The 4 Operations

The methods that are used at
Barnham Primary School
for the four mathematical operations.

Dear Parents and Carers

As you know, mathematics is an incredibly important part of your child's education. At Barnham Primary School we believe the four mathematical operations (addition, subtraction, multiplication and division) are the key building blocks on which all the other areas of the mathematics curriculum depend. Therefore, we believe that providing all children with a clear and confident working knowledge of the four operations is vital to supporting their learning in this subject and as such is a fundamental focus in mathematics teaching here at Barnham.

This booklet aims to provide you with a clear overview of the methods, and how these develop, that we will use to teach the four operations throughout your child's time at Barnham. It is our aim that every child will leave Year 6 being able to work confidently at Step 4 or above in both the written and mental aspects of all of the mathematical operations. Different children will progress through the steps at different speeds and they will be supported appropriately through differentiated and targeted work in class.

The booklet comprises of both the expectations for mental knowledge and calculation methods and the written calculation methods. The steps for the mental mathematics expectations correspond to the written methods they support although we encourage the learning of times tables as soon as possible!

We would ask that you support your child in their learning by using the methods for the four operations outlined in this booklet. We will provide workshops during the year if you wish to receive any support in any of these areas or if you have any questions.

Please feel free to contact us with any questions or comments about the contents of this booklet.

Yours Sincerely

James Everett (Headteacher) Samuel Parkin (Mathematics lead)

Mental Knowledge and Calculation Methods

Step 1: I begin to know some addition facts.	Start to learn and recall addition facts and number bonds to 10. ie: 1 + 9 = 10, 2 + 8 = 10, 3 + 7 = 10 etc
Step 2: I can use mental recall of addition and subtraction facts to 10.	Know, and quickly recall, number bonds to 10. ie: 1 + 9 = 10, 2 + 8 = 10, 3 + 7 = 10 etc Use knowledge that subtraction is the inverse of addition to recall subtraction facts to 10. ie: 1 + 9 = 10 so 10 – 1 = 9 or 10 – 9 = 1
Step 3: I can add and subtract two digit numbers mentally.	Use knowledge of the number line methods to count on/back in units, then 10s. Use knowledge of partitioning. (See written methods of addition and subtraction)
I can use mental recall of addition and subtraction facts to 20 in solving problems involving larger numbers.	14 + 6 = 20 ∴ 140 + 60 = 200 15 – 8 = 7 ∴ 150 – 80 = 70
I can derive associated division facts from known multiplication facts.	Use the knowledge that multiplication is the inverse of division. 5 x 4 = 20 ∴ 20 ÷ 4 = 5 or 20 ÷ 5 = 4
Step 4: I can recall multiplication facts up to 10x10 and quickly derive the corresponding division facts.	Learn multiplication tables by rote, not by counting on. ie: 1 x 2 = 2, 2 x 2 = 4, 3 x 6 = 6, 4 x 2 = 8 etc not: 2, 4, 6, 8 etc Learning by rote will significantly aid pupils' work in both multiplication and division. Derive division facts using knowledge that division is the inverse of multiplication for all times tables.
I can use a range of mental methods of computation for addition, subtraction, multiplication and division.	Addition/Subtraction: Use knowledge of the number line methods to count on/back. Use knowledge of partitioning and decimals. Multiplication/Division: Learn multiplication tables by rote, not by counting on. Derive division facts using knowledge that division is the inverse of multiplication. Use knowledge of partitioning (and decimals) to multiply 2-digit numbers by 1-digit numbers. Use knowledge of the short division method to divide 2-digit numbers by 1-digit numbers.

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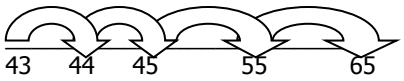
Written Addition

<table>
<tr><td>Step 1:
I can add numbers of objects to 10.
I can record my work.</td><td colspan="3">Practical activities combining 2 or more groups of objects.
Revise vocabulary for addition. Revise + and = signs.
Use this knowledge to create number sentences to write up practical activities.

Investigate number bonds to 10, looking for patterns. Formalise and learn number bonds to 10.

Begin to use a number line to 20 to add 1 more, 2 more etc. Write up in number sentences.</td></tr>
<tr><td>Step 2:
Begin adding 2-digit numbers.</td><td colspan="3">Number Line Addition:
Use a number line to add 2-digit numbers to single-digit numbers.
Use a hundred square to add on 10.
Use a number line to add 2-digit numbers to a teen-number.
Use a number line to add 2-digit to 2-digit numbers.
Use a number line to add 3-digit to 2-digit numbers etc.
ie: 43 + 22 = 65
+1 +1 +10 +10
 
43 44 45 55 65
Begin to partition and add 2-digit numbers informally.
*Adding the units first will help with progression into column addition.</td></tr>
<tr><td>Step 3:
I can add 3-digit numbers using a written method.
(These methods build on each other to develop understanding of the written methods leading to column addition.)</td><td>Partition method:

592 + 263 = 855

2 + 3 = 5
90 + 60 = 150
500 + 200 = 700

700 + 150 + 5 = 855</td><td>Expanded Column Addition 1:

592 + 263 = 855

500 90 2
+ 200 60 3
700 150 5</td><td>Expanded Column Addition 2:

592 + 263 = 855

500 90 2
+ 200 60 3
800 50 5
100</td></tr>
<tr><td>Step 4:
I can use an efficient written method of addition.</td><td colspan="3">Column Addition:

592 + 263 = 855

5 9 2
+ 2 6 3
8 5 5
1</td></tr>
<tr><td>Step 5:
I can use known facts, place value, knowledge of operations and brackets to calculate including all four operations with decimals to two places.</td><td colspan="3">Column Addition:
846.73 + 478.98 = 1325.71

8 4 6. 7 3
+ 4 7 8. 9 8
13 2 5. 7 1
1 1 1 1 1</td></tr>
<tr><td>I can solve simple problems involving adding negative numbers in context.</td><td colspan="2">Number Line Methods:
Pupils use a number line to add numbers in a negative context.

-5 + 4 = -1</td><td>The understanding that:
+ve + +ve = + -ve + +ve = +
+ve + -ve = - -ve + -ve = -
∴-5 + -4 = -9
May be independently held or developed by pupils and they may wish to use this knowledge when carrying out calculations of this nature.</td></tr>
<tr><td>Step 6:
I can add fractions by writing them with a common denominator.</td><td colspan="3">1/2 + 3/4 = 5/4 = 1 1/4

1/2 (x2) + 3/4 = 2/4 + 3/4 = 5/4 = 1 1/4
When answering, fractions should always be simplified or given as a mixed number.</td></tr>
</table>

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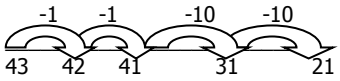
Written Subtraction

<table>
<tr><td>Step 1:
I can subtract numbers of objects to 10.
I can record my work.</td><td colspan="2">Practical activities subtracting using numbers below 10.
Revise vocabulary for subtraction. Revise - and = signs.
Use this knowledge to create number sentences to write up practical activities.

Investigate subtraction facts to 10, looking for patterns. Identify connection to number bonds to 10 to show link between addition and subtraction.

Begin to use a number line to 20 to work out 1 less, 2 less etc. Write up in number sentences.</td></tr>
<tr><td>Step 2:
I can use the knowledge that subtraction is the inverse of addition.</td><td colspan="2">Number Line Subtraction:
Use a number line to subtract single-digit numbers from 2-digit numbers.
Use a hundred square to subtract 10.
Use a number line to subtract a teen-number from a 2-digit numbers.
Use a number line to subtract 2-digit from 2-digit numbers.
Use a number line to subtract 2-digit numbers from 3-digit etc.
For subtraction, count backwards on the number line.
ie: 43 - 22 = 21
 

*As subtraction is the inverse of addition the answers can be found using an addition number line, this link may be made independently and pupils may wish to use this method for subtraction.
*Do not use partitioning for subtraction as it causes misconceptions.</td></tr>
<tr><td>Step 3:
I can subtract 3-digit numbers using a written method.</td><td>Expanded Column Subtraction:

645 - 232 = 413

600 40 5
- 200 30 2
400 10 3</td><td>721 - 556 = 165

600 110
~~700~~ ~~20~~ 11
- 500 50 6
100 60 5</td></tr>
<tr><td>Step 4:
I can use an efficient written method of subtraction.</td><td>Column Subtraction:

645 - 231 = 413

6 4 5
- 2 3 2
4 1 3</td><td>721 - 556 = 165

6 ^{1}1
~~7~~ ~~2~~ ^{1}1
- 5 5 6
1 6 5</td></tr>
<tr><td>Step 5:
I can use known facts, place value, knowledge of operations and brackets to calculate including all four operations with decimals to two places.</td><td colspan="2">Column Subtraction:
8.82 – 7.78 = 1.04
7
8. ~~8~~ ^{1}2
- 7. 7 8
1. 0 4</td></tr>
<tr><td>I can solve problems involving subtracting negative numbers in context.</td><td>Number Line Methods:
Pupils use a number line to subtract numbers in a negative context.
-5 - 4 = -9
Find the difference between 7 and -15.
7 – (-15) = 22</td><td>The understanding that:
+ve - +ve = - -ve - +ve = +
+ve - -ve = + -ve - -ve = +
∴-5 - -4 = -1
May be independently held or developed by pupils and they may wish to use this knowledge when carrying out calculations of this nature.</td></tr>
<tr><td>Step 6:
I can subtract fractions by writing them with a common denominator.</td><td colspan="2">$\frac{3}{5} - \frac{1}{3} = \frac{4}{15}$

$\frac{3}{5}$ (x3) – $\frac{1}{3}$ (x5) = $\frac{9}{15} - \frac{5}{15} = \frac{4}{15}$

When answering, fractions should always be simplified or given as a mixed number.</td></tr>
</table>

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Written Multiplication

<table>
<tr><td>Step 1:
I can begin to understand the concept of multiplication.</td><td colspan="2">Revise vocabulary for multiplication. Revise x and = signs.
Understand multiplication as 'lots of'.
Use this knowledge to create number sentences for multiplication facts.

Use a 100 square to investigate patterns in multiplication tables.</td></tr>
<tr><td>Step 2:
I can understand halving as a way of 'undoing' doubling and vice versa.</td><td colspan="2">Use arrays to understand the commutative nature of multiplication.
Use knowledge of multiplication vocabulary to express this in number sentences.
ie: 3 x 2 = 6 and 2 x 3 = 6

Understand that doubling is multiplying by 2.

Informally, begin to multiply a 2-digit number by a single-digit number using partitioning.</td></tr>
<tr><td>Step 3:
I can multiply two digit numbers by 2, 3, 4 or 5 as well as 10.</td><td>Grid Method:

39 x 3 = 117

<table><tr><td></td><td>30</td><td>9</td></tr><tr><td>x 3</td><td>90</td><td>27</td></tr></table>
9 0
+ 2 7
1 1 7
1</td><td>Expanded Column Multiplication:

39 x 3 = 117

3 9
x 3
2 7 3 x 9 = 27
+9 0 3 x 30 = 90
1 1 7
1</td></tr>
<tr><td>Step 4:
I can use an efficient written method of short multiplication.</td><td colspan="2">Column Method for Short-Multiplication:

39 x 3 = 117

3 9
x 3
1 1 7
1 2</td></tr>
<tr><td>I can multiply a simple decimal by a single digit.</td><td colspan="2">Column Method for Short-Multiplication:

42.3 x 5 = 211.5

4 2 . 3
x 5
2 1 1 . 5
2 1 1</td></tr>
<tr><td>Step 5:
I can use known facts, place value, knowledge of operations and brackets to calculate including all four operations with decimals to two places.</td><td colspan="2">Column Method for Short-Multiplication:

41.37 x 4 = 165.48

4 1 . 3 7
x 4
1 6 5 . 4 8
1 1 2</td></tr>
<tr><td>I understand and can use an appropriate non-calculator method for solving problems that involve multiplying any three digit number by any two digit number.</td><td>Grid Method:

415 x 23 = 9545

<table><tr><td>x</td><td>400</td><td>10</td><td>5</td></tr><tr><td>20</td><td>8000</td><td>200</td><td>100</td></tr><tr><td>3</td><td>1200</td><td>30</td><td>15</td></tr></table>
8000
200
100
1200
30
+ 15
9545</td><td>Expanded Column Multiplication:
415 x 23 = 9545

4 1 5
x 2 3
1 5 3 x 5 = 15
3 0 3 x 10 = 30
1 2 0 0 3 x 400 = 1200
1 0 0 20 x 5 = 100
2 0 0 20 x 10 = 200
+ 8 0 0 0 20 x 400 = 8000
9 5 4 5</td><td>Column Multiplication:
415 x 23 = 9545

4 1 5
x 2 3
1 2 4 5
1 1
+ 8 3 0 0
1
9 5 4 5</td></tr>
<tr><td>Step 6:
I can multiply an integer by a fraction.</td><td colspan="2">1 x 4 = 2
2

1 x 4 = 4 = 2
2 1 2
When answering, fractions should always be simplified or given as a mixed number.</td></tr>
</table>

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Written Division

Step 1: I can begin to understand the concept of division.	Practical activities dividing objects equally into hoops etc. Revise vocabulary for division. Revise ÷ and = signs. Use this knowledge to create number sentences to write up practical activities. Identify connection to multiplication tables to show link between multiplication and division.	
Step 2: I can understand halving as a way of 'undoing' doubling and vice versa.	Understand that halving is dividing by 2. Use knowledge that multiplication is the inverse of division to find halves.	
Step 3: I can divide two digit numbers by 2, 3, 4 or 5 as well as 10.	Short Division: 649 ÷ 3 = 216 r1 2 1 6 r 1 3 | 6 ^{4} ^{1}9	
Step 4: I can use an efficient written method of short division.	Short Division: 842 ÷ 6 = 140 r2 1 4 0 r 2 6 | 8 ^{2}4 2	
Step 5: I can use known facts, place value, knowledge of operations and brackets to calculate including all four operations with decimals to two places.	Short Division: 827.24 ÷ 4 = 206.81 2 0 6 . 8 1 4 | 8 2 ^{2}7 . ^{3}2 4	
I understand and can use an appropriate non-calculator method for solving problems that involve dividing any three digit number by any two digit number.	Long Division (using cheat sheet): 504 ÷ 21 = 24 2 4 21 | ^{4}~~5~~ ^{1}0 4 - 4 2 0 8 4 21 x 10 = 210 21 x 20 = 420 21 x 5 = 105 21 x 2 = 42 21 x 4 = 84	Long Division: 504 ÷ 21 = 24 2 4 21 | ^{4}~~5~~ ^{1}0 4 - 4 2 ↓ 0 8 4 - 8 4 0 0
I can use a calculator, where appropriate, to calculate fractions of quantities.	1/4 of 68 = 17 Use knowledge that to find a fraction of a quantity, you divide by the denominator. 68 ÷ 4 = 17	
Step 6: I can divide an integer by a fraction.	Use practical activities to investigate in order to understand the method. Use formal notation to write up practical activities.	5 ÷ 1/4 = 20 5 ÷ 1/4 = 5 x 4/1 = 20 When answering, fractions should always be simplified or given as a mixed number.
I can calculate fractions of quantities.	Use knowledge that to find a fraction of a quantity, you divide by the denominator. 1/3 of 516 = 172 516 ÷ 3 = 172 1 7 2 3 | 5 ^{2}1 6	