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Blakehill Primary School Mental Calculation Procedures and Guidance

Date: June 2016

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Purpose

The ability to calculate in your head is an important part of mathematics. It is also an essential part of coping with society's demands and managing everyday events. This guidance will help teachers review, consolidate and build on children's developing mental calculation skills throughout Key Stages 1 and 2. It is our intention that children should be secure with a range of mental strategies. Children should be taught to look carefully at the calculation and decide which strategy they should use. Children should explain and reason as to why they have chosen a strategy and whether it is the most efficient.

Introduction

Being able to calculate mentally involves the rapid recall of number facts (developed through the teaching of KIRFs) and understanding the relationship between the four operations and being able to construct equivalent calculations that help them to carry out calculations. Research shows that learning key facts 'by heart' enables children to concentrate on the calculation which helps them to develop calculation strategies. Many children who are not able to recall key facts often treat each calculation as a new one and have to return to first principles to work out the answer again. In order to teach children to calculate mentally you should:

- Commit regular time to teaching mental calculation strategies (revisiting daily or whole lessons).
- Provide practice time with frequent opportunities for children to use one or more facts they have learnt.
- Encourage children to make jottings. This is particularly true for young children. These jottings can help children remember what they have done, can help children explain a particular method and can develop a child's mental imagery.
- Use visual and practical resources in order to develop a sound conceptual understanding e.g. interactive teaching programmes (ITPs), counters, interlocking cubes, coins, counting sticks, bead strings, number lines, 100 squares, place value cards, base 10 blocks and Numicon. Electronic versions of these resources can be found on Abacus Online accessed through www.activelearn.co.uk.
- Engage children in discussion when they explain their methods.
- Explicit teaching of different mental strategies.
- Use the following school resources: Key Instant Recall Facts (KIRFs), Big Maths Beat That (Weekly), Big Maths CLIC Test (fortnightly) and Rising Stars Mental Maths Test (fortnightly).

Once children have been introduced a mental strategy they should be encouraged to speed up their responses.

How to use this policy

Below you will find the mental calculation objectives for your specific year group, along with an overview of the different strategies you can use to teach the four operations. A list of possible classroom activities can be found in the appendix.

Appendix i – a detailed overview of mental strategies you can use to teach addition and subtraction.
Appendix ii – addition and subtraction activities.
Appendix iii – a detailed overview of mental strategies you can use to teach multiplication and division.
Appendix iv – multiplication and division activities.
Appendix v – fractions, decimals and percentages activities.

Year 1 - Objectives

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Objectives:

- Number bonds ('story' of 5, 6, 7, 8, 9 and 10)
- Count on in 1s from a given 2-digit number
- Add two 1-digit numbers
- Add three 1-digit numbers, spotting doubles or pairs to 10
- Count on in 10s from any given 2-digit number
- Add 10 to any given 2-digit number
- Use number facts to add 1-digit numbers to 2-digit numbers
  e.g. *Use 4 + 3 to work out 24 + 3, 34 + 3*
- Add by putting the larger number first

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Objectives:

- Number bonds ('story' of 5, 6, 7, 8, 9 and 10)
- Count back in 1s from a given 2-digit number
- Subtract one 1-digit number from another
- Count back in 10s from any given 2-digit number
- Subtract 10 from any given 2-digit number
- Use number facts to subtract 1-digit numbers from 2-digit numbers
  e.g. *Use 7 – 2 to work out 27 – 2, 37 – 2*

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Objectives:

- Begin to count in 2s, 5s and 10s
- Begin to say what three 5s are by counting in 5s, or what four 2s are by counting in 2s, etc.
- Double numbers to 10

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Objectives:

- Begin to count in 2s, 5s and 10s
- Find half of even numbers to 12 and know it is hard to halve odd numbers
- Find half of even numbers by sharing
- Begin to use visual and concrete arrays or 'sets of' to find how many sets of a small number make a larger number

Year 1 – Overview of Strategies

Addition

Using place value

Count in 1s
  e.g. *45 + 1*
Count in 10s
  e.g. *45 + 10 without counting on in 1s*

34	35	36
44		46
54	55	56

Add 10 to any given 2-digit number

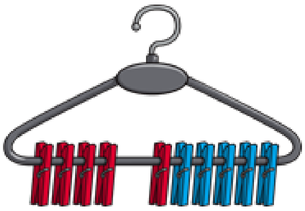
Counting on

Count on in 1s
  e.g. *8 + 3 as 8, 9, 10, 11*

Add, putting the larger number first
Count on in 10s
  e.g. *45 + 20 as 45, 55, 65*

Using number facts

'Story' of 4, 5, 6, 7, 8 and 9
  e.g. *7 = 7 + 0, 6 + 1, 5 + 2, 4 + 3*
Number bonds to 10
  e.g. *5 + 5, 6 + 4, 7 + 3, 8 + 2, 9 + 1, 10 + 0*



4 + 6 = 10

Use patterns based on known facts when adding
  e.g. *4 + 3 = 7 so we know 24 + 3, 44 + 3, 74 + 3*

Subtraction

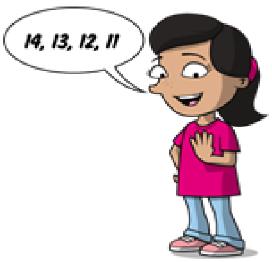
Using place value

Count back in 1s
  e.g. *Know 53 – 1*
Count back in 10s
  e.g. *Know 53 – 10 without counting back in 1s*

32	33	34
42	43	44
52	53	54

Taking away

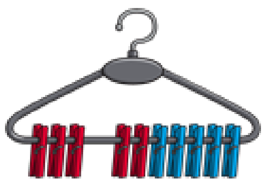
Count back in 1s
  e.g. *11 – 3 as 11, 10, 9, 8*
  e.g. *14 – 3 as 14, 13, 12, 11*



Count back in 10s
  e.g. *53 – 20 as 53, 43, 33*

Using number facts

'Story' of 4, 5, 6, 7, 8 and 9
  e.g. 'Story' of 7 is *7 – 1 = 6, 7 – 2 = 5, 7 – 3 = 4*
Number bonds to 10
  e.g. *10 – 1 = 9, 10 – 2 = 8, 10 – 3 = 7*



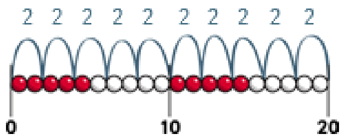
10 – 7 = 3

Subtract using patterns of known facts
  e.g. *7 – 3 = 4 so we know 27 – 3 = 24, 47 – 3 = 44, 77 – 3 = 74*

Multiplication

Counting in steps ('clever' counting)

Count in 2s



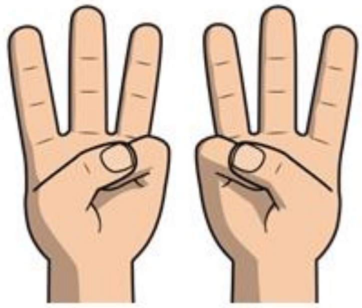
Count in 10s

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Doubling and halving

Find doubles to double 5 using fingers

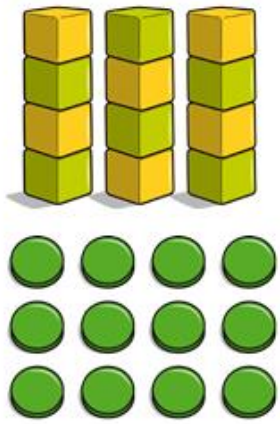
e.g. *double 3*



Grouping

Begin to use visual and concrete arrays and sets of objects to find the answers to 'three lots of four' or 'two lots of five'

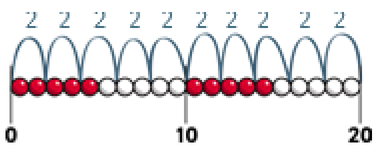
e.g. *three lots of four*



Division

Counting in steps ('clever' counting)

Count in 2s



Doubling and halving

Find half of even numbers up to 12, including realising that it is hard to halve an odd number

Count in 10s

1	2	3	4	5	6	7	8	9	
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Grouping

Begin to use visual and concrete arrays and 'sets of' objects to find the answers to questions such as *'How many towers of three can I make with twelve cubes?'*

Sharing

Begin to find half of a quantity using sharing

e.g. *find half of 16 cubes by giving one each repeatedly to two children*

Year 2 - Objectives

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Objectives:

- Number bonds – know all the pairs of numbers which make all the numbers to 12, and pairs with a total of 20
- Count on in 1s and 10s from any given 2-digit number
- Add two or three 1-digit numbers
- Add a 1-digit number to any 2-digit number using number facts, including bridging multiples of 10
  e.g. *45 + 4*
  e.g. *38 + 7*
- Add 10 and small multiples of 10 to any given 2-digit number
- Add any pair of 2-digit numbers

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Objectives:

- Number bonds – know all the pairs of numbers which make all the numbers to 12
- Count back in 1s and 10s from any given 2-digit number
- Subtract a 1-digit number from any 2-digit number using number facts, including bridging multiples of 10
  e.g. *56 – 3*
  e.g. *53 – 5*
- Subtract 10 and small multiples of 10 from any given 2-digit number
- Subtract any pair of 2-digit numbers by counting back in 10s and 1s or by counting up

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Objectives:

- Count in 2s, 5s and 10s
- Begin to count in 3s
- Begin to understand that multiplication is repeated addition and to use arrays
  e.g. *3 × 4 is three rows of 4 dots*
- Begin to learn the ×2, ×3, ×5 and ×10 tables, seeing these as 'lots of'
  e.g. *5 lots of 2, 6 lots of 2, 7 lots of 2*
- Double numbers up to 20
- Begin to double multiples of 5 to 100
- Begin to double 2-digit numbers less than 50 with 1s digits of 1, 2, 3, 4 or 5

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Objectives:

- Count in 2s, 5s and 10s
- Begin to count in 3s
- Using fingers, say where a given number is in the 2s, 5s or 10s count
  e.g. *8 is the fourth number when I count in 2s*
- Relate division to grouping
  e.g. *How many groups of 5 in 15?*
- Halve numbers to 20
- Begin to halve numbers to 40 and multiples of 10 to 100
- Find $^1/_2$, $^1/_3$, $^1/_4$ and $^3/_4$ of a quantity of objects and of amounts (whole number answers) by knowing that finding a half is the same as dividing by 2, finding $\frac{3}{4}$ is the same as dividing by 4 and then multiplying by 3.

Year 2 – Overview of Strategies

Addition

Using place value

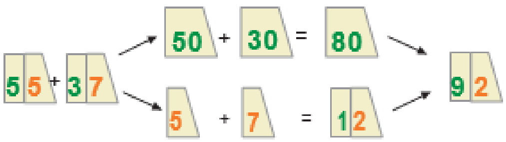
Know 1 more or 10 more than any number

e.g. *1 more than 67*

e.g. *10 more than 85*

Partitioning

e.g. *55 + 37 as 50 + 30 and 5 + 7, then finally combine the two totals: 80 + 12*



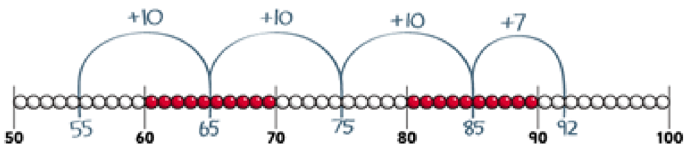
Counting on

Add 10 and multiples of 10 to a given 1- or 2-digit number

e.g. *76 + 20 as 76, 86, 96 or in one hop: 76 + 20 = 96*

Add two 2-digit numbers by counting on in 10s, then in 1s

e.g. *55 + 37 as 55 + 30 (85) + 7 = 92*



Add near multiples of 10

e.g. *46 + 19*

e.g. *63 + 21*

Using number facts

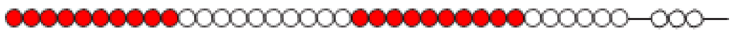
Know pairs of numbers which make the numbers up to and including 12

e.g. *8 = 4 + 4, 3 + 5, 2 + 6, 1 + 7, 0 + 8*

e.g. *10 = 5 + 5, 4 + 6, 3 + 7, 2 + 8, 1 + 9, 0 + 10*

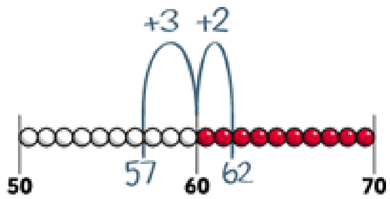
Use patterns based on known facts when adding

e.g. *6 + 3 = 9, so we know 36 + 3 = 39, 66 + 3 = 69, 56 + 3 = 59*



Bridging 10

e.g. *57 + 5 = 57 + 3 (60) + 2 = 62*



Add three or more 1-digit numbers, spotting bonds to 10 or doubles

e.g. *3 + 5 + 3 = 6 + 5 = 11*

e.g. *8 + 2 + 4 = 10 + 4 = 14*

Subtraction

Using place value

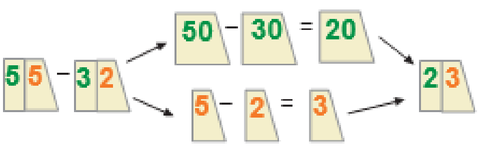
Know 1 less or 10 less than any number

e.g. *1 less than 74*

e.g. *10 less than 82*

Partitioning

e.g. *55 – 32 as 50 – 30 and 5 – 2 and combine the answers: 20 + 3*



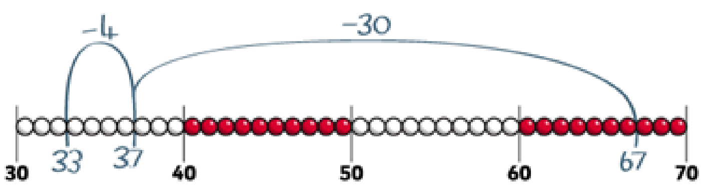
Taking away

Subtract 10 and multiples of 10

e.g. *76 – 20 as 76, 66, 56 or in one hop: 76 – 20 = 56*

Subtract two 2-digit numbers by counting back in 10s, then in 1s

e.g. *67 – 34 as 67 subtract 30 (37) then count back 4 (33)*



Subtract near multiples of 10

e.g. *74 – 21*

e.g. *57 – 19*

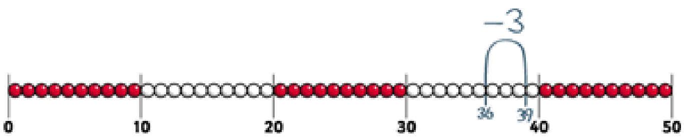
Using number facts

Know pairs of numbers which make the numbers up to and including 12 and derive related subtraction facts

e.g. *10 – 6 = 4, 8 – 3 = 5, 5 – 2 = 3*

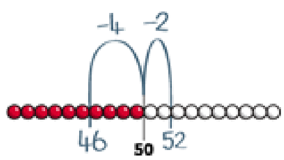
Subtract using patterns of known facts

e.g. *9 – 3 = 6, so we know 39 – 3 = 36, 69 – 3 = 66, 89 – 3 = 86*



Bridging 10

e.g. *52 – 6 as 52 – 2 (50) – 4 = 46*



Counting up

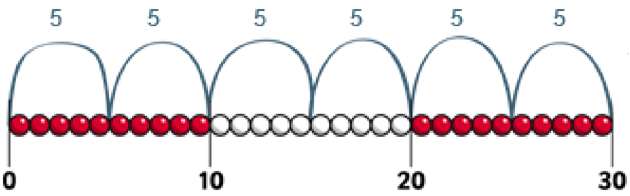
Find a difference between two numbers on a line where the numbers are close together

e.g. *51 – 47*

Multiplication

Counting in steps ('clever' counting)

Count in 2s, 5s and 10s

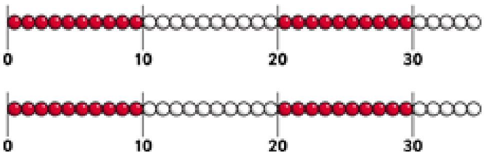


Begin to count in 3s

Doubling and halving

Begin to know doubles of multiples of 5 to 100

e.g. *double 35 is 70*

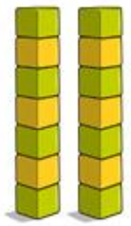


Begin to double 2-digit numbers less than 50 with 1s digits of 1, 2, 3, 4 or 5

Using number facts

Know doubles to double 20

e.g. *double 7 is 14*



Start learning ×2, ×5, ×10 tables, relating these to 'clever' counting in 2s, 5s, and 10s

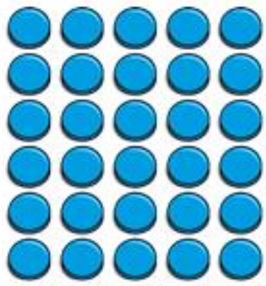
e.g. *5 × 10 = 50, and five steps in the 10s count = 10, 20, 30, 40, 50*

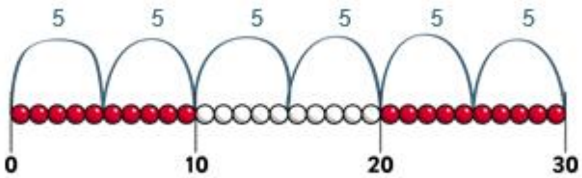
Grouping

Use arrays to find answers to multiplication and relate to 'clever' counting

e.g. *3 × 4 as three lots of four things*

e.g. *6 × 5 as six steps in the 5s count as well as six lots of five*



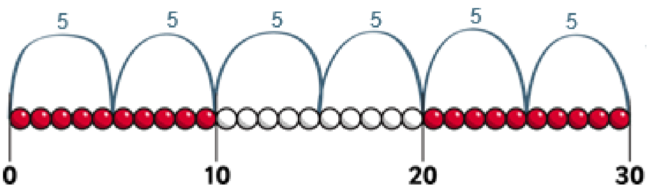


Understand that 5 × 3 can be worked out as three 5s or five 3s

Division

Counting in steps ('clever' counting)

Count in 2s, 5s and 10s

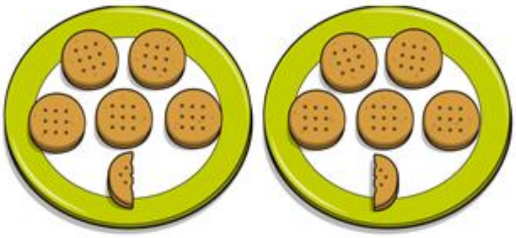


Begin to count in 3s

Doubling and halving

Find half of numbers up to 40, including realising that half of an odd number gives a remainder of 1 or an answer containing a 1/2

e.g. *1/2 of 11 = 5 1/2*



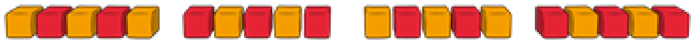
Begin to know half of multiples of 10 to 100

e.g. *half of 70 is 35*

Grouping

Relate division to multiplication by using arrays or towers of cubes to find answers to division

e.g. *'How many towers of five cubes can I make from twenty cubes?' as _ × 5 = 20 and also as 20 ÷ 5 = _*



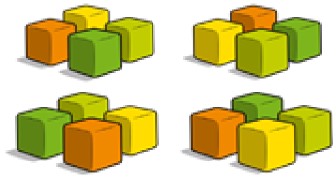
Relate division to 'clever' counting and hence to multiplication

e.g. *'How many fives do I count to get to twenty?'*

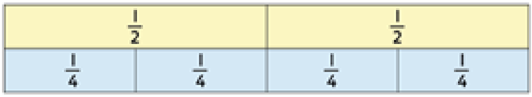
Sharing

Begin to find half or a quarter of a quantity using sharing

e.g. *find a quarter of 16 cubes by sorting the cubes into four piles*



Find 1/4, 1/2, 3/4 of small quantities



Using number facts

Know half of even numbers to 24

Know ×2, ×5 and ×10 division facts

Begin to know ×3 division facts

Year 3 - Objectives

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Objectives:

- Know pairs with each total to 20
  e.g. 2 + 6 = 8, 12 + 6 = 18, 7 + 8 = 15
- Know pairs of multiples of 10 with a total of 100
- Add any two 2-digit numbers by counting on in 10s and 1s or by using partitioning
- Add multiples and near multiples of 10 and 100
- Perform place-value additions without a struggle
  e.g. 300 + 8 + 50 = 358
- Use place value and number facts to add a 1-digit or 2-digit number to a 3-digit number
  e.g. 104 + 56 is 160 since 104 + 50 = 154 and 6 + 4 = 10
  676 + 8 is 684 since 8 = 4 + 4 and 76 + 4 + 4 = 84
- Add pairs of 3-digit numbers that add together easily (often multiples of 10 or 100)
  e.g. 320 + 450
- Begin to add amounts of money using partitioning

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Objectives:

- Know pairs with each total to 20
  e.g. 8 – 2 = 6
  e.g. 18 – 6 = 12
  e.g. 15 – 8 = 7
- Subtract any two 2-digit numbers
- Perform place-value subtractions without a struggle
  e.g. 536 – 30 = 506
- Subtract 2-digit numbers from numbers > 100 by counting up
  e.g. 143 – 76 is done by starting at 76. Then add 4 (80), then add 20 (100), then add 43, making the difference a total of 67
- Subtract multiples and near multiples of 10 and 100
- Subtract, when appropriate, by counting back or taking away, using place value and number facts
- Find change from £1, £5 and £10

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Objectives:

- Know by heart all the multiplication facts in the ×2, ×3, ×4, ×5, ×8 and ×10 tables
- Multiply whole numbers by 10 and 100
- Recognise that multiplication is commutative
- Use place value and number facts in mental multiplication
  e.g. 30 × 5 is 15 × 10
- Partition teen numbers to multiply by a 1-digit number
  e.g. 3 × 14 as 3 × 10 and 3 × 4
- Double numbers up to 50

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Objectives:

- Know by heart all the division facts derived from the ×2, ×3, ×4, ×5, ×8 and ×10 tables
- Divide whole numbers by 10 or 100 to give whole number answers
- Recognise that division is not commutative
- Use place value and number facts in mental division
  e.g. 84 ÷ 4 is half of 42 as finding a $\frac{1}{4}$ involves finding a $\frac{1}{2}$ and then halving again.
- Divide larger numbers mentally by subtracting the 10th multiple as appropriate, including those with remainders
  e.g. 57 ÷ 3 is 10 + 9 as 10 × 3 = 30 and 9 × 3 = 27
- Halve even numbers to 100, halve odd numbers to 20

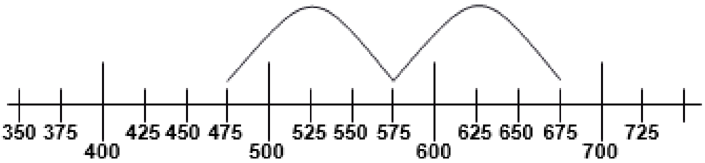
Year 3 – Overview of Strategies

Addition

Using place value

Count in 100s

e.g. *Know 475 + 200 as 475, 575, 675*



Add multiples of 10, 100 and £1

e.g. *746 + 200*

e.g. *746 + 40*

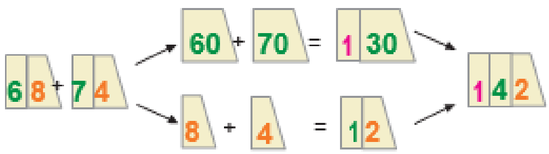
e.g. *£6·34 + £5 as £6 + £5 and 34p*

Partitioning

e.g. *£8·50 + £3·70 as £8 + £3 and 50p + 70p and combine the totals: £11 + £1·20*

e.g. *347 + 36 as 300 and 40 + 30 and 7 + 6 and combine the totals: 370 + 13 = 383*

e.g. *68 + 74 as 60 + 70 and 8 + 4 and combine the totals: 130 + 12 = 142*



Counting on

Add two 2-digit numbers by adding the multiple of 10, then the 1s

e.g. *67 + 55 as 67 + 50 (117) + 5 = 122*

Add near multiples of 10 and 100

e.g. *67 + 39*

e.g. *364 + 199*

Add pairs of 'friendly' 3-digit numbers

e.g. *548 + 120*

Count on from 3-digit numbers

e.g. *247 + 34 as 247 + 30 (277) + 4 = 281*

Using number facts

Know pairs which total each number to 20

e.g. *7 + 8 = 15*

e.g. *12 + 6 = 18*

Number bonds to 100

e.g. *35 + 65*

e.g. *46 + 54*

e.g. *73 + 27*

Add to the next 10 and the next 100

e.g. *176 + 4 = 180*

e.g. *435 + 65 = 500*

Subtraction

Taking away

Use place value to subtract

e.g. *348 – 300*

e.g. *348 – 40*

e.g. *348 – 8*

Take away multiples of 10, 100 and £1

e.g. *476 – 40 = 436*

e.g. *476 – 300 = 176*

e.g. *£4·76 – £2 = £2·76*

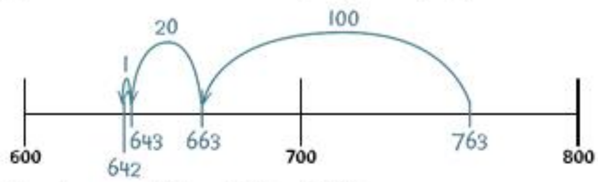
Partitioning

e.g. *68 – 42 as 60 – 40 and 8 – 2*

e.g. *£6·84 – £2·40 as £6 – £2 and 80p – 40p*

Count back in 100s, 10s then 1s

e.g. *763 – 121 as 763 – 100 (663) – 20 (643) – 1 = 642*



Subtract near multiples of 10 and 100

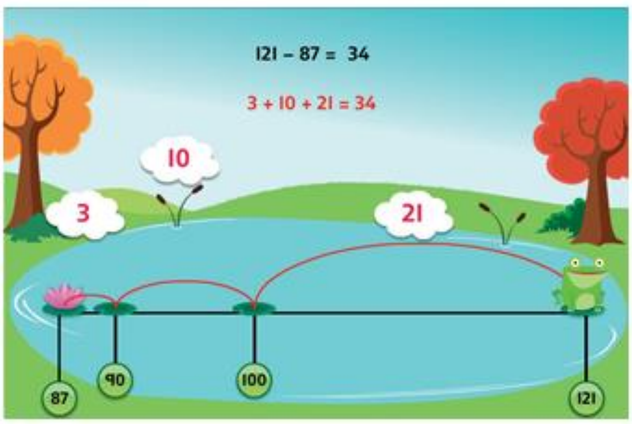
e.g. *648 – 199*

e.g. *86 – 39*

Counting up

Find a difference between two numbers by counting up from the smaller to the larger

e.g. *121 – 87*



Using number facts

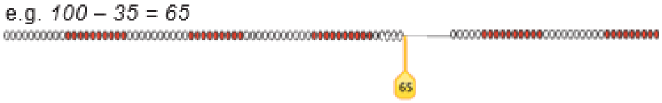
Know pairs which total each number to 20

e.g. *20 – 14 = 6*

Number bonds to 100

e.g. *100 – 48 = 52*

e.g. *100 – 35 = 65*



Subtract using number facts to bridge back through a 10

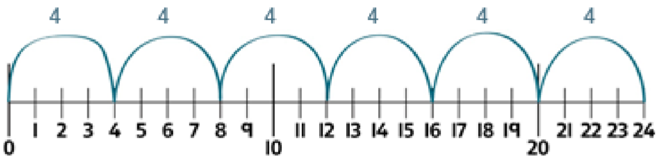
e.g. *42 – 5 = 42 – 2 (40) – 3 = 37*

Multiplication

Counting in steps ('clever' counting)

Count in 2s, 3s, 4s, 5s, 8s and 10s

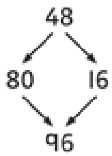
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100



Doubling and halving

Find doubles of numbers to 50 using partitioning

e.g. *double 48*



Use doubling as a strategy in multiplying by 2

e.g. *18 × 2 is double 18 = 36*

Grouping

Recognise that multiplication is commutative

e.g. *4 × 8 = 8 × 4*

Multiply multiples of 10 by 1-digit numbers

e.g. *30 × 8 = 240*

Multiply 'friendly' 2-digit numbers by 1-digit numbers

e.g. *13 × 4*

Using number facts

Know doubles to double 20

e.g. *double 15 is 30*

Know doubles of multiples of 5 to 100

e.g. *double 85 is 170*

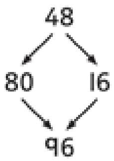
Know ×2, ×3, ×4, ×5, ×8, ×10 tables facts

Division

Doubling and halving

Find doubles of numbers to 50 using partitioning

e.g. *double 48*



Use doubling as a strategy in multiplying by 2

e.g. *18 × 2 is double 18 = 36*

Grouping

Recognise that multiplication is commutative

e.g. *4 × 8 = 8 × 4*

Multiply multiples of 10 by 1-digit numbers

e.g. *30 × 8 = 240*

Multiply 'friendly' 2-digit numbers by 1-digit numbers

e.g. *13 × 4*

Grouping

Recognise that division is not commutative

e.g. *16 ÷ 8 does not equal 8 ÷ 16*

Relate division to multiplications 'with holes in'

e.g. *_ × 5 = 30 is the same calculation as 30 ÷ 5 = _ thus we can count in 5s to find the answer*

_ × £5 = £30

Divide multiples of 10 by 1-digit numbers

e.g. *240 ÷ 8 = 30*

Begin to use subtraction of multiples of 10 of the divisor to divide numbers above the 10th multiple

e.g. *52 ÷ 4 is 10 × 4 (40) and 3 × 4 (12) = 13*

Using number facts

Know doubles to double 20
 e.g. *double 15 is 30*
Know doubles of multiples of 5 to 100
 e.g. *double 85 is 170*
Know ×2, ×3, ×4, ×5, ×8, ×10 tables facts

Using number facts

Know half of even numbers to 40
Know half of multiples of 10 to 200
 e.g. *half of 170 is 85*
Know ×2, ×3, ×4, ×5, ×8, ×10 division facts

Year 4 - Objectives

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Objectives:

- Add any two 2-digit numbers by partitioning or counting on
- Know by heart/quickly derive number bonds to 100 and to £1
- Add to the next 100, £1 and whole number
  e.g. 234 + 66 = 300
  e.g. 3·4 + 0·6 = 4
- Perform place-value additions without a struggle
  e.g. 300 + 8 + 50 + 4000 = 4358
- Add multiples and near multiples of 10, 100 and 1000
- Add £1, 10p, 1p to amounts of money
- Use place value and number facts to add 1-, 2-, 3- and 4-digit numbers where a mental calculation is appropriate
  e.g. 4004 + 156 by knowing that 6 + 4 = 10 and that 4004 + 150 = 4154 so the total is 4160

-

Objectives:

- Subtract any two 2-digit numbers
- Know by heart/quickly derive number bonds to 100
- Perform place-value subtractions without a struggle
  e.g. 4736 – 706 = 4030
- Subtract multiples and near multiples of 10, 100, 1000, £1 and 10p
- Subtract multiples of 0·1
- Subtract by counting up
  e.g. 503 – 368 is done by adding 368 + 2 + 30 + 100 + 3 (so we added 135)
- Subtract, when appropriate, by counting back or taking away, using place value and number facts
- Subtract £1, 10p, 1p from amounts of money
- Find change from £10, £20 and £50

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Objectives:

- Know by heart all the multiplication facts up to 12 × 12
- Recognise factors up to 12 of 2-digit numbers
- Multiply whole numbers and 1-place decimals by 10, 100, 1000
- Multiply multiples of 10, 100 and 1000 by 1-digit numbers
  e.g. 300 × 6
  e.g. 4000 × 8
- Use understanding of place value and number facts in mental multiplication
  e.g. 36 × 5 is half of 36 × 10
  e.g. 50 × 60 = 3000
- Partition 2-digit numbers to multiply by a 1-digit number mentally
  e.g. 4 × 24 as 4 × 20 and 4 × 4
- Multiply near multiples by rounding
  e.g. 33 × 19 as (33 × 20) – 33
- Find doubles to double 100 and beyond using partitioning
- Begin to double amounts of money
  e.g. £35·60 doubled is £71·20

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Objectives:

- Know by heart all the division facts up to 144 ÷ 12
- Divide whole numbers by 10, 100, to give whole number answers or answers with 1 decimal place
- Divide multiples of 100 by 1-digit numbers using division facts
  e.g. 3200 ÷ 8 = 400
- Use place value and number facts in mental division
  e.g. 245 ÷ 20 is half of 245 ÷ 10
- Divide larger numbers mentally by subtracting the 10th or 20th multiple as appropriate
  e.g. 156 ÷ 6 is 20 + 6 as 20 × 6 = 120 and 6 × 6 = 36
- Find halves of even numbers to 200 and beyond using partitioning
- Begin to halve amounts of money
  e.g. half of £52·40 is £26·20

Year 4 – Overview of Strategies

Addition

Using place value

Count in 1000s

e.g. *Know 3475 + 2000 as 3475, 4475, 5475*

Partitioning

e.g. *746 + 40*

e.g. *746 + 203 as 700 + 200 and 40 and 6 + 3*

e.g. *134 + 707 as 100 + 700 and 30 and 4 + 7*

Counting on

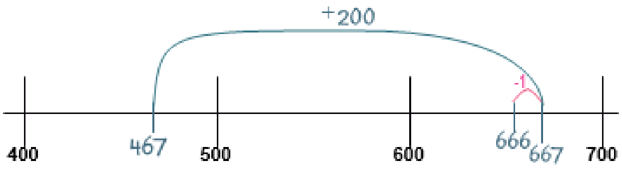
Add 2-digit numbers to 2-, 3- and 4-digit numbers by adding the multiple of 10 then the 1s

e.g. *167 + 55 as 167 + 50 (217) + 5 = 222*

Add near multiples of 10, 100 and 1000

e.g. *467 + 199*

e.g. *3462 + 2999*



Count on to add 3-digit numbers and money

e.g. *463 + 124 as 463 + 100 (563) + 20 (583) + 4 = 587*

e.g. *£4·67 + £5·30 as £9·67 + 30p*

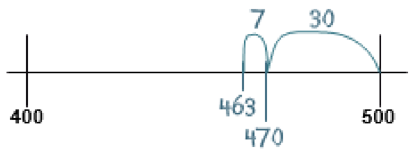
Using number facts

Number bonds to 100 and to the next multiple of 100

e.g. *288 + 12 = 300*

e.g. *1353 + 47 = 1400*

e.g. *463 + 37 = 500*



Number bonds to £1 and to the next whole pound

e.g. *63p + 37p = £1*

e.g. *£3·45 + 55p = £4*

Add to the next whole number

e.g. *4·6 + 0·4*

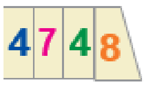
e.g. *7·2 + 0·8*

Subtraction

Taking away

Use place value to subtract

e.g. *4748 – 4000*



Take away multiples of 10, 100, 1000, £1, 10p or 0·1

e.g. *8392 – 50*

e.g. *6723 – 3000*

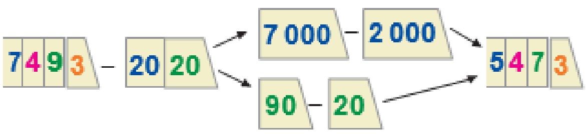
e.g. *£3·74 – 30p*

e.g. *5·6 – 0·2*

Partitioning

e.g. *£5·87 – £3·04 as £5 – £3 and 7p – 4p*

e.g. *7493 – 2020 as 7000 – 2000 and 90 – 20*



Count back

e.g. *6482 – 1301 as 6482 – 1000 (5482) – 300 (5182) – 1 = 5181*

Subtract near multiples of 10, 100, 1000 or £1

e.g. *3522 – 1999*

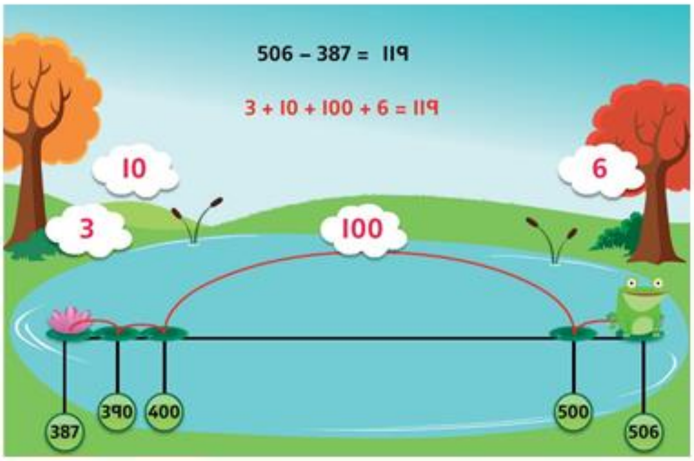
e.g. *£34·86 – £19·99*

Counting up

Find a difference between two numbers by counting up from the smaller to the larger

e.g. *506 – 387*

e.g. *4000 – 2693*

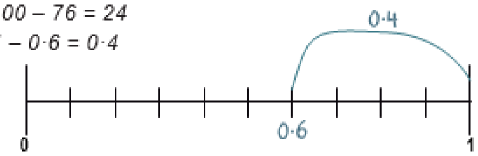


Using number facts

Number bonds to 10 and 100 and derived facts

e.g. *100 – 76 = 24*

e.g. *1 – 0·6 = 0·4*



Number bonds to £1 and £10

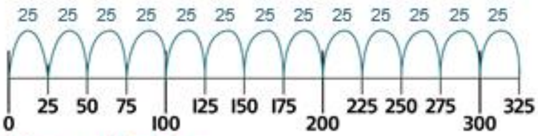
e.g. *£1·00 – 86p = 14p*

e.g. *£10·00 – £3·40 = £6·60*

Multiplication

Counting in steps (sequences)

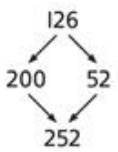
Count in 2s, 3s, 4s, 5s, 6s, 7s, 8s, 9s, 10s, 11s, 12s, 25s, 50s, 100s and 1000s



Doubling and halving

Find doubles to double 100 and beyond using partitioning

e.g. *double 126*



Begin to double amounts of money

e.g. *£3·50 doubled is £7*

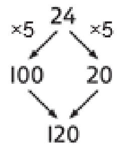
Use doubling as a strategy in multiplying by 2, 4 and 8

e.g. *34 × 4 is double 34 (68) doubled again = 136*

Grouping

Use partitioning to multiply 2-digit numbers by 1-digit numbers

e.g. *24 × 5*



Multiply multiples of 100 and 1000 by 1-digit numbers using tables facts

e.g. *400 × 8 = 3200*

Multiply near multiples by rounding e.g.

24 × 19 as (24 × 20) – 24 = 456

Using number facts

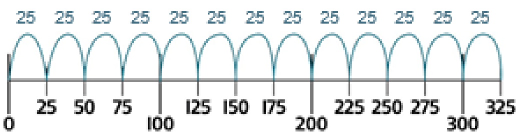
Know times-tables up to 12 × 12

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

Division

Counting in steps (sequences)

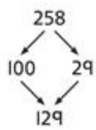
Count in 2s, 3s, 4s, 5s, 6s, 7s, 8s, 9s, 10s, 11s, 12s, 25s, 50s, 100s and 1000s



Doubling and halving

Find half of even numbers to 200 and beyond using partitioning

e.g. *find half of 258*



Begin to halve amounts of money

e.g. *£9 halved is £4·50*

Use halving as a strategy in dividing by 2, 4 and 8

e.g. *164 ÷ 4 is half of 164 (82) halved again = 41*

Grouping

Use multiples of 10 times the divisor to divide by 1-digit numbers above the tables facts

e.g. *45 ÷ 3 as 10 × 3 (30) and 5 × 3 (15)*

Using number facts

Know times-tables up to 12 × 12 and all related division facts

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

Year 5 - Objectives

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Objectives:

- Know number bonds to 1 and to the next whole number
- Add to the next 10 from a decimal number
  e.g. 13·6 + 6·4 = 20
- Add numbers with 2 significant digits only, using mental strategies
  e.g. 3·4 + 4·8
  e.g. 23 000 + 47 000
- Add 1 - or 2-digit multiples of 10, 100, 1000, 10 000 and 100 000
  e.g. 8000 + 7000
  e.g. 600 000 + 700 000
- Add near multiples of 10, 100, 1000, 10 000 and 100 000 to other numbers
  e.g. 82 472 + 30 004
- Add decimal numbers which are near multiples of 1 or 10, including money
  e.g. 6·34 + 1·99
  e.g. £34·59 + £19·95
- Use place value and number facts to add two or more numbers, including money and decimals
  e.g. 3 + 8 + 6 + 4 + 7
  e.g. 0·6 + 0·7 + 0·4
  e.g. 2056 + 44

-

Objectives:

- Subtract numbers with 2 significant digits only, using mental strategies
  e.g. 6·2 – 4·5
  e.g. 72 000 – 47 000
- Subtract 1- or 2-digit multiples of 10, 100, 1000, 10 000 and 100 000
  e.g. 8000 – 3000
  e.g. 60 000 – 200 000
- Subtract 1- or 2-digit near multiples of 10, 100, 1000, 10 000 and 100 000 from other numbers
  e.g. 82 472 – 30 004
- Subtract decimal numbers which are near multiples of 1 or 10, including money
  e.g. 6·34 – 1·99
  e.g. £34·59 – £19·95
- Use counting up subtraction, with knowledge of number bonds to 10, 100 or £1, as a strategy to perform mental subtraction
  e.g. £10 – £3·45
  e.g. 1000 – 782
- Recognise fraction complements to 1 and to the next whole number
  e.g. $1\,{}^{2}/_{5} + {}^{3}/_{5} = 2$

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Objectives:

- Know by heart all the multiplication facts up to 12 × 12
- Multiply whole numbers and 1- and 2-place decimals by 10, 100, 1000, 10 000
- Use knowledge of factors and multiples in multiplication
  e.g. 43 × 6 is double 43 × 3
  e.g. 28 × 50 is $^1/_2$ of 28 × 100 = 1400
- Use knowledge of place value and rounding in mental multiplication
  e.g. 67 × 199 as 67 × 200 – 67
- Use doubling and halving as a strategy in mental multiplication
  e.g. 58 × 5 is half of 58 × 10
  e.g. 34 × 4 is 34 doubled twice
- Partition 2-digit numbers, including decimals, to multiply by a 1-digit number mentally
  e.g. 6 × 27 as 6 × 20 (120) plus 6 × 7 (42)
  e.g. 6·3 × 7 as 6 × 7 (42) plus 0·3 × 7 (2·1)
- Double amounts of money by partitioning
  e.g. £37·45 doubled is £37 doubled (£74) plus 45p doubled (90p) giving a total of £74·90

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Objectives:

- Know by heart all the division facts up to 144 ÷ 12
- Divide whole numbers by 10, 100, 1000, 10 000 to give whole number answers or answers with 1, 2 or 3 decimal places
- Use doubling and halving as mental division strategies
  e.g. 34 ÷ 5 is (34 ÷ 10) × 2
- Use knowledge of multiples and factors, as well as tests for divisibility, in mental division
  e.g. 246 ÷ 6 is 123 ÷ 3
  e.g. we know that 525 divides by 25 and by 3
- Halve amounts of money by partitioning
  e.g. $^1/_2$ of £75·40 = $^1/_2$ of £75 (£37·50) plus half of 40p (20p) which is £37·70
- Divide larger numbers mentally by subtracting the 10th or 100th multiple as appropriate
  e.g. 96 ÷ 6 is 10 + 6, as 10 × 6 = 60 and 6 × 6 = 36
  e.g. 312 ÷ 3 is 100 + 4 as 100 × 3 = 300 and 4 × 3 = 12
- Understand whether a number can be divided wholly by 2, 3, 4, 5, 6, 9 and 25
- Know square numbers and cube number
- Reduce fractions to their simplest form

Year 5 – Overview of Strategies

Addition

Using place value

Count in 0·1s, 0·01s

e.g. *Know what 0·1 more than 0·51 is*

10s	1s	0·1s	0·01s
	0	5	1

Partitioning

e.g. *2·4 + 5·8 as 2 + 5 and 0·4 + 0·8 and combine the totals: 7 + 1·2 = 8·2*

0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9	1
1·1	1·2	1·3	1·4	1·5	1·6	1·7	1·8	1·9	2
2·1	2·2	2·3	2·4	2·5	2·6	2·7	2·8	2·9	3
3·1	3·2	3·3	3·4	3·5	3·6	3·7	3·8	3·9	4
4·1	4·2	4·3	4·4	4·5	4·6	4·7	4·8	4·9	5
5·1	5·2	5·3	5·4	5·5	5·6	5·7	5·8	5·9	6
6·1	6·2	6·3	6·4	6·5	6·6	6·7	6·8	6·9	7
7·1	7·2	7·3	7·4	7·5	7·6	7·7	7·8	7·9	8
8·1	8·2	8·3	8·4	8·5	8·6	8·7	8·8	8·9	9
9·1	9·2	9·3	9·4	9·5	9·6	9·7	9·8	9·9	10

Counting on

Add two decimal numbers by adding the 1s, then the 0·1s/0·01s

e.g. *5·72 + 3·05 as 5·72 + 3 (8·72) + 0·05 = 8·77*

Add near multiples of 1

e.g. *6·34 + 0·99*

e.g. *5·63 + 0·9*

Count on from large numbers

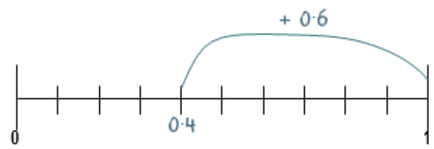
e.g. *6834 + 3005 as 9834 + 5*

Using number facts

Number bonds to 1 and to the next whole number

e.g. *5·7 + 0·3*

e.g. *0·4 + 0·6*



Add to the next 10 from a decimal number

e.g. *7·8 + 2·2 = 10*

Subtraction

Taking away

Use place value to subtract decimals

e.g. *4·58 – 0·08*

e.g. *6·26 – 0·2*

Take away multiples of powers of 10

e.g. *15 672 – 300*

e.g. *4·82 – 2* e.g. *2·71 – 0·5*

e.g. *4·68 – 0·02*

Partitioning or counting back

e.g. *3964 – 1051*

e.g. *5·72 – 2·01*

Subtract near multiples of 1, 10, 100, 1000, 10 000 or £1

e.g. *86 456 – 9999*

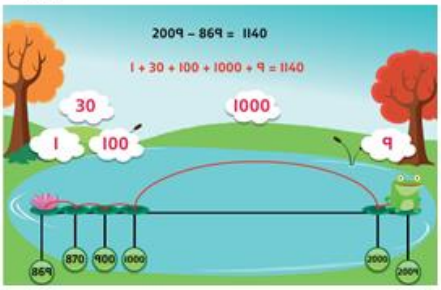
e.g. *3·58 – 1·99*

Counting up

Find a difference between two numbers by counting up from the smaller to the larger

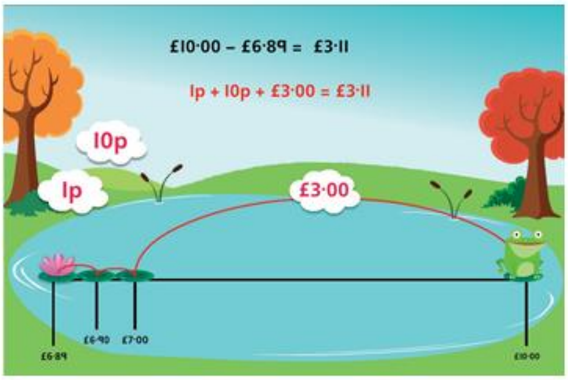
e.g. *£12·05 – £9·59*

e.g. *2009 – 869*



Find change using shopkeepers' addition

e.g. *Buy a toy for £6·89 using £10·00*



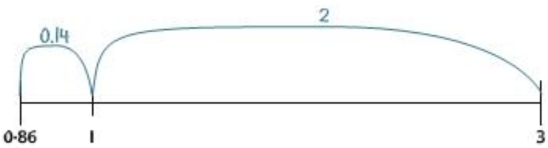
Find a difference between two amounts of money by counting up

Using number facts

Derived facts from number bonds to 10 and 100

e.g. *2 – 0·45 using 45 + 55 = 100*

e.g. *3 – 0·86 using 86 + 14 = 100*



Number bonds to £1, £10 and £100

e.g. *£4·00 – £3·86*

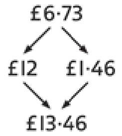
e.g. *£100 – £66 using 66 + 34 = 100*

Multiplication

Doubling and halving

Double amounts of money using partitioning

e.g. *double £6·73*



Use doubling and halving as a strategy in multiplying by 2, 4, 8, 5 and 20

e.g. *58 × 5 is half of 58 × 10 (580) = 290*

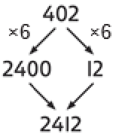
Grouping

Multiply whole numbers and decimals by 10, 100, 1000

e.g. *3·4 × 100 = 340*

Use partitioning to multiply 'friendly' 2- and 3-digit numbers by 1-digit numbers

e.g. *402 × 6 as 400 × 6 (2400) and 2 × 6 (12) = 2412*



Use partitioning to multiply decimal numbers by 1-digit numbers

e.g. *4·5 × 3 as 4 × 3 (12) and 0·5 × 3 (1·5) = 13·5*

Multiply near multiples by rounding e.g.

32 × 29 as (32 × 30) – 32 = 928

Using number facts

Use times-tables facts up to 12 × 12 to multiply multiples of 10/100 of the multiplier

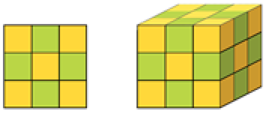
e.g. *4 × 6 = 24 so 40 × 6 = 240 and 400 × 6 = 2400*

Use knowledge of factors and multiples in multiplication

e.g. *43 × 6 is double 43 × 3*

e.g. *28 × 50 is half of 28 × 100 (2800) = 1400*

Know square numbers and cube numbers

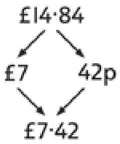


Division

Doubling and halving

Halve amounts of money using partitioning

e.g. *half of £14·84 is half of £14 (£7) plus half of 84p (42p)*



Use doubling and halving as a strategy in dividing by 2, 4, 8, 5 and 20

e.g. *115 ÷ 5 as double 115 (230) ÷ 10 = 23*

Grouping

Divide numbers by 10, 100, 1000 to obtain decimal answers with up to 3 decimal places

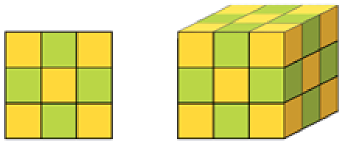
e.g. *340 ÷ 100 = 3·4*

Using number facts

Use division facts from the times-tables up to 12 × 12 to divide multiples of powers of 10 of the divisor

e.g. *3600 ÷ 9 using 36 ÷ 9*

Know square numbers and cube numbers



Year 6 - Objectives

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Objectives:

- Know by heart number bonds to 100 and use these to derive related facts
  e.g. 3·46 + 0·54
- Derive, quickly and without difficulty, number bonds to 1000
- Add small and large whole numbers where the use of place value or number facts makes the calculation solvable mentally
  e.g. 34 000 + 8000
- Add multiples of powers of 10 and near multiples of the same
  e.g. 6345 + 199 would be 6345 + 200 – 1.
- Add negative numbers in a context such as temperature where the numbers make sense
- Add two 1-place decimal numbers or two 2-place decimal numbers less than 1
  e.g. *4·5 + 6·3*
  e.g. *0·74 + 0·33*
- Add positive numbers to negative numbers
  e.g. *Calculate a rise in temperature or continue a sequence beginning with a negative number remembering when the signs are different the answer is negative, when the signs are the same the answer is positive (+ - = -) (- - = +)*

-

Objectives:

- Use number bonds to 100 to perform mental subtraction of any pair of integers by complementary addition
  e.g. *1000 – 654 as 46 + 300 in our heads*
- Use number bonds to 1 and 10 to perform mental subtraction of any pair of 1-place or 2-place decimal numbers using complementary addition and including money
  e.g. *10 – 3·65 as 3.65 + 0·35 + 6*
  e.g. *£50 – £34·29 as £34.29 + 71p + £15*
- Use number facts and place value to perform mental subtraction of large numbers or decimal numbers with up to 2 places
  e.g. *467 900 – 3005*
  e.g. *4·63 – 1·02*
- Subtract multiples of powers of 10 and near multiples of the same
- Subtract negative numbers in a context such as temperature where the numbers make sense

×

Objectives:

- Know by heart all the multiplication facts up to 12 × 12
- Multiply whole numbers and decimals with up to 3 places by 10, 100 or 1000
  e.g. *234 × 1000 = 234 000*
  e.g. *0·23 × 1000 = 230*
- Identify common factors, common multiples and prime numbers and use factors in mental multiplication
  e.g. *326 × 6 is 652 × 3 which is 1956*
- Use place value and number facts in mental multiplication
  e.g. *4000 × 6 = 24 000*
  e.g. *0·03 × 6 = 0·18*
- Use doubling and halving as mental multiplication strategies, including to multiply by 2, 4, 8, 5, 20, 50 and 25
  e.g. *28 × 25 is a quarter of 28 × 100 = 700*
- Use rounding in mental multiplication
  e.g. *34 × 19 as (34 × 20) – 34*
- Multiply 1- and 2-place decimals by numbers up to and including 10 using place value and partitioning
  e.g. *3·6 × 4 is 12 + 2·4*
  e.g. *2·53 × 3 is 6 + 1·5 + 0·09*
- Double decimal numbers with up to 2 places using partitioning
  e.g. *36·73 doubled is double 36 (72) plus double 0·73 (1·46)*

÷

Objectives:

- Know by heart all the division facts up to 144 ÷ 12
- Divide whole numbers by multiples of 10, 100 and 10000 to give whole number answers or answers with up to 3 decimal places
- Identify common factors, common multiples and primes numbers and use factors in mental division
  e.g. *438 ÷ 6 is 219 ÷ 3 which is 73*
- Use tests for divisibility to aid mental calculation
- Use doubling and halving as mental division strategies, for example to divide by 2, 4, 8, 5, 20 and 25 e.g. *628 ÷ 8 is halved three times: 314, 157, 78·5*
- Divide 1- and 2-place decimals by numbers up to and including 10 using place value
  e.g. *2·4 ÷ 6 = 0·4*
  e.g. *0·65 ÷ 5 = 0·13*
  e.g. *£6·33 ÷ 3 = £2·11*
- Halve decimal numbers with up to 2 places using partitioning
  e.g. *Half of 36·86 is half of 36 (18) plus half of 0·86 (0·43)*
- Know and use equivalence between simple fractions, decimals and percentages, including in different contexts
- Recognise a given ratio and reduce a given ratio to its lowest terms e.g. 3:6 = 1:2

Year 6 – Overview of Strategies

Addition

Using place value

Count in 0·1s, 0·01s, 0·001s

e.g. *Know what 0·001 more than 6·725 is*

Partitioning

e.g. *9·54 + 3·23 as 9 + 3, 0·5 + 0·2 and 0·04 + 0·03, to give 12·77*

Counting on

Add two decimal numbers by adding the 1s, then the 0·1s/0·01s/0·001s

e.g. *6·314 + 3·006 as 6·314 + 3 (9·314) + 0·006 = 9·32*

Add near multiples of 1

e.g. *6·345 + 0·999*

e.g. *5·673 + 0·9*

Count on from large numbers e.g.

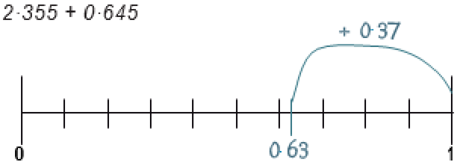
16 375 + 12 003 as 28 375 + 3

Using number facts

Number bonds to 1 and to the next multiple of 1

e.g. *0·63 + 0·37*

e.g. *2·355 + 0·645*



Add to the next 10

e.g. *4·62 + 5·38*

Subtraction

Taking away

Use place value to subtract decimals

e.g. *7·782 – 0·08*

e.g. *16·263 – 0·2*

Take away multiples of powers of 10

e.g. *132 956 – 400*

e.g. *686 109 – 40 000*

e.g. *7·823 – 0·5*

Partitioning or counting back

e.g. *3964 – 1051*

e.g. *5·72 – 2·01*

Subtract near multiples of powers of 10

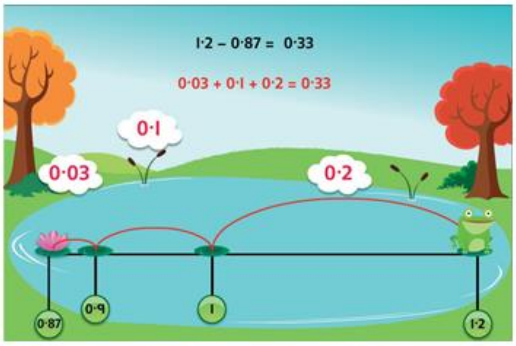
e.g. *360 078 – 99 998*

e.g. *12·831 – 0·99*

Counting up

Find a difference between two decimal numbers by counting up from the smaller to the larger

e.g. *1·2 – 0·87*



Using number facts

Derived facts from number bonds to 10 and 100

e.g. *0·1 – 0·075 using 75 + 25 = 100*

e.g. *5 – 0·65 using 65 + 35 = 100*

Number bonds to £1, £10 and £100

e.g. *£7·00 – £4·37*

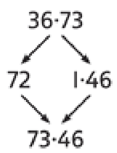
e.g. *£100 – £66·20 using 20p + 80p = £1 and £67 + £33 = £100*

Multiplication

Doubling and halving

Double decimal numbers with up to 2 places using partitioning

e.g. *double 36·73*



Use doubling and halving as strategies in mental multiplication

Grouping

Use partitioning as a strategy in mental multiplication, as appropriate

e.g. *3060 × 4 as 3000 × 4 (12 000) and 60 × 4 (240) = 12 240*

e.g. *8·4 × 8 as 8 × 8 (64) and 0·4 × 8 (3·2) = 67·2*

Use factors in mental multiplication

e.g. *421 × 6 as 421 × 3 (1263) doubled = 2526*

e.g. *3·42 × 5 as half of 3·42 × 10 = 17·1*

Multiply decimal numbers using near multiples by rounding

e.g. *4·3 × 19 as (4·3 × 20) – 4·3 = 81·7*

Using number facts

Use times-tables facts up to 12 × 12 in mental multiplication of large numbers or numbers with up to 2 decimal places

e.g. *6 × 4 = 24 and 0·06 × 4 = 0·24*

Division

Doubling and halving

Halve decimal numbers with up to 2 places using partitioning

e.g. *half of 36·86 is half of 36 (18) plus half of 0·86 (0·43)*

$$\begin{tikzcd}[column sep=small] & 36{\cdot}86 \arrow[dl] \arrow[dr] & \\ 18 \arrow[dr] & & 0{\cdot}43 \arrow[dl] \\ & 18{\cdot}43 & \end{tikzcd}$$

Use doubling and halving as strategies in mental division

Grouping

Use the 10th, 20th, 30th, ... or 100th, 200th, 300th ... multiples of the divisor to divide large numbers

e.g. *378 ÷ 9 as 40 × 9 (360) and 2 × 9 (18), remainder 2*

Use tests for divisibility

e.g. *135 divides by 3, as 1 + 3 + 5 = 9 and 9 is in the ×3 table*

Using number facts

Use division facts from the times-tables up to 12 × 12 to divide decimal numbers by 1-digit numbers

e.g. *1·17 ÷ 3 is 1/100 of 117 ÷ 3 (39)*

Know tests of divisibility for numbers divisible by 2, 3, 4, 5, 9, 10 and 25

Appendix i

Addition and Subtraction Strategies

These strategies can be applied throughout Key Stage 1 and Key Stage 2. Please tailor each strategy to your specific mental calculation objective(s).

1) *Counting forwards and backwards*

Children should begin by counting on in 1s and then extend this to other numbers according to their year group objectives. The image of a number line helps them appreciate the idea of counting forwards and backwards. They will also learn that when adding two numbers together it is generally easier to count on from the larger number than the smaller number e.g.

Year 1: 13 + 5 count on in 1s from 13.
Year 2: 80 – 7 count back in 1s from 80.
Year 3: 34 + 65 count on in 10s then 1s from 34.
Year 4: 960 – 500 count back in 100s from 960.
Year 5: 3.2 + 0.6 count on in 10ths.
Year 6: 1.7 + 0.55 count on in 10ths and 100ths.

2) *Reordering*

Sometimes a calculation can be more easily worked out by changing the orders of the numbers. It is important that children understand which numbers can be reordered e.g. 2 + 5 + 8 = 8 + 2 + 5, and which numbers can't e.g. 8 – 5.

Year 1: 2 + 7 = 7 + 2
Year 2: 5 + 34 = 34 + 5
Year 3: 12 – 7 – 2 = 12 – 2 – 7
Year 4: 28 + 75 = 75 + 28 (thinking of 28 as 25 + 3)
Year 5: 200 + 567 = 567 + 200
Year 6: 1.7 + 2.8 + 0.3 = 1.7 + 0.3 + 2.8

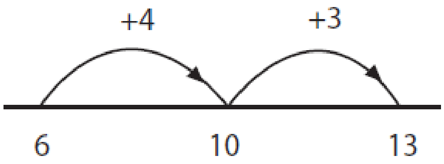
3) *Partitioning: counting on or back*

It is important that children understand that numbers can be partitioned e.g. 326 = 300 + 20 + 6. Although both numbers can be partitioned, it is often helpful to keep the first number as it is and partition the second number.

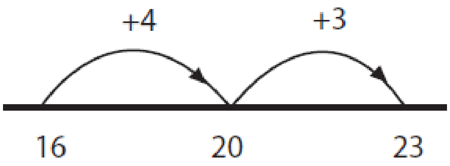
Year 2: 30 + 47 = 30 + 40 + 7
Year 3: 68 – 32 = 68 – 30 – 2
Year 4: 365 – 45 = 365 – 40 – 5
Year 5: 4.7 – 3.5 = 4.7 – 3.0 – 0.5
Year 6: 540 + 280 = 540 + 200 + 80

4) *Partitioning: bridging through multiples of 10*

Children need to develop an understanding of how close a number is to a multiple of 10 e.g. 47 is 3 away from 5. In mental addition and subtraction, it is often to useful to count forwards or backwards bridging a multiple of 10. The empty number line, with multiples of 10 as landmarks, is helpful, since children can visualise jumping, e.g. 6 + 7



Subtraction, the inverse of addition, can also be used by counting up from the smaller number e.g. 23 – 16



Year 2:	24 – 19 = 19 + 1 + 4
Year 3:	90 – 27 = 27 + 3 + 60
Year 4:	57 + 34 = 57 + 3 + 31
Year 5:	607 – 208 = 208 + 12 + 300 + 7
Year 6:	0.8 + 0.35 = 0.8 + 0.2 + 0.15

5) *Partitioning: compensating*

This strategy is useful for adding and subtracting numbers that are close to a multiple of 10. The number to be added or subtracted is rounded to a multiple of 10 plus or minus a small number e.g. adding 9 is carried out by adding 10 and then subtracting 1.

Year 2:	34 + 9 = 34 + 10 – 1
Year 3:	84 – 18 = 84 – 20 + 2
Year 4:	64 – 32 = 64 – 30 – 2
Year 5:	405 – 399 = 405 – 400 + 1
Year 6:	6.8 – 4.9 = 6.8 - 5.0 + 0.1

6) *Partitioning: Near doubles*

If children have a good knowledge of doubles they can use this to solve mental calculations e.g. 7 + 6 rather than counting or bridging through 10.

Year 1:	6 + 7 = double 6 and add 1 OR double 7 and subtract 1
Year 2:	39 + 40 = double 40 and subtract 1
Year 3:	60 + 70 = double 60 and add 10 OR double 70 and subtract 10
Year 4:	76 + 75 = double 76 and 1 OR double 75 and add 1
Year 5:	160 + 170 = double 160 and add 10 OR double 170 and subtract 10
Year 6:	2.5 + 2.6 = double 2.5 and add 0.1 or double 2.6 and subtract 0.1

Appendix ii

Addition and Subtraction Activities

- Counting forwards and backwards: Count from zero in ones, one after the other round the class. When you clap they must count backwards, on the next clap they count forwards and so on.

- Counting forwards and backwards: Tell the class that you will move along an imaginary number line. You will then tell them what number you are standing on and what size steps you are taking e.g.

  I am on 15, and am taking steps of 10. Invite them to visualise the number 15 on a number line and to tell you where you will be after one step forward (25). Take three steps forward and ask: "Where am I now?" (55), take two steps back: "Where am I now?" (35). Repeat.

- Reordering: Have regular short, brisk practice sessions where children are given 10 questions where some pairs total 10. Ask them to rapidly answer the questions.

- Partitioning - counting on or back: Use place value cards 1 to 9, 10 to 90 and 100 to 900. Ask children to use the cards to make two digit or a three digit number by selecting the cards and placing them on top of each other.

- Partitioning – bridging through multiples of 10: Show the class a single digit number and ask children to find its complement to 10. Extend by offering two digit numbers and complements to 100, decimals to make 1 etc.

- Partitioning – compensating: Prepare two sets of cards for a subtraction game. Set A has numbers from 12 to 27. Set B has numbers containing 9 and 11 so the game involves subtracting 9 and 11. Children subtract a number from set A from a number on set B.

- Partitioning – using near doubles: Play 'Think of a number': Use a rule that involves doubling and adding or subtracting a small number, for example:

  I'm thinking of a number.
  I doubled it and added 3.
  My answer is 43.
  What was my answer?

Appendix iii

Multiplication and Division Strategies

These strategies can be applied throughout Key Stage 1 and Key Stage 2. Please tailor each strategy to your specific mental calculation objective(s).

1) *Multiplication, division and corresponding inverse facts*

Fluent recall of multiplication and division facts depends on regular practice. It is crucial that practice is varied and not simply children saying the facts over and over again. It should also lead children to recognising number properties such as doubles and halves, odd and even numbers, multiples, factors and primes.
See Year Group for specific mental calculation objectives(s).

2) *Double and halving*

The ability to double numbers is useful for multiplication. Most people find doubles the easiest multiplication facts to remember, and they can be used to simply other calculations. Sometimes it can be useful to halve one of the numbers in a multiplication calculation and double the other.
See Year Group for specific mental calculation objectives(s).

3) *Multiplying and dividing by multiples of 10, 100 and 1000.*

Being able to multiply and divide by 10, 100 and 1000 and multiples of 10, 100 and 1000 depends on an understanding of place value and knowledge of multiplication and division facts.
See Year Group for specific mental calculation objectives(s).

4) Multiplying and dividing by single digit numbers and multiplying by two digit numbers.

Once children are familiar with some multiplication facts, they can extend their skills.

- One strategy is to partition one of the numbers and use the distributive law of multiplication over addition e.g. 6 x 7 = 6 (5 + 2) = 6 x 5 + 6 x 2.
- Another strategy is to make use of factors, so 7 x 6 is seen as 7 x 3 x 2.

Once children understand the effect of multiplying and dividing by 10, they can start to extend their multiplication and division skills to larger numbers.

- 26 x 3 can be worked out by partitioning 26 into 20 + 6, multiplying each part by 3 and then recombining.
- Multiplying by 2, 4, 8, 16, 32 etc. is to use doubling, so 9 x 8 is seen as 9 x 2 x 2 x 2. A strategy for dividing by the same numbers is to use halving.
- Multiplying by 50, multiplying by 100 then halve. Multiplying by 25, multiply by 100 then divide by 4.

See Year Group for specific mental calculation objectives(s).

5) Fractions, decimals and percentages

Children need an understanding of how fractions, decimals and percentages relate to each other. For example, if they know that $\frac{1}{2}$, 0.5 and 50% are all ways of representing the same part of a whole, then they can see that the calculations: $\frac{1}{2}$ x 40, 40 x $\frac{1}{2}$, 40 x 0.5, 0.5 x 40, 50% of 40 are all different versions of the same calculation.

See Year Group for specific mental calculation objectives(s).

Appendix iv

Multiplication and Division Activities

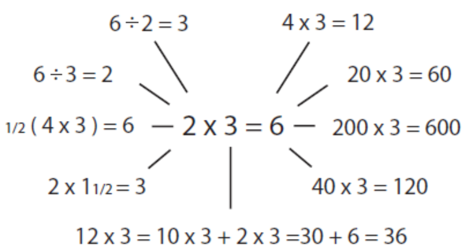
- Multiplication and division facts: Missing number problems e.g. 2 x __ = 10 or 10 ÷ 2 = __

- Play Fours, a game for two players using two dice. Each player draws a 3 by 3 grid. Take turns to roll two dice. Each spot is worth 4. Write your score on your grid. Carry on until each grid is full of numbers. Now take turns to roll the dice again. If the score when two numbers are multiplies together is the same as a number on either player's grid, you can cross out that number. The winner is the first to cross out all their numbers.

- Make cards showing a multiplication on one side and the answer on the other. Children put the cards out in front of them with either all the multiplications showing or all the results showing. A player touches a card, says what it is on the other side and then turns it over. If not correct, the card is turned back over. Play continues until all the cards are turned over.

1 x 7	7 x 9	4 x 7	9 x 7
5 x 7	6 x 7	2 x 7	6 x 7
7 x 6	3 x 7	10 x 7	7 x 5

- Write a multiplication fact in the middle of the board and ask children: 'Now that we know this fact, what other facts do we know?' Invite children to the board to explain and record their ideas.



- Make loop cards of questions and answers, e.g.

3 x 5	6 x 7	4 x 4
40	15	42

9 x 8	8 x 5
16	72

Distribute the cards round the class. Ask one child to read out the multiplication at the top of their card. The child who has the correct answer reads it out and then reads out the question at the top of that card. This continues until all cards are used.

- Distribute a number of cards with a multiplication fact with one number missing, such as:

? x 4 = 24	5 x ? = 35

  Children need to place their cards on the space that gives the missing number on a sorting tray like this:

2	3	4	5
6	7	8	9
10	11	12	13

- Doubling and halving: Use 'doubling' and 'halving' function machines. Ask one child to choose a number and another to choose whether to use the 'doubling' or 'halving' machine. Then ask a third child to say how the number is transformed by the machine, for example:

  ○ → x 2 → ○ → ÷ 2 → ○

- Doubling and halving: Start with a small number, e.g. 2, 3, 5 or 7. Start doubling it by going round the class. How far can you go?

- Doubling and halving: Investigate doubling and halving number chains. Ask someone to choose a number. Say that the rule is: 'If the number is even, halve it; if it is odd, add 1 and halve it.' Go round the class generating the chain.

  14 → 7 → 4 → 2 → 1

- Multiplying and dividing by 10, 100 and 1000: Use function machines. Try starting at different numbers.

  Enter a number → x 2 → x 10 = ?

  Enter the same number → x 10 → x 2 = ?

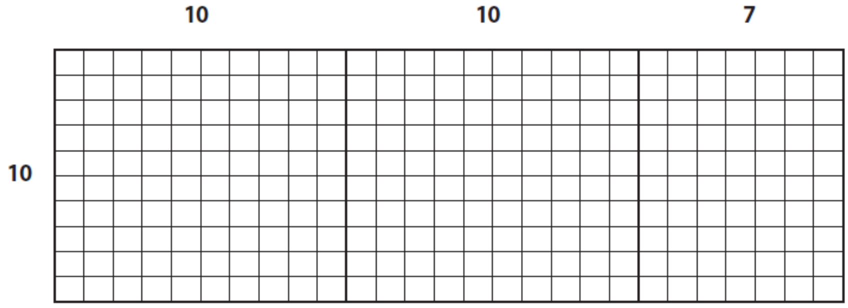
  What do you notice?

  Try some divisions.

  40 → ÷ 4 → ÷10 = ?

  40 → ÷10 → ÷ 4 = ?

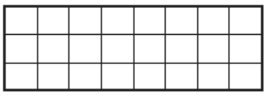
- Multiplying and dividing by 10, 100 and 1000: Use a rectangular array, e.g. to show 27 x 10.



- Multiplying and dividing by 10, 100 and 1000: Use a multiplication grid. Ask children to find the missing numbers.

x	2		7
	40		
10		50	

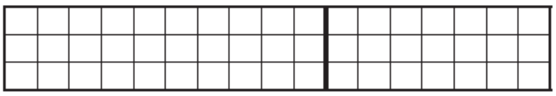
- Multiplying and dividing by single-digit numbers and multiplying by two-digit numbers: Use an area model for single multiplication facts. For example, illustrate 8 x 3 as:



How many … rows? columns? small squares?

Encourage children to visualise other products in a similar way.

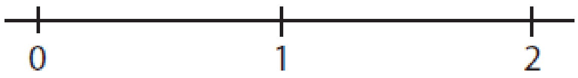
Extend this model to larger numbers, such as 17×3: split the 17 into $10 + 7$ and use $10 \times 3 + 7 \times 3$.



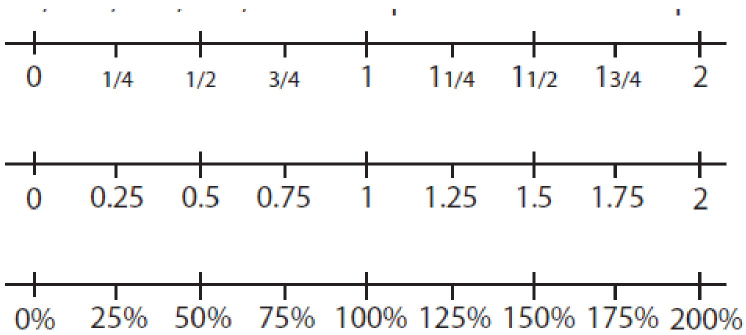
How many … rows? columns? small squares?

<u>Fractions, Decimals and Percentages Activities</u>

- Draw a number line on the board, marking on it the points 0, 1 and 2:



Invite children to show where the fractions $\frac{1}{4}$, $\frac{1}{2}$, 1 $\frac{1}{4}$, 1 $\frac{1}{2}$ and 1 $\frac{3}{4}$ fit on the line. Ask what other fractions between 0 and 2 they could add to the line. When they are familiar with fractions, draw a new line under the first one and ask for the decimals 0.5, 1.5, 0.25, 1.25, 1.75, 0.75 to be placed on this line. Repeat with a line for percentages from 0% to 200%. Discuss the equivalence between them. Choose any number and ask children to call out the equivalents from the other two lines.



- Write a sum of money on the board, e.g. £24. Ask children to tell you what half of £24 is, then 1/3, $\frac{1}{4}$, 1/6, 1/8 and 1/12. Then give fractions such as 2/3, $\frac{3}{4}$, 5/6, 7/8 and 5/12. Ask how they could calculate these fractions of £24.

- Put a percentage example on the board, say 25% of £60. Discuss different ways of interpreting the question, such as 25/100 of £60 or $\frac{1}{4}$ of £60. Ask children to then find 17.5% of £60. Since they know that 5% of £60 is £3, they can work out 2.5% of £60 which is £1.50 and then combine the totals. Invite children to suggest other examples.

End