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Functions

Stretching of Functions

We focus our attention on the transformations that cause a function to stretch and shrink.

Lesson Outcomes

By the end of this lesson, you should be able to:

- use function notation to summarise transformations of functions that involve stretching and shrinking

Curriculum Links

LO 2: Functions and Algebra

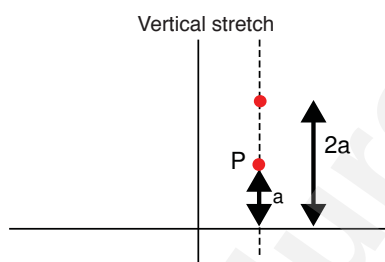
- 12.2.7 (a) Demonstrate the ability to work with various types of functions and relations including the inverses listed in the following Assessment Standard. (Linked to task)
- (b) Demonstrate knowledge of the formal definition of a function (Linked to task)

Lesson Notes

A transformation that stretches or shrinks a function can take place vertically or horizontally. Stretching or shrinking a function or graph can best be explained by look at what happens to one point on the function.

Vertical Stretching or Shrinking

Consider P, a point on a function that is a units away from the x -axis. If we stretch a point vertically by a factor of 2 then the distance from the x -axis will be double what it was originally, namely $2a$.



Similarly, when a function undergoes shrinking, the distance of the point from the x -axis decreases by a scale factor but this time the scale factor is less than one.

In general, for vertical stretching:

The function $g(x) = a \times f(x)$ is a **vertical stretching** of the function $f(x)$ with a scale factor of a , where $a > 1$

In general, for vertical shrinking:

The function $g(x) = a \times f(x)$ is a **vertical shrinking** of the function $f(x)$ with a scale factor of a , where $0 < a < 1$

Horizontal stretching or shrinking

This type of transformation causes a point to either move further away (stretching) or closer to the y -axis (shrinking).

In general, for horizontal stretching:

The function $g(x) = a \times f(x)$ is a **horizontal stretching** of the function $f(x)$ with a scale factor of a , where $0 < a < 1$

In general, for horizontal shrinking:

The function $g(x) = a \times f(x)$ is a **horizontal shrinking** of the function $f(x)$ with a scale factor of a , where $a > 1$

Task

Write down the equations of the following transformations of $y = f(x)$.

- A vertical shift down by $\frac{1}{2}$ a unit of $f(x) = \cos x$
- A horizontal shift of 2 units to the right of $f(x) = \tan x$
- A reflection of $y = 2^x$ about the y -axis
- A reflection of $y = x + 1$ about the x -axis
- A vertical stretch of $y = x^2$ by a factor of 2
- A horizontal stretch by a factor of $\frac{1}{2}$ of $f(x) = \tan x$
- An enlargement by a factor of 2 of $y = f(x) = \sin x$

