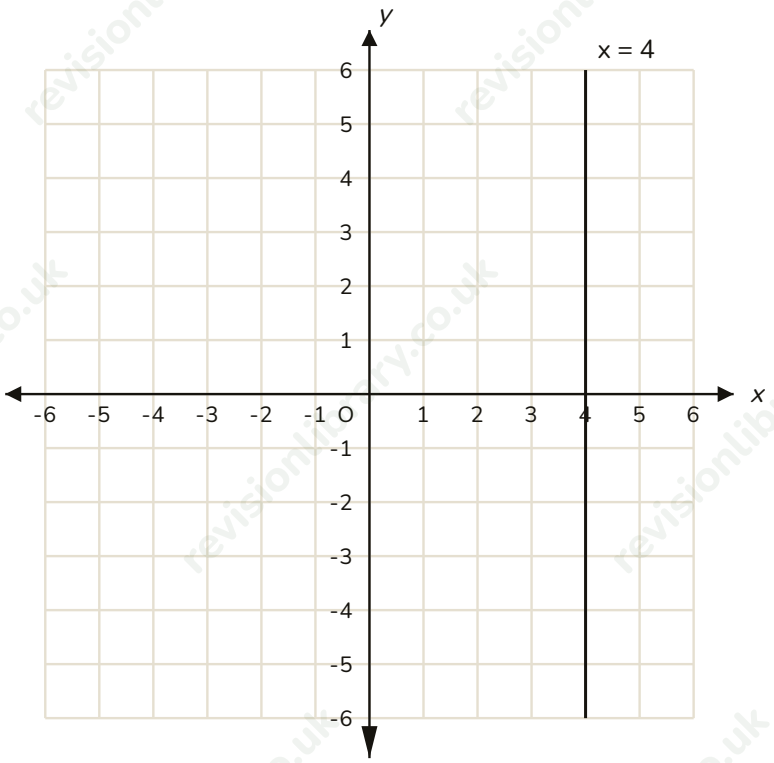


(Total for Question 6 is 6 marks)

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7 A shape is reflected in the line x = 4.

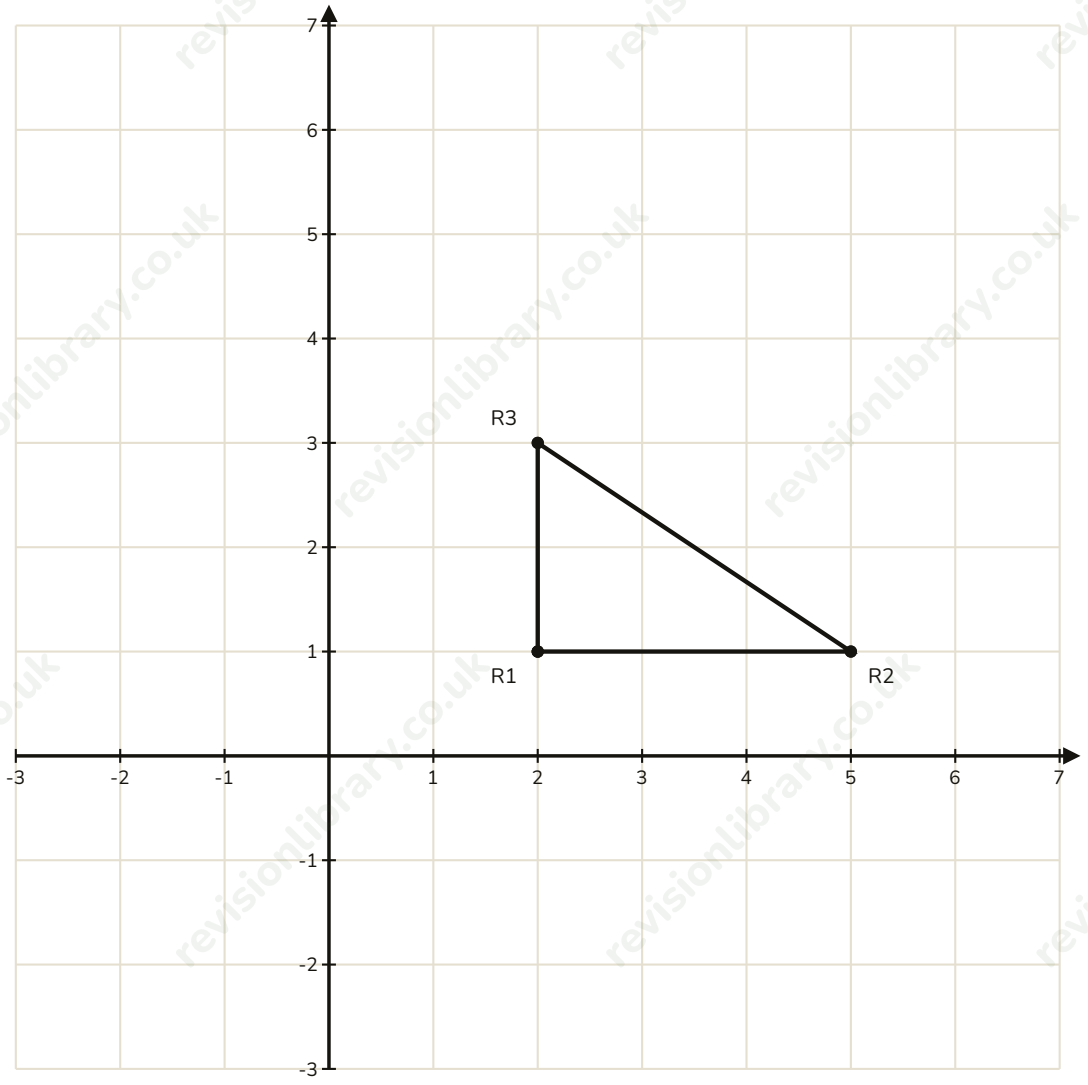
State which points of the plane are invariant (unchanged) under this reflection.



(Total for Question 7 is 1 mark)

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8 Triangle R has vertices (2, 1), (5, 1) and (2, 3). The triangle is enlarged from the centre (2, 1) by a scale factor of 1.5. Work out the coordinates of the image of the vertex (5, 1). Give your answer as exact decimals.



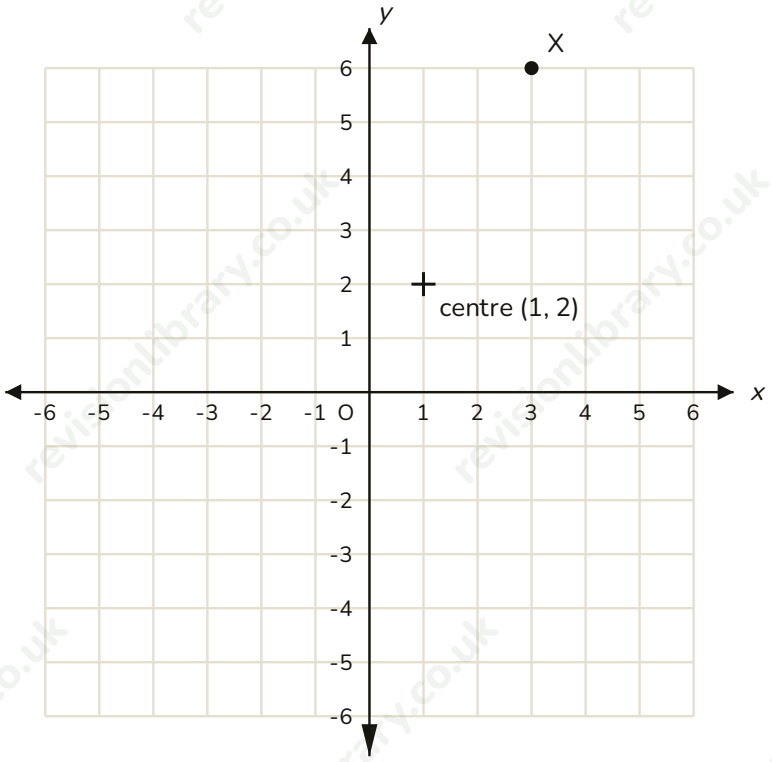
(Total for Question 8 is 4 marks)

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9 The transformation T maps the vector a = (3, 2) to a' = (6, 4). It maps b = (1, -1) to b' = (2, -2). Write down the single transformation T and explain briefly how you know. State the image of c = (5, 0) under T.

(Total for Question 9 is 4 marks)

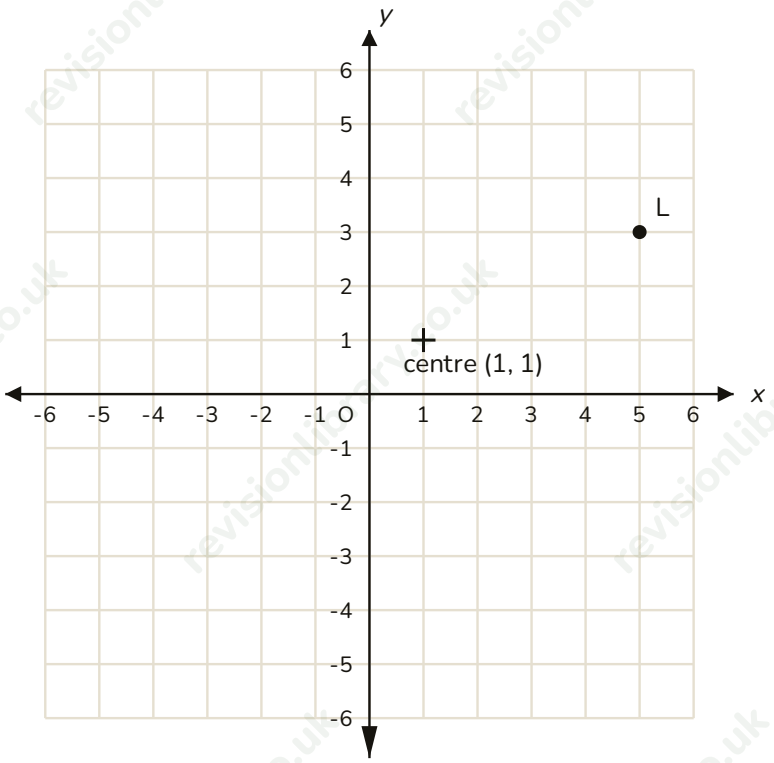
10 Point X has coordinates (3, 6).
Find the coordinates of the image of X after a rotation of 90 degrees clockwise about the point (1, 2).



(Total for Question 10 is 2 marks)

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11 Point L has coordinates (5, 3).
Find the coordinates of the image of L after an enlargement with scale factor -2, centre (1, 1).



(Total for Question 11 is 2 marks)

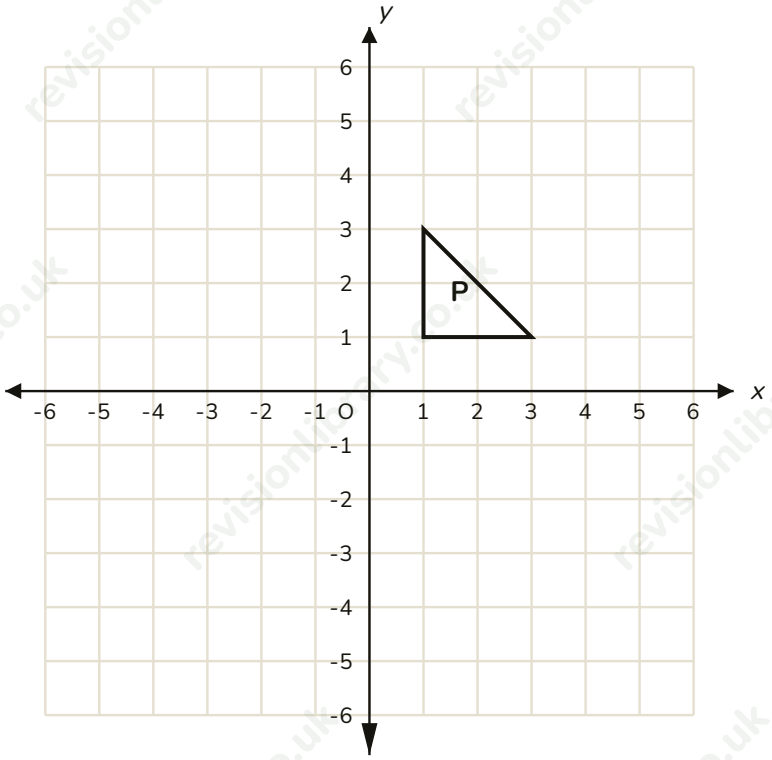
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12 Show that the composite transformation consisting of a rotation of 180 degrees about the origin followed by a reflection in the line y = -x maps any point (x, y) to (y, x). Explain each step.

(Total for Question 12 is 5 marks)

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13 Triangle P has vertices (1, 1), (1, 3) and (3, 1). Triangle P is rotated 90 degrees clockwise about the origin, and the image is then translated by the vector (2, -1), to form triangle Q.



(a) Find the coordinates of the vertices of triangle Q. **(3)**

.....

(b) A student says: 'The single transformation that maps triangle Q back onto triangle P is a rotation of 90 degrees anticlockwise about the origin.' **(2)**
Show, using at least one vertex, that the student is incorrect.

(Total for Question 13 is 5 marks)

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14 A shape is enlarged with scale factor k, centre the origin, and the image is then translated by the vector (h, h), where k and h are constants.

A student claims that, for some values of k and h, this combined transformation maps every point (a, b) onto the point (b, a).

Show that the student's claim is impossible: that is, show that there are no values of k and h for which this is true.

(Total for Question 14 is 4 marks)

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Mark scheme · 3.17 Transformations: Test Pack

Question 1

6, 2 cao	**B1**

Answer: (6, 2)

Question 2

1, 4 cao	**B1**

Answer: (1, 4)

Question 3

subtracts coordinates of A from A'	**M1**
vector (6, -1)	**A1**
B' (8, 4)	**B1**

Answer: B' (8, 4); vector (6, -1)

Question 4

Reflection named	**B1**
full detail of the line, vector or centre	**B1**
all details consistent with the image	**B1**

Answer: Reflection in the line x = 0

Question 5

correct translation of C: (2, 3) + (-2, 1) = (0, 4)	**M1**
state or show correct intermediate point (0, 4) before reflection	**M1**
correct reflection in x-axis: (x, y) -> (x, -y) applied to (0, 4)	**M1**
(0, -4) cao	**A1**

Answer: (0, -4)

Question 6

identify a valid transformation: rotation or reflection	**M1**
state the rotation centre (0, 0), or the reflection axis x = 0 (the y-axis)	**M1**
state 90 degrees anticlockwise (or 270 degrees clockwise) for rotation; for reflection, show that corresponding vertices have opposite x-coordinates and equal y-coordinates	**M1**
show one vertex mapping for the chosen transformation: rotation (2,0) -> (0,2), or reflection (2,0) -> (-2,0)	**M1**
confirm the remaining vertices: rotation (0,2) -> (-2,0) and (0,0) fixed; or reflection (0,2) and (0,0) both fixed	**M1**
clear final statement: rotation 90 degrees anticlockwise (or 270 degrees clockwise) about (0, 0), or reflection in the y-axis (x = 0). Either complete valid description earns all 6 marks without separate working; do not require both transformations.	**A1**

Answer: Rotation 90 degrees anticlockwise (or 270 degrees clockwise) about the origin (0, 0), or reflection in the y-axis (x = 0).

Question 7

any point on the line x = 4 oe, e.g. (4, y) for any y	**B1**

Answer: Every point on the line x = 4 (points of the form (4, y))

Question 8

find vector from centre to point: (5,1) - (2,1) = (3,0)	**M1**
multiply vector by 1.5 to get (4.5, 0)	**M1**
show addition of scaled vector to centre	**M1**
add to centre: (2,1) + (4.5,0) = (6.5, 1) cao	**A1**

Answer: (6.5, 1)

Question 9

identify common multiplication by 2 for given vectors or state scale factor 2	**M1**
state transformation is enlargement with scale factor 2 centre at origin (or equivalent) cao	**A1**
apply to c: (5,0) -> (10,0)	**M1**
state image (10, 0) cao	**A1**

Answer: T is an enlargement with scale factor 2 centre at the origin. Image of c is (10, 0).

Question 10

translates X by (-1,-2) to (2,4), applies (x,y) -> (y,-x) to get (4,-2), oe valid method	**M1**
(5, 0) cao	**A1**

Answer: (5, 0)

Question 11

finds the vector from the centre to L as (4,2) oe	**M1**
(-7, -3) cao	**A1**

Answer: (-7, -3)

Question 12

state rotation 180 about origin maps (x, y) -> (-x, -y) or show this algebraically	**M1**
state reflection in y = -x maps (u, v) -> (-v, -u)	**M1**
apply to (-x, -y): substitute u = -x, v = -y to get (-v, -u)	**M1**
simplify (-v, -u) = (-(-y), -(-x)) = (y, x)	**M1**
conclude with clear explanation linking combined steps to obtain (y, x) (final statement) cao	**A1**

Answer: Rotation 180: (x, y) -> (-x, -y). Reflection in y = -x: (u, v) -> (-v, -u). Apply: (-x, -y) -> (y, x). Hence the composite transformation maps (x, y) to (y, x).

Question 13

(a) rotates at least one vertex of P by 90 degrees clockwise about the origin using (x,y) -> (y,-x)	**M1**
(a) dep translates the rotated vertices by the vector (2,-1)	**M1**
(a) all three vertices correct: (3,-2), (5,-2), (3,-4) cao	**A1**

(a) Answer: (3, -2), (5, -2), (3, -4)

(b) applies a 90 degree anticlockwise rotation about the origin to a vertex of Q, e.g. (3,-2) -> (2,3)	**M1**
(b) correct conclusion that this does not give the corresponding vertex of P (e.g. (2,3) is not equal to (1,1)), so the student is incorrect (accept an explanation that the translation has not been undone, or that the centre of rotation is not the origin)	**A1**

(b) Answer: Incorrect: rotating (3,-2) by 90 degrees anticlockwise about the origin gives (2,3), not (1,1), so a rotation about the origin does not map Q onto P

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Question 14

writes the image of the general point (a,b) under the combined transformation as (ka+h, kb+h)	**M1**
sets ka+h = b and kb+h = a, stating this must hold for every value of a and b	**M1**
compares coefficients of a (or b) in ka+h=b: since the right-hand side b does not depend on a, the coefficient of a on the left must be 0, so k=0	**M1**
cso: substituting k=0 gives h=b for every value of b, which is impossible since h is a fixed constant; therefore no values of k and h exist, so the student's claim is false	**A1**

Answer: No such k and h exist (proof by contradiction, cso)

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