Lytchett Minster School

Year 7
Mathematics
Knowledge Organisers

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2024-25

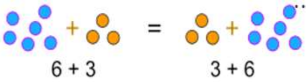
Commutative and Associative law

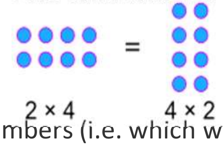
Key Words and Phrases

Commutative Law

The "Commutative Laws" say we can **swap numbers** over and still get the same answer ...

... when we **add**: $a + b = b + a$ ... or when we **multiply**: $a \times b = b \times a$

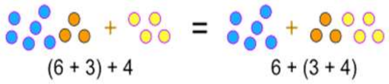


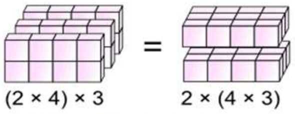


Associative Law

The "Associative Law" says that it doesn't matter how we group the numbers (i.e. which we calculate first) ...

... when we **add**: $(a + b) + c = a + (b + c)$ ... or when we **multiply**: $(a \times b) \times c = a \times (b \times c)$





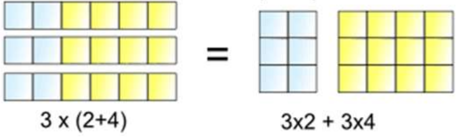
Distributive Law

This is what it lets us do:

3 lots of $(2 + 4)$ is the same as **3 lots of 2** plus **3 lots of 4**

So, the $3 \times$ can be "distributed" across the $2 + 4$,

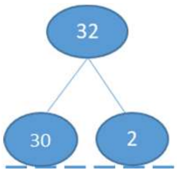
into 3×2 and 3×4 And we write it like this:

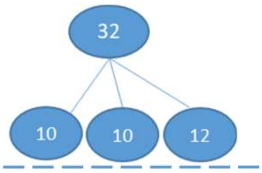


$$a \times (b + c) = a \times b + a \times c$$

Partitioning Numbers

Partitioning can make calculations easier by breaking numbers into parts that you can calculate more easily without the need for a formal method





Associative law for addition

Partitioning and associating numbers to **add** numbers easier

Example 1:

Partition 13 into 10 and 3

$$27 + 13 = (27 + 3) + 10$$

Associate 27 and 3 to make 30

$$= 30 + 10$$

$$= 40$$

Example 2:

Partition 158 and 42

$$158 + 42 = 100 + 58 + 40 + 2$$

Commutative law to change the order

$$= 100 + (58 + 2) + 40$$

Associate 58 and 2 to make 60

$$= 100 + 60 + 40$$

Associate 60 and 40 to make 100

$$= 200$$

Associative law for Multiplication

Partitioning and associating numbers to **multiply** numbers easier

Example 1:

$$2 \times 7 \times 5 = (2 \times 5) \times 7$$

Commutative law to change the order

Associate 2 and 5 to make 10

$$= 10 \times 7$$

$$= 70$$

Example 2:

$$125 \times 26 \times 8 = (125 \times 8) \times 26$$

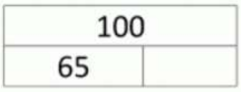
Associate 125 and 8 to make 1000

$$= 1000 \times 26$$

$$= 26000$$

Your turn to practice:

1)



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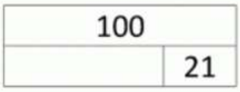

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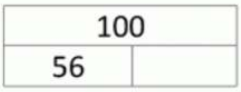
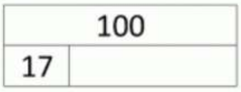


4)



5) $147 + 353$

6) $417 + 283$

7) $12 + 351 + 88$

8) $169 + 602 + 31$

9) $483 + 202 + 117$

10) $2 \times 63 \times 5$

11) $50 \times 63 \times 2$

12) $25 \times 6 \times 4$

13) $5 \times 5 \times 5 \times 8 \times 3$

14) $12.5 \times 4 \times 3 \times 3$

Answers

1) 35
2) 79
3) 44
4) 83
5) 500
6) 700
7) 451
8) 802
9) 802
10) 630
11) 6300
12) 600
13) 3000
14) 450

Place Value and Standard Form

Key Words and Phrases

Place Value

The decimal system is **base 10**. This means we have ten digits possible in each place value (0 to 9)

Words

Thirty million, one hundred thousand

Numeric

30 100 000

Million			Thousands			Unit		
Hundred Millions	Ten Millions	One Million	Hundred Thousands	Ten thousands	Thousand	Hundreds	Tens	Ones
10^8	10^7	10^6	10^5	10^4	10^3	10^2	10^1	1
100 000 000	10 000 000	1 000 000	100 000	10 000	1 000	100	10	1
	3	0	1	0	0	0	0	0

Standard form A general term meaning "written down in the way most commonly accepted" This common way depends upon the subject and country, however in the UK we use "Scientific Notation"

Standard form can also be referred to as standard index form.

To be in standard form a number must be written as:

$a \times 10^m$ where $1 \le a < 10$ and m is an integer

Using a number line can help, as per below:

E.g:

Convert 5 000 000 into standard form

$= 5 \times 10^6$

Billion			Million			Thousands			Unit			Decimals		
Hundred billions	Ten Billions	billion	Hundred Millions	Ten Millions	One Million	Hundred Thousands	Ten thousands	Thousand	Hundreds	Tens	Ones •	Tenths	Hundredths	Thousandths
10^{11}	10^{10}	10^9	10^8	10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0 •	10^{-1}	10^{-2}	10^{-3}
100 000 000 000	10 000 000 000	1 000 000 000	100 000 000	10 000 000	1 000 000	100 000	10 000	1 000	100	10	1 •	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
					5	0	0	0	0	0	0 •			

E.g: 2 750 000 $= 2.75 \times 10^6$ ← Must be a number greater or equal to 1, but less than 10.

Standard form is also used for really small numbers:

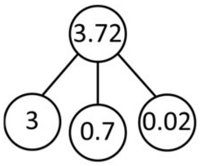
E.g: 0.004 $= 4 \times 10^{-3}$

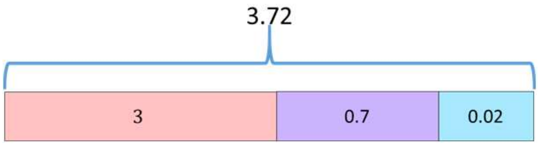
0.00000012 $= 1.2 \times 10^{-7}$

You will also need to know how to convert numbers from standard form into ordinary numbers

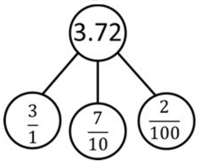
Part-part-whole diagrams

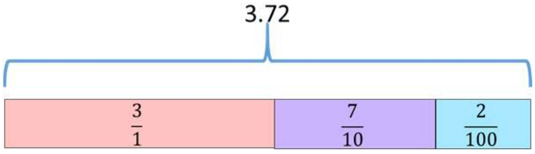
Decimal place value representation of **part-part-whole** diagrams



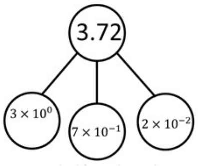


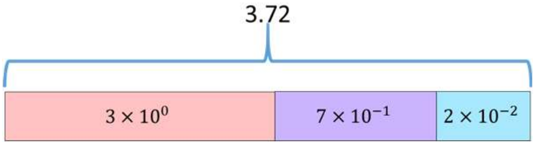
Fractional place value representation of **part-part-whole** diagrams





Standard form place value representation of **part-part-whole** diagrams





Your turn to practice:

What is the value of the 3 in the following numbers?

1) 4 231
2) 50 301 200
3) 73 001
4) 48 300
5) 31 002 000 015

Write the following in words

6) 3 000 000
7) 15 001
8) 20 842
9) 10 450 001
10) 20 015 410

Write the following numbers in figures

11) Four million
12) Three hundred and twenty four thousand
13) One million, thirty two thousand and six
14) Twenty two million, five hundred and seven thousand and twenty six

Write the following numbers as decimal, fractional and standard form part-part-whole diagrams

15) 1.85
16) 0.185
17) 0.0185
18) 1.085
19) 0.1008

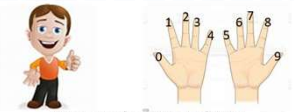
Answers

1) 30
2) 300 000
3) 3000
4) 300
5) 30 000 000
6) Three million
7) Fifteen thousand and one
8) Twenty thousand eight hundred and forty two
9) Ten million four hundred and fifty thousand and one
10) Twenty million, Fifteen thousand, four hundred and ten
11) 4 000 000
12) 324 000
13) 1 032 006
14) 22 507 026

Binary and Ternary numbers

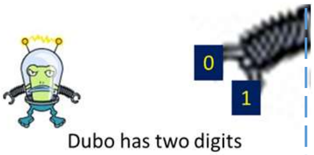
Key Words and Phrases

Base number How many digits in a number system
The decimal number system we use every day has 10 digits {0,1,2,3,4,5,6,7,8,9} and so it is **Base 10**.



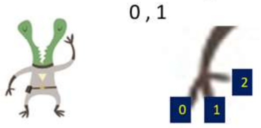
Humans have ten digits
0 , 1 , 2 , 3 , 4 , 5 , 6 , 7 , 8 , 9

Binary A binary digit can only be 0 or 1, so is **Base 2**.
The digital world uses binary code, or "**b**inary dig**it**" often shortened to the word "**bit**"



Dubo has two digits
0 , 1

Ternary A Ternary digit can only be 0, 1 or 2, so is **Base 3**.



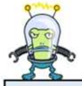
Threebee has three digits
0 , 1, 2

Sexagesimal Is a very special base (Base 60)
It works like clockwork!
There are no special codes, just the numbers 0 to 59, like we use for hours and minutes.

Converting number into Binary

Example: Convert 54 into binary

$54 = 32 + 16 + 4 + 2$ **$54 = 110110$ in binary**



Binary Place Value (Base 2)

Sixty four	Thirty two	Sixteen	Eight	Four	Two	Ones
2^6	2^5	2^4	2^3	2^2	2^1	1
$2 \times 2 \times 2 \times 2 \times 2 \times 2$	$2 \times 2 \times 2 \times 2 \times 2$	$2 \times 2 \times 2 \times 2$	$2 \times 2 \times 2$	2×2	2	1
64	32	16	8	4	2	1
	1	1	0	1	1	0

Converting number into Ternary

Example: Convert 57 into Ternary

Ternary Place Value (Base 3)

$57 = 27 + 27 + 3$ **$57 = 2010$ in Ternary**

Seven hundred and twenty nine	Two hundred and forty three	Eighty one	Twenty Seven	Nine	Three	Ones
3^6	3^5	3^4	3^3	3^2	3^1	1
$3 \times 3 \times 3 \times 3 \times 3 \times 3$	$3 \times 3 \times 3 \times 3 \times 3$	$3 \times 3 \times 3 \times 3$	$3 \times 3 \times 3$	3×3	3	1
729	243	81	27	9	3	1
			2	0	1	0

Your turn to practice:

Convert the following numbers into binary:

1) 53
2) 43
3) 106
4) 864
5) 356

Convert the following numbers into Ternary:

6) 53
7) 43
8) 106
9) 864
10) 356

Answers

1) 110101
2) 101011
3) 1101010
4) 1101100000
5) 101100100
6) 1222
7) 1121
8) 10221
9) 1012000
10) 111012

Ordering, Rounding and Estimating

Key Words and Phrases

Inequalities – Is a symbol used to show which number is smaller or larger.

Ascending – Ordering numbers from smallest to largest

Descending – Ordering numbers from largest to smallest

Integer - A number with no fractional part (no decimals)

Significant figures - Significant figures are the digits in a number that contribute to the accuracy of it

$a \le b$ "a is less than or equal to b"

$a < b$ "a is less than b"

$a \ge b$ "a is greater than or equal to b"

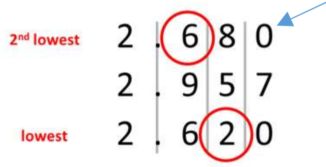
$a > b$ "a is greater than b"

Ordering numbers

Example: Put these numbers in ascending order

2.68 2.957 2.62

Starting with the most significant column, compare digits until you find the lowest number.

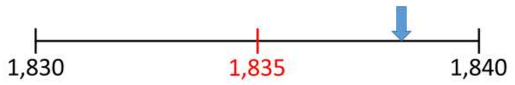


Make the decimals the same length by adding zeros, this makes it easier to compare them

2.62, 2.68, 2.957

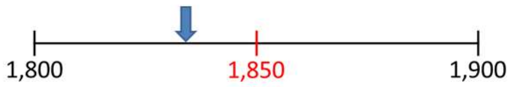
Rounding numbers to integer values

Round 1,838 to the nearest 10



$1838 \approx 1840$ to nearest 10

Round 1,838 to the nearest 100

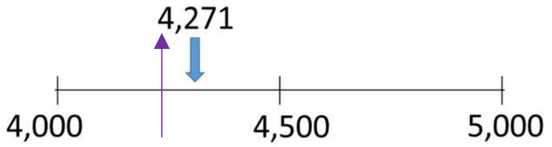


$1838 \approx 1800$ to nearest 100

Rounding numbers to significant figures

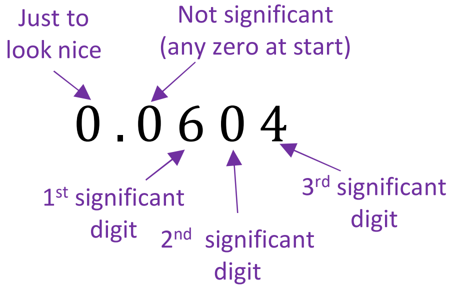
The first significant figure is the first non zero value

Example: Round 4,271 to 1 significant figure.



1st significant digit – so it is like rounding to nearest 1000

$4{,}271 \approx 4{,}000$ to 1 s.f.



Estimation

Rounding all numbers, before you calculate, to one significant figure helps to make the calculation easier to estimate

Estimate the answer to 51.6 + 52.8

$$51.6 + 52.8 \approx 50 + 50$$
$$\approx 100$$

Start by rounding the numbers to 1 significant figure

Your turn to practice:

Write these numbers in ascending order

1) 4.62, 4.51, 4.64
2) 6.3, 6.29, 6.28
3) 4.701, 4.07, 4.78, 4.7
4) 1.56, 1.605, 1.65, 1.556
5) 1.305, 1.503, 1.035, 1.35

Round the following numbers to the nearest 10, 100 and 1000.

6) 892
7) 1893
8) 1948
9) 1991
10) 2991.1

Round to the required significant figure

	1 sf	2 sf
448		
6053		
355		
82854		

Estimate:

11) $748 - 463$
12) 68×12
13) 480×1.94
14) $\frac{18.6 \times 4.6}{2.2}$
15) $\frac{9.61 \times 4}{4.6}$

Answers

1) 4.51, 4.62, 4.64
2) 6.28, 6.29, 6.3
3) 4.07, 4.7, 4.701, 4.78
4) 1.556, 1.56, 1.605, 1.65
5) 1.035, 1.305, 1.35, 1.503

6) 890, 900, 1000
7) 1890, 1900, 2000
8) 1950, 1900, 2000
9) 1990, 2000, 2000
10) 2990, 3000, 3000

	1 sf	2 sf
448	400	450
6053	6000	6100
355	400	360
82854	80000	83000

11) $700 - 500 \approx 200$
12) $70 \times 10 \approx 700$
13) $500 \times 2 \approx 1000$
14) $\frac{20\times5}{2} \approx \frac{100}{2} \approx 50$
15) $\frac{10\times4}{4} \approx \frac{40}{4} \approx 10$

Directed Number and Vectors

Keywords and Phrases:

Vector: These are arrows that have a magnitude (length) and a direction.

Magnitude: A property which determines whether an object is larger or smaller in size – the distance of that number from zero on the number line.

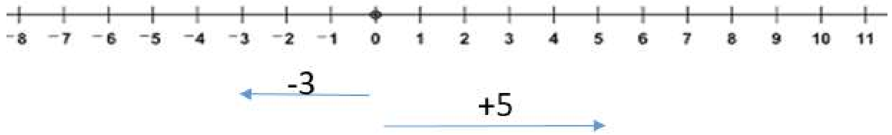
$|3| = |-3|$ The magnitude of 3 is equal to -3

Whenever a number is written using this notation we are comparing magnitude.

-3 in words is negative 3

$|-3|$ in words is the modulus (magnitude) of negative 3

Direction: Positive and negative determine the direction. On a number line, positive is to the right and negative is to the left.



Greater than (>) and less than (<):

$8 > -2$ means 8 is greater than -2

$-8 < -2$ means -8 is less than -2

Ordering numbers by magnitude and value:

Given that -25, 8, 28, -100, 87, 0, -1

In ascending order these numbers read: -100, -25, -1, 0, 8, 28, 87

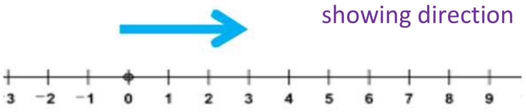
In descending order these numbers read: 87, 28, 8, 0, -1, -25, -100

In order of magnitude with the biggest magnitude first: -100, 87, 28, -25, 8, -1, 0

Vector notation

The diagram is a vector notation describing positive 3.

Starting at 0 in a positive direction by a magnitude of 3.



Must have an arrow showing direction

Your turn to practice:

Complete the following using $<$ or $>$

1) -2°C ○ -6°C
2) -9°C ○ 0°C
3) 15°C ○ -115°C

Write these numbers in ascending order

4) $6, -5, 8, -4$
5) $-13, -15, 17, 0, -8$
6) $3.5, -4, 7, -9, -22$
7) $0, -5.5, -8, 5, -3, -6$
8) 6, -9, 5, 0, 6.7, -3

Write these numbers in order of magnitude, smallest first

9) $6, -5, 8, -4$
10) $-13, -15, 17, 0, -8$
11) $3.5, -4, 7, -9, -22$
12) $0, -5.5, -8, 5, -3, -6$
13) 6, -9, 5, 0, 6.7, -3

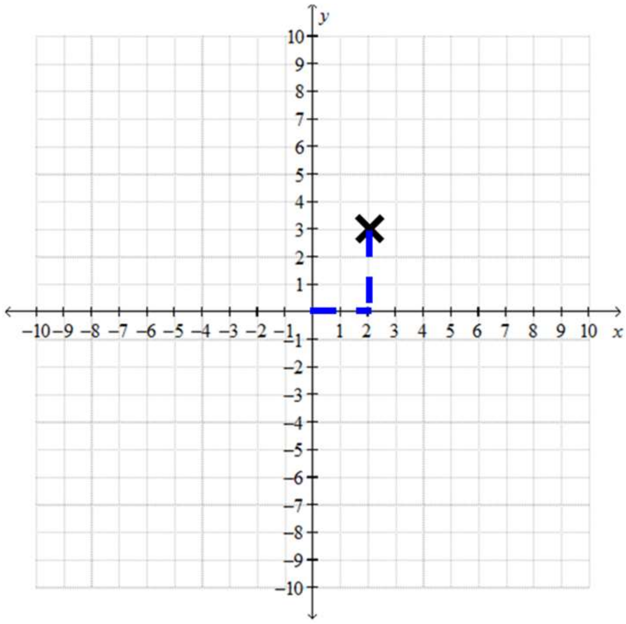
Answers

1) $-2 > 6$
2) $-9 < 0$
3) $15 > -115$
4) $-5, -4, 6, 8$
5) $-15, -13, -8, 0, 17$
6) $-22, -9, -4, 3.5, 7$
7) $-8, -6, -5.5, -3, 0, 5$
8) $-9, -3, 0, 5, 6, 6.7$
9) $-4, -5, 6, 8$
10) $0, -8, -13, -15, 17$
11) $3.5, -4, 7, -9, -22$
12) $0, -3, 5, -5.5, -6, -8$
13) $0, -3, 5, 6, 6.7, -9$

Coordinates and Variables

Keywords and Phrases:

Cartesian plane: The Cartesian plane is a 2 dimensional plane to measure along the x and y axis.



The numbers of the x and y axis are known as real numbers.

Origin: The origin is the middle of this grid. All co-ordinates are measured from the origin. It is written as (0,0)

Quadrant: The Cartesian plane is made up of 4 quadrants.

Coordinates: You are able to plot coordinates on the Cartesian plane, for example: $(2, 3)$

2 along x

3 up y

From the origin

Variable: A symbol for a value we don't know yet, or that can take many values. Variables can be plotted on scatter graphs:

Scatter graphs:

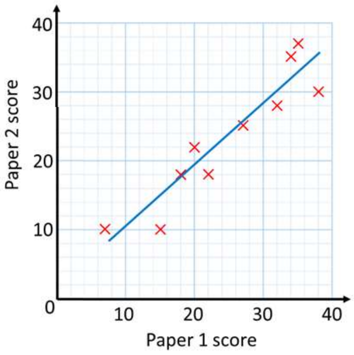
Correlation

Positive correlation

Negative correlation

No correlation

Lines of best fit



Draw the line of best fit on the graph.

- Straight line
- Follow the trend of the data
- Have roughly same number of points on each side

Your turn to practice:

Plot the following on scatter graphs

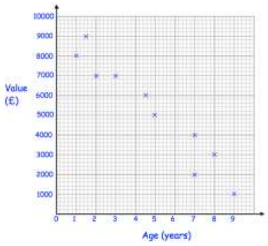
Maths score	9	13	6	18	11	4	15	10
Physics score	10	13	5	20	8	5	12	14

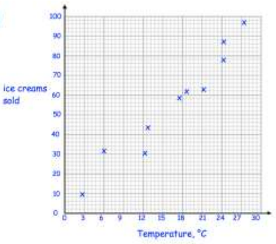
Age, years	4	7	2	4	1	9	3	6
Cost, £	6000	3000	7500	5000	8000	1500	6000	4000

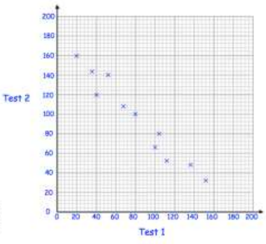
Height, cm	157	160	148	160	177	156	166	170
Weight, kg	53	60	44	53	54	60	54	70

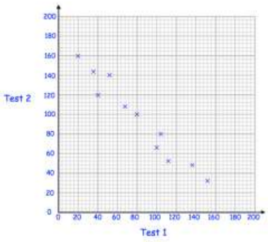
Distance, miles	2.5	0.8	1.2	4.1	2.8	3.3	3.7	1.5
Cost	£3.20	£1.40	£1.80	£4.40	£3.00	£3.60	£4.80	£2.40

What is the correlation of the following scatter graphs









Addition

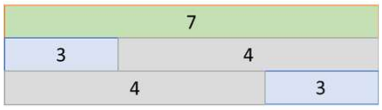
Keywords and Phrases:

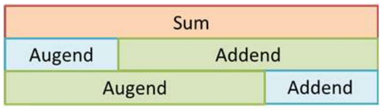
Sum: The result when two numbers are added together.

Commutative law - The "Commutative Laws" say we can swap numbers over and still get the same answer

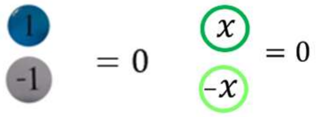
Augend - The augend is always the first number in the addition calculation all other numbers are addends but because the numbers are commutative it doesn't matter

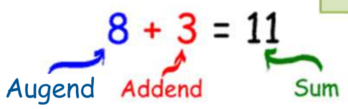
$3 + 4 = 4 + 3$





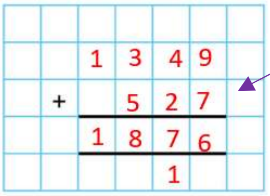
Zero Pair :





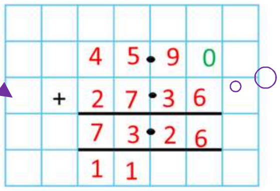
Column addition – Review of KS2

Example: $1349 + 527$



Ensure that all numbers are in the correct place value column

Example: $45.9 + 27.36$



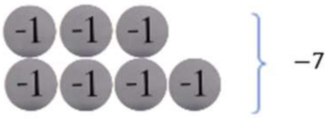
Always put the decimal in before you calculate

Addition of negatives

Negative numbers: the word "minus" is not allowed in the maths classroom!

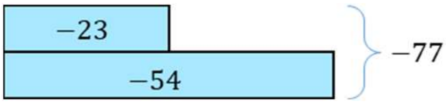
Example: $(-3) + (-4)$

Representing using counters:



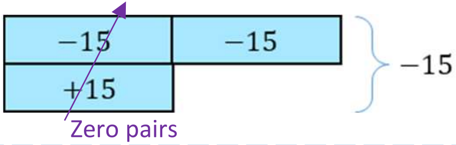
Example: $(-23) + (-54)$

Representing using bar model:



Example: $(-30) + (+15)$

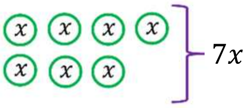
Representing using bar model:



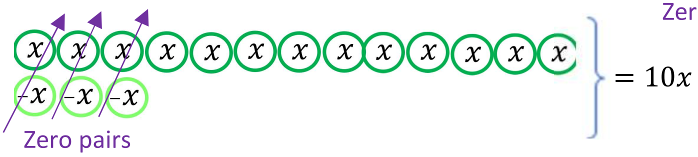
Addition of Algebraic Expressions – Commonly known as Collecting Like Terms

A term is separated by a (+) or (–) sign in an expression. When you collect the terms you are adding them together. Like terms have the same variable such as x or y

Example $4x + 3x \equiv$

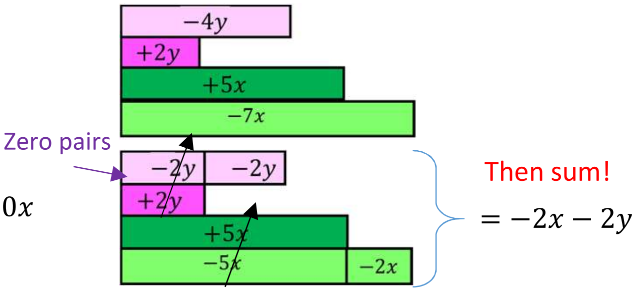


Example $8x - 3x + 5x \equiv (+8x) + (-3x) + (+5x)$



Example $-4y + 5x + 2y - 7x \equiv$

$(-7x) + 5x + 2y + (-4y) \equiv$



Your turn to practice:

Using bar models or counters to show your workings:

1) $5698 + 423$
2) $4635 + 218$
3) $563.84 + 2.04$
4) $845.204 + 42.05$
5) $540.604 + 4.0045$

6) $(+6) + (-2) =$
7) $(-5) + (+8) =$
8) $(+4) + (-10) =$
9) $(+33) + (-48) =$
10) $(-152) + (-231) =$

11) $5y + 2y + 8y + 3y \equiv$
12) $3x + 5x - 2x \equiv$
13) $2x + 6x - 7x - x \equiv$
14) $5y + 2x + 3x + 9y \equiv$
15) $12x + 5x + 8y - 2y \equiv$

Answers

1) 6121
2) 4853
3) 565.88
4) 887.254
5) 544.6085
6) 4
7) 3
8) -6
9) -15
10) -383
11) $18y$
12) $6x$
13) 0
14) $14y + 5x$
15) $17x + 6y$

Fractions 1

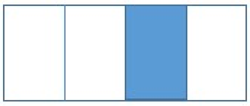
Keywords and Phrases:

Numerator: The top number in a fraction, shows how many parts we have.

Denominator: The bottom number in a fraction, shows how many equal parts the item is divided into

Unit fraction:

One equal part of a whole is called a unit fraction, for example:



Four equal parts, one selected

$= \frac{1}{4}$ one quarter

We can write every fraction as a multiple of a unit fraction.

Numerator gives us the multiple

$$\frac{4}{7} = 4 \times \frac{1}{7}$$

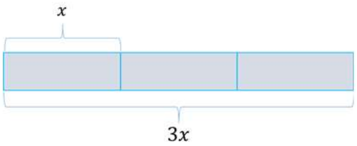
Four lots of one seventh.

Denominator gives us the unit

Unit Multiplication using bar models:

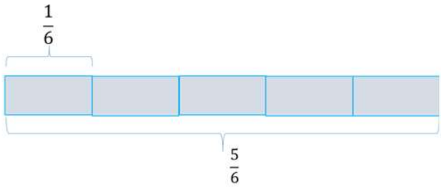
Drawing a bar model to represent different units.

Example 1 – Use a bar model to simplify $3 \times x$



$$3 \times x \equiv 3x$$

Example 2 – Use a bar model to calculate $5 \times \frac{1}{6}$



$$5 \times \frac{1}{6} = \frac{5}{6}$$

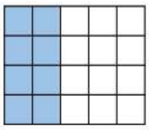
Equivalence and simplifying fractions:

Equivalent Fractions:

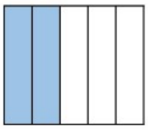
Fractions which have the same value, for example: $\frac{4}{5} = \frac{8}{10} = \frac{12}{15}$

Simplifying Fractions:

You can simplify equivalent fractions by dividing the numerator and denominator by the same number.



$$\frac{8}{20} \underset{\div 4}{\overset{\div 4}{=}} \frac{2}{5}$$



Your turn to practice:

Write these fractions as multiples of a unit fraction

1) $\frac{3}{4} =$

2) $\frac{5}{11} =$

3) $\frac{5}{9} =$

4) $\frac{3}{14} =$

5) $-\frac{4}{8} =$

Draw a bar model to represent

6) $4 \times y$

7) $d \times 3$

8) $\frac{1}{3} \times 7$

9) $3 \times \frac{1}{8}$

Find the missing numbers:

10) $\frac{2}{3} = \frac{}{6}$

11) $\frac{}{5} = \frac{15}{25}$

12) $\frac{3}{4} = \frac{30}{}$

13) $\frac{1}{20} = \frac{5}{}$

14) $\frac{11}{16} = \frac{88}{}$

Answers

1) $3 \times \frac{1}{4}$
2) $5 \times \frac{1}{11}$
3) $5 \times \frac{1}{9}$
4) $3 \times \frac{1}{14}$
5) $-4 \times \frac{1}{8}$
6) $4y$
7) $3d$
8) $\frac{7}{3}$
9) $\frac{3}{8}$
10) $\frac{4}{6}$
11) $\frac{3}{5}$
12) $\frac{30}{40}$
13) $\frac{5}{100}$
14) $\frac{88}{128}$

Subtraction

Keywords and Phrases:

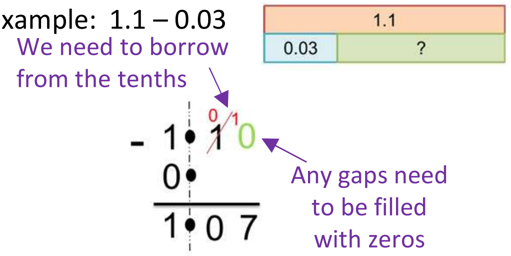
Difference: The distance between two numbers (subtraction)

Flip: Change the direction from positive to negative or negative to positive

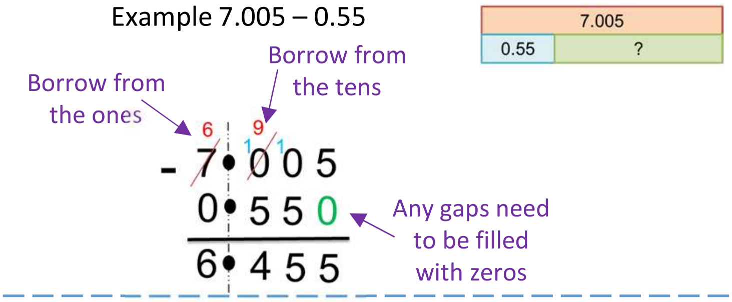
Subtraction - Subtraction is the **inverse** of addition, The commutative law **doesn't** work with subtraction

Column subtraction – Review of KS2

Example: 1.1 – 0.03



Example 7.005 – 0.55



Frequency Trees:

Frequency trees are a way of organising information

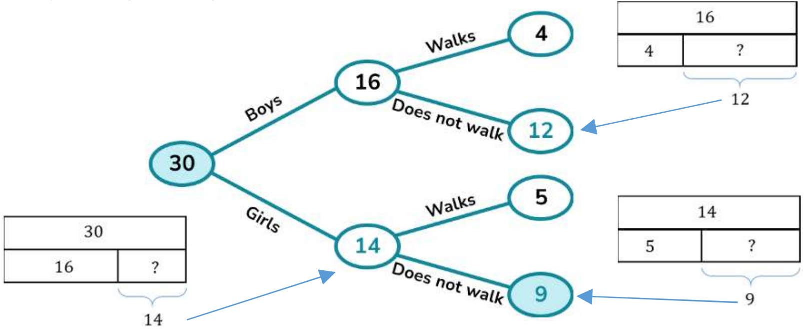
Example

A class has 30 children.

There are 16 boys.

4 boys and 5 girls walk to school.

Show this on a frequency tree



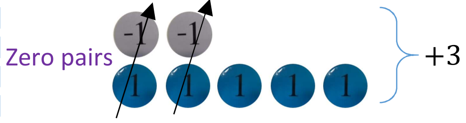
Subtraction of negatives

Subtracting a negative is the same as adding a positive

Example: $(-2)-(-5)$

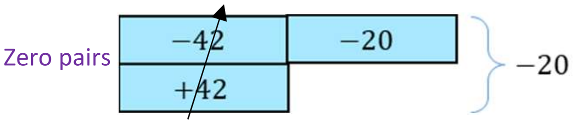
$=(-2)+(+5)$

Representing using counters:



Example: $(-62)-(-42)=(-62)+(+42)$

Representing using bar model:



Use the alternative calculation.

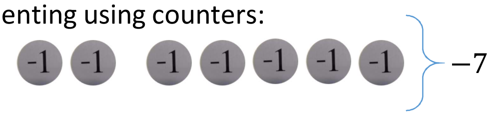
Don't subtract **Add**

Subtracting a positive is the same as adding a negative

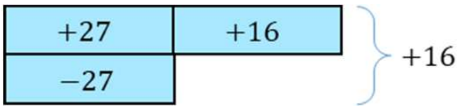
Example: $(-2)-(+5)$

$=(-2)+(-5)$

Representing using counters:



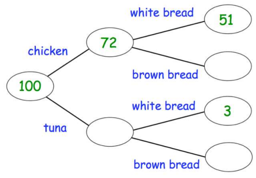
Example: $(+43)-(+27)=(+43)+(-27)$



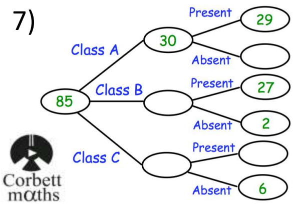
Your turn to practice:

1) $5698-423$
2) $4635-218$
3) $563.84-2.04$
4) $845.204-42.05$
5) $540.604-4.0045$

6)

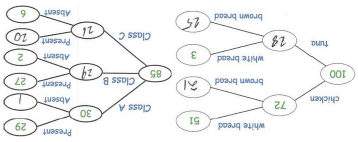


7)



8) $(+6)-(-2)=$
9) $(-5)-(+8)=$
10) $(+4)-(-10)=$
11) $(+33)-(-48)=$
12) $(-152)-(-231)=$

Answers
1) 5275
2) 4417
3) 561.8
4) 803.154
5) 536.5995



8) 8
9) -13
10) 14
11) 81
12) 79

Multiples and Venn diagrams

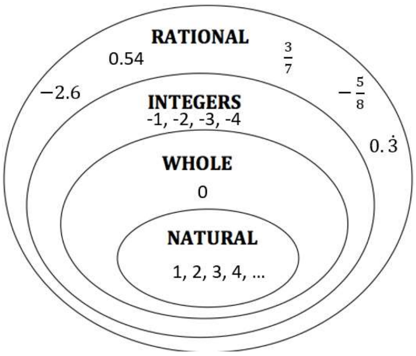
Keywords and Phrases:

Rational number system:

All the numbers seen in the diagram are real.

Natural numbers are sometimes known as counting numbers.
When we count we start at 1

Rational numbers include integers, whole, integers and natural numbers as well as fractions and decimals

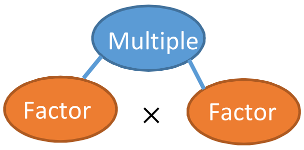


Multiples

A multiple is the result of multiplying one natural number with another

12 is a multiple of 3 because 3 x 4 = 12

12 is not a multiple of 36 because you cannot multiply 36 by another integer to get the answer 12



Lowest Common Multiple (LCM)

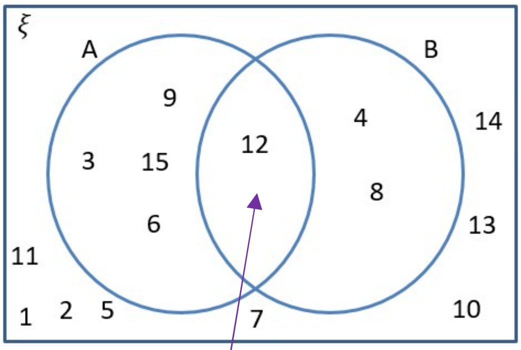
Multiples that appear in the multiplication table for two or more numbers are said to be **common multiples** of those numbers.

Multiples of 2 are 2, 4, 6, 8, 10, 12, 14, 16, 18,
Multiples of 3 are 3, 6, 9, 12, 15, 18

There are infinite common multiples of numbers but only one lowest common multiple.
So, the lowest common multiple of 2 and 3 is 6.

Venn diagrams

Universal set: is often seen as this symbol ξ – it means all the numbers in the diagram



$\boldsymbol{A \cap B}$ = The lowest common multiple
So the LCM of 3 and 4 is 12

Set A – is all the numbers in circle A
Set B – is all the numbers in circle B

$\boldsymbol{A \cap B}$ – The **intersection** of A and B and in a situation where both sets are multiples these are the common multiples

ξ = {1,2,3,4,5,6,7,8,9,10,11,12,13,14,15}

Set A = {multiples of 3}
= {3,6,9,12,15}

Set B = {multiples of 4}
= {4,8,12}

Set: Is represented using these curly brackets

Your turn to practice:

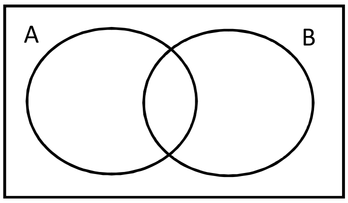
List the multiples of each number and use your lists to find the lowest common multiple of both numbers

1) 3 and 4
2) 3 and 9
3) 2 and 5
4) 8 and 4
5) 6 and 9
6) 10 and 12
7) 108 and 72

8) Complete the following Venn diagram given that: $\xi = \{1 \text{ to } 20\}$

$A = \{Multiples\ of\ 4\}$

$B = \{Multiples\ of\ 6\}$



Answers

1)	12
2)	9
3)	10
4)	8
5)	18
6)	60
7)	216

Factors

Keywords and Phrases:

Factors - Factors are what we can multiply to get the number.

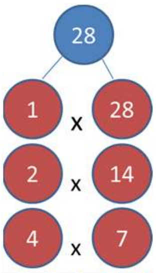
All numbers have factor pairs. Some numbers have more than one factor pair.

Laws of Divisibility – Rules which help to decide if a number can be divided by 2, 3, 4, 5, etc…

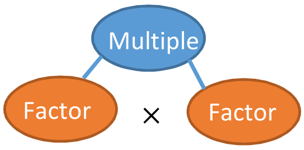
Listing Factors:

Example List all of the factors of 28

Using the laws of divisibility can help find all of the factor pairs.



Drawing a diagram like this can help



Factors of 28 = 1, 2, 4, 7, 14, 28

Laws of Divisibility

Divisible by 2 - If it is even and ends in 0, 2, 4, 6, 8

Divisible by 3 - Add the digits together and if the answer is divisible by 3

Divisible by 4 - If the last two digits are divisible by 4

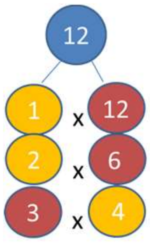
Divisible by 5 - If the number ends in 5 or 0

Divisible by 10 - If the number ends in 0

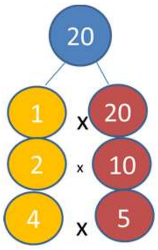
There are others, but these are the most commonly used.

Highest common factor (HCF):

Example: Find the highest common factor of 12 and 20

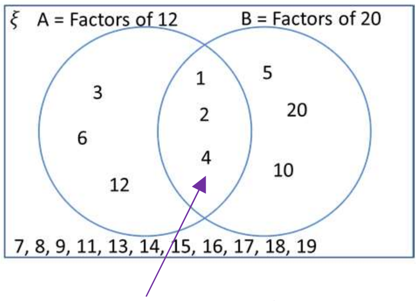


The common factors are 1, 2 and 4



Highest common factor of 12 and 20 = 4

The HCF can also be found using a Venn diagram



$A \cap B$ = The common factors
Which one is the highest.

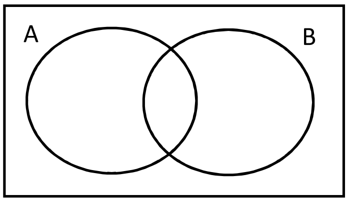
Your turn to practice:

List the factors of each number and use your lists to find the highest common factor of both numbers

1) 14 and 4
2) 6 and 9
3) 9 and 21
4) 8 and 12
5) 6 and 15
6) 10 and 17
7) 150 and 200

8) Complete the following Venn diagram given that:

$$\xi = \{1 \text{ to } 15\}$$
$$A = \{factors\ of\ 12\}$$
$$B = \{factors\ of\ 15\}$$



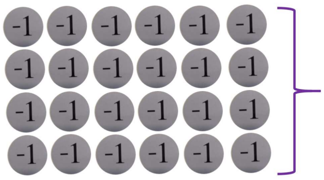
Find the HCF of 12 and 15 from your Venn diagram.

Answers
1) 2
2) 3
3) 3
4) 4
5) 3
6) 1
7) 50
8) 3

Multiplication

Multiplying negative numbers

Example $(+4) \times (-6)$ Four lots of negative six



-24

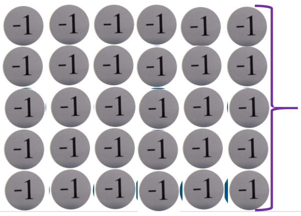
Example $(-5) \times (+6)$

$= -(+5) \times (+6)$

As $-5 = -(+5)$

$(+5) \times (+6)$

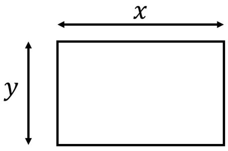
A negative changes the direction! Flip!



$= -30$

Multiplying Algebraic expressions

$x \times y \equiv xy \equiv yx$



These are identical but we usually put the variables in alphabetical order.

Example: Simplify $2a \times 5b$

$2 \times a \times 5 \times b$

This calculation can be expanded

$2 \times 5 \times a \times b$

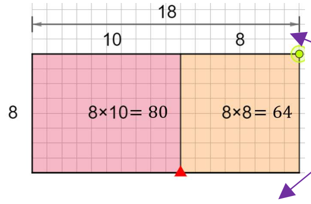
Using the commutative law we can bring the numbers together at the beginning of the calculation

$10 \times a \times b$

$= 10ab$

Multiplying using an area model:

These are the methods for multiplication at Lytchett. Your can use column method, but this method helps when we look at multiplying algebra.



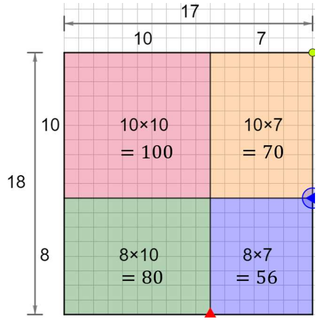
Partitioning 18 into 10 and 8

$8 \times 18 = 8 \times (10 + 8)$ $= 80 + 64$

$= 144$

Distributive Law

Multiplying two digit numbers using area model



Partitioning 17 and 18

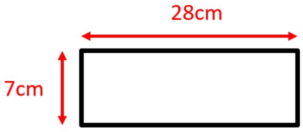
17×18

$= (10 + 7) \times (10 + 8)$

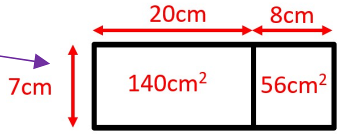
$= 100 + 70 + 80 + 56$

$= 306$

Area of rectilinear shapes:



Use area model and partitioning to calculate the area



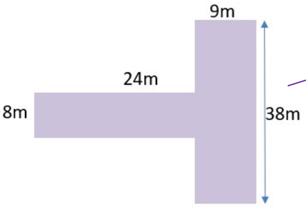
Area $= 7 \times 28$

$= 7 \times (20 + 8)$

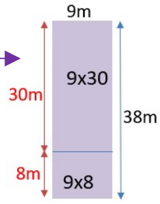
$= 7 \times 20 + 7 \times 8$

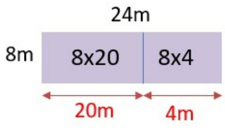
$= 140 + 56 = 196cm^2$

Two areas can combined to create a **compound shape**:



Split the areas into two pieces then calculate individually





Area $= (8 \times 20) + (8 \times 4) + (9 \times 30) + (9 \times 8)$

$= 160 + 32 + 270 + 72$

$= 534m^2$

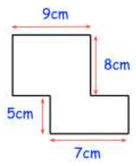
Your turn to practice:

1) $(+3) \times (+5) =$
2) $(-6) \times (+2) =$
3) $(-4) \times (-7) =$
4) $(+8) \times (+6) =$
5) $(+\frac{1}{2}) \times (-5) =$

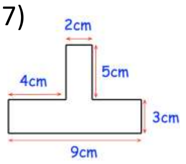
6) $7 \times 8s$
7) $-2 \times 5t$
8) $-3 \times -4t$
9) $f \times g$
10) $2k \times 3h$

11) 32 x 3
12) 23 x 2
13) 23 x 45
14) 46 x 47
15) 46 x 51

16)



17)



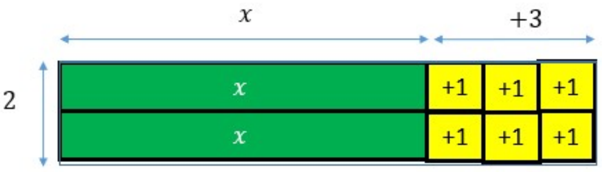
Answers
1) $+15$
2) -12
3) 28
4) 48
5) $-2\frac{1}{2}$
6) $56s$
7) $-10t$
8) $12t$
9) fg
10) $6kh$
11) 96
12) 46
13) 1035
14) 2162
15) 2346
16) $107\ cm^2$
17) $37\ cm^2$

Multiplication with Algebra

Expanding a single bracket

Example 1 $2(x+3) \equiv 2\times(x+3)$

Representing using algebra tiles



$(2\times x)+(2\times 3)$

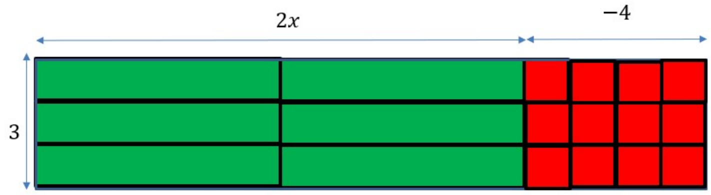
$\equiv 2x+6$

Representing using area model

	x	+3
2	$2x$	+6

Example 2 $3(2x-4) \equiv 3\times(2x-4)$

Representing using algebra tiles



$3\times 2x+3\times(-4) \quad \equiv 6x-12$

Representing using area model

	$2x$	- 4
3	$6x$	- 12

Expanding two different brackets

Very similar to compound area, please look at multiplication knowledge organiser:

Example: Expand and simplify:

$3(2x-2)+5(3x+5)$

	$2x$	-2
3	$6x$	-6

$\rightarrow 6x-6$

$+$

	$3x$	$+5$
5	$15x$	$+25$

$\rightarrow 15x+25$

$\equiv 21x+19$

Remember that subtracting an expressions is the same adding a negative expression →

Example: Expand and simplify:

$5(3x+4)-2(6x-1)$

$5(3x+4)+\ -2(6x-1)$

	$3x$	$+4$
5	$15x$	$+20$

$\rightarrow 15x+20$

$+$

	$6x$	-1
-2	$-12x$	$+2$

$\rightarrow -12x+2$

$\equiv 3x+22$

Your turn to practice:

1) $5(x+3)$
2) $9(x-1)$
3) $5(2x-1)$
4) $4(3y+2)$
5) $5(4+3x)$
6) $-5(x+6)$
7) $-9(x-5)$
8) $-4(2x-1)$
9) $-4(2y+3)$
10) $-5x(4y+3)$
11) $5(x+3)+2(x+7)$
12) $7(2x+3)+9(x+2)$
13) $3(x-2)+4(2x+5)$
14) $7(2x+3)-5(x+2)$
15) $6(x-2)-4(2x-8)$

Answers

1) $5x+15$
2) $9x-9$
3) $10x-5$
4) $12y+8$
5) $20+15x$
6) $-5x-30$
7) $-9x+45$
8) $-8x+4$
9) $-8y-12$
10) $-20xy-15x$
11) $7x+29$
12) $23x+39$
13) $11x+14$
14) $9x+11$
15) $-2x+20$

Primes and Composites

Keywords and Phrases:

Prime Number – A prime number has exactly two factors

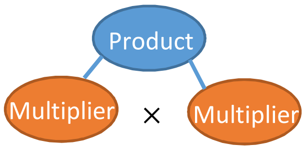
Composite number – A composite number has more than two factors

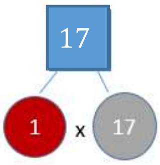
The numbers 1 and 0 are neither prime nor composite

To decide if a number is prime or composite you should find its factors.

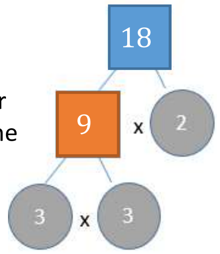
This can be done using a factor tree as shown below:

Product – The answer when two or more numbers are multiplied together.





17 is a PRIME number because it has only one prime factor - itself

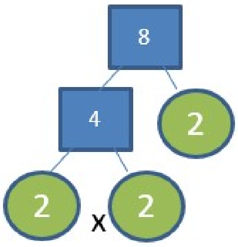


18 is a COMPOSITE number because it has more than one prime factor

Product of primes

All composite numbers can be written as a product of primes

We use a factor tree to find the prime factors that make up a composite number and we always circle the prime numbers.



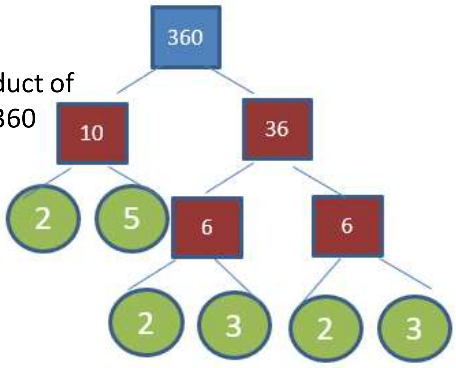
Then you multiply the prime factors together you achieve the product of prime factors

Example:

$$8 = 2 \times 2 \times 2$$

Example :

Work out the product of prime factors for 360



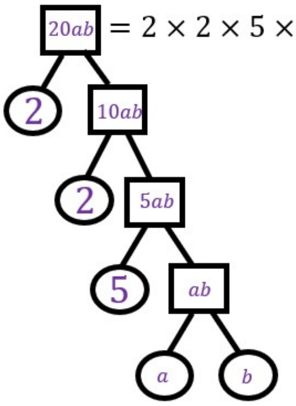
360 = 2 x 2 x 2 x 3 x 3 x 5

Algebraic decomposition

This is the algebraic equivalent of product of primes.

For example

Find the algebraic decomposition of 20ab



$= 2 \times 2 \times 5 \times a \times b$

Your turn to practice:

Write each of the following as a product of their prime factors:

1) 36
2) 40
3) 28
4) 48
5) 80
6) 200

Find the algebraic decomposition of the following:

7) $32y$
8) $40xy$
9) $105abc$
10) $81de$
11) $52gfy$
12) $242stu$

Answers:

1) $2 \times 2 \times 3 \times 3$
2) $2 \times 2 \times 2 \times 5$
3) $2 \times 2 \times 7$
4) $2 \times 2 \times 2 \times 2 \times 3$
5) $2 \times 2 \times 2 \times 2 \times 5$
6) $2 \times 2 \times 2 \times 5 \times 5$
7) $2 \times 2 \times 2 \times 2 \times 2 \times y$
8) $2 \times 2 \times 2 \times 5 \times x \times y$
9) $3 \times 5 \times 7 \times a \times b \times c$
10) $3 \times 3 \times 3 \times 3 \times 3 \times d \times e$
11) $2 \times 2 \times 13 \times g \times f \times y$
12) $2 \times 11 \times 11 \times s \times t \times u$

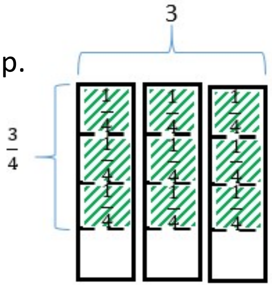
Multiply and Simplify Fractions

Multiply an integer by a fraction:

To multiply a fraction by an integer draw an array to help.

Example: $\frac{3}{4} \times 3 = \frac{9}{4}$

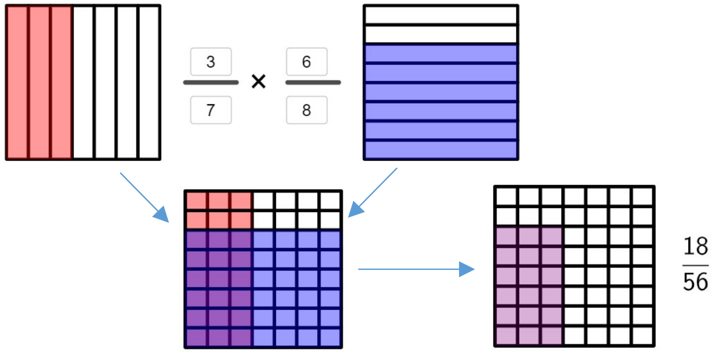
$$\boxed{c \times \frac{a}{b} = \frac{a \times c}{b}} \quad \boxed{\frac{a}{b} \times c = \frac{a \times c}{b}}$$



Multiply a fraction by a fraction:

Use an array to help:

Alternatively you could calculate like this:



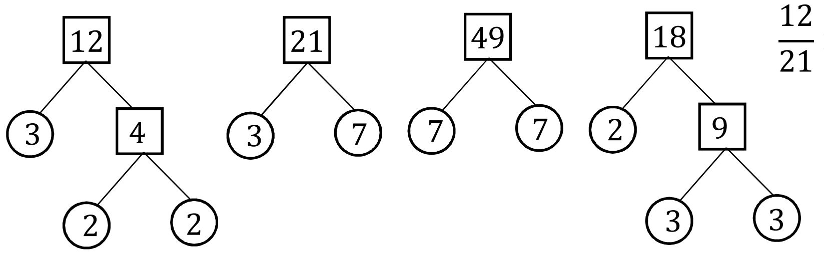
$$\frac{3}{7} \times \frac{6}{8} = \frac{3 \times 6}{7 \times 8}$$

$$= \frac{18}{56}$$

$$\boxed{\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}}$$

Sometimes it is best to simplify using product of primes before you multiply, e.g:

$$\frac{12}{21} \times \frac{49}{18}$$



$12 = 3 \times 2 \times 2$ $\quad 21 = 3 \times 7$ $\quad 49 = 7 \times 7$ $\quad 18 = 2 \times 3 \times 3$

$$\frac{12}{21} \times \frac{49}{18} = \frac{3 \times 2 \times 2 \times 7 \times 7}{3 \times 7 \times 2 \times 3 \times 3}$$

$$\frac{2 \times 2 \times 3 \times 7 \times 7}{2 \times 3 \times 3 \times 3 \times 7}$$

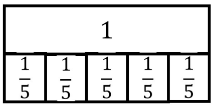
$$\frac{2}{2} \times \frac{3}{3} \times \frac{7}{7} \times \frac{2 \times 7}{3 \times 3}$$

$$1 \times 1 \times 1 \times \frac{14}{9} = 1\frac{5}{9}$$

Reciprocals:

The reciprocal is the number that we have to multiply by to make one.

$5 \times \frac{1}{5} = 1$ Five lots of one fifth.



The reciprocal of 5 is $\frac{1}{5}$

$\frac{1}{5} \times 5 = 1$ ← The commutative law for multiplication!

The reciprocal of $\frac{1}{5}$ is 5

$$\frac{2}{3} \times \frac{3}{2} = \frac{2 \times 3}{3 \times 2} = \frac{2}{2} \times \frac{3}{3} = 1 \times 1 = 1$$

The reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$

Your turn to practice:

Calculate and simplify:

1) $\frac{1}{3} \times 5 =$

2) $3 \times \frac{1}{7} =$

3) $\frac{2}{5} \times 4 =$

4) $4 \times \frac{3}{16} =$

5) $-\frac{6}{3} \times -4 =$

6) $\frac{1}{3} \times \frac{1}{5} =$

7) $\frac{3}{5} \times \frac{1}{7} =$

8) $\frac{2}{5} \times \frac{3}{2} =$

9) $\frac{4}{15} \times \frac{3}{16} =$

10) $-\frac{16}{13} \times -\frac{13}{4} =$

11) What is the reciprocal of 7

12) What is the reciprocal of $\frac{1}{6}$

13) What is the reciprocal of $\frac{5}{9}$

Answers:

1) $\frac{5}{3}$ *8)* $\frac{3}{5}$

2) $\frac{3}{7}$ *9)* $\frac{1}{20}$

3) $\frac{8}{5}$ 10) 4

4) $\frac{8}{5}$ *11)* $\frac{1}{7}$

5) 8 12) 6

6) $\frac{1}{15}$ *13)* $\frac{9}{5}$

7) $\frac{3}{35}$

Linking numbers with Multiplication

Keywords and Phrases:

Reciprocal -The reciprocal is the number that we have to multiply by to make one.

$\frac{1}{2} \times \boxed{2} = 1$ One half of two is a whole.

$\boxed{5} \times \frac{1}{5} = 1$ Five lots of one fifth is a whole.

$\boxed{\frac{1}{10}} \times 10 = 1$ One tenth of ten is a whole.

$\boxed{\frac{1}{a} \times a = 1 \qquad a \neq 0 \qquad a \text{ is the reciprocal of } \frac{1}{a}}$

Linking numbers by multiplying

What is the missing number?

$13 \times \boxed{} = 22$

What is the reciprocal of 13? $= \frac{1}{13}$

$\underbrace{13 \times \frac{1}{13}}_{= 1} \times 22 = 22$

$13 \times \boxed{\frac{22}{13}} = 22$

$\frac{2}{3} \times \boxed{} = 5$

What is the reciprocal of $\frac{2}{3}$? $= \frac{3}{2}$

$\underbrace{\frac{2}{3} \times \frac{3}{2}}_{= 1} \times 5 = 5$

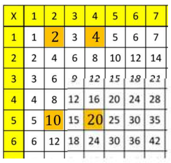
$\frac{2}{3} \times \boxed{\frac{15}{2}} = 5$

Any two numbers can be linked by a multiplication.

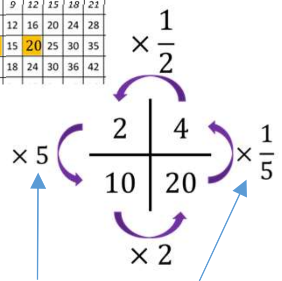
$\boxed{a \times \frac{b}{a} = b \qquad a \neq 0}$ $\boxed{\frac{a}{b} \times \frac{b \times c}{a} = c \qquad a, b \neq 0}$

Proportional reasoning grids

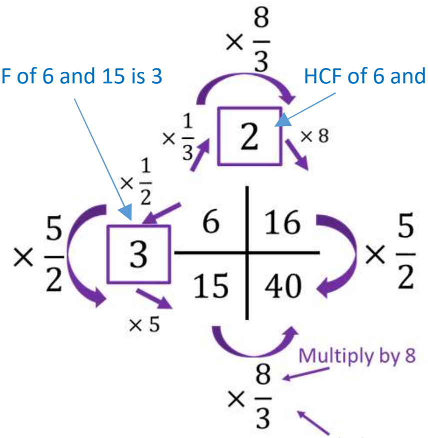
Any set of four numbers from the times table grid have similar multiplicative relationships.



x	1	2	3	4	5	6	7
1	1	2	3	4	5	6	7
2	2	4	6	8	10	12	14
3	3	6	9	12	15	18	21
4	4	8	12	16	20	24	28
5	5	10	15	20	25	30	35
6	6	12	18	24	30	36	42



Opposite direction, multiply by the reciprocal

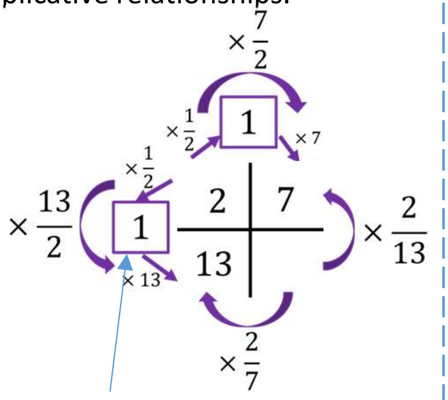


HCF of 6 and 15 is 3

HCF of 6 and 16 is 2

Multiply by 8

Divide by 3



When two numbers have a HCF of 1, they are called co-prime

Your turn to practice:

Fill in the blanks to complete the calculations

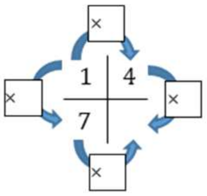
1) $4 \times \boxed{} = 1$

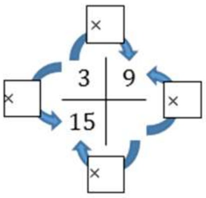
2) $\frac{2}{3} \times \boxed{} = 1$

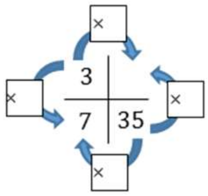
3) $9 \times \boxed{} = 15$

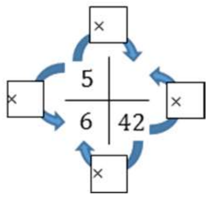
4) $\frac{2}{5} \times \boxed{} = 3$

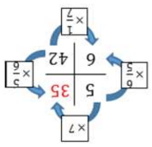
Fill in the blanks to fully describe the multiplicative relationships

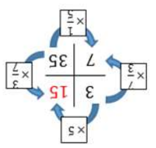


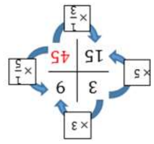


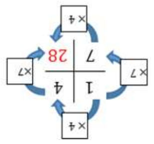












Answers

1) $4 \times \frac{1}{4} = 1$

2) $\frac{2}{3} \times \frac{3}{2} = 1$

3) $9 \times \frac{15}{9} = 15$

4) $\frac{2}{5} \times \frac{15}{2} = 3$

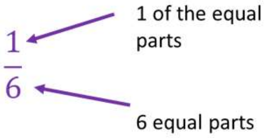
Proportion

Keywords and Phrases:

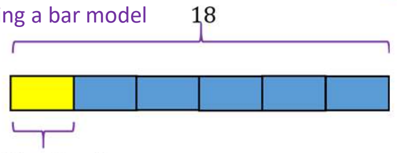
Proportion - a part, a share, or number considered in comparative relation to a whole.
Percent – The parts per 100, a ratio "out of 100"

Fractions of an amount:

Example 1: Find $\frac{1}{6}$ of 18



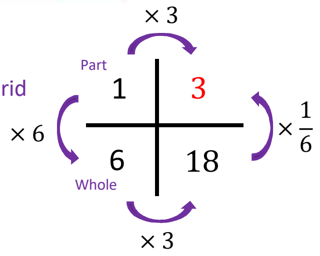
Using a bar model



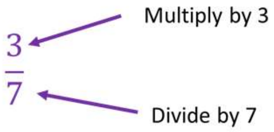
$18 \div 6 = 3$

$18 \times \frac{1}{6} = 3$

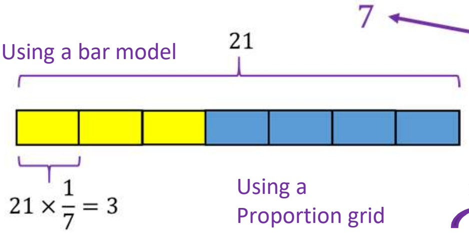
Using a Proportion grid



Example 2: Find $\frac{3}{7}$ of 21



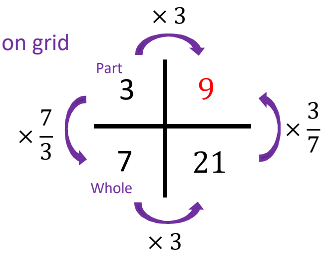
Using a bar model



$21 \times \frac{1}{7} = 3$

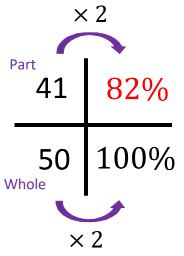
$3 \times 3 = 9$

Using a Proportion grid



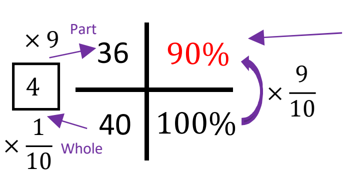
Writing a Number as a Percentage of a Quantity – Non Calc

Example 1: Bob scored 41 out of 50 on his test.
What is this as a percentage?



$$\frac{41}{50} = 82\%$$

Example 2: Jane scored 36 out of 40 on her test.
What is this as a percentage?

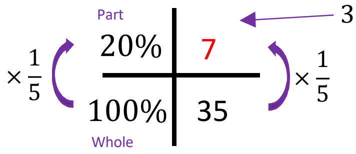


$100 \times \frac{9}{10} = 90$

$$\frac{36}{40} = 90\%$$

Percentages of an amount

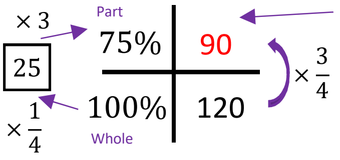
Example 1: Find 20% of 35



$35 \times \frac{1}{5} = 7$

20% of 35 = 7

Example 2: Find 75% of 120



$120 \times \frac{3}{4} = 90$

75% of 120 = 90

Your turn to practice

Write as a percentage:

1)	Find $\frac{2}{3}$ of 9.	6)	9 out of 25	11)	Find 25% of 40	16)	Find 5% of 60
2)	Find $\frac{3}{5}$ of 15.	7)	34 out of 50	12)	Find 25% of 80	17)	Find 15% of 60
3)	Find $\frac{3}{4}$ of 8.	8)	14 out of 20	13)	Find 75% of 20	18)	Find 35% of 65
4)	Find $\frac{6}{11}$ of 55.	9)	17 out of 25	14)	Find 75% of 200	19)	Find 65% of 85
5)	Find $\frac{4}{5}$ of 20.	10)	21 out of 30	15)	Find 5% of 40	20)	Find 75% of 160

Answers

1)	6	6)	36%	11)	10	16)	3
2)	9	7)	68%	12)	20	17)	9
3)	6	8)	70%	13)	15	18)	22.75
4)	30	9)	68%	14)	150	19)	55.25
5)	16	10)	70%	15)	2	20)	120

Data and Averages

Keywords and Phrases:

Secondary data is information collected by someone else. For example weather data from the Met office

Primary data is collected by you, for example weather data can be collected from a local weather station daily or hourly.

Discrete data – data that can only take certain values

Quantitative data can be discrete or continuous. It is data described in numbers

Qualitative data is always discrete. It is data described in words

Continuous data – data can take any value. Measured data such as time and rainfall are continuous. All continuous data is **quantitative.**

Discrete data – data that can only take certain values it can be **quantitative** **or** **qualitative** data.

Tally Charts:

Here is an example of a Tally you would have seen at KS2.

| This means 1

𝍸 This means 5

	Tally	Total
cars	𝍸 𝍸 𝍸 𝍸 ||	22
buses	𝍸 |	6

The only difference at KS3 is the work total. The correct word for the total is **Frequency**

Type of ball	Tally	Frequency
Tennis ball	𝍸 𝍸 |	11
Football	𝍸 |	6
Rugby ball	||||	4

Measures of Central Tendency (Averages)

The mean, median and mode in maths are averages.

Mean:

The mean is a calculation

$$Mean = \frac{Sum\ of\ the\ values}{Total\ frequency} = \frac{\sum xf}{\sum f}$$

When ever you are analysing things statistically you should look at calculating an average and a measure of spread.

Median:

The median is the middle value of ordered data. To find the position of the middle number in a set of data we use $Q_2 = \frac{n+1}{2}$

Mode:

The mode is the most common piece of data. Sometimes referred to as the modal average.

Measures of Spread (Ranges)

The range is a measure of how spread out the data is.

To calculate the range we find the difference between the highest and lowest value

$$Range = Highest\ Value\ - Lowest\ Value$$

The Interquartile Range (IQR) is a measure of how spread out the data is.

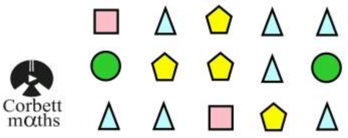
To calculate the range we find the difference between the highest and lowest value

$$Range = Upper\ Quartile - Lowe\ \ Quartile$$

The **advantage** of using the Interquartile range is that it does not include the outliers. Sometimes outliers are called anomalies in the data

Your turn to practice

1) Complete the tally chart below:



Shape	Tally	Frequency
Circle		
Pentagon		
Square		
Triangle		

Calculate the mode, median, mean, range and interquartile range of the following:

2) 4, 9, 7, 10, 5, 4

3) 2, 8, 2, 3, 2, 7, 4

4) 3, 2, 1, 3, 2, 2, 1, 3, 1, 2, 3, 2, 1

5) 1, 8, 7, 5, 6, 4, 7, 6

6) 12, 8, 14, 5, 1, 3, 0, 8, 10, 11

Answers

2) Mode – 4, Median – 6,
Mean – 6.5, Range – 6,
IQR – 5

3) Mode – 2, Median – 3,
Mean – 4 , Range – 6,
IQR – 5

4) Mode – 2, Median – 2,
Mean – 2 , Range – 2,
IQR – 2

5) Mode – 6 & 7, Median –
6, Mean – 5.5 , Range –
7, IQR – 2.5

6) Mode – 8, Median – 8,
Mean – 7.2, Range – 14,
IQR - 8

Averages, Pictograms & Bar charts

Measures of Central Tendency (Averages) from Frequency table

Age (x)	Frequency (f)
18	15
19	6
20	4
	Total = 25

Cumulative frequency

15th

21st

25th

Median Class Interval

The data in the table is already ordered but you need to find the middle value.

$$\textit{The position of the median } Q_2 = \frac{\sum f}{2} = \frac{25}{2}$$

$$= 12.5th\ value$$

In green on the table you can see the positions known as the cumulative frequency the 12.5th value is in the first section because it is less than the 15th value

18 *years old* is the median average

$$\boldsymbol{Mea} \quad \frac{Sum\ of\ the\ data}{Sum\ of\ the\ frequency} = \frac{\sum xf}{\sum f}$$

$$= \frac{(18 \times 15) + (19 \times 6) + (20 \times 4)}{25}$$

$$= \frac{464}{25} = 18.56\ Years\ old\ (2dp$$

Modal Average

The modal average is the data that occurs the most often which means it has the highest frequency.

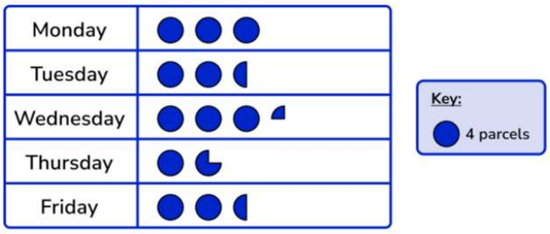
18 *years old is the modal average*

Measure of Spread

The range = 20-18 = 2 years of age

Pictograms:

A pictograph (or pictogram) is a chart which uses a symbol to represent a certain frequency. This is then used in a chart.

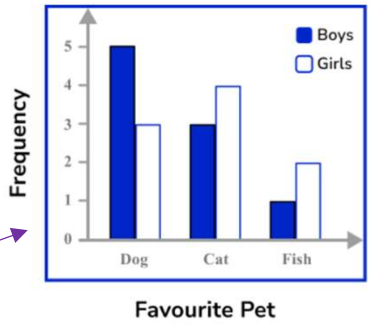


A full circle represents 4 parcels.
Half circle = 2 parcels
Quarter circle = 1 parcel

Bar Charts:

A bar chart represents data by using vertical (or horizontal) bars of equal width. They are used for categorical or discrete numerical data.

Bar charts can become more complicated and extend to comparative bar charts or compound bar charts (or stacked bar charts).



Comparative bar chart
Comparing Boys and girls

Your turn to practice

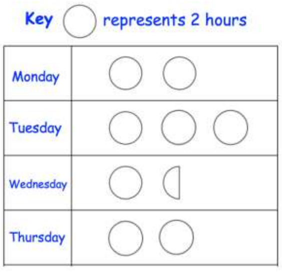
1) Calculate the mode, median, mean and range from the following frequency table:

Age	Frequency
18	5
19	5
20	9
21	4

2) Draw a bar chart for the above

James is revising for an exam. The pictogram shows how many hours he spent revising over four days.

3) How many hours did James spend revising on Monday?
4) How many hours did James spend revising on Wednesday?
5) On which day did James spend 6 hours revising?
6) How many hours did James spend revising in total?



Answers
1) Mode – 20,
Median – 20,
Mean – 19.522,
Range - 3
2) Bar chart
3) 4 hours
4) 3 hours
5) Tuesday
6) 17 hours

Averages from grouped data

Measures of Central Tendency (Averages) from grouped data

Weight, kg	(f) Frequency	(x) Midpoint	Cumulative frequency
$2 < w \leqslant 3$	13	2.5	13th
$3 < w \leqslant 4$	6	3.5	19th
$4 < w \leqslant 5$	3	4.5	22nd
$5 < w \leqslant 6$	1	5.5	23rd
$6 < w \leqslant 7$	15	6.5	38th

These are known as class intervals

The midpoint is a good estimate for the data in this case the weight

$$\boldsymbol{Mean} = \frac{Sum\ of\ the\ (midpoin\ \ \times frequency)}{Sum\ of\ the\ frequency} = \frac{\sum xf}{\sum f}$$

$$= \frac{(13 \times 2.5) + (6 \times 3.5) + (3 \times 4.5) + (1 \times 5.5) + (15 \times 6.5)}{13 + 6 + 3 + 1 + 15} = \frac{168.5}{38} = 4.43\ kg\ (2dp)$$

Modal Class Interval

The modal class interval is the class interval that occurs the most often which means it has the highest frequency.

$6 < w \leq 7$ is the modal class with a frequency of 15

Median Class Interval

The data in the table is already ordered but you need to find the middle value.

$$The\ position\ of\ the\ median\ Q_2 = \frac{\sum f}{2} = \frac{38}{2} = 19th\ value$$

In green on the table you can see the positions known as the cumulative frequency the 19th number is in the second class interval

$3 < w \leq 4$ is the median class interval

Your turn to practice

Calculate the following averages from the three grouped frequency tables:

- Estimated mean
- Modal class interval
- Median Class interval

1)

Length (x cm)	Frequency
$10 < x \leq 20$	17
$20 < x \leq 30$	26
$30 < x \leq 40$	11
$40 < x \leq 50$	6

2)

Time (t seconds)	Frequency
$0 < t \leq 20$	4
$20 < t \leq 40$	12
$40 < t \leq 60$	19
$60 < t \leq 80$	60
$80 < t \leq 100$	5

3)

Mass (m kg)	Frequency
$40 < m \leq 45$	64
$45 < m \leq 50$	74
$50 < m \leq 55$	155
$55 < m \leq 60$	80
$60 < m \leq 65$	26
$65 < m \leq 70$	1

Answers

1) Estimated mean = 26, Modal class interval = $20 < x \leq 30$, Median class interval = $20 < x \leq 30$

2) Estimated mean = 26, Modal class interval = $60 < x \leq 80$, Median class interval =$60 < x \leq 80$

3) Estimated mean = 51.6375, Modal class interval = $50 < x \leq 55$, Median class interval =$50 < x \leq 55$

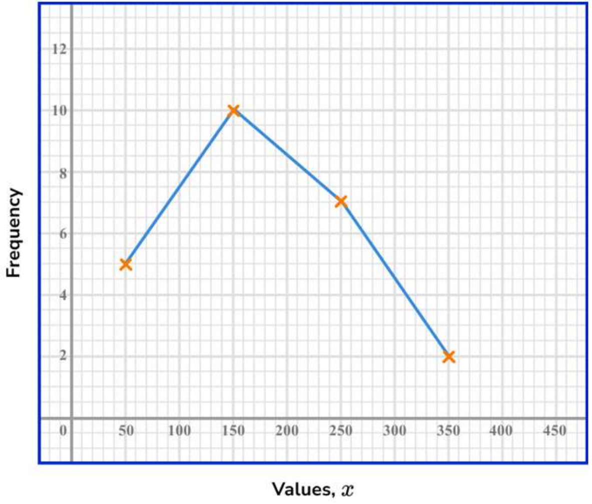
Pictograms & Stem and Leaf diagrams

A **frequency polygon** is a graph that shows the frequencies of grouped data. It is a type of frequency diagram that plots the **midpoints** of the **class intervals** against the frequencies and then joins up the points with straight lines.

Values, x	Frequency
$0 \leq x < 100$	5
$100 \leq x < 200$	10
$200 \leq x < 300$	7
$300 \leq x < 400$	2

The modal class interval can be read from a frequency polygon. It is the **midpoint** at the maximum height

$$100 \leq x < 300$$



Stem and leaf diagrams organise numerical data based on the place value of the numbers.

To do this, we:

- Organise the data into ascending order, smallest to largest
- Determine how the numbers are split into 2 parts by writing a key for the stem ar[illegible]
- Separate th[illegible] 2 p[illegible] other for th[illegible]
- Write the v[illegible] tem[illegible] lea[illegible]
- Write the v[illegible] eaf i[illegible] af diagram, these values must be ordered from smallest to largest.

3) 3 | 5 8 9
4 | 1 4 5 8
5 | 0 3 5
Key: 4|1 means 41
4) 0 | 5 9 9
1 | 1 5 8
2 | 4 4 8 9
3 | 2 3 8
4 | 0 2
Key 2|4 means 24
5) 13 | 5 9
14 | 0 0 2 4 4 5 8 9
15 | 3 8
16 | 0
Key 13|5 means 135
6) 1 | 9
2 | 2 8
3 | 1 4 7 9
4 | 5 8
5 | 1
Key 5|1 means 5.1kg

Stem

Leaf – Ordered smallest to largest

1 | 8, 9
2 | 3, 5, 7
[illegible] | 4, 4, 5
[illegible] | 9
5 | 2, 8

Key
1 | 8 = 18

Key

Your turn to practice

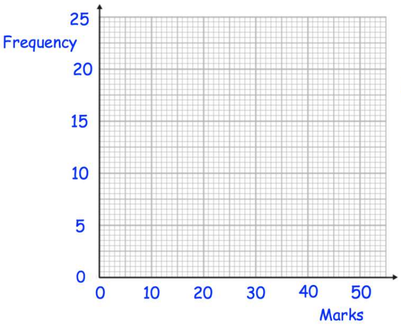
Draw a frequency polygon for the following grouped frequency tables:

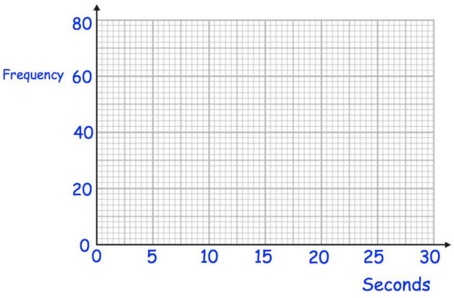
1)

Marks	Frequency
0 < m ≤ 10	8
10 < m ≤ 20	11
20 < m ≤ 30	23
30 < m ≤ 40	19
40 < m ≤ 50	15

2)

Time, seconds	Frequency
0 < t ≤ 5	10
5 < t ≤ 10	50
10 < t ≤ 15	75
15 < t ≤ 20	80
20 < t ≤ 25	45
25 < t ≤ 30	35





Draw ordered stem and leaf diagrams for the following sets of data. Remember to include a suitable key

3) 35, 50, 38, 44, 53, 41, 39, 45, 48, 55
4) 18, 42, 5, 28, 33, 9, 15, 38, 32, 9, 11, 24, 40, 29, 24
5) 153, 144, 148, 140, 149, 145, 144, 142, 158, 135, 140, 139, 160
6) 3.4kg, 1.9kg, 2.8kg, 3.1kg, 5.1kg, 3.9kg, 4.8kg, 4.5kg, 2.2kg, 3.7kg,

3) 3 | 5 8 9
4 | 1 4 5 8
5 | 0 3 5
Key: 4|1 means 41

4) 0 | 5 9 9
1 | 1 5 8
2 | 4 4 8 9
3 | 2 3 8
4 | 0 2
Key 2|4 means 24

5) 13 | 5 9
14 | 0 0 2 4 4 5 8 9
15 | 3 8
16 | 0
Key 13|5 means 135

6) 1 | 9
2 | 2 8
3 | 1 4 7 9
4 | 5 8
5 | 1
Key 5|1 means 5.1kg