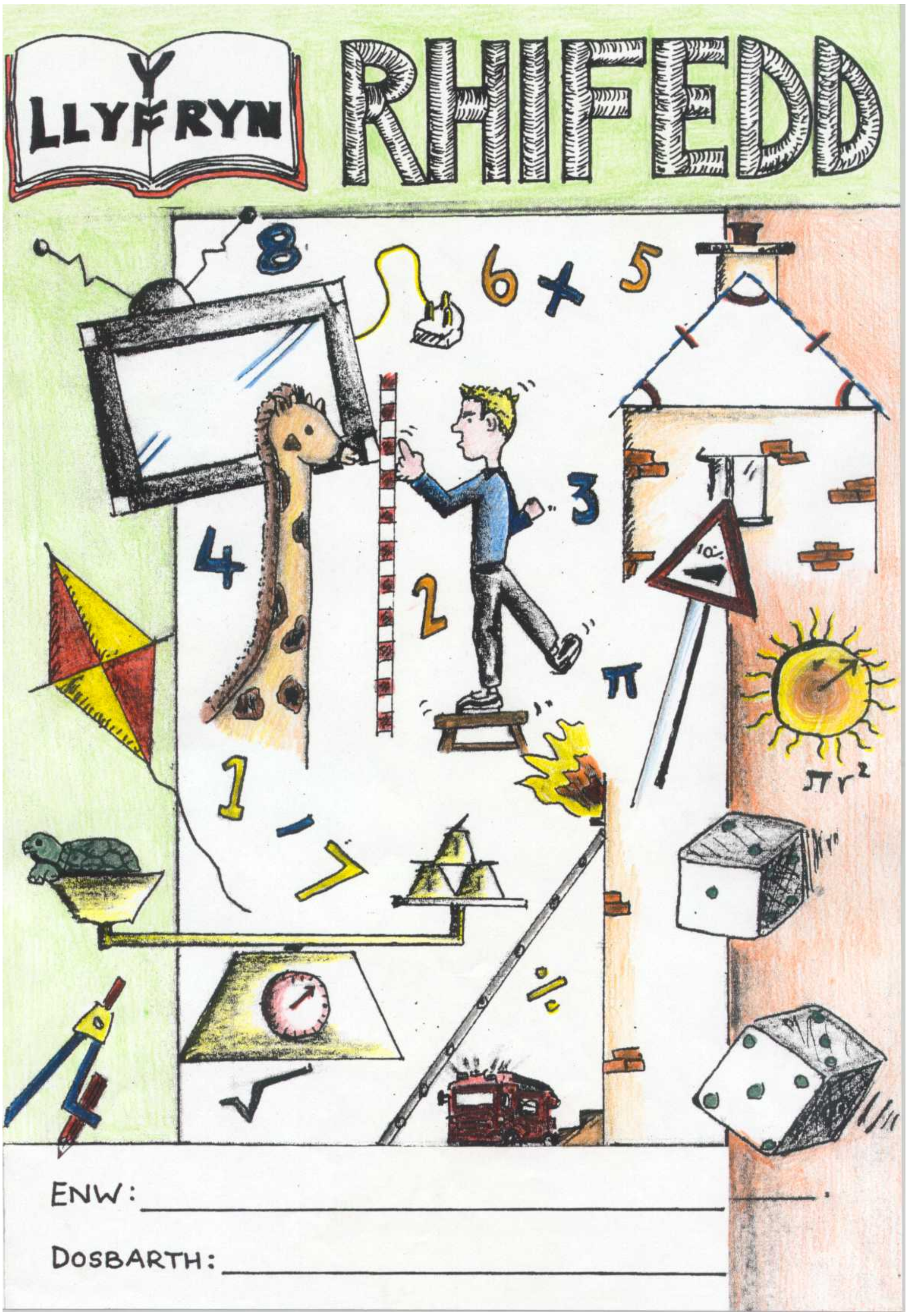
YSGOL BRYNREFAIL

The Numeracy Booklet



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1. METHODS OF CALCULATION

1. ADDITION

(a) Adding the most significant digits first.
In this method we will add the thousands, hundreds, tens and units separately.

Example

(i)
7648
+ $\underline{1486}$
8000 (7000 + 1000)
1000 (600 + 400)
+ 120 (40 + 80)
$\underline{14}$ (8 + 6)
$\underline{9134}$

There is no need to 'carry ' at all using this method

This is the usual method

(b) Carrying from one column to the next, starting with the units.

Example

(i)
7 6 4 8
+ $\underline{1_1 4_1 8_1 6}$
$\underline{9\ 1\ 3\ 4}$

carrying above the line

or

(ii)
7 6 4 8
+ $\underline{1\ 4\ 8\ 6}$
$\underline{9\ 1\ 3\ 4}$
1 1 1

carrying under the line

(c) We can use the methods above with decimals but we must remember to place the decimal points underneath each other and to fill every gap with '0' (zero) as required.

Example

124.90
+ $\underline{73.25}$
100.00 (only one number in the 100s)
90.00 (20 + 70)
7.00 (4 + 3)
1.10 (0.9 + 0.2)
$\underline{0.05}$ (only one number in the hundredths)
$\underline{198.15}$

2. SUBTRACTION

(a) Counting on method

In this method we gradually add to the lower number.

Example

start with 2684, then add to get the nearest hundred, add to get the nearest thousand and then add to get 6467

6467 – 2684

Rewrite as

$$\begin{array}{rr} & 6467 \\ - & \underline{2684} \\ & 16 \\ & 300 \\ + & \underline{3467} \\ & \underline{3783} \\ & {\scriptstyle 1} \end{array} \qquad \begin{array}{l} \\ \\ (2684 + \mathbf{16} = 2700) \\ (2700 + \mathbf{300} = 3000) \\ (3000 + \mathbf{3467} = 6467) \\ \\ \\ \end{array}$$

add these

Therefore 6467 – 2684 = 3783

(b) Compensation method

In this method we will take away more than is necessary and then add back a little to get the right balance.

Example

$$\begin{array}{rr} & 6467 \\ - & \underline{2684} \\ & 3467 \\ + & \underline{326} \\ & \underline{3783} \end{array}$$

call this 3000

6467 – 3000 = 3467

compensate (+) 326
because we have taken away too much

(c) Decomposition method

In this method we borrow from the next column.

Example

$$\begin{array}{rcccc} & {}^{5}\cancel{6} & {}^{13}\cancel{4} & {}^{1}6 & 7 \\ - & \underline{2} & \underline{6} & \underline{8} & \underline{4} \\ & 3 & \underline{7} & \underline{8} & \underline{3} \end{array} \qquad \begin{array}{rcccc} & {}^{5}\cancel{6} & {}^{1}4 & {}^{7}\cancel{8} & {}^{1}4 \\ - & \underline{2} & \underline{6} & \underline{6} & \underline{7} \\ & \underline{3} & \underline{8} & \underline{1} & \underline{7} \end{array}$$

(d) We can use the above methods with decimals but we must remember to place the decimal points underneath each other and to fill every gap with '0' (zero) as required.

Example

(i)

$$\begin{array}{rrl} & 324.90 & \\ - & \underline{7.25} & \\ & 2.75 & (7.25 + \mathbf{2.75} = 10) \\ + & 14.90 & (10 + \mathbf{14.90} = 24.90) \\ & \underline{300.00} & (24.90 + \mathbf{300} = 324.90) \\ & \underline{317.65} & \end{array}$$

add on

(ii)

$$\begin{array}{rrl} & 324.90 & \\ - & \underline{7.25} & \\ & 314.90 & (324.90 - 10 = \mathbf{314.90}) \\ + & \underline{2.75} & (10 - 7.25 = \mathbf{2.75}) \\ & \underline{317.65} & \\ & {}^{1} & \end{array}$$

compensate

(iii)

$$\begin{array}{rr} & 3^{1}\cancel{2}^{1}4.^{8}\cancel{9}^{1}0 \\ - & \underline{7.2\ 5} \\ & \underline{3\ 1\ \ 7.6\ 5} \end{array}$$

decompose

3. MULTIPLICATION

(a) Doubling method

We need to know how to double numbers to use this method.

Example

38 x 25

We always start with 1 and double following the pattern: 1, 2, 4, 8, 16, 32 etc.
We need to carry on doubling until we reach the nearest double that is LESS than the number chosen.
Then, the answers are placed underneath each other in columns.

(i) 38 x 25

1 + 8 + 16 = 25

1 x 38 = 38
~~2 x 38 = 76~~ (38 x 2)
~~4 x 38 = 152~~ (76 x 2)
8 x 38 = 304 (152 x 2)
16 x 38 = 608 (304 x 2)

the last double that is less than 25

The next double after 16 is 32. 32 is MORE THAN 25, therefore we finish the doubling with 16. In the left-hand column (1, 2, 4, 8, 16) we look at which numbers add up to make 25. We cross out the rest and add the numbers in the right hand column to get the answer.
25 = 16 + 8 + 1
Therefore we have:-

1 x 38 = 38
\+ 8 x 38 = 304 +
16 x 38 = 608
25 x 38 = 950

38 x 25 = 950

(ii) 25 x 38

We get the same answer by doubling if we start with 25.

~~1 x 25 = 25~~
2 x 25 = 50
4 x 25 = 100
~~8 x 25 = 200~~
~~16 x 25 = 400~~
32 x 25 = 800

2 + 4 + 32 = 38

the last double that is less than 38

The next double is 64, which is MORE THAN 38, therefore we stop doubling at 32.

38 = 32 + 4 + 2 therefore we have

25 x 38 = 50 + 100 + 800
25 x 38 = 950

(b) Box method / (Napier)

This method requires you to create a grid.

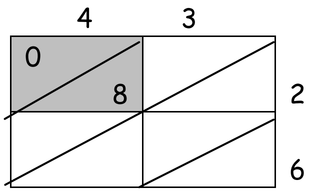
To multiply 43 x 26 we need to create a 2 by 2 grid, because we need to multiply a two-digit number by a two-digit number.

Multiplying 264 x 53 would mean creating a 3 by 2 grid etc.

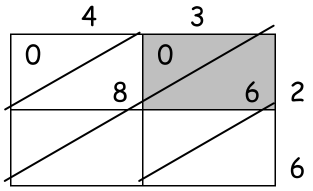
Example

(i) 43 x 26

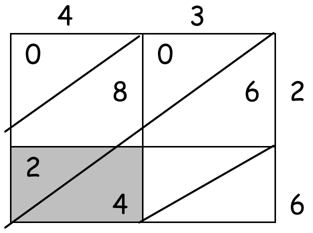
The diagrams below illustrate the multiplication method. We need to draw a diagonal in each box of the grid in order to place tens and units when multiplying each individual box. Always write the tens ABOVE the diagonal in each box.



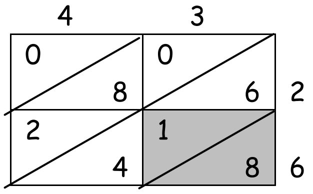
The first box in the top row 4 x 2 = 8.
Write 08 to show that there are no tens.



Add 3 x 2 = 6 to complete the top row of the grid.

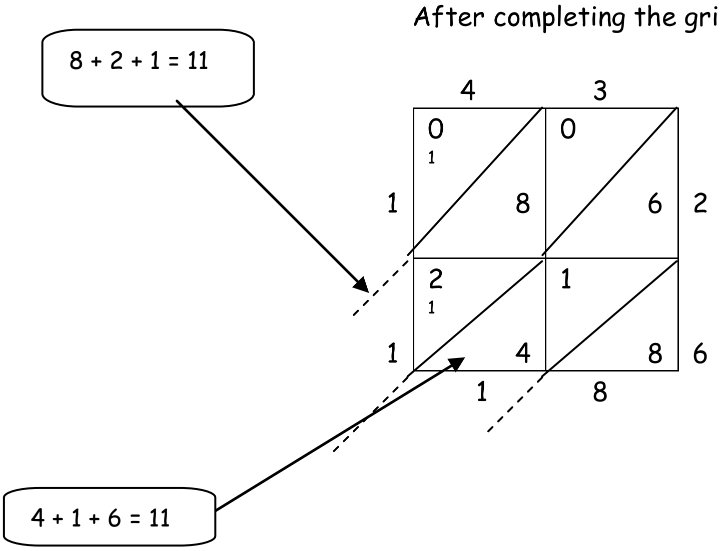


Add the first box in the bottom row.
4 x 6 = 24 (remember to put the 2 above the diagonal).



Complete the grid with 3 x 6 = 18.

After completing the grid, we need to add the columns along the diagonals.

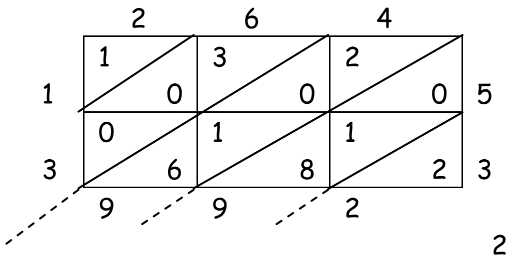


Note that we sometimes need to carry over from one column to the next.
To get the answer, read the totals down and to the right.

43 x 26 = 1 1 1 8

(ii) 264 x 53

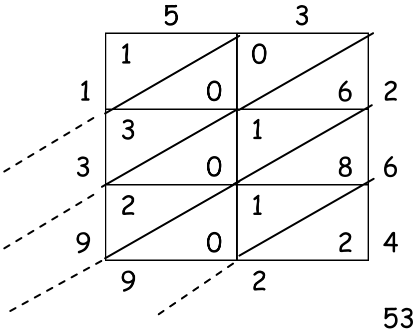
Draw a 3 x 2 box and follow the guidelines in example (i)



264 x 53 = 13992

Note that there is no need to carry over in this example.

You can also draw a 2 by 3 box to multiply 264 x 53 (53 x 264).



53 x 264 = 13992

(c) Partition Method

In this method the smaller number is partitioned.

it is broken down into tens and units

Example

(i)

	352
x	27
352 x 20	7040
352 x 7	2464
352 x 27 =	9504
	1

(ii) or

	352
x	27
352 x 10	3520
352 x 10	3520
352 x 7	2464
352 x 27 =	9504

The method of partitioning into tens as in (ii) simplifies the multiplication further because to multiply successively by 10 is to add a '0' as necessary.

(d) Factor Method

If a number (usually a two digit number) has factors, the factors can be used to multiply as follows.

Example

21 = 3 x 7

264 x 21

21 can be written as 3 x 7.
Using 21 = 3 x 7 gives

264 x 21 as 264
x 3
792 (multiply by 3)
x 7
5544 (multiply the answer by 7)

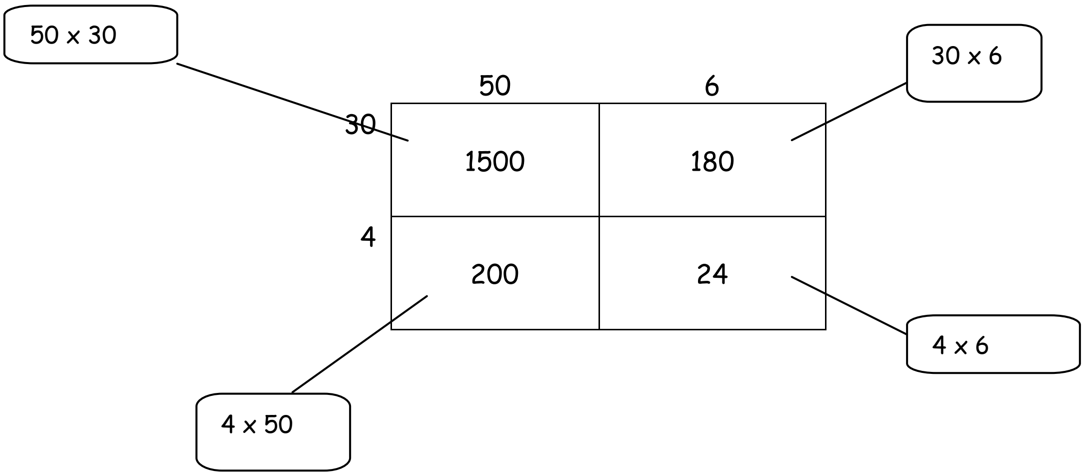
(e) Area Method

In this method we will break down the numbers as the sides of a rectangle. The area of the rectangle will be the answer to the multiplication.

Example

(i) 56 x 34

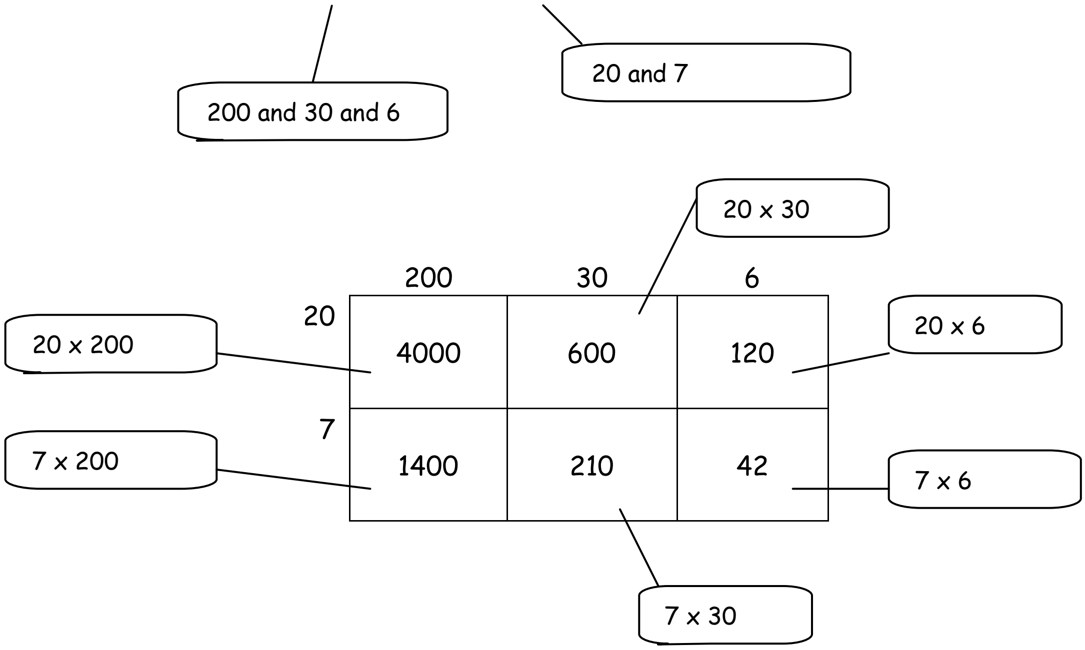
50 and 6
30 and 4



The answer is the total area therefore:-

56 x 34 = 1500 + 180 + 300 + 24
= 1904

(ii) 236 x 27



	200	30	6
20	4000	600	120
7	1400	210	42

236 x 27 = 4000 + 600 + 120 + 1400 + 210 + 42
= <u>6372</u>

(f) Multiplying Decimals

We can adapt the previous methods of multiplication to multiply decimals.
To simplify the multiplication process we will eliminate the decimal point and then put it back in the right place at the end, after multiplying.

Example

(i) 3.8 x 2.5
Using the doubling method to calculate 38 x 25 we arrived at 38 x 25 = 950.
With 3.8 x 2.5 we see that there is a total of two digits after the decimal point, i.e. 8 after the 3 and 5 after the 2. This means that we need two digits after the decimal point in the answer.

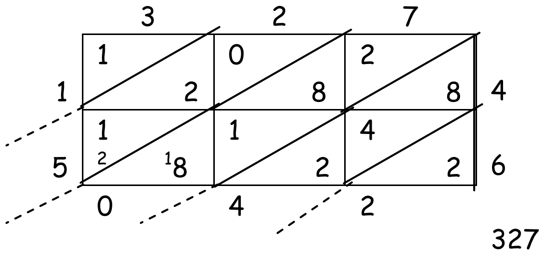
Therefore 3.8 x 2.5 = 9.50 (place the decimal point so that there are two digits after it).

Similarly, we have

	38 x 2.5	=	95.0
also	3.8 x 25	=	95.0
and	3.8 x 0.25	=	0.950

(ii) with three digit numbers, the box method is the most suitable.

Consider 3.27 x 4.6 as 327 x 46 and create a 3 by 2 grid.



327 x 46 = 15042
Therefore 3.27 x 4.6 = 15.042

3 digits are required after the decimal point in the answer to correspond to the three digits after the two decimal points in the question.

(iii) Using the factor and partition methods with decimals follows the same pattern.

Think about 368 x 1.8 as 2 x 9 (or 3 x 6)

$$\begin{array}{r} 368 \\ \times \quad \underline{2} \\ 736 \\ \times \quad \underline{9} \\ \underline{6624} \\ {\scriptstyle 3\,5} \end{array}$$

If 368 x 18 = 6624, 368 x 1.8 = 662.4 (only one digit after the decimal point in the question, therefore one digit is required after the decimal point in the answer).

Similarly we have
36.8 x 1.8 = 66.24
3.68 x 18 = 66.24

4 DIVISION

the number we are going to divide

(a) Tower Method

In this method, we need to know how to multiply by 10 and double (or find another multiple). We will start the tower with the dividend (864 in the example below) and then subtract multiples of the divisor (36) out of the dividend.

Example

how many sets of 36 are there in 864?

(i) 864 ÷ 36

10 sets of 36

864
- $\underline{360}$ = 36 x 10 (864 is greater than 360, therefore x 10 and then subtract)
504

10 more sets of 36

- $\underline{360}$ = 36 x 10 (504 is greater than 360, therefore x 10 and subtract again)
144

2 sets of 36

- $\underline{72}$ = 36 x 2 (144 is less than 360, therefore we double and subtract)
$\underline{72}$

2 sets of 36

$\underline{72}$ = 36 x $\underline{2}$ (double and subtract again)
00 $\underline{24}$

To get the answer we add the multiples, i.e. 10 + 10 + 2 + 2 = 24
Therefore 864 ÷ 36 = 24

If the small number does not divide exactly we can show the answer with a remainder or as a mixed number.

(ii) 423 ÷ 32

423
- $\underline{320}$ = 32 x 10 (423 is greater than 320, therefore x 10 and subtract)
103
- $\underline{96}$ = 32 x 3 (103 is less than 320, therefore x 3)
$\underline{7}$ $\underline{13}$

therefore 423 ÷ 32 = 13 r 7 or $13^{7/}{}_{32}$.

13 remainder 7 or
13 and $^{7/}{}_{32}$. = $13^{7/}{}_{32}$.

(b) Factor Method

If the divisor has factors, they can be used to divide.
As a general method, it is suggested that the divisor should be divided into only two factors, although more than two factors may sometimes exist. In addition, it should be divided by the largest factor first and then the answer should be divided by the other factor. This simplifies the process if the divisor does not divide exactly (remainder).

Example

(i) 864 ÷ 36

36 can be written in a number of ways:-

36 = 2 x 2 x 3 x 3
36 = 4 x 3 x 3
36 = 4 x 9
36 = 3 x 12
36 = 6 x 6
36 = 2 x 18

Choose a pair of factors (such as the pairs highlighted) and divide by the largest factor of the pair first.

(a) write 36 = 4 x 9

$$\begin{array}{r|rl} 9 & \underline{86^{5}4} & \text{(divide by the largest factor first)} \\ 4 & \underline{96} & \text{(divide the answer by the other factor)} \\ & \underline{24} & \end{array}$$

Therefore 864 ÷ 36 = 24

(b) or write 36 = 3 x 12

$$\begin{array}{r|rl} 12 & \underline{86^{2}4} & \text{(divide by the largest factor first)} \\ 3 & \underline{72} & \text{(divide the answer by the other factor)} \\ & \underline{24} & \end{array}$$

Therefore 864 ÷ 36 = 24

(ii) 423 ÷ 32 = 24

(a) write 32 = 4 x 8

$$\begin{array}{r|rll} 8 & \underline{42^{2}3} & & \text{(divide by the largest factor first)} \\ 4 & \underline{52} & g\ 7 & \text{(divide the answer by the other factor)} \\ & \underline{13} & g\ 7 & \end{array}$$

Therefore 423 ÷ 32 = 13 remainder 7
or 423 ÷ 32 = $13\ ^{7}/_{32}$

This is the traditional method

(c) Long division method

In this method it is important that you set out work with the tens and units columns correctly underneath each other

Example

(i) 782 ÷ 34

$$\begin{array}{rrl} & 23 & \text{(answer line)} \\ 34 & \big) \, 782 & \\ - & \underline{680} & \text{(34 x 20 = 680, put 2 in the tens column on the answer line)} \\ & 102 & \\ - & \underline{102} & \text{(34 x 3 = 102, put 3 in the units column on the answer line)} \\ & \underline{000} & \end{array}$$

Therefore 782 ÷ 34 = 23

(ii) 977 ÷ 36

$$\begin{array}{rrl} & 27 & \text{(answer line)} \\ 36 & \big) \, 977 & \\ - & \underline{720} & \text{(36 x 20 = 720, put 2 in the tens column on the answer line)} \\ & 257 & \\ - & \underline{252} & \text{(36 x 7 = 252, put 7 in the units column on the answer line)} \\ & \underline{5} & \end{array}$$

Therefore 782 ÷ 36 = 27 remainder 5
or 782 ÷ 36 = $27\ ^{5}/_{36}$

(d) Dividing decimals

Dividing decimals has been limited to cases where the divisor is a whole number, and the dividend is a decimal.

With this combination we can adapt the previous three methods to divide decimals. The numbers must be placed in columns underneath each other so that the decimal points are aligned underneath each other.
We must remember how to multiply decimals such as 0.8 x 10 = 8 or 8.0 6 x 10 = 60 or 60.0

Example

(i) 87.5 ÷ 7
This is the tower method

$$\begin{array}{rrcl} & 87.5 & & \\ - & \underline{70.0} & = & 7 \times 10 \text{ (87.5 is greater than 70.0, therefore x 10 and then subtract)} \\ & 17.5 & & \\ - & \underline{14.0} & = & 7 \times 2 \text{ (17.5 is less than 70.0, therefore we double and subtract)} \\ & 3.5 & = & 7 \times \underline{0.5} \text{ (3.5 is less than 7, therefore x 0.5 and subtract)} \end{array}$$

To arrive at the final answer, we add the multipliers,
i.e. 10 + 2 + 0.5 = 12.5
therefore 875 ÷ 7 = <u>12.5</u>

(ii) 94.5 ÷ 35

Using the factor method, we get the following:-
Write 35 as 7 x 5
As previously, we divide by the larger factor first and then divide the answer by the other factor. Remember to place the decimal points underneath each other in the column.

$$\begin{array}{r|l} 7 & 9^{2}4.^{3}5 \\ \hline 5 & 1\,3\,.^{3}5 \\ \hline & \underline{\;2\,.\,7\;} \end{array}$$

Therefore 94.5 ÷ 35 = 2.7

(iii) 75.4 ÷ 29

Using the long division method and remembering to put the decimal points in a column, we arrive at the following:-

$$\begin{array}{rll} & 2.6 & \text{(answer line)} \\ 29 & \overline{)75.4} & \\ - & \underline{58.0} & \text{(29 x 2 = 58.0, put 2 in the units column on the answer line)} \\ & 17.4 & \\ - & \underline{17.4} & \text{(29 x 6 = 174, therefore 29 x 0.6 = 17.4, put 6 in the tenths column on the answer line)} \\ & \underline{00.0} & \end{array}$$

Therefore 75.4 ÷ 29 = 2.6

MENTAL CALCULATION

1. RE-ARRANGING

When trying to add a row of numbers, we should look for pairs that add up to make a multiple of 10 or 100

e.g. **13** + 8 + **7** + 6 + 2 13 + **8** + 7 + 6 + **2**

20 **10**

20 + 10 + 6 = 36

2. BRIDGING

When adding two numbers, part of one number can be taken to make the other number a multiple of 10, which is easier to handle; i.e. we bridge through the nearest ten.

e.g. 47 + **26** [Subtract 3 from the 26 (leaving 23) and add it to the 47 to make 50]

+3 = **50 + 23 = 73**

e.g. 36 + **17** = **40 + 13 = 53**

+4

We can also bridge through ten when subtracting:

e.g. 23 – 17

We subtract 3 first in order to bridge the 10 and then we subtract the remainder, which is 14

(23 – 3) – 14 = 20 - 14 = 6

e.g. 134 - 57

Method 1

= (134 – 4) – 53 (subtract 4 first)
= 130 – 53
= (130 – 30) – 23 (then subtract 30)
= 100 – 23 = 77

Method 2

= (134 – 34) – 23 (subtract 34 first)
= 100 – 23 (then subtract the remainder - 23)
= 77

3. COMPENSATION

We can sometimes add or subtract more than we should and then compensate. We usually round the number to the nearest 10.

e.g. 37 + 19 We can round up the 19 to 20 and then compensate by subtracting 1, because we have added 1 too much

= (37 + 20) - 1 = 57 - 1 = **56**

e.g. 6.7 + 3.9 We can round the 3.9 up to 4.0 and then compensate by subtracting 0.1, because we have added 0.1 too much.

= (6.7 + 4.0) – 0.1 = 10.7 - 0.1 = **10.6**

A similar method can be used in subtraction:

e.g. 137 - 28 We can round the 28 up to 30 and compensate by adding 2, because we have subtracted 2 too many

= (137 - 30) + 2 = 107 + 2 = **109**

e.g. 138 + 69	e.g. 405 – 399	e.g. $2\frac{1}{2} + 1\frac{3}{4}$	e.g. 5.7 + 3.9
= 138 + 70 – 1	= 405 – 400 + 1	= $2\frac{1}{2} + 2 - \frac{1}{4}$	= 5.7 + 4.0 – 0.1
= 208 – 1	= 5 + 1	= $4\frac{1}{2} - \frac{1}{4}$	= 9.7 – 0.1
= **207**	= **6**	= $\mathbf{4\frac{1}{4}}$	= **9.6**

The most difficult part of the compensation method is knowing whether we should add or subtract when compensating. You should ask yourself "Have I added or subtracted too much or not enough?"

4. NEAR DOUBLES

If we are adding two numbers that are near to each other, we can double one number and then compensate. We can double the smaller number and add or double the larger number and subtract.

e.g. 13+14 This can be considered as double 13 add one
or double 14 subtract one

13 + 13 + 1 = 26 + 1 = 27
or
14 + 14 - 1 = 28 - 1 = 27

Sometimes, the gap between the two numbers is more than one, but the method still works:

e.g. 18 + 16 = 18 + 18 – 2 or = 16 + 16 + 2
= 36 – 2 = 36 - 2
= **34** = **34**

(Note that 18 + 16 could be 17 + 17, i.e. double 17; this always happens when there is a difference of 2 between the numbers)

e.g. 60 + 70 = 60 + 60 + 10 (double 60 add 10)
= 120 + 10
= **130**

e.g. 1.5 + 1.6 = 1.5 + 1.5 + 0.1 (double 1.5 add 0.1)
= 3.0 + 0.1
= **3.1**

We sometimes double and compensate in 2 directions

e.g. 421 + 387 = 400 + 400 + 21 – 13
= 800 + 8
= **808**

MULTIPLICATION AND DIVISION

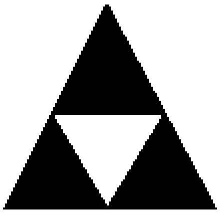
Most mental strategies for multiplication and division depend on a knowledge of tables. This must be extended to the multiplication and division of larger numbers:

x 2	double	2 x 56 = (2 x 50) + (2 x 6) = 100 + 12 = 112
x 3	double, then add the number	3 x 125 = (2 x 125) + 125 = 250 + 125 = 375
x 4	double and double again	4 x 34 = (2 x 34) x 2 = 68 x 2 = 136
x 5	multiply by 10 and halve	5 x 240 = (240 x 10) / 2 = 2400 / 2 = 1200
x 6	multiply by 5 and add the number	
x 7	double, double and double again and subtract the number	
x 8	double, double again and double again	8 x 24 = (24 x 2) x 2 x 2 = (48 x 2) x 2 = 96 x 2 = 192
x 9	multiply by 10 and subtract the number	9 x 57 = (10 x 57) – 57 = 570 - 57 = 513
x 10	move the numbers to the left	10 x 12 = 120 10 x 3.75 = 37.5

3. FRACTIONS, DECIMALS AND PERCENTAGES

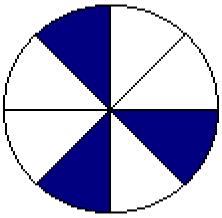
3.1 FRACTION

A fraction is one whole number divided by another whole number

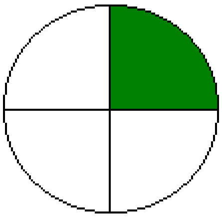


The fraction here is $\frac{3}{4}$ - three shaded pieces and four equal pieces altogether.

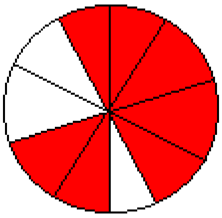
Here are some other examples



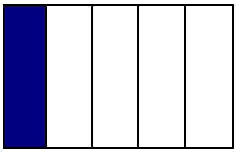
$\frac{3}{8}$



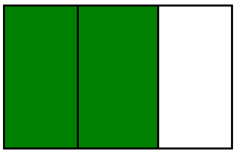
$\frac{1}{4}$



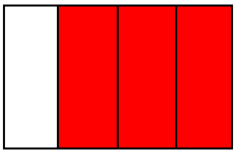
$\frac{7}{10}$



$\frac{1}{5}$

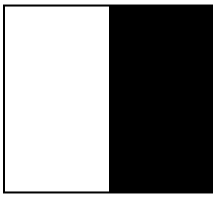


$\frac{2}{3}$



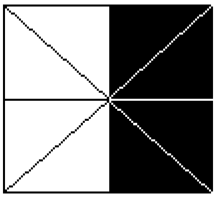
$\frac{3}{4}$

Equal / Equivalent Fractions



$\frac{1}{2}$

$\frac{2}{4}$



$\frac{4}{8}$

The shaded parts are the same size in the three diagrams, therefore $\frac{1}{2} = {}^{2}/_{4} = {}^{4}/_{8}$.

We can create equal fractions by multiplying or dividing.

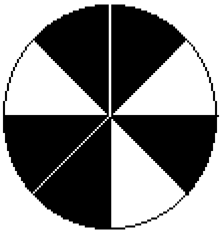
$$\begin{tikzcd} \frac{3}{15} \arrow[r, phantom, "="] \arrow[r, bend left, "\div 3"] \arrow[r, bend right, "\div 3"'] & \frac{1}{5} \end{tikzcd} \qquad \begin{tikzcd} \frac{2}{3} \arrow[r, phantom, "="] \arrow[r, bend left, "\times 4"] \arrow[r, bend right, "\times 4"'] & \frac{8}{12} \end{tikzcd}$$

3.1 PERCENTAGES

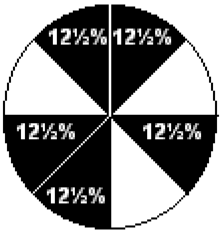
Percentage means OUT of 100.
The symbol for percentage is %.
We say that one whole is 100%.

The strip has ten equal parts, therefore each part is worth: 100% ÷ 10 = 10%. Therefore the shaded parts are 10% x 7 = 70%.

By comparing the shaded parts in the fractions and percentages diagrams, we observe a relationship between percentages and fractions.



=



$^5/8 = 12\frac{1}{2}\%+12\frac{1}{2}\%+12\frac{1}{2}\%+12\frac{1}{2}\%+12\frac{1}{2}\% \quad = \quad 62\frac{1}{2}\%$

3.3 CHANGING A FRACTION INTO A PERCENTAGE

To change a fraction into a percentage, we multiply the top of the fraction by 100 and then cancel as necessary.

Expressing 7/20 as a percentage

$$\frac{7\text{x}10\cancel{0}}{2\cancel{0}} \quad = \quad \frac{70}{2} \quad = \quad 35\%$$

3.4 FINDING A PERCENTAGE OF A NUMBER

(a) What is 10% of £40?
10% is £40.00 ÷ 10 = £4

(b) What is 5% of 50kg?
10% is 50kg ÷ 10 = 5kg
5% = 2.5kg (5% is half of 10%)

(c) What is 17½% of £80?
10% is £8
5% is £4
2 ½% is £2

17½% is £14

(ch) What is 8% of 250kg?
10% is 25kg
1% is 2.5kg
2% is 5kg

8% is 10% - 2% i.e. 25kg – 5kg = 20kg

3.5 FRACTIONS AND DECIMALS

To change a fraction into a decimal we must divide the top by the bottom (using a calculator if necessary).

(a) Expressing ${}^{3}/_{8}$ as a decimal

$3 \div 8 = 0.375$

(b) Expressing $4\,{}^{2}/_{5}$ as a decimal

$2 \div 5 = 0.4$

therefore $4\,{}^{2}/_{5} = 4 + 0.4$

$= 4.4$

To change a decimal into a fraction we must create a fraction over 10, 100, 1000 etc. and then cancel if necessary.

(c) Expressing 0.54 as a fraction

$$0.54 = \frac{54}{100} = \frac{27}{50}$$

(ch) Expressing 3.6 as a fraction

$3.6 = 3 + 0.6$

$$0.6 = \frac{6}{10} = \frac{3}{5}$$

$3.6 = 3 + {}^{3}/_{5} = 3\,{}^{3}/_{5}$

3.6 DECIMALS AND PERCENTAGES

To change a decimal into a percentage we must multiply by 100. This moves the decimal point 2 places to the right.

Expressing 0.35 as a percentage
0.35 x 100 = 35%

Expressing 1.275 as a percentage
1.275 x 100 = 127.5%

To change a percentage into a decimal, we divide by 100. This moves the decimal point 2 places to the left.

Expressing 45% as a decimal
45% ÷ 100 = 0.45

Expressing $17\frac{1}{2}$% as a decimal
$17\frac{1}{2}$% = 17.5%
17.5% ÷ 100 = 0.175

3.7 TABLES

(a) A table of common fractions, decimals and percentages.

FRACTION	DECIMAL	PERCENTAGE
$\frac{1}{2}$	0.5	50%
$\frac{1}{4}$	0.25	25%
$\frac{3}{4}$	0.75	75%
$^{1}/_{8}$	0.125	12.5%
$^{1}/_{10}$	0.1	10%
$^{1}/_{5}$	0.2	20%
$^{3}/_{10}$	0.3	30%
$^{3}/_{5}$	0.6	60%

(b) A table of common fractions.

<table>
<tr><td colspan="240">1</td></tr>
<tr><td colspan="120">1/2</td><td colspan="120">1/2</td></tr>
<tr><td colspan="60">1/4</td><td colspan="60">1/4</td><td colspan="60">1/4</td><td colspan="60">1/4</td></tr>
<tr><td colspan="30">1/8</td><td colspan="30">1/8</td><td colspan="30">1/8</td><td colspan="30">1/8</td><td colspan="30">1/8</td><td colspan="30">1/8</td><td colspan="30">1/8</td><td colspan="30">1/8</td></tr>
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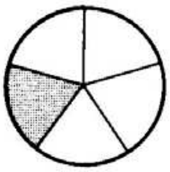
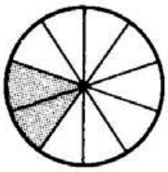
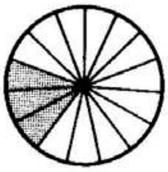
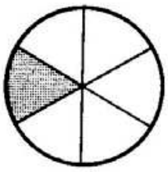


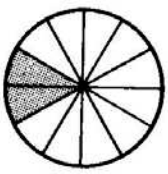
$\frac{1}{5}$

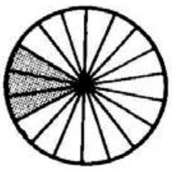


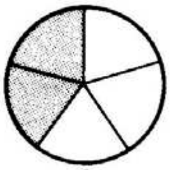




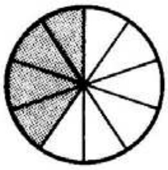
$\frac{1}{6}$

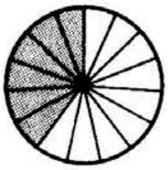


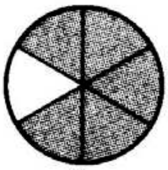




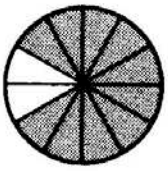
$\frac{2}{5}$

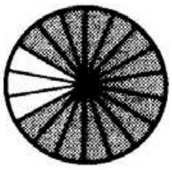






$\frac{5}{6}$





4. DATA HANDLING

COLLECTING DATA

The method we use to collect data depends on the sort of data that is collected.

(a) Listing the Data

We list the data when the sample of information is small.
Here is an example of a situation where we list data.
The eye-colour of ten babies in a hospital:
Blue, Blue, Green, Brown, Green, Blue, Green, Blue, Brown, Blue.

(b) Frequency Table (Tally chart)

When we have a lot of information in the sample we can use a frequency table. The table tells us how often each value appears.
Here is an example of a frequency table:

The number of goals scored by 30 football teams on one Saturday is:

1	3	2	3	4	2	1	3	0	5
3	0	1	4	0	4	4	3	3	4
1	3	4	3	1	2	1	3	4	3

Here is the tally for the ten numbers in the first row:

No. of Goals	Tally	Frequency
0	ι	
1	ι ι	
2	ι ι	
3	ι ι ι	
4	ι	
5	ι	

Here is the completed frequency table:

No. of Goals	Tally	Frequency
0	ι ι ι	3
1	~~ι ι ι ι~~ ι	6
2	ι ι ι	3
3	~~ι ι ι ι~~ ~~ι ι ι~~ ι	10
4	$\overline{\iota\ \iota\ \iota\ \iota}$ ι ι	7
5	ι	1

Every fifth tally (or notch) is drawn across the other four tallies.
Four tallies like this ι ι ι ι
Five tallies like this ~~ι ι ι ι~~
The frequency column is the total number of ticks in the tally column.

(c) Grouping Data

Sometimes there are very many different values in the table of data. In this case, it is better to arrange the data into classes or groups.
Here is an example of grouping data.
In a science test 30 children gained the following marks:

29	16	18	44	41	24	28	39	34	32
63	67	70	72	81	85	50	51	90	89
48	48	60	58	52	52	67	80	63	61

Here is the frequency table noting the ten marks in the first row.

Test Mark	Tally	Frequency
1 - 20	ι ι	
21 - 40	~~ιιιι~~ ι	
41 - 60	ι ι	
61 - 80		
81 - 100		

Note
The groups do not overlap and they are usually the same width

Here is the completed frequency table. Again the notches have been grouped in fives in the tally column.

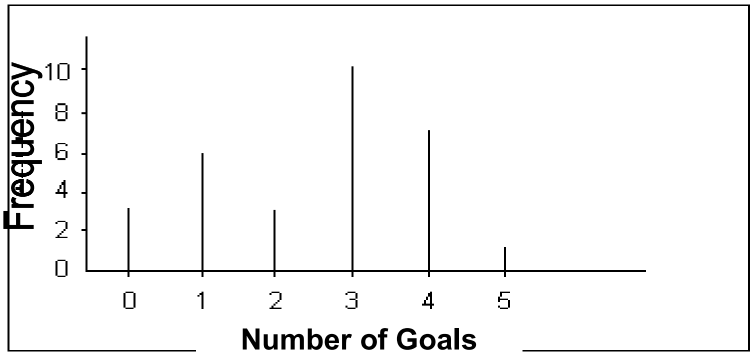
Test Mark	Tally	Frequency
1 - 20	ι ι	2
21 - 40	~~ιιιι~~ ι	6
41 - 60	~~ιιιι~~ ~~ιιιι~~	10
61 - 80	~~ιιιι~~ ι ι ι	8
81 - 100	ι ι ι ι	4

REPRESENTING DATA

Here are different methods of representing data on a diagram or a graph.

(a) Here is a vertical line graph showing the number of goals scored by 30 football teams on Saturday.

Vertical Line Graph (Frequency diagram)



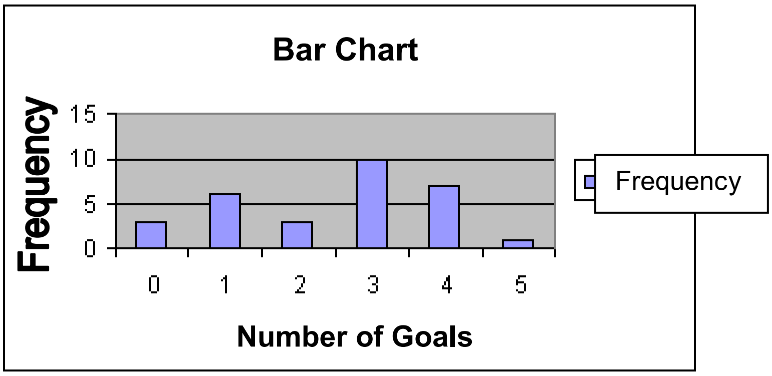
Can you answer these questions?

(a) How many teams failed to score any goals?
(b) What was the modal number of goals scored?
(c) What was the total number of goals scored?

The height of the lines is the frequency from the table.

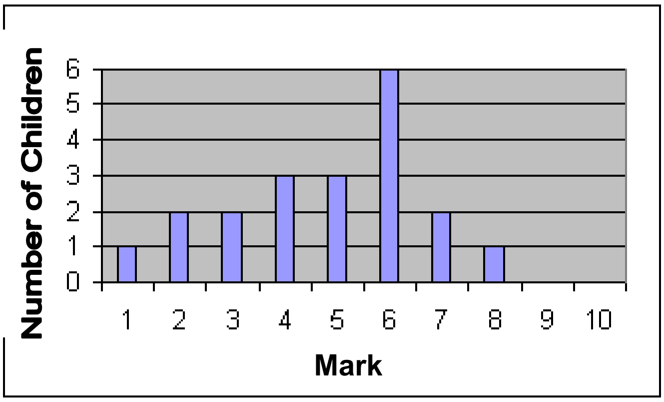
(b) (i) Bar Chart

In the bar chart, the height of each bar represents the frequency from the frequency table.



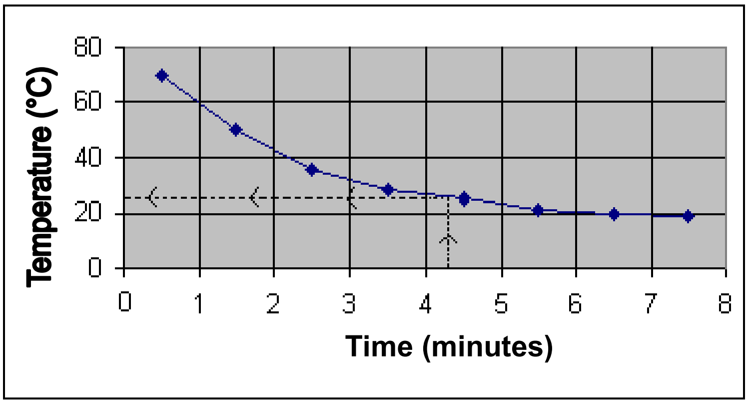
We usually draw a line graph and a bar chart for data that display specific values such as examination marks, shoe sizes, the score when throwing dice. There are no values in between the specific values. This sort of data is called **discrete** data.

Here is a bar chart .....



(c) Line Graph / Curve Graph

In a line graph, we join particular points with straight lines or a curve. The graph can be used to estimate values between the specific points.



The graph can be used to estimate the temperature after 4 ½ minutes. From the graph we see that it would be 25°.

(d) Pie Chart

We usually use a pie chart to display categorised data. The frequency of each category is graded so that the total adds up to 360°. Each sector of the pie chart is drawn with a protractor.

Here are some examples of how to draw a pie chart:

(i) In a car park, there are 13 red cars, 10 blue cars, 5 white cars and 2 black cars.

Step 1

Add the frequencies

13 + 10 + 5 + 2 = 30

There are 30 cars altogether

Step 2

Divide 360°(a whole circle) by the total frequencies to give a value for 1 car in terms of the circle.

360°÷30 = 12°

Therefore each car is 12°

Step 3

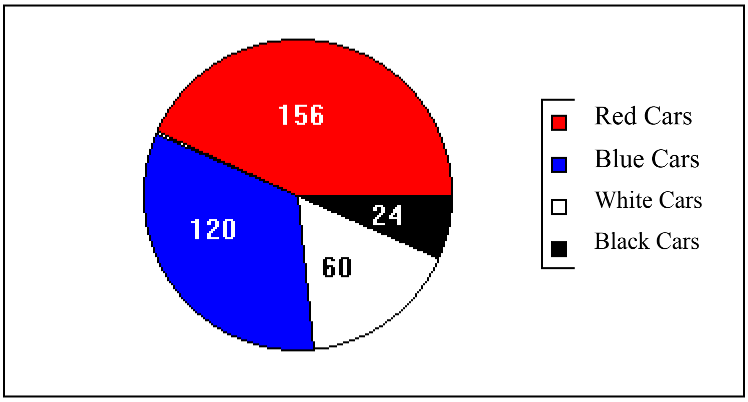
Exchange the number of cars in each category for a circular angle to find out the size of each sector of the pie chart.

Red Cars = 13 x 12° = 156°
Blue Cars = 10 x 12° = 120°
White Cars = 5 x 12° = 60°
Black Cars = 2 x 12° = 24°

you should check that these add up to 360°.

Note
You will sometimes have to round to the nearest degree.

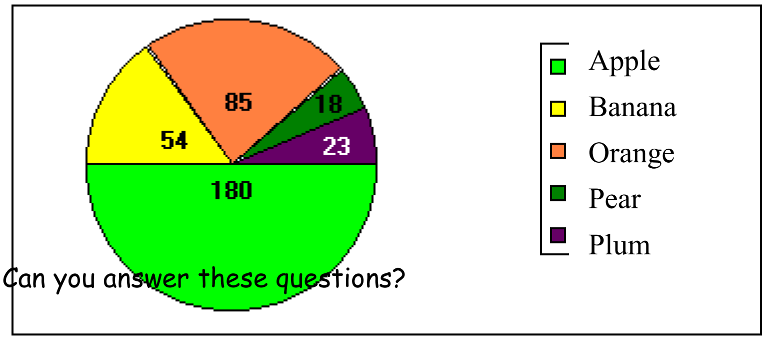
We can now draw a pie chart:



We sometimes note the % too.

It is a good idea to state the size of the angle in the middle of each sector as well as labelling each sector.

(ii) Here is a pie chart showing which fruit children preferred to eat.



Can you answer these questions?

a) How big is the angle of the plum sector?
b) What fraction of children preferred apples?
c) If 20 children were questioned, how many children preferred oranges?

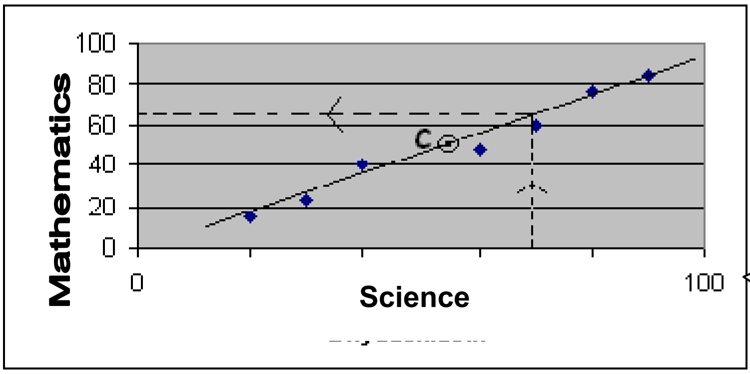
(e) Scatter Diagram

We draw a **scatter diagram** when trying to discover a connection or a relationship between two variables (something that changes or varies in size). If there is a connection, i.e. if a change in one influences the other, we say that there is a **correlation** between the two variables.

STEP 1 Plot a series of points with crosses, with one variable on each axis. The points should not be joined up.
STEP 2 Notice if there is a pattern or a trend in the position of the crosses.
STEP 3 If there is a correlation, we can draw the line of best fit, i.e. the line that shows the trend and is as close as possible to each point, without necessarily going through every point.

Note
If we know the mean of the two variables, the line of best fit should go through the point where the two means were plotted.

Here is an example of a scatter diagram:

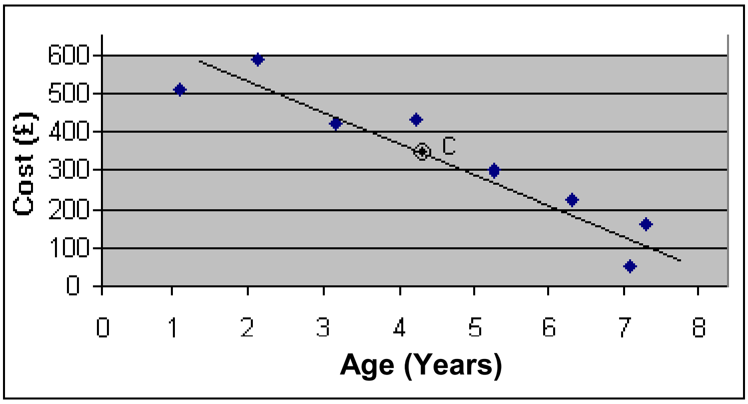


Pupils' results in mathematics and science examinations.

There is a close correlation here since ability in mathematics influences ability in science; if a pupil is good in one, then he/she is good in the other.

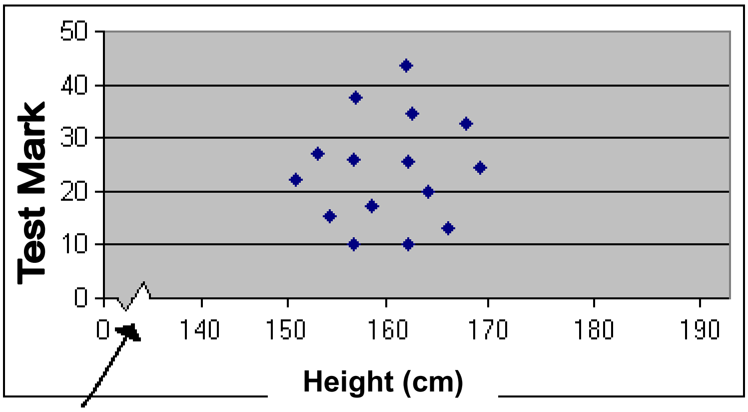
The line of best fit shows a positive correlation between marks in the two papers, namely that a high mark in the science paper suggests a high mark in the mathematics paper. The same number of points lie above and below the line of best fit.
The line goes through the mean mark of the two papers, point C, and extends beyond all the points.
We can use a line to estimate the mark in one paper given the mark in the other paper. A mark of 70 in the science paper suggests a mark of 65 in the mathematics paper.

Here is a scatter diagram showing the price of second hand bikes and their age. This is a scatter diagram showing a negative correlation:



In negative correlation, as one value increases, the other decreases, e.g. using the line of best fit gives the price of a 6 year old second hand bike as £200 and the price of a 3 year old second hand bike as £450.

A scatter diagram showing that there is no correlation.



When the points are scattered on the map there is no correlation, i.e. there is no connection, e.g. height does not influence a test mark.

The convolution shows a break in the x axis.

5. ABBREVIATIONS

a.m.	ante meridiem/in the morning
°C	degree centigrade/Celsius
cm	centimetre
cm^2	square centimetre
cm^3	cubic centimetre
E	east
°F	degree Fahrenheit
g	gram
kg	kilogram
km	kilometre
l	litre
L.C.M.	lowest common multiple
m	metre
mg	milligram
ml	millilitre
mm	millimetre
m.p.h.	mile per hour
N	north
NE	north-east
NW	north-west
p	penny/pence
p.m.	post meridiem/in the afternoon
S	south
SE	south-east
SW	south-west
V.A.T.	Value Added Tax
W	west
2-D	two-dimension
3-D	three-dimension

6. METRIC AND IMPERIAL UNITS

Metric Units

Weight

1 kilogram = 1000 grams
1 metric tonne = 1000 kilogram

Length

1 kilometre = 1000 metres
1 metre = 100 centimetres
1 metre = 1000 milimetre

Capacity

1 litre = 1000 millilitres
1 litre = 100 centilitres
1 centilitre = 10 millilitres

7. CONVERSION TABLES

Converting between metric units and imperial units

These are some rough equivalent imperial and metric measures.
The meaning of this symbol ≈ is ' approximztely equal to ' or about

Length

8 Kilometre ≈ 5 miles or 1 kilometr ≈ 0.675 mile
1 mile ≈ 1.6 kilometr
1 metre ≈ 40 inches
1 inch ≈ 2.5 centimetres
1 foot ≈ 30 centimetres

Pwysau
1 kilogram ≈ 2.2 pounds (lbs)

Capacity

4 litres ≈ 7 pints or 1 litre ≈ 1.75 pints
1 pint ≈ 0.6 litres
1 gallon ≈ 4.6 litres
1 litres ≈ 0.22 gallons

8. OTHER UNITS

Time

60 seconds = 1 minute
60 minutes = 1 hour
24 hours = 1 day
7 days = 1 week
12 months = 1 year
52 weeks = 1 year
365 days = 1 year (366 in a leap year)

10 years = 1 decade
100 years = 1 century

Angular Measures

60 seconds = 1 minute (1')
60 minutes = 1 degree (1°)
360 degrees (360°) = 1 full turn

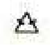
Temperature

Boiling point of water: 212°F or 100°C

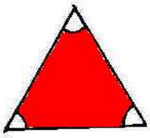
Freezing point of water: 32°F or 0°C

Thirty days hath September
April, June and November
All the rest have thirty-one
Excepting February alone
Which has but twenty-eight days clear
And twenty nine in each leap year.

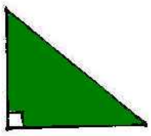
10. SYMBOLS

=	equal sign/equals	√	square root
≠	is not equal to	$^3\sqrt{}$	cube root
≈	approximately equals	π	'pi' (3.142)
≡	is identical to	10^0	10 degrees
>	greater than	26′	26 minutes
<	less than	42″	42 seconds
≥	greater than or equal to	%	percent/percentage
≤	less than or equal to	.	decimal point
+	add/plus	∟	right angle
-	subtract/minus	∠	angle
×	multiply/times	Δ	triangle
÷	divide by		equal lines
/	divide by		parallel lines
±	add or subtract (plus or minus)	$\parallel$	parallel to
£	pound(s)	⊥	perpendicular to
5^2	5 squared, 5 x 5 = 25	∴	therefore
5^3	5 cubed, 5 x 5 x 5 = 125	:	Ratio

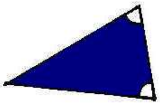
9. COMMON SHAPES



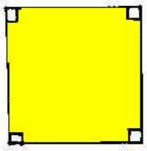
Equilateral Triangle



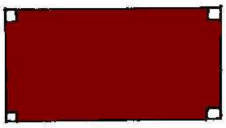
Right-angled Triangle



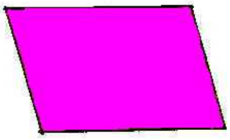
Isosceles Triangle
(two equal sides)



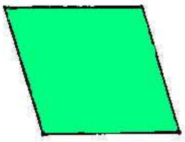
Square



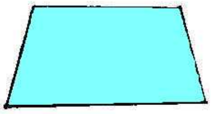
Rectangle



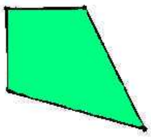
Parallelogram
(two pairs of opposite sides
are parallel and equal)



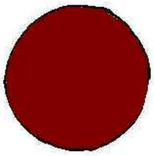
Rhombus
(opposite sides are
parallel, all sides are equal)



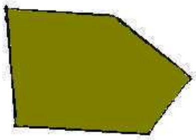
Trapezium
(one pair of opposite sides
are parallel)



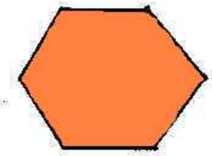
Kite



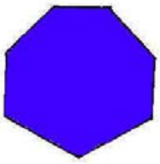
Circle



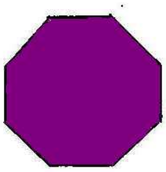
Pentagon



Hexagon



Heptagon



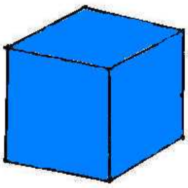
Octagon

11. COMMON SOLIDS

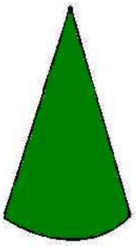
Table of Regular Shapes

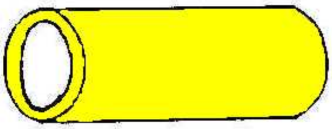
A regular shape has all sides the same length and all angles equal.

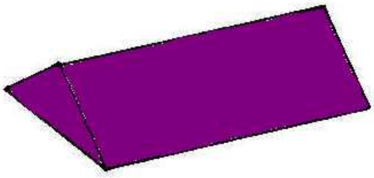
NAME OF THE SHAPE	NUMBER OF SIDES	TOTAL OF ANGLES	ONE INTERNAL ANGLE
Equilateral Triangle	3	180°	60°
Square	4	360°	90°
Pentagon	5	540°	108°
Hexagon	6	720°	120°
Heptagon	7	900°	128.6°
Octagon	8	1080°	135°
Nonagon	9	1260°	140°
Decagon	10	1440°	144°
Dodecagon	12	1800°	150°

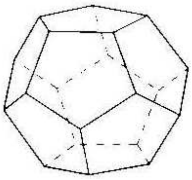

Cube

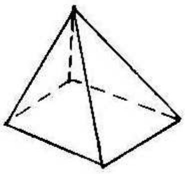

Cuboid

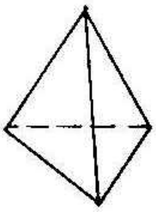

Cone

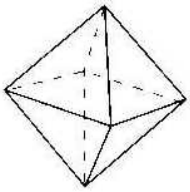

Cylinder


Triangular Prism
(Regular cross-section along its length)


Dodecahedron


Pyramid


Tetrahedron


Octahedron

12. MATHEMATICAL TERMS

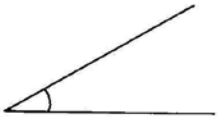
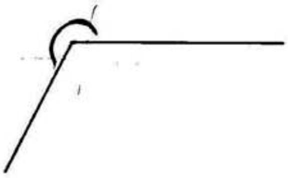
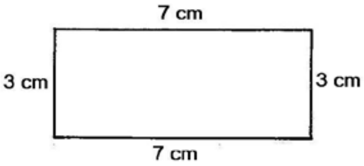
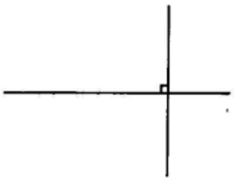
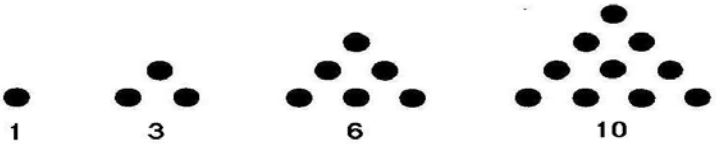
Examples of uses of the terms surrounded by a solid line are given in the next section.

Acute angle		Ongl lem
Angle		Ongl
Anti-clockwise		Gwrthglogwedd
Area		Arwynebedd
Average		Cyfartaledd
Axis		Echelin
Balance		Cydbwysedd
Benefits		Budd-daliadau
Bills		Biliau
Calculator		Cyfrifiannell
Capacity		Cynhwysedd
Cash		Arian parod
Cheque		Siec
Cheque card		Cerdyn Siec
Circle		Cylch
Circumference		Cylchyn
Clockwise		Clocwedd
Column		Colofn
Compass		Cwmpas
Compass		Cwmpawd
Computer		Cyfrifiadur
Cone		Côn
Co-ordinates		Cyfesurynnau
Credit card		Cerdyn credyd
Cube		Ciwb
Curve		Cromlin
Cylinder		Silindr
Decimal		Degolyn
Deposit		Blaendal
Diameter		Diamedr
Dice		Dis
Digit		Digid
Discount		Disgownt
East		Dwyrain
Electricity Bill		Bil Trydan
Equal/Unequal		Hafal/Anhafal
Estimate		Amcangyfrif
Even Number		Eilrif
Factor		Ffactor
Fraction		Ffracsiwn
Frequency		Amlder
Gas Bill		Bil Nwy
Gradient (slope)		Graddiant
Hexagon		Hecsagon
Hire purchase		Hurbwrcas
Horizontal axis		Echelin lorwedd
Income Tax		Treth Incwm
Index (power)		Indecs (pwer)
Interest (rate)		Llog (cyfradd llog)
Invest		Buddsoddi
Invoice		Archeb
Loan		Benthyciad
Loss		Colled

Lowest common multiple (L.C.M.)		Lluosrif cyffredin lleiaf (LL.C.LL)
Mean		Cymedr
Measure		Mesur
Median		Canolrif
Mode		Modd
Multiple		Lluosrif
North		Gogledd
North-east		Gogledd-ddwyrain
North-west		Gogledd-orllewin
Obtuse angle		Ongl aflem
Octagon		Octagon
Odd Number		Odrif
Overtime		Goramser
Parallel		Paralel
Percentage		Canran
Perimeter		Perimedr
Perpendicular		Perpendicwlar
Phone Bill		Bil Ffôn
Pound		Punt
Pressure		Gwasgedd
Prime number		Rhif cysefin
Prism		Prism
Probability		Tebygolrwydd
Profit		Elw
Pyramid		Pyramid
Radius		Radiws
Range		Amrediad
Rate of exchange		Cyfradd cyfnewid
Ratio		Cymhareb
Receipt		Derbynneb
Rectangle		Petryal
Reflection		Adlewyrchiad
Reflex angle		Ongl atblyg
Right angle		Ongl sgwâr
Round off		Talgrynnu
Row		Rhes
Salary (income)		Cyflog (incwm)
Save		Cynilo
Scale		Graddfa
South		De
South-east		De-ddwyrain
South-west		De-orllewin
sphere		Sffêr
Square		Sgwâr
Square number		Rhif Sgwâr
Square Root		Ail Isradd
Symmetry		Cymesuredd
Total		Cyfanswm
Triangle		Triongl
Triangular number		Rhif Triongl
Value Added Tax (VAT)		Treth ar Werth (TAW)
Vertical axis		Echelin fertigol
Volume		Cyfaint
Weigh		Pwyso
West		Gorllewin

12.1 DEFINITION OF COMMON TERMS

RANGE	Difference within the set of data. Range = largest datum – smallest datum. 1,2,3,3,5,6,8. Range = 8 – 1 = 7.
MEDIAN	The central value after placing the numbers in order. 1,2,3,3,5,6,8. Median = 3
VOLUME	Volume is the measure of space. Volume is measured in cubic units.
AVERAGE	There are three ways of calculating average value: Mean, median and mode.
CIRCUMFERENCE	Circumference is the line around the outside of a circle *(Cylchyn)* and also refers to the length of the line around the outside of a circle *(Cylchedd).*
MEAN	The total of the numbers divided by the number of numbers. 1,2,3,3,5,6,8. Mean = $\frac{1+2+3+3+5+6+8}{7} = \frac{28}{7} = 4$
PRIME	A number with only two factors – itself and 1. e.g. 2,3,5,7,11,13,17,19, ...
CAPACITY	The amount of liquid a container can hold.
MODE	The value that occurs most often, i.e. the value with the greatest frequency. 1,2,3,3,5,6,8. Mode = 3

ACUTE ANGLE	An angle less than 90°. 
OBTUSE ANGLE	An angle between 90° and 180°. 
REFLEX ANGLE	An angle between 180° and 360°. 
RIGHT ANGLE	An angle that is exactly 90°. 
PERIMETER	The distance around the edge of a shape. e.g. The perimeter of this rectangle is:-  7 + 3 + 7 + 3 = 20cm
PERPENDICULAR	When two lines intersect at a right angle. 
SQUARE NUMBER	When a number is multiplied by itself, it forms a square number. e.g. 1x1 = 1, 2x2 = 4, 3x3 = 9, 4x4 = 16, ... 1,4,9,16, ... are all square numbers.
TRIANGULAR NUMBER	The number of spots in a triangular arrangement. 

13. EXAMPLES OF THE USE OF COMMON TERMS

GEOGRAPHY - Mean / Range / Total

Temperature and Rainfall in Bethesda

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
°C	5	6	7	9	11	13	15	15	13	11	8	7
mm	125	100	65	65	65	70	80	90	115	120	120	120

a) What is the mean temperature?
(add the temperatures of each month and then divide by 12)

(5+6+7+9+11+13+5+15+13+11+8+7) ÷ 12

Answer = 120° ÷ 12
= 10 °C

b) What is the temperature range?
(subtract the lowest temperature from the highest)

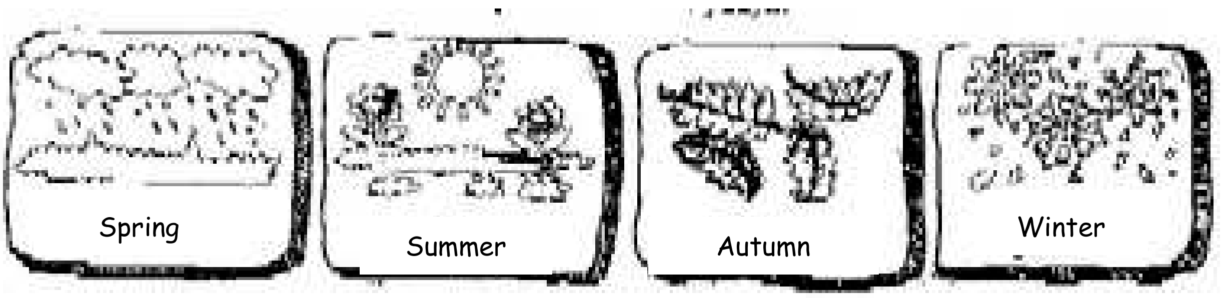
Answer = 15 °C – 5 °C
= 10 °C

c) What is the total rainfall?
(add the rainfall for each month)

(125+100+65+65+65+70+80+90+115+120+120+120)

Answer = 1135 mm

There are 4 seasons in a year



There are 365 days in a normal year, but every four years we have a **leap year, which has 366 days.**

DESIGN AND TECHNOLOGY - FOOD - Ratio

Using a recipe for Shortbread to explain ratio.

Shortbread

150g plain flour
100g margarine
50g caster sugar

These ingredients are enough to make eight biscuits.

Can you see a pattern in the weights of these ingredients?

The amount goes down (up) in multiples of 50g

This pattern is called a RATIO

Step 1 What is the smallest amount ? Answer (50g)
Step 2 How many times does 50 divide into the other two amounts?

100g ÷ 50g = 2 times

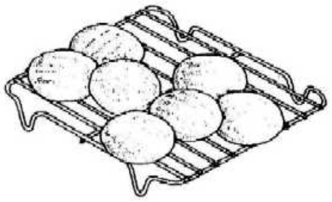
150g ÷ 50g = 3 times

They display the ratio 1: 2 : 3

Task

You are working for a biscuit manufacturer and need to **mass-produce** the original biscuits.

By adapting the original recipe, work out the total ingredients necessary to make 64 biscuits



……… caster sugar

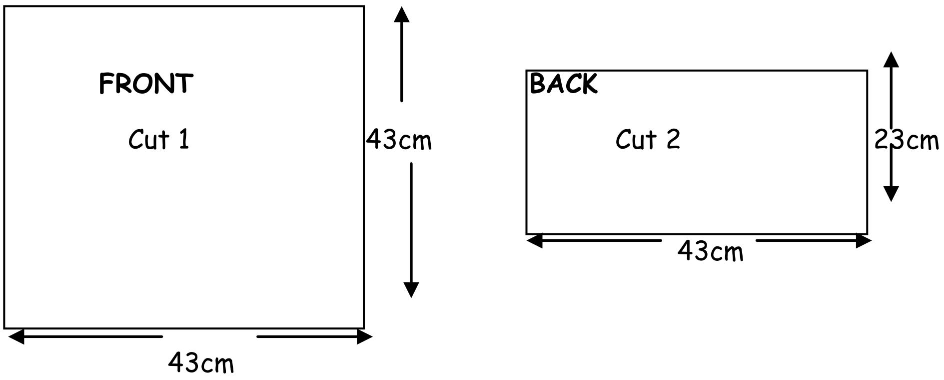
……… margarine

……… plain flour

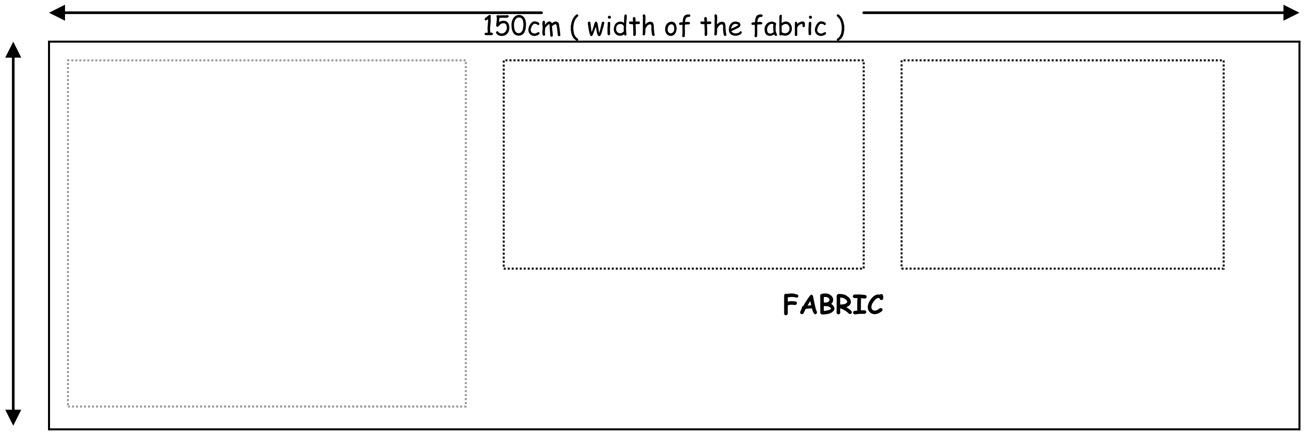
DESIGN AND TECHNOLOGY - TEXTILES - Estimate

A question to test pupils' understanding of the difference between the length and the width of fabric.

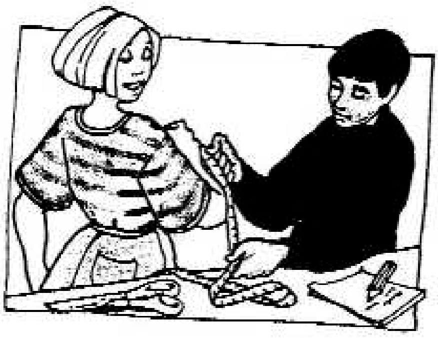
Imagine that you are going to make a 40cm x 40cm cushion with a zip opening in the middle of the back. The pattern pieces, which include a seam allowance of 1.5cm are shown below.



Place the different pieces of the cushion on the picture of the fabric that is 150cm wide, and then calculate how much fabric you need.



Correct answer 43cm (0.43m) An estimate is 0.5 metre



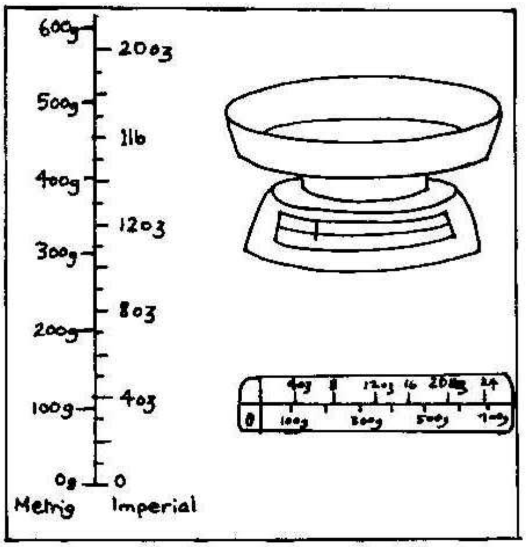
DESIGN AND TECHNOLOGY – FOOD - Weighing and measuring ingredients

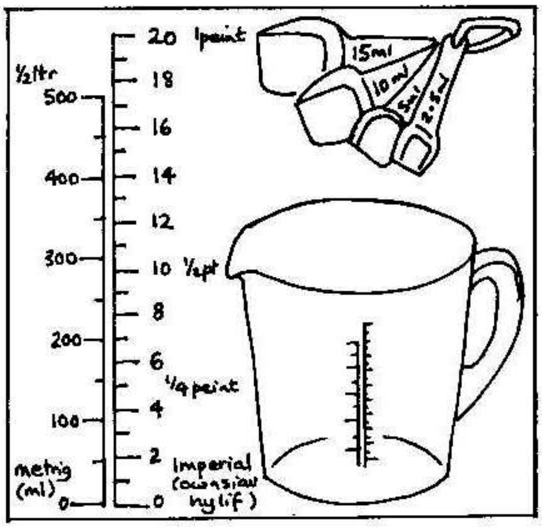
The **exact amount** of each ingredient is not important with dishes such as stir-fry vegetables or a stew. With other dishes, you must make detailed measurements in order to achieve successful results. For example, in a sponge mixture, the proportions of the ingredients must be accurate in order for the cake to rise.

Each ingredient must be measured to get the right proportions. The two main methods of measuring ingredients are by weight and by volume.

Weighing

Kitchen scales are used to weigh ingredients. Most scales measure in grams (g) and kilograms (kg) and are correct to the nearest gram. If your recipe is in Imperial weights – ounces (oz) or pounds (lb) – it can be converted by saying that 1 ounce = 25g and 1 pound (16 ounces) = 500g





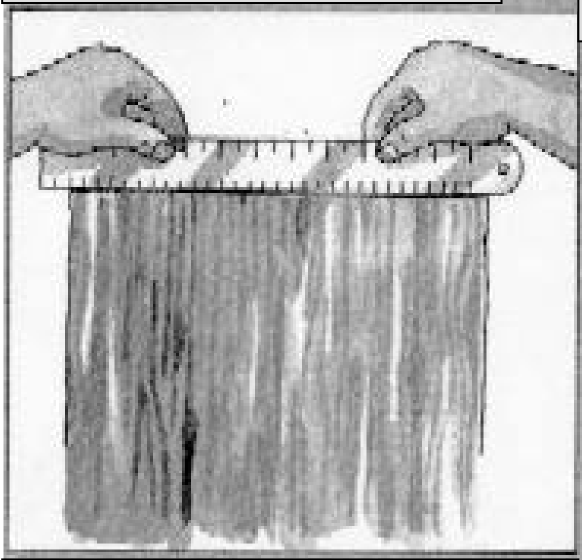
Measuring Volume

Use a jug to measure large volumes of liquid. Jugs are usually marked in millilitres (ml) and pints.
They are only accurate to the nearest 20ml.
Use measuring spoons to measure small amounts of liquid or powder. Four sizes of measuring spoons are available - 2.5ml, 5ml, 10ml ac 15ml.

DESIGN AND TECHNOLOGY – RESISTANT – Measuring and marking

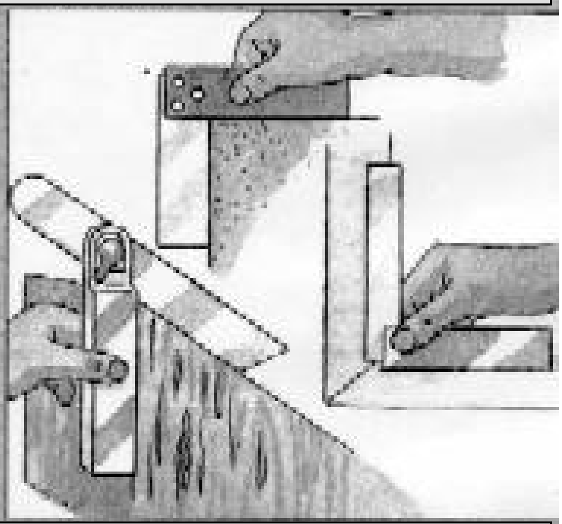
You will need to transfer your drawings very carefully to the materials in order to be able to cut and shape them correctly. If you do not measure and mark accurately it will be difficult to make a good product.

Begin with the straightest edge
Your material will usually have at least one surface or edge that is already correct. Confirm this with a steel rule.
Use this surface or edge as a starting point when marking

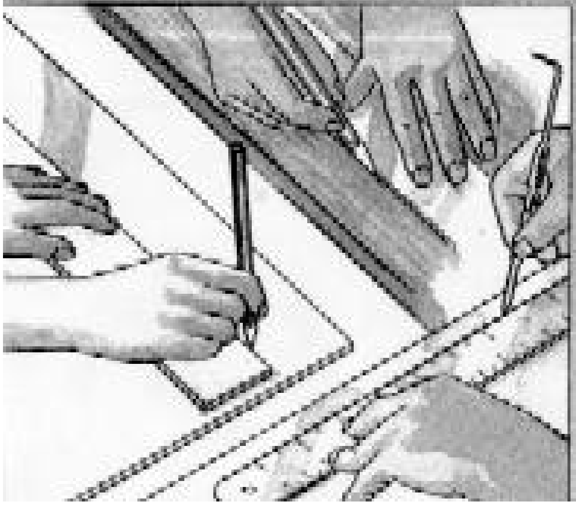


Marking and Checking Angles
Equipment to help you to mark and check 90° angles

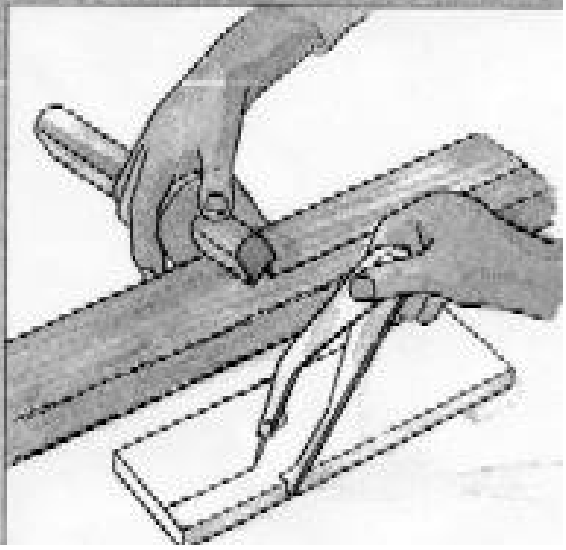
- Use a try square with wood
- Use an engineer's square with metal or plastic
- Draw or check other angles with an adjustable bevel



Marking
Use different markers on different materials.
Use a sharp pencil on wood or the protective paper on a sheet of plastic.
Use a scriber or a spirit-based marker on metal or uncovered sheets of plastic.



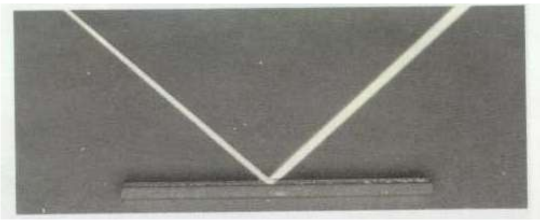
Marking lines parallel with a straight edge
Use a marking gauge on wood.
Use jenny callipers on metal or sheets of plastic.



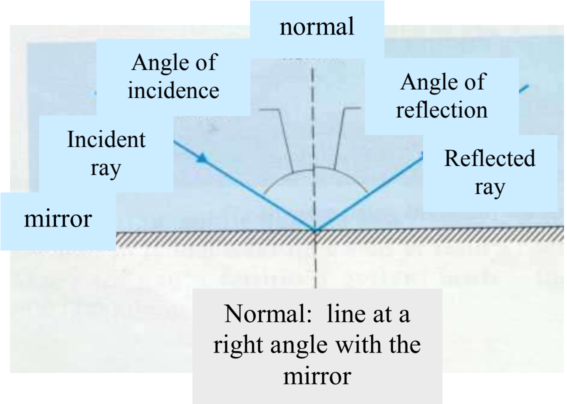
SCIENCE - Reflection

The door is not as smooth as the mirror. It sends light in all directions.
Mirrors reflect light so that they produce images.

Laws of reflection



A ray of light bounces off a flat mirror. Here are some of the words used to describe the reflection of the ray:



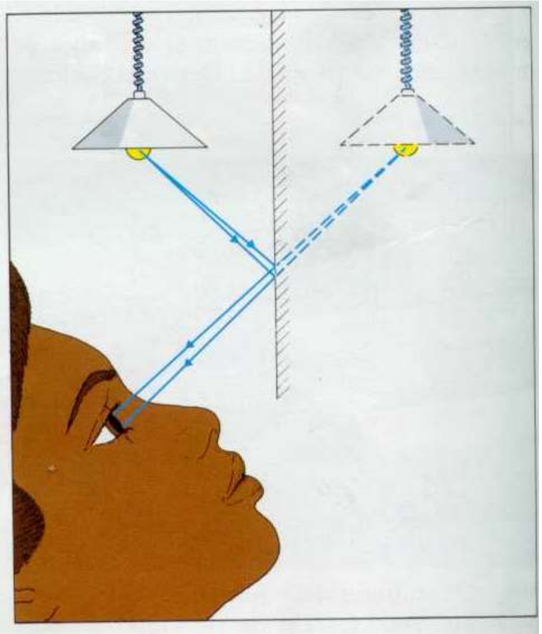
When a ray of light is reflected from a mirror, it obeys two simple rules:

1. The angle of reflection equals the angle of incidence. The ray is reflected from the mirror at the same angle as it arrives.

2. The ray that strikes the mirror, the reflected ray and the normal all lie in the same plane. You can draw the three lines on the same piece of flat paper.

These are the rules of reflection.

How a flat mirror creates an image.



Thousands of rays come from the lamp. But to keep things simple, only two of them are shown in the picture. The rays are reflected into the eye. It appears as though they come from a position behind the mirror. This is where you would see an image of the lamp.

The rays do not actually pass through the image. They only appear to come from it. The image is called a virtual image. It cannot be displayed on a screen.

SCIENCE – Pressure

Which causes the most damage?

Believe it or not, the stiletto heel.
It can damage carpets and make holes in floors. Not only because of the large downward force, but because the force acts on such a small area. It produces a high pressure.

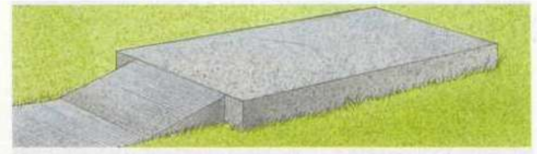
Pressure tells us how concentrated a force is. It is calculated by using the equation

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

and is measured in newtons/metre^2 (N/m^2) or pascals (Pa).

For example:

The meaning of the figures



Pressure under the concrete floor of a garage: 8000 N/m^2 (newtons per square metre of ground)

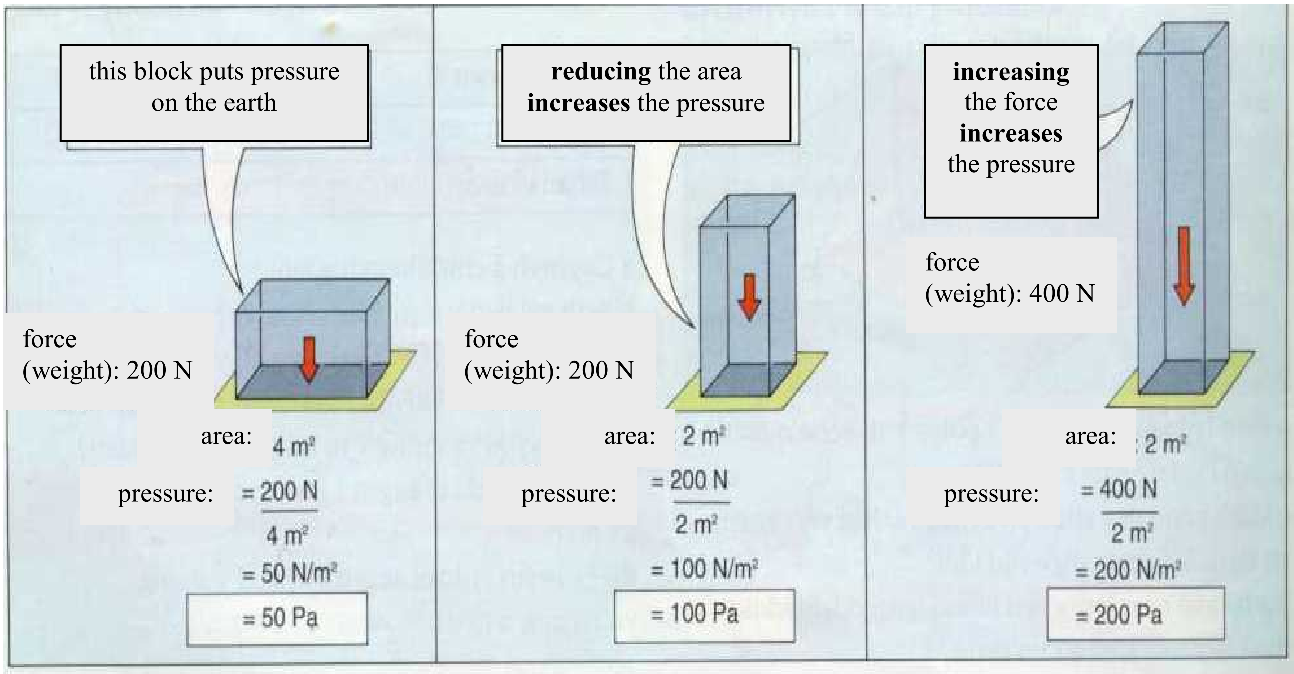
Pressure under a stiletto heel: 2 000 000 N/m^2. There is much less than a square metre here of course. But the heel has the same pressure effect on the floor as a force of 2 000 000 newtons spread over one square metre.

Pressure Problems

Rearrange the pressure equation, and you get

force = pressure x area

This equation is useful if you know the pressure, and the area on which it acts, but you want to find out the force.



BUSINESS – Hire Purchase

If a person does not have enough money to pay for goods in cash, they can pay monthly (or weekly). This method is called HIRE PURCHASE.

A sum of money is usually required at the start as a DEPOSIT (a percentage of the cash price).

The total of the deposit and all the other payments is greater than the normal price, as you have to pay for borrowing the money.

Example

A colour television set costs £200. It can be bought on hire purchase with a deposit of 10% of the cost price together with 12 monthly payments of £18. What will the hire purchase price be?

Hire purchase price = Deposit + Payments

Deposit

10% of £200 is £200 ÷ 10 = £20

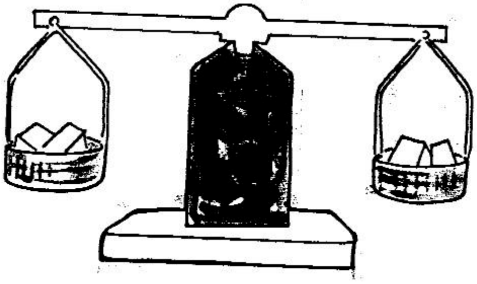
Payments

The payments are 12 x £18 = £216

Hire purchase price

Hire purchase price = Deposit + Payments
= £20 + £216
= £236

This shows that the hire purchase price is £36 more than the cash price, i.e. an additional £36 for borrowing the money.



BUSINESS – Value Added Tax (VAT)

As the title suggests, VAT is tax on sales or services. At present, most items covered by this tax are taxed at a rate of 17½%. It is charged on costs of repairs, new equipment, petrol, etc. There is no tax on basic foodstuffs, children's clothing and books at present.

Here is an example of calculating the additional VAT on the price of goods.

A washing machine costs £480 together with 17½% Value Added Tax. How much will the washing machine cost including VAT?

Method 1

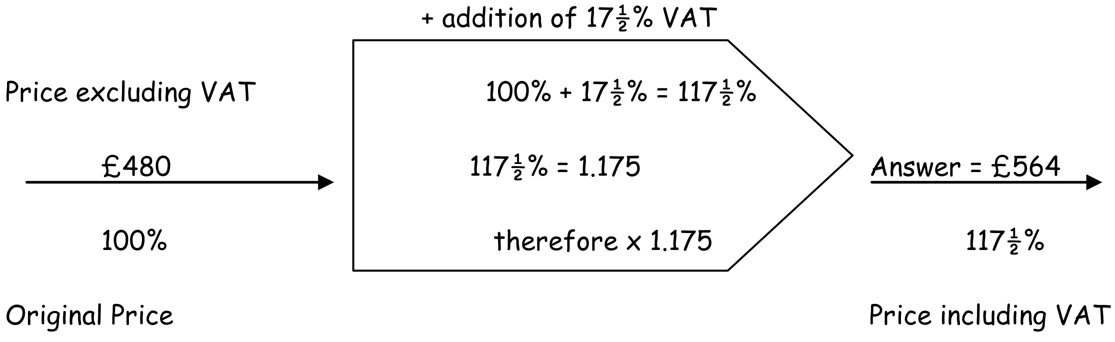
Calculating VAT without a calculator

10% = £480 ÷ 10 = £48
5% = £24 (half 10%)
2½% = £12 (half 5%)
17½% = 10% + 5% + 2½%
= £48 + £24 + £12
= £84

Therefore the price including VAT = £480 + £84 = £564

Method 2

To calculate the price of the washing machine including VAT with a calculator, we can use a multiplication machine.



The price including VAT is £480 x 1.175 = £564

14. SUBJECT TERMS

Terms that are common to a number of subjects

add	*adio*	pattern	*patrwm*
calendar	*calendr*	pay	*talu*
chart	*siart*	penny	*ceiniog*
cheap	*rhad*	pentagon	*pentagon*
circle	*cylch*	point	*pwynt*
count	*cyfrif*	polygon	*polygon*
day	*diwrnod*	position	*safle*
diagram	*diagram*	pound	*punt*
diameter	*diamedr*	price	*pris*
discount	*disgownt*	questionnaire	*holiadur*
divide	*rhannu*	rectangle	*petryal*
double	*dwbl*	remainder	*gweddill*
east	*dwyrain*	represent	*cynrychioli*
expensive	*drud*	row	*rhes*
graph	*graff*	season	*tymor*
group	*grŵp*	sell	*gwerthu*
guess	*dyfalu*	sequence	*dilyniant*
half	*hanner*	shape	*siâp*
halve	*haneru*	short	*byr*
horizontal	*llorwedd*	side	*ochr*
hundreds	*cannoedd*	size	*maint*
journey	*taith*	slow	*araf*
label	*label*	south	*de*
last	*diwethaf*	spend	*gwario*
length	*hyd*	square	*sgwâr*
likely	*tebygol*	subtract	*tynnu*
list	*rhestr*	tens	*degau*
maximum	*uchafswm*	tenth	*degfed*
measure	*mesur*	thousands	*miloedd*
minimum	*lleiafswm*	thrice/three times	*teirgwaith*
money	*arian*	time	*amser*
month	*mis*	total	*cyfanswm*
movement	*symudiad*	triangle	*triongl*
multiply	*lluosi*	unit	*uned*
net	*rhwyd*	vertical	*fertigol*
north	*gogledd*	week	*wythnos*
octagon	*octagon*	west	*gorllewin*
pair	*pâr*	year	*blwyddyn*
parallelogram	*paralelogram*		

Language

buy	*prynu*		quarter	*chwarter*
circle	*cylch*		second	*eiliad*
column	*colofn*		sell	*gwerthu*
cost	*cost*		sets of	*setiau o*
discount	*disgownt*		smallest	*lleiaf*
first	*cyntaf*		square	*sgwâr*
hour	*awr*		statistics	*ystadegau*
line	*llinell*		table	*tabl*
long	*hir*		total	*cyfanswm*
minute	*munud*		twentieth	*ugeinfed*
more than	*mwy na*		triangle	*triongl*
organize	*trefnu*		weigh	*pwyso*
per cent	*y cant*		weight	*pwysau*
percentage	*canran*		width	*lled*
price	*pris*			

Science

angle	*ongl*		least	*lleiaf*
area	*arwynebedd*		line	*llinell*
average	*cyfartaledd*		long	*hir*
axis	*echelin*		low	*isel*
calculator	*cyfrifiannell*		lower	*is*
centimetre	*centimetr*		metre	*metr*
classify	*dosbarthu*		metre rule	*ffon fetr*
column	*colofn*		milimetre	*milimetr*
concave	*ceugrwm*		more than	*mwy na*
convex	*amgrwm*		parallel	*paralel*
data	*data*		predict	*rhagfynegi*
decrease	*lleihau*		protractor	*onglydd*
degree	*gradd*		reflect	*adlewyrchu*
distance	*pellter*		second	*eiliad*
equal to	*hafal i*		slow	*araf*
estimate	*amcangyfrif*		solid	*solid*
factor	*ffactor*		surface	*arwyneb*
fast	*cyflym*		total	*cyfanswm*
formula	*fformiwla*		width	*lled*
kilometre	*cilometr*			

Design and Technology

angle	*ongl*		net	*rhwyd*
area	*arwynebedd*		parallel	*paralel*
average score	*sgôr cyfartalog*		pependicular	*perpendicwlar*
bar graph	*graff bar*		percentage	*canran*
centimetre	*centimedr*		pie chart+	*graff pei*
centre	*canolbwynt*		protractor	*onglydd*
circle	*cylch*		radius	*radiws*
compass	*cwmpas*		ratio	*cymhareb*
count	*cyfrifo*		rectangular	*petryal*
cube	*ciwb*		right angle	*ongl sgwâr*
cylinder	*silindr*		rough estimate	*bras amcan*
diameter	*diamedr*		scale	*graddfa*
equal shares	*rhannau cyfartal*		space	*gofod*
estimate	*amcangyfrif*		sphere	*sffêr*
gram	*gram*		square	*sgwâr*
hoop	*cylchyn*		straight line	*llinell syth*
kilogram	*cilogram*		symmetry	*cymesuredd*
litre	*litr*		three dimension	*tri dimensiwn*
mean	*cymedr*		triangle	*triongl*
metre	*medr*		two dimension	*dau ddimensiwn*
mile	*milltir*		unitary method	*dull unedol*
milimetre	*milimedr*		worth	*gwerth*

Music

balance	*cydbwysedd*		low	*isel*
fast	*cyflym*		lower	*is*
fifth	*pumed*		metre	*mesur*
first ... eighth	*cyntaf ... wythfed*		more	*yn fwy*
high	*uchel*		octave	*wythfed*
how much less? (Interval)	*faint yn llai? (Cyfwng)*		one whole pattern	*un cyfan* *patrwm*
how much more? (Interval)	*faint yn fwy? (Cyfwng)*		slow	*araf*
long	*hir*		value	*gwerth*

Geography

above	*uwchben*		equal to	*hafal i*
anti clockwise	*gwrthglocwedd*		equivalent	*cyfwerth*
area	*arwynebedd*		estimate	*amcangyfrif*
axis	*echelin*		fraction	*ffracsiwn*
bar chart	*siart bar*		height	*uchder*
calculate	*cyfrifo*		irregular	*afreolaidd*
calculator	*cyfrifiannell*		label	*label*
centre	*canolbwynt*		left	*chwith*
classify	*dosbarthu*		map	*map*
clockwise	*clocwedd*		maximum	*uchafswm*
closed	*caeedig*		most popular	*mwyaf poblogaidd*
column	*colofn*		predict	*rhagfynegi*
compass	*cwmpawd*		pyramid	*pyramid*
concave	*amgrwm*		regular	*rheolaidd*
count	*cyfrif*		relation	*perthynas*
data	*data*		representing	*yn cynrychioli*
data base	*cronfa ddata*		scale	*graddfa*
decrease	*lleihau*		set	*setio*
degree	*gradd*		sort	*didoli*
depth	*dyfnder*		statistics	*ystadegau*
direction	*cyfeiriad*		survey	*arolwg*
divide equally	*rhannu'n gyfartal*		unlikely	*annhebygol*

Religious Education

bar chart	*siart bar*		tally chart	*siart marciau rhifo*
data	*data*		ten times	*deg gwaith*
day	*diwrnod*		twentieth	*ugeinfed*
five times	*pum gwaith*		week	*wythnos*
four times	*pedair gwaith*		year	*blwyddyn*
set	*set*			

Information Technology

average	*cyfartaledd*		integer	*cyfanrif*
binary digit	*digid deuaidd*		kilobite	*cilobeit*
cells	*celloedd*		megabite	*megabeit*
characters	*nodau*		minimum	*isafswm*
decimals	*degolion*		number	*rhif*
estimate	*amcangyfrif*		percentages	*canrannau*
finance	*cyllido*		point size	*maint pwynt*
formula	*fformiwla*		size	*maint*
gigabite	*gigabeit*			

History

average	*cyfartaledd*		label	*label*
buy	*prynu*		least common	*lleiaf cyffredin*
century	*canrif*		millenium	*mileniwm*
classification	*dosbarthiad*		million	*miliwn*
compare	*cymharu*		money	*arian*
compass point	*pwynt cwmpawd*		more than	*yn fwy na*
correct	*cywir*		most common	*mwyaf cyffredin*
cost	*cost*		opposite	*cyferbyn*
decade	*degawd*		pound	*punt*
estimate	*amcangyfrif*		price	*pris*
exchange	*cyfnewid*		scale	*graddfa*
factor	*ffactor*		sell	*gwerthu*
fifth, sixth, etc.	*pumed, chweched a.y.y.b.*		sure	*sicr*
first	*cyntaf*		survey	*arolwg*
five times	*pum gwaith*		table	*tabl*
foot	*troedfedd*		ten thousand	*deg mil*
four times	*pedair gwaith*		total	*cyfanswm*
fourteenth, fifteenth etc.	*pedwerydd ar ddeg, pymthegfed a.y.b.*		twenties, thrities etc.	*dau ddegau, tri degau a.y.b.*
how often?	*pa mor aml?*		twentieth	*ugeinfed*
hundred thousand	*can mil*		unlikely	*annhebygol*
inch	*modfedd*		year	*blwyddyn*
incorrect	*anghywir*			

Physical Education

above	*uwchben*		metre rule	*ffon fetr*
angle	*ongl*		mile	*milltir*
anti clockwise	*gwrthglocwedd*		milimetre	*milimetr*
balance	*cydbwysedd*		more than	*mwy na*
centimetre	*centimetr*		parallel	*paralel*
chance	*siawns*		percentage	*canran*
clockwise	*clocwedd*		radius	*radiws*
compass	*cwmpas*		reflection line	*llinell ddrych*
diametr	*diamedr*		right angle	*ongl sgwar*
estimate	*amcangyfrif*		ruler	*pren mesur*
exchange	*cyfnewid*		score	*sgôr*
fast	*cyflym*		shape	*siâp*
fold	*plygu*		straight / direct	*union*
foot	*troedfedd*		strategy	*strategaeth*
fraction	*ffracsiwn*		surface	*arwyneb*
half-circle	*hanner cylch*		symmetry	*cymesuredd*
inch	*modfedd*		symmetry line	*llinell gymesuredd*
kilometre	*cilometr*		vertex	*fertig*
measuring tape	*tâp mesur*		width	*lled*
meter	*metr*			

Art

angle	*ongl*	lower	*gostwng*
area	*arwynebedd*	milimetre	*milimetr*
centimetre	*centimetr*	millenium	*mileniwn*
centre	*canolbwynt*	minute	*munud*
century	*canrif*	mirror line	*llinell ddrych*
circumference	*cylchoedd*	negative	*negatif*
closed	*caeedig*	parallel	*paralel*
column	*colofn*	path	*llwybr*
compass	*cwmpas*	perimeter	*perimedr*
corner	*cornel*	perpendicular	*perpendicwlar*
corresponding	*cyfatebol*	point	*pwynt*
cross-section	*trawstoriad*	positive	*positif*
cube	*ciwb*	protractor	*onglydd*
cylinder	*silindr mesur*	range	*amrediad*
depth	*dyfnder*	reflect	a*dlewyrchu*
diagonal	*croeslin*	regular	*rheolaidd*
display	*arddangos*	remainder	*gweddill*
distance	*pellter*	ruler	*pren mesur*
draw a line	*tynnu llinell*	second	*eiliad*
edge	*ymyl*	shape	*siâp*
equal parts	*rhannau cyfartal*	short	*byr*
estimate	*amcangyfrif*	sketch	*braslunio*
fold	*plygu*	solid	*solid*
form	*llunio*	space	*gofod*
formula	*fformiwla*	straight line	*llinell syth*
height	*uchder*	symmetry	*cymesuredd*
hour	*awr*	three dimension	*tri dimensiwn*
layer	*haen*	two-dimension	*dau ddimensiwn*
left	*chwith*	width	*lled*