

## Lesson 2

## GCSE Mathematics Functions I

### 2.1 Algebraic Inputs

Previously we looked at what the following function did to various numbers;

$$f(x) = x^2 + 1 \quad x \in \mathbb{R}$$

In words, “whatever the input, square it and then add 1”.

For example,

$$\begin{aligned} f(5) &= 5^2 + 1 \\ &= 26 \end{aligned}$$

We can also drop algebraic expressions into function  $f$ .

The algebra dropped in will be squared and then have 1 added on.

For example, let's drop  $4z$  into function  $f$ .

$$\begin{aligned} f(4z) &= (4z)^2 + 1 \\ &= (4z)(4z) + 1 \\ &= 16z^2 + 1 \end{aligned}$$

What will happen if  $3z + 5$  is dropped into function  $f$  ?

Write the answer without any brackets for a BONUS MARK !



Dear Sir,

Here is my most excellent answer and also my thinking.

What I thought was that I have to square and add 1

So  $(3z + 5)$  is to be squared and not to have brackets.

$$(3z + 5)(3z + 5) = 9z^2 + 30z + 25$$

Am I doing good, Sir ?

I bet you think I'm going to forget to add 1

Sir, guess what ? I'm NOT !

$$\begin{aligned} f(3z + 5) &= (3z + 5)^2 + 1 \\ &= 9z^2 + 30z + 25 + 1 \\ &= 9z^2 + 30z + 26 \end{aligned}$$

And so, please may I have the BONUS MARK !

Yours mathematically,

Bert

## 2.2 You Try

Here are five questions for you to try.

The answers are on the following page - Don't look yet !

Try each one yourself first, then check over the page to see if you got it correct.

If

$$h(x) = 4x + 13, \quad x \in \mathbb{R}$$

find expressions that do not involve brackets for;

**Try 1**             $h(5)$

[ 1 mark ]

**Try 2**             $h(3z)$

[ 1 mark ]

**Try 3**             $h(3z + 1)$

[ 1 mark ]

**Try 4**             $h(z^2 + 7)$

[ 1 mark ]

**Try 5**             $h(x^5 + 7)$

[ 1 mark ]

**Reminder :**

$$h(x) = 4x + 13, \quad x \in \mathbb{R}$$

In words: "Multiply the input by four and then add on 13"

**So the answers are :**

**Try 1**             $h(5)$

$$\begin{aligned} h(5) &= 4 \times 5 + 13 \\ &= 33 \end{aligned}$$

[ 1 mark ]

**Try 2**             $h(3z)$

$$\begin{aligned} h(3z) &= 4 \times 3z + 13 \\ &= 12z + 13 \end{aligned}$$

[ 1 mark ]

**Try 3**             $h(3z + 1)$

$$\begin{aligned} h(3z + 1) &= 4(3z + 1) + 13 \\ &= 12z + 4 + 13 \\ &= 12z + 17 \end{aligned}$$

[ 1 mark ]

**Try 4**             $h(z^2 + 7)$

$$\begin{aligned} h(z^2 + 7) &= 4(z^2 + 7) + 13 \\ &= 4z^2 + 28 + 13 \\ &= 4z^2 + 41 \end{aligned}$$

[ 1 mark ]

**Try 5**             $h(x^5 + 7)$

$$\begin{aligned} h(x^5 + 7) &= 4(x^5 + 7) + 13 \\ &= 4x^5 + 28 + 13 \\ &= 4x^5 + 41 \end{aligned}$$

[ 1 mark ]

How did you do ?

Dear Sir,  
I did do done good !  
Yours mathematically,  
Bert

### 2.3 Exercise

Marks Available : 40

#### Question 1

If

$$f(x) = 5x + 11 \quad x \in \mathbb{R}$$

find expressions that do not involve brackets for;

( i )  $f(3)$                       ( ii )  $f(5)$                       ( iii )  $f(12)$

( iv )  $f(2z)$

( v )  $f(6z + 5)$

( vi )  $f(3z + 7)$

( vii )  $f(-2)$                       ( viii )  $f(-1)$                       ( ix )  $f(0.1)$

( x )  $f(4z - 2)$

( xi )  $f(8z - 3)$

[ 6 marks ]

**Question 2**

If

$$g(x) = 8x - 10 \quad x \in \mathbb{R}$$

find expressions that do not involve brackets for;

(i)  $g(2)$                       (ii)  $g(6)$                       (iii)  $g(0)$

(iv)  $g(3z)$

(v)  $g(5z + 2)$

(vi)  $g(7 + 2z^2)$

(vii)  $g(-2)$                       (viii)  $g(-5)$                       (ix)  $g(0.1)$

(x)  $g(-4z)$

(xi)  $g(8\sqrt{z} - 1)$

**[ 6 marks ]**

**Question 3**

If

$$h(x) = x^2 \quad x \in \mathbb{R}$$

find expressions that do not involve brackets for;

(i)  $h(3)$                       (ii)  $h(-3)$                       (iii)  $h(8)$

(iv)  $h(3z)$

(v)  $h(5z + 1)$

**HINT : FOIL**

(vi)  $h(2z + 7)$

(vii)  $h\left(\frac{3}{2}\right)$                       (viii)  $h\left(-\frac{3}{10}\right)$                       (ix)  $h\left(\frac{1}{2}\right)$

(x)  $h(-4z)$

(xi)  $h(6z - 2)$

**[ 6 marks ]**

**Question 4**

If

$$k(x) = 7x + 3 \quad x \in \mathbb{R}$$

find expressions that do not involve brackets for;

**(i)**  $k(7)$

**(ii)**  $k(6)$

**(iii)**  $k(-11)$

**(iv)**  $k(3x)$

**(v)**  $k(2x + 10)$

**(vi)**  $k(5x + 1)$

**(vii)**  $k\left(\frac{1}{10}\right)$

**(viii)**  $k\left(-\frac{1}{10}\right)$

**(ix)**  $k\left(\frac{1}{2}\right)$

**(x)**  $k(4x - 1)$

**(xi)**  $k(7x - 2)$

**[ 6 marks ]**

**Question 5**

If

$$m(x) = x^2 + 5 \quad x \in \mathbb{R}$$

find expressions that do not involve brackets for;

( i )  $m(7)$                       ( ii )  $m(-7)$                       ( iii )  $m(20)$

( iv )  $m(3x)$

( v )  $m(-3x)$

( vi )  $m(5x + 1)$

( vii )  $m(-1)$                       ( viii )  $m\left(\frac{1}{2}\right)$                       ( ix )  $m\left(\frac{3}{2}\right)$

( x )  $m(4x + 7)$

( xi )  $m(7x - 2)$

**[ 6 marks ]**



### Question 6

If

$$n(x) = 4x^2 + 1 \quad x \in \mathbb{R}$$

find expressions that do not involve brackets for;

( i )  $n(3)$                       ( ii )  $n(-3)$                       ( iii )  $n(100)$

( iv )  $n(3x)$

( v )  $n(-3x)$

( vi )  $n(7x + 1)$

( vii )  $n(0)$                       ( viii )  $n\left(\frac{1}{2}\right)$                       ( ix )  $n\left(\frac{3}{2}\right)$

( x )  $n(2x + 3)$

( xi )  $n(5x - 2)$

[ 10 marks ]

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In October 2020, Shrewsbury School was voted "**Independent School of the Year 2020**"

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Teachers may obtain detailed worked solutions to the exercises by email from [mhh@shrewsbury.org.uk](mailto:mhh@shrewsbury.org.uk)