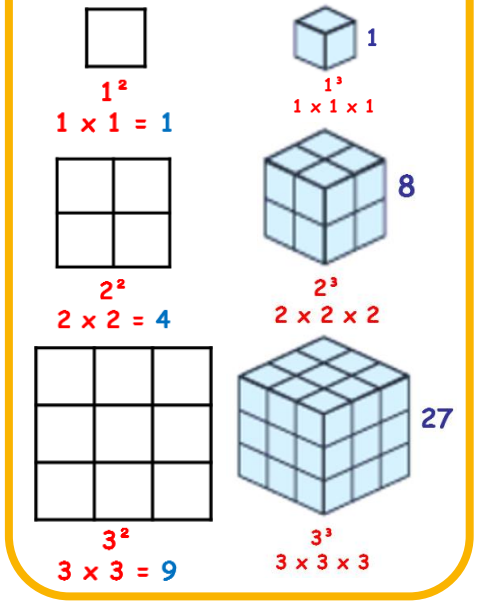
Year 9
POWERS AND ROOTS

Key Concept

Square numbers



Cube numbers

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Clip Numbers
27-30, 99-101

Key Words

Square: A square number is the result of multiplying a number by itself.
Cube: A cube number is the result of multiplying a number by itself twice.
Root: A root is the reverse of a power.
Prime number: A prime is a number that has only two factors which are 1 and itself.
Reciprocal: This is found by doing 1 divided by the number.
Factor: A number that fits into another number exactly.

Tip

A number with an odd amount of factors must be a square number.

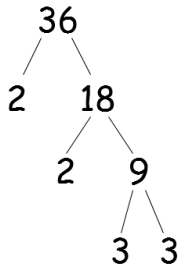
Examples

What is 2^4 ? $2 \times 2 \times 2 \times 2 = 16$

What is $\sqrt{64}$? $8^2 = 64$, so $\sqrt{64} = \pm 8$

What is the reciprocal of 5? $\frac{1}{5}$

Write 36 as a product of prime factors



$36 = 2 \times 2 \times 3 \times 3 = 2^2 \times 3^2$

Product means 'multiply'

Questions

1) a) 2^5 b) 3^3 c) 1^{17} d) $\sqrt{81}$ e) $\sqrt{16}$ f) $\sqrt[3]{64}$
2) Find the reciprocal of: a) 4 b) $\frac{1}{3}$ c) 0.25
3) Write 72 as a product of primes.

ANSWERS: 1) a) 32 b) 27 c) 1 d) ±9 e) ±4 f) 4
2) a) $\frac{1}{4}$ b) 3 c) 4 3) $2^3 \times 3^2$

Year 9
INDICES AND ROOTS

Key Concepts

$$a^m \times a^n = a^{m+n}$$

$$a^m \div a^n = a^{m-n}$$

$$(a^m)^n = a^{mn}$$

$$a^{\frac{1}{n}} = \sqrt[n]{a}$$

$$a^{-m} = \frac{1}{a^m}$$

Examples

Simplify each of the following:

1) $a^6 \times a^4 = a^{6+4}$
$= a^{10}$

2) $a^6 \div a^4 = a^{6-4}$
$= a^2$

3) $(a^6)^4 = a^{6\times4}$
$= a^{24}$

4) $(3a^4)^3 = 3^3a^{4\times3}$
$= 27a^{12}$

5) $\frac{5^2 \times 5^6}{5^4} = \frac{5^8}{5^4}$
$= 5^{8-4}$
$= 5^4$

6) $a^{\frac{1}{2}} = \sqrt{a}$

7) $9^{\frac{1}{2}} = \sqrt{9}$
$= 3$ or -3

8) $2^{-3} = \frac{1}{2^3} = \frac{1}{8}$

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Key Words
Powers
Roots
Indices
Reciprocal

Simplify:

1) $a^3 \times a^2$ 2) $b^4 \times b$ 3) $d^{-5} \times d^{-1}$ 4) $m^6 \div m^2$ 5) $n^4 \div n^4$

6) $\frac{8^4 \times 8^5}{8^6}$ 7) $\frac{4^9 \times 4}{4^3}$ 8) $(3^2)^5$ 9) $81^{\frac{1}{2}}$ 10) 5^{-2}

ANSWERS: 1) a^5 2) b^5 3) d^{-6} 4) m^4 5) 1 6) 8^3 7) 4^7 8) 3^{10} 9) 9 or −9 10) $\frac{1}{25}$

Year 9
CALCULATIONS, CHECKING AND ROUNDING

Key Concepts

A value of 5 to 9 rounds the number up.

A value of 0 to 4 keeps the number the same.

Estimation is a result of rounding to one significant figure.

Examples

Round 3.527 to:

a) 1 decimal place

3 . 5 | 2 7 ⟶ 3.5

b) 2 decimal places

3 . 5 2 | 7 ⟶ 3.53

c) 1 significant figure

3 . | 5 2 7 ⟶ 4

Estimate the answer to the following calculation:

$$\frac{46.2 - 9.85}{\sqrt{16.3 + 5.42}}$$

$$\frac{50 - 10}{\sqrt{20 + 5}}$$

$$\frac{40}{5} = 8$$

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17,
56,
130

Key Words

Integers
Operation
Negative Significant figures
Estimate

A) Round the following numbers to the given degree of accuracy

1) 14.1732 (1 d.p.) 2) 0.0568 (2 d.p.) 3)3418 (1 S.F)

B) Estimate:

1) $\sqrt{4.09 \times 8.96}$

2) $25.76 - \sqrt{4.09 \times 8.96}$

3) $\sqrt[3]{26.64} + \sqrt{80.7}$

4) $\frac{\sqrt{6.91 \times 9.23}}{3.95^2 \div 2.02^3}$

ANSWERS A 1) 14.2 2) 0.06 3) 3000 B 1) 6 2) 24 3) 12 4) 4

Year 9
STANDARD FORM

Key Concepts

We use standard form to write a very large or a very small number in scientific form.

Must be $\times 10$

b is an integer

$$a \times 10^b$$

Must be $1 \leq a < 10$

Examples

Write the following in **standard form**:

1) 3000 = 3×10^3

2) 4580000 = 4.58×10^6

3) 0.0006 = 6×10^{-4}

4) 0.00845 = 8.45×10^{-3}

Calculate the following, write your answer in **standard form**:

1) $(3 \times 10^3) \times (5 \times 10^2)$

$3 \times 5 = 15$
$10^3 \times 10^2 = 10^5$
15×10^5
$= 1.5 \times 10^6$

2) $(8 \times 10^7) \div (16 \times 10^3)$

$8 \div 16 = 0.5$
$10^7 \div 10^3 = 10^4$
0.5×10^4
$= 5 \times 10^3$

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Key Words
Standard form
Base 10

Links
Science

A) Write the following in standard form:
1) 74 000 2) 1 042 000 3) 0.009 4) 0.000 001 24
B) Work out:
1) $(5 \times 10^2) \times (2 \times 10^5)$ 2) $(4 \times 10^3) \times (3 \times 10^8)$
3) $(8 \times 10^6) \div (2 \times 10^5)$ 4) $(4.8 \times 10^2) \div (3 \times 10^4)$

ANSWERS: A1) 7.4×10^4 2) 1.042×10^6 3) 9×10^{-3} 4) 1.24×10^{-6}
B1) 1×10^8 2) 1.2×10^{12} 3) 4×10 4) 1.6×10^{-2}

Year 9
ALGEBRAIC EXPRESSIONS

Key Concepts

When collecting like terms involving addition or subtraction, add/subtract the numbers in front of the letters.

If the like terms are multiplied, multiply the numbers in front of the letters and put the letters next to each other.

If the like terms are divided, divide the numbers in front of the letters.

Examples

Simplify the following expressions:

1) $4p + 6t + p - 2t = 5p + 4t$
2) $3 + 2t + p - t + 2 = 5 + t + p$
3) $f + 3g - 4f = 3g - 3g$
4) $f^2 + 4f^2 - 2f^2 = 3f^2$
5) $6a \times 3b \times 2c = 36abc$
6) $\frac{9b}{3} = 3b$

Questions - Simplify:

1) $7p + 3q + p - 3q$
2) $5 + 4t + 3p - 2t + 7$
3) $m - 8g - 5m$
4) $b^2 - 7b^2 + 2b^2$
5) $2a \times 5b \times 4c$
6) $8m \times 3n \times 2m$
7) $\frac{36p}{12}$
8) $\frac{6t}{18}$

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151 – 152

156 – 157

Key Words

Simplify
Term
Collect

ANSWERS: 1) $8p$ 2) $12 + 2t + 3p$ 3) $-4m - 8g$ 4) $-4b^2$
5) $40abc$ 6) $48m^2n$ 7) $3p$ 8) $\frac{t}{3}$

Year 9

EXPRESSIONS/EQUATIONS/IDENTITIES AND SUBSTITUTION

Key Concepts

A **formula** involves two or more letters, where one letter equals an **expression** of other letters.

An **expression** is a sentence in algebra that does NOT have an equals sign.

An **identity** is where one side is the equivalent to the other side.

When **substituting** a number into an expression, replace the letter with the given value.

Examples

1) $5(y + 6) \equiv 6y + 30$ is an identity as when the brackets are expanded we get the answer on the right hand side
2) $5m - 7$ is an expression since there is no equals sign
3) $3x - 6 = 12$ is an equation as it can be solved to give a solution
4) $C = \frac{5(F - 32)}{9}$ is a formula (involves more than one letter and includes an equal sign)
5) Find the value of $3x + 2$ when $x = 5$

$(3 \times 5) + 2 = 17$

6) Where $A = b^2 + c$, find A when $b = 2$ and $c = 3$

$A = 2^2 + 3$

$A = 4 + 3$

$A = 7$

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153, 189

Key Words

Substitute
Equation
Formula
Identity
Expression

Questions

1) Identify the equation, expression, identity, formula from the list

(a) $v = u + at$ (b) $u^2 - 2as$

(c) $4x(x - 2) = x^2 - 8x$ (d) $5b - 2 = 13$

2) Find the value of $5x - 7$ when $x = 3$

3) Where $A = d^2 + e$, find A when $d = 5$ and $e = 2$

ANSWERS: 1) (a) formula (b) expression (c) identity (d) equation

2) 8

3) A = 27

Year 9
EXPAND AND SIMPLIFY BRACKETS

Key Concepts

Expanding brackets
Multiply the number outside the brackets with EVERY term inside the brackets

Factoring expressions
Take the highest common factor outside the bracket.

Examples

Expand and simplify where appropriate

1) $7(3 + a) = 21 + 7a$

2) $2(5 + a) + 3(2 + a) = 10 + 2a + 6 + 3a = 5a + 16$

3) Factorise $9x + 18 = 9(x + 2)$

4) Factorise $6e^2 - 3e = 3e(2e - 1)$

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160, 161, 168, 189, 105, 106

Key Words
Expand
Factorise
Simplify

Questions

1) Expand and simplify

(a) $3(2 - 7f)$ (b) $5(m - 2) + 6$ (c) $3(4 + t) + 2(5 + t)$

2) Factorise

(a) $6m + 12t$ (b) $9t - 3p$ (c) $4d^2 - 2d$

ANSWERS: 1) (a) $6 - 21f$ (b) $5m - 4$ (c) $22 + 5t$ 2) (a) $6(m + 2t)$ (b) $3(3t - p)$ (c) $2d(2d - 1)$

Year 9
REARRANGE AND SOLVE EQUATIONS

Key Concepts

Solving equations:
Working with inverse operations to find the value of a variable.

Rearranging an equation:
Working with inverse operations to isolate a highlighted variable.

In solving and rearranging we **undo the operations** starting from the last one.

For each step in solving an equation we must do the **inverse** operation

Solve:

$5(x - 3) = 20$
Expand
$5x - 15 = 20$
+15 +15
$5x = 35$
÷5 ÷5
$x = 7$

Solve:

$12 = 3x - 18$
+18 +18
$30 = 3x$
÷3 ÷3
$x = 10$

Solve:

$7p - 5 = 3p + 3$
-3p -3p
$4p - 5 = 3$
+5 +5
$4p = 8$
÷ 2 ÷ 2
$p = 2$

Examples

Rearrange to make r the subject of the formulae :

$$Q = \frac{2r - 7}{3}$$
×3 ×3
$$3Q = 2r - 7$$
+7 +7
$$3Q + 7 = 2r$$
÷ 2 ÷ 2
$$\frac{3Q + 7}{2} = r$$

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177-186, 280-284, 287

Key Words
Solve
Rearrange
Term
Inverse operation

1) Solve $7(x + 2) = 35$
2) Solve $4x - 12 = 28$
3) Solve $4x - 12 = 2x + 20$

4) Rearrange to make x the subject:
$$y = \frac{3x + 4}{2}$$

ANSWERS: 1) $x = 3$ 2) $x = 10$ 3) $x = 16$ 4) $x = \frac{2y - 4}{3}$

Year 9
EQUATIONS IN CONTEXT

Key Concepts

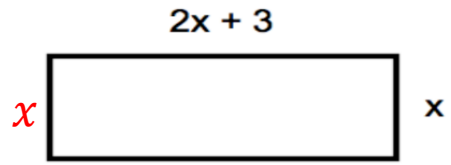
Algebra can be used to support us to find unknowns in a **contextual problem**.

We can always apply a letter to an unknown quantity, to then **set up an equation**.

It will often be used in area and perimeter problems and angle problems in geometry.

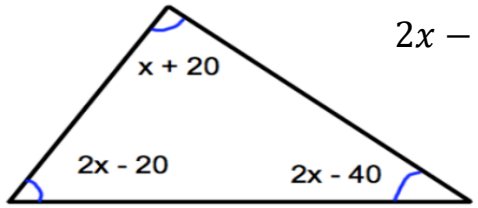
Solve to find the value of x when the perimeter is 42cm.

HINT: Write on all of the lengths of the sides.



We know the perimeter is 42cm

$$2x + 3 + 2x + 3 + x + x = 42$$
$$9x + 6 = 42$$
$$6x = 36$$
$$x = 6$$



Angles in a triangle sum to 180°

$$2x - 20 + x + 20 + 2x - 40 = 180$$
$$5x - 40 = 180$$
$$5x = 220$$
$$x = 45$$

Examples

Jane is 4 years older than Tom.
David is twice as old as Jane.
The sum of their ages is 60.
Using algebra, find the age of each person.

Tom = x → 12
Jane = $x + 4$ → $12 + 4 = 16$
David = $2x + 8$ → $(2 \times 12) + 8 = 32$

$$x + x + 4 + 2x + 8 = 60$$
$$4x + 12 = 60$$
$$4x = 48$$
$$x = 12$$

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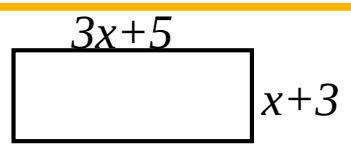
Key Words
Solve
Term
Inverse operation



1) If the perimeter is 40cm. What is the length of the longest side?

2) Jane is 12 years older than Jack.
Sarah is 3 years younger than Jack.
The sum of their ages is 36.
Using algebra, find the age of each person.

ANSWERS: 1) $x = 3$ therefore the longest length is 14cm 2) Jack = 9, *Jane = 21, Sarah =6*