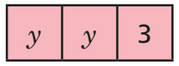
Evaluate algebraic expressions with directed numbers

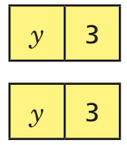
1 Use the bar models to help you substitute $y = -5$ into the expressions.

a) $2y + 3$



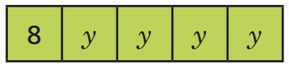
−7

$2(y + 3)$



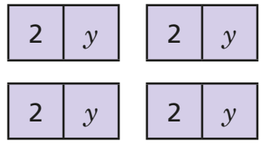
−4

b) $8 + 4y$



−12

$4(2 + y)$



−12

What is the same and what is different in each part?

2 Evaluate the expressions when $g = -8$

a) $2g + 7 =$ −9

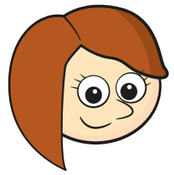
b) $2g - 7 =$ −23

c) $2 + 7g =$ −54

d) $7g - (-2) =$ −54

3 Rosie and Jack are substituting $b = -2$ into this expression.

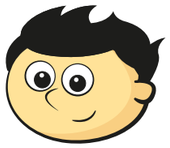
$5 - 4b$



Rosie

The answer is −3

I think the answer is 13



Jack

Who is correct? Jack

What mistake do you think the other person made?

Rosie has calculated 5 − 8 not 5 − (−8)

4 Evaluate the expressions when $h = -7$

a) $2h + 16 =$ 2

b) $2h - 16 =$ −30

c) $16 - 2h =$ 30

d) $-16 - 2h =$ −2

5 Evaluate the expressions by substituting the values $a = -6$, $b = 5$, $c = 2$ and $d = -4$

a) $a - d =$ −2

$7(a - d) =$ −14

$-7(a - d) =$ 14

b) $ab =$ −30

$2(ab) =$ −60

$\frac{ab}{2} =$ −15

c) $2d =$ −8

$d^2 =$ 16

$2d - d^2 =$ −24

6 $x = -2$ $y = 10$ $z = 3$

Using only letters, write algebraic expressions that give these answers.

e.g.

a) 12 $y - x$

b) –20 xy

c) –15 $x - y - z$

d) –60 xyz

Compare answers with a partner. Did you get the same expressions?

7 Filip is evaluating the expression $n - p^2$ when $n = -7$ and $p = -3$

$$-7 - -3^2$$
$$= -7 - -9$$
$$= -7 + 9$$
$$= 2$$

What mistake has Filip made?

Correct his working out.

$-7 - (-3)^2 = -7 - 9 = -16$

How could Filip make sure he doesn't make this mistake again?

Use brackets.

8 Here are some expression cards.

$m - k$ mk $\frac{k}{m}$

$\frac{m}{k}$ $2k - 8m$ k^2

What is the range of the cards when $k = -8$ and $m = -2$?

64

9 An approximate rule for converting degrees Fahrenheit (F) to degrees Celsius (C) is given by the formula.

$$C = \frac{F - 30}{2}$$

a) Use this rule to convert 18 °F into °C.

-6°C

b) Aisha substitutes a different value for F and gets $C = 0$

What was Aisha's value for F?

30°F

10 If y is negative, which card would give the greater value?

$y + x$ $y - x$

Does it matter what the value of x is?

Use order of operations with directed numbers

1 Tom works out $2 + 5 \times 4$ and says the answer is 28

a) What mistake has Tom made?

He has done the addition first.

b) What is the correct answer?

22

2 Work out the calculations without a calculator.

a) $8 \div 4 + 3 =$ 5

b) $5 + (10 \div 2) =$ 10

c) $5 + 10 \div 2 =$ 10

d) $8 \div 2 + 5 \times 5 =$ 29

e) $5 + 3 \times 15 + 2 =$ 52

f) $30 + 6 \times 11 - 11 =$ 85

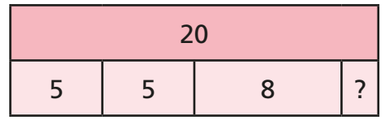
g) $12 + (19 + 2) \div 3 =$ 19

h) $30 \div 10 + 3 \times 2 =$ 9

i) $20 \div 2^2 + (19 - 12) =$ 12

j) $(5^2 + 45) \div 5 \times 8 =$ 112

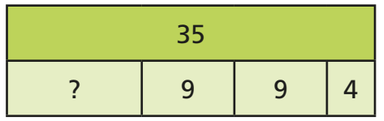
3 **a)** Circle the calculation that does **not** find the unknown number in the bar model.



$20 - 8 - 2 \times 5$ $20 - (5 \times 2 + 8)$

$20 - 2 \times 5 + 8$ $20 - 2 \times 5 - 8$

b) Write four different number sentences that find the unknown in this bar model.



E.g. $35 - (2 \times 9 + 4)$ $35 - (9 + 9 + 4)$

$35 - 2 \times 9 - 4$ $35 - 4 - 2 \times 9$

4 Dani is answering this question.

$11 - 12 \div -3$

Here is her working out.

$12 \div -3 = -4$

$11 - 4 = 7$

Explain the mistake that Dani has made.

She has ignored the subtraction that's already there.

It should be $11 - (-4)$

What is the correct answer? 15

What could Dani use in the future so that she doesn't make the same mistake again?

5 Complete the calculations.

a) $35 + 8 \div -2 =$ 31

b) $-2 - 7^2 =$ -51

c) $(-8)^2 - 5 \times 3 - 17 =$ 32

d) $-6 \div -2 + -1 \times 9 =$ -6

e) $11 - 2 \times -7 + 4 =$ 29

f) $\frac{35 + 8}{-2} =$ -21·5

g) $-(2 - 7)^2 =$ -25

h) $-8^2 - 5 \times 3 - 17 =$ -96

i) $-6 \div (-2 + -1) \times 9 =$ 18

j) $11 - 2(-7 + 4) =$ 17

6 Fill in the missing numbers.

a) $6 +$ 7 $\times 2 = 20$

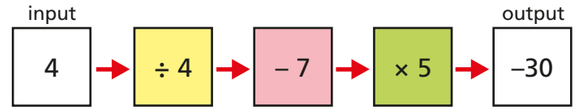
b) $-2 \times 5 -$ 8 $\div 4 = -12$

c) $42 = ($ ±4 $)^2 + 13 \times 2$

d) $- 3 = 17 -$ 6 $\times 3 +$ -2

Can you find more than one solution for any of the calculations?

7



Tick the correct number sentence for the function machine.

- $4 \div 4 - 7 \times 5 = -30$ ✓
- $(4 \div 4) - (7 \times 5) = -30$
- $4 \div (4 - 7) \times 5 = -30$
- $(4 \div 4 - 7) \times 5 = -30$

8 Evaluate these expressions when $a = -4$, $b = 6$, $c = 3$ and $d = -8$

a) $d + 2(c - a)$ 6

b) $c + ad$ 35

9 Insert brackets into the calculations to make the answers correct.

a) $5 - (20 + 2) \div 11 = 3$

b) $21 = 5 + 4 \times (15 - 11)$

10 Use these numbers, operations and brackets to make each of the numbers.

You can use each one once only per part. You do not need to use them all.

2	3	4	5	+	–	×	÷	(	)

a) 13 $5 \times 3 - 2$

b) –1 $2 - 3$

c) –9 $-3 \times (5 - 2)$

d) 0 $5 + 3 - 4 \times 2$

Can you find more than one answer for each number?

Solve two-step equations

1 Use the bar models to help you solve the equations.

a)

20			
y	y	y	8

$3y + 8 = 20$

$y =$ 4

b)

2			
y	y	y	8

$3y + 8 = 2$

$y =$ −2

Which bar model do you prefer? Talk about it with a partner.

2 Dexter is solving an equation.

$2n + 9 = 5$

$2n = 9 - 5$

$2n = 4$

$n = 2$

$2n + 9 = 5$

$2n = 5 - 9$

$2n = -4$

$n = -2$

What mistake has Dexter made?

Write the correct solution next to Dexter's workings.

3 Solve the equations.

a) $4a + 20 = 8$

$a =$ −3

b) $3c + 23 = 8$

$c =$ −5

c) $9y + 10 = -8$

$y =$ −2

d) $15 + 7b = 8$

$b =$ −1

e) $0 = 8 + 2d$

$d =$ −4

f) $2h + 12 = -5$

$h =$ −8·5

4 Solve the equations.

a) $2y - 4 = 6$

$y =$ 5

b) $2y - 4 = -6$

$y =$ −1

c) $2y - 6 = 4$

$y =$ 5

d) $2y - 6 = -4$

$y =$ 1

Discuss your answers with a partner.

5 Solve the equations.

a) $-5m + 40 = 10$

$m =$ 6

b) $1 - 3g = 10$

$g =$ -3

c) $3 = 15 - 10k$

$k =$ 1·2

d) $13 = 7 - 4p$

$p =$ -1·5

6 Solve the equations.

a) $\frac{g}{2} + 7 = 12$

$g =$ 10

b) $\frac{g}{2} + 12 = 7$

$g =$ -10

c) $12 + \frac{g}{2} = 7$

$g =$ -10

d) $12 = \frac{g}{2} - 7$

$g =$ 38

e) $7 = \frac{g}{2} - 12$

$g =$ 38

f) $12 - \frac{g}{2} = 7$

$g =$ 10

7 Solve the equations.

a) $\frac{x}{5} + 1 = 3$

$x =$ 10

b) $\frac{x + 1}{5} = 3$

$x =$ 14

What is the same and what is different about the two equations?

8 The value of x in this equation is 7

Work out possible missing numbers for each equation.

e.g -2 $x +$ 15 $= 1$

2 $x -$ 13 $= 1$

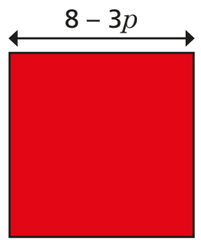
How many different answers can you find?

Various answers.

9 The diagram shows a square with sides $8 - 3p$ cm.

The perimeter of the square is 74 cm.

Calculate the value of p.

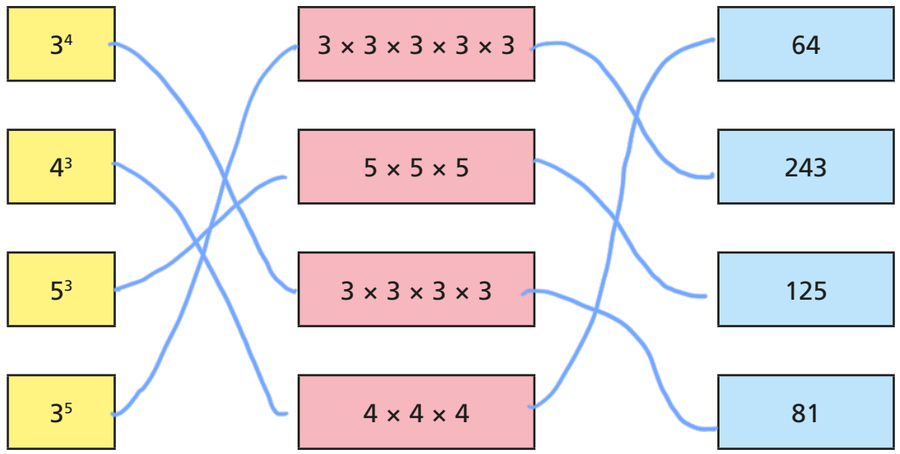


$p =$ -3·5

Explore higher powers and roots

H

1 Match the calculations and answers.



2 Without using a calculator, evaluate the values.

a) 4^3 = 64

b) 6^2 = 36

c) 1^{10} = 1

d) $(-11)^2$ = 121

e) 5^3 = 125

f) $(-5)^3$ = −125

g) 3^6 = 729

h) 10^1 = 10

3 Work out the values.

The cube of 8 = 512

The cube root of 8 = 2

The cube root of –8 = −2

4 Write the calculations in the correct columns.

4^2 9^2 $(-4)^2$ 3^4 2^4

4^3 $(-8)^2$ 2^6 $(-3)^4$

Answer of 16	Answer of 64	Answer of 81
4^2 $(-4)^2$ 2^4	4^3 $(-8)^2$ 2^6	9^2 3^4 $(-3)^4$

5 Fill in possible missing numbers to make the number sentences correct.

Use a calculator to help you.

a) $2^8 = 256$ $16^2 = 256$ $4^4 = 256$

b) $9^2 = 81$ $3^4 = 81$

c) $8^2 = 64$ $64^1 = 64$

$2^6 = 64$

Can you find any other numbers that have more than one calculation involving a power?

6 **a)** Use a calculator to complete the tables.

3^0	3^1	3^2	3^3	3^4	3^5	3^6	3^7
1	3	9	27	81	243	729	2,187

$(-3)^0$	$(-3)^1$	$(-3)^2$	$(-3)^3$	$(-3)^4$	$(-3)^5$	$(-3)^6$	$(-3)^7$
1	–3	9	-27	81	-243	729	-2,187

b) What patterns do you notice between the tables?

The numbers are the same but in the second table every other value is negative.

c) How do you know that $(-2.5)^8$ will be positive?

The power is even.

7 Circle all the calculations that will have a negative answer.

5^7 $(-4)^7$ $(-5)^4$ $(-6)^3$

$(-3)^6$ $(-11.8)^{15}$ $(-7)^{80}$ 17^{39}

Compare answers with a partner.

What do you notice?

8 Work out the calculations.

Use a calculator to help you.

a) $\sqrt[1]{27} =$ 27

c) $\sqrt[5]{32} =$ 2

b) $\sqrt[4]{1,296} =$ 6

d) $\sqrt[5]{3,125} =$ 5

Is there more than one possible solution for any of the questions?

9 Complete the function machines.

Use a calculator to help you.

a)

input				output
–27	→	$\sqrt[3]{\ldots}$	→	–3

b)

input				output
27	→	$(\ldots)^3$	→	19,683

c)

input				output
625	→	$\sqrt[4]{\ldots}$	→	5

d)

input				output
4	→	$(\ldots)^5$	→	1,024

10 Tommy and Rosie think of the same number.

Tommy squares the number.

Rosie cubes the number.

Tommy's answer is greater than Rosie's.

What number could Tommy and Rosie be thinking of? –2

How many different solutions can you find?