

The Fen Rivers Academy Calculation & Vocabulary Policy 2023

The Fen Rivers Academy allows students to build up previous learning by being taught the most appropriate and efficient method for calculations.

This calculation policy focusses on the use of the CPA (concrete, pictorial, abstract) approach. Concrete is the 'doing' stage where manipulatives should be used. Pictorial is the 'seeing' stage where drawings and representations are used. Abstract is the 'symbolic' stage where the use of mathematical numbers, symbols expressions and equations are used. CPA is for any age and any ability and is a method used to deepen and clarify mathematical thinking.

Students must be encouraged to use the correct mathematical language, and this will be promoted through the modelling from *all adults*.

Students will build on their fluency, reasoning, and problem-solving skills throughout their mathematics lessons.


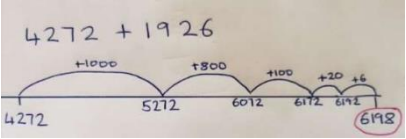
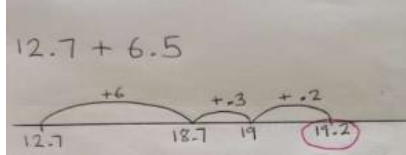
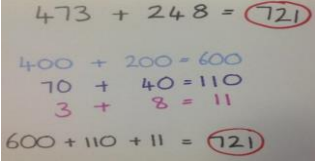
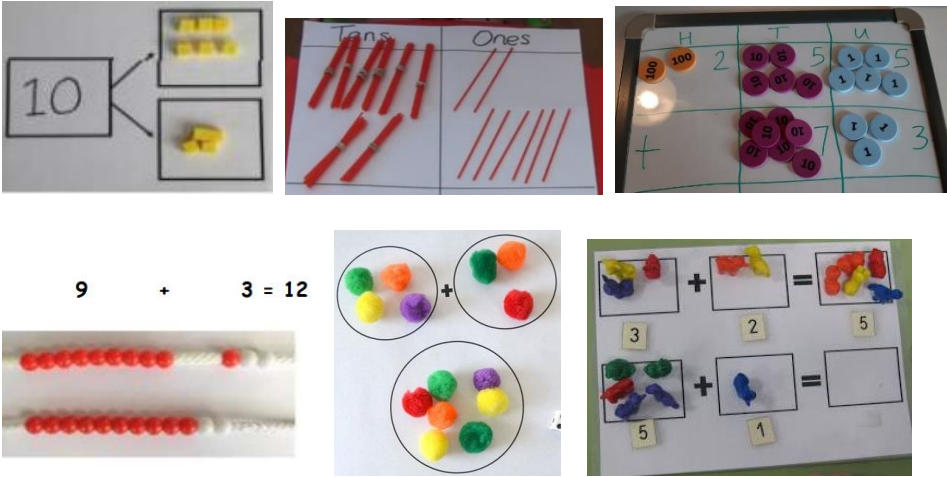
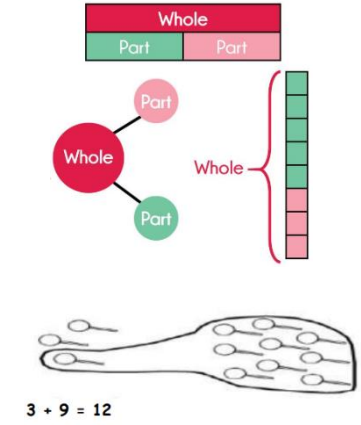
Addition
Add, total, sum, altogether, more, more than, plan, increase, double, inverse, groups of, BODMAS, how many more?
Subtraction
Subtract, take away, difference, leave, minus, decrease, halve, half, inverse, fewer than, less than, BODMAS, how many left?
Multiplication
Groups of, multiply, multiple, factor, product, repeated addition, array, row, inverse, squared numbers, cubed numbers, prime numbers, BODMAS, repeated addition, grouping.
Division
Divide, division, factor, halve, share, group, divisible by, remainder, left over, quotient, inverse, chunking, BODMAS.

Examples of mathematics pedagogical questions / statements	
What do you notice?	Can you explain?
What is the same/different?	Can you justify your thinking?
Can you spot a pattern?	What have you found out?
If you know ... what else do you know?	Can you prove it?
Is it always true, sometimes true, or never true?	What mathematics do you think you will use?
Give me a POG example (Peculiar, obvious, general)	What if ... changes?
Convince me/convince someone else	Is this a special case?
Can you suggest a conjecture?	Do you agree?
How do you know?	Can we improve on the answer?
What can't the answer be?	Can you describe the problem to someone else?
What happens if ...?	Is it always true that ...?
How many different ways are there?	Can you find all the possibilities?

Fluency	Reasoning	Problem Solving
Count accurately	Offer conjectures	Show they can work systematically
Use a variety of counting strategies	Describe and explain their thinking	Check the answer using a different strategy
Choose a variety of manipulatives to support understanding	Convince someone of their answer	Offer more than one solution
Calculate effectively	Justify with some logical arguments	Notice, create, extend pattern
Recognise and use arithmetic laws to help calculations (inverse, commutative etc.)	Prove whether they're right or wrong	Record their thinking in a variety of ways including using manipulatives
Demonstrate that they understand the importance of equivalence	Specialise to test a particular example to see what happens	Demonstrate resilience and perseverance in keeping going
Recognise number structure (prime, odd, even etc.)	Offer generalisations even if they are incorrect	Work backwards
Recognise mathematical symbols	Offer reasons for their thinking	Find all the possibilities
Use place value effectively	Notice connections	Solve a variety of problems in different contexts (real life, fictitious, diagrams, words)
Choose when to calculate mentally or use written strategies	Use a high level of mathematical vocabulary	Use the bar model to understand the problem
Notice number within numbers (number bonds, partitioning)	Use both additive and multiplicative reasoning	Use the language of part and whole, and known and unknown
Subitise	Decide if situations are always, sometimes, or never true	Use information given to work out information not given
Use rounding and adjusting	Interpolate an extrapolate information	Classify different types of problems
Use doubling and halving.	Offer counter examples	Critique and improve their own work and that of their peers
	Ask "what happens if...?"	
	Notice and characterised the problem	



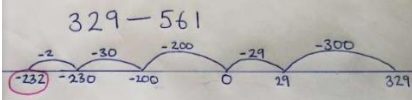
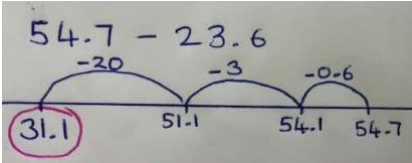
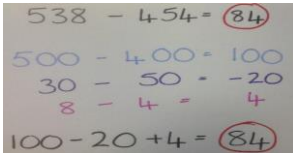



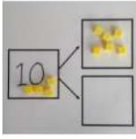
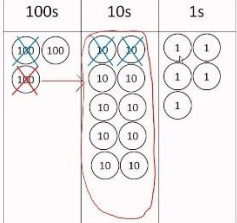


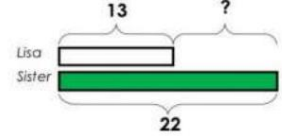
Addition: finding the total by combining two or more numbers/amounts.

The below are examples but practise is not limited to these.

	Number Tracks (concrete & pictorial)	Number Lines (pictorial and abstract)	Partitioning (pict. & abstract)																																																																																																				
Working Methods	 <table border="1" data-bbox="889 368 1229 715"> <tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr> <tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td></tr> <tr><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr> <tr><td>31</td><td>32</td><td>33</td><td>34</td><td>35</td><td>36</td><td>37</td><td>38</td><td>39</td><td>40</td></tr> <tr><td>41</td><td>42</td><td>43</td><td>44</td><td>45</td><td>46</td><td>47</td><td>48</td><td>49</td><td>50</td></tr> <tr><td>51</td><td>52</td><td>53</td><td>54</td><td>55</td><td>56</td><td>57</td><td>58</td><td>59</td><td>60</td></tr> <tr><td>61</td><td>62</td><td>63</td><td>64</td><td>65</td><td>66</td><td>67</td><td>68</td><td>69</td><td>70</td></tr> <tr><td>71</td><td>72</td><td>73</td><td>74</td><td>75</td><td>76</td><td>77</td><td>78</td><td>79</td><td>80</td></tr> <tr><td>81</td><td>82</td><td>83</td><td>84</td><td>85</td><td>86</td><td>87</td><td>88</td><td>89</td><td>90</td></tr> <tr><td>91</td><td>92</td><td>93</td><td>94</td><td>95</td><td>96</td><td>97</td><td>98</td><td>99</td><td>100</td></tr> </table>	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	 	
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CPA approach	<p>(concrete)</p> 	<p>(pictorial)</p> 	<p>(abstract)</p> <p>e.g. $527 + 87 =$</p> <p>Written calculations and worded problems.</p> <p>Missing box questions.</p>																																																																																																				

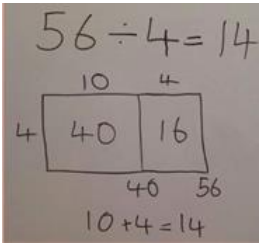

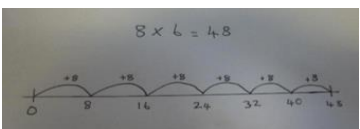
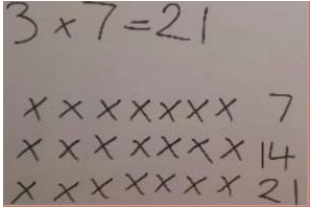


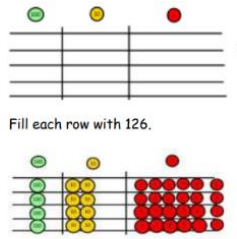


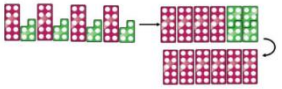

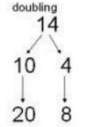
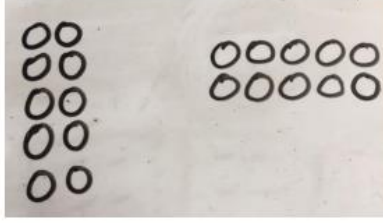
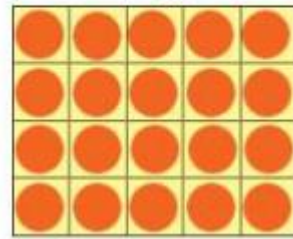
Subtraction: taking away or finding the difference.

The below are examples but practise is not limited to these.

	Number Tracks (concrete & pictorial)	Number Lines (pictorial & abstract)	Partitioning (pict. & abstract)
Working Methods	<p>Number Tracks</p>  	 	
CPA approach	<p>(concrete)</p> <p>Use counters and move them away from the group as you take them away counting backwards.</p> <p>$13 - 4 = 9$</p>   <p>$14 - 5 =$</p>  <p>Link to addition- use the part whole model to help explain the inverse between addition and subtraction.</p>  <p>If 10 is the whole and 6 is one of the parts. What is the other part? $10 - 6 =$</p>  <p>$305 - 124$</p> 	<p>(pictorial)</p> <p>Cross out drawn objects to show what has been taken away.</p> <p>$6 - 2 = 4$</p>  <p>Comparison Bar Models</p> <p>Lisa is 13 years old. Her sister is 22 years old. Find the difference in age between them.</p> 	<p>(abstract)</p> <p>e.g. $783 - 45 =$</p> <p>Written calculations and worded problems.</p> <p>Missing box questions.</p>

Multiplication: repeated addition or scaling.

The below are examples but practise is not limited to these.

	Grouping (CPA)	Number Lines (pictorial)	Arrays (concrete & pictorial)																					
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CPA approach	<p>(concrete)</p> <p>Count in multiples supported by concrete objects in equal groups.</p>    <p>Fill each row with 126.</p> <p>Add together the columns to find the answer.</p> <p>Making the arrays to solve word problems.</p>   <p>4 x 3 = 12 "4 cakes, 3 times" 4 multiplied by 3</p> <p>Partition to multiply using Numicon, base 10 or Cuisenaire rods.</p>  <p>Use base 10 Use money.</p>  <p>Double 23 x 4 20 + 20 + 40 3 + 3 + 16</p> <p>doubling</p> 	<p>(pictorial)</p>  <p>Link arrays to area of rectangles.</p> 	<p>(abstract)</p> <p>e.g. 36 x 82 =</p> <p>Written calculations and worded problems.</p> <p>Missing box questions.</p> <table border="1" data-bbox="1713 1013 2027 1157"> <tr> <td></td> <td>1000</td> <td>300</td> <td>40</td> <td>2</td> </tr> <tr> <td>10</td> <td>10000</td> <td>3000</td> <td>400</td> <td>20</td> </tr> <tr> <td>8</td> <td>8000</td> <td>2400</td> <td>320</td> <td>16</td> </tr> </table> <table border="1" data-bbox="1713 1165 2027 1260"> <tr> <td></td> <td>30</td> <td>5</td> </tr> <tr> <td>7</td> <td>210</td> <td>35</td> </tr> </table>		1000	300	40	2	10	10000	3000	400	20	8	8000	2400	320	16		30	5	7	210	35
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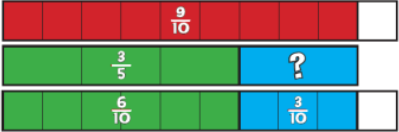

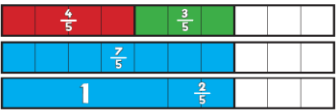



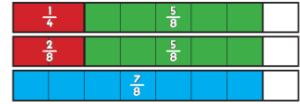
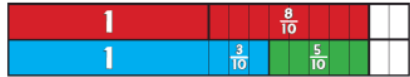
Fractions

1 Numerator
4 Denominator

$\frac{8}{5}$ or $\frac{12}{5}$
Improper Fraction
(Numerator > Denominator)

$\frac{2}{5}$ or $\frac{4}{5}$
Proper Fraction
(Numerator < Denominator)

$1\frac{3}{5}$
Mixed Fraction
(Whole number + Proper Fraction)

Addition	Subtraction	Multiplication	Division
$\frac{2}{4} + \frac{1}{4} = \frac{3}{4}$ 	$\frac{9}{10} - \frac{3}{5} = \frac{3}{10}$ 	$\frac{2}{5} \times 4 = \frac{8}{5} = 1\frac{3}{5}$ 	<p>Sharing Model - Dividing a fraction by a whole number</p> $\frac{1}{3} + 2 = \frac{1}{6}$ <p>"If I share a third into 3 equal amounts, how much in each group?" Answer: A sixth.</p>
$\frac{4}{5} + \frac{3}{5} = \frac{7}{5} = 1\frac{2}{5}$ 		<p>Scaling Model</p> $\frac{1}{4} \times 2 = \frac{1}{2}$  $\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$ 	<p>Grouping Model - Dividing by a Fraction</p> $3\frac{2}{5} + \frac{1}{5} = 17$ <p>"How many groups can I fit into a 3 and 2 fifths?" Answer: 17."</p>
$\frac{1}{4} + \frac{5}{8} = \frac{2}{8} + \frac{5}{8} = \frac{7}{8}$ 	$1\frac{4}{5} - \frac{1}{2} = 1\frac{8}{10} - \frac{5}{10} = 1\frac{3}{10}$ 		
$1\frac{1}{2} + \frac{1}{3} = 1\frac{3}{6} + \frac{2}{6} = 1\frac{5}{6}$ 