

Maths Knowledge Organiser (Set 3 – H)

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 | 27 → 3.5

b) 2 decimal places

3.527 → 3.53

c) 1 significant figure

3 | 5 2 7 → 4

Estimate the answer to the following calculation:

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

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

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

 **Sparx Learning**
U480,U298,
U731, U965

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:

$$1) \sqrt{4.09 \times 8.96}$$
$$2) \quad 25.76 - \sqrt{4.09 \times 8.96}$$

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

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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:

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

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

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

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

Examples

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

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

$$6) 2a^{-4} = \frac{2}{a^4} = \sqrt{\frac{16}{25}}$$

$$7) a^{\frac{1}{2}} = \sqrt[2]{a^1} = \sqrt{a} = \frac{4}{5}$$

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

 **Sparx Learning**
U851, U235, U694,
U985, U772

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) $m^6 \div m^2$

$$5) n^4 \div n^4 \quad 6) \frac{8^4 \times 8^5}{8^6} \quad 7) \frac{4^9 \times 4}{4^3}$$

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) $27^{-\frac{2}{3}}$

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FACTORS, MULTIPLES AND PRIMES

Key Concepts

Prime factor decomposition

Breaking down a number into its prime factors

Highest common factor

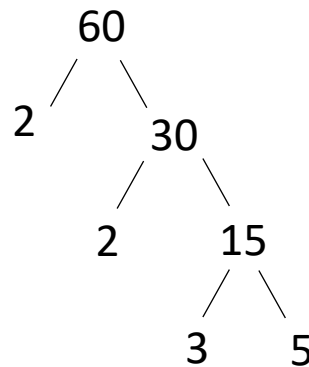
Finding the largest number which divides into all numbers given

Lowest common multiple

Finding the smallest number which both numbers divide into

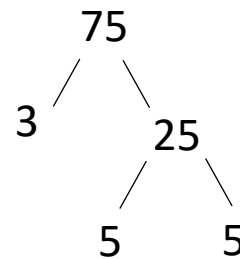
Examples

Find the **highest common factor** and **lowest common multiple** of 60 and 75:



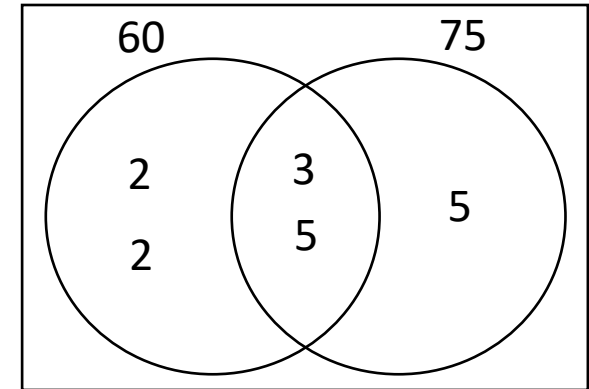
$$2 \times 2 \times 3 \times 5$$

$$2^2 \times 3 \times 5$$



$$3 \times 5 \times 5$$

$$3 \times 5^2$$



HCF – Multiply all numbers in the intersection
 $= 3 \times 5 = 15$

LCM – Multiply all numbers in the Venn diagram
 $= 2 \times 2 \times 3 \times 5 \times 5 = 300$

 Sparx Learning

U739, U250

Key Words

Factor
Multiple
Prime

Highest Common Factor
Lowest Common
Multiple

Questions

- 1) Write 80 as a product of its prime factors
- 2) Write 48 as a product of its prime factors
- 3) Find the LCM and HCF of 80 and 48

ANSWERS: 1) $2^4 \times 5$ 2) $2^4 \times 3$ 3) LCM = 240 HCF = 16

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STANDARD FORM

Key Concepts

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

Must be $\times 10^b$
b is an integer

$$a \times 10^b$$

Must be $1 \leq a < 10$

Examples

Write the following in **standard form**:

1) $3000 = 3 \times 10^3$

2) $4580000 = 4.58 \times 10^6$

3) $0.0006 = 6 \times 10^{-4}$

4) $0.00845 = 8.45 \times 10^{-3}$

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

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

$$\left. \begin{array}{l} 3 \times 5 = 15 \\ 10^3 \times 10^2 = 10^5 \end{array} \right\} \begin{array}{l} 15 \times 10^5 \\ = 1.5 \times 10^6 \end{array}$$

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

$$\left. \begin{array}{l} 8 \div 16 = 0.5 \\ 10^7 \div 10^3 = 10^4 \end{array} \right\} \begin{array}{l} 0.5 \times 10^4 \\ = 5 \times 10^3 \end{array}$$

 **Sparx Learning**
U330, U534,
U264, U290

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 4) 1.6×10^{-2}

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SURDS

Key Concepts

Surds are irrational numbers that cannot be simplified to an integer from a root.

Examples of a surd:
 $\sqrt{3}$, $\sqrt{5}$, $2\sqrt{6}$

Examples

Simplify:

$$\begin{aligned} 4\sqrt{20} \times 2\sqrt{3} &= 8\sqrt{20 \times 3} \\ &= 8\sqrt{60} \\ &= 8\sqrt{4 \times 15} \\ &= 16\sqrt{15} \end{aligned}$$

$$\begin{aligned} 3\sqrt{40} \div \sqrt{2} &= 3\sqrt{40 \div 2} \\ &= 3\sqrt{20} \\ &= 3\sqrt{4 \times 5} \\ &= 6\sqrt{5} \end{aligned}$$

Simplify:

$$\begin{aligned} \sqrt{3}(5 + \sqrt{6}) &= 5\sqrt{3} + \sqrt{18} \\ &= 5\sqrt{3} + \sqrt{9 \times 2} \\ &= 5\sqrt{3} + 3\sqrt{2} \end{aligned}$$

$$\begin{aligned} (3 + \sqrt{2})(4 + \sqrt{12}) &= 12 + 4\sqrt{2} + 3\sqrt{12} + \sqrt{24} \\ &= 12 + 4\sqrt{2} + 3\sqrt{4 \times 3} + \sqrt{4 \times 6} \\ &= 12 + 4\sqrt{2} + 6\sqrt{3} + 2\sqrt{6} \end{aligned}$$

* Sparx Learning

U338, U499

Key Words

Rational
Irrational
Surd

Simplify fully:

- 1) $2\sqrt{27}$ 2) $2\sqrt{18} \times 3\sqrt{2}$ 3) $\sqrt{72}$ 4) $12\sqrt{56} \div 6\sqrt{8}$
 5) $3\sqrt{2}(5 - 2\sqrt{8})$ 6) $(2 + \sqrt{5})(3 - \sqrt{5})$

ANSWERS: 1) $6\sqrt{3}$ 2) 36 3) $6\sqrt{2}$ 4) $2\sqrt{7}$ 5) $15\sqrt{2} - 24$ 6) $1 + \sqrt{5}$

Maths Knowledge Organiser (Set 3 – H)

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) $5(y + 6) \equiv 5y + 30$ 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 $c = 3$
 $A = 2^2 + 3$
 $A = 4 + 3$
 $A = 7$

* Sparx Learning

U613, U585, U144

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 $e = 2$

Maths Knowledge Organiser (Set 3 – H)

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:

$$\begin{array}{lcl}
 7p - 5 = 3p + 3 & & \\
 \text{-3p} & & \text{-3p} \\
 4p - 5 = 3 & & \\
 \text{+5} & & \text{+5} \\
 4p = 8 & & \\
 \div 2 & & \div 2 \\
 p = 2 & &
 \end{array}$$

Solve:

$$\begin{array}{lcl}
 5(x - 3) = 4(x + 2) & & \\
 \text{expand} & & \text{expand} \\
 5x - 15 = 4x + 8 & & \\
 \text{-4x} & & \text{-4x} \\
 x - 15 = 8 & & \\
 \text{+15} & & \text{+15} \\
 x = 23 & &
 \end{array}$$

Rearrange to make r the subject of the formulae :

$$\begin{array}{lcl}
 Q = \frac{2r - 7}{3} & & \\
 \times 3 & & \times 3 \\
 3Q = 2r - 7 & & \\
 \text{+7} & & \text{+7} \\
 3Q + 7 = 2r & & \\
 \div 2 & & \div 2 \\
 \frac{3Q + 7}{2} = r & &
 \end{array}$$

Rearrange to make c the subject of the formulae :

$$\begin{array}{lcl}
 2(3a - c) = 5c + 1 & & \\
 \text{expand} & & \\
 6a - 2c = 5c + 1 & & \\
 \text{+2c} & & \text{+2c} \\
 6a = 7c + 1 & & \\
 \text{-1} & & \text{-1} \\
 6a - 1 = 7c & & \\
 \div 7 & & \div 7 \\
 \frac{6a - 1}{7} = c & &
 \end{array}$$

 **Sparx Learning**
U755, U325,
U505, U870

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) $x = \frac{4y+15}{y+5}$

Maths Knowledge Organiser (Set 3 – H)

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:

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

$$= 4m + 20 + 3$$

$$= 4m + 23$$

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

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

$$= p^2 + 3p - 2$$

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

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

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

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

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

Factorise fully:

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

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

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

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

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

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

$$4) \quad 4x^2 - 25$$

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

 **Sparx Learning**
U179, U768,
U606, U365, U178

Key Words

Expand
Factorise fully
Bracket
Difference of
two squares

A) Expand:

$$1) \quad 5(m - 2) + 6 \quad 2) \quad (5g - 4)(2g + 1) \quad 3) \quad (y + 1)(y - 2)(y + 3)$$

B) Factorise:

$$1) \quad 5b^2c - 10bc \quad 2) \quad x^2 - 8x + 15 \quad 3) \quad 3x^2 + 8x + 4 \quad 4) \quad 9x^2 - 25$$

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

Maths Knowledge Organiser (Set 3 – H)

SEQUENCES

Key Concepts

Arithmetic sequences

increase or decrease by a common amount each time.

Quadratic sequences have a common 2nd difference.

Fibonacci sequences

Add the two previous terms to get the next term

Geometric series has a common multiple between each term

Linear sequences:

4, 7, 10, 13, 16....

a) State the nth term

$3n + 1$
 Difference The 0th term

Examples

b) What is the 100th term in the sequence?

$$3n + 1$$

$$3 \times 100 + 1 = 301$$

c) Is 100 in this sequence?

$$3n + 1 = 100$$

$$3n = 99$$

$$n = 33$$

Yes as 33 is an integer.

Quadratic sequences:

$a + b + c$	3	9	19	33	51
$3a + b$	6	10	14	18	
$2a$	4	4	4		

First difference

Second difference

$$2a = 4 \quad 3a + b = 6 \quad a + b + c = 3$$

$$a = 2 \quad 3 \times 2 + b = 6 \quad 2 + 0 + c = 3$$

$$b = 0 \quad c = 1$$

$$2n^2 + 0n + 1 \rightarrow 2n^2 + 1$$

* Sparx Learning
 U498, U206,
 U680

Key Words

Linear
 Quadratic
 Arithmetic
 Geometric
 Sequence
 Nth term

A) 1, 8, 15, 22, ...

1) Find the nth term b) Calculate the 50th term c) Is 120 in the sequence?

B) Find the nth term for:

1) 5, 12, 23, 38, 57, ... 2) 3, 11, 25, 45, 71, ...

ANSWERS: A1) $7n - 6$ 2) 344 3) 18 so yes as n is an integer B1) $2n^2 + n + 2$ 2) $3n^2 - n + 1$

Maths Knowledge Organiser (Set 3 – H)

TYPES OF ANGLE AND ANGLES IN POLYGONS

Key Concepts

Regular polygons have equal lengths of sides and equal angles.

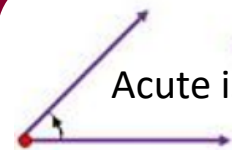
Angles in polygons

Sum of interior angles
 $= (\text{number of sides} - 2) \times 180$

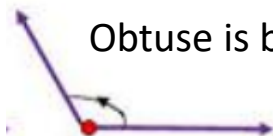
Exterior angles of **regular** polygons = $\frac{360}{\text{number of sides}}$

Types of angle

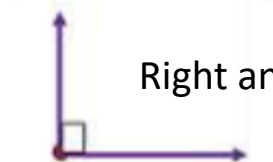
There are four types which need to be identified – acute, obtuse, reflex and right angled.



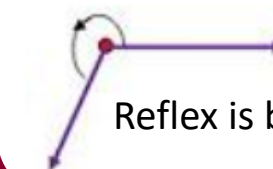
Acute is less than 90°



Obtuse is between 90° and 180°



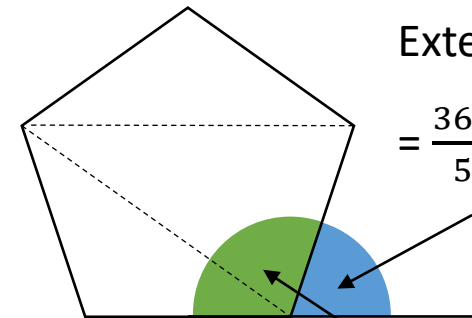
Right angled is 90°



Reflex is between 180° and 360°

Examples

Regular Pentagon



Exterior angles

$$= \frac{360}{5} = 72^\circ$$

$$\begin{aligned} \text{Sum of interior angles} &= (5 - 2) \times 180 \\ &= 540^\circ \end{aligned}$$

$$\text{Interior angle} = \frac{540}{5} = 108^\circ$$

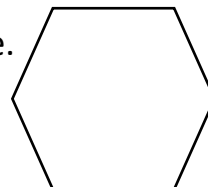
 **Sparx Learning**
U447, U427

Key Words

Polygon
 Interior angle
 Exterior angle
 Acute
 Obtuse
 Right angle
 Reflex

Questions

- 1) Calculate the sum of the interior angles for this regular shape.
- 2) Calculate the exterior angle for this regular shape.
- 3) Calculate the size of one interior angle in this regular shape.



Maths Knowledge Organiser (Set 3 – H)

ANGLE FACTS INCLUDING ON PARALLEL LINES

Key Concepts

Angles in a **triangle** equal **180°**.

Angles in a **quadrilateral** equal **360°**.

Vertically opposite angles are equal in size.

Angles on a **straight line** equal **180°**.

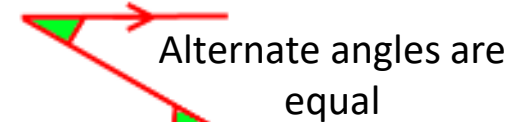
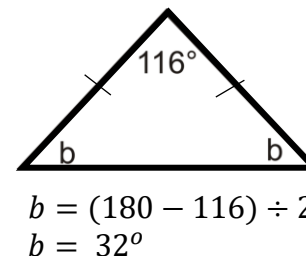
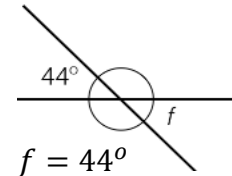
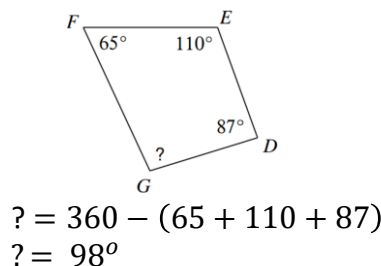
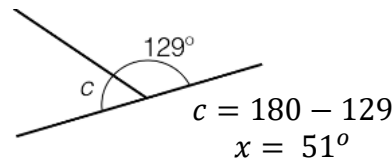
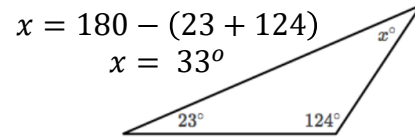
Base angles in an **isosceles triangle** are equal.

Alternate angles are equal in size.

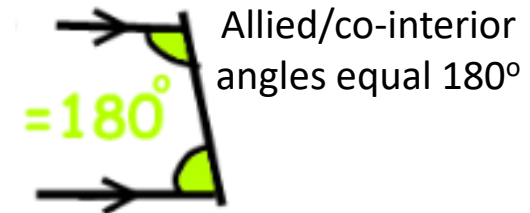
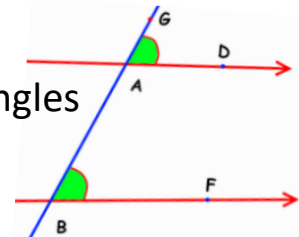
Corresponding angles are equal in size.

Allied/co-interior angles are equal 180°.

Examples



Corresponding angles are equal



Sparx Learning

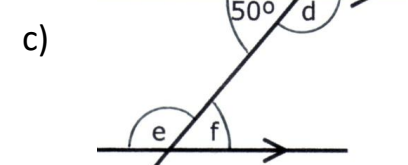
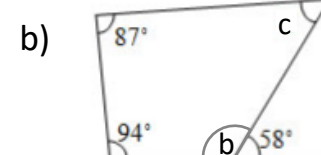
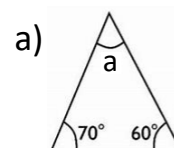
**U390, U730, U826,
U628, U655**

Key Words

Angle
Vertically opposite
Straight line
Alternate
Corresponding
Allied
Co-interior

Questions

Calculate the missing angle:



ANSWERS: 1) a=50° 2) b=122° c=57° 3) d=130° e=130° f=50°

Maths Knowledge Organiser (Set 3 – H)

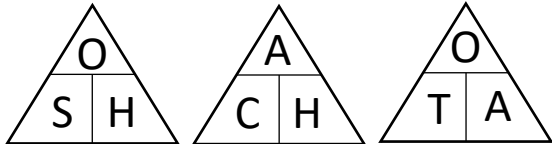
PYTHAGORAS AND TRIGONOMETRY

Key Concepts

Pythagoras' theorem and basic trigonometry both work with **right angled triangles**.

Pythagoras' Theorem – used to find a missing length when two sides are known
 $a^2 + b^2 = c^2$
 c is always the hypotenuse (the longest side)

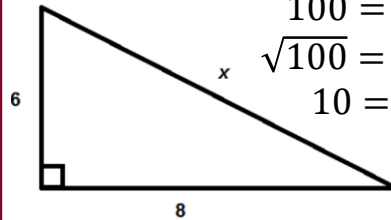
Basic trigonometry SOHCAHTOA – used to find a missing side or an angle



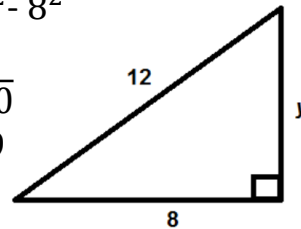
When finding the missing angle we must press **SHIFT** on our calculators first.

Pythagoras' Theorem

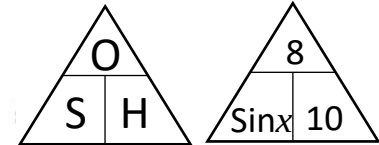
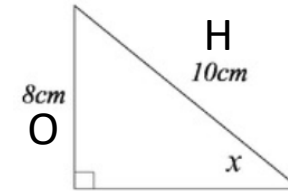
$$\begin{aligned} a^2 + b^2 &= c^2 \\ 6^2 + 8^2 &= x^2 \\ 100 &= x^2 \\ \sqrt{100} &= x \\ 10 &= x \end{aligned}$$



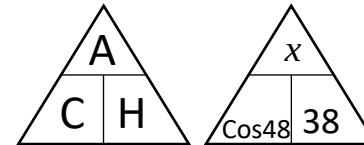
$$\begin{aligned} a^2 + b^2 &= c^2 \\ a^2 + 8^2 &= 12^2 \\ a^2 &= 12^2 - 8^2 \\ a^2 &= 80 \\ a &= \sqrt{80} \\ a &= 8.9 \end{aligned}$$



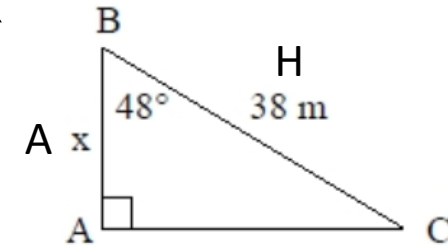
Examples



$$\begin{aligned} \sin x &= \frac{8}{10} \\ x &= \sin^{-1}\left(\frac{8}{10}\right) \\ x &= 53.1^\circ \end{aligned}$$



$$\begin{aligned} \cos 48 &= \frac{x}{38} \\ 38 \times \cos 48 &= x \\ x &= 25.4m \end{aligned}$$



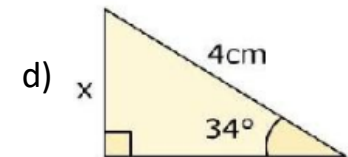
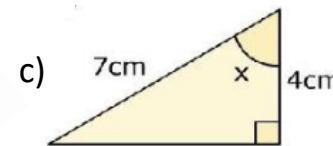
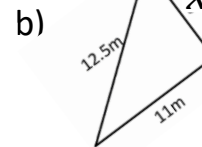
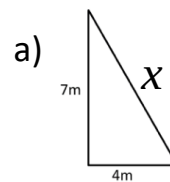
Sparx Learning
 U385, U605, U283,
 U545

DELTA
 Academies Trust

Key Words

Right angled triangle
 Hypotenuse
 Opposite
 Adjacent
 Sine
 Cosine
 Tangent

Find the value of x.



ANSWERS: a) 8.06m b) 5.94m c) 55.15° d) 2.34cm

Maths Knowledge Organiser (Set 3 – H)

FRACTIONS

Key Concepts

Equivalent fractions have the same value as one another.

Eg. $\frac{1}{4} = \frac{2}{8} = \frac{3}{12}$

A number multiplied by it's **reciprocal** gives the answer of 1. Or the reciprocal of a number is 1 over the number.

Eg. $\frac{1}{8}$ is the reciprocal of 8.
 $\frac{2}{5}$ is the reciprocal of $\frac{5}{2}$

$$1\frac{2}{3} + 2\frac{1}{4}$$

$$= \frac{5}{3} + \frac{9}{4}$$

$$= \frac{20}{12} + \frac{27}{12}$$

$$= \frac{47}{12}$$

$$= 3\frac{11}{12}$$

Convert into an improper fraction

Find a common denominator

Convert back into a mixed number

$$2\frac{2}{3} - 1\frac{1}{4}$$

$$= \frac{8}{3} - \frac{5}{4}$$

$$= \frac{32}{12} - \frac{15}{12}$$

$$= \frac{17}{12}$$

$$= 1\frac{5}{12}$$

$$1\frac{1}{3} \times 2\frac{3}{4}$$

$$= \frac{4}{3} \times \frac{11}{4}$$

$$= \frac{44}{12}$$

$$= 3\frac{8}{12}$$

$$2\frac{1}{3} \div 1\frac{3}{5}$$

$$= \frac{7}{3} \div \frac{8}{5}$$

$$= \frac{7}{3} \times \frac{5}{8}$$

$$= \frac{35}{24}$$

$$= 1\frac{11}{24}$$

Examples

Find the reciprocal of the second fraction....

...and multiply

 **Sparx Learning**

U646, U692, U475, U736,
 U793, U224, U475, U224,
 U544, U538

Key Words

Fraction
 Equivalent
 Reciprocal
 Numerator
 Denominator
 Improper/Top heavy
 Mixed number

Calculate:

1) $1\frac{2}{3} + 2\frac{3}{4}$

2) $3\frac{3}{4} - 1\frac{1}{3}$

3) $3\frac{1}{5} \times 1\frac{2}{3}$

4) $1\frac{3}{5} \div 2\frac{7}{10}$

What is the reciprocal of:

5) $\frac{2}{3}$ 7) 0.75

6) 9

ANSWERS A 1) $4\frac{12}{5}$ 2) $2\frac{12}{5}$ 3) $5\frac{1}{16}$ 4) $\frac{27}{16}$ 5) $\frac{3}{2}$ 6) $\frac{1}{9}$ 7) $\frac{4}{7}$

Maths Knowledge Organiser (Set 3 – H)

PERCENTAGE CHANGE AND REVERSE PERCENTAGES

Key Concepts

Calculating percentages of an amount without a calculator:

10% = divide the value by 10
1% = divide the value by 100

Calculating percentages of an amount with a calculator:

Amount $\times$ percentage
as a decimal

Calculating percentage increase/decrease:

Amount $\times$ (1 $\pm$ percentage
as a decimal)

Percentage change:

A dress is reduced in price by 35% from £80. What is its **new price**?

$$\begin{aligned} \text{Value} &\times (1 - \text{percentage as a decimal}) \\ &= 80 \times (1 - 0.35) \\ &= £52 \end{aligned}$$

A house price appreciates by 8% in a year. It originally costs £120,000, what is the **new value** of the house?

$$\begin{aligned} \text{Value} &\times (1 + \text{percentage as a decimal}) \\ &= 120,000 \times (1 + 0.08) \\ &= £129,600 \end{aligned}$$

Reverse percentages: This is when we are trying to find out the original amount.

A pair of trainers cost £35 in a sale. If there was 20% off, what was the **original price** of the trainers?

$$\begin{aligned} \text{Value} &\div (1 - 0.20) \\ &= 35 \div 0.8 \\ &= £43.75 \end{aligned}$$

A vintage car has increased in value by 5%, it is now worth £55,000. What was it worth **originally**?

$$\begin{aligned} \text{Value} &\div (1 + 0.05) \\ &= 55,000 \div 1.05 \\ &= £52,380.95 \end{aligned}$$

Examples

 **Sparx Learning**
U773,
U671, U286

Key Words
Percent
Increase/decrease
Reverse
Multiplier
Inverse

- 1a) Decrease £500 by 6%
- b) Increase 70 by 8.5%
- 2) A camera costs £180 in a 10% **sale**. What was the **pre-sale** price
- 3) The cost of a holiday, including **VAT** at 20% is £540. What is the **pre-VAT** price?

Maths Knowledge Organiser (Set 3 – H)

PERCENTAGES AND INTEREST

Key Concepts

Calculating percentages of an amount without a calculator:

10% = divide the value by 10
1% = divide the value by 100

Per annum is often used in monetary questions meaning **per year**.

Depreciation means that the value of something is going down or reducing.

Examples

Simple interest:

Joe invest £400 into a bank account that pays 3% **simple interest** per annum. Calculate how much money will be in the bank account after 4 years.

$$3\% = £4 \times 3 \\ = £12$$

$$4 \text{ years} = £12 \times 4$$

$$\text{Interest} = £48$$

$$\text{Total in bank account} = £400 + £48 \\ = £448$$

Compound interest:

Joe invest £400 into a bank account that pays 3% **compound interest** per annum. Calculate how much money will be in the bank account after 4 years.

$$\begin{aligned} \text{Value} \times (1 \pm \text{percentage as a decimal})^{\text{years}} \\ = 400 \times (1 + 0.03)^4 \\ = 400 \times (1.03)^4 \\ = £450.20 \end{aligned}$$

 **Sparx Learning**
U533,
U332, U988

Key Words

Percent
Depreciate
Interest
Annum
Simple
Compound
Multiplier

- 1) Calculate a) 32% of 48 b) 18% of 26
- 2) Kane invests £350 into a bank account that pays out simple interest of 6%. How much will be in the bank account after 3 years?
- 3) Jane invests £670 into a bank account that pays out 4% compound interest per annum. How much will be in the bank account after 2 years?

Maths Knowledge Organiser (Set 3 – H)

DIVIDING AN AMOUNT INTO RATIOS

Key Concepts

An amount can be divided into a given ratio.

Red : Green
1 : 3

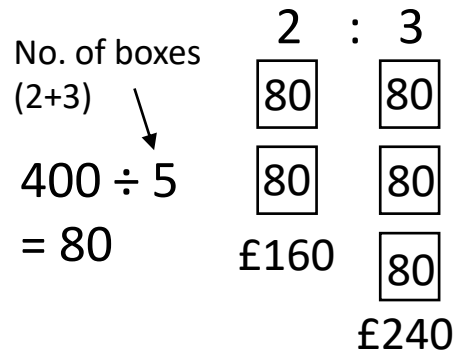
For every 1 red there are 3 greens.

A ratio can be converted into fractions.

Red : Green
1 : 3

$\frac{1}{4}$ are red and $\frac{3}{4}$ are green.

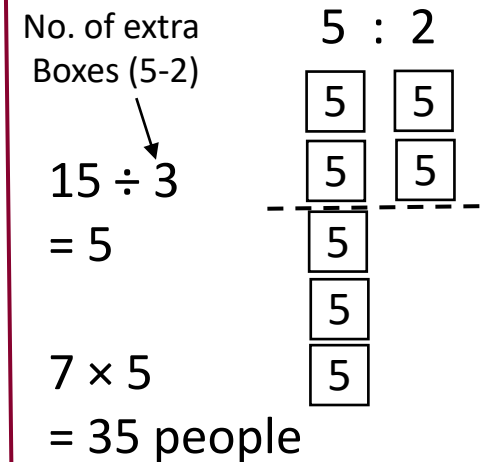
A woman has £400. She is going to split her money between her two children in the ratio 2:3. How much does each child receive?



Child 1 receives £160 and Child 2 receives £240.

There are boys and girls at a party in the ratio 5:2.

There are 15 more boys than girls.
Calculate the number of people at the party.



Examples

 **Sparx Learning**

U687, U176

Key Words

Ratio
Divide
Parts

- Ann made some cakes. She made vanilla cakes and chocolate cakes in the ratio 2:9. What fraction of the cakes were chocolate?
- Share £25 in the ratio 7:3
- Katy and Becky share some money in the ratio 2:1. Katy receives £10 more than Becky. How much do they each receive?
- Claire and John share some money in the ratio 3:2. Claire receives £18. How much does John receive?

ANSWERS 1) $\frac{11}{9}$ 2) £17.50, £7.50 3) £20, £10 4) £12

Maths Knowledge Organiser (Set 3 – H)

RATIO AND DIRECT PROPORTION

Key Concepts

To calculate the **value** for a single item we can use the **unitary method**.

When working with best value in monetary terms we use:

$$\text{Price per unit} = \frac{\text{price}}{\text{quantity}}$$

In recipe terms we use:

$$\text{Weight per unit} = \frac{\text{weight}}{\text{quantity}}$$

If 20 apples weigh 600g. How much would 28 apples weigh?

$$600 \div 5 = 120\text{g} \quad \xrightarrow{\text{weight of 4 apples}}$$

$$7 \times 4 = 28 \text{ apples} \quad 7 \times 120 = \mathbf{840\text{g}}$$

Box A has 8 fish fingers costing £1.40.
Box B has 20 fish fingers costing £ 3.40.
Which box is the better value?



$$A = \frac{£1.40}{8} = £0.175 \quad B = \frac{£3.40}{20} = £0.17$$

Therefore Box B is better value as each fish finger costs less.

Examples

The recipe shows the ingredients needed to make 10 Flapjacks.
How much of each will be needed to make 25 flapjacks?

Ingredients for 10 Flapjacks

80 g rolled oats

60 g butter

30 ml golden syrup

36 g light brown sugar

Method 1: Unitary

$$\begin{array}{ll} 80 \div 10 = 8 & 30 \div 10 = 3 \\ 8 \times 25 = \mathbf{200\text{g}} & 3 \times 25 = \mathbf{75\text{g}} \\ 60 \div 10 = 6 & 36 \div 10 = 3.6 \\ 6 \times 25 = \mathbf{150\text{g}} & 3.6 \times 25 = \mathbf{90\text{g}} \end{array}$$

Method 2: 5 flapjacks

$$\begin{array}{ll} 80 \div 2 = 40 & 30 \div 2 = 15 \\ 40 \times 5 = \mathbf{200\text{g}} & 15 \times 5 = \mathbf{75\text{g}} \\ 60 \div 2 = 30 & 36 \div 2 = 18 \\ 30 \times 5 = \mathbf{150\text{g}} & 18 \times 5 = \mathbf{90\text{g}} \end{array}$$

 Sparx Learning

U753, U921

Key Words

Unitary
Best Value
Proportion
Quantity

Ingredients to make 16 gingerbread men

180 g flour
40 g ginger
110 g butter
30 g sugar

1) How much will we need to make 24 gingerbread men?

2) Packet A has 10 toilet rolls costing £3.50.
Packet B has 12 toilet rolls costing £3.60.
Which is better value for money?

3) If 15 oranges weigh 300g. What will 25 oranges weigh?

Maths Knowledge Organiser (Set 3 – H)

DIRECT AND INVERSE PROPORTION

Key Concepts

Variables are **directly proportional** when the **ratio is constant** between the quantities.

Variables are **inversely proportional** when **one quantity increases in proportion to the other decreasing**.

Examples

Direct proportion:

Value of A	32	P	56	20	72
Value of B	20	30	35	R	45

Ratio constant: $20 \div 32 = \frac{5}{8}$

From A to B we will multiply by $\frac{5}{8}$.

From B to A we will divide by $\frac{5}{8}$.

$$P = 30 \div \frac{5}{8} = 48$$

$$R = 20 \times \frac{5}{8} = 12.5$$

Inverse proportion:

Value of A	10	20	14	R	28
Value of B	14	P	10	70	5

$$P = 7$$

$$R = 2$$

 **Sparx Learning**

U721, U357, U640,
U407, U364, U138

Key Words

Direct
Inverse
Proportion
Divide
Multiply
Constant

Complete each table:

1) Direct proportion

Value of A	5	P	22
Value of B	9	28.8	Q

2) Inverse proportion

Value of A	4	P	18
Value of B	9	3	Q

ANSWERS 1) P = 16, Q = 39.6 2) P = 12, Q = 2

Maths Knowledge Organiser (Set 3 – H)

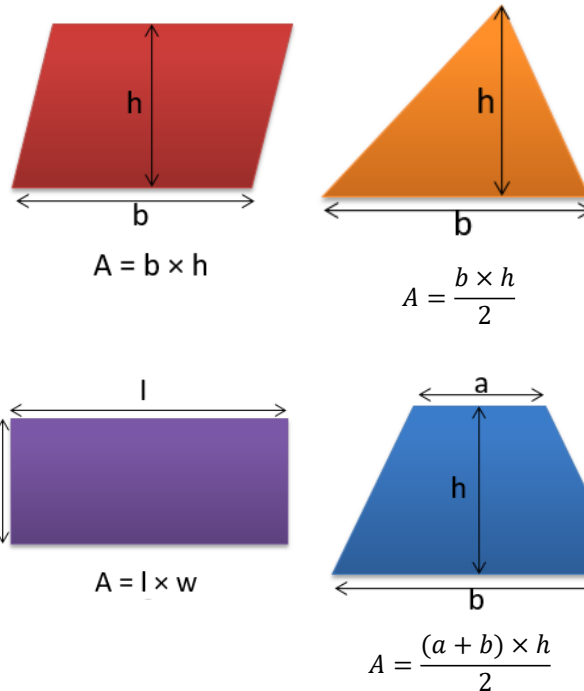
AREA AND PERIMETER OF BASIC SHAPES

Key Concepts

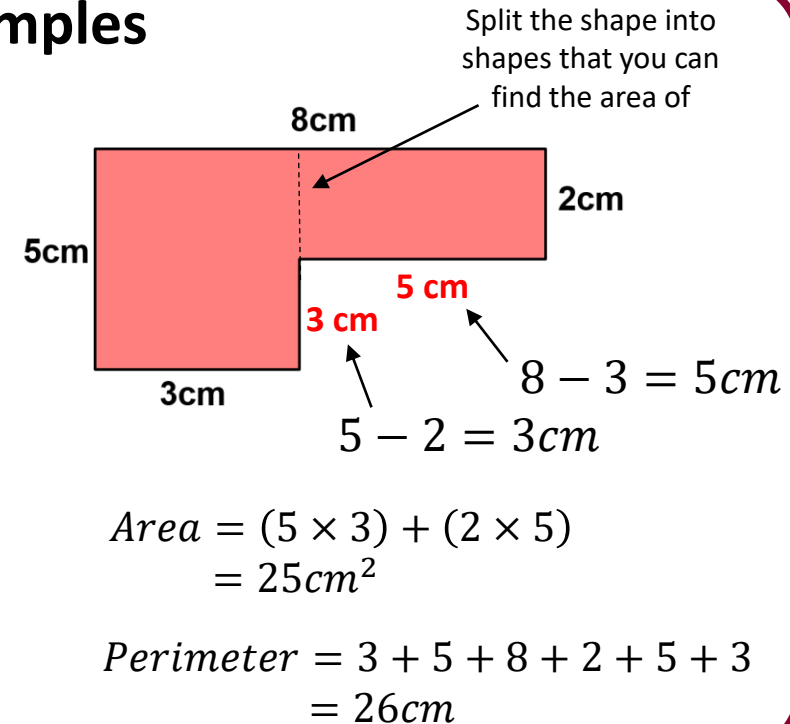
The **area** of a 2D shape is the space inside it. It is measured in units squared e.g. cm^2

The **perimeter** of a shape is the distance around the edge of the shape. Units of length are used to measure perimeter e.g. mm, cm, m

A **compound shape** is a shape made up of others joined together.



Examples



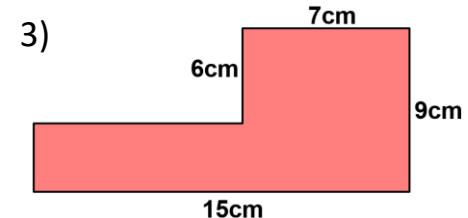
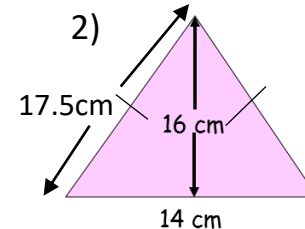
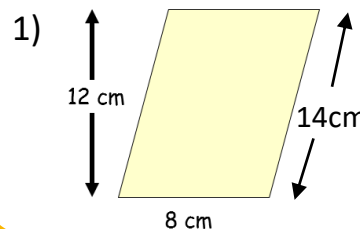
 Sparx Learning

U993, U904

Key words

Area
Perimeter
Base
Height
Width
Length

Calculate the area and perimeter of each shape:



ANSWERS: 1) $A = 96\text{ cm}^2$ $P = 44\text{ cm}$ 2) $A = 112\text{ cm}^2$ $P = 49\text{ cm}$ 3) $A = 87\text{ cm}^2$ $P = 48\text{ cm}$

Maths Knowledge Organiser (Set 3 – H)

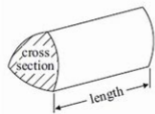
VOLUME AND SURFACE AREA OF PRISMS

Key Concept

The **volume** of an object is the amount of space that it occupies. It is measured in units cubed e.g. cm^3 .

To calculate the volume of any prism we use:

area of cross section $\times$ *length*

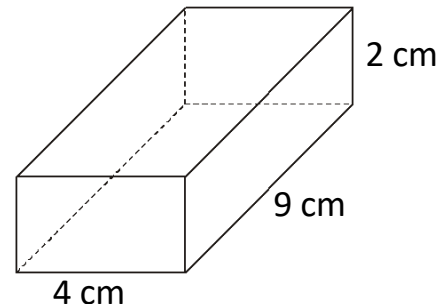


A **prism** is a 3D shape which has a continuous cross-section.

The **surface area** of an object is the sum of all of its faces. It is measured in units squared e.g. cm^2 .

Examples

$$\begin{aligned}\text{Volume} &= 4 \times 9 \times 2 \\ &= 72\text{cm}^3\end{aligned}$$

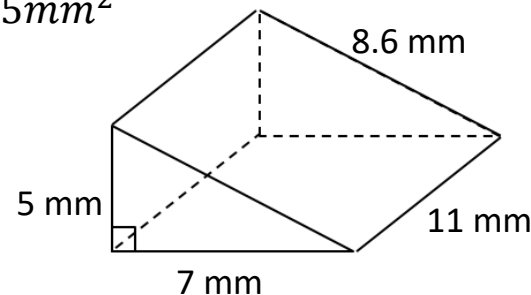


Surface area:

$$\begin{aligned}\text{Front} &= 4 \times 2 = 8 \\ \text{Back} &= 4 \times 2 = 8 \\ \text{Side 1} &= 9 \times 2 = 18 \\ \text{Side 2} &= 9 \times 2 = 18 \\ \text{Bottom} &= 4 \times 9 = 36 \\ \text{Top} &= 4 \times 9 = 36 \\ \text{Total} &= 126\text{cm}^2\end{aligned}$$

$$\begin{aligned}\text{Area of triangle} &= \frac{5 \times 7}{2} \\ &= 17.5\text{mm}^2\end{aligned}$$

$$\begin{aligned}\text{Volume} &= 17.5 \times 11 \\ &= 192.5\text{mm}^3\end{aligned}$$



Surface area:

$$\begin{aligned}\text{Front} &= \frac{7 \times 5}{2} = 17.5 \\ \text{Back} &= \frac{7 \times 5}{2} = 17.5 \\ \text{Side} &= 5 \times 11 = 55 \\ \text{Bottom} &= 7 \times 11 = 77 \\ \text{Top} &= 11 \times 8.6 = 94.6 \\ \text{Total} &= 261.6\text{cm}^2\end{aligned}$$

 **Sparx Learning**

U174, U259

Key Words

Volume

Capacity

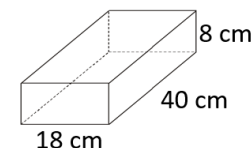
Prism

Surface area

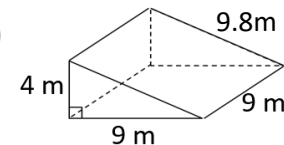
Face

Find the volume and surface area of each of these prisms:

1)



2)



ANSWERS: 1) Volume = 5760 cm^3 Surface area = 2368 cm^2 2) Volume = 162 m^3 Surface area = 241.2 m^2

Maths Knowledge Organiser (Set 3 – H)

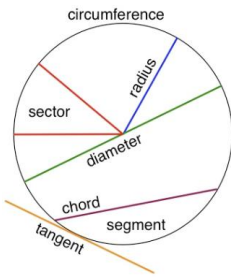
PERIMETER AND CIRCUMFERENCE

Key Concepts

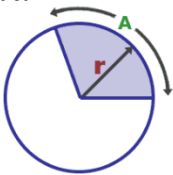
Parts of a circle

Circumference

of a circle is calculated by πd and is the distance around the circle.

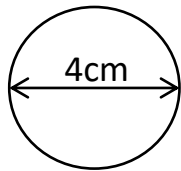


Arc length of a sector is calculated by $\frac{\theta}{360} \pi d$.



Calculate:

a) Circumference



$$C = \pi \times 4$$

$$= 4\pi$$

$$\text{or } = 12.57\text{cm}$$

b) Diameter when the circumference is 20cm

$$C = \pi \times d$$

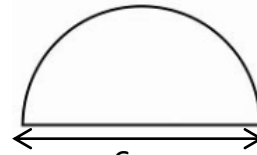
$$20 = \pi \times d$$

$$\frac{20}{\pi} = d$$

$$\text{Or } 6.37\text{cm}$$

Examples

c) Perimeter



$$P = \frac{\pi \times d}{2} + d$$

$$P = \frac{\pi \times 6}{2} + 6$$

$$P = 3\pi + 6$$

$$\text{Or } = 15.42\text{cm}$$

d) Arc length

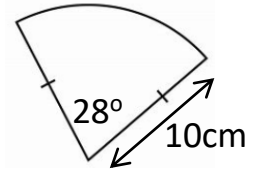
$$\text{Arc} = \frac{\theta}{360} \times \pi \times d$$

$$\text{Arc} = \frac{28}{360} \times \pi \times 2 \times 10$$

$$\text{Arc} = \frac{28}{360} \times \pi \times 20$$

$$\text{Arc} = \frac{14}{9} \pi$$

$$\text{Or } = 4.89\text{cm}$$



 Sparx Learning

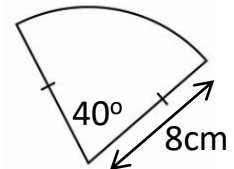
U604, U950, U221

Key Words

Circle
Perimeter
Circumference
Radius
Diameter
Pi
Arc

Calculate:

- 1) The circumference of a circle with a diameter of 12cm
- 2) The diameter of a circle with a circumference of 30cm
- 3) The perimeter of a semicircle with diameter 15cm
- 4) The arc length of the diagram



ANSWERS: 1) 12π or 37.7cm 2) $\frac{\pi}{30}$ or 9.54cm 3) 38.56cm 4) $\frac{9}{16}\pi$ or 5.59cm

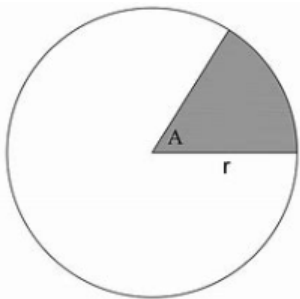
Maths Knowledge Organiser (Set 3 – H)

AREA OF CIRCLES AND PART CIRCLES

Key Concepts

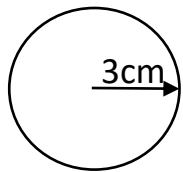
The **area** of a circle is calculated by πr^2

The **area of a sector** is calculated by $\frac{A}{360} \pi r^2$



Calculate:

a) **Area**



$$A = \pi \times 3^2$$

$$= 9\pi$$

$$\text{or} = 28.3\text{cm}^2$$

b) **Radius** when the area is 20cm^2

$$A = \pi \times r^2$$

$$20 = \pi \times r^2$$

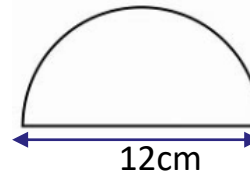
$$\frac{20}{\pi} = r^2$$

$$\sqrt{\frac{20}{\pi}} = r$$

$$\text{Or } 2.52\text{cm}$$

Examples

c) **Area**



$$P = \frac{\pi \times r^2}{2}$$

$$P = \frac{\pi \times 6^2}{2}$$

$$P = 18\pi$$

$$\text{Or } 56.55\text{cm}^2$$

d) **Area of a sector**

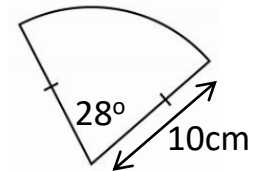
$$\text{Arc} = \frac{\theta}{360} \times \pi \times r^2$$

$$\text{Arc} = \frac{28}{360} \times \pi \times 10^2$$

$$\text{Arc} = \frac{28}{360} \times \pi \times 100$$

$$\text{Arc} = \frac{70}{9} \pi$$

$$\text{Or } = 24.43\text{cm}$$



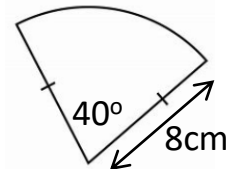
 **Sparx Learning**
U950, U373

Key Words

Circle
Area
Radius
Diameter
Pi
Sector

Calculate:

- 1) The area of a circle with a radius of 9cm
- 2) The radius of a circle with an area of 45cm^2
- 3) The area of a semicircle with diameter of 16cm
- 4) The area of the sector in the diagram



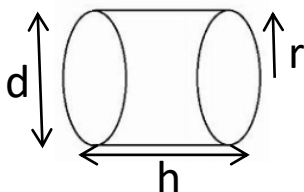
ANSWERS: 1) 81π or 254.47cm^2 2) $\sqrt{\frac{45}{\pi}}$ or 3.78cm 3) 32π or 100.53cm^2 4) $\frac{9}{64}\pi$ or 22.34cm^2

Maths Knowledge Organiser (Set 3 – H)

VOLUME AND SURFACE AREAS OF CYLINDERS

Key Concepts

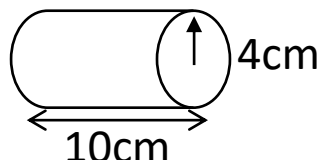
A **cylinder** is a **prism** with the cross section of a circle.



The **volume** of a cylinder is calculated by $\pi r^2 h$ and is the space inside the 3D shape

The **surface area** of a cylinder is calculated by $2\pi r^2 + \pi dh$ and is the total of the areas of all the faces on the shape.

From the diagram calculate:



a) **Volume**

$$V = \pi \times r^2 \times h$$

$$V = \pi \times 4^2 \times 10$$

$$V = 160\pi$$

$$\text{Or} = 502.65\text{cm}^3$$

Examples

b) **Surface Area** – You can use the net of the shape to help you

Area of two circles

$$= 2 \times \pi \times r^2$$

$$= 2 \times \pi \times 4^2$$

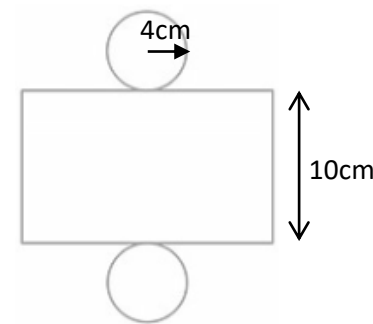
$$= 32\pi$$

Area of rectangle

$$= \pi \times d \times h$$

$$= \pi \times 8 \times 10$$

$$= 80\pi$$



$$\text{Surface Area} = 32\pi + 80\pi$$

$$= 112\pi$$

$$\text{or} = 351.86\text{cm}^2$$

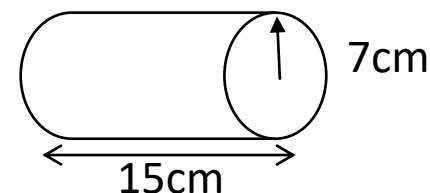
 **Sparx Learning**

U915, U464

Key Words

Cylinder
Surface Area
Radius
Diameter
Pi
Volume
Prism

Calculate the volume and surface area of this cylinder



ANSWERS: Volume = 735π or 2309.07cm^3 Surface area = 308π or 967.61cm^2

Maths Knowledge Organiser (Set 3 – H)

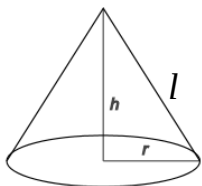
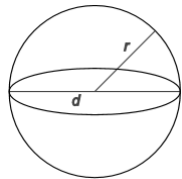
VOLUME AND SURFACE AREA OF CONES, SPHERES AND PYRAMIDS

Key Concepts

In your exam you will be **given** the following formulae to use:

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

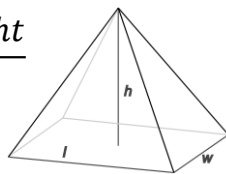


$$\text{Volume of a cone} = \frac{\pi r^2 h}{3}$$

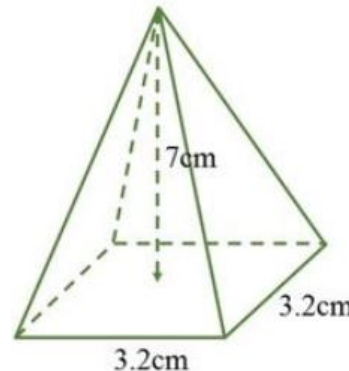
$$\text{Surface area of a cone} = \pi r^2 + \pi r l$$

In your exam you will **need to know** the following formulae:

$$\text{Volume of a pyramid} = \frac{\text{base area} \times \text{height}}{3}$$



Examples



$$\text{Volume of a pyramid} = \frac{(3.2 \times 3.2) \times 7}{3}$$

$$= 23.89\text{cm}^3$$

$$\text{Surface area} = \text{base} + 4 \text{ triangles}$$

$$3.2 \times 3.2 = 10.24\text{cm}^2$$

We will need to find the slanted height to be able to calculate the area of our triangles.

$$\begin{aligned} \text{Slanted height} &= \sqrt{7^2 + 1.6^2} \\ &= \sqrt{51.56}\text{cm} \end{aligned}$$

$$\text{Area of 4 triangles} =$$

$$4 \left(\frac{3.2 \times \sqrt{51.56}}{2} \right) = 45.96\text{cm}^2$$

$$\text{Surface area} = 10.24 + 45.96 = 56.20\text{cm}^2$$

 Sparx Learning

U617, U484,
U116, U523

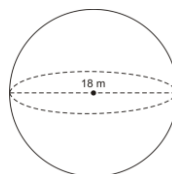
 DELTA
Academies Trust

Key Words

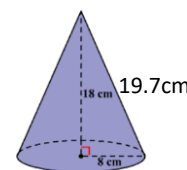
Surface Area
Volume
Sphere
Cone
Pyramid
Radius
Height
Slanted length

Calculate the volume and surface area of:

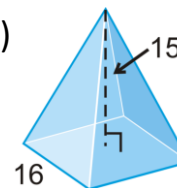
1)



2)



3)



ANSWERS: 1) V = 3053.6cm³ SA = 1017.9cm² 2) V = 1206.4cm³ SA = 696.2cm² 3) V = 1280cm³ SA = 800cm²

Maths Knowledge Organiser (Set 3 – H)

BOUNDARIES

Key Concepts

The boundaries of a number derive from **rounding**.

E.g. State the boundaries of 360 when it has been rounded to 2 significant figures:

$$355 \leq x < 365$$

E.g. State the boundaries of 4.5 when it has been rounded to 2 decimal place:

$$4.45 \leq x < 4.55$$

These boundaries can also be called the **error interval** of a number.

	+	-	×	÷
Upper bound answer	$UB_1 + UB_2$	$UB_1 - LB_2$	$UB_1 \times UB_2$	$UB_1 \div LB_2$
Lower bound answer	$LB_1 + LB_2$	$LB_1 - UB_2$	$LB_1 \times LB_2$	$LB_1 \div UB_2$

A restaurant provides a cuboid stick of butter to each table. The dimensions are 30mm by 30mm by 80mm, correct to the nearest 5mm. Calculate the upper and lower bounds of the volume of the butter.

$$Volume = l \times w \times h$$

$$Upper\ bound = 32.5 \times 82.5 \times 32.5 \\ = 87140.63mm^3$$

$$Lower\ bound = 27.5 \times 77.5 \times 27.5 \\ = 58609.38mm^3$$

Examples

When completing calculations involving boundaries we are aiming to find the greatest or smallest answer.

$$D = \frac{x}{y}$$

$x = 99.7$ correct to 1 decimal place.
 $y = 67$ correct to 2 significant figures.
 Work out an upper and lower bounds for D .

$$Upper\ bound\ D = \frac{99.75}{66.5} = 1.5$$

$$Lower\ bound\ D = \frac{99.65}{67.5} = 1.48$$

 Sparx Learning

U657, U587

Key Words

Bound

Upper

Lower

Accuracy

Rounding

1) Jada has 100 litres of oil, correct to the nearest litre.

The oil is poured into tins of volume 1.5 litres, correct to one decimal place.

Calculate the upper and lower bounds for the number of tins that can be filled.

2) There are 110 identical marbles in a bag. A marble is taken and weighed as 15.6 g to the nearest tenth of a gram. Find the upper and lower bounds for the weight of all the marbles.

ANSWERS: 1) $LB = 69.3 \approx 69$ $UB = 69.7 \approx 70$ 2) $LB = 1710.5$ $UB = 1721.5$ g

Maths Knowledge Organiser (Set 3 – H)

SOLVING QUADRATICS

Key Concepts

We can solve quadratic equations in 4 different ways:

$$ax^2 + bx + c = 0$$

Factorising – put into brackets first

Completing the square

$$\left(x + \frac{b}{2}\right)^2 + c - \left(\frac{b}{2}\right)^2 = 0$$

Quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Graphically

Examples

Factorising:

$$x^2 + 7x + 10 = 0$$

$$(x + 2)(x + 5) = 0$$

$$\text{Either: } x + 2 = 0$$

$$x = -2$$

$$\text{Or: } x + 5 = 0$$

$$x = -5$$

Completing the square – leave your answer in root form:

$$x^2 + 6x + 5 = 0$$

$$\left(x + \frac{6}{2}\right)^2 + 5 - \left(\frac{6}{2}\right)^2 = 0$$

$$(x + 3)^2 + 5 - 3^2 = 0$$

$$(x + 3)^2 - 4 = 0$$

$$\text{Either: } x = \sqrt{4} - 3$$

$$\text{Or: } x = -\sqrt{4} - 3$$

Quadratic formula – give your answer to 2 decimal places:

$$x^2 + 4x - 2 = 0$$

$$x = \frac{-4 \pm \sqrt{4^2 - 4(1)(-2)}}{2(1)}$$

$$x = \frac{-4 \pm \sqrt{16 + 8}}{2}$$

$$\text{Either: } x = 0.45$$

$$\text{Or: } x = -4.45$$

 **Sparx Learning**

**U365, U178, U963,
U397, U665**

Key Words

Solve

Quadratic

Equation

Factorise

Completing the

Square

Quadratic formula

- 1) Solve by factorising: $x^2 + 6x + 8 = 0$
- 2) Solve by completing the square: $x^2 + 8x + 10 = 0$
- 3) Solve by using the quadratic formula: $x^2 + 9x - 1 = 0$

ANSWERS: 1) $x = -2, x = -4$ 2) $x = \sqrt{6} - 4, x = -\sqrt{6} - 4$ 3) $x = 0.11, x = -9.11$

Maths Knowledge Organiser (Set 3 – H)

INEQUALITIES

Key Concepts

Inequalities show the **range** of numbers that satisfy a rule.

$x < 2$ means x is less than 2

$x \leq 2$ means x is less than or equal to 2

$x > 2$ means x is greater than 2

$x \geq 2$ means x is greater than or equal to 2

On a **number line** we use circles to highlight the key values:

○ is used for less/greater than
● is used for less/greater than or equal to

Examples

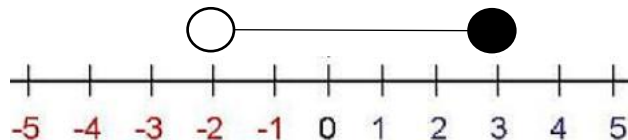
a) State the values of n that satisfy:

$$-2 < n \leq 3$$

Cannot be equal to 2 Can be equal to 3

-1, 0, 1, 2, 3

b) Show this inequality on a number line:



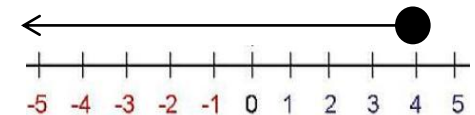
Solve this inequality and represent your answer on a number line:

$$5x - 6 \leq 14$$

$$\begin{array}{cc} +6 & +6 \\ 5x & \leq 20 \end{array}$$

$$\begin{array}{cc} \div 5 & \div 5 \\ x & \leq 4 \end{array}$$

$$x \leq 4$$



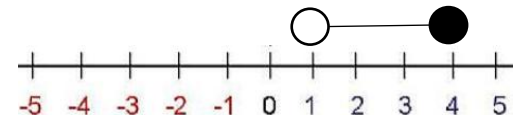
Solve this inequality and represent your answer on a number line:

$$4 < 3x + 1 \leq 13$$

$$\begin{array}{cc} -1 & -1 \\ 3 < 3x & \leq 12 \end{array}$$

$$\begin{array}{cc} \div 3 & \div 3 \\ 1 < x & \leq 4 \end{array}$$

$$1 < x \leq 4$$



*** Sparx Learning**

**U509, U759,
U738, U145**

Key Words

Inequality
Greater than
Less than
Represent
Number line

1) State the values of n that satisfy: $-3 \leq n < 2$

2) Solve $4x - 2 \leq 6$ and represent your answer on a number line

3) Solve $5 < 2x + 3 \leq 9$ and represent your answer on a number line

ANSWERS: 1) -3, -2, -1, 0, 1 2) $x \leq 2$ 3) $1 < x \leq 3$

Maths Knowledge Organiser (Set 3 – H)

SIMULTANEOUS EQUATIONS

Key Concepts

Simultaneous equations are when **more than one equation** are given, which involve **more than one variable**. The variables have the **same value** in each equation.

Two linear equations:

$$\begin{array}{r} 3x + 2y = 18 \\ 3x - y = 9 \quad \times 2 \end{array}$$

$$\begin{array}{r} 3x + 2y = 18 \\ 6x - 2y = 18 \end{array}$$

$$9x = 36$$

$$x = 4$$

Substitute in $x = 4$ into an original equation

$$3x + 2y = 18$$

$$(3 \times 4) + 2y = 18$$

$$12 + 2y = 18$$

$$2y = 6$$

$$y = 3$$

SSS – Same Sign Subtract
DSA – Different Sign Add

One linear and one quadratic equation: Examples

$$x^2 + y^2 = 17$$

$$y = x - 3$$

Substitute $y = x - 3$ into y in the quadratic equation.

$$x^2 + (x - 3)^2 = 17$$

$$x^2 + x^2 - 6x + 9 - 17 = 0$$

$$2x^2 - 6x - 8 = 0$$

Solve by factorising or using the quadratic formula.

$$x = 4 \text{ or } x = -1$$

Substitute the x values into the linear equation to find the corresponding y values.

$$\text{When } x = 4, \quad y = 4 - 3 = 1$$

$$\text{When } x = -1, \quad y = -1 - 3 = -4$$

 Sparx Learning

U760, U757

Key Words

Simultaneous
Substitution
Elimination
Linear
Quadratic

Solve each set of simultaneous equations:

$$\begin{array}{l} 1) \quad 3x + 2y = 4 \\ \quad \quad 4x + 5y = 17 \end{array}$$

$$\begin{array}{l} 2) \quad x^2 + y^2 = 13 \\ \quad \quad x = y - 5 \end{array}$$

ANSWERS: 1) $x = -2$ and $y = 5$ 2) $y = 3$ and $x = -2$, $y = -2$ and $x = -3$

Maths Knowledge Organiser (Set 3 – H)

DISTANCE-TIME GRAPHS

Key Concepts

A **distance-time** graph, plots time against the distance away from a starting point.

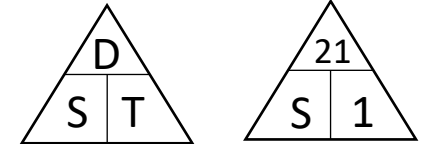
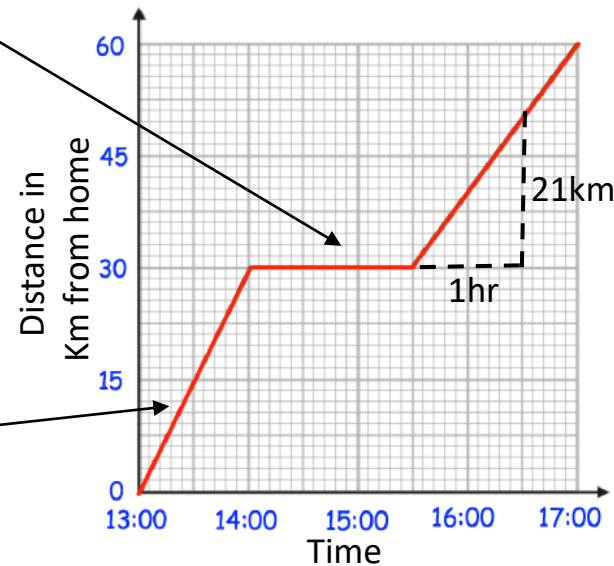
Speed can be calculated from these graphs by finding the gradient of the graph.

Horizontal lines are sections where the object is stationary.

Examples

Horizontal sections are where the object is stationary

Diagonal lines show the object moving away from home or moving closer to home



$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{Speed} = \frac{21}{1}$$

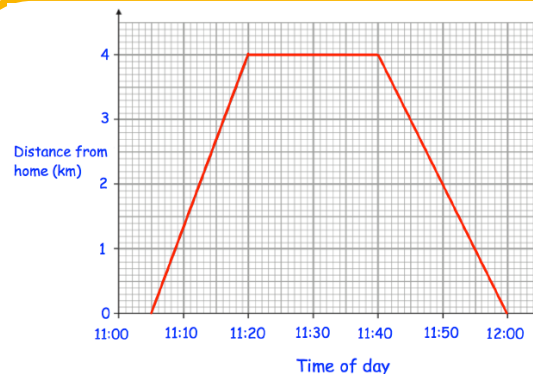
$$\text{Speed} = 21\text{km/h}$$

 Sparx Learning

U914, U403,
U462, U966

Key Words

Distance
Time
Speed
Gradient
Stationary



A distance-time graph shows the journey of someone from home to the shop and back again.

- 1) How long were they at the shop for?
- 2) How far away from home is the shop?
- 3) How far did they travel in total?
- 4) What speed did they travel on the way to the shop in km/h?

Maths Knowledge Organiser (Set 3 – H)

VELOCITY-TIME GRAPHS

Key Concepts

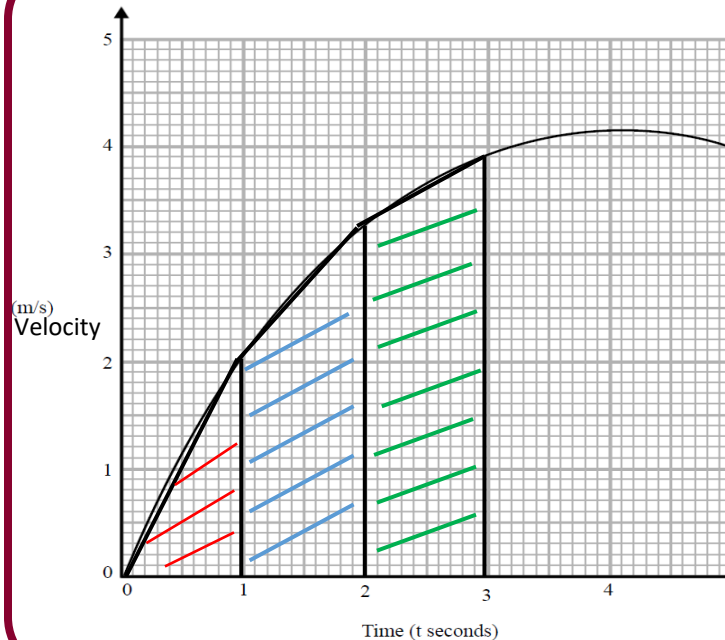
A **velocity-time** graph (or speed-time graph) is a way of visually expressing a journey. With speed or velocity on the y-axis and time on the x-axis.

A velocity-time graph tells us **how someone's speed has changed over a period of time**.

The **distance** completed in the journey can be calculated from the **area underneath the curve**.

 **Sparx Learning**

U800, U882



Examples

Use 3 strips of equal width to find an estimate of the distance travelled in the first 3 seconds.

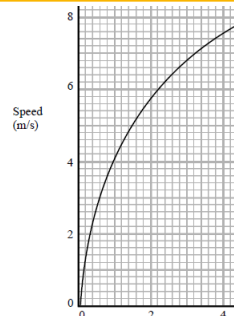
The strips will either be triangles or trapeziums. You will calculate the area of each section separately and combine the answers for the complete distance.

$$\left(\frac{1 \times 2}{2}\right) + \left(\frac{(2 + 3.2) \times 1}{2}\right) + \left(\frac{(3.2 + 3.9) \times 1}{2}\right)$$

$\Rightarrow 7.15m$

Key Words

Velocity
Speed
Distance
Area



Use 2 strips of equal width to find an estimate of the distance travelled in the first 4 seconds.

Maths Knowledge Organiser (Set 3 – H)

STRAIGHT LINE GRAPHS AND EQUATION OF A LINE

Key Concepts

Coordinates in 2D are written as follows:

x is the value that is to the left/right
 y is the value that is to up/down

Straight line graphs always have the equation:

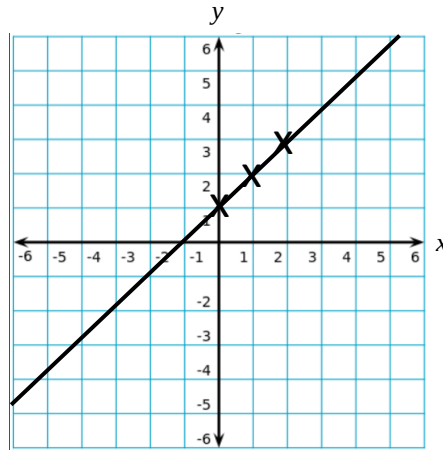
$$y = mx + c$$

m is the **gradient** i.e. the steepness of the graph.

c is the **y intercept** i.e. where the graph cuts the y axis.

Plot the graph of $y = x + 1$

x	0	1	2
y	1	2	3



Examples

Calculate the equation of this line:

$$y = mx + c$$

$$m = \frac{4}{2} = 2$$

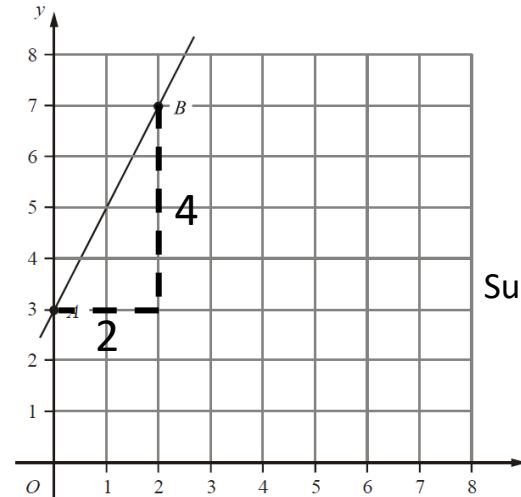
$$y = 2x + c$$

Substitute in a coordinate: (2,7)

$$7 = (2 \times 2) + c$$

$$3 = c$$

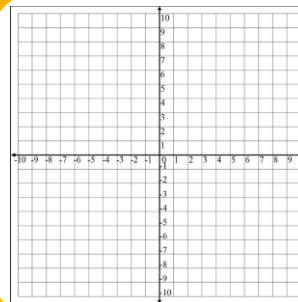
$$y = 2x + 3$$



 **Sparx Learning**

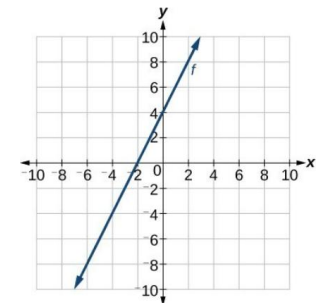
**U789, U933, U741,
U315, U669**

Key Words
Coordinate
Gradient



1) Plot the line $y = 3x - 2$

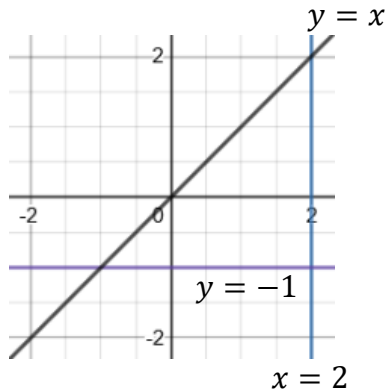
2) Find the equation of the line for the attached graph.



Maths Knowledge Organiser (Set 3 – H)

COORDINATE GEOMETRY

Key Concepts



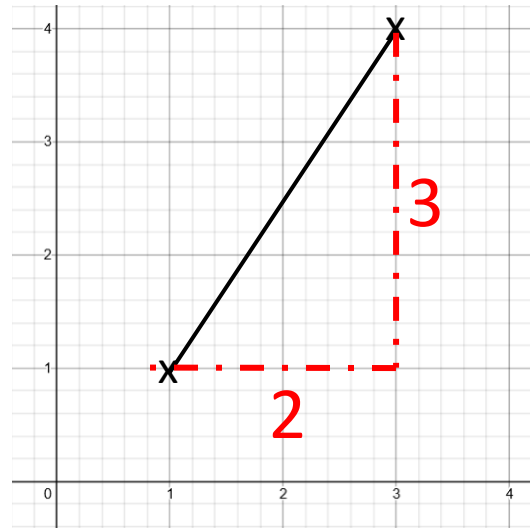
Parallel lines have the same gradient.

e.g. $y = 2x + 3$ and $y = 2x - 1$

Perpendicular line gradients are the negative reciprocal of one another

e.g. $y = 2x$ and $y = -\frac{1}{2}x$

Examples



Calculate the midpoint between the coordinates (1,1) and (3,4).

$$\text{Midpoint} = \left(\frac{3 + 1}{2}, \frac{1 + 4}{2} \right) = (2, 2.5)$$

Calculate the distance between the coordinates (1,1) and (3,4).

$$\text{Length} = \sqrt{2^2 + 3^2}$$

$$= 3.61$$

 **Sparx Learning**

**U933, U848,
U377, U898**

Key Words

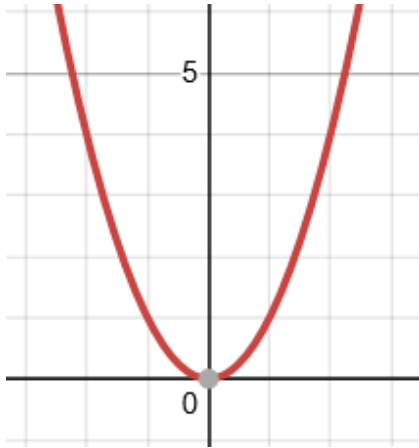
Parallel
Perpendicular
Gradient
Midpoint
Length

- 1) Calculate the midpoint between the coordinates (2,7) and (9,11).
- 2) Calculate the distance between the coordinates (2,7) and (9,11).

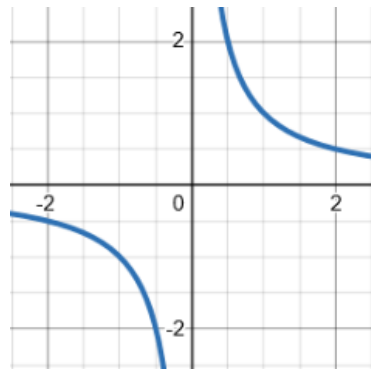
Maths Knowledge Organiser (Set 3 – H)

TYPES OF GRAPH

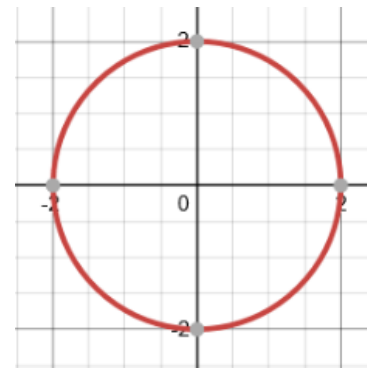
Examples



Quadratic graphs
 $y = x^2$



Reciprocal graphs
 $y = \frac{1}{x}$



Circle graphs
 $x^2 + y^2 = 4$



Cubic graphs
 $y = x^3$

 **Sparx Learning**

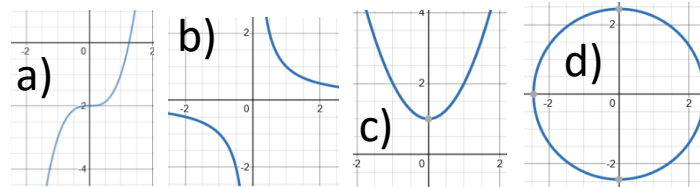
**U667, U980,
U593, U229 U567**

DELTA
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Key Words

Quadratic
Cubic
Reciprocal
Circle
Graph

Match the graph with the correct equation:



- 1) $x^2 + y^2 = 6$
- 2) $y = \frac{1}{x}$
- 3) $y = x^3 - 2$
- 4) $y = x^2 + 1$