BRIDGE OF DON ACADEMY
A Curriculum for Excellence

# Numeracy Across the Curriculum

## Introduction

All staff in all schools are responsible for numeracy skills.

This booklet concerns itself with the mechanisms, processes, methods and working associated with each Numeracy Outcome at levels 2, 3 and 4.

| **Level** | **Roughly corresponding to pupil group** |
|---|---|
| Early | Pre-school and P1 |
| 1st | P2 to P4 |
| 2nd | P5 to P7 |
| 3rd | S1 to S3 |
| 4th | S4 to S6 |

The entries in this booklet identify most the experiences and outcomes that the majority of pupils should have achieved by the end of the stated level.

The strategies used in this booklet are not the only ones that can be used. They are just a suggestion and illustrate a method that every pupil will have been shown in their maths class. Use of other, valid methods is perfectly acceptable.

**General points**:

1. Notice that the equals symbols are in a column to show that it is a connected calculation.

2. Do not abuse equals signs (e.g. 3 + 9 = 12 – 4 = 8 is not true: 3 + 9 = 12 then 12 – 4 = 8).

3. Encourage arithmetic (i.e. non-calculator)

4. Make sure “working” is shown (as set out in this booklet).

5. Commas are no longer used when writing large numbers. Instead a small space is inserted (e.g. 3 million should be written as 3 000 000 not 3,000,000). This is to avoid confusion with other countries, most notably in Europe where a comma is used as a decimal point.

# CONTENTS

# ESTIMATING AND ROUNDING

## 2nd level:

“***I can use my knowledge of rounding to routinely estimate the answer to a problem, then after calculating, decide if my answer is reasonable, sharing my solution with others.***”

- I know what is meant by an estimate and can give examples
- I can round a whole number to the nearest 10 or 100
- I can give an estimated answer by rounding the numbers in my calculation

*Worked examples*:

1. “I am about 160 cm tall”
   “I woke up at around 7 am”
   “Nearly 5000 people were injured in the earthquake”

2. 478 is 480 (to the nearest 10)
   478 is 500 (to the nearest 100)

> When rounding, consider only the next unit down. The rule is, ‘5 or more round up’. Hence
> 35 is 40 (to the nearest 10)
> 150 is 200 (to the nearest 100)

3. 316 × 9

   My estimate is 300 × 10 = 3000

   Calculation

$$\begin{array}{r} 316 \\ \times 9 \\ \hline \underline{2844} \\ {\scriptstyle 1\;5} \end{array}$$

## 3rd level:

"***I can round a number using an appropriate degree of accuracy, having taken into account the context of the problem.***"

- I know when to round an answer
- I can round a number to any number of decimal places
- I can round a number to any number of significant figures

*Worked examples:*

1. Three friends share £10 equally. How much does each get?

The calculator says 3.3333….
Since we are using money the answer is £3.33

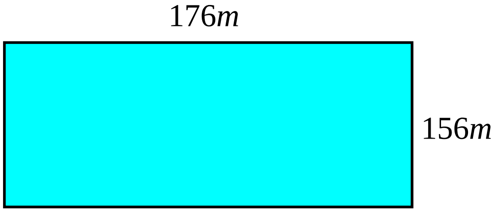
2.

| | |
|---|---|
| 1·8754 | is 1·875 (3 decimal places) |
| 1·8754 | is 1·88 (2 decimal places) |
| 1·8754 | is 1·9 (1 decimal place) |

Be careful 2·03 is 2·0 (1 decimal place) NOT just 2

3. Find the area of a rectangular car park which is 176m long and 156m wide; giving your answer to 3 significant figures.

$$\begin{aligned} \text{Area} &= l \times b \\ &= 176\text{m} \times 156\text{m} \\ &= 27456m^2 \\ &= 27500m^2 \quad \text{to 3 significant figures} \end{aligned}$$



The last two zeros are not significant. They only ensure that the 2, 7 and 5 have the correct place value only.

When rounding decimal fractions, the leading zeros are not significant, (they only ensure correct place value for the other digits) but zeros after the digits are significant.

e.g. $\underset{\uparrow\ \text{not significant}}{0}\cdot 071\underset{\uparrow\ \text{significant}}{\underline{0}}$

This number has been rounded to 3 significant figures.

## **<u>4th level</u>**:

"***Having investigated the practical impact of inaccuracy and error, I can use my knowledge of tolerance when choosing the required degree of accuracy to make real life calculations.***"

- I know rounding can effect calculations
- I know how to use rounding in calculations in order to obtain the degree of accuracy I require

*Worked examples:*

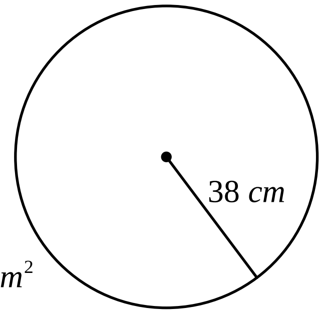
1. Find the area of a circle with radius 38 cm, giving your answer to the nearest 1 $cm^2$.

(a) using π key

$$\begin{aligned} Area &= \pi r^2 \\ &= \pi \times 38^2 \\ &= 4536 \cdot 459792\, cm^2 \\ &= 4536\, cm^2 \text{ to the nearest } cm^2 \end{aligned}$$

(b) using 3·14

$$\begin{aligned} Area &= \pi r^2 \\ &= 3 \cdot 14 \times 38^2 \\ &= 4534 \cdot 16\, cm^2 \\ &= 4535\, cm^2 \text{ to the nearest } cm^2 \end{aligned}$$



2. The crowd at the football match was estimated at 20 000 and **about** 20% were women. How many women were there?

This statement suggests that you would find 20% of 20 000 i.e. 4000 but it is too vague to give an accurate number.
The key word here is "about". If this proportion has been rounded to the nearest 5% then the actual figure could be anywhere between 3000 (15%) and 5000 (25%).

Photo printed with permission of SFA

## NUMBER AND NUMBER PROCESSES

### 2nd level:

"***I have extended the range of whole numbers I can work with and having explored how decimal fractions are constructed, can explain the link between a digit, its place and its value.***"

- I know the value of any digit by its place in a whole number
- I know the value of any digit by its place in a decimal fraction
- I can multiply or divide any number by 10 or 100 and understand the effect this has on a digit with the number

*Worked examples:*

1. 7421 The 7 is 7 thousands
   The 2 is 2 tens

2. 0·147 The 1 is 1 tenth
   The 7 is 7 thousandths

3. 74 × 10 = 740 (digits move one place to the left or you can think on this as "*add a zero to make the number 10 times bigger*")

4. 63 × 100 = 6300 (digits move two places to the left or you can think on this as "*add two zeros to make the number 100 times bigger*")

5. 69·4 ÷ 10 = 6·94 (digits move one place to the right or you can think on this as "*the decimal point moving one place to the left making the number 10 times smaller*"
   i.e. 6 tens became 6 units
   9 units became 9 tenths
   4 tenths became 4 hundredths)

“***Having determined which calculations are needed, I can solve problems involving whole numbers using a range of methods, sharing my approaches and solutions with others.***”

- I know terms which mean the same as add, subtract, multiply and divide
- I can use addition and subtraction to solve problems containing whole numbers
- I can use multiplication and division by a single digit to solve whole number problems
- I know which arithmetical operation to use when solving a problem

*Worked examples:*

1. Find the sum of 242 and 179

$$\begin{array}{r} 242 \\ \underline{+179} \\ \underline{421} \\ {\scriptstyle 1\ 1\ \ } \end{array}$$

(*carry* below the bottom line)

2. Find the difference between 6236 and 4487

$$\begin{array}{r} \overset{5}{\cancel{6}}\ \overset{{}^{1}1}{\cancel{2}}\ \overset{{}^{1}2}{\cancel{3}}\ \overset{1}{6} \\ -4\ \ 4\ 8\ 7 \\ \hline 1\ 7\ 4\ 9 \\ \hline \end{array}$$

(using decomposition)

3. 140 chocolate cakes and 160 iced cakes were ordered for a party but only 258 were eaten.
The rest were shared between 3 waiters.
How many cakes did each one get?

140 + 160 = 300 cakes

300 – 258 = 42 cakes

$$\begin{array}{r} 1\ \ 4 \\ 3\overline{)\ 4\ {}^{1}2} \end{array}$$

$\therefore$ 14 cakes each

Watch your logic
140 + 160 = 300 – 258 = 42 ÷ 3 = 14 is not acceptable because 140 + 160 ≠ 14
Use equal signs correctly!
Do the calculation one part at a time.

"***I have explored the contexts in which problems involving decimal fractions occur and can solve related problems using a variety of methods.***"

- I can add and subtract decimal fractions
- I can use decimal calculations to solve problems

*Worked examples:*

1. (a)

$$\begin{array}{r} 4\cdot39 \\ +1\cdot76 \\ \hline 6\cdot15 \\ {\scriptstyle 1\ \ 1} \end{array}$$

(b)

$$\begin{array}{r} 2\cdot{}^{8}\cancel{9}\,{}^{1}1 \\ -1\cdot3\ 6 \\ \hline 1\cdot5\ 5 \\ \hline \end{array}$$

The decimal points are in line, so a point can be placed in the answer before calculating

2. The tallest person in the class is 1·70m and the smallest is 1·49m. What is the difference in their heights in centimetres?

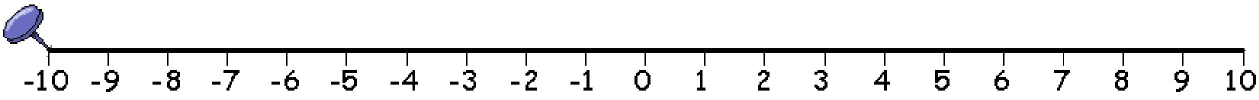
$$\begin{array}{r} 1\cdot{}^{6}\cancel{7}\,{}^{1}0 \\ -1\cdot4\ 9 \\ \hline 0\cdot2\ 1 \\ \hline \end{array}$$

0·21 *metres* = 21 *centimetres*

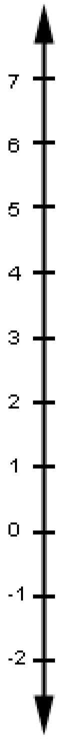
“***I can show my understanding of how the number line extends to include numbers less than zero and have investigated how these numbers occur and are used.***”

- I know negative numbers can be used to describe various thing below zero
- I know how to write negative numbers
- I can draw a number line both above and below zero
- I know that -5°c is colder than -1° c

## Number Lines



Vertical number lines are often easier to use than horizontal ones.



## 3rd level:

“***I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my processes and solutions.***”

- I can solve number problems using whole numbers and decimal fractions
- I can multiply and divide by 2 and 3 digit numbers
- I can multiply and divide by decimal fractions

*Worked example:*

1. 8 identical buckets can hold a total of 70 litres of water.

(a) What is the capacity of each bucket?

$$\begin{array}{r} 8\cdot 7\ 5 \\ 8\overline{)\,7\ 0\cdot{}^{6}0\,{}^{4}0} \end{array}$$

Each bucket can hold 8·75 litres.

(b) What would 5 buckets hold?

$$\begin{array}{r} 8\cdot 75 \\ \times 5 \\ \hline \underline{4\underset{3}{3}\cdot\underset{2}{7}5} \end{array}$$

Five buckets will hold 43·75 litres.

“***I can continue to recall number facts quickly and use them accurately when making calculations.***”

- I know my multiplication tables and can use them quickly and accurately
- I can multiply by multiples of 10 and 100
- I can use BODMAS

*Worked examples:*

1. $3{\cdot}4 \times 30 = 3{\cdot}4 \times 3 \times 10$
$= 10{\cdot}2 \times 10$
$= 102$

**2.** **B**rackets
p**O**wers
**D**ivide
**M**ultiply
**A**dd
**S**ubtract

This means that we work out anything that’s inside brackets first, then do powers then multiply & divide and finally we add & subtract.

Some people say BIDMAS, using ‘I’ for indices rather than ‘O’ for ‘Power’.

$100 - 3 \times (4 + 1)^2 + 6 \div 2$

**B**rackets
p**O**wers
**D**ivide
**M**ultiply
**A**dd
**S**ubtract

$= 100 - 3 \times 5^2 + 6 \div 2$
$= 100 - 3 \times 25 + 6 \div 2$
$= 100 - 3 \times 25 + 3$
$= 100 - 75 + 3$
$= 28$

N.B.
Add / Subtract is calculated in the order they are written
100 – 75 then + 3

“***I can use my understanding of numbers less than zero to solve simple problems in context.***”

- I can add and subtract negative numbers
- I can multiply and divide negative numbers
- I can use negative numbers in a variety of problems and contexts e.g. plotting, coordinates, banking, direction, etc

*Worked examples:*

1. Joe has £69 in his savings account.
He withdraws £100 from the cash machine.

£69 – £100 = – £31
He is overdrawn by £31

2. (a) – 7 + 3 = – 4
(b) – 6 + (– 4) = – 10
(c) – 4 – (– 3) = – 4 + 3 = – 1
(d) 3 × (– 5) = – 15
(e) – 3 × (– 5) = 15
(f) 15 ÷ (– 3) = (– 5)

N.B.
Subtracting a negative number is the same as adding a positive number.
A negative number times a negative number makes a positive number.

# FRACTIONS, DECIMAL FRACTIONS AND PERCENTAGES

## 2nd level:

"***I have investigated the everyday contexts in which simple fractions, percentages or decimal fractions are used and can carry out the necessary calculations to solve related problems***."

- I can calculate simple fractions of a quantity e.g. $\frac{1}{2}, \frac{1}{3}$ or $\frac{1}{4}$ of something
- I can calculate any fraction of an amount.
- I can calculate percentages.

*Worked examples*:

1. I have 24 apples. I give away a half of them.
How many apples do I have left?

$\frac{1}{2}$ of 24 = 12

2. $\frac{4}{5}$ of 60 = $60 \div 5 \times 4$
= $12 \times 4$
= 48

3. 10% of 270 = $270 \div 10$
= 27

"***I can show the equivalent forms of simple fractions and percentages and can choose my preferred form when solving a problem, explaining my choice of method.***"

- I can find equivalent fractions by multiplying the top and bottom by the same number.
- I can simplify fractions by dividing the top and bottom by the same number.
- I can write a percentage as a fraction.
- I can convert fractions and percentages into decimal fractions.

*Worked examples*:

1. $\frac{3}{4} = \frac{3 \times 2}{4 \times 2} = \frac{6}{8}$

2. $\frac{5}{10} = \frac{5 \div 5}{10 \div 5} = \frac{1}{2}$

3. $32\% = \frac{32}{100} = \frac{8}{25}$

4. $\frac{3}{5} = 3 \div 5 = 0 \cdot 6$

## 3rd level:

"***I can solve problems by carrying out calculations with a wide range of fractions, decimal fractions and percentages, using my answers to make comparisons and informed choices for real life situations***."

- I can solve problems by using fractions, percentages or decimal fractions.

*Worked examples*:

1. James scored 16 out of 20 in his Maths test, 15 out of 25 in his Chemistry test and 17 out of 22 in his History test.
In which subject did he do best?

$$\text{Maths: } \frac{16}{20} = \frac{80}{100} = 80\% \qquad \text{Chemistry: } \frac{15}{25} = \frac{60}{100} = 60\%$$

$$\text{History: } \frac{17}{22} = 17 \div 22 \times 100\% \approx 77\%$$

$\therefore$ James did better in his maths test.

N.B. The Maths and Chemistry scores could be converted without a calculator. For the History score, a calculator was used. Type in "$17 \div 22 \times 100$" (do **not** type in the % symbol). The squiggly equals sign means "roughly equal to".
Any score can be converted by doing "$top \div bottom \times 100$".

2. $$\begin{aligned} 89\% \text{ } of \text{ } 356 &= 0\cdot89 \times 356 \\ &= 316\cdot84 \end{aligned}$$

"***I can show how quantities that are related can be increased or decreased proportionally and apply this to solve problems in everyday contexts***."

- I know what proportion is.
- I can increase or decrease quantities when they are in proportion.

*Worked example*:

1. Two bottles of cola cost £1.80.
How much will seven bottles cost?

$$\begin{array}{lcl} \text{2 bottles} & \longrightarrow & £1.80 \\ \div 2 & & \div 2 \\ \text{1 bottle} & \longrightarrow & £1\cdot80 \div 2 = £0\cdot90 \\ \times 7 & & \times 7 \\ \text{7 bottles} & \longrightarrow & £0\cdot90 \times 7 = \underline{\underline{£6\cdot30}} \end{array}$$

## 4th level:

"***I can choose the most appropriate form of fractions, decimal fractions and percentages to use when making calculations mentally, in written form or using technology then use my solutions to make comparisons, decisions and choices***."

- I can calculate percentages mentally using 'building blocks'.
- I can choose the best way to calculate a fraction, percentage or decimal fraction

*Worked example*:

1. Calculate 35% of 170.

$$\begin{aligned} 10\% \text{ of } 170 &= 170 \div 10 \\ &= 17 \end{aligned} \qquad \begin{aligned} 5\% \text{ of } 170 &= 17 \div 2 \\ &= 8 \cdot 5 \end{aligned}$$

$$\begin{aligned} 35\% &= 3 \times 17 + 8 \cdot 5 \\ &= \underline{\underline{59 \cdot 5}} \end{aligned}$$

"***Using proportion, I can calculate the change in one quantity caused by a change in a related quantity and solve real life problems***."

- I can calculate changes when quantities are in proportion.

*Worked example*:

1. It takes 3 people 60 minutes to paint a fence.
How long will it take 5 people?

$$\begin{array}{lcl} \text{3 people} & \longrightarrow & \text{60 minutes} \\ \textcircled{\div 3} & & \textcircled{\times 3} \\ \text{1 person} & \longrightarrow & 60 \times 3 = \text{180 minutes} \\ \textcircled{\times 5} & & \textcircled{\div 5} \\ \text{5 people} & \longrightarrow & 180 \div 5 = \text{36 minutes} \end{array}$$

# MONEY

## 2nd level:

"***I can use the terms profit and loss in buying and selling activities and can make simple calculations for this***."

- I know what the terms profit and loss mean.
- I know what is meant by 'cost price' and 'selling price'.
- I can calculate profit: Profit = Selling Price – Cost Price
- I can calculate losses: Loss = Cost Price – Selling Price

*Worked example*:

1. Rory bought a car for £15 475 and sold it two years later for £8 995.
   Calculate his loss.

Loss = Cost Price – Selling Price
= 15 475 – 8 995
= £6 480

## **4th level**:

***"I can source information on earnings and deductions and use it when making calculations to determine net income."***

- I have researched the possible deductions made from earnings.
- I can calculate the deductions from earnings.
- I know what the terms 'gross income' and 'net income' mean.
- I can calculate net income (*Net income = Gross Income – Deductions*).

*Worked example*:

1. Paula has a gross income of £28 500 per annum. Her total deductions come to £7 450. Calculate her net income.

Net income = Gross Income – Deductions
= 28 500 – 7 450
= £21 050

# TIME

## 2nd level:

***"I can use and interpret electronic and paper-based timetables and schedules to plan events and activities, and make time calculations as part of my planning."***

- I can use 24-hour clock times (1st level).
- I can read a bus/train timetable.
- I can work out how long a journey takes from a timetable.

*Worked examples*:

1. This is part of the timetable for trains going from Dundee to Aberdeen.

| | | | | |
|---|---|---|---|---|
| Dundee | 0635 | 0656 | 0724 | 0828 |
| Carnoustie | --- | 0708 | 0736 | 0844 |
| Arbroath | 0651 | 0715 | 0743 | 0859 |
| Montrose | 0705 | 0729 | 0757 | 0920 |
| Stonehaven | 0726 | 0751 | 0819 | --- |
| Portlethen | --- | 0800 | 0827 | 0940 |
| Aberdeen | 0750 | 0813 | 0840 | 0955 |

Adam caught the 0656 train from Dundee and travelled to Aberdeen.
How long was his train journey?

0656 *to* 0700 = 4 *min*
0700 *to* 0813 = 1 *hr* 13 *min*
*Total time* = 1 *hr* 17 *min*

As a general way of working out time intervals:
(i) how long to the next o'clock time?
then
(ii) how long from the o'clock time to the end?
Do **not** try and add or subtract with a chimney sum like you would with *normal* numbers.

2. A film starts at 9.40 pm and lasts for one and a half hours.
When will the film finish?

9.40 *pm* + 30 *min* = 10.10 *pm*
10.10*pm* + 1 *hr* = 11.10*pm*

"***I can carry out practical tasks and investigations involving timed events and can explain which unit of time would be most appropriate to use.***"

- I can convert minutes into hours (and vice versa).

*Worked examples*:

1. $$\frac{1}{2}\,hour = \frac{1}{2} \times 60\,min$$
$$= 30\,min$$

2. $$20\,min = \frac{20}{60}\,hr$$
$$= \frac{1}{3}\,hr$$

The magic number here is "60".
20 minutes is

$20min$ **out of** $60min$ so $\frac{20}{60}\,hr.$

It will always be ×60 or ÷60 to convert.
Always use common sense to check and see if your answer makes sense.

"***Using simple time periods, I can give a good estimate of how long a journey should take, based on my knowledge of the link between time, speed and distance.***"

- I can work out how long a journey will take, given basic information about speed and distance (simple cases only).

*Worked example*:

1. Owen rides his bike at an average speed of 10 miles per hour.

(*a*) How far will he have travelled after 2 hours?

$$\begin{aligned} Distance &= Speed \times Time \\ &= 10 \times 2 \\ &= \underline{\underline{20\,miles}} \end{aligned}$$

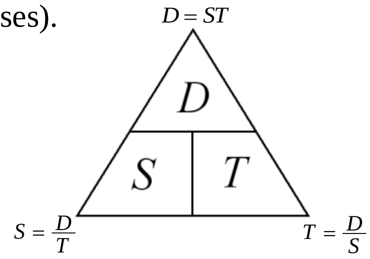
(*b*) How far will Owen have cycled after $2\frac{1}{2}$ hours?

$$\begin{aligned} Distance &= Speed \times Time \\ &= 10 \times 2 \cdot 5 \\ &= \underline{\underline{25\,miles}} \end{aligned}$$

## **3rd level**:

"***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 time, speed and distance.***"

- I know the relationships (formulae) linking speed, distance and time
- I can work out speed, distance or time given the other two (simple cases).

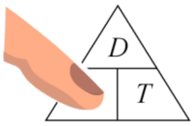


This triangle helps us remember the formulae. *D* for distance, *S* for speed and *T* for time (fill in the triangle in alphabetical order).
Cover up the one you are trying to find and what's left is the formula.

*Worked example*:

1.

A tortoise covers 13·8*m* in one minute.
Calculate the speed of the tortoise, in *metres per second*.



$$Speed = \frac{D}{T}$$
$$= \frac{13\cdot8}{60}$$
$$= \underline{\underline{0\cdot23 \text{ metres per second}}}$$

## **4th level**:

"***I can research, compare and contrast aspects of time and time management as they impact on me.***"

- I can use my planner to organise my time effectively.
- I have prepared a study schedule for exams.

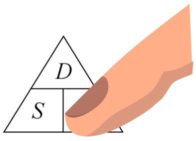
"***I can use the link between time, speed and distance to carry out related calculations.***"

- I know the relationships (formulae) linking speed, distance and time
- I can work out speed, distance or time given the other two.

*Worked example*:

1.

Greig travels 250 miles at an average speed of 60 mph.
How long does this journey take?



$$Time = \frac{D}{S}$$
$$= \frac{25\cancel{0}}{6\cancel{0}}$$
$$= 4\frac{1}{6}\, hour$$
$$= \underline{\underline{4hr\ 10\, min}}$$

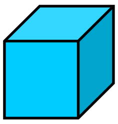
## MEASURE

### 2nd level:

"***I can use my knowledge of the sizes of familiar objects or places to assist me when making an estimate of measure***."

- I can estimate lengths and heights using metres, $\frac{1}{2}$ metres and $\frac{1}{10}$ metres.
- I can describe lengths in terms of metres and centimetres (e.g. 3 metres and 50 centimetres can be written as 3*m* and 50*cm*, $3\frac{1}{2}$ metres or 3·5*m*).
- I have measured the length of a classroom with a tape measure.
- I have run one hundred metres.
- I know that a bag of sugar weighs 1 kilogram
- I know that a bottle of diluting juice holds 1 litre.

"***I can use the common units of measure, convert between related units of the metric system and carry out calculations when solving problems***."



- I know that 10 millimetres is the same as 1 centimetre (10*mm* = 1*cm*) and 100*cm* = 1*m*.
- I know that 1000 grams is the same as 1 kilogram (1000*g* = 1*kg*).
- I know that a cubic centimetre is the same as a millilitre ($1cm^3 = 1ml$) and that 1 000 *ml* = 1 *litre*.

It is useful to note that
"kilo" comes from the ancient Greek, meaning "one thousand",
"centi" comes from Latin, meaning "one hundredth of" and
"milli" comes from Latin, meaning "one thousandth of".

*Worked example*:

1. Convert 80*mm* into centimetres.

$$80 \div 10 = 8$$
$$\therefore 80mm = 8cm$$

"***I can explain how different methods can be used to find the perimeter and area of a simple 2D shape or volume of a simple 3D object.***"

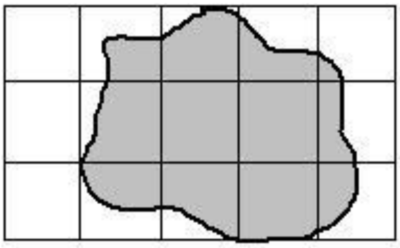
- I can work out the perimeter of a straight-edged shape by adding up all of the sides.
- I can find the area of irregular shapes by counting the squares it covers up on a grid.
- I have measured out volumes of water using measuring jugs.

*Worked examples*:

1. What is the area of this shape?

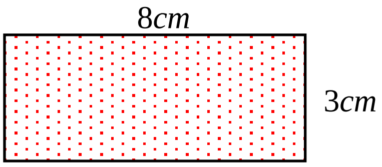
[By counting squares and estimating]

$6\frac{1}{2}\ squares$



2. Calculate the perimeter of this rectangle.

$$\begin{aligned} Perimeter &= 8+3+8+3 \\ &= 22cm \end{aligned}$$



Notice that the equals symbols are in a column to show that it is a connected calculation.

## **3rd level**:

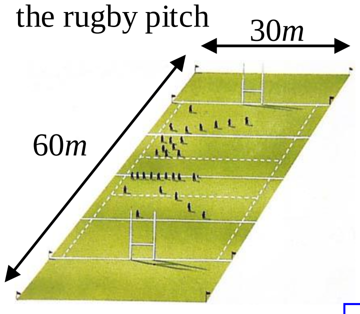
"***I can solve practical problems by applying my knowledge of measure, choosing the appropriate units and degree of accuracy for the task and using a formula to calculate area or volume when required.***"

- I can calculate the area of a rectangle using the formula $Area = length \times breadth$ .
- I can calculate the area of a right-angled triangle using the formula $Area = \frac{1}{2}\ of\ base \times height$ .
- I can calculate the volume of a cuboid using the formula $Volume = length \times breadth \times height$ .

*Worked examples*:

1. Calculate the area of:

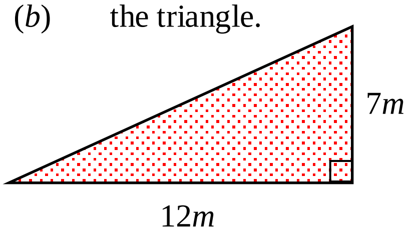
(*a*) the rugby pitch



$$\begin{aligned} Area &= lb \\ &= 60 \times 30 \\ &= 1800m^2 \end{aligned}$$

Please note that $m^2$ is pronounced "**square metres**" not "metres squared".

(*b*) the triangle.



$$\begin{aligned} Area &= \frac{1}{2}bh \\ &= \frac{1}{2} \times 12 \times 7 \\ &= 42m^2 \end{aligned}$$

2. Work out the volume of this box.

$$\begin{aligned} Volume &= lbh \\ &= 32 \times 25 \times 28 \\ &= 22\,400 cm^3 \end{aligned}$$

Please note that $cm^3$ is pronounced
"**cubic centimetres**"
not "centimetres cubed".

## DATA AND ANALYSIS

### 2nd level:

"***Having discussed the variety of ways and range of media used to present data, I can interpret and draw conclusions from the information displayed, recognising that the presentation may be misleading***."

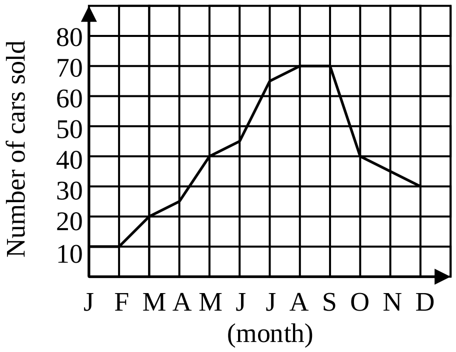
- I can read information from a pictograph, table, bar chart and line graph.
- I know how to describe a position on a graph as a coordinate.

"***I have carried out investigations and surveys, devising and using a variety of methods to gather information and have worked with others to collate, organise and communicate the results in an appropriate way***."

- I can record information in a table.
- I can construct a bar chart.
- I can construct a line graph.
- I can describe a relationship (or trend) shown on a bar chart or line graph.
- I can enter information into a spreadsheet.
- I have conducted a survey in my class.
- I have gathered information from the internet (or other source).

*Worked example*:

1. This graph shows the car sales from a car dealership over a year.



Describe the trend shown on the graph.

*Sales started of low at 10 cars. They increased relatively steadily each month until August when they reached 70 cars. They stayed high for one month and fell rapidly, eventually falling to 30 cars.*

## <u>4th level</u>:

"***I can evaluate and interpret raw and graphical data using a variety of methods, comment on relationships I observe within the data and communicate my findings to others***."

- I can construct a simple pie chart and a scattergraph.
- I can use a "line of best fit" to approximate the relationship (or correlation) on a scattergraph.

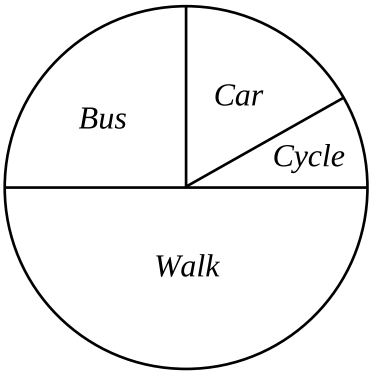
*Worked examples*:

1. This table shows the how pupils got to school to one day.

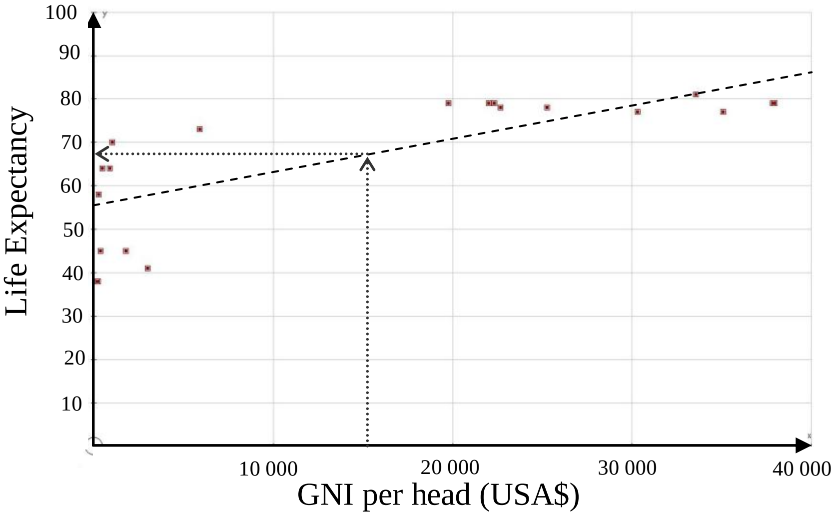
| Method of transport | Walk | Cycle | Car | Bus |
|---|---|---|---|---|
| Number of pupils | 30 | 5 | 10 | 15 |

Draw a pie chart to show this.

*There are* 26 + 7 + 12 + 15 = 60 *pupils.*
*Each pupil can be represented by* $360° \div 60 = 6°$
$Walk$ : $30 \times 6° = 180°$
$Cycle$ : $5 \times 6° = 30°$
$Car$ : $10 \times 6° = 60°$
$Bus$ : $15 \times 6° = 90°$



2. This scattergraph shows the connection between "Gross National Income per head of capita" and "Life Expectancy".



(a) Describe the relationship shown. *There is a positive correlation between GNI and life expectancy.*

(b) Draw a line of best fit. [*shown by the dashed line*]

(c) Use your line of best fit to determine how long somebody living in a country with a GNI of $15 000 is likely to live.

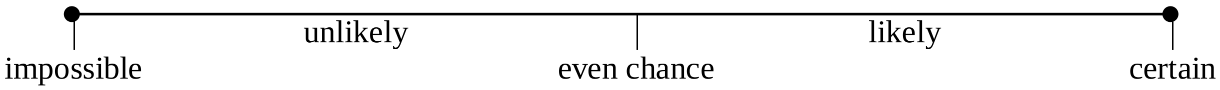
*About 68 years* [*see the dotted arrows*].

# IDEAS OF CHANCE AND UNCERTAINTY

## 2nd level:

"***I can conduct simple experiments involving chance and communicate my predictions and findings using the vocabulary of probability***."

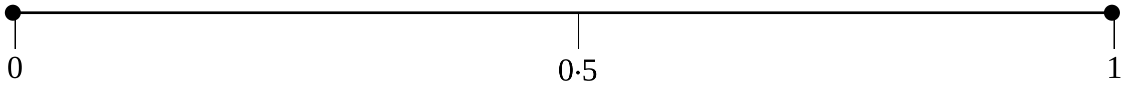
- I can decide how probable something is using the terms impossible, unlikely, even chance, likely and certain.



## 3rd level:

"***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***."

- I can determine the probability of something (simple) happening from an experiment or data.
- I can describe probability using a numerical scale (from 0 to 1).



*Worked example*:

1. A survey of car park shows how many cars of each colour there are.

| Colour | Red | Blue | Black | Silver |
|---|---|---|---|---|
| Number of cars | 30 | 15 | 20 | 35 |

Based on this information, what is the probability that the next car to come into the car park is black?

*There are* 30 + 15 + 20 + 35 = 100 *cars*

$$P(black\ \ car) = \frac{20}{100} = 0 \cdot 2$$

*P*(*black car*) is short hand for writing "the probability of it being a black car".

## **4th level**:

"***By applying my understanding of probability, I can determine how many times I expect an event to occur, and use this information to make predictions, risk assessment, informed choices and decisions***."

- I can describe probability as a number between 0 and 1 (see 3rd level), a decimal or as a fraction.
- I have checked the randomness of a dice by repeatedly rolling it and recording my results.
- I can determine the likelihood of events based on experiment or data.

*Worked examples*:

1. If you that picked a person at random from the British population, the probability of picking a person that lives in Scotland is 0·084.
The population of Britain is 60 600 000.
How many people live in Scotland?

$$0 \cdot 084 \times 60\,600\,000 = 5\,090\,400\,people$$

Please note that it is important that a person is picked at **random**, not chosen.

2. In Scotland, 64 people per 100 000 are involved in serious or fatal car accidents [ source: www.statistics.gov.uk].
What is the probability that a person picked at random in Scotland will be involved in a serious or fatal car accident?

$$\begin{aligned} P(serious\ \ accident) &= \frac{64}{100\,000} \\ &= 64 \div 100\,000 \\ &= 0 \cdot 00064 \\ &= 0 \cdot 064\% \end{aligned}$$

# Addendum: USING FORMULAE AND SOLVING EQUATIONS

This is not included in the Numeracy Outcomes but is used across the curriculum.

## 2nd level:

"***I can apply my knowledge of number facts to solve problems where an unknown value is represented by a symbol or letter.***"

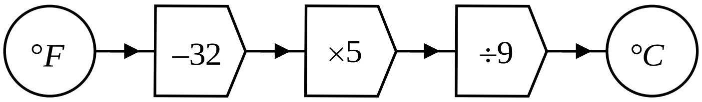
- I can use a simple formula expressed in words or as a number machine
- I have used balancing scales to create equations and see how they are solved.
- I can solve simple equations.

*Worked examples*:

1. To change a temperature from Celsius to Fahrenheit:
multiply by nine, divide by 5 then take that answer and add 32.
Write $100^{\circ}C$ in Fahrenheit.

$$\begin{aligned}100 \times 9 \div 5 &= 180\\ 180 + 32 &= \underline{\underline{212^{\circ}F}}\end{aligned}$$

2. We can covert temperatures given in Fahrenheit into Celsius using this number machine.



Convert $32^{\circ}F$ into Celsius.

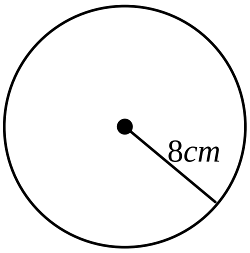
$$\begin{aligned}32 - 32 &= 0\\ 0 \times 5 &= 0\\ 0 \div 9 &= \underline{\underline{0^{\circ}C}}\end{aligned}$$

3. To work out the cost, £$C$, of hiring a car for $n$ days, use this formula $C = 40n + 5$.
Calculate the cost of hiring a car for 6 days.

$$\begin{aligned}C &= 40n + 5\\ &= 40 \times 6 + 5\\ &= \underline{\underline{£245}}\end{aligned}$$

Notice that there are at least three lines in the solution:
**formula**,
**working** and
**answer** with units.

4. The area of a circle can be found using the formula $A = \pi r^2$, where $r$ is the radius and $\pi \approx 3\cdot 14$.
Calculate the area of this circle.



$$\begin{aligned} A &= \pi r^2 \\ &= 3\cdot 14 \times 8^2 \\ &= \underline{\underline{200\cdot 96cm^2}} \end{aligned}$$

Notice that the equals symbols are in a column to show that it is a connected calculation.

5. Solve this equation to find the value of $x$ $3x + 5 = 26$.

$$\begin{aligned} 3x + 5 &= 26 \\ \enclose{circle}{-5} \quad & \quad \enclose{circle}{-5} \\ 3x &= 21 \\ \enclose{circle}{\div 3} \quad & \quad \enclose{circle}{\div 3} \\ x &= 7 \end{aligned}$$

Notice that the equals symbols are in a column.

We use the elimination method: do the same thing to each side. We do not use “change side, change sign”.

See below for more details.

## **3rd level**:

“***Having discussed ways to express problems or statements using mathematical language, I can construct, and use appropriate methods to solve, a range of simple equations.***”

- I can solve equations using the elimination method.

*Worked example*:

1. To solve equations:

$$4(a-5)=a+14$$

(i) expand any brackets

$$4a-10=a+14$$

(ii) eliminate any letters on the right hand side

$$\enclose{circle}{-a} \qquad \enclose{circle}{-a}$$

$$3a-10=14$$

(iii) eliminate any “loose numbers” on the left

$$\enclose{circle}{+10} \qquad \enclose{circle}{+10}$$

$$3a=24$$

(iv) divide by the number in front of the letter

$$\enclose{circle}{\div 3} \qquad \enclose{circle}{\div 3}$$

$$\div 3 \qquad \div 3$$

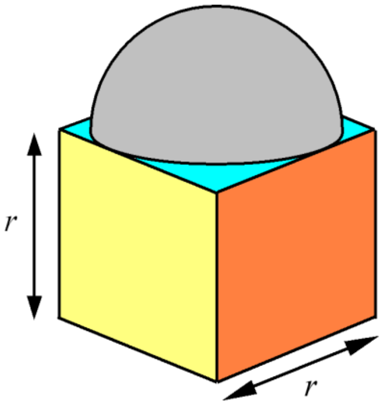
$$a=8$$

“***I can create and evaluate a simple formula representing information contained in a diagram, problem or statement.***”

- I can use a formula expressed in algebraic terms.

*Worked example*:

1. The volume of this container can be calculated using the formula



$$V=\frac{6r^3 \;\; 1+4\pi}{6} \qquad \text{where } \pi \approx 3\cdot 14.$$

Calculate the volume when $r = 9cm$.

$$\begin{aligned}V&=\frac{6r^3 \;\; 1+4\pi}{6}\\&=\frac{6\times 9^3 \;\; 1+4\times 3\cdot 14}{6}\\&=\frac{4378\times 13\cdot 56}{6}\\&=\underline{\underline{9885\cdot 24cm^3}}\end{aligned}$$

Appendix:

This booklet is meant as a way of exemplifying the experiences and outcomes. Some are not easy to illustrate but are, instead, an application of other skills. As such, they have not been included in this booklet.

2nd, 3rd and 4th level Numeracy Experiences and Outcomes not mentioned in this booklet are:

- I can manage money, compare costs from different retailers, and determine what I can afford to buy. **MNU 2-09a**
- I understand the costs, benefits and risks of using bank cards to purchase goods or obtain cash and realise that budgeting is important. **MNU 2-09b**
- When considering how to spend my money, I can source, compare and contrast different contracts and services, discuss their advantages and disadvantages, and explain which offer best value to me. **MNU 3-09a**
- I can budget effectively, making use of technology and other methods, to manage money and plan for future expenses. **MNU 3-09b**
- I can discuss and illustrate the facts I need to consider when determining what I can afford, in order to manage credit and debt and lead a responsible lifestyle. **MNU 4-09a**
- I can research, compare and contrast a range of personal finance products and, after making calculations, explain my preferred choices. **MNU 4-09c**
- I can apply my knowledge and understanding of measure to everyday problems and tasks and appreciate the practical importance of accuracy when making calculations. **MNU 4-11a**
- I can work collaboratively, making appropriate use of technology, to source information presented in a range of ways, interpret what it conveys and discuss whether I believe the information to be robust, vague or misleading. **MNU 3-20a**

and from the **“**Addendum: USING FORMULAE AND SOLVING EQUATIONS”:

- Having discussed the benefits of using mathematics to model real-life situations, I can construct and solve inequalities and an extended range of equations. **MTH 4-15a**