

Aiming for Grades 1 to 3

Order of Operations

Order of Operations

Exam Style Questions

Use your calculator to work out the following. Write your answers as decimals.

a) $2.65 \div 0.32$

b) $2.5^2 + \sqrt{5}$

c) $\sqrt{2.5^2}$

d) $\frac{2}{0.07}$

a) Use your calculator to work out the value of $2.65 \div 0.32$.
 $2.65 \div 0.32 = 8.28125$

b) Diana's calculator gave an answer of -4.847717096. Write, in order the buttons Diana may have pressed on her calculator to get this answer.

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Calculations with Negative Numbers

Calculations with Negative Numbers

Here is a list of numbers: -12, -7, -2, 8, 2, 4, 8

a) Write down two numbers from the list that add up to -5.

b) Write down two numbers from the list that have a difference of 15.

c) Write down three numbers from the list that have a product of -96.

d) Use three different numbers from the list to make the following calculation correct:

$$21 \div \text{ } = \text{ } - \text{ } = \text{ }$$

The numbers in the green squares are the product of the numbers in the adjoining purple circles.

Complete the diagram.

Work these out:

a) -5^2 b) $(-5)^2$

c) $(11 - 17)^2$ d) $-5^2 \div (-6)^2$

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Converting Between Metric and Imperial Units

Imperial and Metric Conversions

Standard Conversions

Imperial	Metric
1 inch = 2.54 cm	
1 foot = 30 cm	
1 mile = 1.6 km	

Imperial to Metric

1 pound = 450 g
 22 seconds = 1 min
 1 stone = 6.3 kg

Metric to Imperial

1 gram = 0.001 kg
 1 km = 1000 m
 1 litre = 1.05 quarts

Daniel drives a total of 320 km in 170 minutes. Calculate his speed in miles per hour.

Railay is filling a garden pond from a 14 litre bucket. The garden pond has a capacity of 32 gallons. How many buckets of water are needed to fill the pond?

Michelle is cycling to Valencia, in Spain, when she sees this sign.

She knows her average speed was 30 mph. How long would she expect the journey to take?

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Area and Perimeter of Rectangles

Area and Perimeter of Rectilinear Shapes

Exam Style Questions

The diagram shows Shape A. All the dimensions are in cm.

a) Write an expression for the perimeter of Shape A in terms of y .

b) A square has the same perimeter as Shape A. Write an expression for length of one side of the square.

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Collecting Like Terms

Simplifying Expressions

The diagram shows a rectangle. Write an expression for:

a) perimeter

b) area

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An isosceles triangle is shown. The lengths shown are in centimetres.

Four triangles identical to the one shown can be put together to form a parallelogram like this.

Using algebra, find the perimeter of the parallelogram.

a) Simplify $3a^2 + 3a + 1 + 2a + 4$

b) Simplify $3a^2 + 8b + a^2 - 6b + 2a^2$

c) Simplify $b^2 + 4ab - 2b + ab + 5b^2$

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Problems with Function Machines

Problems with Function Machines

Here is a rule to work out the time it takes to cook a piece of meat:

Weight (kg) $\times 30 =$ Time (mins)

a) Work out the output y when $x = 12$.

b) Write down the input x when $y = 30$.

A piece of meat has a weight of 2.3 kg. a) Work out the time it takes to cook the meat.

It takes 2 hours and 15 minutes to cook a different piece of meat. a) Work out the weight of the piece of meat.

b) Work out x when $y = 7$

c) Work out y when $x = 2$

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Algebraic Products and Brackets

Expanding Brackets

Exam Style Questions

a) Show that $x(x + 5) - (x + 2)(x + 3)$

b) $3(x + 1)(x - 2) - x(x + 1)$ simplifies to $ax + b$. Work out the values of a and b .

c) Write an expression for the shaded area of this shape in the form $ax + b$.

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Highest Common Factors

Factors and Highest Common Factor

Set A = Factors of 24
 Set B = Factors of 18
 Set C = Factors of 40

Which of the numbers from the box are common multiples of the following?

a) 9 and 18 b) 42 and 56

c) 60 and 35 d) 20 and 24

Find the highest common factor of the following.

a) 4 and 14 b) 9 and 27

c) 38 and 65 d) 9, 36, and 45

Complete the Venn Diagram.

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Angle Properties

Angle Properties

The diagram shows a straight line.

Work out the value of z .

Work out the size of angle s .

The diagram shows two isosceles triangles.

a) Work out the value of angle n .

b) Work out the value of the angle p .

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Equivalent Fractions and Mixed Numbers

Equivalent Fractions and Mixed Numbers

Exam Style Questions

a) Write the fraction $\frac{22}{33}$ in its simplest form.

b) Shade $\frac{3}{4}$ of this grid.

c) Arrange the following in ascending order:

$\frac{2}{3}, \frac{7}{6}, \frac{5}{15}, \frac{3}{20}, \frac{9}{4}$

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Powers and Roots

Powers and Roots

Complete the table below without using a calculator.

x	1	2	3	4	5	6	7	8	9	10
x^2										

Evaluate the following without using a calculator.

a) $\sqrt{64}$ b) $\sqrt{3^2 + 4^2}$

c) $\sqrt{5^2 - 3^2}$ d) $\sqrt{13^2 - 12^2}$

Evaluate the following without using a calculator.

a) 2^3 b) 4^3 c) 5^3

d) $\sqrt{16}$ e) $\sqrt{27}$ f) $\sqrt{100}$

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Writing Probabilities

Writing Probabilities

There are 6 counters in a bag. A spinner is shown at random from the bag. Here is a probability scale.

Which letter shows the probability of choosing:

a) green b) blue c) red d) not blue

A bag contains 20 counters. 14 of the counters are blue. A counter is picked at random. What is the probability that it is blue?

A spinner has six equal sections. The spinner is spun. What is the probability of it landing on:

a) blue b) 1 c) not green d) pink and even

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Multiples and Lowest Common Multiple

Multiples and Lowest Common Multiple

List the first 6 multiples of each number:

a) 4 b) 7 c) 8

d) 11 e) 15 f) 21

Which numbers from the box are common multiples of the following:

a) 3 and 4 b) 5 and 4 c) 7 and 8 d) 6 and 5

12, 20, 36, 1, 4, 15, 100, 8, 10, 16, 112, 68, 18, 25, 32

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Volume and Surface Area of Cuboids

Volume and Total Surface Area

A bath is in the shape of a cuboid shown below.

1 litre = 1000 cm³

Water comes out of a tap at a rate of 12.8 litres per minute. At this rate how long will it take to completely fill the bath tub?

A kitchen is in the shape of a cuboid shown below.

The kitchen is going to be redecorated with new paint for the walls and ceiling and new tiling for the floor.

A 12 litre tin of paint covers 20 m² and costs £8.50. 1.5 m² of tiling costs £5.20. Work out the cost of redecorating the kitchen.

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Percentages of an Amount

Non-Calculator Percentage Problems

720 people are asked if they travel to work by car. Some of the results are shown.

- 20% do not travel to work by car.
- 25% of those who do travel by car travel with a colleague.

Complete the frequency tree.

A school plans a coach trip to a free museum. The cost of hiring the coach is £280. The school pays 10% of this cost. The students pay the rest of the cost. Each student pays £3.50. Work out the number of students on the coach trip.

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Balance Method to Solve Two-Step Equations

Solving Equations with the Unknown on One Side

Exam Style Questions

Q1 ABC is an isosceles triangle.

AB = 2x cm, AC = 3(1 + 4x) cm and BC = 45 cm.

Work out the perimeter of the triangle.

Q2 The area of the blue shaded region is 130 cm².

Work out the value of x .

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Constructing Triangles and Circles

Constructing Triangles and Circles

Construct the triangle ABC shown below.

Construct the triangle DEF shown below.

Construct a circle of radius 6.7 cm.

On the circle draw and label a chord.

On the circle draw and label a tangent.

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Fractions of an Amount

Fractions of an Amount

Find the following:

a) $\frac{2}{3}$ of 36 b) $\frac{1}{5}$ of 55 c) $\frac{3}{4}$ of 64

d) $\frac{7}{8}$ of 48 e) $\frac{2}{3}$ of 18 f) $\frac{3}{5}$ of 20

Work out the following:

a) $\frac{2}{3}$ of 34 b) $\frac{1}{11}$ of 45 c) $\frac{2}{5}$ of 18

d) $48 \times \frac{1}{2}$ e) $36 \times \frac{1}{3}$ f) $62 \times \frac{2}{5}$

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Best Value Ratio Problems

Area of 2D Shapes

Area of 2D Shapes

Calculate the area of the following shapes.

A rectangle measures 5 m by 4 m. Part of the rectangle is covered by a square of length 2 m.

Show that 20% of the rectangle is covered by the square.

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Fractions, Decimals and Percentages

Fractions, Decimals and Percentages

Exam Style Questions

Q1 Here are three fractions.

Work out which of the fractions is closer to 75%.

Q2 Write these numbers in order of size. Start with the smallest number.

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Best Value

Buttons are sold loose, or pre-packed in 100 g bags.

The 100 g bags are £1.80 each. The loose buttons are £1.15 for 100 g.

Which is better value?

A shop is running a promotion on cans of body spray.

Body Spray: 3 cans for £4.20, 3 cans for £5.42.

Which is better value?

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Isometric and Elevation Drawings

Isometric & Elevation Drawings

Draw a plan, front elevation and side elevation of the solid on the grid below.

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Adding and Subtracting with Fractions

Adding and Subtracting Fractions

Calculate the following additions. Simplify when possible.

Calculate the following subtractions. Simplify when possible.

Work out the perimeter of the following shapes. Simplify when possible.

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Area of Triangular Shapes

Area of Triangular Shapes

Find the area of the following triangles.

Calculate the base of the following triangles.

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Primes and Prime Factors

Prime Numbers and Prime Factors

Write down all the prime numbers between 15 and 25.

Explain why 51 is not a prime number.

Calculate the product of:

- the largest prime number that is a factor of 42
- and the smallest prime number that is a factor of 100.

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Multiplying with Decimals

Multiplying with Decimals

Exam Style Questions

Michelle takes her 3 children to a show. She has £36 to spend.

Ticket Prices: Adult: £7.50, Child: £3.50

Popcorn Prices: Large: £3.25, Regular: £2.40, Small: £1.80

Michelle buys 1 adult ticket and 3 child tickets.

She buys each child the same size popcorn with the money she has left.

What is the price of largest size popcorn she can buy for each child?

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Averages and Range

Averages and Range

Katie went on a cycling holiday. The table shows how far she cycled each day.

Work out the largest number.

Four numbers are written in order. They have a mode of 3, a mean of 8, a range of 8.

What are the 4 numbers?

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Direct Proportion

Direct Proportion

Match the following ratios to their simplified version.

Christine bought 4 kg of oranges from the supermarket for £1.60.

What is the cost of 7 kg of oranges?

A craft shop sells material by the metre. Michael bought 4 m of fabric for £8.00.

What is the cost of 13 m of the same fabric?

Emma buys 6 pens for £1.02.

How much would 11 pens at the same price cost?

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Pie Charts

Pie Charts

There were four candidates standing for election: Simon, Jo, Clare and James.

Jo received half as many votes as Simon.

Complete the pie chart.

A sports team can either win, lose or draw a game. Here are some results over the course of a season.

Win = $\frac{1}{4}$, Lose = $\frac{1}{2}$

Complete the pie chart.

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Percentage Changes

Percentage Changes

Exam Style Questions

Q1 Michelle buys a car for £24500. In the first year the value of the car decreased by 15%. In the second year the value of the car decreased by 15%.

What was the value of the car at the end of the second year?

Q2 Julian sees a bicycle he wants to buy in two shops.

Shop A: Price without VAT £240, VAT is 20%.

Shop B: Normal price is £320, 8% is added, then £35 is off.

In which shop is the bicycle cheaper?

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Rounding and Estimates

Rounding and Estimates

Round the following numbers to the given decimal places.

Round the following numbers to the given place values.

Round the following numbers to the given significant figures.

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Aiming for Grades 4 to 5

Multiplication with Decimals

Example Style Questions

Q1 Michelle takes her 3 children to a show. She has £30 to spend.

Ticket Prices		Popcorn Prices	
Adult	£7.50	Large	£4.50
Child	£4.00	Regular	£2.50
		Small	£1.50

Michelle buys 1 adult ticket and 3 child tickets.

She buys each child the same size popcorn with the money she has left.

What is the price of largest size popcorn she can buy for each child?

[Work out](#) [Check answer](#)

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Division with Decimals

Example Style Questions

Q1 A church fairs took £100 selling raffle tickets.

Each raffle ticket cost £1.25.

How many raffle tickets were sold?

Q2

a) Work out $\frac{4.2}{0.07}$

b) What is the value of the 5 in the answer to $25.12 \div 100$

[Work out](#) [Check answer](#)

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Written Methods to Solve Worded Problems

Written Methods for Real Life Problems

Q1 Dominique has £5.50 to buy pens and pencils.

Prices	
Pencils	13p each
Pens	45p each

She intends to buy 12 pencils and as many pens as she can afford.

Dominique will spend any money left over on more pencils.

How many pencils will Dominique buy?

Q2 Mr and Mrs Roberts and their 3 children go to a theme park.

Mrs Roberts pays for 2 adult tickets and 3 child tickets.

The price of an adult ticket is £7.50.

The price of a child ticket is half the price of an adult ticket.

Mrs Roberts pays for the tickets with one £20 note and one £10 pound note.

Work out how much change she should get.

[Work out](#) [Check answer](#)

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Plotting Straight Line Graphs

Plotting Linear Graphs

Q1 On the grid, draw the graph of $y = 2x + 5$ for values of x from -2 to 2.

Q2 On the grid, draw the graph of $y = x - 1$ from $x = -2$ to $x = 4$.

[Work out](#) [Check answer](#)

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Rules of Indices

Example Style Questions

Q1 Simplify fully $\frac{25x^6y^4}{5x^2y^2}$

Q2 Simplify $\frac{a^{15}}{a^7 \times a^3}$

Q3 Simplify $(x^2y^3)^4$

Q4 Simplify $(3x^2)^3$

[Work out](#) [Check answer](#)

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Problems with Ratios

Sharing to a Ratio

Purple paint is made by mixing red paint and blue paint in the ratio 5 : 2.

Red paint costs £5.30 per litre.

Blue paint costs £4.60 per litre.

Work out the cost of 42 litres of green paint.

Q2 Concrete is made by mixing cement, sand and gravel in the ratio 1 : 2 : 5.

A builder mixes 416 kg of concrete.

How much gravel does he need?

Q3 A sample of 400 people are chosen.

- 340 people are right handed.
- The ratio of women to men is 11 : 9.
- $\frac{1}{5}$ of them are right handed men.

How many left handed women are there?

[Work out](#) [Check answer](#)

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Substitution into Formulae

Substitution into Formulae

Q1 $P = 3x + 2y$
 $x = 5$ $y = 4$

Work out the value of P .

Q2 $v = u + at$
 $u = 7$ $t = 3$

Work out the value of v .

Q3 $P = 2.5x - y$

Work out the value of P when
a) $x = 11$ and $y = 5$
b) $x = -8$ and $y = -4$

Q4 Here is a formula to convert degrees Celsius ($^{\circ}\text{C}$) to degrees Fahrenheit ($^{\circ}\text{F}$).
 $F = 1.8C + 32$

F is the number of degrees Fahrenheit.
 C is the number of degrees Celsius.

a) Show that $-40^{\circ}\text{C} = -40^{\circ}\text{F}$

The temperature is -12°C .
Arthur says:
"Because the temperature is negative in Celsius, it must be negative in Fahrenheit."
Is he correct?

[Work out](#) [Check answer](#)

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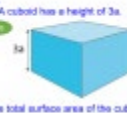
Factorising Expressions

Example Style Questions

Q1 The first 5 terms in a number sequence are
90, 9, 2, -5, -12, ...

a) Work out the n th term of the sequence.

Q2 a) A cuboid has a height of $3a$.



The total surface area of the cuboid is given as $6ab + 6ac + 2bc$ units².

Write an expression for the volume of the cuboid.

b) Find the value of a when
 $30a^2b + 10ab^2 = 90ab + 5$

c) Find the value of b when
 $20a^2b^2 - 11a^2b^2 = 9a^2 - 14a^2$


[Work out](#) [Check answer](#)

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Pythagoras' Theorem

Pythagoras' Theorem

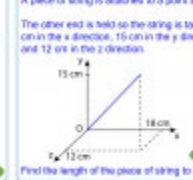
a) Calculate the volume of the prism.



b) The prism has a mass of 2.5 kg.

Calculate the density in g/cm^3 .

Q2 A piece of string is attached to a point at O.



The other end is held so the string is taut.

Find the length of the piece of string to 3 s.f.

[Work out](#) [Check answer](#)

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Expectation and Mutually Exclusive Events

Mutually Exclusive Events

There are 32 counters in a bag. 14 are red, 7 are blue and the rest are orange. A counter is chosen at random.

Work out the probability that it is orange.

Q2 Chocolates come in four flavours.

Flavour	Dark	Milk	White	Mint
Probability	0.2	0.15	0.25	

a) What is the probability that a chocolate chosen at random is mint flavoured?

There are 325 chocolates altogether.

b) How many are milk chocolate flavoured?

c) How many are not dark chocolate flavoured?

Q3 The two possible outcomes of a trial are A, B, C and D.

	A	B	C	D
Probability	0.25	0.3		0.15

What is the probability that the outcome of the trial is C?

[Work out](#) [Check answer](#)

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Nth Term of Arithmetic Sequences

Example Style Questions

Q1 The first 5 terms in a number sequence are given as $T_n - 3$.

a) Work out the first four terms of the number sequence.

b) Work out the n th term of this different number sequence.
7, 12, 17, 22, ...

c) Work out the first number to appear in both number sequences.

Q2 a) A cuboid has a height of $3a$.



The total surface area of the cuboid is given as $6ab + 6ac + 2bc$ units².

Write an expression for the volume of the cuboid.

b) Find the value of a when
 $30a^2b + 10ab^2 = 90ab + 5$

c) Find the value of b when
 $20a^2b^2 - 11a^2b^2 = 9a^2 - 14a^2$

[Work out](#) [Check answer](#)

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Averages from a Grouped Frequency Table

Example Style Questions

The table shows information about the weekly earnings of 25 people who work in a shop.

a) Work out an estimate for the mean of the weekly earnings.

Earnings, £ (E)	Frequency
$180 \leq E < 190$	5
$190 \leq E < 200$	13
$200 \leq E < 210$	7
$210 \leq E < 220$	0
$220 \leq E < 230$	3

Jermaine says:
"The median would have been a better average to represent this data".

b) Do you agree with Jermaine? Explain your decision.


[Work out](#) [Check answer](#)

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Angles in Parallel Lines


Angles in Parallel Lines

Q1 ABC and ADE are straight lines.
GD and AC are parallel.
Angle GDA = 52
Angle FDC = 68



Work out the size of the angle marked y .
Give reasons for your answer.

Q2 ABC and ACD are straight lines.
EB and CD are parallel.
Angle EAB = 29
Angle EDC = 120



Work out the size of the angle marked x .
Give reasons for your answer.

[Work out](#) [Check answer](#)

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Problems with Proportional Reasoning

Applying Equivalent Ratios

The ratio of teachers to students in a school is 3 : 40.

There are 27 teachers in the school.

How many students are there?

Q2 A paint mix uses yellow and blue in a ratio 1 : 12.

How much yellow paint will be needed to mix with 2.4 litres of blue?

Q3 Bethany, Ryan and Ben travel in a car from Liverpool to London.

They share the driving in the ratio 2 : 3 : 5.

Ryan drives 72 miles.

How much further does Ben drive than Bethany?

Q4 Daniel, Michelle and Vicki save some money in the ratio 5 : 3 : 7.

Daniel saved £34 more than Michelle.

Calculate the total money saved.

[Work out](#) [Check answer](#)

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Prime Factors, HCF and LCM

Prime Factors, Highest Common Factor and Lowest Common Multiple

Write each of the following numbers as a product of their prime factors in index form.

a) 18 b) 30 c) 50

d) 72 e) 42 f) 75

g) 360 h) 425 i) 300

Use prime factors to calculate the highest common factor and lowest common multiple of A and B.

$A = 2^3 \times 3 \times 5$ $A = 2 \times 3 \times 5^2$ $A = 2^2 \times 7$

$B = 2^2 \times 3^2$ $B = 2^2 \times 3 \times 5$ $B = 2^2 \times 7^2$


[Work out](#) [Check answer](#)

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Constructing Loci

Constructing Loci

The scale drawing shows the positions of three boats in a sea.



A shipwreck is buried less than 400 metres from A, less than 500 metres from B, nearer to A than to B.

Shade the region where the treasure could be.

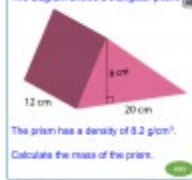
[Work out](#) [Check answer](#)

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Density and Pressure

Pressure and Density


The diagram shows a triangular prism.



The prism has a density of 0.2 g/cm^3 .

Calculate the mass of the prism.

Q2 A cylinder with a height of 60 cm is resting with one of its circular faces on horizontal ground.



The weight of the cylinder is 52 N and it exerts a pressure of 1.2 N/cm² on the ground.

What is the volume of the cylinder?


[Work out](#) [Check answer](#)

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Enlarging Shapes on a Grid

Positive Scale Factor Enlargements on a Grid

Q1 Enlarge triangle ABC by scale factor 4 with centre O.



Q2 Describe fully the single transformation that maps triangle ABC on to triangle PQR.



[Work out](#) [Check answer](#)

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Reverse Percentages

Reverse Percentages

Sharon buys a game costing £45. This cost includes VAT at a rate of 20%. How much is the watch without VAT?

A discount voucher offering 15% off is used to pay a bill. After using the voucher the bill costs £72. How much was the bill before applying the discount voucher?

A group of people sit their driving test and 32 people passed. 80% of the people passed the driving test. How many people sat the test altogether?

Toni competes in a javelin competition. Her second throw of 60 m is a 12% increase on her first throw. How far was her first throw?

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Writing Numbers in Standard Form

Writing Numbers in Standard Form

Exam Style Questions

Q1. a) These numbers are not in standard form. Rewrite them in correct standard form.
 i) 79×10^5 ii) 0.04×10^6 iii) 28×10^2 iv) 150×10^3

b) Evaluate these calculations. Give your answer in standard form.
 i) $(2.5 \times 10^4) \times (3.8 \times 10^3)$ ii) $(4.35 \times 10^3) \times (5.8 \times 10^2)$

iii) $(7.4 \times 10^{-2}) \times (1.3 \times 10^{-3})$ iv) $(7 \times 10^5) \div (4 \times 10^3)$

c) Divide 9400 million by 200. Give your answer in standard form.

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Problems with Simultaneous Equations

Problems with Simultaneous Equations

Exam Style Questions

Solve these simultaneous equations using an algebraic method.
 $4x + 3y = 21$
 $2x + y = 8$

The cost of buying a coffee and two teas in a cafe is £5. The cost of buying two coffees and three teas in the same cafe is £10.25. Work out the cost of buying a coffee and the cost of buying a tea.

Coffee =
 Tea =

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Performing and Describing Transformations

Performing and Describing Transformations

Transformations on a Grid

a) Describe fully the single transformation that maps shape A onto shape B.
 b) Reflect shape A in the line $y = x$.

a) Describe fully the single transformation that maps shape A onto shape B.
 b) Describe fully the single transformation that maps shape B onto shape C.

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Venn Diagrams and Set Notation

Venn Diagrams and Set Notation

There are 25 flowers in a bunch.
 • 16 of the flowers are tulips.
 • 9 of the flowers are yellow.
 • 5 of the flowers are yellow tulips.
 Draw a Venn Diagram to show this information.

135 students are asked if they walk to school (set A) and buses from school (set B). The Venn diagram shows some of the results.

What is the probability that a student chosen at random only walks one way, either to or from school?

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Adding and Subtracting with Fractions

Adding and Subtracting with Fractions

Calculate the following fractions. Leave your answer as a simplified fraction or mixed number.

a) $\frac{1}{2} + \frac{1}{3}$ b) $\frac{2}{3} + \frac{1}{4}$ c) $\frac{1}{2} - \frac{1}{3}$ d) $\frac{2}{3} - \frac{1}{4}$

e) $\frac{1}{2} + \frac{3}{4}$ f) $\frac{1}{2} - \frac{1}{4}$ g) $\frac{3}{4} + \frac{1}{3}$ h) $\frac{3}{4} - \frac{1}{3}$

Calculate the following. Leave your answer as a simplified fraction or mixed number.

a) $2\frac{1}{2} + \frac{1}{3}$ b) $2\frac{1}{2} - \frac{1}{3}$ c) $3\frac{1}{2} + 1\frac{1}{3}$

d) $3\frac{1}{2} - 1\frac{1}{3}$ e) $3\frac{1}{2} + 2\frac{1}{3}$ f) $4\frac{1}{2} - 3\frac{1}{3}$

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Calculations with Standard Form

Calculations with Numbers in Standard Form

Exam Style Questions

Q1 (Calculator)
 $W = \frac{x^2}{y}$
 $x = 4.2 \times 10^3$
 $y = 7.3 \times 10^2$
 Work out the value of W.
 Give your answer in standard form to 3 significant figures.

Q2 (Calculator)
 Volume of Sphere = $\frac{4}{3}\pi r^3$
 The mass of the Earth is 5.972×10^{24} kg. The radius of the Earth is 6371 km.
 The mass of the Sun is 1.989×10^{30} kg. The radius of the Sun is 695 510 km.
 Which has the greater density (g/cm³) the Earth or the Sun?

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Probability Trees and Independent Events

Probability Trees and Independent Events

Isabelle rolls a die and flips a coin.
 a) Work out the probability that she gets a 3 and a tail.
 b) Work out the probability that she gets an even number and a head.

A football team plays two matches. The probability that the team wins is 0.7. The probability that the team will win one match and draw another.

A fair die is tossed twice.

a) Complete the probability tree.
 b) Calculate the probability of tossing a four and then not a two.

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Compound Percentage Changes

Compound Percentage Changes

The cost of DVDs has been falling. Four years ago the average cost of a DVD was £14.95. The average price of a DVD is now £12.95.
 If the price keeps falling at the same rate what will the average price of a DVD be in 3 years time?

A compound annual interest rate of 12% is applied to an investment. After how many years will the original amount have doubled?

Michelle has £5800 to invest in a bank account for 6 years. In which bank should she invest?

ABC Bank
 2% for first 2 years
 0.75% thereafter

Southern Bank
 1.3% for 10 years

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Equation of Straight Line Graphs

Equation of Straight Line Graphs

Write the equation of each line in the form $y = mx + c$.

a)

b)

c)

d)

e)

f)

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Multiplying and Dividing with Fractions

Multiplying and Dividing with Fractions

Exam Style Questions

Q1.
 $x = \frac{1}{2}$, $y = \frac{2}{3}$ and $z = \frac{3}{4}$
 Work out the value of $x \times y$.
 Give your answer as a simplified mixed number.

Q2.
 a) Work out $2\frac{1}{2} \times 3\frac{1}{3}$
 b) Work out $2\frac{1}{2} \times 1\frac{1}{3}$
 c) Work out $1\frac{1}{2} \div \frac{1}{3}$

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Problems with Circular Shapes

Problems with Circles

The diagram shows an equilateral triangle and a circle. The circle is an area of 16π cm². Calculate the shaded area.

The diagram shows an equilateral triangle and a circle. What percentage of the diagram is shaded?

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Trigonometry

Trigonometry (Right-Angled Triangles)

ABCD is a square.
 CX : XB = 3 : 5
 a) Calculate the size of angle CDX.
 b) Calculate the length of CX.

Ernie leaves home and cycles 16 km on a bearing of 220° to a wood. She changes direction and cycles 12 km to a lake which is due South of her home.
 a) On what bearing does she cycle from the wood to the lake?
 b) How far does she have to cycle home?

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Aiming for Grades 5 to 6

Multiplication with Decimal Numbers

Exam Style Questions

Michele takes her 3 children to a show. She has £30 to spend.

Ticket Prices		Popcorn Prices	
Large	£7.00	Large	£1.25
Child	£4.00	Regular	£2.00
		Small	£1.00

Michele buys 1 adult ticket and 3 child tickets. She buys each child the same size popcorn with the money she has left. What is the price of largest size popcorn she can buy for each child?

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Division with Decimal Numbers

Dividing with Decimals

Calculate

a) $6.2 \div 0.2$ b) $1.6 \div 0.4$ c) $0.15 \div 0.3$

d) $6.3 \div 0.09$ e) $0.9 \div 0.03$ f) $1.86 \div 0.06$

g) $3.54 \div 0.4$ h) $15.2 \div 0.4$ i) $10.8 \div 0.12$

Calculate

a) $0.05 \div 30$ b) $5.76 \div 480$ c) $7.15 \div 90$

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Performing and Describing Transformations

Transformations on a Grid

a) Describe fully the single transformation that maps triangle A onto triangle B.
b) Reflect triangle B in the line $y = x$.

a) Enlarge shape A by scale factor 3, centre (4, 5).
b) Describe fully the single transformation that maps triangle A onto triangle B.

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Interior and Exterior Angles of Polygons

Angles with Regular Polygons

For each polygon calculate the (i) interior angle, (ii) exterior angle and (iii) sum of the total interior angles.

a) 5 Sides b) 6 Sides c) 7 Sides

d) 8 Sides e) 9 Sides f) 10 Sides

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Volume of Prisms

Volume of Prisms

A box measures 30 cm by 80 cm by 20 cm. Cartons are arranged so they completely fill the box.

Work out the volume of the prism.

Work out the greatest number of cartons that can fit into the box.

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Writing Numbers in Standard Form

Converting Numbers to and from Standard Form

Write these numbers in standard form.

a) 23×10^7 b) 0.34×10^6 c) 28×10^7 d) 156×10^4

Evaluate these calculations. Give your answer in standard form.

a) $(2.9 \times 10^7) \div (3.8 \times 10^7)$ b) $(4.35 \times 10^7) \div (5.9 \times 10^7)$

c) $(7.4 \times 10^5) \times (1.3 \times 10^5)$ d) $(7 \times 10^5) - (4 \times 10^5)$

Divide 8400 million by 200. Give your answer in standard form.

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Exchange Rates

Exchange Rates

Given that £1 = \$1.65. Convert the following into dollars.

a) £50 b) £100 c) £450

Convert the following into pounds.

d) \$60 e) \$140.25 f) \$412.50

Howard goes on holiday. He changes £500 to euros. The exchange rate is £1 = 1.2 euros. Howard spends 500 euros. How much, in pounds, does he get back?

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Pythagoras' Theorem

Pythagoras' Theorem

a) Calculate the volume of the prism.

b) The prism has a mass of 2.5 kg. Calculate the density in g/cm^3 .

A piece of string is attached to a point at O. The other end is held so the string is taut 18 cm in the x direction, 15 cm in the y direction and 12 cm in the z direction.

Find the length of the piece of string to 3 s.f.

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Scatter Graphs and Correlation

Scatter Graphs and Correlation

The scatter graph shows the number of driving lessons and the number of tests needed to pass by 10 people.

Age (years): 13, 16, 14, 12, 14, 11
Hours of lessons per week: 5.8, 7.2, 6.0, 4.9, 6.6, 3.1
Age (years): 16, 18, 17, 12, 15, 10
Hours of lessons per week: 7.2, 7.4, 3.9, 3.9, 2.3, 2.8

a) Plot the 12 points.
b) What type of correlation is shown.
c) Draw a line of best fit.

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Setting up and Solving Equations

Equations with the Unknown on Both Sides

Exam Style Questions

Q1. Solve the equation $3y - 7 = 4y + 3$.

The diagram shows a rectangle. Work out the area of the rectangle.

Two parallel lines are shown. Work out the value of x .

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Setting up and Solving Inequalities

Solving Inequalities

Exam Style Questions

n is an integer. Write down all the values of n which satisfy $-3 \leq n \leq 2$.

Solve the inequality $2x + 15 \geq 6$. n is a negative integer. Write down all the values of n which satisfy $2x + 15 \geq 6$.

List the integers that satisfy both these inequalities: $2x + n < 0$ and $x \geq -5$.

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Angles in Parallel Lines

Angles in Parallel Lines

Q1) ABC and ADE are straight lines. GD and AC are parallel. Angle GDA = 52. Angle FDE = 68. Work out the size of the angle marked x. Give reasons for your answer.

Q2) ABC and ACD are straight lines. EB and CD are parallel. Angle EAB = 25. Angle BDC = 125. Work out the size of the angle marked x. Give reasons for your answer.

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Sharing to a Ratio

Sharing to a Ratio

Sarah and Clare share £35 in the ratio 3 : 4. Work out how much each person gets.

Michele and Donna share £140 in the ratio 4 : 1. Work out how much more Michele gets, compared to Donna.

The angles in a triangle are in the ratio 3 : 4 : 5. Calculate the size of each angle.

At a sports event, the ratio of children to adults is 2 : 3. A total of 240 children and adults attend the event. Each adult ticket costs £5.00. Each child ticket costs a third of the adult ticket. Work out the total money made from ticket sales.

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Problems with Circles

Problems with Circles

The diagram shows an equilateral triangle and a circle. The circle has an area of $16\pi \text{ cm}^2$. Calculate the shaded area.

The diagram shows an equilateral triangle and a circle. What percentage of the diagram is shaded?

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Compound Percentage Change

Compound Percentage Change

£600 is invested for 3 years at a compound interest rate of 5%. How much is in the account after 3 years?

A car depreciates in value each year by 4%. When new the car cost £24 000. What is the value of the car after 6 years?

£125 000 is invested at a compound interest rate of 3% for 10 years. a) How much interest is earned after 10 years? b) Assuming no withdrawals are made what is the balance of the account after 10 years?

House prices are rising. A terraced house cost £175 000 last year and now costs £180 000. Assume the prices continues to rise at the same rate. How much will the house cost in 5 years time?

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Solving Quadratics by Factorisation

Solving $x^2 + bx + c = 0$ by Factorising

Exam Style Questions

Q3. A triangle has a base of $2x - 10$ cm and a perpendicular height of $x - 4$ cm. The area of the triangle is 12 cm^2 . Work out the length of the base of the triangle.

Q4. Prove $x^2 + 5x + 4$ has no negative solutions.

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Density and Pressure

Pressure and Density

The diagram shows a triangular prism. The prism has a density of 8.2 g/cm^3 . Calculate the mass of the prism.

A cylinder with a height of 80 cm is resting with one of its circular faces on horizontal ground. The weight of the cylinder is 52 N and it exerts a pressure of 1.2 N/cm^2 on the ground. What is the volume of the cylinder?

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Linear Simultaneous Equations

Solving Simultaneous Equations

Exam Style Questions

Solve these simultaneous equations using an algebraic method.

$3x + 2y = 21$
 $2x + y = 8$

The cost of buying a coffee and two teas is £3. The cost of buying two coffees and three teas is £10.25. Work out the cost of buying a coffee and the cost of buying a tea.

Coffee =
Tea =

Two numbers have a sum of 53. Three times the smaller number is the same as 13 more than the larger number. What are the numbers?

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Right-Angled Trigonometry

Trigonometry (Right - Angled Triangles)

ABCD is a square.
 $AX : XB = 3 : 5$
 a) Calculate the size of angle CDX.
 b) Calculate the length of CX.

12 cm

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Sectors and their Formulae

Sectors and their Formulae

The diagram shows a regular hexagon and six sectors. The sides of the hexagon have length 8 cm.

8 cm

Work out the shaded area.

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Reverse Percentages

Reverse Percentages

Shawn buys a game costing €45. This cost includes VAT at a rate of 20%. How much is the watch without VAT?

A discount voucher offering 15% off is used to buy a hat. After using the voucher the hat costs €72. How much was the hat before applying the discount voucher?

A group of people sit their driving test and 32 people passed. 80% of the people passed the driving test. Her second throw of 66 m is a 12% increase on her first throw. How many people sat the test altogether? How far was her first throw?

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Changing the Subject of a Formula

Rearranging Formulae

Here is a formula.
 $m = \sqrt{a^2 - 1}$
 Rearrange the formula to make a the subject.

Here is a formula.
 $y = \sqrt{\frac{p}{4}}$
 a) Calculate the value of y when $p = 162$.
 b) Make p the subject of the formula.

A cylinder of radius r and height h is shown.

a) Write a formula for the total surface area of the cylinder.
 b) Make h the subject.

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Equations with Fractions

Solving Equations Involving Fractions

Exam Style Questions

Q3. Solve the following.
 a) $\frac{m}{2} = 4$
 b) $\frac{2x-3}{5} = \frac{2x+1}{3}$
 c) $\frac{x+2}{3} + \frac{x+1}{2} = 12$

Q4. Solve the following.
 a) $\frac{m}{3} + 3 = 7$
 b) $\frac{2x-2}{3} = x + 3$
 c) $\frac{x}{2} + \frac{x+1}{3} = \frac{x+1}{4}$

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Rules of Indices

Rules of Indices

Exam Style Questions

a) Simplify fully $\frac{32a^8b^4}{4a^2b^2}$
 b) Simplify $\frac{6^{15}}{6^7 \times 6^5}$
 c) Simplify $(4y^{12})^2$
 d) Simplify $(8x^{12})^3$

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Calculations with Standard Form

Calculations with Numbers in Standard Form

Exam Style Questions

Q1 (Calculator)
 $W = \frac{x^2}{y}$
 $x = 4.2 \times 10^5$
 $y = 7.3 \times 10^3$
 Work out the value of W .
 Give your answer in standard form to 3 significant figures.

Q2 (Calculator)
 Volume of Sphere $= \frac{4}{3}\pi r^3$
 The mass of the Earth is 5.972×10^{24} kg.
 The radius of the Earth is 6371 km.
 The mass of the Sun is 1.989×10^{30} kg.
 The radius of the Sun is 695 510 km.
 Which has the greater density (g/cm³) the Earth or the Sun?

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Kinematics Formulae

Kinematics Formulae

SUVAT Equations
 u = Initial Velocity v = final velocity
 a = acceleration t = time
 s = displacement / distance
 $v = u + at$ $s = ut + \frac{1}{2}at^2$
 $v^2 = u^2 + 2as$ $s = \frac{1}{2}(u + v)t$

A car is travelling with an initial velocity of 4 m/s. It accelerates at a constant rate until it reaches a speed of 36 m/s 16 seconds later.
 Calculate the displacement.

A train leaves a station and accelerates at a constant rate of 3.2 m/s^2 for 18 seconds. Find the distance travelled.

A train has an initial velocity of $x \text{ m/s}$. The train accelerates to a speed of $3x \text{ m/s}$ in 42 seconds.
 The train then travels at a constant speed of $3x \text{ m/s}$ for the next 38 seconds.
 Assuming that the acceleration is constant find the total displacement, in terms of x , travelled by the train.

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Probability Trees and Independent Events

Probability Trees and Independent Events

Isabella rolls a die and flips a coin.
 a) Work out the probability that she gets a 2 and a tail.
 b) Work out the probability that she gets an even number and a head.

A football team plays two matches. The probability that the team wins is 0.7. The probability that the team loses is 0.2. Work out the probability that the team will win one match and draw another.

A fair die is tossed twice.

a) Complete the probability tree.
 b) Calculate the probability of tossing a four and then not a two.

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Similar Shapes

Lengths of Similar Shapes

The two triangles are similar.

Work out the value of x .

a) Prove that triangles ABC and ACD are similar.
 b) Find the lengths CB, AD and DC.
 c) Calculate the angles ABC, ACD.

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Equation of Straight Line Graphs

Equation of Straight Line Graphs

Write the equation of each line in the form $y = mx + c$.

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Surds

Surds

Expand and simplify where possible.
 a) $\sqrt{3}(1 - \sqrt{3})$ b) $\sqrt{3}(3 + 2\sqrt{6})$
 c) $2\sqrt{3}(4 - \sqrt{3})$ d) $\sqrt{3}(1 + \sqrt{27})$

A right-angled triangle is shown.

Work out the length y in its exact form.

A cuboid of length $2\sqrt{32} \text{ cm}$ and height $3\sqrt{2} \text{ cm}$ is shown.

The volume of this cuboid is $192\sqrt{2} \text{ cm}^3$.
 Work out the total surface area. Leave your answer in its exact form.

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Nth Term of Linear Sequences

Nth Term of a Sequence

Exam Style Questions

Q3. The first 5 terms in a number sequence are
 16, 9, 2, -5, -12, ...
 a) Work out the n th term of the sequence.
 b) Find the 50th term of the sequence.
 c) Explain whether -33 ever appears in this number sequence.

Q4. The n th term of a number sequence is given as $7n - 3$.
 a) Work out the first four terms of the number sequence.
 b) Work out the n th term of this different number sequence.
 7, 12, 17, 22, ...
 c) Work out the first number to appear in both number sequences.

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Aiming for Grades 7 to 9

Limits of Accuracy and Error Intervals

Error Intervals

Write down the error interval for x when the following are measured to the given level of accuracy.

a) 3.4 (1 d.p.)
b) 12.9 (1 d.p.)
c) 6.24 (2 d.p.)
d) 90 (1 s.f.)
e) 400 (1 s.f.)
f) 1.8 (2 s.f.)

A rectangle has length L and width W .
 $L = 5.4$ cm correct to the nearest mm.
 $W = 5.8$ cm correct to the nearest mm.

a) Calculate the error interval for the perimeter of the rectangle.
b) Calculate the error interval for the area of the rectangle.

$V = 320$ to the nearest 10.
 $W = 5600$ to the nearest 100.
Work out the error interval for V .

Variation

Variation

y is directly proportional to x .
When $x = 15$, $y = 5$.

a) Write a formula for y in terms of x .
b) Calculate the value of y when $x = 7$.
c) Calculate the value of x when $y = 48$.

M is directly proportional to N^2 .
When $N = 8$, $M = 128$.

a) Write a formula for M in terms of N .
b) Calculate the value of M when $N = 9$.
c) Calculate the value of N when $M = 192$.

v varies directly with a .

a	4	15	
v	18		244

Complete the table.

g varies inversely with t .

t	12	8	
g		10	6

Complete the table.

Similarity

Similarity

Two cubes have side lengths in the ratio 1 : 3.

Calculate:

a) the ratio of their surface areas
b) the ratio of their volumes.

The area of Circle A is 20 cm^2 .
The radius of Circle B is double that of Circle A.

Calculate the area of Circle B.

A 500 ml bottle of water is 18 cm tall. A similar bottle is 24 cm tall.

What is the capacity of the larger bottle?

A field has an area of 1.25 km^2 . It is shown on a map by an area of 20 cm^2 .
Calculate the scale of the map.

Drawing and Interpreting Histograms

Drawing and Interpreting Histograms

The histogram shows information about the weight, in kg, of plants in a garden centre.

a) Estimate the number of plants that weigh between 15 kg and 25 kg.
b) Estimate the mean average weight of all the plants.

Indices with Fractional and Negative Powers

Negative and Fractional Indices

Exam Style Questions

a) Find the value of $555 \times 33^{\frac{1}{3}}$.
Write your answer as an ordinary number.

b) Find the value of $(44) \times 125^{-\frac{1}{3}}$.
Write your answer as a simplified fraction in the form $\frac{a}{b}$.

c) Solve $4^x = \frac{1}{32}$.

3D Trigonometry

3D Trigonometry

The diagram shows a triangular prism. EDN and FCB are congruent right-angled triangles. $FCG = 62^\circ$.

Calculate angle ECK.

The diagram shows a triangular prism. M is a point on AB such that $AM : MB = 4 : 5$.

Calculate the size of the angle between EM and the base of the prism.

Conditional Probability

Conditional Probability

A bag contains 3 blue and 2 red sweets. Jo takes a sweet at random and eats it. She then takes another sweet. Work out the probability that Jo takes a sweet of each colour.

A box contains 10 marbles. 4 of them are blue. A marble is taken at random and not replaced. A second marble is taken out of the bag at random. Work out the probability that both marbles are blue.

Some of the children at a birthday party bring a gift.

- 40% of the children at the party are boys.
- 60% of the boys at the party bring a gift.
- 75% of the girls at the party bring a gift.

What is the probability that a child chosen at random brings a gift to the party?

Completing the Square

Solving Quadratics by Completing the Square

Exam Style Questions

Q1. The expression $x^2 - 6x + 6$ can be written in the form $(x - p)^2 + q$ for all values of x .

a) Find the value of p and the value of q .

The graph of $y = x^2 - 8x + 8$ has a minimum point.

a) Write down the coordinates of this point.

Q2. A quadratic graph in the form $y = x^2 + bx + c$ has a minimum turning point of $(2, -4)$.

Work out the values of b and c .

Functions and Composite Functions

Functions and Composite Functions

For all values of x , $f(x) = (x + 1)^2$.
Find:
a) $f(2)$
b) $f(-3)$
c) $f(2x)$
d) $f(-3x)$

$g(x) = 5 - 2x$, $g(x) = x^2 + 3$

Work out:
a) $g(4)$
b) $g(7)$
c) $fg(4)$
d) $fg(7)$
e) $fg(x)$
f) $g(2x)$

Hence solve $f(x) = g(x)$.

Sine and Area Rules

Sine and Area Rule

The diagram shows a triangle ABC.

Use the information given to calculate the length of BC.

Port B is 18 m north of Port A. Port C lies 20 m from Port B, on a bearing of 064° from A. Find the bearing of Port C from Port B, to the nearest degree.

Find the area of the triangle.

Expanding Cubic Expressions

Expanding Cubic Expressions

Expand and simplify:

a) $x(x - 2)(x + 5)$
b) $(x^2 + 3x - 5)(x + 4)$

Expand and simplify the following:

a) $(x + 2)^3$
b) $(2x + 3)^3$
c) $(4 - 3x)^3$

Shown below is a cuboid.

Form and simplify an expression for the volume of the cuboid.

Parallel and Perpendicular Gradients

Parallel and Perpendicular Gradients

The straight line L_1 has equation $y = 3x + 2$. The straight line L_2 is parallel to L_1 and passes through the point $(5, -1)$. Find the equation of line L_2 .

Line L_1 has the equation $12x - 6y = 5$.

a) Circle the equation of the line that runs parallel to line L_1 .
 $4y = 5 - 8x$ $4y = 8x - 5$

b) Circle the equation of the line that runs perpendicular to line L_1 .
 $8y = 4x + 5$ $8y = 5 - 4x$

On the grid below, the lines L_1 and L_2 are drawn.

Are the lines L_1 and L_2 perpendicular? Explain your answer.

Sine, Cosine and Area Rules

Sine, Cosine and Area Rule

Michelle walks 4.3 miles on a bearing of 138° . She then walks 7.8 miles on a bearing of 250° .

a) Calculate how far Michelle is from the point where she started.

b) Find, as a bearing, the direction in which Michelle would have to walk to return to where she started.

The diagram shows triangle ABC in which $AB = 10.5$ cm, $AC = 11.2$ cm and $BC = 9.5$ cm.

Find the area of the triangle to 3 significant figures.

Rearrange Complex Formulae

Rearranging Complex Formulae

Make a the subject of:

$$W = \frac{ab}{a + b}$$

$a = at^2$ $y = 3at$

a) Write a formula for a in terms of b and W .

b) Write a formula for y in terms of t and x .

Rearrange the formula:

$$a = x + \frac{y}{1 + y}$$

to make g the subject.

Rearrange the formula:

$$\frac{1}{7} = \frac{1}{u} + \frac{1}{v}$$

to make u the subject.

Area Under Non-Linear Graphs

Estimating the Area Under a Graph

Here is a speed-time graph for a projectile.

Work out an estimate for the distance travelled.

The velocity-time graph represents a journey.

a) Estimate the total distance travelled.
b) State whether this is an under or over-estimate.

Algebraic Proof

Algebraic Proof

Prove that:
 $(2n + 1)^2 - (2n - 1)^2$
 is always a multiple of 8.

Prove that:
 $(2n + 3)^2 - (2n - 3)^2$
 is a multiple of 24.

Prove that the sum of three consecutive even numbers is always a multiple of 6.

Prove that:
 $(n + 1)^2 - (n - 1)^2$
 is always even.

Prove that the sum of the squares of two consecutive even numbers is always a multiple of 4.

Prove that the sum of the squares of two consecutive odd numbers is always a multiple of 2.

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Trigonometric Graphs and Equations

Trigonometric Graphs and Equations

Here is a graph of $y = \sin x$ in the range $-360 \leq x \leq 360$.

a) Write down the coordinates of A.
 b) Write down the coordinates of B.
 c) Write down the coordinates of C.

Here is the graph for $y = 4\cos 3x$ for $0 \leq x \leq 360$.

a) How many solutions are there for $2 = 4\cos 3x$ in the range $0 \leq x \leq 360$?
 b) Given that $\cos 60 = 0.5$ solve $2 = 4\cos 3x$

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Solving $ax^2 + bx + c = 0$ by Factorisation

Solving Equations in the form $ax^2 + bx + c = 0$ Using Factorisation

Exam Style Questions
 A rectangle has a length of $3x + 1$ cm and a width of $2x + 5$ cm. The area of the rectangle is 8 cm^2 .

$(2x + 5)(3x + 1) = 8$

a) Show that $6x^2 + 17x - 3 = 0$

b) Work out the value of x .

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Gradients of Curves

Gradients of Curves

The graph of $y = \frac{1}{x}$ is shown.

Estimate the gradient of the graph at:
 a) $x = -3$
 b) $x = 1$

Find the gradient of the curve when $x = 5$.

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Non-Linear Sequences

Non-Linear Sequences

Here are the first three diagrams in a pattern.

a) How many dots will there be in the 25th pattern?
 b) Is it possible to have a diagram in this pattern with 82 dots?

The second and third terms of a geometric progression are 2 and 18. Find the sum of the first 5 terms of the sequence.

The sum of the first four terms of a geometric progression is 195 and its common ratio is 1.5.

a) Find the first term of the progression.
 b) Find the sixth term of the progression.

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Inverse Functions

Inverse & Composite Functions

$f(x) = x^2$
 $g(x) = x - 3$

Solve the equation $gf(x) = g^{-1}(x)$

Two functions f and g are defined as:
 $f: x \mapsto 1 + \frac{1}{x}$ for $x > 0$
 $g: x \mapsto \frac{x-1}{2}$ for $x > 0$

Given that $h = fg$, express the inverse function h^{-1} in the form $h^{-1}: x \mapsto \dots$

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Simplify Algebraic Fractions

Simplifying Algebraic Fractions

Show that:
 $\frac{a^2 - 9}{a^2 - 3a}$
 can be written in the form $\frac{a+b}{a-c}$ where a and b are integers to be found.

Simplify fully:
 $\frac{a(a-3)^2}{a(a-3)(a+2)}$

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Spheres, Cones and Pyramids

Spheres, Cones & Pyramids

The diagram shows a hemisphere and a square based pyramid.

The volume of hemisphere is equal to the volume of the square based pyramid.

Work out the perpendicular height of the square based pyramid to 1 decimal place.

The diagram shows a solid cone with radius 2.0 cm and slant height 6.3 cm. A sphere has the same total surface area of the cone.

Calculate the volume of the sphere correct to 3 significant figures.

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Geometrical Proof

Geometric Proof

ABCD is a regular pentagon. A, B, C, D are points along the circumference of a circle.

BO and AC are straight lines. OB = OC.

Prove that triangles ABE and ABC are congruent.

Prove BD is not the diameter of the circle.

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Calculations with Surds

Calculations with Surds

Find the exact value of the total surface area of the sphere shown.

Give your answer in the form $a\pi$ where a and b are integers to be found.

$3\sqrt{2} + 2\sqrt{5} \text{ cm}$

Challenge 1:
 $a = \sqrt{3} \cdot \sqrt{7}$
 $b = \sqrt{45} \cdot \sqrt{49}$
 Given that $x:y$ is in the ratio 1:9. Find the ratio $a:b$.

Challenge 2:
 $a = \sqrt{12} \cdot \frac{\sqrt{5}}{2}$
 $b = \sqrt{182} \cdot \sqrt{7}$
 Given that $x:y$ is in the ratio 1:4. Find the ratio $a:b$.

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Transforming Functions

Graphs of Functions

The graph of $y = \cos x$ has been transformed to give $y = \cos(x + b)$.

Work out the values of a and b .

The graph of $y = \sin x$ has been transformed to give $y = \sin(x + c)$.

Work out the values of a , b and c .

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Equations with Algebraic Fractions

Equations with Algebraic Fractions

$f(x) = \frac{7}{x-3}$, $g(x) = \frac{6}{x+1}$

Solve the equation:
 $f(x) + g(x) = 1$
 give your solutions as surds.

Solve:
 $1 - \frac{10}{x^2} = \frac{3}{x}$

Solve:
 $\frac{2}{x-3} + \frac{x}{x+1} = 1$

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Circle Theorems

Circle Theorems

Points A, B, C and D lie on the circumference of a circle. Lines AC and BD intersect at E. AC is the diameter of the circle.

Work out the size of angle DAC.

The diagram shows a circle, centre O. The straight line AD is a tangent to the circle at point D.

Work out the value of x .

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Vectors and Geometry

Vectors

In triangle OAB, M is the midpoint of AB. OM = a and OB = b.

Find OM in terms of a and b . Give your answer in its simplest form.

OABC is a parallelogram. M is the midpoint of OB. OM = 2a and OC = 2b.

a) Express OM in terms of a and b .
 b) Prove M is the midpoint of AC.

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Setting Up and Solving Quadratics

Setting Up and Solving Quadratics using the Formula

Exam Style Questions
 The diagram shows a piece of metal pipe. The volume of the pipe is $2880\pi \text{ cm}^3$.

Work out the value of x .

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Linear and Quadratic Simultaneous Equations

Quadratic and Linear Simultaneous Equations

Solve the simultaneous equations:
 $y = 2x$
 $y = x^2 - 5x + 8$
 Do not use a method of trial and improvement.

Solve the simultaneous equations:
 $y = x^2 - x - 1$
 $y = 3 - 3x$
 Do not use a method of trial and improvement.

The diagram shows the graph of $y = 2x^2 + x - 2$ and $y = x - 5$.

Find the coordinates of the points where the two graphs intersect.

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