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VCE Mathematical Methods ½
Transformations Exam Skills [2.5]
Homework

Admin Info & Homework Outline:

Student Name	
Questions You Need Help For	
Compulsory Questions	Pg 2 – Pg 24
Supplementary Questions	Pg 25 – Pg 43

Section A: Compulsory Questions

Sub-Section [2.5.1]: Apply Quick Method to Find Transformations

Question 1

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

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

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Question 2

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

Question 3

Describe a sequence of transformations that maps the graph of $y = 3^{2x+1} - 2$ onto the graph of $y = 1 - 3^x$.

Sub-Section [2.5.2]: Find Opposite Transformations

Question 4

Describe a sequence of transformations that map $f(x) = 2(x - 1)^2 + 4$ to $y = x^2$.

Question 5

The following sequence of transformations map the graph of $y = f(x)$ on the graph of $y = 2\sqrt{x - 1} + 1$.

- A reflection in the y-axis
- A dilation by factor 2 from the x-axis
- A translation 2 units to the right

Find the rule of f.

Question 6

Describe a sequence of transformations that map $f(x) = 3x^2 - 12x + 16$ to $y = x^2 - 2x + 2$.

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Sub-Section [2.5.3]: Apply Transformations of Functions to Find its Domain, Range, Transformed Points.

Question 7

Find the image of the point $A(2,5)$ under the transformation

$$T:\mathbb{R}^2 \to \mathbb{R}^2, T(x,y) = \left(2x-1, \frac{1}{2}(y-1)\right)$$

Question 8

Consider the function $f:[-3,1] \to \mathbb{R}, f(x) = x^2 - 4$. The sequence of transformations

- A dilation by factor 2 from the x-axis
- A dilation by factor 2 from the y-axis
- A translation 3 units to the left

Map the function f to the function g. Find the domain of g.

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Question 9

Consider the function $f: [-3, 2] \to \mathbb{R}, f(x) = x^2 + 4x - 1$. The sequence of transformations

- A dilation by factor 3 from the x-axis
- A dilation by factor 2 from the y-axis
- A translation 1 unit to the right
- A reflection in the x-axis

Map the function f to the function g. Find the range and domain of g.

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Sub-Section [2.5.4]: Find Transformations of the Inverse Functions

Question 10

Let $f: [0, \infty) \to \mathbb{R},\ f(x) = \sqrt{x}$.

f is mapped to function g, by a dilation by factor 2 from the x-axis and a translation 1 unit to the right.

Describe a sequence of transformations that map f^{-1} to g^{-1}.

Question 11

Consider the one-to-one functions, f and g. The transformation $T: \mathbb{R}^2 \to \mathbb{R}^2,\ T(x, y) = (2x + 4, y - 3)$ maps the function f to the function g.

Describe a sequence of transformations that map the function f^{-1} to the function g^{-1}.

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Question 12

Consider the functions $f: [0, \infty) \to \mathbb{R}, 2\sqrt{x} + 1$ and $g: [2, \infty) \to \mathbb{R}, g(x) = 4\sqrt{x-2} - 1$.

The transformation $T: \mathbb{R}^2 \to \mathbb{R}^2, T(x, y) = (ax + b, y + c)$ maps the function f^{-1} to the function g^{-1}.

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Sub-Section [2.5.5]: Find Multiple Transformations for the Same Functions

Question 13

Let $f(x) = x^3$ and $g(x) = 8x^3$.

a. State a dilation that maps $f(x)$ to $g(x)$.

b. State a different dilation that maps $f(x)$ to $g(x)$.

Question 14

Let $f(x) = (x - 1)^2 + 3$ and $g(x) = 4(x + 2)^2 + 1$.

a. Find a sequence of transformations that map $f(x)$ to $g(x)$, without using a dilation from the y-axis.

b. Find a sequence of transformations that map $f(x)$ to $g(x)$, without using a dilation from the x-axis.

Question 15

Let $f(x) = x^2 + 4x + 1$ and $g(x) = 9x^2 - 18x + 2$.

a. Find a sequence of transformations that map $f(x)$ to $g(x)$, without using a dilation from the y-axis.

b. Find a sequence of transformations that map $f(x)$ to $g(x)$, without using a dilation from the x-axis.

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Sub-Section: Exam 1 Questions

Question 16

Consider the transformation:

$$T : \mathbb{R}^2 \to \mathbb{R}^2, \qquad T(x, y) = (2x + 1, 3y - 1)$$

a. Find the image of the point $P(2, 3)$ under T.

b. Write out what the transformation T does in the order DRT.

c. Find the image of the curve $y = x^2$ under the transformation T.

Question 17

Let $f : \mathbb{R} \to \mathbb{R}, f(x) = x^2 - 9$.

a. Find the coordinates of all axes intercepts of f.

b. Let the graph of g be a transformation of the graph of f where the transformations have been applied in the following order:

- Dilation by a factor of $\frac{1}{2}$ from the y-axis.
- Dilation by a factor of 2 from the x-axis.
- Translation 1 unit to the left.

Find the rule for $g(x)$.

c. State the coordinates for the axes intercepts of g.

Question 18

Consider the function $f(x) = \frac{2}{(x+1)^2} - 3$.

Apply the following sequence of transformations to $f(x)$.

- Dilation by a factor 3 from the x-axis
- Translated 2 units in the negative direction of the x-axis
- Reflection in the y-axis
- Translated 4 units in the positive direction of the y-axis
- Dilation by a factor of $\frac{1}{3}$ from the y-axis.

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Question 19

Let $f(x) = \frac{1}{2x+2}$.

a. The transformation T_1 given by:

$$T_1 : \mathbb{R}^2 \to \mathbb{R}^2, T_1(x, y) = (x + a, by)$$

maps the graph of $y = f(x)$ onto the graph of $y = \frac{1}{x}$.

Find the values of a and b.

b. The transformation T_2 given by

$$T_2 : \mathbb{R}^2 \to \mathbb{R}^2, T_2(x, y) = (c(x + d), y)$$

maps the graph of $y = \frac{1}{x}$ onto the graph of $y = f(x)$.

Find the values of c and d.

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Question 20

The image of the curve $y = \sqrt{9 - x^2}$ under a transformation T, has the equation

$$y = \sqrt{32 - 4x - x^2} + 4$$

Find the transformations that makeup T, with dilations before translations.

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Sub-Section: Exam 2

Question 21

The graph of the function f passes through the point $(2, -6)$. If $h(x) = 3f(x-3)$, then the graph of the function h must pass through the point:

A. $(0, -6)$

B. $(-1, -18)$

C. $(5, -18)$

D. $(-1, -6)$

Question 22

The graph of the function $f : \mathbb{R} \to \mathbb{R}, f(x) = 2^x$, is reflected in the y-axis and then translated 3 units to the right and 2 units up. Which one of the following is the rule of the transformed graph?

A. $y = 2^{-x} + 2$

B. $y = 2^{-x+3} + 1$

C. $y = \left(\frac{1}{2}\right)^{x-3} + 2$

D. $y = \frac{1}{2}.2^{-x+3} + 2$

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Question 23

The graph of the function g is obtained from the graph of the function:

$$f : [-2, 1] \to \mathbb{R}, f(x) = 2x^2 - 4x + 8,$$

by a dilation of factor 3 from the y-axis, followed by a dilation of factor $\frac{1}{3}$ from the x-axis, followed by a reflection in the x-axis, and finally followed by a translation of 2 units in the positive direction of the y-axis. The domain and range of g are respectively:

A. $[-6, 3]$ and $[-6, 3]$

B. $[-3, 6]$ and $[-3, 0]$

C. $[-6, 3]$ and $[-6, 0]$

D. $[-6, 3]$ and $[-3, 3]$

Question 24

Consider the functions $f(x) = \frac{1}{x-2} + 1$ and $g(x) = 2 - \frac{1}{x-1}$. If T transforms the graph of f onto the graph of g, then:

A. $T : \mathbb{R}^2 \to \mathbb{R}^2, T(x, y) = (1 - x, y - 3)$

B. $T : \mathbb{R}^2 \to \mathbb{R}^2, T(x, y) = (x - 1, y - 3)$

C. $T : \mathbb{R}^2 \to \mathbb{R}^2, T(x, y) = (x - 1, 3 - y)$

D. $T : \mathbb{R}^2 \to \mathbb{R}^2, T(x, y) = (1 - x, 3 - y)$

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Question 25

The image of the function $g(x) = x^3$ is $y = -5\left(\frac{x}{2} + 2\right)^3$. The transformations that could have been applied are:

A. Reflection in the x-axis, then translation in the positive direction of the x-axis by 2 units followed by a dilation from the y-axis by a factor of $\frac{1}{2}$.

B. Reflection in the x-axis, then translation in the negative direction of the x-axis by 2 units, followed by a dilation from the x-axis by a factor of 5 and a dilation by factor 2 from the y-axis.

C. Reflection in the x-axis, then a dilation from the x-axis by a factor of 2, followed by a translation in the positive direction of the x-axis by 2 units, and finally a dilation from the y-axis by a factor of 2.

D. Reflection in the x-axis, then a dilation from the y-axis by a factor of $\frac{1}{2}$ followed by a translation in the negative direction of the x-axis by 2 units, and finally a dilation from the x-axis by a factor of $\frac{5}{2}$

Question 26

Consider the function $f : (-1, 2) \to \mathbb{R}, f(x) = (x - 1)^2(2x + 5)$.

a. State the range of f.

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b. The following sequence of transformations, T, map the graph of f onto the graph of g.

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

i. State the rule of g.

ii. State the domain of g.

iii. State the range of g.

iv. Find the image of the point $(1, 0)$ under T.

Let g be a function with the same rule as f but defined for all $x \in \mathbb{R}$.

That is $g : \mathbb{R} \rightarrow : \mathbb{R}, g(x) = f(x)$.

c. A transformation $S : \mathbb{R}^2 \rightarrow \mathbb{R}^2,\ S(x, y) = (a - x, b - y)$ maps the graph of g onto itself.

Determine the values of a and b.

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Question 27

Consider the function $f : [-4, 4] \rightarrow \mathbb{R}, f(x) = x^2 - 9$

a. Consider the transformation $T(x, y) = \left(2x + 4, \frac{1}{3}y - 2\right)$. Find the transformed function of $y = f(x)$ under the transformation T. State the new domain and range also.

b. Let g be the function that is the image of f under T.

Find a transformation $T_1 : \mathbb{R}^2 \rightarrow \mathbb{R}^2$ that maps the function g to the function f.

c. A function h is such that applying the transformation T to h maps it to the function f. Find the rule and domain for the function h.

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Section B: Supplementary Questions

Sub-Section [2.5.1]: Apply Quick Method to Find Transformations

Question 28

Find the image of the graph of $y = x^2$ under the transformation, $T : \mathbb{R}^2 \to \mathbb{R}^2,\ T(x, y) = (1 - 2x, y + 5)$.

Question 29

Describe a sequence of transformations that maps the graph of $y = x^3$ onto the graph of $y = 2(3x + 2)^3 - 3$.

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Question 30

Find the image of the graph of $y = \log_2(x)$ under the following sequence of transformations:

- A dilation by a factor of 3 from the x-axis, followed by,
- A translation of 2 units left and 3 units up, followed by,
- A reflection in the y-axis, followed by,
- A dilation by a factor of 5 from the y-axis.

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Sub-Section [2.5.2]: Find Opposite Transformations

Question 31

Describe a sequence of transformations that maps the graph of $y = 4(x-2)^2 - 3$ onto the graph of $y = x^2$.

Question 32

The transformation, $T : \mathbb{R}^2 \to \mathbb{R}^2, T(x, y) = \left(2x + 3, \frac{1}{3}y - 4\right)$ maps the graph of $y = f(x)$ onto the graph of $y = x^3$.

Find the rule of f.

Question 33

The following sequence of transformations maps the graph of f onto the graph of $y = \sqrt{x}$, for $x \in (2, \infty)$:

A dilation by a factor of 3 from the x-axis, followed by,

A translation of 2 units left and 4 units up, followed by,

A reflection in both the x-axis and the y-axis.

State the rule and domain of f.

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Sub-Section [2.5.3]: Apply Transformations of Functions to Find its Domain, Range, Transformed Points

Question 34

The function $f: \mathbb{R} \to \mathbb{R}$ has a range of $[2, \infty]$.

The transformation, $T: \mathbb{R}^2 \to \mathbb{R}^2, T(x, y) = (5 - 2x, 3 + y)$ maps the graph of f onto the graph of g. State the domain and range of g.

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Question 35

The function $f : (-\infty, -1) \to \mathbb{R}$ has a range of $(-2, \infty)$.

Describe a sequence of transformations that maps the graph of f onto a graph of a function with a domain of $[0, \infty]$ and a range of $(-\infty, 2)$.

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Question 36

Consider the function, $f : [-2, \infty] \rightarrow R, f(x) = 3\sqrt{x+2} - 5$.

The following sequence of transformations maps the graph of f onto the graph of g:

- A reflection in the x-axis, followed by,
- A dilation by a factor of 3 from the x-axis, followed by,
- A dilation by a factor of $\frac{1}{2}$ from the y-axis, followed by,
- A translation of 3 units up and 2 units left.

State the domain and range of g.

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Sub-Section [2.5.4]: Find Transformations of Inverse Functions

Question 37

Consider the function, $f: \mathbb{R}\{1\} \to \mathbb{R}, f(x) = \frac{2}{x-1} + 4$. The transformation, $T: \mathbb{R}^2 \to \mathbb{R}^2,\ T(x,y) = (x+a, y+b)$ maps the graph of f onto the graph of its inverse function. Find the values of a and b.

Question 38

Consider the one-to-one functions, $f(x)$ and $g(x)$. The transformation $T: \mathbb{R}^2 \to \mathbb{R}^2,\ T(x,y) = (3-x, 2y+7)$ maps the graph of f onto the graph of g.

Describe a sequence of transformations that maps the graph of f^{-1} onto the graph of g^{-1}.

Question 39

Let $f: [1, \infty] \to \mathbb{R}, f(x) = 3x^2 - 6x + 8$ and $g: [-3, \infty] \to \mathbb{R},\ g(x) = \sqrt{x\ +\ 3} + 4$.

Describe a sequence of transformations that maps the graph of f onto the graph of g^{-1}.

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Sub-Section [2.5.5]: Find Multiple Transformations for the Same Functions

Question 40

Describe a sequence of transformations that map the graph of $f(x) = 4(x-3)^2 + 5$ to $g(x) = x^2$ without using a dilation from the x-axis.

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Question 41

Consider the functions $f(x) = x^2 - 8x + 10$ and $g(x) = 4(x + 2)^2 - 5$. Find 2 different sets of transformations, one using a dilation from the x-axis and one using a dilation from the y-axis to map the graph of $f(x)$ to the graph of $g(x)$.

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Question 42

Consider the functions $f(x) = x^2 + 6x + 7$ and $g(x) = 16x^2 - 32x + 6$. Find 2 different sequences of 3 transformations, one using a dilation from the x-axis and one using a dilation from the y-axis to map the graph of $f(x)$ to the graph of $g(x)$.

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Sub-Section: Exam 1 Questions

Question 43

Consider the transformation $T: \mathbb{R}^2 \to \mathbb{R}^2, T(x, y) = \left(\frac{1}{2}x - 3, 4y + 2\right)$.

a. Find the image of the point $(4, 1)$ under T.

b. Write out what the transformation T does in the order DRT.

c. Find the image of the curve $y = x^3$ under the transformation T. Give your answer in the form $y = a(x + b)^3 + c$.

Question 44

Consider the function $f: \mathbb{R} \to \mathbb{R},\ f(x) = 4x^2 - 16$.

a. Find the coordinates of all axes intercepts of f.

b. Let the graph of g be a transformation of the graph of f where the transformations have been applied in the following order:

1. Dilation by a factor of 2 from the y-axis.

2. Dilation by a factor of 3 from the x-axis.

3. Translation 6 units to the right.

Find the rule for $g(x)$.

c. State the coordinates of the axes intercepts of g.

Question 45

Consider the function $f(x) = 4\sqrt{3x + 7} + 2$.

Apply the following transformations to $f(x)$:

1. Dilation by a factor of $\frac{1}{2}$ from the x-axis.

2. Translated 3 units in the positive direction of the y-axis.

3. Reflection in the x-axis.

4. Translated 2 units in the negative direction of the x-axis.

5. Dilated by a factor of 2 from the y-axis.

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Sub-Section: Exam 2 Questions

Question 46

The graph of the function f passes through the point $(2, -3)$.

If $h(x) = 3f(x - 2)$, then the graph of the function h must pass through the point:

A. $(4, -9)$

B. $(0, -9)$

C. $(4, -1)$

D. $(0, -1)$

Question 47

The graph of the function $f: \mathbb{R} \to \mathbb{R}, f(x) = 3^x - 1$, is reflected in the y-axis and then translated 2 units to the left and then 3 units up.

Which one of the following is the rule of the transformed graph?

A. $y = \left(\frac{1}{3}\right)^{x+2} + 2$

B. $y = \frac{1}{3} \times 3^{x+2} + 3$

C. $y = 3^{-x} + 3$

D. $y = 3^{-x+2} + 3$

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Question 48

The graph of the function g is obtained from the transformed graph of the function:

$$f: [-2,6] \to \mathbb{R}, f(x) = 3x^2 + 5x - 2$$

which undergoes a dilation of factor 2 from the y-axis, followed by a dilation of factor $\frac{1}{4}$ from the x-axis, followed by a reflection in the x-axis, and finally followed by a translation of 6 units in the positive direction of the y-axis. The domain and range of g are respectively:

A. $[-4, 12]$ and $[-12, 4]$

B. $[-4, 12]$ and $\left[-28, \frac{337}{48}\right]$

C. $[-12, 4]$ and $\left[-\frac{239}{48}, 40\right]$

D. $[-4, 12]$ and $\left[-40, \frac{239}{48}\right]$

Question 49

The image of the function $f(x) = x^4$ is $y = -40(x + 2)^4$. The transformations that could have been applied are:

A. Reflection in the x-axis, then translation in the positive direction of the x-axis by 2 units, followed by a dilation from the y-axis by a factor of $\frac{1}{2}$.

B. Reflection in the x-axis, then translation in the negative direction of the x-axis by 2 units, followed by a dilation from the x-axis by a factor of 5 and a dilation by factor 2 from the y-axis.

C. Reflection in the x-axis, then a dilation from the x-axis by a factor of 2, followed by a translation in the positive direction of the x-axis by 2 units, and finally a dilation from the y-axis by a factor of 2.

D. Reflection in the x-axis, then a dilation from the y-axis by a factor of $\frac{1}{2}$, followed by a translation in the negative direction of the x-axis by 2 units, and finally a dilation from the x-axis by a factor of $\frac{5}{2}$.

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Question 50

Consider the function $f: (-3,1) \to \mathbb{R}, f(x) = (x+3)(x+2)(3x-3)$.

a. State the range of f, correct to 3 decimal places.

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b. The following sequence of transformations, T, map the graph of f onto the graph of g.

- A dilation by a factor of $\frac{1}{2}$ from the y-axis, followed by,
- A translation of 2 units up and 1 unit left, followed by,
- A reflection in the x-axis.

i. State the rule of g.

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ii. State the domain of g.

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iii. State the range of g correct to 3 decimal places.

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iv. Find the image of the point $(1, 0)$ under T.

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