National Curriculum for Mathematics 2014

Exemplification of the Programmes of Study for

YEAR 6

This document brings together the exemplification materials that are available on the NCETM website. Where there were gaps on the website, we have included other examples from past SATs papers and NCETM Mastery documents.

fluency, reasoning and problem-solving

Contents

Purpose of study

Mathematics is a creative and highly inter-connected discipline that has been developed over centuries, providing the solution to some of history's most intriguing problems. It is essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment. A high-quality mathematics education therefore provides a foundation for understanding the world, the ability to reason mathematically, an appreciation of the beauty and power of mathematics, and a sense of enjoyment and curiosity about the subject.

Aims

The national curriculum for mathematics aims to ensure that all pupils:

become **fluent** in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately.

reason mathematically by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language

can **solve problems** by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions.

Mathematics is an interconnected subject in which pupils need to be able to move fluently between representations of mathematical ideas. The programmes of study are, by necessity, organised into apparently distinct domains, but pupils should make rich connections across mathematical ideas to develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems. They should also apply their mathematical knowledge to science and other subjects.

The expectation is that the majority of pupils will move through the programmes of study at broadly the same pace. However, decisions about when to progress should always be based on the security of pupils' understanding and their readiness to progress to the next stage. Pupils who grasp concepts rapidly should be challenged through being offered rich and sophisticated problems before any acceleration through new content. Those who are not sufficiently fluent with earlier material should consolidate their understanding, including through additional practice, before moving on.

The School Curriculum

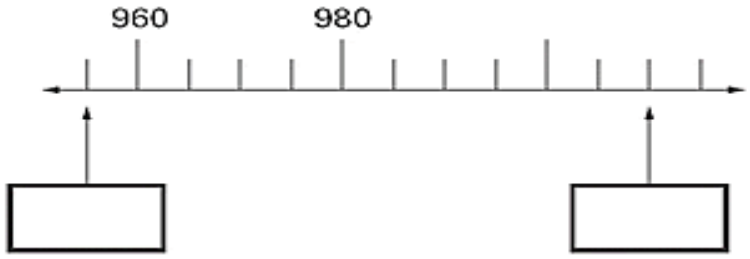
The programmes of study for mathematics are set out year-by-year for key stages 1 & 2. Schools are, however, only required to teach the relevant programme of study by the end of the key stage. Within each key stage, schools therefore have the flexibility to introduce content earlier or later than set out in the programme of study.

YEAR 6 - NUMBER & PLACE VALUE

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

read, write, order and compare numbers up to 10 000 000 and determine the value of each digit

Children should be able to determine the steps used in different scales, and so complete activities such as -



round any whole number to a required degree of accuracy

Children should be able to circle the best estimate of the answer to questions such as;

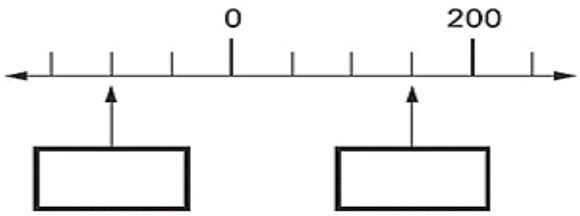
72.34 ÷ 8.91

When given 6 7 8 9 10 11 as possible answers

Children should **estimate** the position of numbers on a number line. They should suggest which number lies about two-fifths of the way along a line from 0 to 1000, or a line from 0 to 1. They should be able to justify their decisions.

use negative numbers in context, and calculate intervals across zero

Children should be able to work with negative numbers in a similar way, determining values on a scale and estimating.



solve number and practical problems that involve all of the above

Children should be able to use rounding and inverse operations to estimate and check calculations such as;

The temperature inside an aeroplane is 20°C The temperatures outside the aeroplane is -30°C. What is the difference between these temperatures?

YEAR 6 - ADDITION & SUBTRACTION

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why

Two numbers have a difference of 1.583

One of the numbers is 4.728.

What is the other? Is this the only answer?

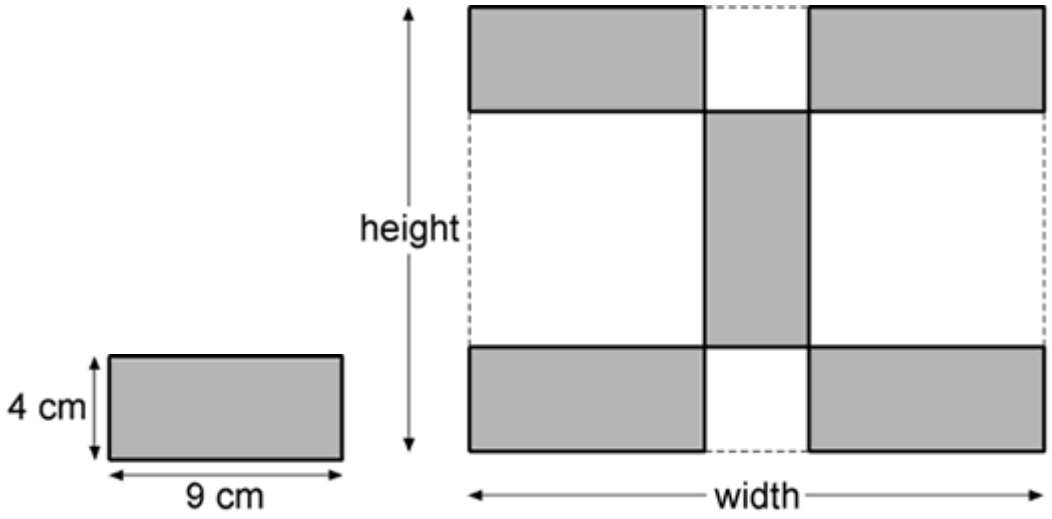
solve problems involving addition, subtraction, multiplication and division

use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy

Identify subtractions they can do without writing anything down

Identify why it is possible to solve a calculation mentally, explain the clues they looked for and then solve it

- Peter has £10. He buys 3 kg of potatoes at 87p per kg and 750 g of tomatoes at £1.32 per kg. How much money does he have left?
- Each tile is 4 centimetres by 9 centimetres.



Calculate the width and height of the design.

Write down the calculations that you did

YEAR 6 - MULTIPLICATION & DIVISION

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

multiply multi-digit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication

Look at long-multiplication calculations containing errors, identify the errors and determine how they should be corrected.

Solve word problems such as:

- Printing charges for a book are 3p per page and 75p for the cover. I paid £4.35 to get this book printed. How many pages are there in the book? Write down the calculations that you did. Seeds are £1.45 for a packet. I have £10 to spend on seeds. What is the greatest number of packets I can buy?

divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context

- Every day a machine makes 100 000 paper clips, which go into boxes. A full box has 120 paper clips. How many full boxes can be made from 100 000 paper clips?

  Each paper clip is made from 9.2 centimetres of wire. What is the greatest number of paper clips that can be made from 10 metres of wire?

- A DJ has two different sized storage boxes for her CDs. Small boxes hold 15 CDs. Large boxes hold 28 CDs. The DJ has 411 CDs. How could the DJ pack her CDs?

solve problems involving multiplication and division

use estimation to check answers to calculations and determine, in the context of a problem, levels of accuracy

Children should be able to:

- Give the best approximation to work out 4.4 × 18.6 and explain why. Answer questions such as: roughly, what answer do you expect to get? How did you arrive at that estimate? Do you expect your answer to be greater or less than your estimate? Why?

perform mental calculations, including with mixed operations and large numbers

- Use mental strategies to calculate in their heads, using jottings and/or diagrams where appropriate. For example, to calculate 24 × 15, they multiply 24 × 10 and then halve this to get 24 × 5, adding these two results together. They record their method as (24 × 10) + (24 × 5). Alternatively, they work out 24 × 5 = 120 (half of 24 × 10), then multiply 120 by 3 to get 360.

identify common factors, common multiples and prime numbers

Children should be able to answer questions such as:

- How can you use factors to multiply 17 by 12?
- Start from a two-digit number with at least six factors, e.g. 72. How many different multiplication and division facts can you make using what you know about 72? What facts involving decimals can you derive?
- What if you started with 7.2? What about 0.72?
- Which three prime numbers multiply to make 231?
- use their knowledge of the order of operations to carry out calculations involving the four operations

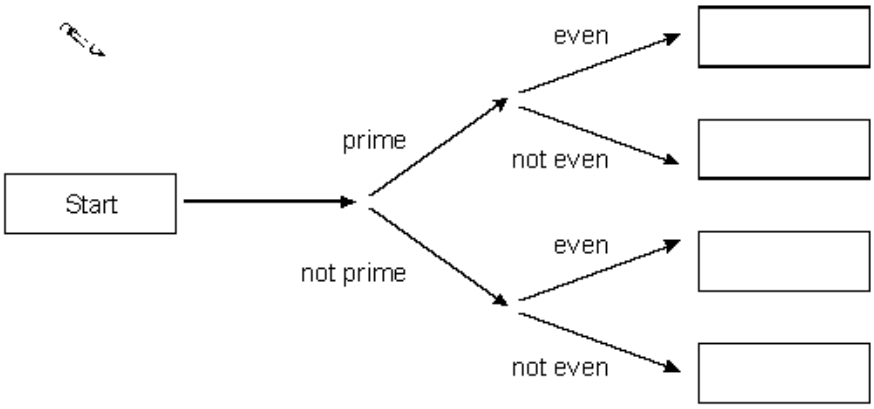
Children should be able to find answers to calculations such as 5.6 ☐ = 0.7 or 3 × 0.6, drawing on their knowledge of number facts and understanding of place value. They should be able to approximate, use inverses and apply tests of divisibility to check their results.

Children should know the square numbers up to 12 × 12 and derive the corresponding squares of multiples of 10, for example 80 × 80 = 6400.

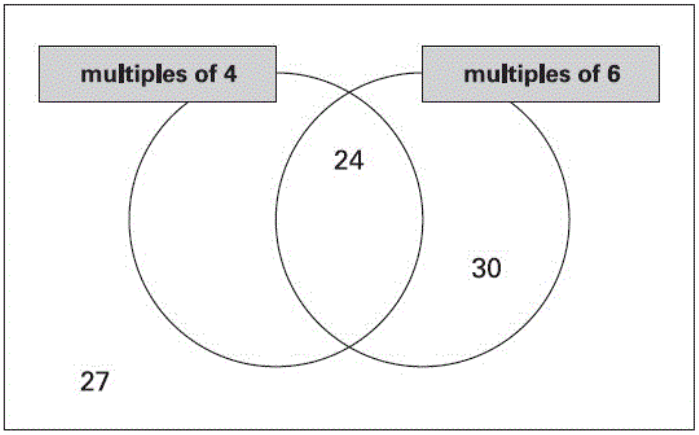
Use the sorting machine below to decide where each of the following numbers will go –

17, 15, 72

Write them in the boxes at the end



Write these numbers in the correct places on the sorting diagram – **16; 26; 36**



YEAR 6 - FRACTIONS

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

use common factors to simplify fractions; use common multiples to express fractions in the same denomination

Children should be able to recognise that a fraction such as $^{5}/_{20}$ can be reduced to an equivalent fraction of ¼ by dividing both numerator and denominator by the same number [cancelling]

They should be familiar with identifying fractions in different units. E.g. what fraction is 20 pence of two pounds? Of four pounds etc…

compare and order fractions, including fractions >1

Children should be able to position fractions on a number line; e.g. mark fractions such as $^{7}/_{5}$, $^{11}/_{20}$, $^{18}/_{12}$ on a number line graduated in tenths

Answer questions such as:

What number is half way between 5 ¼ and 5 ½ ?

Which is larger, ⅓ or $^{2}/_{5}$? Explain how you know.

associate a fraction with division to calculate decimal fraction equivalents (e.g. 0.375) for a simple fraction (e.g. ⅜)

Children should be able to find fractions of numbers and quantities:

- What fraction of £1 is 35p, … 170p ?
- Write $^{23}/_{100}$ of 4 kilogrammes in grams
- What fraction of 1 litre is 413 ml?

Convert a fraction to a decimal using known equivalent fractions:

- ¼ = 0.25
- $^{2}/_{5}$ = 0.4

Explain how much pizza each person would get if they divided 4 pizzas between 5 people, as a fraction and a decimal

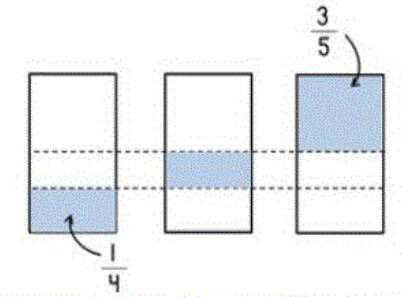
add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions

Children should be able to solve practical problems such as –

Here are three identical rectangles.

A fraction of each has been shaded.

What fraction of the middle rectangle has been shaded?



Here is a chocolate bar.

William eats 3 pieces and Amber eats 2 pieces.

What fraction of the chocolate bar remains?

multiply simple pairs of proper fractions, writing the answer in its simplest form, (e.g. ¼ × ½ = ⅛)

Children should be able to:

i] Recognise that ¼ of 12, ¼ x 12 and 12 divided by 4 are equivalent

ii] Use cancellation to simplify the product of a fraction and an integer

eg ⅕ x 15 = 3

⅖ x 15 = 2 x ⅕ x 15 = 2x3 = 6

ii] Work out how many ½s in 15, how many ⅖s in 15, how many 2/5s in 1 etc.

divide proper fractions by whole numbers (e.g. ⅓ ÷ 2 = ⅙)

Children should be able to decide whether they would prefer to share ½ of a pizza with 2 people or ¾ of a pizza with 4 people and explain why.

identify the value of each digit to three decimal places and multiply and divide numbers by 10, 100 and 1000 where the answers are up to three decimal places

Children should be able to identify the value of each digit in the number 17.036 and multiply and divide this by 10 and 100 and 1000

multiply one-digit numbers with up to two decimal places by whole numbers

Children should be able to calculate the answer to questions such as -

What is 3.86 multiplied by nine?

use written division methods in cases where the answer has up to two decimal places

Children should be able to calculate 601 divided by 36, to two decimal places etc.

solve problems which require answers to be rounded to specified degrees of accuracy

Children should be able to solve problems such as -

- Four friends win £48,623. The money is to be shared equally between them – how much will each person receive?
- 107 pupils and teachers need to be taken to the theatre. How many 15-seater minibuses will be required?
- How many boxes of 60 nails can be filled from 340 nails?

recall and use equivalences between simple fractions, decimals and percentages, including in different contexts.

Circle the two fractions that are equivalent to 0.6.

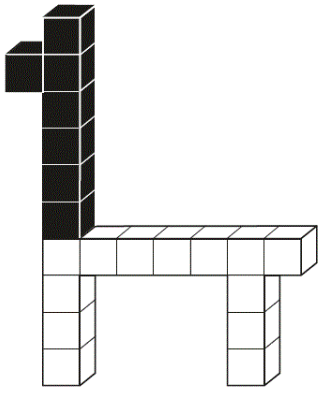
$\frac{6}{10}$ $\frac{1}{60}$ $\frac{60}{100}$ $\frac{1}{6}$

Put a ring around the percentage that is equal to three-fifths –

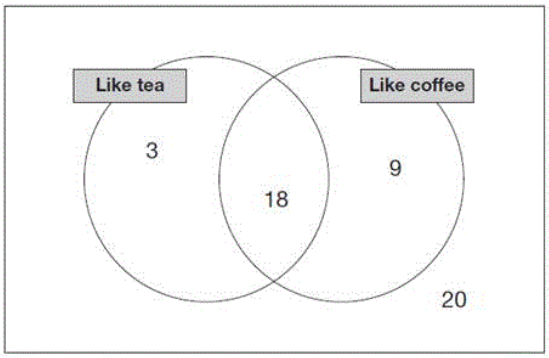
20% 30% 40% 50% 60%

This model is made of 20 cubes.

What percentage of the model is made from black cubes?



In a survey people were asked if they liked tea or coffee.



What percentage of people liked **both** tea and coffee?

What percentage did not like either?

YEAR 6 - RATIO

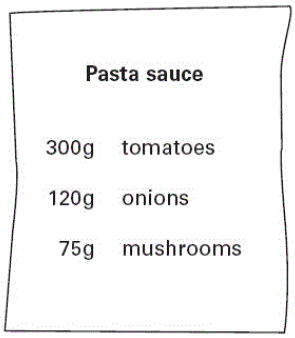
Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts

Children recognise proportionality in context when relations between quantities are in the same ratio, such as recipes and similar shapes.

Children consolidate their understanding of ratio when comparing quantities, sizes and scale drawings by solving a variety of problems. They might use notation such as ***a:b*** to record their work.

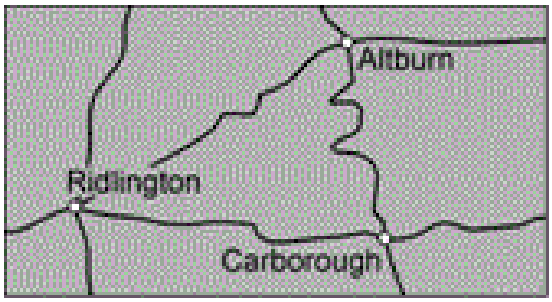
Here is a recipe for pasta sauce: -



Sam makes the pasta sauce using 900 g of tomatoes.

What weight of onions should he use?
What weight of mushrooms?

This map has a scale of 1 cm to 6 km.



The road from Ridlington to Carborough measured on the map is 6.6 cm long.

What is the length of the road in kilometres?

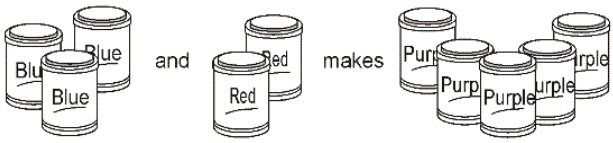
A recipe for 3 portions requires 150 g flour and 120 g sugar.

Desi's solution to a problem says that for 2 portions he needs 80 g flour and 100 g sugar.

What might Desi have done wrong?

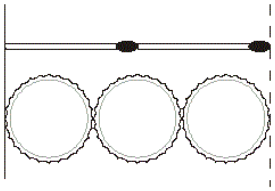
Work out the correct answer.

Purple paint is made by mixing red and blue paint



How many tins of red paint are needed to make 25 tins of purple?

Two matchsticks have the same length as three bottle tops -



How many bottle tops are same length as 50 matchsticks?

solve problems involving the calculation of percentages (e.g. of measures) such as 15% of 360 and the use of percentages for comparison

Find simple percentages of amounts and compare them. For example:

- A class contains 12 boys and 18 girls. What percentage of the class are girls? What percentage are boys?
- 25% of the apples in a basket are red. The rest are green. There are 21 red apples. How many green apples are there?

solve problems involving similar shapes where the scale factor is known or can be found

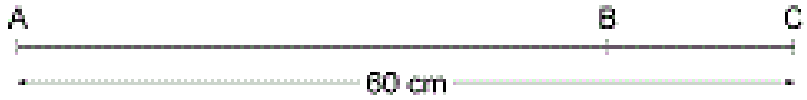
- Solve simple problems involving direct proportion by scaling quantities up or down, for example:

  Two rulers cost 80 pence. How much do three rulers cost?

- Use the vocabulary of ratio and proportion to describe the relationships between two quantities solving problems such as:

  Two letters have a total weight of 120 grams. One letter weighs twice as much as the other. Write the weight of the heavier letter.

  The distance from A to B is three times as far as from B to C. The distance from A to C is 60 centimetres. Calculate the distance from A to B.



solve problems involving unequal sharing and grouping using knowledge of fractions and multiples

Children solve problems involving unequal quantities, for example, 'for every egg you need 3 spoons of flour'. Relate fractions to multiplication and division (e.g. 6 ÷ 2 = ½ of 6 = 6 × ½), simplify fractions by cancelling common factors, find fractions of whole-number quantities and solve problems such as:

- What fraction is 18 of 12
- What fraction is 500ml of 400ml?
- What is $^{14}/_{35}$ in its simplest form?
- What is two thirds of 66?
- What is three quarters of 500?

A gardener plants tulip bulbs in a flower bed. For every 3 red bulbs, she plants 4 white bulbs.

If she plants 60 white bulbs, how many red bulbs does she need?

YEAR 6 - MEASUREMENT

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

solve problems involving the calculation and conversion of units of measure, using decimal notation up to three decimal places where appropriate

Children should be able to draw a flow chart to help someone else convert between mm, cm, m and km.

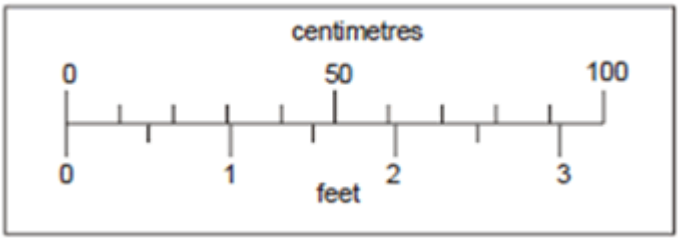
They should know the approximate equivalence between commonly used imperial units and metric units:

- 1 litre is approximately 2 pints (more accurately, 1 ¾ pints)
- 4.5 litres is approximately 1 gallon or 8 pints
- 1 kilogram is approximately 2 lb (more accurately, 2.2 lb)
- 30 grams is approximately 1 oz

They should be able to answer questions such as: approximately how many litres are there in 3 gallons? Give your answer to the nearest litre.

use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to three decimal places

This scale (not actual size) shows length measurements in centimetres and feet.



Look at the scale. Estimate the number of centimetres that are equal to 2 ½ feet.

Estimate the difference in centimetres between 50 cm and 1 foot.

convert between miles and kilometres

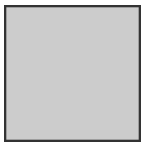
Children should know that 8 kilometres is approximately 5 miles

Children should be able to use conversion graphs that show miles/kilometres.

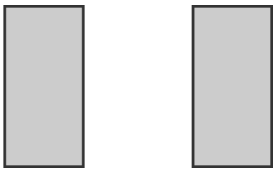
They should be able to use it to estimate a distance of 95 miles in kilometres.

recognise that shapes with the same areas can have different perimeters and vice versa

The perimeter of this square is 72 centimetres.

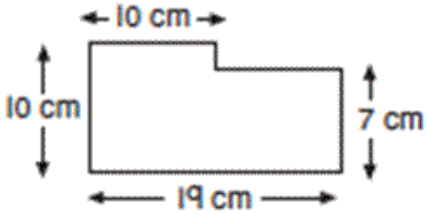


The square is cut in half to make two identical rectangles.



What is the perimeter of one rectangle?

Children should be able to calculate the perimeters of compound shapes that can be split into rectangles. What is the perimeter of this shape?



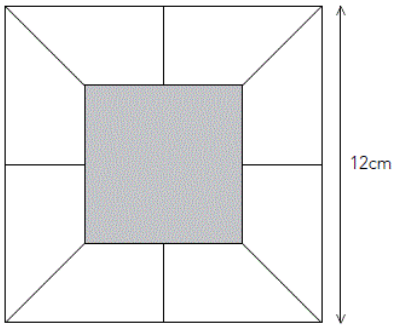
recognise when it is possible to use formulae for area and volume of shapes

The shaded square is surrounded by 8 identical trapeziums to make a bigger square.

The larger square has a side length of 12cm.

The shaded square has a side length of 6cm.

What is the area of one of the trapeziums?



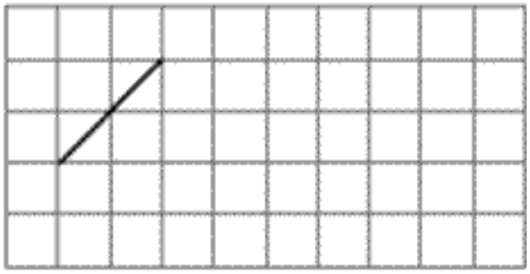
calculate the area of parallelograms and triangles

This is a centimetre grid.

Draw 3 more lines to make a parallelogram

with an area of 10cm^2.

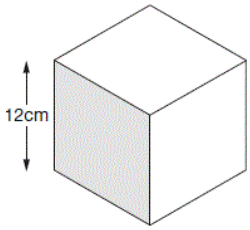
Use a ruler.

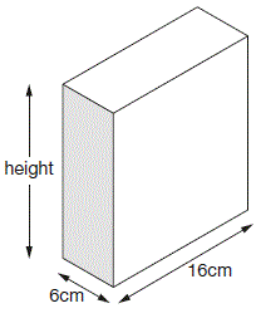


Calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres and cubic metres, and extend to other units (eg mm³)

This cube and cuboid have the same volume.

What is the height of the cuboid?





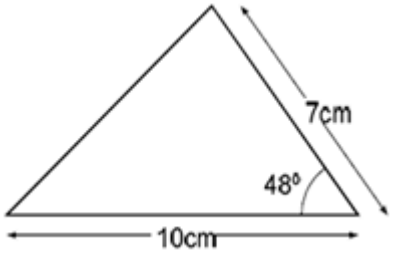
Y6 - Geometry – PROPERTIES OF SHAPE

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

draw 2-D shapes using given dimensions and angles

Children should be able to construct a triangle given two sides and the included angle

Here is a sketch of a triangle. (It is not drawn to scale).



Draw the full size triangle accurately, below. Use an angle measurer (protractor) and a ruler. One line has been drawn for you.

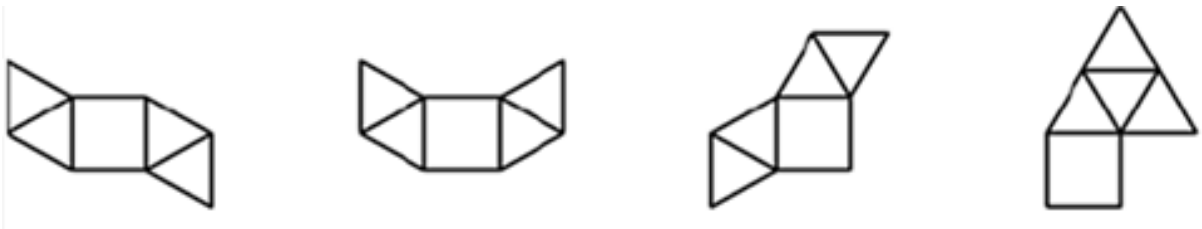
recognise, describe and build simple 3-D shapes, including making nets

Children should be able to identify, visualise and describe properties of rectangles, triangles, regular polygons and 3-D solids; use knowledge of properties to draw 2-D shapes and identify and draw nets of 3-D shapes

Children should be able to respond accurately to questions such as -

'I am thinking of a 3D shape. It has a square base. It has four other faces which are triangles. What is the name of the 3D shape?'

'Which of these nets are of square based pyramids? How do you know?



compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons

Children should be able to make and draw shapes with increasing accuracy and knowledge of their properties. They should be able to carry out activities such as -

'Give me instructions to get me to draw a rhombus using my ruler and a protractor'

'On the grid below, use a ruler to draw a pentagon that has three right angles'

illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius

Children should know that:

- The circumference is the distance round the circle
- The radius is the distance from the centre to the circumference
- The diameter is 2 x radius

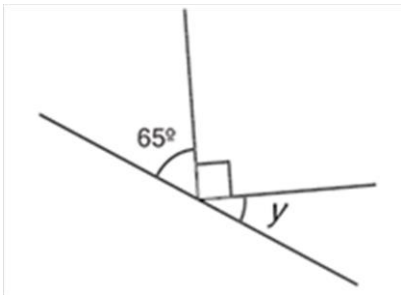
recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles

Children should be able to estimate angles, use a protractor to measure and draw them, on their own and in shapes. They should know that the angle sum of a triangle is 180˚, and the sum of angles around a point is 360˚.

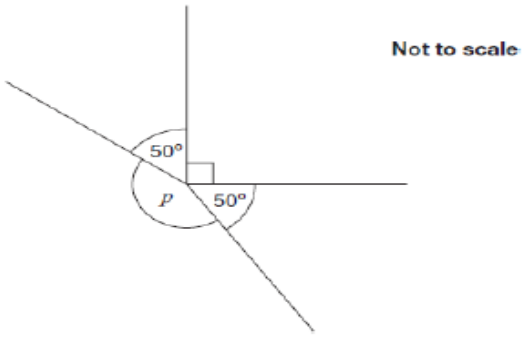
They should be able to use this knowledge to respond accurately to questions such as;

'There are nine equal angles around a point. What is the size of each angle?'

'There are a number of equal angles around a point. The size of each angle is 24°. How many equal angles are there?'



Children should be able to calculate the size of angle 'y' in this diagram without using a protractor.



Calculate the size of angle p

Y6 - Geometry – POSITION & DIRECTION

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

describe positions on the full coordinate grid (all four quadrants)

Children should be able to draw and label a pair of axes in all four quadrants with equal scaling. They extend their knowledge of one quadrant to all four, including the use of negative numbers.

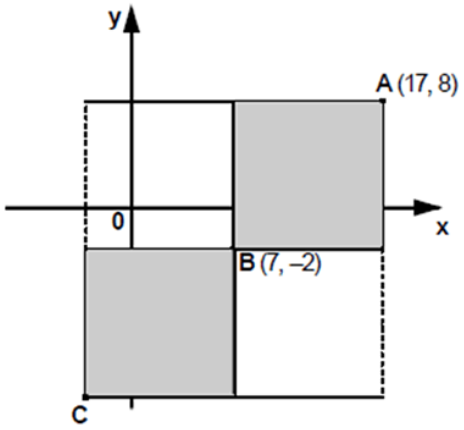
Children should be able to draw and label rectangles, parallelograms and rhombuses, specified by co-ordinates in the four quadrants, predicting missing co-ordinates using the properties of shapes.

The two shaded squares below are the same size.

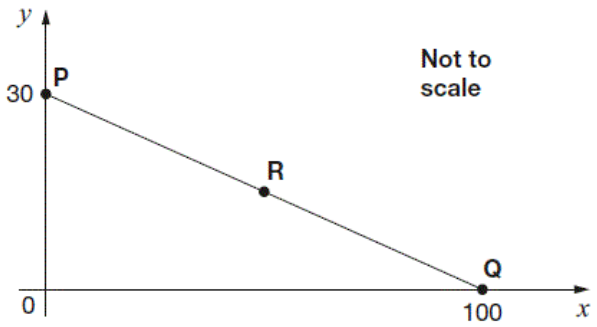
A is the point (17,8)

B is the point (7, -2)

What are the co-ordinates of point C?



In this diagram R is an equal distance from P and Q



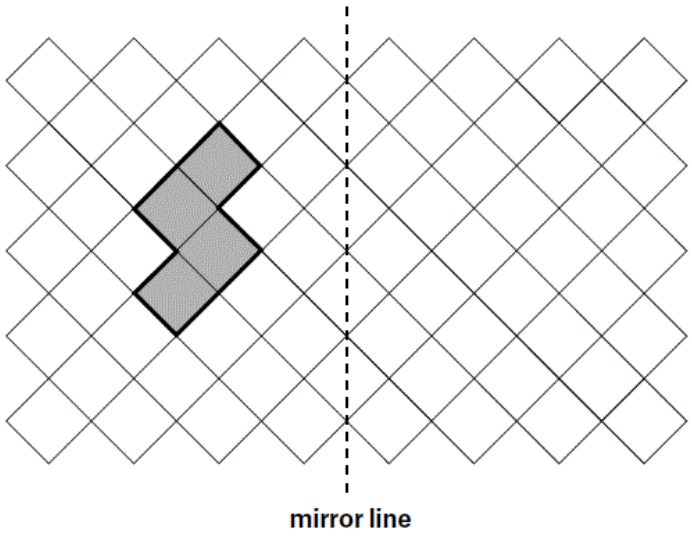
What are the co-ordinates of R?

draw and translate simple shapes on the coordinate plane, and reflect them in the axes

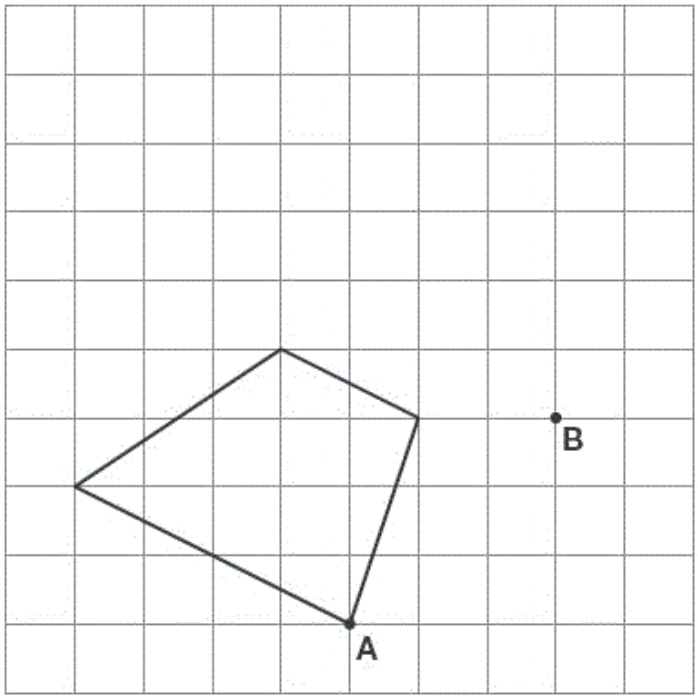
Children should be able to draw a shape with corners at given vertices, and describe the properties of the shape. Can they create the same shape where all of the coordinates will be positive? Negative?

Children should be able to sketch the reflection of a simple shape in two mirror lines at right angles and find the coordinates of selected points.

Complete the diagram by reflecting the shape in the mirror line –



Here is a quadrilateral. The shape is translated so that point A is now at point B. Complete the shape in its new position. Use a ruler.



YEAR 6 - STATISTICS

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

interpret and construct pie charts and line graphs and use these to solve problems

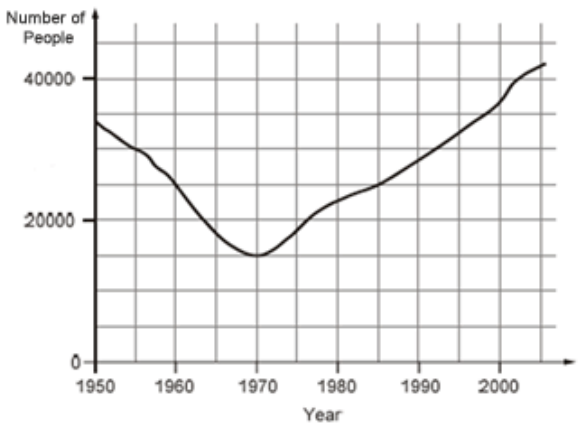
Children should be able to connect their work on angles, fractions and percentages to the interpretation of pie charts.

Class 6 did a survey of the number of trees in a country park. This pie chart shows their results.

Estimate the fraction of trees in the survey that are oak trees. The children counted 60 ash trees. Use the pie chart to estimate the number of beech trees they counted.

Children should be able to interpret and draw graphs relating two variables, arising from their own enquiry and in other subjects. They should be able to interpret a graph connecting kilometres and miles.

This graph shows the number of people living in a town.



How many people lived in the town in 1985?
In which year was the number of people the same as in 1950?

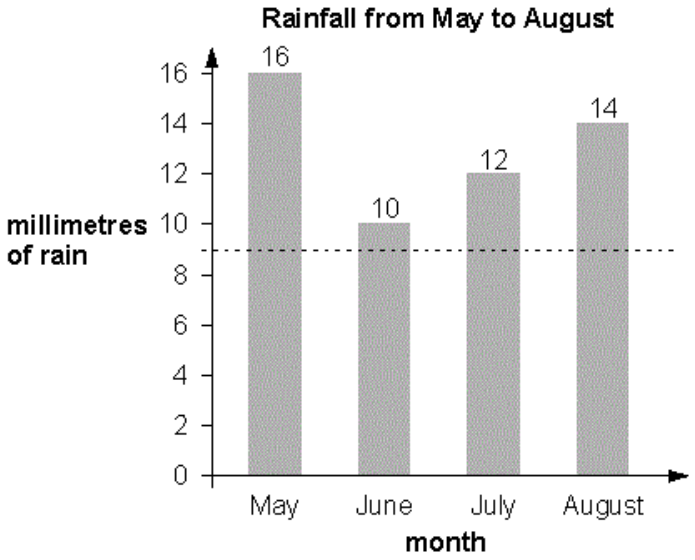
Find the year when the number of people first went below 20 000.

calculate and interpret the mean as an average

From a simple database, children should be able to find the most common score (mode) as well as the mean score for each test.

Children should be able to choose their own sets of data to match given criteria, e.g. find a set of five numbers that have a mean of 5 and a range of 7.

Here is a bar chart showing rainfall.



Kim draws a dotted line on the bar chart.

She says,

'The dotted line on the chart shows the mean rainfall for the four months.'

Use the chart to explain why Kim **cannot** be correct.

(a) Here are five number cards.

Write the missing number so that the **mean** is **2**.

YEAR 6 - ALGEBRA

Examples of what children should be able to do, in relation to each (boxed) Programme of Study statement

find pairs of numbers that satisfy number sentences with two unknowns

enumerate all possibilities of combinations of two variables.

Children should be confident to answer questions such as -

Here are five number cards:

A and B stand for two different whole numbers.

The sum of all the numbers on all five cards is 30.

What could be the values of A and B?

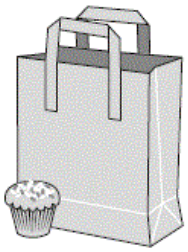
express missing number problems algebraically

use simple formulae

Children should be able to express a relationship in symbols, and start to use simple formulae.

- Use symbols to write a formula for the number of months m in y years.
- Write a formula for the cost of c chews at 4p each.
- Write a formula for the nth term of this sequence: 3, 6, 9, 12, 15…
- The perimeter of a rectangle is 2 × (l + b), where l is the length and b is the breadth of the rectangle.
- What is the perimeter if l = 8 cm and b = 5 cm?
- The number of bean sticks needed for a row which is m metres long is 2m + 1. How many bean sticks do you need for a row which is 60 metres long?
- Plot the points which show pairs of numbers with a sum of 9.
- Find missing numbers, lengths, co-ordinates and angles
- Understand equivalent expressions (eg a + b = b + a)

Maria bakes cakes and sells them in bags.



She uses this formula to work out
how much to charge for one bag of cakes.

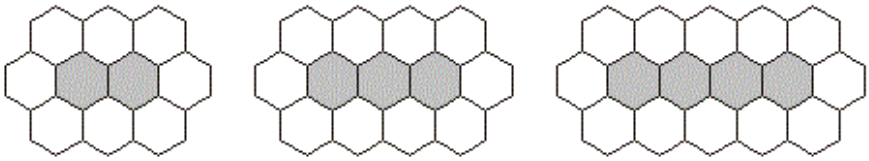
Cost = number of cakes × 20p + 15p for the bag

How much will a bag of 12 cakes cost?

generate and describe linear number sequences

Children should experience activities such as -

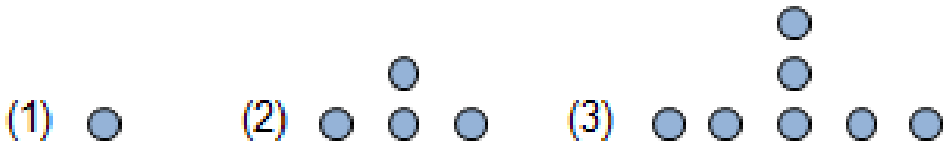
In this pattern **white hexagons** surround **shaded hexagons**.



How many **white hexagons** are needed to surround a line of **100 shaded hexagons**?

Write a formula which connects the number of white hexagons (W) with the shaded ones (S)

A number sequence is made from counters. There are 7 counters in the third number.



How many counters in the 6th number? the 20th...?

Write a formula for the number of counters in the nth number in the sequence.

Acknowledgements –

This resource has been collated by the North Yorkshire Mathematics Team using the exemplification of the 2014 National Curriculum which is freely available from NCETM website. The resource has been adapted and revised where there were gaps; errors or further clarification seemed appropriate.

Here is a list of other resources you may find useful –

NCETM Resource Tool -

https://www.ncetm.org.uk/resources/41211

NCETM Teaching for Mastery –

https://www.ncetm.org.uk/resources/46689

Nrich Curriculum Maps for KS1 and KS2

http://nrich.maths.org/8935

STEM centre resources

https://www.stem.org.uk/audience/primary#section--resources

SATs Papers -

http://www.sats-papers.co.uk/

http://satspapers.org/mathsKS2SATS.htm

Testbase -

http://www.testbase.co.uk/sec/index.php

White Rose Maths Hub Resources –

https://www.tes.com/teaching-resource/reasoning-and-problem-solving-questions-collection-ks1-and-ks2-11249968

http://www.trinitytsa.co.uk/maths-hub/free-learning-schemes/