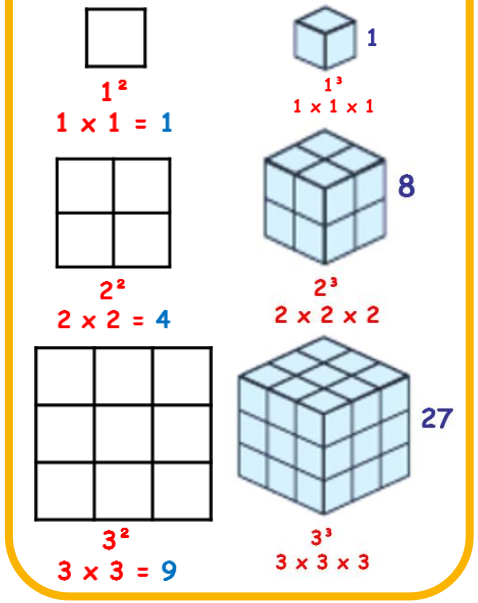
Year 9
POWERS AND ROOTS

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.

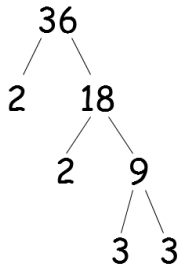
Examples

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

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

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

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

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

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

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

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

Examples

5) $a^{-3} = \frac{1}{a^3}$

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

7) $a^{\frac{1}{2}} = \sqrt[2]{a^1} = \sqrt{a}$

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

9) $\left(\frac{25}{16}\right)^{-\frac{1}{2}} = \left(\frac{16}{25}\right)^{\frac{1}{2}}$
$= \sqrt{\frac{16}{25}}$
$= \frac{4}{5}$

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102 – 110

Key Words
Powers
Roots
Indices
Reciprocal

Write as a single power: 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) $\frac{4^9 \times 4}{4^3}$

Evaluate : 1) $(3^2)^5$ 2) 2^{-2} 3) $81^{\frac{1}{2}}$ 4) $\left(\frac{1}{9}\right)^{\frac{1}{2}}$ 5) $16^{\frac{3}{2}}$ 6) $27^{-\frac{2}{3}}$

ANSWERS: 1) a^5 2) b^5 3) d^{-6} 4) m^4 5) 1 6) 8^3 7) 4^7
1) 3^{10} 2) $\frac{1}{4}$ 3) 9 4) $\frac{1}{3}$ 5) 64 6) $\frac{1}{9}$

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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121 – 129

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

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
EXPANDING AND FACTORISING

Key Concepts

Expanding brackets
Where every term inside each bracket is multiplied by every term all other brackets.

Factorising expressions
Putting an expression back into brackets. To "factorise fully" means take out the HCF.

Difference of two squares
When two brackets are repeated with the exception of a sign change. All numbers in the original expression will be square numbers.

Examples

Expand and simplify:

1) $4(m + 5) + 3$

$= 4m + 20 + 3$

$= 4m + 23$

2) $(p + 2)(2p - 1)$

$= p^2 + 4p - p - 2$

$= p^2 + 3p - 2$

3) $(p + 3)(p - 1)(p + 4)$

$= (p^2 + 3p - p - 3)(p + 4)$

$= (p^2 + 2p - 3)(p + 4)$

$= p^3 + 4p^2 + 2p^2 + 8p - 3p - 12$

$= p^3 + 6p^2 + 5p - 12$

Factorise fully:

1) $16at^2 + 12at$ $= 4at(4t + 3)$

2) $x^2 - 2x - 3$ $= (x - 3)(x + 1)$

3) $6x^2 + 13x + 5$

$= 6x^2 + 3x + 10x + 5$

$= 3x(2x + 1) + 5(2x + 1)$

$= (3x + 5)(2x + 1)$

4) $4x^2 - 25$

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

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160-166, 168, 169,223-228

Key Words
Expand
Factorise fully
Bracket
Difference of two squares

A)Expand:
1) 5(m – 2) + 6 2) (5g – 4)(2g + 1) 3) $(y + 1)(y - 2)(y + 3)$
B) Factorise:
1) $5b^2c - 10bc$ 2) $x^2 - 8x + 15$ 3) $3x^2 + 8x + 4$ 4) $9x^2 - 25$

ANSWERS: A 1) $5m - 4$ 2) $10g^2 - 3g - 4$ 3) $y^3 + 2y^2 - 5y - 6$
B 1) $5bc(b - 2)$ 2) $(x - 3)(x - 5)$ 3) $(3x + 2)(x + 2)$ 4) $(3x + 5)(3x - 5)$

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.

Examples

Solve:

$7p - 5 = 3p + 3$

-3p -3p

$4p - 5 = 3$

+5 +5

$4p = 8$

÷ 2 ÷ 2

$p = 2$

Solve:

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

expand expand

$5x - 15 = 4x + 8$

-4x -4x

$x - 15 = 8$

+15 +15

$x = 23$

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

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

Rearrange to make c the subject of the formulae :

$2(3a - c) = 5c + 1$

expand

$6a - 2c = 5c + 1$

+2c +2c

$6a = 7c + 1$

-1 -1

$6a - 1 = 7c$

÷ 7 ÷ 7

$\frac{6a-1}{7} = c$

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177-186, 287

Key Words
Solve
Rearrange
Term
Inverse

Links
Science

1) Solve $7(x + 2) = 5(x + 4)$
2) Solve $4(2 - x) = 5(x - 2)$
3) Rearrange to make m the subject $2(2p + m) = 3 - 5m$
4) Rearrange to make x the subject $5(x - 3) = y(4 - 3x)$

ANSWERS: 1) $x = 3$ 2) $x = 2$ 3) $m = \frac{3-4p}{7}$ 4) $x = \frac{4y+15}{5+3y}$