Cambridge International AS & A Level

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Mathematics 9709/12

Paper 1 Pure Mathematics 1 **May/June 2021**

Question No (2)

2 **(a)** The graph of $y = f(x)$ is transformed to the graph of $y = 2f(x - 1)$.

Describe fully the two single transformations which have been combined to give the resulting transformation.

(b) The curve $y = \sin 2x - 5x$ is reflected in the y-axis and then stretched by scale factor $\frac{1}{3}$ in the x-direction.

Write down the equation of the transformed curve.

Solution:

(a)

The graph of $y = f(x - a)$ *is a translation of the graph* $y = f(x)$ *by the vector* $\begin{bmatrix} a \\ 0 \end{bmatrix}$.

The graph of $y = af(x)$ *is a stretch of the graph* $y = f(x)$ *with stretch factor* $'\boldsymbol{a}'$ *parallel to the* $y-$*axis, upward* $\because a$ *is* $+ve$.

First translation is by vector $\begin{bmatrix} 1 \\ 0 \end{bmatrix}$

second translation is a stretch by factor 2 *vertically upward.*

$(\boldsymbol{b})$

The graph of $y = f(-x)$ *is a reflection of the graph* $y = f(x)$ *in the* $y-$*axis*

$y = \sin 2x - 5x$

$f(x) = \sin 2x - 5x \qquad \because\ y = f(x)$

$f(-x) = \sin 2(-x) - 5(-x)$

$f(-x) = -\sin 2x + 5x$ $\qquad \because \ \sin(-\theta) = -sin\theta$

$y = -\sin 2x + 5x$

The graph of $y = f(ax)$ *is a stretch of the graph* $y = f(x)$ *with stretch factor* $\frac{1}{a}$ *parallel to the* $x - axis$

Now

$y = -\sin 2x + 5x$

$f(x) = -\sin 2x + 5x$

$f(3x) = -\sin 2\,(3x) + 5(3x)$ $\qquad \because$ *we have scale factor* $\frac{1}{3}$

$f(3x) = -sin6x + 15x$

$y = -\sin 6x + 15x$

$y = \sin(-6x) + 15x$