

## ALGEBRA - Substitute, Simplify, expand, factorise

Page	Description
1	Substitute
2	Simplify and writing expressions using algebra
3	Simplify, expand single bracket, factorise single bracket
4	Simplify, expand single bracket, expand and simplify, factorise single bracket
5	Expand two brackets. Factorise quadratics
6	Expand single bracket, expand and simplify, expand two brackets, factorise quadratics, factorise single bracket
7	Expand and factorise single bracket and two brackets
8	Simplify expressions. Expand single bracket, expand and simplify, expand two brackets, factorise quadratics, factorise single bracket
9	Recap on factorising
10	Factorise harder quadratics
11	Factorise harder quadratics. Simplify algebraic fractions
12	Simplify algebraic fractions

Substitution

For questions 13 to 24

1)  $a = 3$   $\frac{a}{\square} + 3 =$

$a = 4, b = 3$  and  $c = 2$

2)  $b = 7$   $\frac{b}{\square} - 1 =$

13)  $a + 9 =$

3)  $e = 4$   $\frac{3e}{3} \times \frac{e}{\square} =$

14)  $4b =$

4)  $s = 8$   $\frac{s}{\square} \div 2 =$

15)  $3c + a =$

5)  $p = 6$   $\frac{2p + 1}{2} \times \frac{p}{\square} + 1 =$

16)  $ab =$

6)  $q = 7$   $\frac{3q - 4}{3} \times \frac{q}{\square} - 4 =$

17)  $2(a + b) =$

18)  $2bc =$

7)  $r = 8$   $\frac{3(r - 5)}{3} \times \left( \frac{r}{\square} - 5 \right) =$

19)  $13 - a =$

20)  $ab + c =$

8)  $a = 2$   
 $b = 3$   $\frac{a}{\square} + \frac{b}{\square} =$

21)  $4(a - c) =$

22)  $4c + 7 =$

9)  $a = 2$   
 $b = 3$   $\frac{ab}{\square} \times \frac{b}{\square} =$

23)  $20 - 2a =$

24)  $abc =$

10)  $c = 4$   
 $d = 5$   $\frac{4c + d}{4} \times \frac{c}{\square} + \frac{d}{\square} =$

11)  $c = 2$   
 $d = 5$   $\frac{4cd}{4} \times \frac{c}{\square} \times \frac{d}{\square} =$

12)  $e = 6$   
 $f = 2$   $\frac{3e + 4f}{3} \times \frac{e}{\square} + 4 \times \frac{f}{\square} =$

## Simplify where possible

1)  $a + a$

2)  $2a - a$

3)  $3 \times 2a$

4)  $a \times a$

5)  $2a + a$

6)  $\frac{2a}{a}$

7)  $a - a$

8)  $a^2 + a^2 + a$

9)  $a^2 - a$

10)  $a^2 \times a$

11)  $2a + 3b - 5a + b + 5$

12)  $2s \times 3s$

13)  $y^2 \times y^3$

14)  $y^2 + y^3$

15)  $3ab \times 2a$

## Writing in algebra

1) What number is two more than  $n$ ?

2) What number is three less than  $n$ ?

3) What number is twice as big as  $n$ ?

4) What number is a quarter the size of  $n$ ?

5) Write in terms of  $n$  an expression that is always odd.

6) Show that the expression  $4n - 1 + n + 11$  is always a multiple of 5.

Write in a more simple way

1)  $x + x + x + x =$

2)  $y \times y =$

3) 3 lots of  $2x =$

4) 2 lots of  $3y$

5)  $x^2 + x =$

6)  $4 \times 2y =$

Simplify these ones

1)  $3a + 4a + a =$

2)  $7x - 4x$

3)  $a + 2b + b + 4a =$

4)  $5p + q - 2q =$

5)  $4g + 5 + g - 2 =$

6)  $4a + 3a - 7a =$

7)  $4g + 2h + 3 + g - 3h =$

8)  $9b + 2c - 3b =$

9)  $x + x + s + 3s + 2x =$

10)  $2y + h - 3y - 2h =$

Expand these brackets

1)  $2(x + 3)$

2)  $4(y + 3)$

3)  $3(2a + 1)$

4)  $2(5y + 3)$

5)  $6(2x + 1)$

6)  $4(3x - 1)$

7)  $2(5x - 1)$

8)  $3(2 + 3y)$

Factorise these expressions

1)  $2x + 4 = 2(\underline{\quad} + \underline{\quad})$

2)  $2x + 6 = 2(\underline{\quad} + \underline{\quad})$

3)  $3x + 3 = 3(\underline{\quad} + \underline{\quad})$

4)  $3x + 6 = 3(\underline{\quad} + \underline{\quad})$

5)  $4x + 8 = 4(\underline{\quad} + \underline{\quad})$

6)  $3y + 9 = 3(\underline{\quad} + \underline{\quad})$

7)  $4x + 6 = 2(\underline{\quad} + \underline{\quad})$

8)  $9y + 6 = 3(\underline{\quad} + \underline{\quad})$

## Algebra Review

Simplify the following expressions if possible

1)  $a + a + a =$  \_\_\_\_\_

2)  $a \times a =$  \_\_\_\_\_

3)  $2a \times a =$  \_\_\_\_\_

4)  $a^2 + 2a^2 =$  \_\_\_\_\_

5)  $a^2 + 2a =$  \_\_\_\_\_

6)  $5\pi + 2\pi =$  \_\_\_\_\_

7)  $5a - 6a =$  \_\_\_\_\_

8)  $2a + 3b =$  \_\_\_\_\_

9)  $a \times a^2 =$  \_\_\_\_\_

10)  $4a \div 2 =$  \_\_\_\_\_

11)  $4a \div 2a =$  \_\_\_\_\_

12)  $2a \times 3a \times 4 =$  \_\_\_\_\_

Work out the answers to

13)  $-4 - 3 =$  \_\_\_\_\_

14)  $-2 + 7 =$  \_\_\_\_\_

15)  $6 - 8 =$  \_\_\_\_\_

16)  $3 \times -2 =$  \_\_\_\_\_

17)  $-4 \times -3 =$  \_\_\_\_\_

18)  $-8 \times 2 =$  \_\_\_\_\_

19)  $-3 \times 2 + -4 \times -2 =$  \_\_\_\_\_

20)  $-3 + 5 - 8 - 4 + 2 =$  \_\_\_\_\_

Expand

21)  $3(2x + 3) =$  \_\_\_\_\_

22)  $x(x + 1) =$  \_\_\_\_\_

23)  $4x(3 - 2x) =$  \_\_\_\_\_

24)  $-2(3 - 2x) =$  \_\_\_\_\_

Expand and simplify

25)  $3(x - 3) + 2(5 - 2x) =$  \_\_\_\_\_

Expand

$=$  \_\_\_\_\_

Simplify

26)  $4(2x - 1) - 2(3x - 2) =$  \_\_\_\_\_

Expand

$=$  \_\_\_\_\_

Simplify

27)  $7 - (4 - x) =$  \_\_\_\_\_

Expand

$=$  \_\_\_\_\_

Simplify

28)  $x(x - 2) - 3x(2x + 1) =$  \_\_\_\_\_

Expand

$=$  \_\_\_\_\_

Simplify

Factorise

29)  $4x + 8 =$  \_\_\_\_\_

30)  $3x^2 - 7x =$  \_\_\_\_\_

31)  $9x^2 - 6x =$  \_\_\_\_\_

32)  $4ab^2 - 6a^2b =$  \_\_\_\_\_

## Expanding and Factorising Quadratics

Expand and simplify the following

1)  $(x + 2)(x + 3)$

2)  $(x - 4)(x + 3)$

3)  $(x + 5)(x - 2)$

4)  $(x - 2)(x - 7)$

5)  $(x+3)^2$

6)  $(2x - 3)(4x + 1)$

7)  $(3x - 1)(3x + 1)$

8)  $(2 - x)(x - 3)$

Find two numbers that

Qu.	Times to make	Add to make	Answers	Qu.	Times to make	Add to make	Answers
9)	6	5		14)	-12	-4	
10)	8	6		15)	-24	2	
11)	-8	2		16)	10	-11	
12)	-6	1		17)	-16	0	
13)	8	-6		18)	0	4	

Factorise these quadratics

19)  $x^2 + 6x + 8 = (x \quad)(x \quad)$

2 numbers times to make 8

Add to make 6

20)  $x^2 + 10x + 21 = (x \quad)(x \quad)$

2 numbers times to make

Add to make

21)  $x^2 - x - 6 = (x \quad)(x \quad)$

2 numbers times to make

Add to make

22)  $x^2 - 2x - 15 = (x \quad)(x \quad)$

2 numbers times to make

Add to make

23)  $x^2 - 8x + 15 = (x \quad)(x \quad)$

24)  $x^2 - 25 = (x \quad)(x \quad)$

25)  $x^2 - x - 20 = (x \quad)(x \quad)$

26)  $x^2 - 10x + 16 = (x \quad)(x \quad)$

27)  $x^2 + 5x - 24 = (x \quad)(x \quad)$

28)  $x^2 - 2x - 35 = (x \quad)(x \quad)$

29)  $x^2 + 8x + 7 = (x \quad)(x \quad)$

30)  $x^2 - 100 = (x \quad)(x \quad)$

# Algebra Revision

## Expand

1)  $3(2x + 3) = \underline{\hspace{2cm}}$       2)  $x(x + 1) = \underline{\hspace{2cm}}$   
 3)  $4x(3 - 2x) = \underline{\hspace{2cm}}$

## Expand and simplify

4)  $3(x - 3) + 2(5 - 2x) = \underline{\hspace{2cm}}$  Expand  
 $= \underline{\hspace{2cm}}$  Simplify  
 5)  $4(2x - 1) - 2(3x - 2) = \underline{\hspace{2cm}}$  Expand  
 $= \underline{\hspace{2cm}}$  Simplify  
 6)  $7 - 2(4 - x) = \underline{\hspace{2cm}}$  Expand  
 $= \underline{\hspace{2cm}}$  Simplify

## Expand

7)  $(x + 1)(x + 3)$

times	x	+1
x		
+3		

$\underline{\hspace{2cm}}$  simplify

8)  $(x - 1)^2$

times	x	-1
x		
-1		

this means  $(x - 1)(x - 1)$   $\underline{\hspace{2cm}}$  simplify

9)  $(x - 2)(2x + 3)$

times	x	-2
2x		
+3		

$\underline{\hspace{2cm}}$  simplify

## Factorise

10)  $x^2 + 3x + 2 = (x + \underline{\hspace{1cm}})(x + \underline{\hspace{1cm}})$  two numbers, times make 2, add make 3  
 11)  $x^2 + 7x + 6 = (x + \underline{\hspace{1cm}})(x + \underline{\hspace{1cm}})$  two numbers, times make 6, add make 7  
 12)  $x^2 + 7x + 12 = (x + \underline{\hspace{1cm}})(x + \underline{\hspace{1cm}})$  two numbers, times make 7, add make 12

## Factorise

13)  $4x + 8 = 4(\underline{\hspace{1cm}} + \underline{\hspace{1cm}})$   
 14)  $2x^2 - x = x(\underline{\hspace{1cm}} - \underline{\hspace{1cm}})$   
 15)  $9x^2 - 6x = 3x(\underline{\hspace{1cm}} - \underline{\hspace{1cm}})$

## Multiplying out or expanding

Single bracket

Two brackets

$$2(x - 4)$$

$$(x + 2)(x + 4)$$

$$x(x + 2)$$

$$(x - 1)(x + 4)$$

$$2x(3x - 1)$$

$$(x - 2)(x - 5)$$

## What type of factorising

Single bracket

Two brackets

$$3x + 6$$

$$x^2 + 5x + 6$$

$$x^2 - 4x$$

$$x^2 - x - 6$$

$$4x^2 - 8x$$

$$x^2 + x - 6$$

$$6a^2b - 4ab^2$$

$$x^2 - 5x + 6$$

$$x^2 - 36$$

## Multiply out (Expand)

1)  $x(2x - 3)$

5)  $(x - 4)(x - 5)$

2)  $7(x - 2)$

6)  $(x + 2)(2 - x)$

3)  $3x(2 - x)$

7)  $(x + 5)(x - 5)$

4)  $(x - 2)(x + 7)$

8)  $(2x - 3)(3x - 2)$

## Factorise

1)  $4x + 2$

5)  $x^2 + 5x + 4$

2)  $6x^2 - x$

6)  $x^2 - 5x + 4$

3)  $6x^2 - 2x$

7)  $x^2 - 3x - 4$

4)  $x^2 - 16$

8)  $x^2 + 3x - 4$



# Expressions

## Add and take

$$3x + 2y - 5 + 6x - 4y - 2$$

$$4a^2 + 5a^2$$

$$9x^2y^3 - 6x^2y^3 + 2x^3y^2$$

## Multiply

$$5 \times 3a$$

$$5x \times 2x$$

$$4a^2 \times 3a^3$$

## Divide

$$6x \div 2$$

$$8y^3 \div 2y$$

$$\frac{12x^2y^3}{3xy^2}$$

## Expand single brackets

$$3(x - 3)$$

$$y(y + 2)$$

$$2x(3x + 4)$$

## Expand two brackets

$$(x - 3)(x + 7)$$

$$(x + 1)(x + 6)$$

$$(x - 3)(x - 4)$$

$$(x - 2)^2$$

## Expand and simplify

$$2(3x + 5) + 4(x - 3)$$

$$3(x - 2) - 2(x - 4)$$

$$3x - (x - 4)$$

## Factorise into 1 bracket

$$2x + 6$$

$$x^2 - 2x$$

$$4x^2 + 6x$$

$$10a^2b^3 + 15a^3b^2$$

## Factorise into 2 brackets

$$x^2 + 6x + 8$$

$$x^2 - x - 12$$

$$x^2 + 2x - 15$$

$$x^2 - 6x + 5$$

$$x^2 - 25$$

<p>Set A Qu. 1</p> <p><b>Factorise</b></p> <p><math>3x + 12</math></p> <p>How many brackets?</p>	<p>Set A Qu. 2</p> <p><b>Factorise</b></p> <p><math>x^2 - x - 12</math></p> <p>How many brackets?</p>	<p>Set A Qu. 3</p> <p><b>Factorise</b></p> <p><math>x^2 + 2x</math></p> <p>How many brackets?</p>	<p>Set A Qu. 4</p> <p><b>Factorise</b></p> <p><math>4x^2 + 10x</math></p> <p>How many brackets?</p>	<p>Set A Qu. 5</p> <p><b>Factorise</b></p> <p><math>x^2 + 7x + 12</math></p> <p>How many brackets?</p>
<p>Set A Qu. 6</p> <p><b>Factorise</b></p> <p><math>x^2 + 2x - 8</math></p> <p>How many brackets?</p>	<p>Set A Qu. 7</p> <p><b>Factorise</b></p> <p><math>x^2 - 5x + 6</math></p> <p>How many brackets?</p>	<p>Set A Qu. 8</p> <p><b>Factorise</b></p> <p><math>x^3 + 3x^2</math></p> <p>How many brackets?</p>	<p>Set A Qu. 9</p> <p><b>Factorise</b></p> <p><math>x^2 - 16</math></p> <p>How many brackets?</p>	<p>Set A Qu. 10</p> <p><b>Factorise</b></p> <p><math>6x^2 - 16x^3</math></p> <p>How many brackets?</p>

$x^2$  term       $x$  term      number term

	$2x^2 + 5x + 3$	$2x^2 + 3x - 9$	$3x^2 - 5x - 2$
Multiply $x^2$ term and number term together	$2 \times 3 = 6$		
Find two numbers that multiply together make this new number but add to make the $x$ term	times = 6 add = 5      2 and 3		
Split the $x$ term using these two numbers	$5x = 2x + 3x$		
Re-write the equation using this split	$2x^2 + 2x + 3x + 3$		
Factorise the front two pairs and the back two pairs creating the same term in the brackets	$2x(x + 1) + 3(x + 1)$		
Factorise again to give the answer	$(x + 1)(2x + 3)$		

Factorise these quadratics

1)  $6x^2 + 5x + 1 =$

5)  $6x^2 - 5x + 1 =$

9)  $9x^2 - 4 =$

2)  $2x^2 + 11x + 12 =$

6)  $4x^2 - 8x + 3 =$

10)  $9a^2 - b^2 =$

3)  $2x^2 - x - 6 =$

7)  $x^2 - 16 =$

4)  $4x^2 - 7x - 2 =$

8)  $x^2 - 4 =$

By putting the factorised version (from above) of each quadratic into the fraction, simplify the fraction

Qu. 1  $\frac{2x^2 + 11x + 12}{2x^2 - x - 6}$

Qu. 4  $\frac{2x^2 + 11x + 12}{x^2 - 16}$

Qu. 2  $\frac{2x^2 - x - 6}{4x^2 - 7x - 2}$

Qu. 5  $\frac{2x^2 - x - 6}{x^2 - 4}$

Qu. 3  $\frac{6x^2 - 5x + 1}{4x^2 - 8x + 3}$

Qu. 6  $\frac{9x^2 - 4}{4x^2 - 8x + 3}$

(11)

## Algebraic Fractions

1)  $\frac{1}{x} + \frac{1}{y}$

6)  $\frac{1}{x+1} + \frac{1}{x+2}$

2)  $\frac{a}{x} + \frac{b}{y}$

7)  $\frac{2}{x+1} + \frac{3}{x-2}$

3)  $\frac{2}{x} - \frac{3}{y}$

8)  $\frac{x-1}{x+1} - \frac{x+1}{x+2}$

4)  $\frac{a}{x} \times \frac{b}{y}$

9)  $\frac{1}{x+1} \times \frac{1}{x+2}$

5)  $\frac{3}{x} \div \frac{2}{y}$

10)  $\frac{1}{x+1} \div \frac{1}{x+2}$