Numeracy Across Learning

Airdrie Academy

Numeracy is developed in Maths but is reinforced in departments across the school.

Introduction

This is the 1st edition of the Airdrie Academy Numeracy booklet.

This booklet is designed to be a guide for pupils, parents and teachers of all subject areas to show how Numeracy is approached in Airdrie Academy.

Aim

The main aim of this booklet is to show pupils, parents and teachers the key strategies the Maths department use to teach each of the topics.

It is hoped that with a consistent approach across the whole school and at home, pupils will be able to enjoy and progress in numeracy, thus improving their attainment.

Thanks

A huge thank you to everyone who helped produce this booklet. It could not have happened without your help. Thanks!

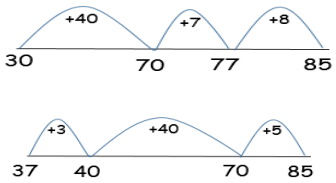
Contents

Addition

MNU 3-03a I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my process and solutions.

Pupils are taught to understand addition as combining two sets and counting on.

<table>
<tr>
<td>Adding up in Chunks / Counting on

37 + 48
= 85
 

</td>
<td>Place Value—Partitioning

116 + 127

100 + 100 = 200
10 + 20 = 30
6 + 7 = 13

200 + 30 + 13 = 243</td>
<td>Compensation

67 + 28
+2
= 67 + 30
= 97—2
= 95</td>
</tr>
<tr>
<td>Reordering

25 + 26 + 75
 
100 + 26 = 126</td>
<td>Friendly Numbers

49 + 38
+1 -1

= 50 + 37
= 87</td>
<td>Doubles/ Near Doubles

16 + 17

= 16+16+1
= 32 + 1
= 33</td>
</tr>
<tr>
<td>Written / Chimney

4 5 7
+ 8 6 2
1 3 1 9
1</td>
<td colspan="2">Pupils will be encouraged to perform as many calculations as possible in their heads.</td>
</tr>
</table>

Subtraction

MNU 3-03a I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my process and solutions.

Pupils are taught to understand subtraction as taking away (counting back) and finding the difference (counting on).

<table>
<tr>
<td>Removal or Counting Back

123—69
123—(20+40+3+6)
123—20 = 103
103—40 = 63
63—3 = 60
60—6 = 54</td>
<td>Place Value— Partitioning

367—154
367—100 = 267
267—50 = 217
217—4 = 213</td>
<td>Keep a constant difference

151—98
+2 +2
153—100
= 53</td>
</tr>
<tr>
<td>Reordering

25—6—5
 
20 - 6 = 14</td>
<td>Adjusting for Easier numbers

123—59
+1
123—60
= 63 + 1
= 64</td>
<td>Adding up / Bridging through 10

23—16
16 + 4 + 3 = 23

4 + 3 = 7</td>
</tr>
<tr>
<td>Place Value and Negative numbers

399—254
(300+90+9) - (200+50+4)
300 + 90 + 9
-200 - 50 - 4

100 + 40 + 5
= 145</td>
<td colspan="2">Written / Chimney

8 9 7
- 6 7 4
2 2 3

4 5 10 9 10
- 2 6 8
2 3 2</td>
</tr>
</table>

Multiplication

MNU 3-03a I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my process and solutions.

Pupils are taught to understand multiplication as repeated addition and scaling. It can also describe an array, for example the grid method.

<table>
<tr>
<td>Friendly Numbers

9 x 15

10 x 15 = 150
150—15 = 135</td>
<td>Partial Products

6 x 125
6 x (100 + 20 +5)

(6x100) + (6x20) + (6x5)
600 + 120 + 30
= 750</td>
<td>Breaking into factors

12 x 25
 
2 x 6 x 25
2 x 25 = 50
50 x 6 = 300</td>
</tr>
<tr>
<td>Repeated Addition

6 x 15
15+15+15+15+15+15
15+15 = 30
30+15 = 45
45+15 = 60
60 + 15 = 75
75 + 15 = 90</td>
<td>Doubling and Halving

24 x 8

x2 ÷2

48 x 4
x2 ÷2
96 x 2
= 192</td>
<td>Written Sum

137 x 4

137
<u>x 4</u>
<u>548</u>
1 2</td>
</tr>
<tr>
<td>Grid Method

35 x 7

<table><tr><td>X</td><td>30</td><td>5</td></tr><tr><td>7</td><td>210</td><td>35</td></tr></table>
210 + 35 = 245</td>
<td></td>
<td></td>
</tr>
</table>

Division

MNU 3-03a I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my process and solutions.

Pupils are taught to understand division as sharing and grouping.

Partial Quotients	Multiplying Up	Repeated subtraction
550 ÷ 15 36 r 10 15 | 550 -150 (10 x 15) 400 -300 (20 x 15) 100 -90 (6 x 15) 10 10 + 20 + 6 = 36	**72 ÷ 8** **8 x 5 = 40** **8 x 4 = 32** **+** **72** **5 + 4 = 9** **72 ÷ 8 = 9**	24 ÷ 6 24-6 = 18 (1) 18—6 =12 (2) 12—6 = 6 (3) 6—6 =0 (4) 24 ÷ 6 = 4

Factors and Multiples

MTH 3-05a I have investigated strategies for identifying common multiples and common factors, explaining my ideas to others and can apply my understanding to solve related problems.

Correct language is very important for use in algebraic work from level 2 onwards

3 is a factor of 12

12 is a multiple of 3

4 is a common factor of 20 and 24

24 is a common multiple of 3 and 4

4 is the highest common factor of 12 and 16

12 is the lowest common multiple of 3 and 4

Finding factors of a number in an organised fashion is essential for algebraic fluency

List the factors of 48 - list as ordered pairs so that none are missed

1 x 48, 2 x 24, 3 x 16, 4 x 12, 6 x 8

Order of Calculations

MNU 3-03b I can continue to recall number facts quickly and use them accurately when making calculations.

The rule BODMAS (or BIDMAS) tells us what operations should be done first.

B	Brackets	B	Brackets
O	Of	I	Indices
D	Division	D	Division
M	Multiplication	M	Multiplication
A	Addition	A	Addition
S	Subtraction	S	Subtraction

For example:

$26 - 2 \times 12$

$= 26 - 24$ BODMAS tells us to multiply before we subtract

$= 2$

$(10 + 5) \times 8$

$= 15 \times 8$ BODMAS tells us to do the brackets first then multiply

$= 120$

$4^2 + 8 \times 3$

$= 16 + 24$ BODMAS tells us to do the power and multiply

$= 40$ before we add

Rounding

MNU 3-01a I can round a number using an appropriate degree of accuracy, having taken into account the context of the problem.

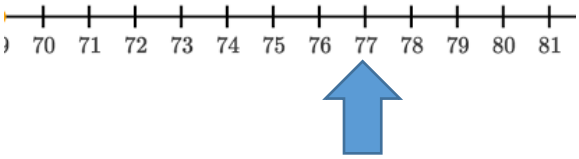
Numbers can be rounded to give an approximate answer. For example numbers are rounded when a general picture is required not the actual number.

For example - We do not need to know that there were 220,753 spectators in one day at the London Olympics. We would round it accordingly to 221,000

Rules of rounding
If the next number is a 4 or below we round down
If the next number is a 5 or above we round up

Examples

Round 77 to the nearest 10 Answer = 80 Because 77 is closer to 80



6713 to the nearest 100 is 6700

6713 to the nearest 1000 is 7000

Rounding to Decimal places

Pupils will be asked to round to a set number of decimal places. The number of digits to be left after the decimal point. The above rules still apply just to the next number.
For example
25.8437 rounded to 3 decimal places is 25.844
25.8437 rounded to 1 decimal place is 25.8

Rounding to Significant Figures

Pupils will be asked to round to a set number of significant figures. Significant figures start from the first digit of the number. Again the above rules still apply.
For example
46843 rounded to 4 significant figures is 46840
46843 rounded to 3 significant figures is 46800
46843 rounded to 2 significant figures is 47000
46843 rounded to 1 significant figure is 50000

Notice with significant figures we still require to keep the zeros as place holders

Estimating

MNU 3-03a I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my process and solutions.

Estimating is used to give an approximate answer so we can check our calculations.

For example - The numbers of ice creams sold were:

Monday	Tuesday	Wednesday	Thursday	Friday
96	76	102	52	113

We could round the numbers so we can estimate where the answer should be.

Instead of 96 + 76 + 102 + 52 +113
We add 100 + 80 +100 + 50 + 110 = 440

Pupils should be encouraged to estimate their answers before they perform the calculations.

Place Value

MNU 3-03b I can continue to recall number facts quickly and use them accurately when making calculations.

Millions	Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Units	• Tenths
	3	5	1	4	8	9	• 3

Adding and Subtracting Integers

MNU 3-04a I can use my understanding of numbers less than zero to solve simple problems in context.

Integers are numbers that are not fractions and can be positive, negative and zero. We put brackets around the negative numbers to highlight that they are negative.

1) 8 – 12 = -4
2) (– 5) – 6 = -11
3) (–4) + (-9) = -4 – 9 = -13
4) 8 + (-14) = 8 – 14 = -6
5) (-3) – (- 10) = -3 + 10 = 7
6) (-7) – (-5) = -7 + 5 = -2

Multiplying and Dividing Integers

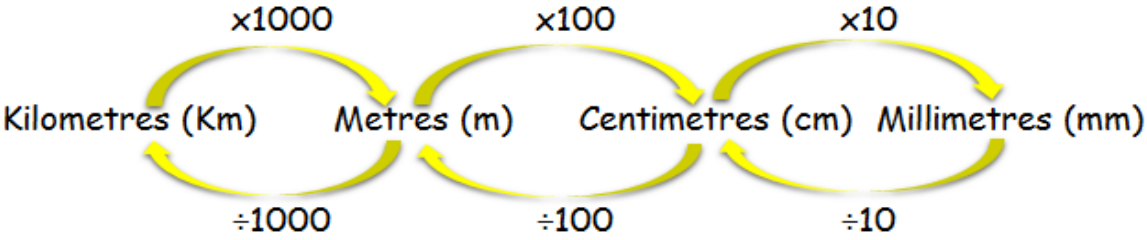
1) (-5) x 8 = -40
2) 6 x (-7) = -42
3) (-2) x (-9) = 18
4) (-12) ÷ 3 = -4
5) 20 ÷ (-10) = -2
6) (-45) ÷ (-5) = 9

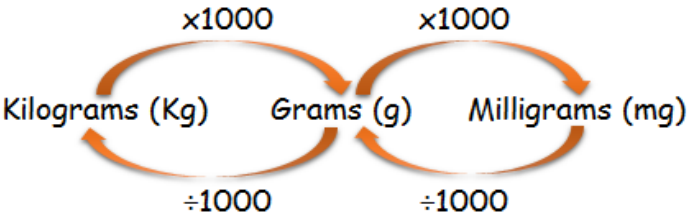
+ × + = +
+ × – = –
– × + = –
– × – = +

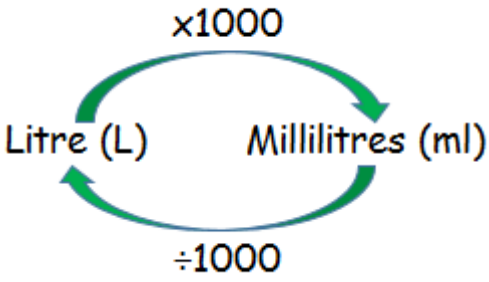
+ ÷ + = +
+ ÷ – = –
– ÷ + = –
– ÷ – = +

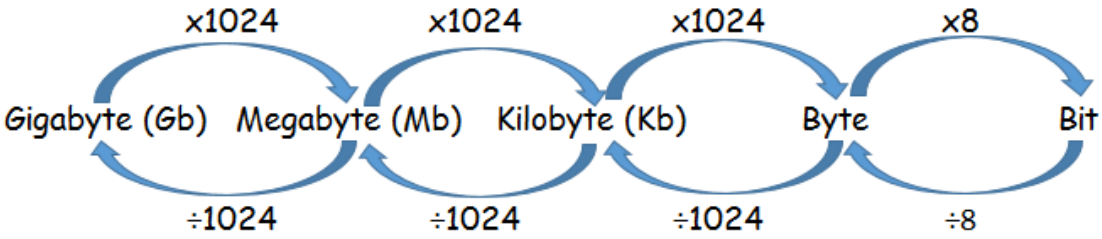
Numeracy Conversions

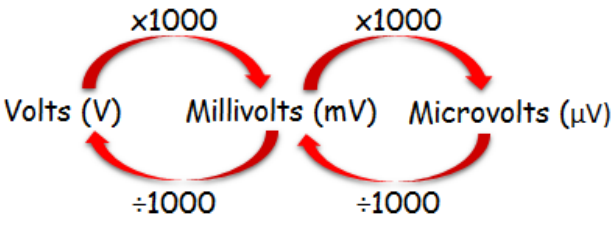
MNU 3-11a I can solve practical problems by applying my knowledge of measure, choosing the appropriate units and degree of accuracy for the task and using a formula to calculate area and volume when required.

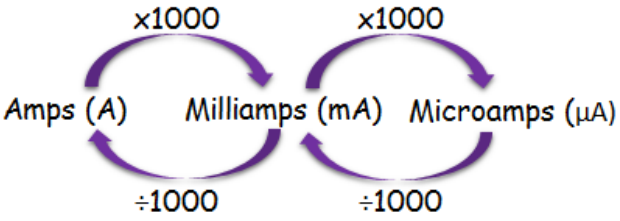








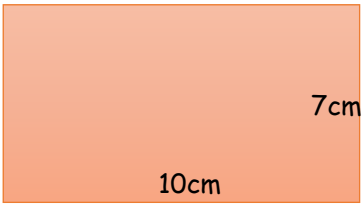
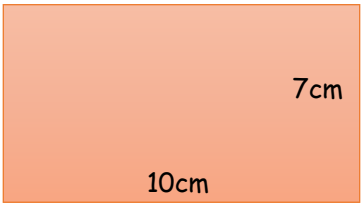
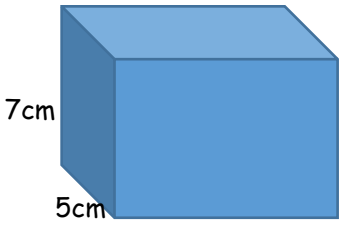




Remember to choose the right units for the calculations!

Perimeter, Area and Volume

MNU 3-11a I can solve practical problems by applying my knowledge of measure, choosing the appropriate units and degree of accuracy for the task and using a formula to calculate area and volume when required.

Perimeter	Area	Volume
The perimeter is defined as the length round the outside of the shape	The area is defined as the amount of surface inside the boundary of a 2 dimensional object.	The volume is defined as the amount of space inside a 3 dimensional object.
Example Find the perimeter of this shape.  Perimeter = 10 + 7 +10 + 7 = 34cm	Example Find the area of this shape.  Area = length x breadth = 10 x 7 = 70cm^2	Example Find the volume of this cuboid.  Volume = length x breadth x height = l x b x h = 10 x 5 x 7 = 350cm^3

Time

MNU 3 -10a Using simple time periods, I can work out how long a journey will take, the speed travelled at or distance covered, using my knowledge of the link between speed distance and time.

Time can be displayed on a clock face or a digital clock.

09:30

These clocks both show half past nine.

12 – Hour Notation

When writing time in 12 hour notation, we need to add am or pm after.

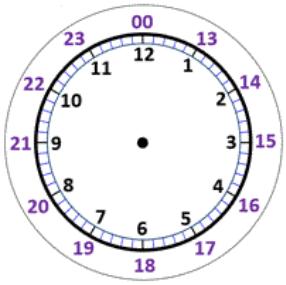
- am is used between midnight and 12 noon (Morning)
- pm is used between 12 noon and midnight (Afternoon)

24 – Hour Notation

In 24 hour notation the hours are written between 00 and 24.

- Midnight is 00:00 and noon 12:00

This can be written with or without the dots.
For example bus or train timetables do not have dots.



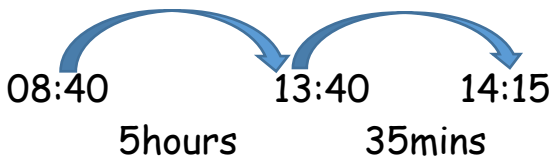
Examples

8.50am → 08:50	03:15 →3:15am
3.45pm → 15:45	11:20 → 11.20am
9.30pm → 21:30	22:10 → 10:10pm

Counting Time

When calculating time we will always use the counting on method. Pupils should be able to work in am/pm and 24hour notation and answer questions appropriately.

Find the time difference between 08:40 and 14:15



Time can be broken down into several different intervals. Pupils should be encouraged to do whatever they feel comfortable with but still be able to get the correct answer.

Speed, Distance and Time

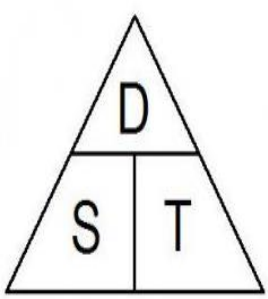
MNU 3 -10a Using simple time periods, I can work out how long a journey will take, the speed travelled at or distance covered, using my knowledge of the link between speed distance and time.

For any given journey the distance travelled depends on the speed and the time taken. If the speed is a constant then the following formulas apply.

$$\boldsymbol{Speed = \frac{Distance}{Time}} \qquad \boldsymbol{S = \frac{D}{T}}$$

$$\boldsymbol{Distance = Speed\ x\ Time} \qquad D = S\ x\ T$$

$$\boldsymbol{Time = \frac{Distance}{Speed}} \qquad \boldsymbol{T = \frac{D}{S}}$$



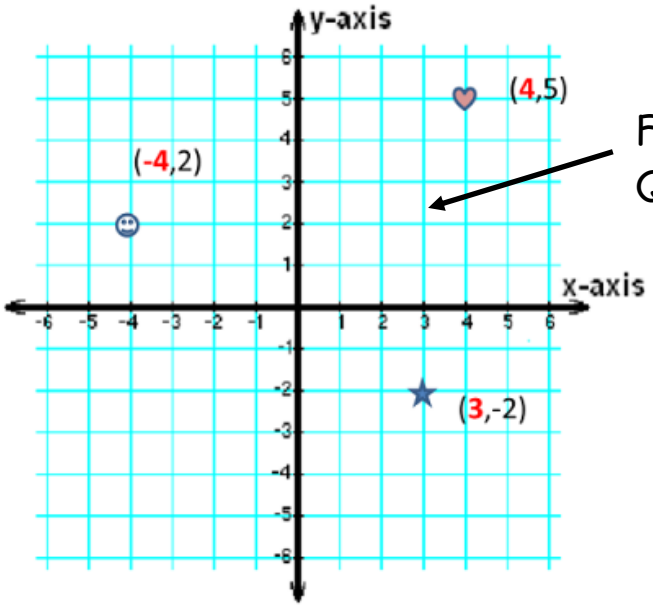
In Physics the speed is sometimes called the Velocity (v) however the calculations are exactly the same.

Coordinates

MNU 3-18a I can use my knowledge of the coordinate system to plot and describe the location of a point on a grid.

Level 2 pupils should be able to use coordinates in the 1st quadrant where both numbers are positive. Level 3 will then progress on to the four quadrants as pictured below.

Grid lines are numbered and points should be denoted (4, 5) with a comma between the numbers and using round brackets.



First Quadrant

(x coordinate, y coordinate)

(Along, Up or Down)

Bar Graph

MNU 3-21a I can display data in a clear way using a suitable scale, by choosing appropriately from an extended range of tables, chart, diagrams and graphs, making effective use of technology.

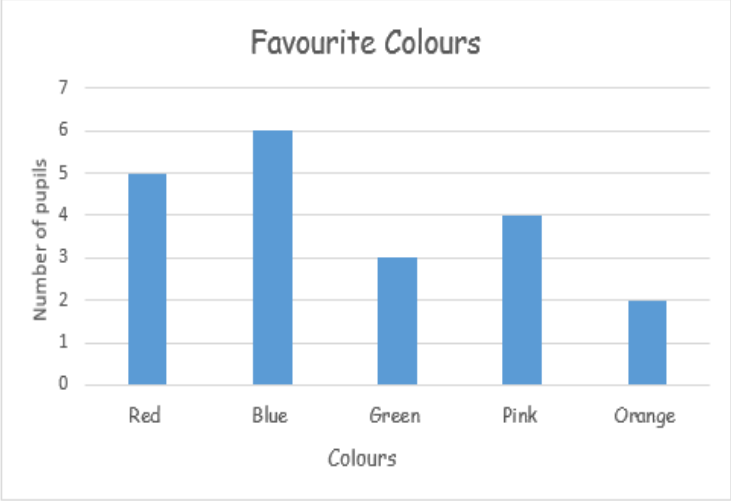
Bar graphs are used to display data. The horizontal axis (x axis) should show the categories and the vertical axis (y axis) should show the frequency.

All graphs should have titles and each axis should be labelled.

Example

Pupils were asked what their favourite colour was.

Red	Blue	Green	Pink	Orange
5	6	3	4	2



Bar Charts need to include

- Correct scales
- Spaces in between the bars
- A heading
- Labels on both axes

Bar graphs should show **discrete data**

Discrete data is data can be categorised into a classification. Discrete data is based on counts and there are only a few values possible.

For example

-the number of pupils in a class

- people's income
- favourite colour
- favourite animal

Line Graphs

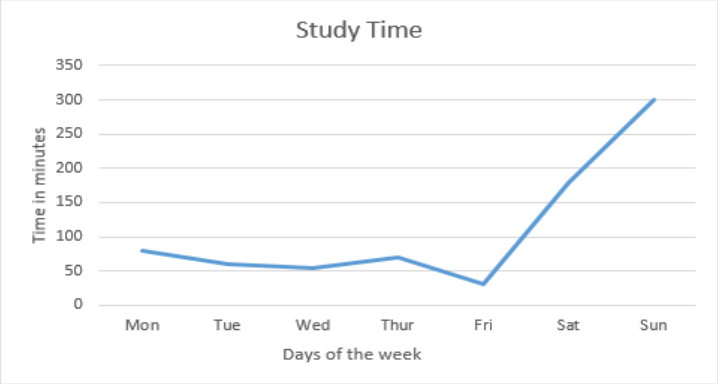
MNU 3-21a I can display data in a clear way using a suitable scale, by choosing appropriately form an extended range of tables, chart, diagrams and graphs, making effective use of technology.

Line graphs are made up of several points joined up with a line. The horizontal axis (x axis) show the continuation of time and the vertical axis (y axis) should show the frequency.

All graphs should have titles and each axis should be labelled.

Number of ice creams sold over a week.

Mon	Tue	Wed	Thur	Fri	Sat	Sun
80	60	55	70	30	180	300



Line Graphs need to include

- Correct scales
- A heading
- Labels on both axes
- A continuous line drawn with a ruler

A Line Graph should show **continuous data**

Continuous data is data that can be measured and broken down into smaller parts and still have meaning.

For example

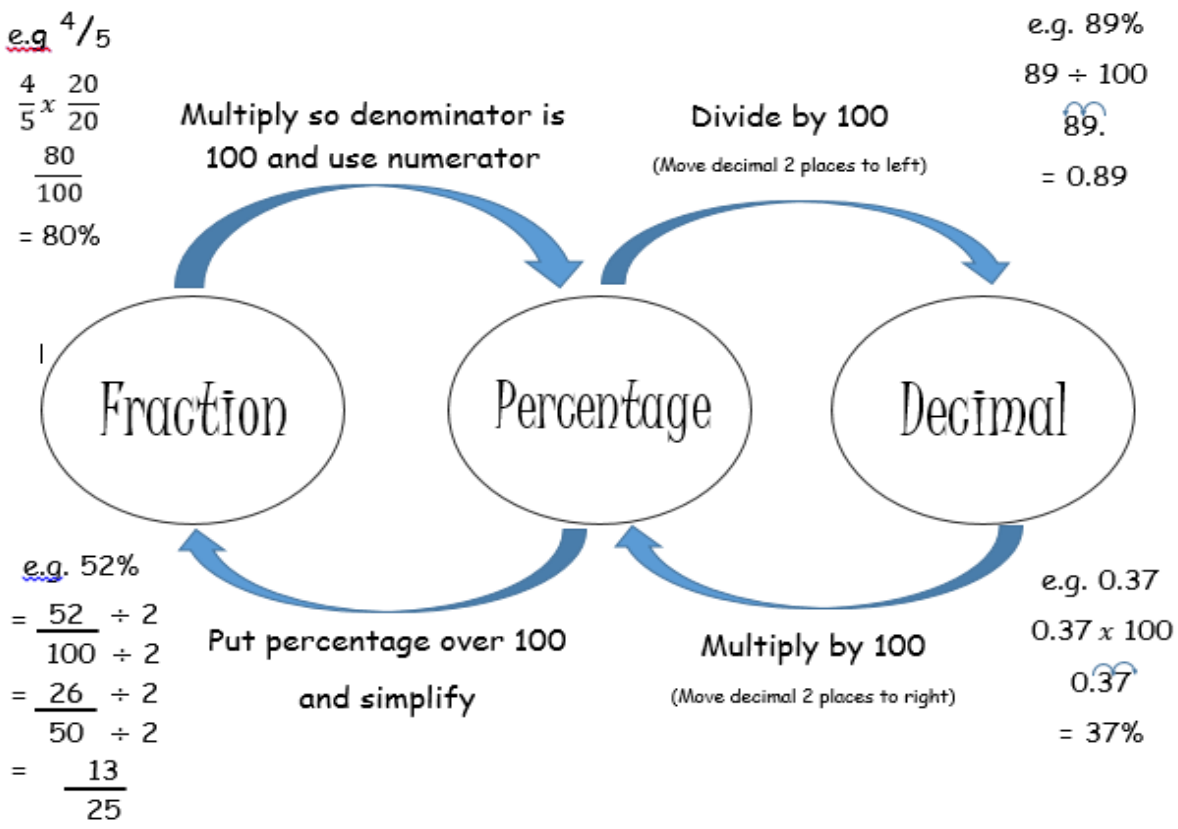
- Money
- Temperature
- Time

Remember

Discrete data is counted,
Continuous data is measured

Connecting Fraction, Percentages and Decimals

MNU 3-07a I can solve problems by carrying out calculations with a wide range of fractions, decimals fractions and percentages, using my answers to make comparisons and informed choices for real life situations.



Percentages

MNU 3-07a I can solve problems by carrying out calculations with a wide range of fractions, decimals fractions and percentages, using my answers to make comparisons and informed choices for real life situations.

Percent means "out of one hundred"

To calculate simple percentages pupils need to convert percentages into fractions.

10%	20%	$33\frac{1}{3}\%$	50%	$66\frac{2}{3}\%$	75%
$\frac{1}{10}$	$\frac{1}{5}$	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{3}{4}$

Find $33\frac{1}{3}\%$ of 1500

$33\frac{1}{3}\%$ of 1500
$\frac{1}{3}$ of 1500
= 500

Harder Percentages

Non Calculator Method	Calculator Method
Find some combination of simple percentages to make up the complex percentage. For example 5% = 10% ÷ 2 35% = 3 x 10% + 5% 19% = 20% - 1% Find 17.5% of £300 10% = 300 ÷ 10 = £30 5% = 10% ÷ 2 = 30 ÷ 2 = £15 2.5% = 5% ÷ 2 = 15 ÷ 2 = £7.50 17.5% = £52.50	Type into the calculator Percentages = % ÷ 100 x amount Find 17% of £30 17 ÷ 100 x 30 = £5.10

Decimal

MNU 3-07a I can solve problems by carrying out calculations with a wide range of fractions, decimals fractions and percentages, using my answers to make comparisons and informed choices for real life situations.

Adding and Subtracting Decimals

Calculate 16.8 + 8.49

Fill in the missing place values with zeros then add or subtract accordingly

$$\begin{array}{r} 16.80 \\ +\ 08.49 \\ \hline 25.29 \\ \scriptstyle 1\ \ 1 \end{array}$$

Calculate 83.05 – 6.9

$$\begin{array}{r} {\scriptstyle 7\ 1\ 2}\\ 8\not{3}\ .\ {\scriptstyle 1}05 \\ -\ 06\ .\ 90 \\ \hline 76\ .\ 15 \end{array}$$

The decimal points line up!

Multiplying and Dividing Decimals

Calculate 34.2 x 3

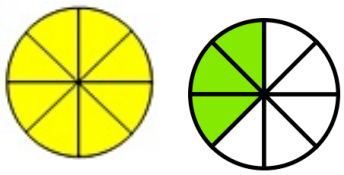
$$\begin{array}{r} 34.2 \\ \times\ \ 3 \\ \hline 102.6 \\ \scriptstyle 1 \end{array}$$

Calculate 1.24 ÷ 4

$$\begin{array}{r} 0.31 \\ 4\overline{)\,1\ .\ {\scriptstyle 1}2\,4} \end{array}$$

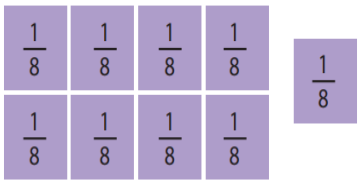
Proper to Improper Fractions (Top heavy)

MTH 3-07c Having used practical pictorial and written methods to develop my understanding, I can convert between whole or mixed numbers and fractions.

$1\frac{3}{8}$ Looks like  $= \frac{11}{8}$

$2\frac{5}{7} = \frac{2 \times 7 + 5}{7} = \frac{19}{7}$

Improper to Proper Fractions

$\frac{9}{8}$ **looks like**  $= 1\frac{1}{8}$

$\frac{11}{5} = 11 \div 5 = 2$ remainder $1 = 2\frac{1}{5}$

Simplifying Fractions

We should always check if a fraction can be simplified.

$\frac{2}{4} \overset{\div 2}{=} \frac{1}{2}$ $\qquad \frac{3}{12} \overset{\div 3}{=} \frac{1}{4}$ $\qquad \frac{15}{20} \overset{\div 5}{=} \frac{3}{4}$

Sometimes when it is not obvious to see a higher factor there is nothing wrong with halving and halving again until you do notice a factor.

$$\frac{28}{42} \overset{\div 2}{=} \frac{14}{21} \overset{\div 7}{=} \frac{2}{3}$$

Adding and Subtracting Fractions

MTH 3-07b By applying my knowledge of equivalent fractions and common multiples, I can add and subtract commonly used fractions.

You can only add and subtract fractions if they have the same denominator.

$$\frac{3}{7} + \frac{2}{7} = \frac{5}{7} \qquad \frac{8}{11} - \frac{3}{11} = \frac{5}{11}$$

If they are not the same you have to multiply each fraction to make the same denominator.

$$\frac{1}{2} + \frac{3}{5} = \frac{5}{10} + \frac{6}{10} = \frac{11}{10} = 1\frac{1}{10}$$

When adding it is easier to add the whole numbers then add the fractions.

$$1\frac{1}{5} + 3\frac{4}{7} = 4\frac{1}{5} + \frac{4}{7} = 4\frac{7}{35} + \frac{20}{35} = 4\frac{27}{35}$$

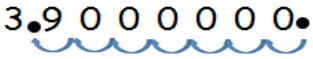
Scientific Notation or Exponentials

MTH 3-06a Having explored the notation and vocabulary associated with whole number powers and the advantages of writing numbers in this form, I can evaluate powers of whole numbers mentally or using technology.

In mathematics scientific notation consists of a number between 1 and 10 multiplied by some power of 10

Writing in scientific notation

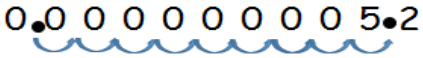
Write 39,000,000 in scientific notation?



= 3.9×10^7

The point moves 7 places to the left and as it is a big number it is a positive power

Write 0.0000000052 in scientific notation?



= 5.2×10^{-9}

The point moves 9 places to the right and as it is a small number it is a negative power

More Examples

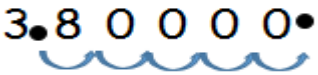
27 800 000 = 2.78×10^7 600 000 = 6×10^5 0.0000789 = 7.89×10^{-5}

Writing whole numbers from Scientific notation

Write 3.8×10^5 in full?

Use the first part of the scientific notation and count how many places the decimal is going to move.

Fill in the spaces with zeros



Then write the number out properly

3 8 0 0 0 0

More examples

$4.86 \times 10^6 = 4{,}860{,}000$ $7.6548 \times 10^8 = 765{,}480{,}000$ $7.914 \times 10^{-7} = 0.0000007914$

How Science do it –

Science uses the term - exponential and often they only use 10 raised to a power.

$10^3 = 10 \times 10 \times 10 = 1000$

$10^{-3} = 0.001$ $10^6 = 1000000$ $10^{-6} = 0.000001$

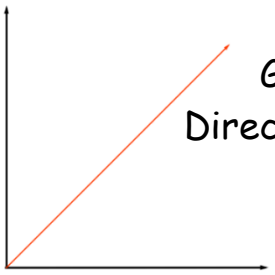
Direct Proportion

MNU 3-08a I can show how quantities that are related can be increased or decreased proportionally and apply this to solve problems in everyday contexts.

If two things are directly proportional it means as one rises the other rises also.

When you buy something the

more you buy the more is costs.



Graph of
Direct proportion

Example

If 8 sweeties cost £2.56, how much will 13 cost?

8 Sweeties	= £2.56
1 Sweet	£2.56 ÷ 8 = £0.32
13 Sweeties	£0.32 x 13 = <u>£4.16</u>

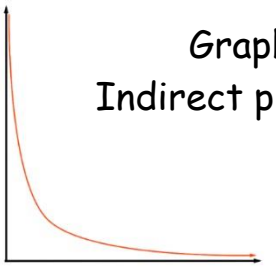
Indirect proportion

If two quantities are indirectly proportional then one quantity increases and the other decreases.

For example

The more workers on a job

the shorter the time



Graph of
Indirect proportion

Example

If it takes 5 workers 30 hours to build a wall how long will it take 3 workers?

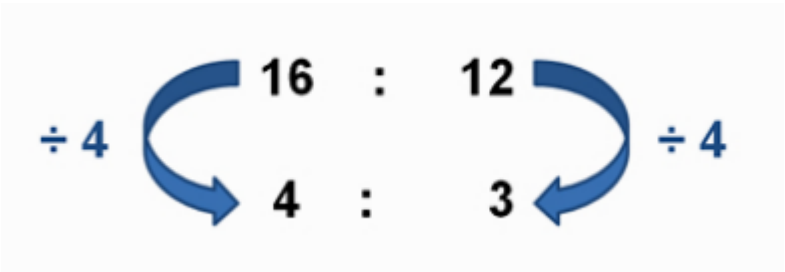
5 workers	30 hours
1 worker	= 5 x 30 = 150
3 workers	= 150 ÷ 3 = <u>50 hours</u>

Ratio

MNU 3-08a I can show how quantities that are related can be increased or decreased proportionally and apply this to solve problems in everyday contexts.

Ratio is a way of comparing two or more quantities.

Simplifying ratio works the same as simplifying fractions.



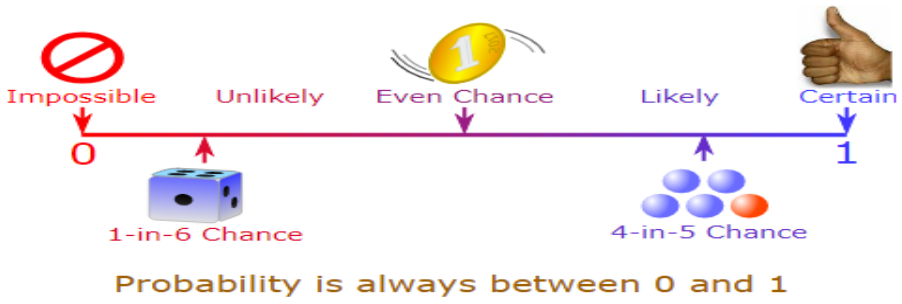
Divide by the highest common factor

The simplified ratio is 4:3

Probability

MNU 3-22a I can find the probability of a simple event happening and explain why the consequences of the event, as well as its probability, should be considered when making choices.

How **likely** something is to happen



Probability of an event = $\frac{\text{Number of ways it can happen}}{\text{Total number of possible outcomes}}$

Example

Tossing a head with a coin P(head) = $\frac{1}{2}$

Throwing a 4 on a die P(4) = $\frac{1}{6}$

Multiplication Grid

MNU 3-03b I can continue to recall number facts quickly and use them accurately when making calculations.

X	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

Useful Websites

www.sumdog.com
All S1 and S2 pupils have been issued with a username and password.

https://blogs.glowscotland.org.uk/nl/airdrieacadmaths/workouts/
The password is mathspupil

http://www.mathsrevision.com/