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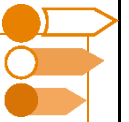
VCE Mathematical Methods ½
Transformations [2.4]
Homework

Homework Outline:

Compulsory Questions	Pg 2 – Pg 19
Supplementary Questions	Pg 20 – Pg 42



Section A: Compulsory Questions



Sub-Section [2.4.1]: Applying x' and y' Notation to Find Transformed Points, Find Interpretation of Transformations and Altered Order of Transformations

Question 1



Consider the following transformations on the plane:

- S a dilation by a factor 2 from the x -axis.
- T a translation 3 units to the right and 2 units down.
- W a reflection in the x -axis.

Find the image, (x', y') , of the point (x, y) and the transformation:

a. S

b. T

c. S then T .

d. T then W then S .

Question 2



A transformation T is applied to points on the plane such that the image is given by $(x', y') = (2x + 4, -y + 2)$.

a. Describe T in words where dilations and reflections occur before translations.

b. Describe T in words where translations occur before reflections and dilations.


Question 3

The transformation $T : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ is described by the following sequence of transformations.

- A dilation by factor 2 from the x -axis.
- A dilation by factor 3 from the y -axis.
- A reflection in the x -axis.
- A translation 2 units left.
- A translation 6 units down.

a. Let (x', y') be the image of (x, y) under T . Find (x', y') .

b. Describe in words, the transformations T , in the order of translations, reflections, and dilations.

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Sub-Section [2.4.2]: Find Transformed Functions

Question 4




a. Find the rule for the image of $f(x) = x^2$ under the transformations:

 A dilation by factor 2 from the x -axis.


 A translation 1 unit up.


b. Find the rule for the image of $f(x) = \sqrt{x}$ under the transformations:

 A dilation by factor 4 from the y -axis.

 A translation 1 unit down.

c. Find the rule for the image of $f(x) = \frac{1}{x}$ under the transformations:

 A dilation by factor 2 from the x -axis.

 A translation 1 unit up and 3 units to the left.

Question 5



a. Find the rule for the image of $f(x) = 2x^2 + 4$ under the transformation $T: \mathbb{R}^2 \rightarrow \mathbb{R}^2$, $T(x, y) = (2x + 1, -y + 2)$.

- b. Find the rule for the image of $f(x) = \frac{3}{x-3}$ under the transformation $T: \mathbb{R}^2 \rightarrow \mathbb{R}^2$, $T(x, y) = (x + 1, -2y + 2)$.





- c. Find the rule for the image of $f(x) = \sqrt{2x - 4} + 3$ under the transformation $T: \mathbb{R}^2 \rightarrow \mathbb{R}^2$, $T(x, y) = (-2x + 1, 2y + 3)$.

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Question 6




a. Find the rule for the image of $f(x) = 2(x - 1)^2 + 3$ under the transformations:


-  A dilation by factor 2 from the x -axis.
-  A translation 3 units to the left.
-  A translation 1 unit up.
-  A reflection in the x -axis.


[illegible]

b. Find the rule for the image of $f(x) = \frac{1}{x-1}$ under the transformations:





 A dilation by factor 4 from the x -axis.

 A dilation by factor $\frac{1}{2}$ from the y -axis.

 A reflection in the x -axis.

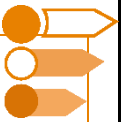
 A translation 2 units right.

c. Find the rule for the image of $f(x) = \sqrt{2x + 6} - 4$ under the transformations:

-  A translation 1 unit up.
-  A translation 4 units to the right.
-  A reflection in the y -axis.
-  A dilation by factor 2 from the x -axis.

[illegible]

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Sub-Section [2.4.3]: Find Transformations from Transformed Function

Question 7



- a. Let $f(x) = x^2$ and $g(x) = 4x^2 + 1$.

Describe a sequence of transformations that maps the graph of f onto the graph of g .

- b. Let $f(x) = \sqrt{x}$ and $g(x) = 2\sqrt{x+1} - 3$.

Describe a sequence of transformations that maps the graph of f onto the graph of g .

c. Let $f(x) = \frac{1}{x}$ and $g(x) = \frac{3}{x+2}$.

Describe a sequence of transformations that maps the graph of f onto the graph of g .

Question 8



a. Let $f(x) = x^2$ and $g(x) = 4(x - 2)^2 + 3$.

Describe a sequence of transformations that maps the graph of f onto the graph of g .

- b. Let $f(x) = \sqrt{2x}$ and $g(x) = 2\sqrt{4x - 2}$.

Describe a sequence of transformations that maps the graph of f onto the graph of g .

- c. Let $f(x) = \frac{6}{x-1}$ and $g(x) = \frac{3}{x+2} + 1$.

Describe a sequence of transformations that maps the graph of f onto the graph of g .

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Question 9

- a. Let $f(x) = 2\sqrt{x+1}$ and $g(x) = 5\sqrt{5-3x} + 4$.

Describe a sequence of transformations that maps the graph of f onto the graph of g .

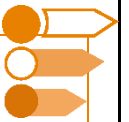
- b. Let $f(x) = 2(x - 3)^2 + 2$ and $g(x) = x^2 + 4x + 7$.

Describe a sequence of transformations that maps the graph of f onto the graph of g .

c. Let $f(x) = \frac{3}{x^2} + 1$ and $g(x) = -\frac{6}{(2x-3)^2} + 4$.

Describe a sequence of transformations that maps the graph of f onto the graph of g .

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Sub-Section: The 'Final Boss'

Question 10

Consider the function $f(x) = x^2 - 4x + 7$ and the transformation $T: \mathbb{R}^2 \rightarrow \mathbb{R}^2$, $T(x, y) = (3x - 6, -2y + 2)$.

a. Use words to describe the transformation T with:

i. Dilations and reflections before translations.

ii. Translations before reflections and dilations.

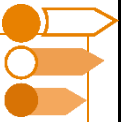
b. Write $f(x)$ in turning point form.

c. Find the rule for the image of $f(x)$ under T .

- d. Determine a sequence of transformations that map $f(x)$ to $g(x) = 2x^2 - 16x + 28$.

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Section B: Supplementary Questions



Sub-Section [2.4.1]: Applying x' and y' Notation to Find Transformed Points, Find Interpretation of Transformations and Altered Order of Transformation

Question 11



Find the coordinates of the image point for the following:

- a. The point $(2, 3)$ undergoes a dilation by a factor of 6 from the y -axis, a reflection in the x -axis, followed by a translation 1 unit up.

- b. The point $(1, 5)$ undergoes a translation 2 units left, a dilation by a factor of $\frac{1}{4}$ from the y -axis, a translation 3 units up, followed by a reflection in the x -axis.

- c. The point $(-4, 2)$ is dilated by a factor of 3 from the x -axis, translated 1 unit right, reflected in the x -axis, reflected in the y -axis, dilated by a factor of 2 from the y -axis, and then translated 5 units down.

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Question 12

Consider the sequence of transformations:

- A dilation by a factor of $\frac{1}{2}$ from the y -axis.
- A reflection in the x -axis.
- A dilation by a factor of 6 from the x -axis.
- A translation 4 units down.
- A translation 1 unit right.
- A translation 9 units up.

- a.** Rewrite the transformations in the order of a dilation, a translation, a dilation, a reflection, and then a translation.

- b. Express the transformations as a sequence of two translations, followed by two dilations and a reflection.

- c. Express the transformations in the order of a dilation, a translation, a dilation, a translation, and then a reflection.

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Question 13

The transformation T is defined as $T : \mathbb{R}^2 \rightarrow \mathbb{R}^2, T(x, y) = (5 - 2x, 6y + 1)$.

a. Evaluate $T(-3, 8)$.

b. Find the pre-image of $(7, -35)$ under the transformation T .

c. Express T as a sequence of two translations, two dilations, and a reflection.

- d. Identify a sequence of transformations that maps the point $(-3, 8)$ to the image of $(-3, 8)$ under T and also maps the point $(1, -2)$ to the point $(23, -1)$.

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Question 14

a. Consider the transformation T described by:

- A translation 2 units left.
- A dilation by a factor of 3 from the x -axis.
- A dilation by a factor of $\frac{1}{4}$ from the y -axis.
- A reflection in the x -axis.
- A translation 1 unit up.
- A reflection in the line $y = x$.
- A translation 4 units right.

i. Apply T to the point $(5,2)$.

ii. Express T as a sequence of 2 dilations followed by 2 reflections, and then 2 translations.

b. Consider the transformation S described by:

- A dilation by a factor of 2 from the x -axis.
- A reflection in the y -axis.
- A dilation by a factor of $\frac{1}{3}$ from the y -axis.
- A reflection in the line $y = 4$.
- A translation 5 units down.
- A translation 1 unit right.

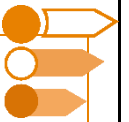
i. S can also be defined $S : \mathbb{R}^2 \rightarrow \mathbb{R}^2, S(x, y) = (ax + b, cy + d)$. Find the values of a , b , c , and d .

ii. Hence, evaluate $S(-2, 4)$.

- c. A point (x, y) undergoes the transformations T followed by S . Find the image point.

- d. Given that the image point from **part c.**, is $(-4, 6)$, find the pre-image.

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Sub-Section [2.4.2]: Find Transformed Functions

Question 15



Find the resultant function when:

- a. $y = x^2$ is dilated by a factor of 2 from the y -axis, reflected in the x -axis, translated 3 units up, and translated 1 unit left.

- b. $y = \frac{1}{x}$ is reflected in the y -axis, translated 3 units up, dilated by a factor of 2 from the x -axis, dilated by a factor of $\frac{1}{4}$ from the y -axis, and translated 2 units right.

- c. $y = \sqrt{x}$ is translated 3 units down, translated 5 units right, reflected in the y -axis, dilated by a factor of 3 from the x -axis, dilated by a factor of 2 from the y -axis, and reflected in the x -axis.

Question 16


Find the resultant function when:

- a. $y = -2(x + 5)^2 + 1$ is dilated by a factor of $\frac{1}{3}$ from the x -axis, translated 4 units right, translated 1 unit down, reflected in the y -axis, and dilated by a factor of 2 from the y -axis.

- b. $y = \frac{2}{(5-x)^2} + 7$ is reflected in the x -axis, translated 2 units up, dilated by a factor of 3 from the y -axis, reflected in the y -axis, translated 4 units right, and dilated by a factor of $\frac{1}{4}$ from the x -axis.

- c. $y = 4 - 2(x + 1)^3$ is translated 4 units right, dilated by a factor of 3 from the x -axis, reflected in the y -axis, translated 5 units up, reflected in the x -axis, and dilated by a factor of 2 from the y -axis.

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Question 17

Find the resultant function when:

- a. $(x - 2)^2 + (y + 5)^2 = 9$ is dilated by a factor of 3 from the y -axis, reflected in the x -axis, translated 4 units up, translated 1 unit left, and dilated by a factor of 3 from the x -axis.

- b. $y = 2x^2 + 3x - 6$ is reflected in the y -axis, dilated by a factor of 4 from the x -axis, translated 5 units down, translated 1 unit right, dilated by a factor of $\frac{1}{2}$ from the y -axis.

- c. $x = -\sqrt{-y^2 + 6y + 15} + 4$ is translated 2 units down, dilated by a factor of 3 from the x -axis, reflected in the y -axis, translated 5 units left, dilated by a factor of $\frac{1}{4}$ from the y -axis, translated 5 units up, reflected in the y -axis, and dilated by a factor of 2 from the x -axis.

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Question 18

a. When the graph $y = 6 - 2(x + 1)^2$ undergoes the transformation T , described as:

- A translation 4 units right.
- A dilation by a factor of 2 from the y -axis.
- A translation 4 units down.
- A reflection in the y -axis.
- A dilation by a factor of 3 from the x -axis.

It is mapped onto an equation $y = a(x - h)^2 + k$, where $a, h, k \in \mathbb{R}$.

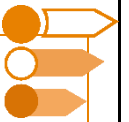
Find the values of a , h , and k .

- b. The graph $y = 6 - 2(x + 1)^2$ can also be mapped to the same equation from **part a.**, by a sequence of 2 dilations, a reflection, and 2 translations. Describe this sequence of transformations.

- c. Find the pre-image, that when undergoes the transformation T , results in the equation $y = 6 - 2(x + 1)^2$.

- d. The graph of $y = 6 - 2(x + 1)^2$ undergoes the transformation T , followed by a dilation by a factor of 2 from the x -axis, a reflection in the line $x = 6$, a reflection in the line $y = x$, and a translation 1 unit up. Find the image equation.

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Sub-Section [2.4.3]: Find Transformations from Transformed Function (Reverse Engineering)

Question 19



Find the sequence of transformations that map:

a. $y = x^2$ to $y = -3(x + 1)^2 + 7$.

b. $y = \frac{1}{x}$ to $y = \frac{3}{5-2x} + 6$.

c. $y = \sqrt{x}$ to $y = 1 - \frac{\sqrt{4-3x}}{2}$.

Question 20


Find the sequence of transformations that map:

a. $y = 4(x + 8)^3 - 5$ to $y = 5 - 2(6x - 1)^3$.

b. $y = 3\sqrt{16 - (x + 1)^2} + 5$ to $y = 1 - 2\sqrt{16 - (3x + 5)^2}$.

c. $y = \frac{3}{(4-2x)^2} + 7$ to $y = -\frac{6}{(x+1)^2} + 5$.

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Question 21

- a. The function $y = -2(3(x - 1))^4 + 5$ undergoes a sequence of 2 transformations, a reflection, and 2 dilations to become the graph $y = 6(2 - x)^4 - 1$.

- b. The transformation $T : \mathbb{R}^2 \rightarrow \mathbb{R}^2, T(x, y) = (ax + b, y + c)$ maps the equation $y = 11 + 5(x + 3)^2$ onto the equation $y = 20(x - 6)^2 + 9$. Find the values of a , b , and c .

- c. The graph $y = \frac{\sqrt{6x-4}}{3} + 2$ is mapped onto $y = 5 - 2\sqrt{-1-x}$ by a sequence of 2 dilations and 2 reflections, followed by a translation.

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Question 22

Find the sequence of transformations that map:

a. $y = x^2 - 4x + 6$ onto $y = -2x^2 + 10x - 7$.

b. $y = 2\sqrt{(x + 4)^2 + 1} - 5$ onto $y = 3 - \sqrt{(2x - 6)^2 + 9}$.

c. $f : [-4, \infty) \rightarrow \mathbb{R}, f(x) = -x^2 - 8x + 9$ onto $g : (-\infty, 5] \rightarrow \mathbb{R}, g(x) = 2x^2 - 20x + 13$.

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