Year 5 - Arithmetic Expectations

This series of documents aims to summarise the number facts, mental calculation strategies and the stage(s) of the progression towards the written methods for each of the four operations.

For each strategy, the concrete and pictorial representations have been suggested. However, to keep the document to a more manageable size, the imagery has not been shown explicitly as this should be found in your school's agreed mental calculations policies.

The strategies used within this document are taken from the Lancashire Mathematics Team Progression in Mental Calculation Strategies Policies and the Progression Towards Written Methods Policies.

See www.lancsngfl.ac.uk/curriculum/primarymaths for the full policies.

Each strategy will require specific modelling (teaching) and sufficient practice for children to develop confidence, accuracy and fluency in performing them.

Children should also be taught when it is appropriate to use each strategy, by looking at the numbers involved and making effective decisions. Again, this is a sign of a child's fluency in mathematics; being able to recognise which strategy best suits a given calculation, rather than always using the same method regardless of the numbers involved.

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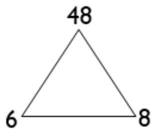
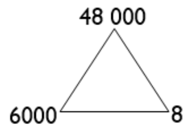
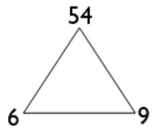
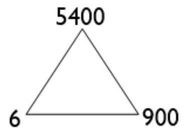
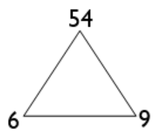
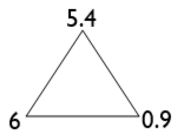
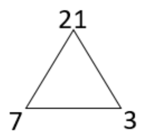
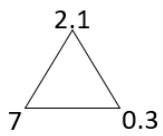
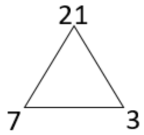
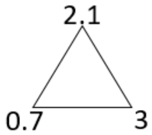
Arithmetic Expectations – Year 5

Skills	Examples
Counting	
Count forwards or backwards in steps of powers of 10 for any given number up to 1 000 000.	Count on from 34 642 in hundreds. What four numbers would come next in this counting sequence? 422 734, 412 734…
Count forwards or backwards in decimal steps.	Continue this count: 4.4, 3.8, 3.2,… What four numbers would come next in this counting sequence? 2.16, 2.27, 3.38…
Find 0.01, 0.1, 1, 10, 100, 1000 and other powers of 10 more or less than a given number.	154 041 – 100 474 985 + 1 000 202 883 – 10 000 23.47 + 0.1 6.07 – 0.1 31.09 + 0.01 12.3 – 0.01
Number Facts	
Recall addition and subtraction facts for 1 and 10 (with numbers to one decimal place).	0.6 + 0.4 = ___ 0.2 + ___ = 1 1 = ___ + 0.5 1 – 0.3 = ___ 1 – ___ = 0.1 0.7 = 1 – ___ 1.3 + 8.7 = ___ 2.5 + ___ = 10 10 = ___ + 4.6 10 – 5.2 = ___ 10 – ___ = 6.3 1.9 = 10 – ___
Recall related tables facts for multiples of 10	70 x 6 8 x 40 90 x 6
Recall prime numbers up to 19	Instantly know the prime numbers 2, 3, 5, 7, 11, 13, 17 and 19
Recall square (^{2}) numbers up to 12 x 12	Instantly know the square of all numbers to 12: $1^2 = 1$, $2^2 = 4$, $3^2 = 9$, $4^2 = 16$, $5^2 = 25$, $6^2 = 36$, $7^2 = 49$, $8^2 = 64$, $9^2 = 81$, $10^2 = 100$, $11^2 = 121$ and $12^2 = 144$
Mental Calculation Strategies – Addition and Subtraction	
Derive and use addition and subtraction facts for 1 (with decimal numbers to two decimal places) *Concrete – (if necessary) place value counters* *Pictorial – number line*	0.45 + ___ = 1 ___ + 0.27 = 1 1 = 0.39 + ___ 1 = ___ + 0.78 1 – 0.08 = ___ 1 – ___ = 0.61 0.54 = 1 – ___ ___ = 1 – 0.89

Partition and combine multiples of thousands hundreds, tens and ones. *Concrete (if necessary) – place value counters* *Pictorial – number line*	4300 + 1400 — 4300 **add 1000** = 5300 then **add 400** = 5700 364 + 250 — 364 **add 200** = 564 then **add 50** = 614 3600 – 1200 — 3600 **subtract 1000** = 2600 then **subtract 200** = 2400 432 – 240 — 432 **subtract 200** = 232 then **subtract 40** = 192 5124 + 1352 — 5124 **add 1000** = 6124 then **add 300** = 6424 then **add 50** = 6474 then **add 2** = 6476 (not crossing any boundaries) 7584 – 2351 — 7584 **subtract 2000** = 5584 then **subtract 300** = 5284 then **subtract 50** = 5234 then **subtract 1** = 5233 (not crossing any boundaries)
Partition and combine multiples of ones and tenths. *Concrete (if necessary) – place value counters* *Pictorial – number line*	5.4 + 3.2 — 5.4 **add 3** = 7.4 then **add 0.2** = 7.6 4.7 – 2.5 — 4.7 **subtract 2** = 2.7 then **subtract 0.5** = 2.2
Identify and use knowledge of number bonds within a calculation and identify related facts, e.g. 1.5 + 2.7 from 15 + 27 *Concrete (if necessary) – place value counters*	1.2 + 0.8 — using knowledge of 12 + 8 = 20 2.5 + 1.3 — using knowledge of 25 + 13 = 38 3.8 + 4.5 — using knowledge of 38 + 45 = 83 2 – 0.7 — using knowledge of 20 – 7 = 13 4.6 – 1.5 — using knowledge of 46 – 15 = 31 8.3 – 5.4 — using knowledge of 83 – 54 = 29
Bridge through 10 when adding or subtracting a single digit number (partitioning, e.g. 58 + 5 = 58 + 2 + 3 or 76 – 8 = 76 – 6 – 2) *Concrete (if necessary) – Diennes equipment, place value counters* *Pictorial – number line*	594 + 170 — as 594 + 6 + 164 = 600 + 164 1995 + 278 — as 1995 + 5 + 273 = 2000 + 273 703 – 128 — as 703 – 3 – 125 = 700 – 125 3002 – 87 — as 3002 – 2 – 85 = 3000 – 85
Find differences by counting up through the next multiple of 1, 10, 100 or 1000 *Concrete (if necessary) – place value counters* *Pictorial – number line*	604 – 289 — 289 **+ 11** = 300 **+ 300** = 600 **+ 4** = 604 so the difference is **315** 523 – 160 — 160 **+ 40** = 200 **+ 300** = 500 **+ 23** = 523 so the difference is **363** 1200 – 785 — 785 **+ 15** = 800 **+ 400** = 1200 so the difference is **415** 5003 – 1960 — 1960 **+ 40** = 2000 **+ 3003** = 5003 so the difference is **3043** 7.3 – 2.8 — 2.8 **+ 0.2** = 3 **+ 4** = 7 **+ 0.3** = 7.3 so the difference is **4.5** 20.1 – 6.7 — 6.7 **+ 3.3** = 10 **+ 10.1** = 20.1 so the difference is **13.4**
Add or subtract a multiple of 10 and adjust (for those numbers close to multiples of 10) *Concrete (if necessary) – Diennes equipment, place value counters* *Pictorial – number line*	257 + 68 — as 257 + 70 – 2 = 327 – 2 325 + 298 — as 325 + 300 – 2 = 625 – 2 764 – 88 — as 764 – 90 + 2 = 674 + 2 876 – 397 — as 876 – 400 + 3 = 476 + 3
Mental Calculation Strategies – Multiplication and Division	
Multiply/divide whole numbers and decimals by 10, 100 and 1000 *Concrete (if necessary) – Diennes equipment, place value counters* *Pictorial – place value chart*	75.91 x 10 — 874 ÷ 10 5.07 x 10 — 60.1 ÷ 10 670.4 x 100 — 7043 ÷ 100 360 x 1000 — 48 750 ÷ 1000 0.76 x 1000

Use related facts to multiply Th000 by a one-digit number and divide a ThH00 by a one-digit number *Pictorial – place value chart for multiplying/dividing by 1000, related facts multiplication trio and related facts division trio*    	3000 x 3 related to 3 x 3 = 9 *This should be understood as 'three thousand threes'.* *As the number of 3s is 1000x greater than three threes, so the product is 1000x greater.* 7000 x 5 8000 x 9 7200 ÷ 9 related to 72 ÷ 9 *This should be understood as 'how many nines in 7200? Compared to how many nines in 72?'* *As the dividend is 100x greater, then the number of nines in it will be 100x greater.* 3000 ÷ 6 9600 ÷ 8
Use related facts to multiply 0.t by a one-digit number *Pictorial – related facts multiplication trio*  	0.3 x 7 related 3 x 7 = 21 *The number of 7s is 10x less, so the product will be 10x less.* 0.6 x 9 0.5 x 4
Use factor pairs to multiply T0 x T0 *Pictorial – place value chart for multiplying by 100*	30 x 60 becomes 3 x 10 x 6 x 10 reordered as 3 x 6 x 10 x 10 70 x 80 becomes 7 x 10 x 8 x 10 reordered as 7 x 8 x 10 x 10 50 x 40 becomes 5 x 10 x 4 x 10 reordered as 5 x 4 x 10 x 10
Use compensation to multiply H99 by a one-digit number NB H99 represents a three-digit number with 9 tens and 9 ones *Pictorial – rectangular array or a rectangle with given dimensions*	599 x 4 considered as 600 x 4 – 1 x 4 (read as '*six hundred fours subtract one four*') 399 x 6 considered as 400 x 6 – 1 x 6 (read as '*four hundred sixes subtract one six*') 699 x 9 considered as 700 x 9 – 1 x 9 (read as '*seven hundred nines subtract one nine*')
Use partitioning to multiply U.t by a one-digit number *Pictorial – partitioning diagram using grid method strategy*	6.7 x 4 becomes **6** x 4 + **0.7** x 4 3.2 x 7 becomes **3** x 7 + **0.2** x 7 8.5 x 6 becomes **8** x 6 + 0.**5** x 6
Use partitioning to double or halve numbers including those with two decimal places *Concrete (if necessary) – place value counters* *Pictorial – partitioning diagram*	Double 56.7 / Find half of 4.62 Double 485.6 / Find half of 18.46 Double 8.59 / Find half of 8.94 Double 36 742 / Find half of 17.92 Find half of 32 784
Use related facts to divide U.t by a one-digit number *Pictorial – place value chart, related facts division trio* *e.g. 21 ÷ 7 = 3 then 2.1 ÷ 7 = 0.3*  	2.1 ÷ 7 related to 21 ÷ 7 = 3 *This should be understood as 'how many sevens in 2.1? Compared to how many sevens in 21?'* *As the dividend is 10x smaller, then the number of sevens in it will be 10x smaller.* 3.6 ÷ 9 4.8 ÷ 4

Use related facts to divide U.t by a 0.t *Pictorial – place value chart, related facts division trio* *e.g. 21 ÷ 7 = 3 then 2.1 ÷ 0.7 = 3*   	2.1 ÷ 0.7 related to 21 ÷ 7 = 3 *This should be understood as 'how many 0.7s in 2.1? Compared to how many sevens in 21?'* *As the dividend is 10x smaller and the divisor is 10x smaller, then the answer (quotient) will be the same.* 3.6 ÷ 0.9 4.8 ÷ 0.4
Use partitioning to divide HTU by a one-digit number *Concrete (if necessary) – Diennes equipment, place value counters* *Pictorial – part-part-whole diagram*	756 ÷ 9 By partitioning into 720 and 36 (two multiples of 9 totalling 756) 765 ÷ 5 By partitioning into 500 and 250 and 15 (three multiples of 5 totalling 765) 861 ÷ 7 By partitioning into 700 and 140 and 21 (three multiples of 7 totalling 861)

Progression Towards Written Calculation Strategies – Addition

This final stage of the method should have been achieved in Year 3, and should be continued to be used for all written addition calculations.

The first example would be explained as follows:

5 + 8 = 13, put 3 down and carry the 10 *(written as a 1 in the tens column)*

20 + 40 + 10 that was carried over = 70 *(7 written in the tens column)*

600 + 0 = 600 *(6 written in the hundreds column)*

Children will be expected to use this method for adding numbers with up to seven digits, numbers involving decimals and adding any number of amounts together.

Supported (if necessary) by the use of place value counters.

HTU		321	
625	367	+ 7	£3.48
+ 48	+ 85	+ 48	+ £0.78
673	452	376	£4.26
1	11	1	1 1

Progression Towards Written Calculation Strategies – Subtraction

This final stage is the compact method of decomposition should have been achieved in Year 4, and should be continued to be used for all written subtraction calculations.

Children will be expected to use this method for subtracting numbers with up to seven digits and numbers involving decimals.

Supported (if necessary) by the use of place value counters.

The example shown would be explained as follows:

We are subtracting 86 from 754. Start with the least significant place value column.

Are there enough hundredths to subtract 3 hundredths?

No – so let's exchange a tenth from the tenths column for ten hundredths. 2 tenths and 0 hundredths becomes 41 tenth and 10 hundredths.

10 hundredths subtract 3 hundredths = 8 hundredths

Are there enough tenths to subtract 8 tenths?

No – so let's exchange a one from the ones column for ten tenths.

1 one and 1 tenth becomes 0 ones and 1 tenths.

11 tenths subtract 8 tenths = 3 tenths.

Are there enough ones to subtract 4 ones?

No – so let's exchange a ten from the tens column for ten ones. 5 tens and 0 ones becomes 4 tens and 10 ones

10 – 4 = 6

4 tens (40) – 0 tens = 4 tens (40)

Answer 46.37

```
 4 10 11 1
  5 1 . 2 0
-   4 . 8 3
-----------
  4 6 . 3 7
```

Progression Towards Written Calculation Strategies – Multiplication

As the grid method for multiplication supports children's number sense and appreciation of the values of each digit, schools can decide if this is the final stage of written multiplication.

It is often easier for children to keep track of the partial products calculated by using the grid method rather than the compact vertical method.

Concerns over 'acceptable methods' for 2 mark questions in the end of key stage 2 test should be weighed up against the improved chance of gaining 2 marks for the correct answer by using the grid method.

4.92 x 3

×	4	0.9	0.02
3	12	2.7	0.06

```
    12
+   2.7
+   0.06
  14.76
```

Children may add these mentally.

Optional

If schools wish to proceed to the compact vertical method for written multiplication then this is how it should progress, with different colours for the partial products to highlight how the steps taken are the same, just in a different order.

72 x 38

x	70	2
30	2100	60
8	560	16

```
   2100
+   560
+    60
+    16
   2736
    1
```

Children may add these mentally.

Optional

368 x 6

x	300	60	8
6	1 800	360	48

```
   1800
+   360
+    48
   2208
    1 1
```

```
Th H T U
   3 6 8
x      6
     4 8   (8 x 6)
   3 6 0   (60 x 6)
+ 1 8 0 0   (300 x 6)
  2 2 0 8
   1 1
```

```
Th H T U
   3 6 8
x      6
 2 2 0 8
   4 4
```

```
Th H T U
   3 6 8
x      6
     4 8   (8 x 6)
   3 6 0   (60 x 6)
+ 1 8 0 0   (300 x 6)
  2 2 0 8
   1 1
```

Progression Towards Written Calculation Strategies – Division

As the chunking method for division supports children's number sense and appreciation of the values of each digit, schools can decide if this is the final stage of written division. It can be used for both short and long division (Year 6 expectation) and leads to more efficient mental methods.

As children develop their understanding of this method, they should use ever more efficient steps. The menu box may not need to be written, but the children should continue to think in this way.

```
   32 r4
6) 196
 - 180   30x
    16
 -  12    2x
     4
```

1x = 6
2x = 12
5x = 30
10x = 60
20x = 120

```
   640 r2
8) 5122
 - 4800   600x
    322
 -  320    40x
      2
```

Decision Making

When calculating, children should ask themselves:

- do I know the answer because it is a fact I have learnt?
- can I work it out easily in my head?
- can I use some equipment or a jotting?
- do I need to use the written method?

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