NUMERACY POLICY

Formulation date:	**June 2016**	**Reviewing Committee**	**Curriculum & Standards**
Approved on:	**June 2016**	**Next Review date:**	**June 2019**

Newbridge High School Numeracy Policy

Definition:

1. Teachers should use every relevant subject to develop pupils' mathematical fluency. Confidence in numeracy and other mathematical skills is a precondition of success across the national curriculum.
2. Teachers should develop pupils' numeracy and mathematical reasoning in all subjects so that they understand and appreciate the importance of mathematics. Pupils should be taught to apply arithmetic fluently to problems, understand and use measures, make estimates and sense check their work. Pupils should apply their geometric and algebraic understanding, and relate their understanding of probability to the notions of risk and uncertainty. They should also understand the cycle of collecting, presenting and analysing data. They should be taught to apply their mathematics to both routine and non-routine problems, including breaking down more complex problems into a series of simpler steps.

   National Curriculum 2013

We expect students to develop

- ✓ the ability to make sense of more than just number.
- ✓ mental strategies as well as pencil and paper methods.
- ✓ a competence in using and applying maths in a range of different subjects.
- ✓ use of correct mathematical language to communicate findings, both written and verbally.
- ✓ the ability to break a problem down into simpler more manageable tasks.

Rationale

To develop Newbridge pupils Numeracy skills through the delivery of mathematical concepts, using appropriate terminology and encouraging the application of Numeracy in all curricular areas. This in turn will create a person with skills required in further education and in the work place.

Aims

- Numeracy should be promoted throughout all areas of the curriculum in a consistent and efficient manner.
- Standards of Numeracy will be raised by enhancing the quality of learning and teaching.
- Implementing appropriate procedures for the monitoring and evaluation of the delivery of Numeracy throughout the school.

Areas of responsibility:

The Role of the Numeracy Co-ordinator

The role of the coordinator is:

- ✓ To be responsible to the Head Teacher and Governing Body for the development of Numeracy throughout the school.
- ✓ To play a leading role in the design and production of a whole school policy for Numeracy.
- ✓ The formulation, monitoring and evaluation of the Numeracy policy.
- ✓ To help identify training needs of staff in relation to Numeracy.
- ✓ To liaise with all subject departments to ensure that Numeracy is developed in a coherent and consistent manner throughout the school.
- ✓ Liaise within Mathematics department on continuity of delivery of key concepts.

Curriculum Leaders

- ✓ CLs know their subject and schemes of work well and they have the task of incorporating Numeracy, with liaison, directly into existing schemes.
- ✓ CLs are also empowered to identify areas where the delivery of Numeracy could be enhanced and lead to training.

The Role of Parents

The parents' role in the Numeracy development of their children is important and to be encouraged. This can be done in a number of ways, including discussion of work done in all subject areas and things such as:

- ✓ Recollection of number facts.
- ✓ Estimation while shopping.
- ✓ Use of maps, both roads and footpaths.
- ✓ Measuring tasks parents may have to do, such as buying carpet, paint, and wallpaper.
- ✓ Discussion on how to break a problem down and examine whether the outcomes are realistic.
- ✓ Ask their children to explain their mathematical thinking when doing maths homework or performing everyday mathematical tasks.
- ✓ ***Encourage your child(ren) to use the MyMaths website regularly***
- ✓ ***Encourage your child(ren) to use the maths page on the Newbridge website, which contains details about the maths scheme of work and links to useful apps.***

How other subjects may help Numeracy

There are opportunities for drawing mathematical experience out of a wide range of pupil activities. Mathematics contributes to many subjects of the curriculum, often in practical ways. Activities such as recording the growth of a plant or an animal, measuring temperature and rainfall, or investigating the cog wheels in a bicycle can provide data or starting points for discussion in your mathematics lessons as well as opportunities to apply and use mathematics in real context.

English

English lessons can help to develop and support pupils' Numeracy skills, for example, by use of mathematical vocabulary and technical terms, by asking children to read and interpret problems to identify the mathematical content, and by encouraging them to explain, argue and present their conclusions to others.

Science

Almost every scientific investigation or experiment is likely to require one or more of the mathematical skills of classifying, counting, measuring, calculating, estimating, and recording in tables and graphs. In science pupils will, for example, order numbers, including decimals, calculate

simple means and percentages, use negative numbers when taking temperatures, decide whether it is more appropriate to use a line graph or bar chart, and plot, interpret and predict from graphs. They will use and measure angles. They will also use and manipulate formulæ to calculate, e.g. moments, speed and pressure.

Art and Design

Design & Technology takes Mathematics away from abstract investigation and applies it to real world situations. Application of many scientific principles and the use of relevant formulae and relevant SI units are commonplace in lessons. Measurement is prominent in both Art and Design & Technology. Many patterns and constructions are based on spatial ideas and properties of shapes, including symmetry. A lot of work is also undertaken using estimation of measurement and quantities. Designs may need enlarging or reducing, introducing ideas of multiplication and ratio. In food technology, proportions, fractions and accuracy of measuring solids as well as liquids feature often.

Timing and predicting judgements against time are also practised.

Design & Technology

Application of the four rules of number, precision measurement, working to tolerances, geometry, scale and ratio, scientific calculations/working with variables, including velocity ratio, efficiency, bending moments, Ohms Law, force, pressure, mass/weight, collecting, displaying and interpreting data, %, decimals and fractions, costing, , enlargement, imperial to metric conversions, prefixes, exponential numbers and SI units, Logic, Binary and Digital, anthropometrics.

ICT

Children will apply and use mathematics in a variety of ways when they solve problems using ICT. For example, they will collect and classify data, enter it into data handling software, produce graphs and tables, and interpret and explain their results. Their work in graphic design includes measurements of distance and the use of measurements in calculations. When they use computer models and simulations they will draw on their abilities to manipulate numbers and identify patterns and relationships.

History, Geography, and Religious Education

In History and Geography children will collect data by counting and measuring and make use of measurements of many kinds. The study of maps includes the use of co-ordinates and ideas of angle, direction, position, scale and ratio. The pattern of the days of the week, the calendar and recurring annual festivals all have a mathematical basis. For older children historical ideas require understanding of the passage of time, which can be illustrated on a time line, similar to the number line that they already know.

Music

Beats, rhythms and sequence patterns.

Physical Education

Athletic activities require measurement of height, distance and time, while ideas of counting; time, symmetry, movement, position and direction are used extensively in music, dance, gymnastics and ball games.

Careers and Citizenship

In these two areas Numeracy can be directly related to everyday life. Budgeting, paying bills, running a home and other money management issues can be undertaken. Understanding of the difference between credit and debit and the impact of debt feature overtly and in careers the importance of competency in Mathematical skills is stressed.

Modern Languages

Looking at different currencies. Calculations in a foreign language. A lot of work that is already undertaken in the mathematics classes and careers can be applied here to learn about different countries. Counting.

The key to making the most of all these opportunities is to identify the mathematical possibilities across the curriculum at the planning stage. This will be achieved in each area of study by deciding what Numeracy is required. Teachers of all subjects should make the links between their subject and Numeracy explicit, by talking about links frequently in their classes.

Core Numeracy Curriculum areas

The following topics have been identified in schemes of work that can contribute to the specific development of Numeracy.

Geography

Collection and displaying data, interpretation of data, line of best fit, rates (eg. per 1000, per 100 000), scale, grid references, area/distance, application of the four rules of number, angles and bearings.

Science

Decimals, fractions, mass/weight, %, collect, display and interpret data, manipulate formulae, speed/distance/time, standard form, large numbers, small numbers, measures, area, volume, application of the four rules of number, square and square roots, proportional and inverse proportion, line of best fit, ratio, hypothesis

Technology

Length, area, volume, mass/weight, collect, display and interpret data, %, decimals and fractions, costing, application of the four rules of number, scale/ ratio / enlargement, imperial / metric conversions.

Calculator Policy

- ✓ The Mathematics department encourages all pupils to purchase Sharp scientific calculators, which use direct algebraic logic. Pupils should bring these to every lesson along with their other equipment to enable them to improve their competency.
- ✓ This calculator is also suitable for GCSE
- ✓ The use of calculators is primarily determined by the ability of pupils. All pupils should be encouraged to use non-calculator methods when dealing with simple numerical problems. If a calculation has been performed on a calculator, pupils should be encouraged to reflect on the sensibility of the answer.
- ✓ Effective use of calculators encourages exploration of problems, such as sequences and relationships. As pupils progress through school they will need to become more familiar with the methods of calculation and the correct interpretation of the display.

Assessment and Monitoring

It is the role of every member of staff to monitor the numerical processes pupils employ when performing calculations in their curriculum areas. Regular misunderstanding or miscalculations should be noted and reported to the CL or the pupil's mathematics teacher, if they can't be corrected easily in class.

The Head of Mathematics will lead a discussion in ML meetings to discuss the development of Numeracy and any changes to help facilitate improvements. The developments will take into account KS2, KS3 and GCSE maths results. Results from the KS2 exams will be analysed and used to provide information to CLs and Subject teachers. Results from KS3 will be broken down into strands namely, Using and Applying, Number & Algebra, Shape & Space and Data Handling. All data will be discussed with the CLs and steps taken to amend common problems.

Classroom support.

Learning Support Assistants need to be familiar with the calculation strategies employed by pupils, the appendix notes will be made available to them for examination and reference. The Mathematics CL will discuss any training needs of the LSAs with the SENCo. Using the experience of the LSA attached to the Mathematics Department will also be a valuable asset to all support staff in the work across the curriculum.

APPENDICES

Calculation Strategies

Handling Data

Problem Solving

Accuracy in Measurement & Drawing

Numeracy Skill by Year Group

Audit Sheets

Calculation Strategies

Addition & Subtraction

Below, you will find examples of problems involving the four operators, how they are taught, and approached by pupils at different stages in their school lives. **It is important to remember that, pupils on entry to secondary school may still be using these earlier methods of calculation.**

Pupils are encouraged to use mental calculations to support their written recordings.

Year	Addition	Subtraction
5/6	Example: 8642 + 753 8000 + 600 + 40 + 2 700 + 50 + 3 8000 + 1300 + 90 + 5=**9395** **or** 8000 + (600 + 700) + (40 + 50) + (2 + 3) = 8000 + 1300 + 90 + 5 **= 9395** **or**	Example: 2410 - 482 1000 1300 100 10 2000 + 400 + 10 + 0 400 + 80 + 2 1000 + 900 + 20 + 8**= 1928** **or** 2410 - 482 Using what they -2 know about -70 negative numbers 2000 **1928** **or**
7/8	8642 By this time they +753 *understand* **9395** carrying 1 ***All these skills are Level 4***	1 13 10 1 By now they 2410 understand - 482 *borrowing* **1928**

By Year 5/6 pupils will be able to extend their experience of addition and subtraction into a range of contexts, including calculations with money and measurement with decimals.

Multiplication and Division

Multiplication is usually associated with the idea of repeated addition, e.g.:

7 x 6 = 6 + 6 + 6 + 6 + 6 + 6 + 6 = 42

Division is associated with repeated subtraction or sharing, e.g.:

42 ÷ 7 = 42 – 7 – 7 – 7 – 7 – 7 – 7 – 7 = 0 (42 shared equally 6 times)

Year	Multiplication	Division
5/6	Example: 24 x 16 24 x 16 < 24 x 10 = 240 24 x 6 = (20 x 6) + (4 x 6) = 144 240 + 144 = **384** **or** 20 | 4 10 | 200 | 40 6 | 120 | 24 26 x 16 = 200 + 120 + 40 + 24 = **384** ***Note: This is a very popular method is known as the 'box' or 'grid' method. This is an algorithmic method that does require understanding but is utilised very effectively by many pupils.***	Example: 432 ÷ 15 20 + 8 15)432 (15 x 20) 300 132 (15 x 8) 120 15 x 10 = 150 15 x 20 = 300 15 x 4 = 60 15 x 8 = 120 ∴ 432 ÷ 15 = **28 remainder 12** The above method is referred to as '***chunking'***, as they are subtracting chunks of 15 at a time. ***All these skills are Level 5***
7/8	Standard method – long multiplication 24 x 16 144 (6 x24) 240 (10 x 24) **384**	Standard method – long division 28 r 12 15)432 30 132 120 12

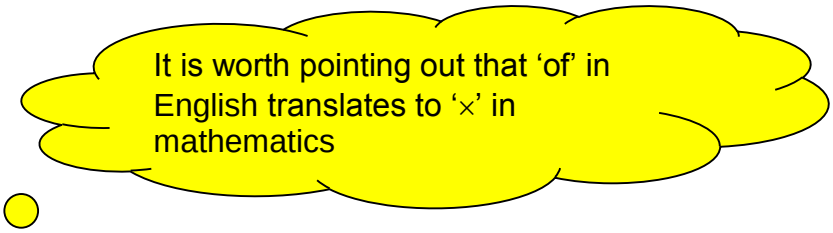
		The fraction 12/15 can be simplified to 4/5

Many lower attaining pupils experience great difficulty in understanding some formal methods of calculation. It is essential to build upon what the child knows, understands and can do. The examples above are real examples of how pupils have approached the problems.

Calculation with fractions, decimals and percentages

NON-CALCULATOR METHODS

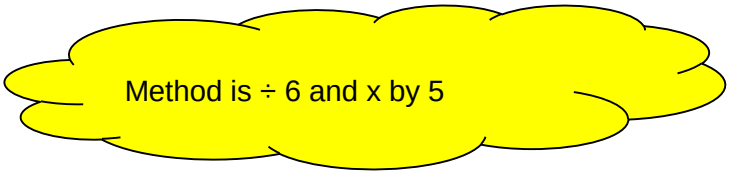
Calculating with fractions



Example: Calculate $\frac{5}{6}$ of £48

Solution:

Now $\frac{5}{6}$ = 5 x $\frac{1}{6}$, but before we can find $\frac{5}{6}$, we need to find the value of $\frac{1}{6}$, then multiply by 5.

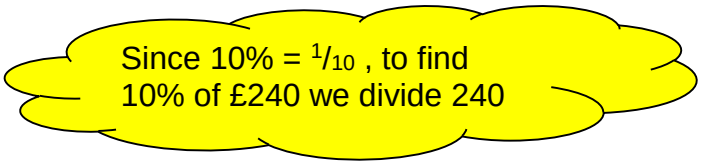


$\frac{5}{6}$ **of £48 = £40**

Calculating with Percentages

Example: Calculate the VAT on £240 @ 20%

Solution:



Now 10% of £240 = £24

So 20% is 2x10% = **£48**

Whilst it is possible, it would be inefficient to calculate 23.608% of 406.87kg using this method.

For this a calculator is best used!

These skills are Level 6

Calculator Methods

Calculator methods generally involve changing the fraction or percentages into a decimal first. Decimals are often referred to as "multiplying factors" since, having turned the fraction or percentage into a decimal, we use it to multiply.

Changing a fraction into a decimal

To change a fraction into a decimal, you 'divide the top number (numerator) by the bottom number (denominator)'. To help pupils to remember this it is often useful to remind them that a fraction looks like a divide sign:

numerator
denominator

This line means "divide"

Changing a percentage into a decimal

To change a percentage into a decimal we aim to remember that percentage means "per-hundred". Therefore 23% means 23 per 100. This is written as $^{23}/_{100}$, and to change this fraction into a decimal we divide 23 by 100, as above.

Lower ability students will still have a problem with this skill area.

Note:

Most pupils simply need to remember that to change a percentage into a decimal; they should divide the percentage by 100.

A "starter" to a lesson where this skill needs to be utilised might look like this, where the pupils need to fill in the blank spaces with the appropriate value.

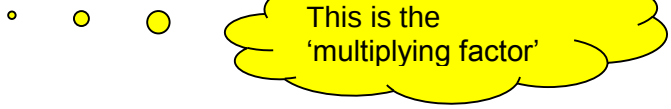
As this is a recurring decimal, how many decimal places do we need to write down? It is worth pointing out that you would use all the numbers on the calculator and round off at the end of the calculation only.

Fraction	Decimal	Percentage
$^{4}/_{5}$	?	?
?	0.125	?
?	?	65%
$^{8}/_{13}$	?	?

Example: Calculate 5.35% of 23,456kg

Solution: 5.35% as a decimal?

5.35 ÷ 100 = .0535



So,

0.0535 x 23,456 = 1,254.896

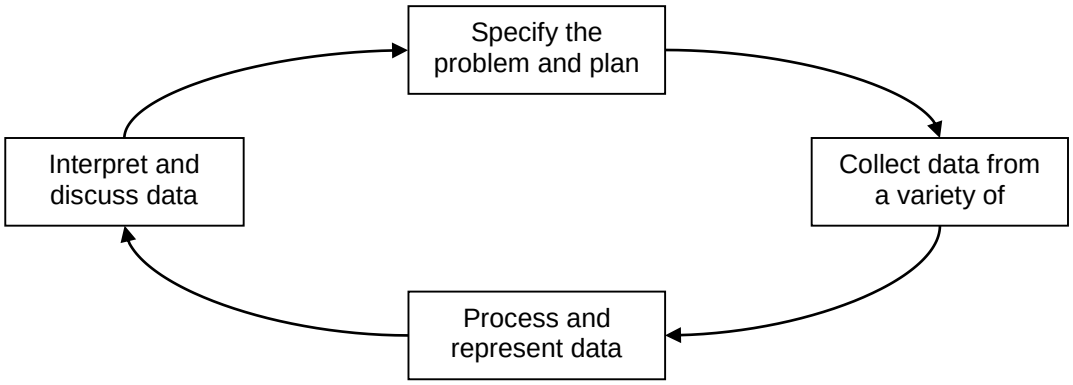
Final answer

5.35% of 23,456kg = 1,254.896kg

Depending upon the context, a suitable degree of accuracy would now be required.

Handling Data

Throughout the mathematics curriculum the clear message is that data handling is best taught in the context of real statistical enquiries, in a coherent way so that teaching objectives arise naturally from the whole cycle, as represented in the following diagram:



Other subjects within the national curriculum have similar descriptions for the role of data handling within their subject-specific contexts:

1. Specifying the problem and planning

In order to specify a problem, pupils need to suggest a conjecture (hypothesis) that could be investigated. A ***conjecture*** or ***hypothesis is Level 7; (****in order to 'prove' or 'disprove')****.* This means that it is a statement about something you're going to investigate, e.g.:

- tallest athletes jump best
- the cost of a car has an effect on its speed

2. Collecting Data

It is important that data are collected for a purpose. Data are found as either:

a) Primary data – data you collect yourself using a survey or experiment; the amount is always dependant on the hypothesis; or

b) Secondary data – data that is already collected for you. You can find secondary data in books or on the Internet. (***Level 6).***

Example: Survey/Questionnaire

To decide whether traffic outside school can be reduced, the Maypole High Governors want to ask drivers:

- How far is it to school?
- Do you drive in every day?
- Why do you drive your children to school?
- How long does your car journey take?
- How many people do you bring to school?
- Do any other pupils live near you?
- What do you think of the traffic outside school?
- What buses go from near your house?

Some of the questions have yes or nor answers:

- Do you drive in every day?
- Do any other pupils live near you?

Others have numerical answers:

- How far is it to school?
- How long does your car journey take?
- How many people do you bring to school?

These have many different answers:

- Why do you drive your children to school?
- What buses go from near your house?
- What is your opinion on the traffic outside school?

*These are **closed** questions. They have particular answers. You could use tick boxes to collect this data*

*These are **open** questions. They can include answers you haven't thought of.*

The governing body develop a questionnaire for their questions:

Traffic Questionnaire

1. Do you drive to school every day of the week? ❑ Yes ❑ No
2. How many people do you bring to school? ❑ 1 ❑ 2 ❑ 3 ❑ 4+
3. How far do you travel to school? _____
4. How long does your car journey take? _____
5. Why do you drive your children to school?
6. What do you think about the traffic outside school? (1 = good, 5 = bad)

   ❑ 1 ❑ 2 ❑ 3 ❑ 4 ❑ 5

Yes/No answers give very limited information but the data is easy to collect

This question has an exact, or discrete, number of answers

These questions have a range of numeric answers. The data is easier to use if you collect it in ranges in a **frequency table**

Why questions are very open so the responses may not be easy to analyse

An open question can be closed down to specific responses using a scale

You can use a questionnaire to conduct a survey. Open questions invite any response. Closed questions invite choice.

To understand how to collect data properly, it is necessary to consider different types of data, so that collection and handling activities can take place. One key idea, important to the proper collection of data, is that of sampling.

The Vocabulary of Sampling *(Level 8)*

Population: The entire group of people, animals, or things about which we want information

Sample: A part of the *population* from which we actually collect data/information, used to draw conclusions about the whole

IMPORTANT:
In order for a sample to be suitable,
at least 30
pieces of information need to be collected.

3. Representing data and interpretation

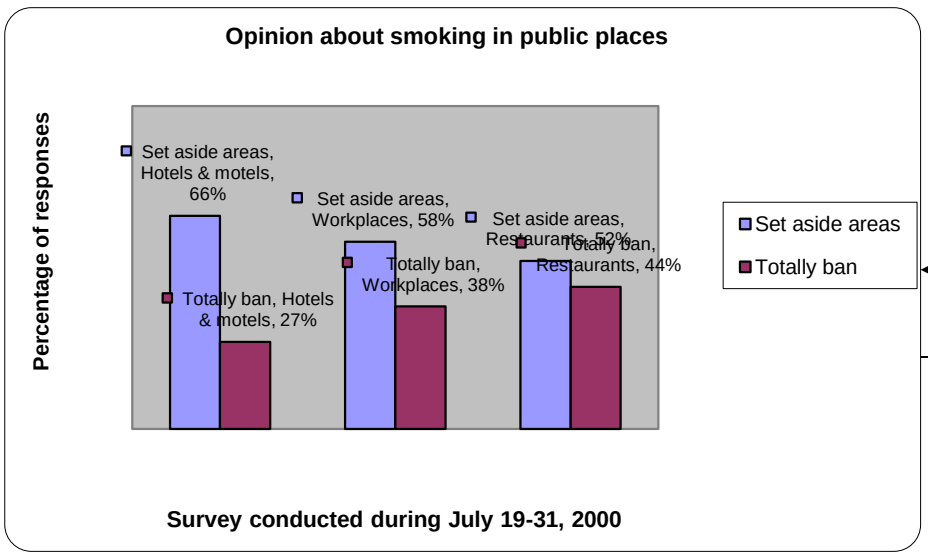
Representing data in an orderly and easy-to-read/understand form is paramount to Handling Data. Charts and diagrams without headings, labels and an appropriate scale are useless.

The representations synthesise the raw data into summary information. We will be looking at how to draw the most common charts: bar charts, pie charts and scatter diagrams. Also a brief look at averages.

Bar Charts *(Level 5)*:

A bar chart uses bars to represent data. Each bar represents a category or class.

Title



Key if required

- The bar chart shows that more people would set aside areas for smokers in public places than would ban them completely.
- The more enclosed the space, the more would actually ban smoking totally
- None of the bars add to 100%, so it is assumed that the rest of the respondents 'didn't know' or perhaps they said smoking should be allowed everywhere.
- There is no information about who took part in the survey, such as whether it included smokers as well as non-smokers, and so it is difficult to draw any firm conclusions. ***(Level 5)***

Label both axes

PIE CHARTS *(LEVEL 6)*:

A pie chart uses a circle to show data. Each class or category has a slice of the circle.
Example: Draw a pie chart to illustrate the following information.

Type of transport	Train	Coach	Car	Ship	Plane
Frequency	48	28	125	22	27

We need to find the fraction of the total, which represents each type of transport, and express this as a decimal. Many pupils prefer to remember that we simply divide each frequency by the total. This decimal is called the 'multiplying factor'. To find the angle we then multiply 360 degrees by the multiplying factor.

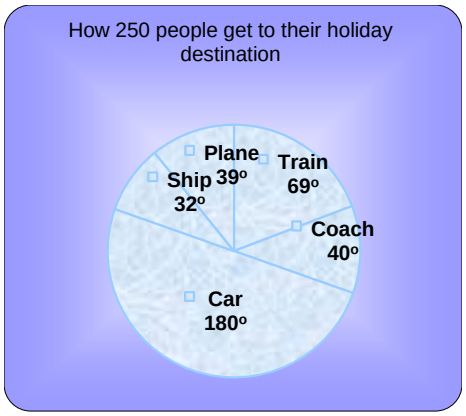
Type of transport	**Frequency**	**Multiplying Factor**	**Angle**
Train	48	48 ÷ 250 = 0.192	360× 0.192 ≈ 69°
Coach	28	28 ÷ 250 = 0.112	360× 0.112 ≈ 40°
Car	125	125 ÷ 250 = 0.5	360× 0..5 ≈ 180°
Ship	22	22 ÷ 250 = 0.088	360× 0.088 ≈ 32°
Plane	27	27 ÷ 250 = 0.108	360× 0.108 ≈ 39°

Totals	**250**	**1**	**360°**

Notice:

- We use the total of 250 to calculate each fraction
- We round off each angle to the nearest degree
- We check that the sum of all the angles is 360°

The pie chart can now be drawn. Remember, it is always good practice to draw the smallest angle first, then the next smallest, and so on, until the last angle will automatically be the largest. This reduced the effect that the successive additions of error have on the accuracy of the last angle drawn.

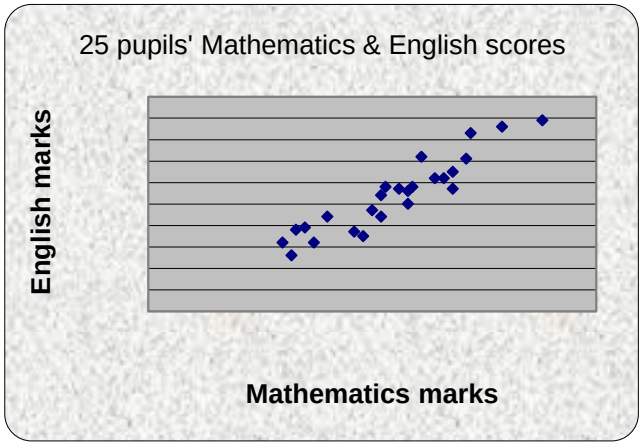


INTERPRETATIONS

- Most people travel to holiday by car
- Less than a quarter go by train
- If 1000 people went on holiday, about 160 would go by coach
- There is no information about who took part in the survey, so is the pie chart representative of the population? ***(Level 6)***

SCATTER DIAGRAMS *(LEVEL 7)*

A scatter diagram is a method of comparing two sets of data, and discovering if there is a link (relationship) between them, e.g.



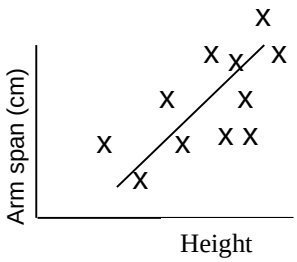
Looking at relationships, scatter diagrams tell us whether there is a **correlation** (link) between the two data sets. It is quite common when using scatter diagrams to include a line of best fit (a straight line), which goes through the middle of the data, passing as close to as many points as possible. This would allow us to make estimates for certain cases.

Here are three statements that may or may not be true.

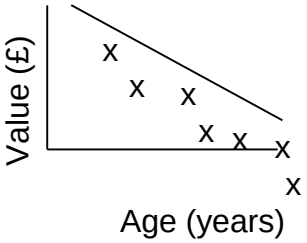
- The taller people are, the wider their arm span is likely to be.
- The older a car is, the lower its value will be.

- The distance you live from your place of work will affect how much you can earn.

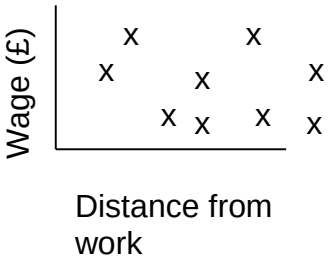
Collecting data and plotting the data on a scatter diagram could test these relationships. For example, the first statement may give a scatter diagram like that on the right. This has a **positive correlation** because the data has a clear 'trend' and we can draw a line of best fit that passes quite close to most of the points. From such a scatter diagram we could say that the taller someone is, the wider the arm span.



Testing the second statement may give a scatter diagram like that on the right. This has a **negative correlation** because the data has a clear 'trend', and we can draw a line of best fit that passes quite close to most of the points. From such a scatter diagram we could say that as a car gets older, its value decreases.



Testing the third statement may give a scatter diagram like that on the right. **This scatter diagram has no correlation.** It is not possible to draw a line of best fit. It could therefore say that there is no relationship between the distance a person lives from his or her work and how much the person earns. ***(Level 7)***



Averages

This is a number that is used to represent a set of data. There are three main averages used in different circumstances. You have to choose the most appropriate average to use. ***(Level 6)***

MEAN*:* The sum of all the values divided by the number of values, eg Find the mean of 6, 3, 1, 4

$$\text{Mean} = \frac{6 + 3 + 1 + 4}{4}$$

$$= 14 \div 4$$

= 3.5 Note: The mean is a good **average** when the range is small.

MEDIAN*:* The value in the **middle** of the data after it has been arranged in size order. If we have an even number of data, then we find the mean of the middle two values.

Example 1. Find the median of 4, 6, 3, 2, 1

6, 4, ③, 2, 1 ∴ **Median is 3**

Example 2. Find the median of 4, 6, 3, 2, 1, 2

6, 4, 3, 2, 2, 1 ∴ Median = $\frac{3 + 2}{2}$ = 2.5

Note: The median is a useful average when the range is large.

MODE*:* The value in the data that occurs **most** frequently, e.g.

Find the mode of: 3, 15, 0, 3, 1, 0, 4, 3 **Mode = 3**
Note: If there is no number that occurs most often, there is no mode.

The **range** is the spread of data, i.e. the largest value subtract the smallest value.

7, 6, 8, 12, 9 **Range = 12 – 6 = 6**

Problem solving

Algebra – a common approach

Algebra is often referred to as the language of mathematics. When working with algebra it is important that before attempting to perform any calculations pupils translate the 'algebra' into 'English'.

Substituting into formulae

Again, it is essential that pupils write out what the formula means in "long hand", before replacing the letters with numbers. Stressing the importance of method is essential to obtaining the correct answer. It is expected that pupils show all of the following working out exactly as detailed below, the equal signs all underneath each other. ***(Level 6)***

Example: $v = u + at$ means '$v = u + a \times t$' (remembering to multiply first!)

So given $u = 4$, $a = -5$, $t = 10$, $v = ?$

We now *literally* replace the letters with the numbers and perform the calculation in the normal way, not forgetting to multiply first!

$v = 4 + (-5) \times 10$

$v = 4 + (-50)$

$v = -46$

Note

Problems will occur if you provide the pupils with values for v, u and a and ask them to find the value of t. This is quite a difficult question/concept for pupils and will need reminding of the method.

Example: $5x + 3 = 18$ *means* "five times a number plus three equals eighteen"

Solving Equations

There are three main methods for solving equations.

METHOD ONE – COVER UP METHOD

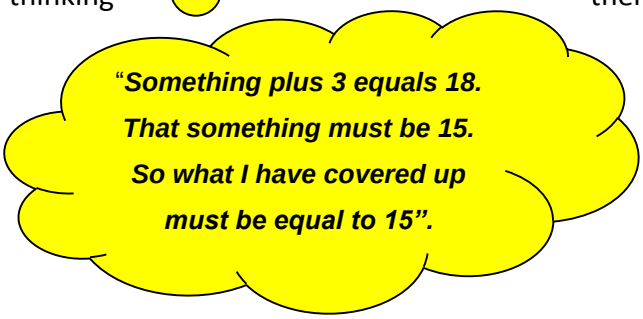
Example

Solve: 5*x* + 3 = 18

We first cover up the "5*x*" with something:

📖 + 3 = 18

The thinking then goes something like this:



We can then write down: 5*x* = 15

Five times something equals 15

So

***x* = 3**

METHOD TWO – BALANCING METHOD

Example

Solve: **5*x* + 3 = 18**

The idea here is to consider the equals sign as a set of balancing scales, and therefore whatever you do to one side of the equals sign you have to do to other if the scales are to remain balanced. For example, if you add 3 to one side you must add 3 to the other; if you divide by 4 on one side, you divide by 4 on the other. This is the mathematically conventional way of solving all equations and thus the one least liked by middle/low attaining pupils.

So, to solve our equation: 5*x* + 3 = 18 (-3)

subtract 3 from both sides

5*x* = 15 (÷ 5)

divide both sides by 5 and ***x* = 3**

Pupils should check solutions by substituting answers back into the original equations

METHOD THREE – MACHINE/INVERSE METHOD

Example: Solve $5x + 3 = 18$ ***(Level 5)***

Solution: First we look at 'what is happening to *x*', in the correct order, to get 18.

$$x \rightarrow \boxed{\times 5} \rightarrow \boxed{+ 3} \rightarrow 18$$

We then push the "18" back through the machine in the reverse order performing the inverse operation e.g. **+ 3** becomes **– 3** and **× 5** becomes **÷ 5**

We then get:

$$3 \leftarrow \boxed{\div 5} \overset{(15)}{\leftarrow} \boxed{- 3} \leftarrow 18$$

so

$$\boldsymbol{x = 3}$$

This method can also be used effectively when **rearranging** simple equations. ***(Level 8)***

Example

Rearrange the following equation, writing *v* in terms of *u*

$$v = \frac{u}{2} + 14$$

First we look at what is happening to *u*, in the correct order, to get *v*. We then reverse the flow diagram by putting the "*v*" back through the machine.

$$u \rightarrow \boxed{\div 2} \rightarrow \boxed{+ 14} \rightarrow v$$

Performing the inverse operations e.g. **+14** becomes **–14** and **÷2** becomes **×2**

$$2(v - 14) \leftarrow \boxed{\times 2} \overset{(V - 14)}{\leftarrow} \boxed{-14} \leftarrow v \text{ and so } \quad \boldsymbol{u = 2(v - 14)}$$

Accuracy in measurement & drawing

Pupils should be expected to draw and measure accurately. It is an essential requirement in many subjects. For example:

- *Reading scales in science and technology*
- *Measuring and cutting materials in textiles*
- *Plotting points on graphs in geography*
- *Measuring distances and times in physical education*

Equipment:

Pupils should be actively encouraged to have with them at all times ***a ruler, protractor, a pair of compasses, a sharp pencil and an eraser*** so that they can work accurately.

Estimation:

Estimation is an important aspect of measurement and drawing. Pupils should be encouraged whenever possible to make sensible estimates before measurement. Estimation can help pupils avoid careless mistakes in measurement. Estimation can also be used to introduce discussion on appropriate and sensible degrees of accuracy.

Units:

The choice of units is also important particularly as many pupils confuse the units of length, area and volume. (Note: in mathematics, cm^3 is called 'cubic centimetres' rather than 'centimetres cubed'). Pupils also need to understand that in some contexts, millimetres are used as the principle unit of length rather than centimetres. Note: pupils are taught about commonly used imperial units and their metric conversions.

Checking accuracy:

Pupils involved in measurement tasks need to be clear about the level of accuracy required so their work can be checked and marked fairly. Peer assessment is a very useful strategy for improving accuracy and promotes self-evaluation.

Tables, Charts and graphs:

For consistency and accuracy, drawing will usually be done in pencil, with straight lines drawn using a ruler, *for example, in tables, graph axes, sketches and diagrams.* Points and lines on graphs should be plotted and drawn using a sharpened pencil. Labelling of graphs and diagrams should normally be completed in ink, *for example titles, axes labels etc.* The use of a pencil and eraser can be a helpful way to improve drawing, *for example in drawing curved line graphs.* Sketches that do not

need to be accurately measured still need to be neat and legible *(as does numerical working and jottings).*

Numeracy Skill by Year group

The following are the basic skills a core pupil will have achieved by the end of the given year – as outlined in the National Numeracy Strategy.

Pupils working at a level below their current year peers will be expected to, in most cases, be working at a level equivalent to one or two years below. E.g. a low ability year 7 will be working at an equivalent year 5/6 pupil.

Years 5 and 6 Skills

We might well expect pupils at this level to able to:

- Use all four operations to solve simple word problems involving number and quantities based on real life money and measures
- Multiply and divide positive whole numbers by 10, 100 and 1000
- Order positive and negative numbers
- Use decimal and negative numbers
- Use decimal notation for tenths and hundredths
- Find basic fractions of quantities, e.g. ½ of, ¼ of, $^{1}/_{10}$ of
- Find simple percentages of quantities, e.g. 10%, 50%, 25%
- Basic calculator skills but NO scientific calculator skills taught at primary school
- Round a number with one or two decimal places to the nearest whole number
- Use, read and write standard metric units, including their abbreviations, and conversions between them
- Suggest suitable units and measuring equipment to estimate or measure length, mass or capacity
- Measure and draw lines to the nearest millimetre
- Calculate area and perimeter of simple shapes
- Record estimates and readings from scales to a suitable degree of accuracy
- Recognise perpendicular and parallel lines
- Recognise where a shape will be after reflection

- Read and plot co-ordinates in all four quadrants
- Use a protractor to measure angles ***up to 180^o***
- Find the mode and range of a set of data and begin to calculate a mean of a set of data
- Able to extract and ***interpret*** data in tables and bar charts

Year 7 Skills

All of the above, plus …

- Know and use the order of operations, including brackets, i.e. brackets, × and ÷, then + and − **(4)**
- Mental methods to calculate simple decimals, fractions and percentages **(4)**
- Check a result by considering whether it is of the right magnitude – estimation **(5)**
- Use a letter to represent unknown numbers **(5)**
- Simplify algebraic expressions, e.g. $x + 2y + 3x – y = y + 4x$ **(6)**
- Use simple formulae **(5)**
- Calculate area, perimeter and volume for simple shapes **(5)**
- Design a data collection sheet or questionnaire to use in a simple survey; construct frequency tables (**4/5)**
- Construct, on paper and using ICT, graphs and diagrams to represent data including bar-line graphs, frequency diagrams **(6)**
- Use ICT to generate pie charts **(6)**
- Compare data using the range, mean, median and mode **(7)**
- Interpret diagrams and graphs (including pie charts) and draw simple conclusions based on the shape of graphs and simple statistics **(7)**

Year 8 Skills

All of the above plus …

- Add, subtract, multiply and divide positive and negative numbers **(5)**
- Calculate any fraction of any quantity **(5)**
- Use squares, square roots, cubes and cube roots **(5/6)**

- Find any percentage of any quantity **(5)**
- Reduce a ratio to its simplest form **(5)**
- Use a scientific calculator to carry out more difficult calculations **(7)**
- Solving simple algebraic equations, e.g. $2x + 3 = 15$ **(5)**
- Plot graphs of simple algebraic equations, including interpretation of the gradient of a straight line **(6)**
- Use and read and write standard metric units to solve problems involving perimeter, area and volume **(5)**
- Calculate area, perimeter and volume of simple shapes including triangles **(6/7)**
- Understand and use the language and notation associated with enlargement **(6/7)**
- Collect data using a suitable method, including data logging using ICT **(6)**
- Able to construct, extract and interpret data in tables, bar charts, pie charts, simple line graphs and scatter graphs **(NB – both on paper and using ICT) (6)**
- Find the mean, median, mode and range of a set of data, both discrete and continuous, and begin to calculate mean of a set of continuous data (**6/7)**

Year 9 Skills

All of the above plus …

- Begin to use numbers in standard form **(8)**
- Add, subtract, multiply and divide fractions **(6)**
- Make and justify estimates and approximations of calculations **(5/6)**
- Use formulae from mathematics and other subjects including substitution of numbers into those formulae and changing the subject of those formulae **(6/7)**
- Construct graphs arising from real life problems, for example: distance time graphs, conversion graphs, e.g. temperature, currency **(6)**
- Circle facts - formulae for perimeter and area **(6)**
- Use and interpret maps and scale drawings **(6)**
- Suggest a problem to explore using statistical methods, frame questions and raise conjectures/hypotheses **(8)**