

# DNEAT Calculation Progression

This calculation progression is to support schools within DNEAT in writing their own calculation policy. This progression is not to replace calculation policies which are the responsibility of each school.



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Solutions 

This calculation progression has been created by subjects leaders within DNEAT and a dedicated team of maths ambassadors listed below.



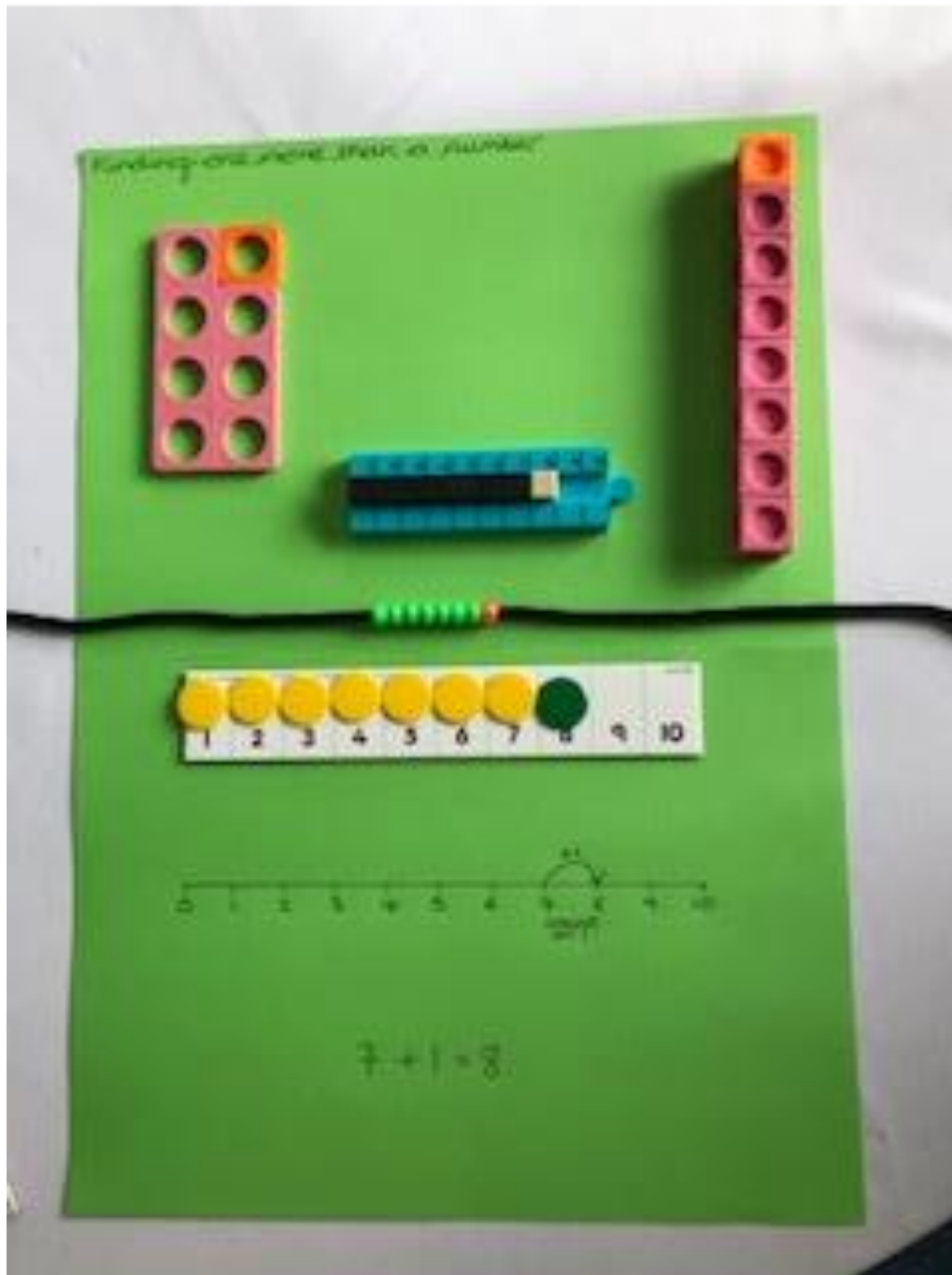
Name	School
Kalle Boyle *	The Bishop's C of E Primary Academy
Sharon Brett *	Cawston C of E Primary Academy
Becki Bunkle *	Dereham Church of England Junior Academy
Lee Frost	Swaffham C of E Junior School
Christina Maskell *	Nar Valley Federation
Andy Petersen	Hopton Church of England Primary Academy
Rebekah Smithee	St Michael's C of E Academy
Rebecca Tovell	Peterhouse C of E Primary Academy
Zoe Warren	Whitefriars C of E Primary Academy

With thanks also to Mathematics Advisers, Anna Hogg and Sarah Jay from Educator Solutions who have provided knowledge, support and guidance throughout the creation of this progression.

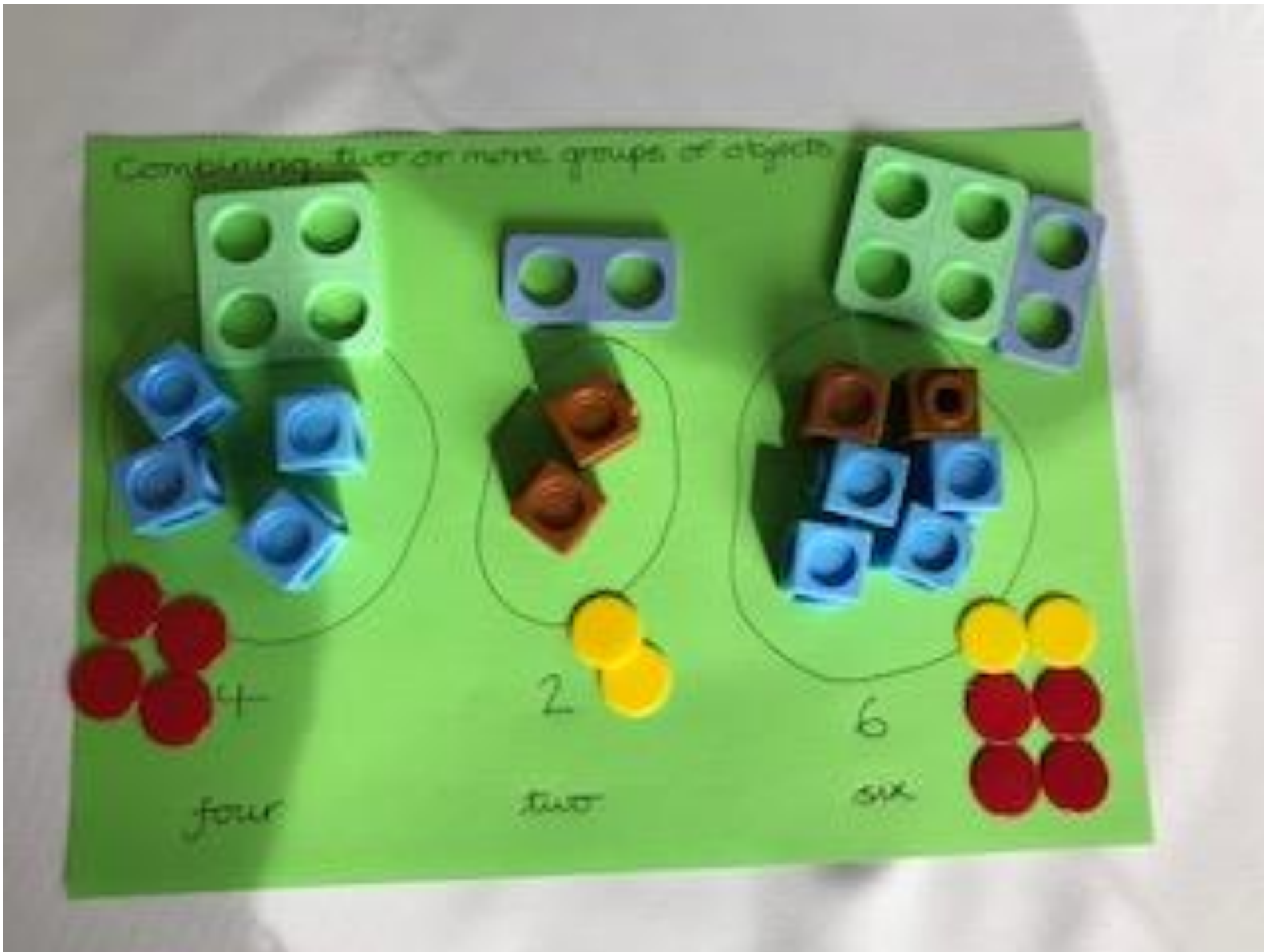


\* These ambassadors attended all twilight sessions working on the calculation progression.

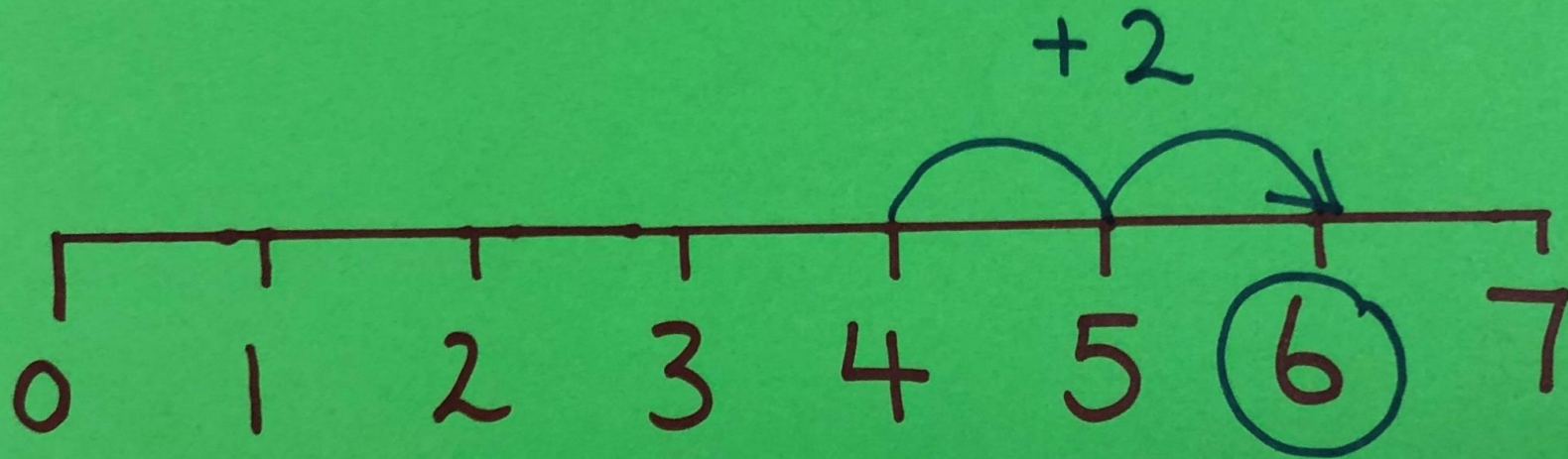
# Addition







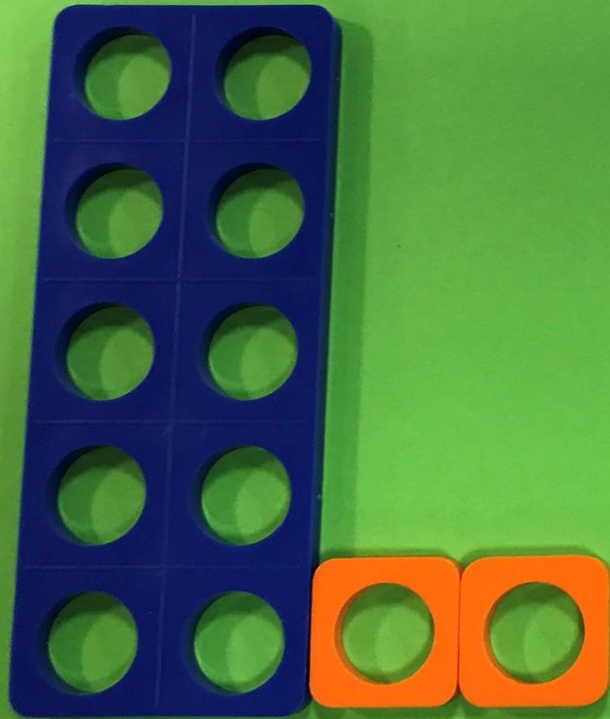
$$4 + 2$$







Making teen numbers

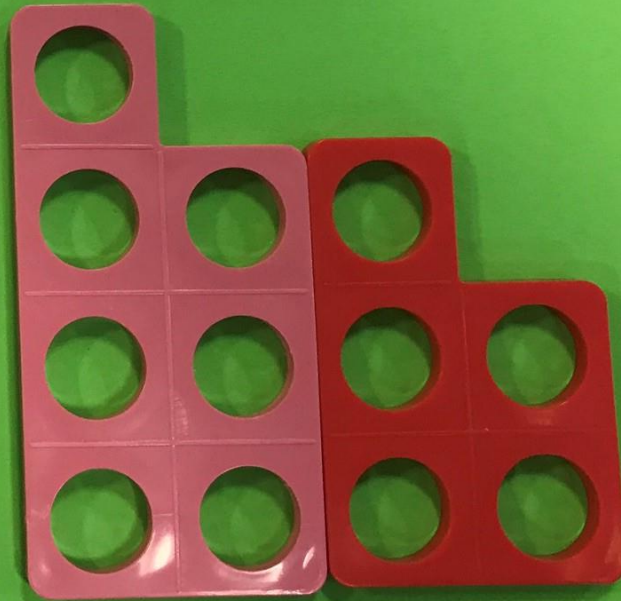


$12 = 1 \text{ lot of } 10$   
 $2 \text{ ones}$

or  $6 + 6$   
2 lots of 6



or  $7 + 5$   
1 lot of 7  
1 lot of 5



making ten

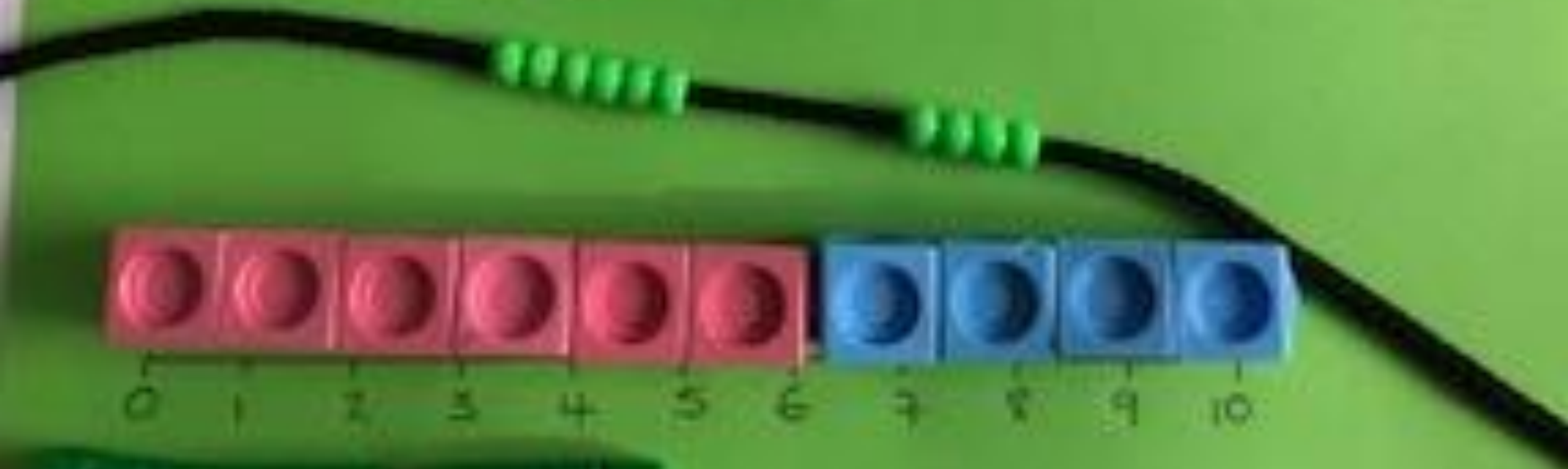


$$6 + 4 = \square$$

$$6 + \square = 10$$

$$10 = \square + 4$$

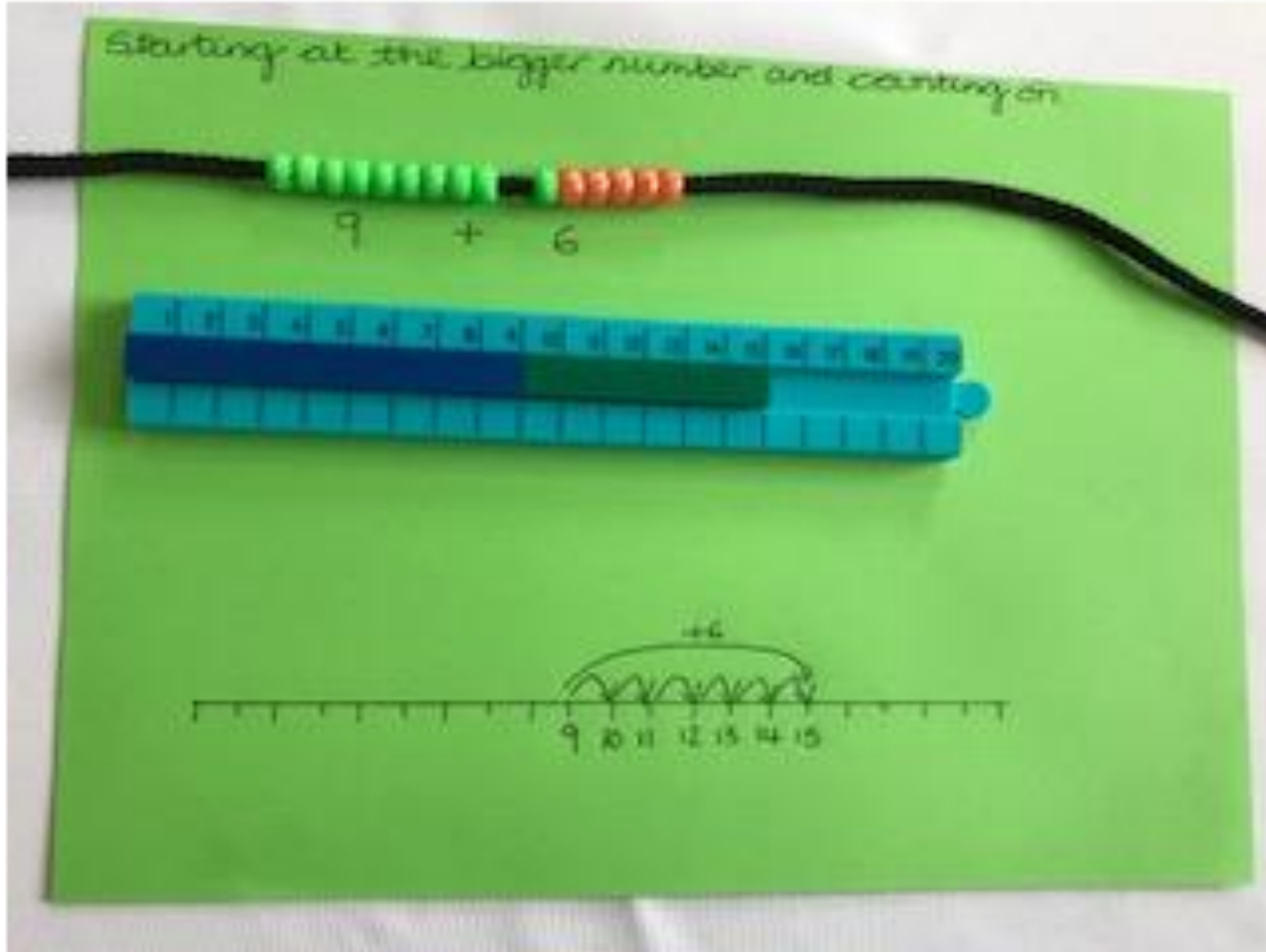
$$10 = 6 + \square$$

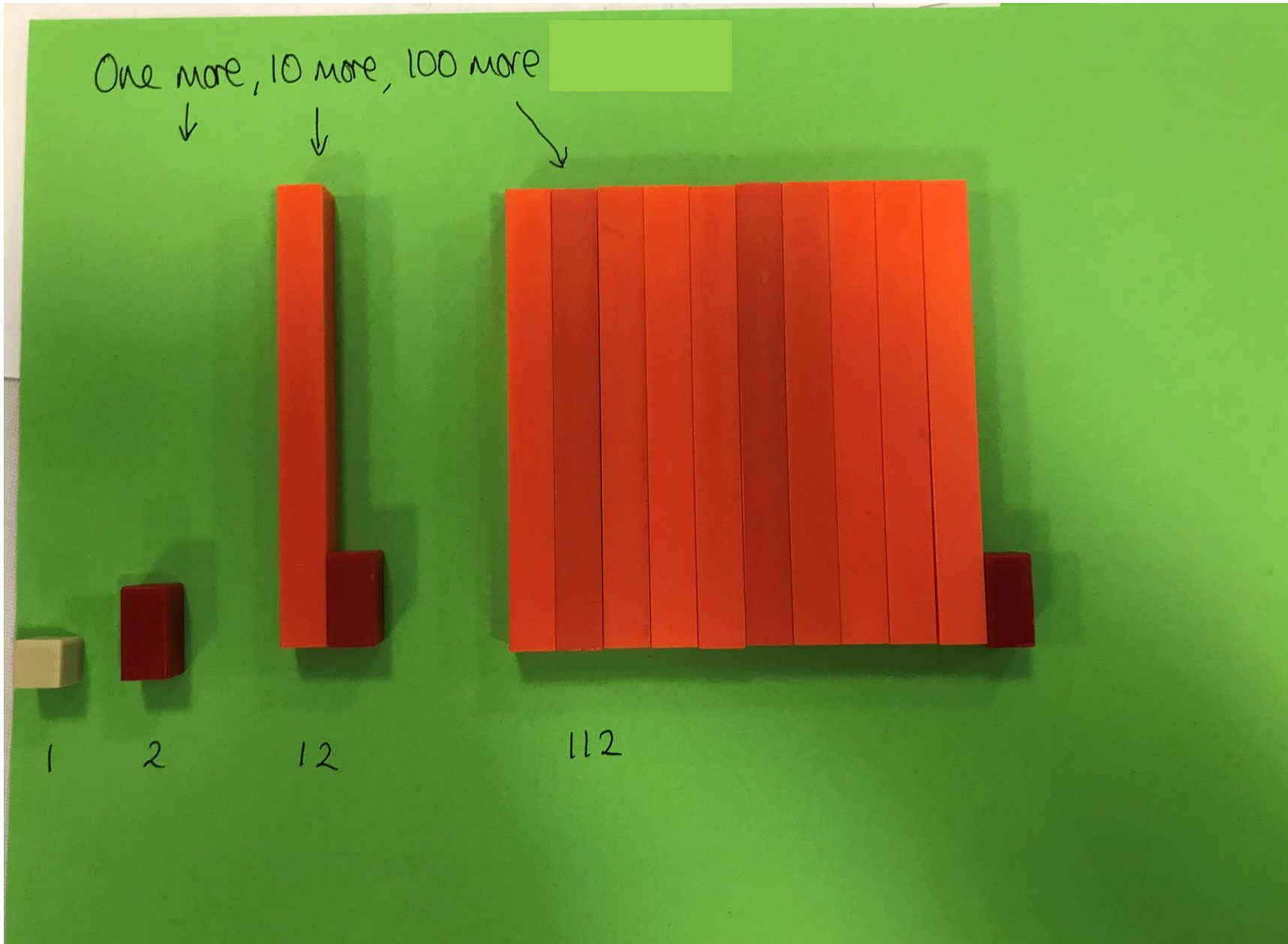


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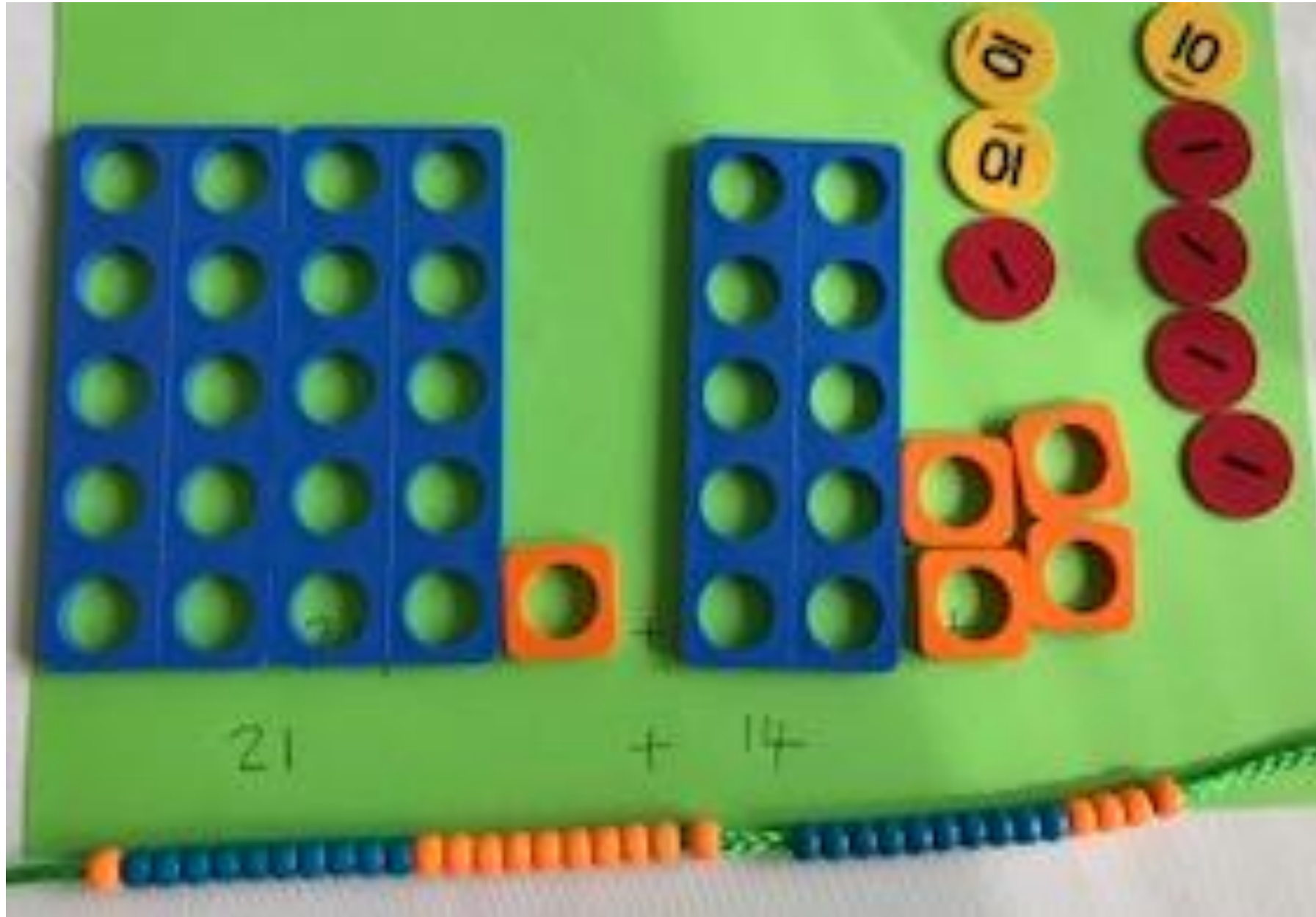
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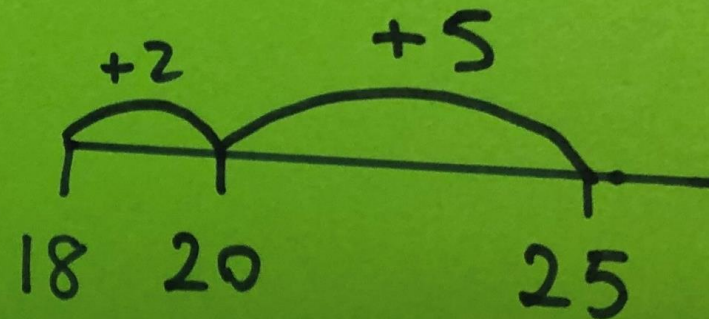
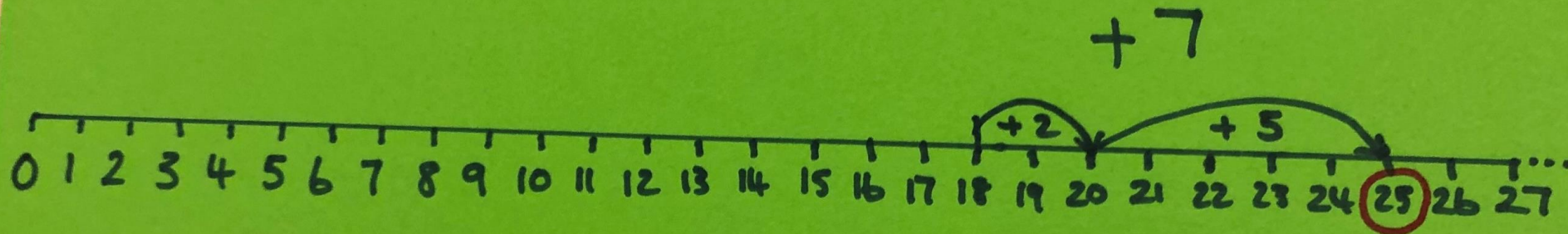
Place value: partition numbers into tens and ones





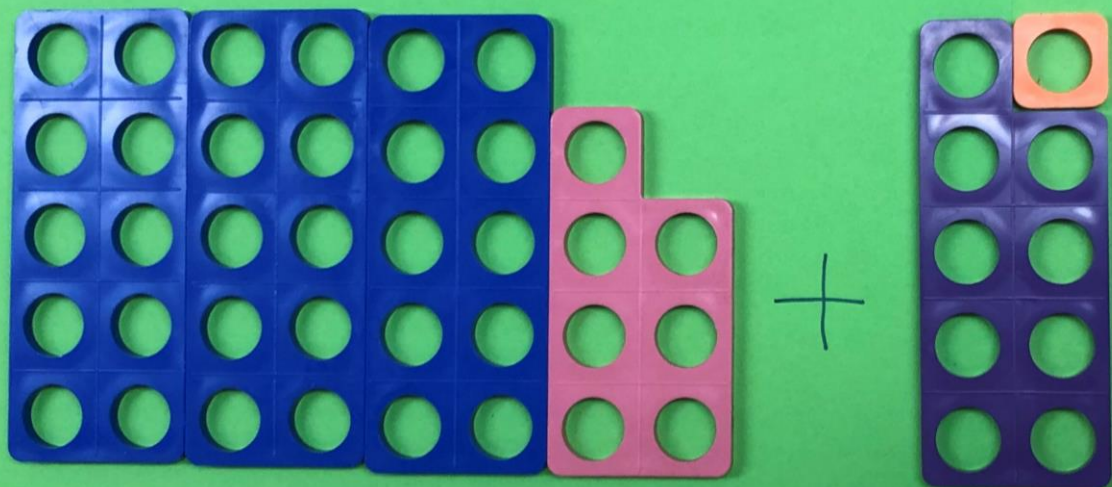


$$18 + 7 = 25$$

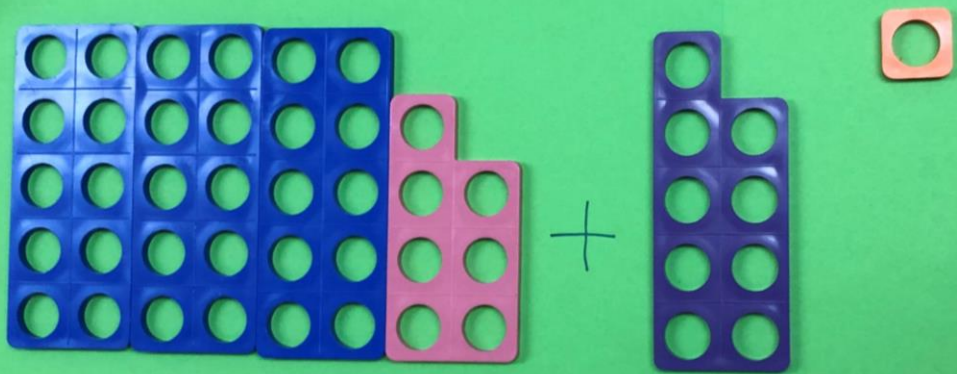




$$37 + 9 = 37 + (10 - 1)$$



$$37 + 9 = 37 + (10 - 1) = 46$$



$$42 + 23$$



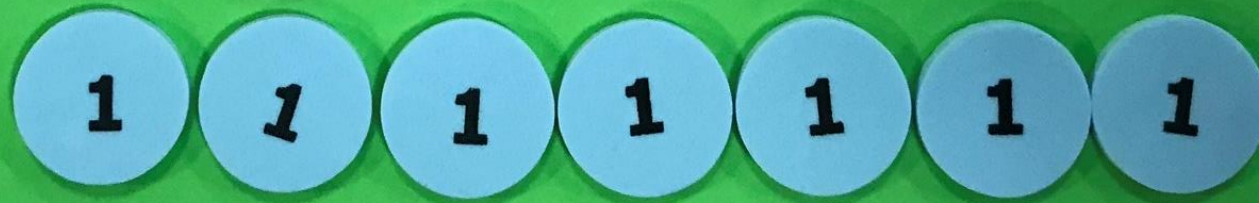
+





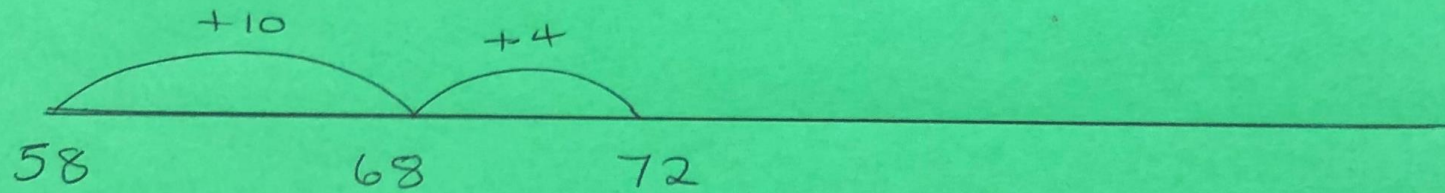
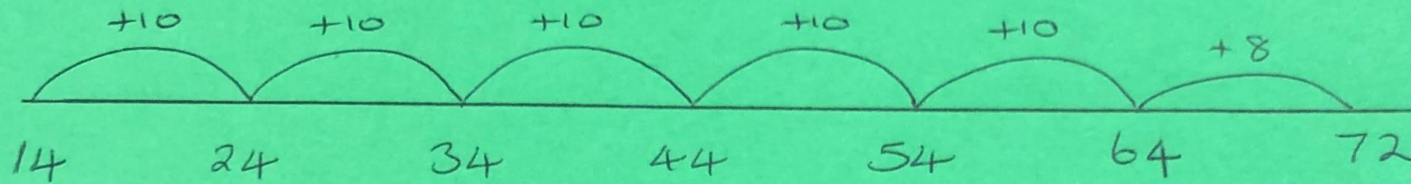
# Expanded Column method with concrete representation

$$\begin{array}{r} 65 \\ + 27 \\ \hline \end{array}$$



Efficient number line v inefficient

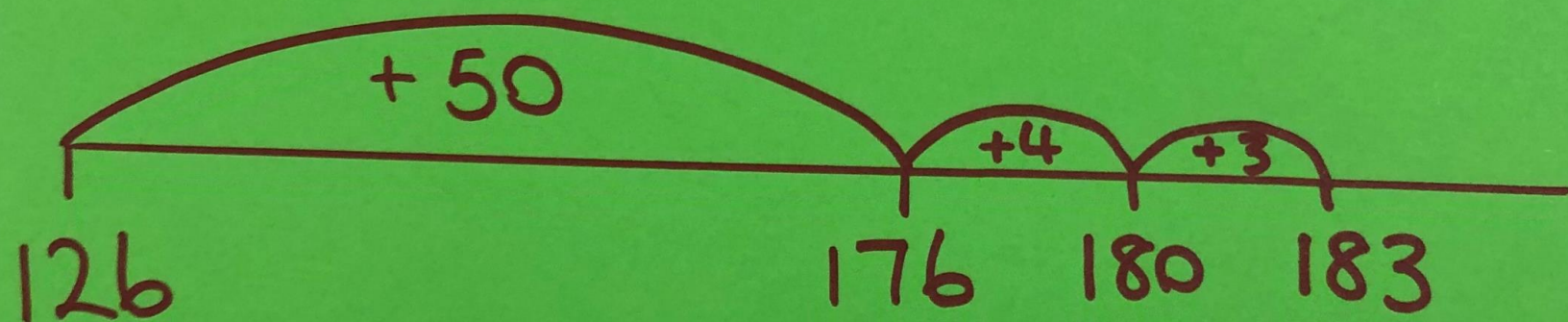
$$14 + 58 =$$



Which would you use?  
And why?



$$126 + 57$$



$$\begin{array}{r} 65 \\ + 27 \\ \hline \end{array}$$



$$\begin{array}{r} + \quad 60 + 5 \\ \quad 20 + 7 \\ \hline \end{array}$$

Expanded Column method with concrete representation

$$\begin{array}{r} 65 \\ + 27 \\ \hline \end{array}$$



$$\begin{array}{r} + \quad 60 + 5 \\ \quad 20 + 7 \\ \hline 80 + 12 \end{array}$$



Expanded Column method with concrete representation

$$\begin{array}{r} 65 \\ + 27 \\ \hline \end{array}$$



$$\begin{array}{r} 60 + 5 \\ 20 + 7 \\ \hline 80 + 12 \end{array}$$







$$137 + 348$$

$$100 + 300 = 400$$

$$30 + 40 = 70$$

$$7 + 8 = 15 = 10 + 5$$

$$400 + 70 + 10 + 5 \\ = 485$$





$$137 + 348$$

$$\begin{array}{r} 100 + 30 + 7 \\ + 300 + 40 + 8 \\ \hline 400 + 70 + 15 \\ = 485 \end{array}$$



$$137 + 348$$

$$\begin{array}{r} 137 \\ + 348 \\ \hline 15 \\ 70 \\ 400 \\ \hline 485 \end{array}$$

$$137 + 348$$

$$\begin{array}{r} 137 \\ + 348 \\ \hline 485 \end{array}$$



$$7.685\text{L} + 1038\text{ml}$$

$$\begin{array}{r} 7685 \\ + 1038 \\ \hline 8723 \end{array}$$

$$8723\text{ml}$$

$$8.723\text{L}$$

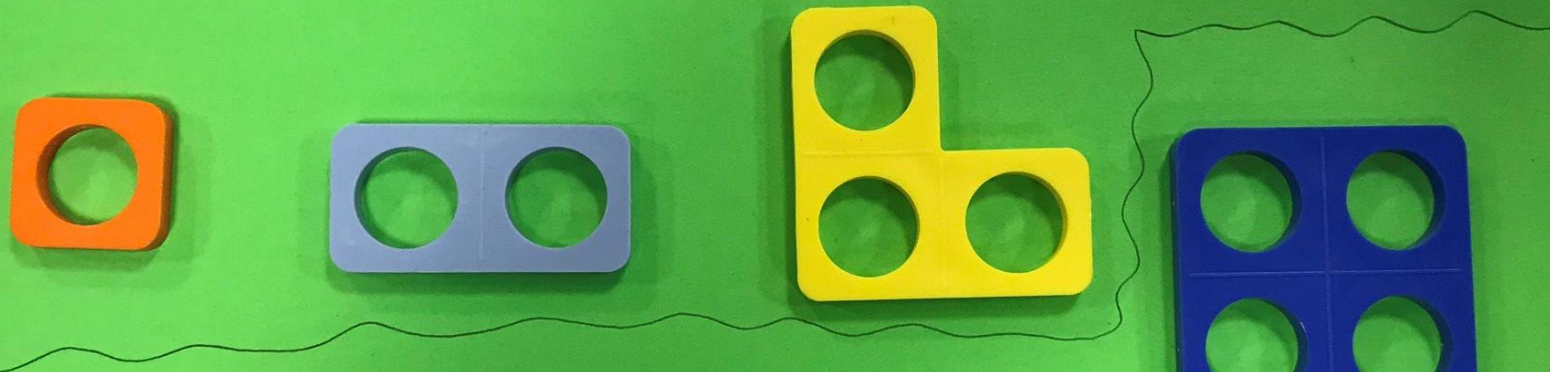
Potential misconception!

$$\begin{array}{r} + 7.685 \\ \hline 1038 \end{array}$$

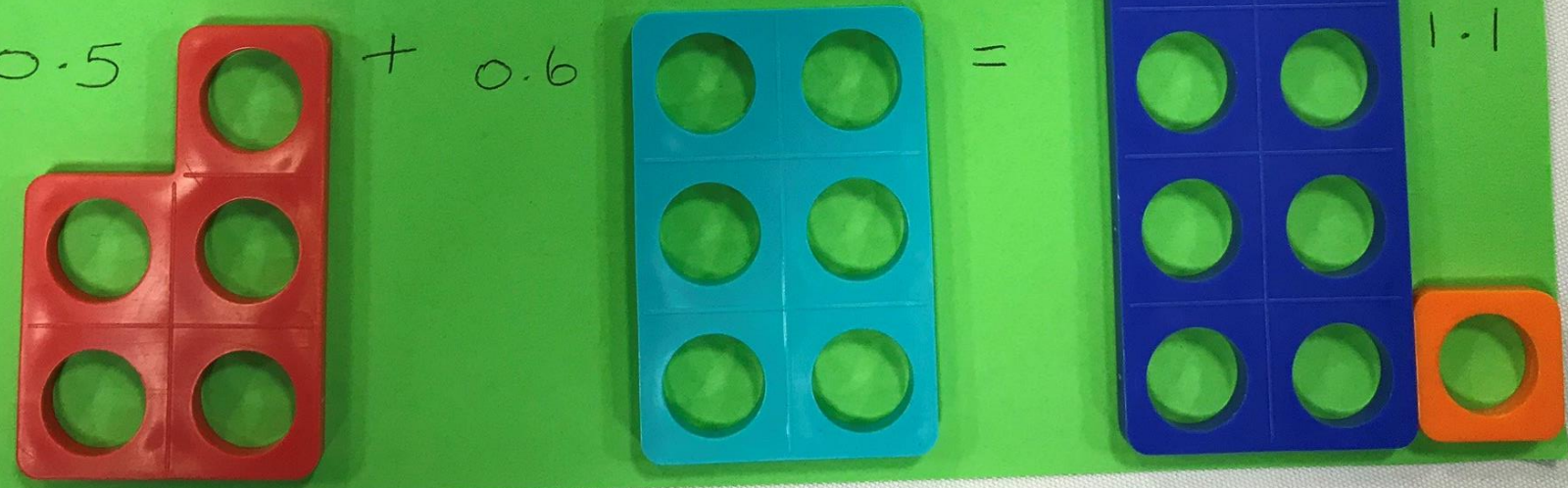


# Adding Decimals

$$0.1 + 0.2 = 0.3$$



$$0.5 + 0.6 = 1.1$$





$$325.8 + 268.7$$

$$\begin{array}{r} 325.8 \\ + 268.7 \\ \hline \end{array}$$

$$1.5$$

$$13.0$$

$$80.0$$

$$500.0$$

$$\begin{array}{r} 500.0 \\ 80.0 \\ 13.0 \\ 1.5 \\ \hline 594.5 \end{array}$$

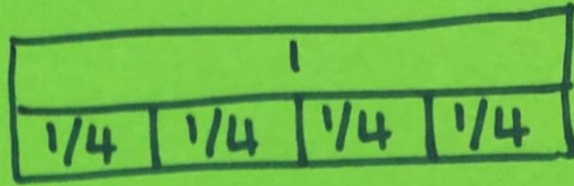
$$147.28 + 259.76$$

$$\begin{array}{r} 147.28 \\ + 259.76 \\ \hline 407.04 \end{array}$$

$$\frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1 \text{ whole}$$



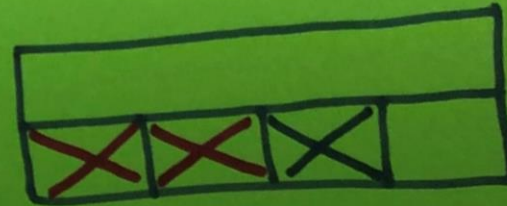




$$\frac{2}{4} + \frac{1}{4} =$$




$$\frac{3}{4}$$





True or False?

$$\frac{1}{4} + \frac{1}{4} + \frac{1}{4} = 1$$

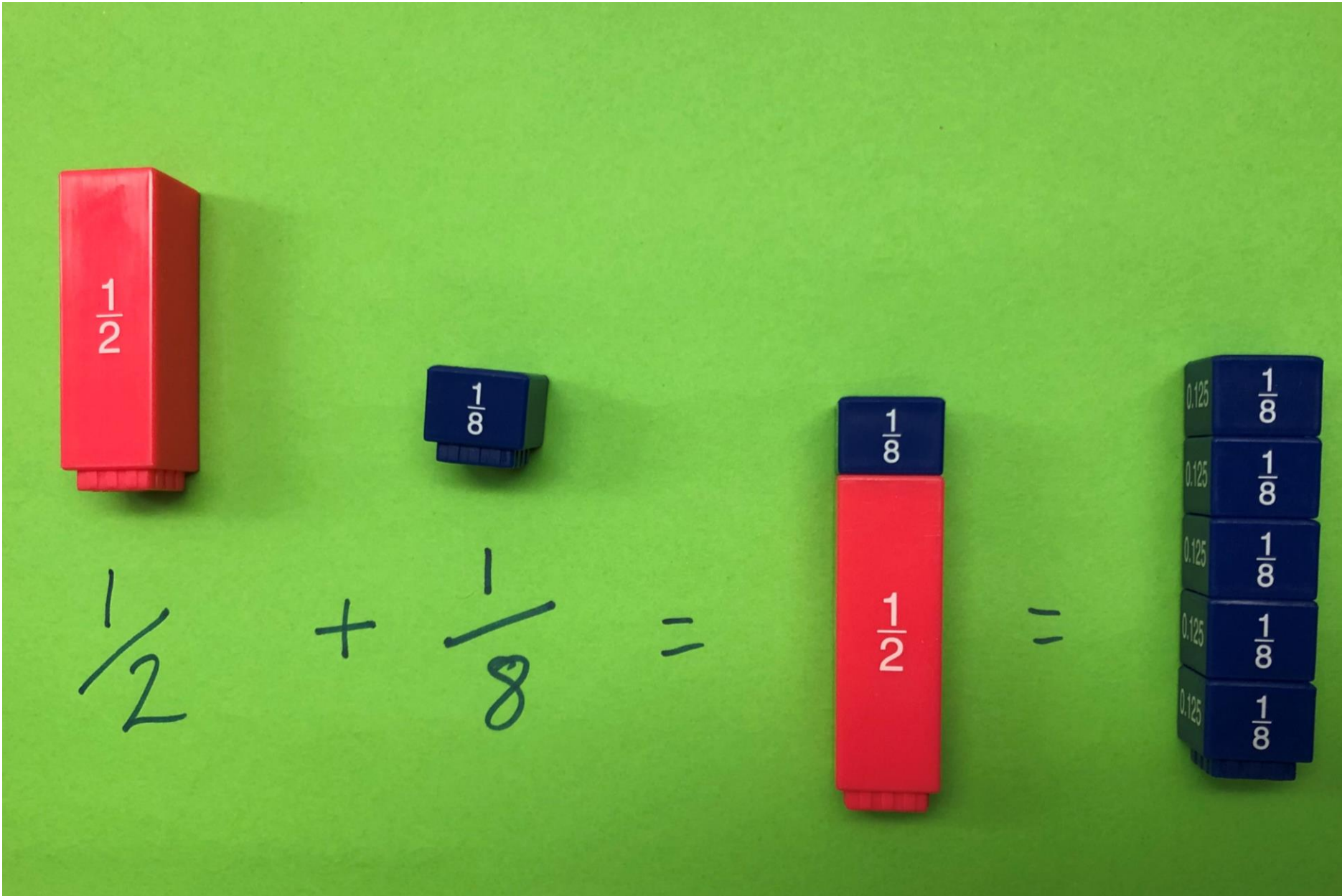


False!



$$\frac{1}{2} + \frac{1}{4} = \frac{3}{4}$$



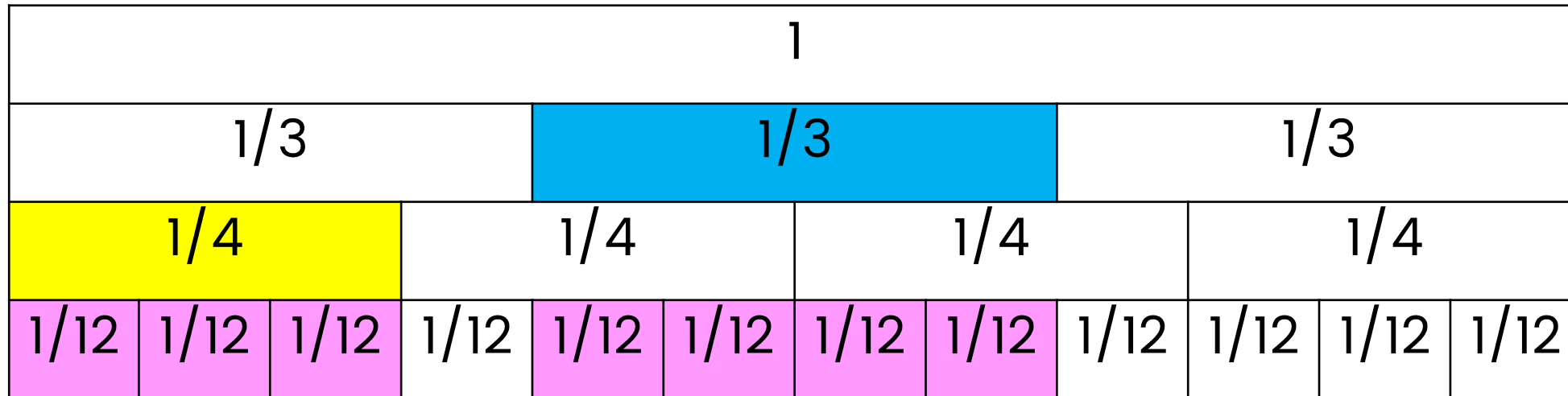


$\frac{1}{2} + \frac{1}{8} =$

$\frac{1}{2} + \frac{1}{8} =$

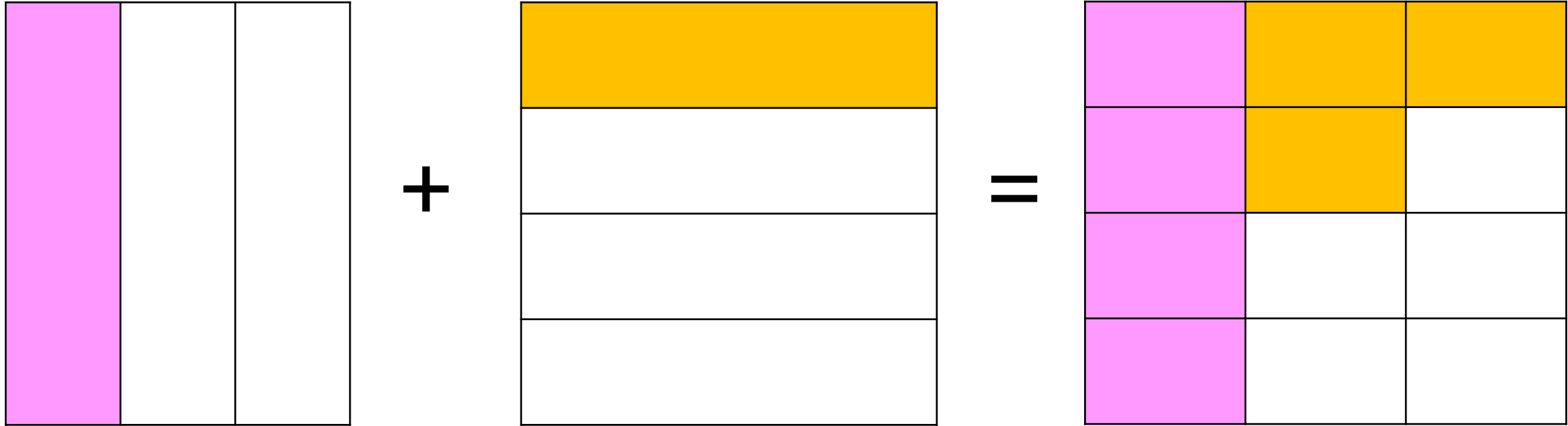
$\frac{1}{2} + \frac{1}{8} =$

$$\frac{1}{3} + \frac{1}{4} = \frac{4}{12} + \frac{3}{12} = \frac{7}{12}$$





$$\frac{1}{3} + \frac{1}{4} = \frac{7}{12}$$



# Subtraction

One less than  
four cubes is  
three cubes.

Four cubes take  
away one cube is  
three cubes.

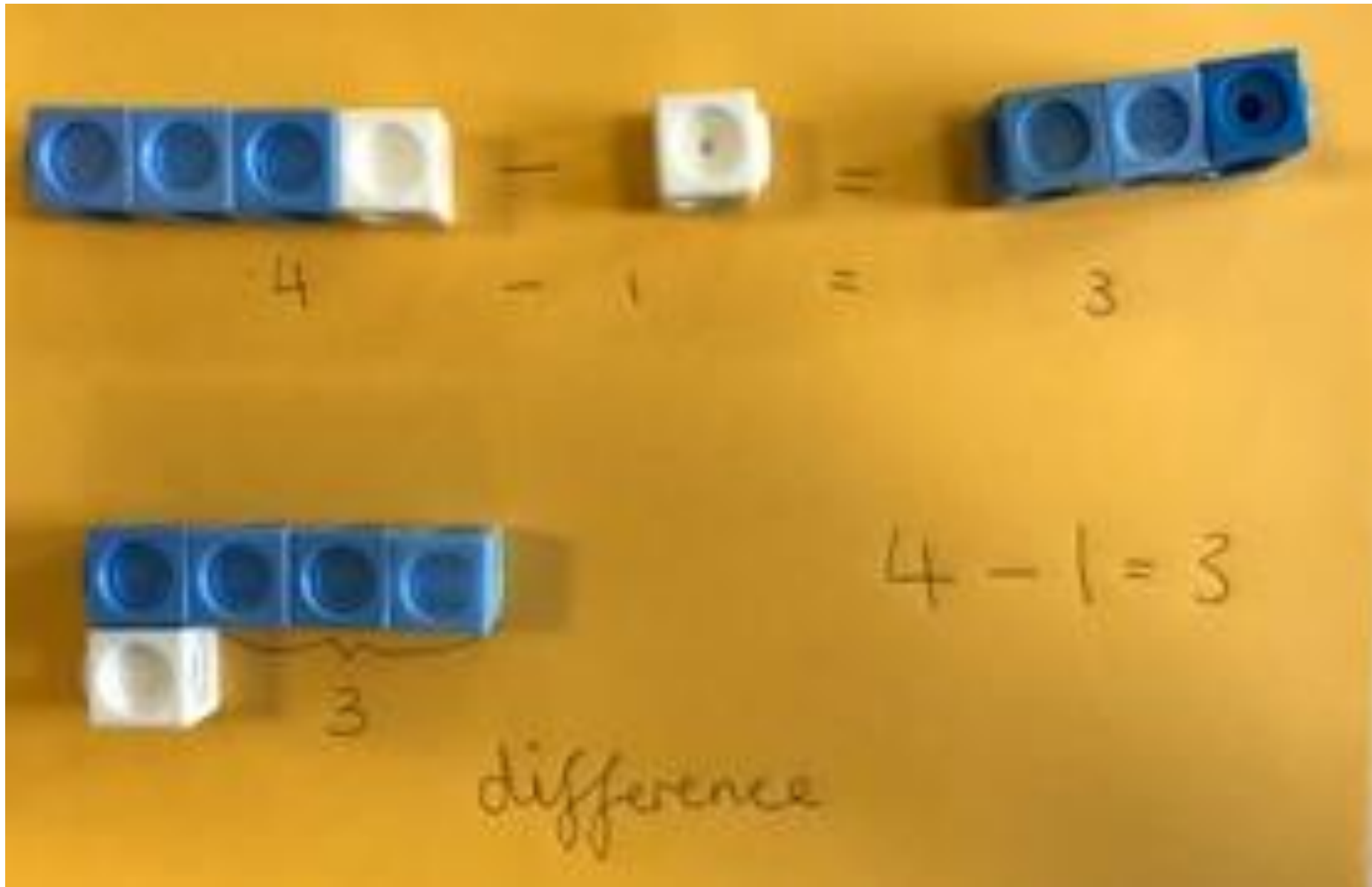


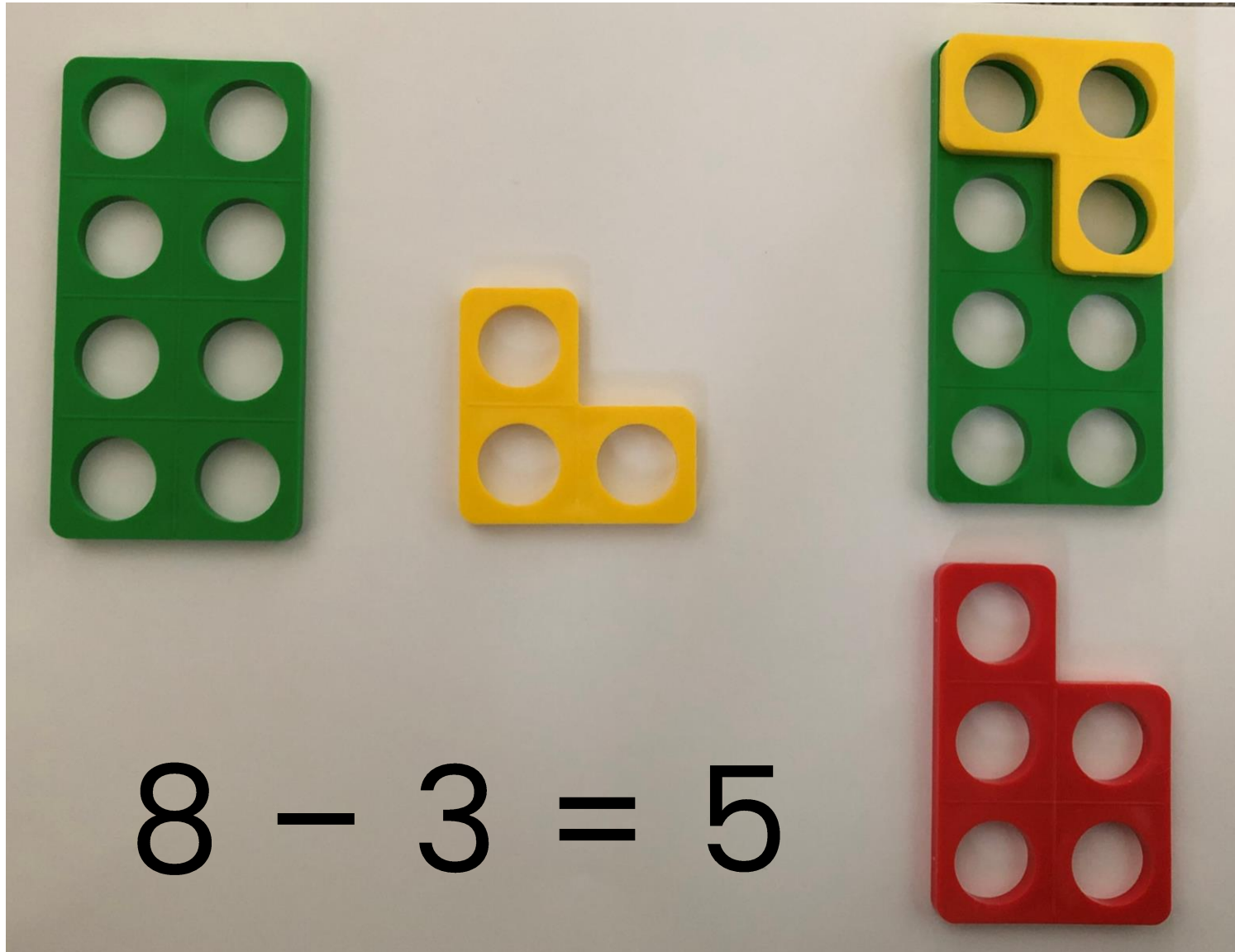


$$4 - 1 = 3$$

Counting back using  
concrete objects and  
a number track







8 - 3 = 5



Introducing partitioning in a concrete way



24

-



12 = 12



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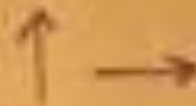
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1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86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

$$45 - 9$$

$$-10 + 1$$



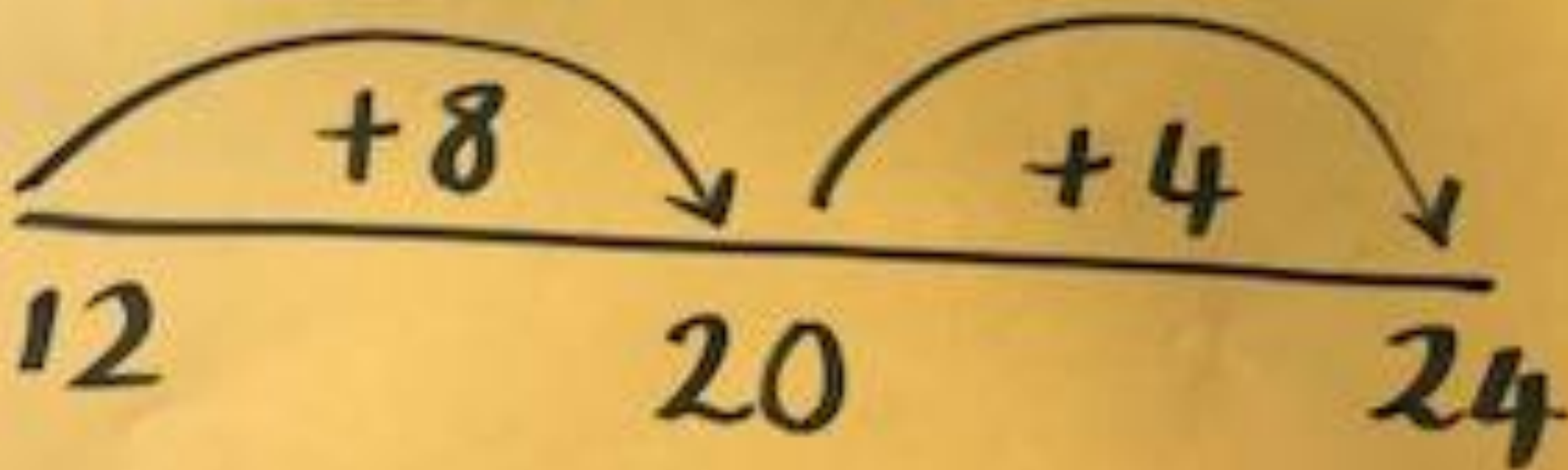
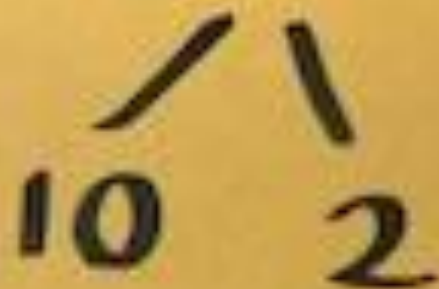
35	36
45	

subtract  
near multiples  
of ten

visualise

Subtraction approaches using written methods, counting on, counting back.

$$24 - 12 = 12$$

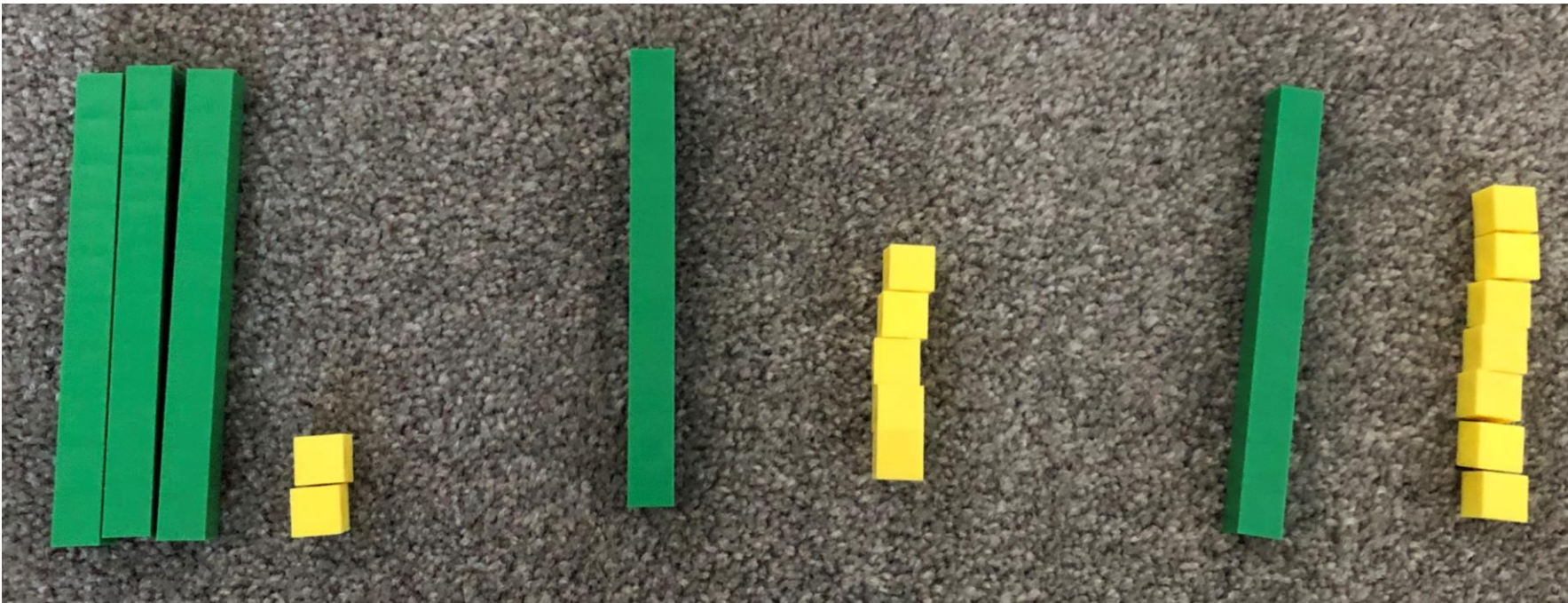





$$30 - 14 = 16$$



$$32 - 15 = 17$$



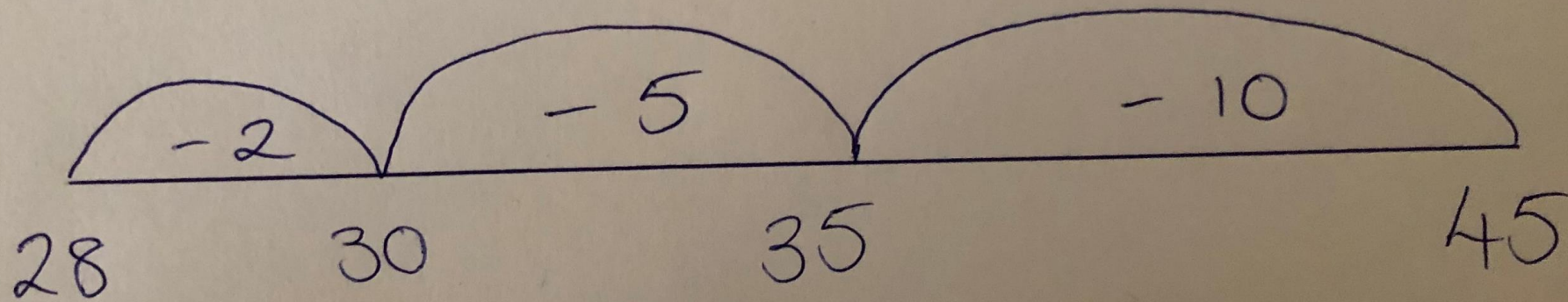
$55 - 28 =$   
 $27$



$10 + 10 + 5 + 2 = 27$



$$45 - 17 = 28$$



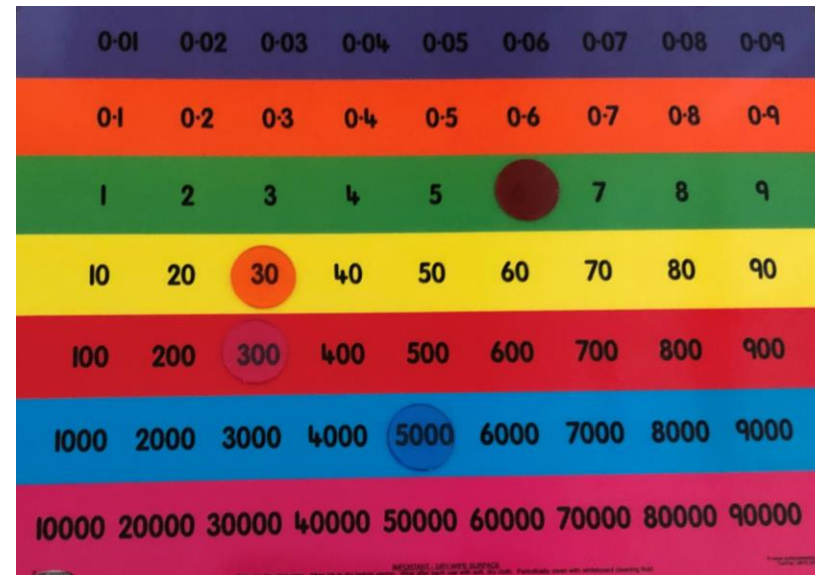
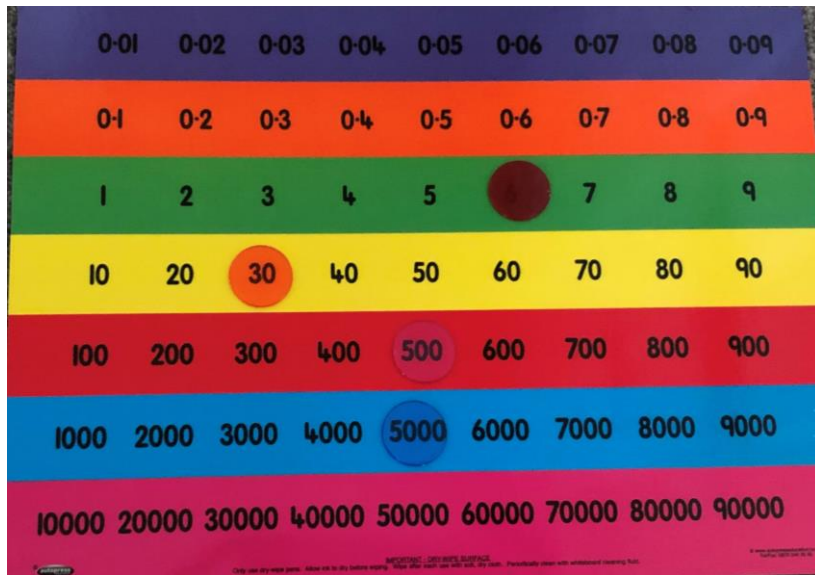


$$150 - 80$$
$$= 150 - 50 - 30$$

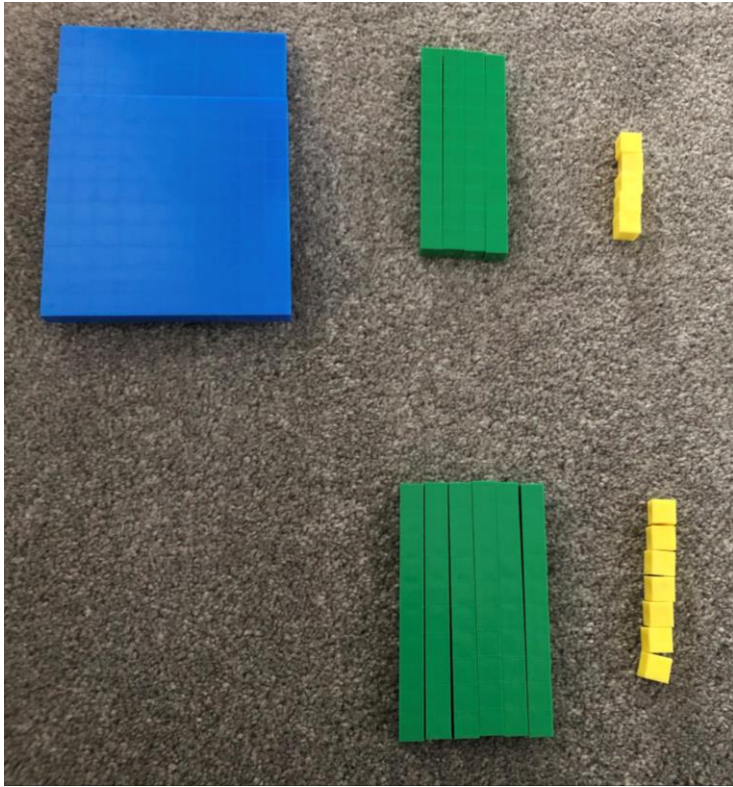
The diagram shows the number 80 in the first equation being decomposed into 50 and 30 in the second equation. An arrow points from the 80 in the first line to the 50 and 30 in the second line.

Partitioning

$$5,536 - 200$$







$$245 - 67$$

=

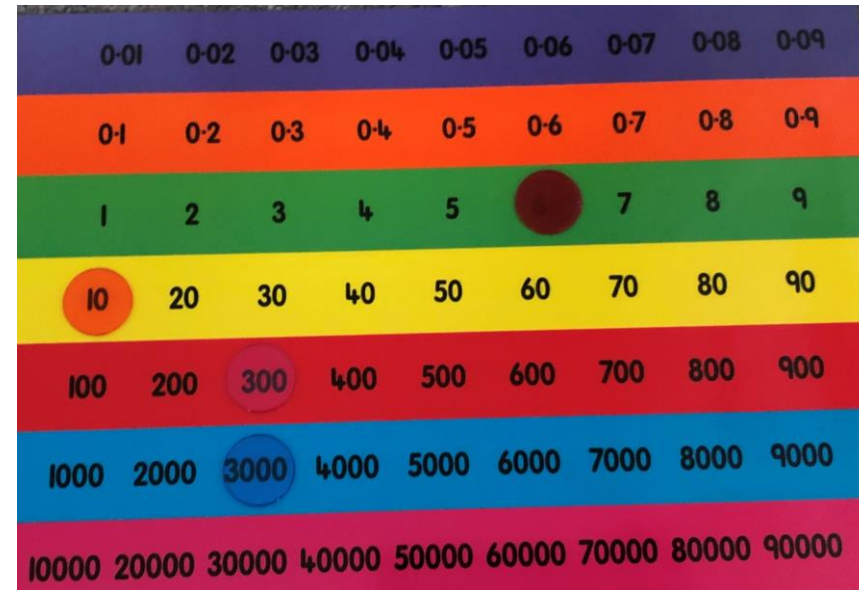


$$(100 + 130 + 15) - 67$$

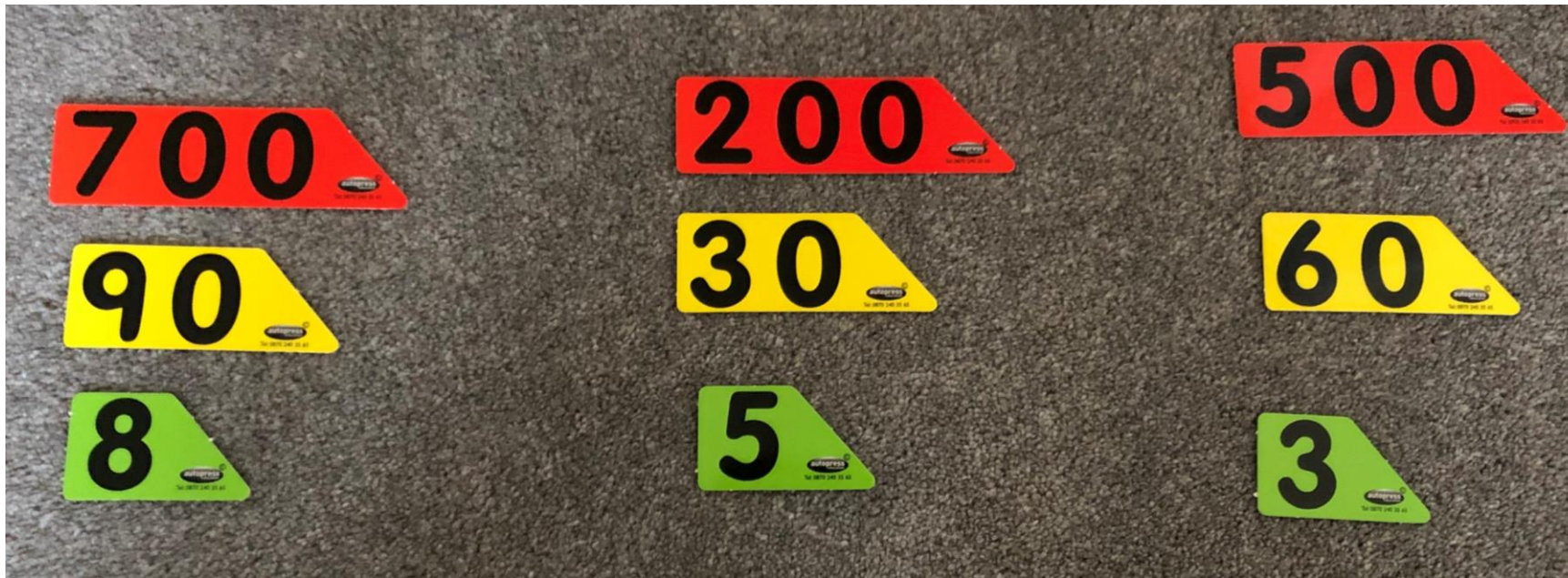
$$245 - 67 = 178$$



$$5,516 - 2,000$$

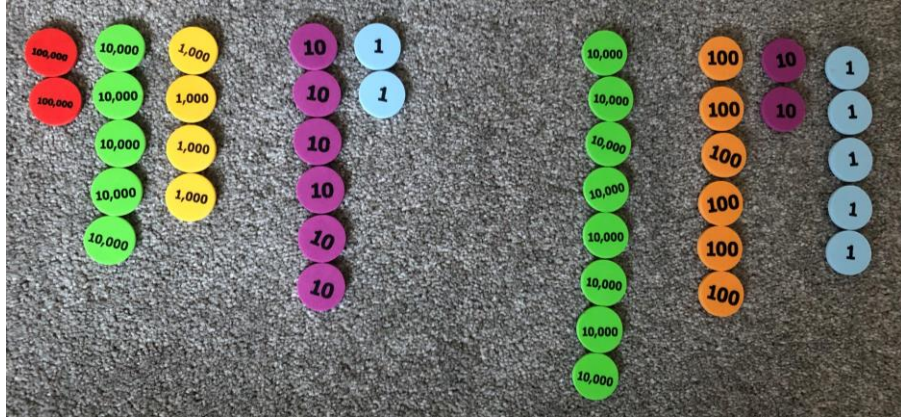




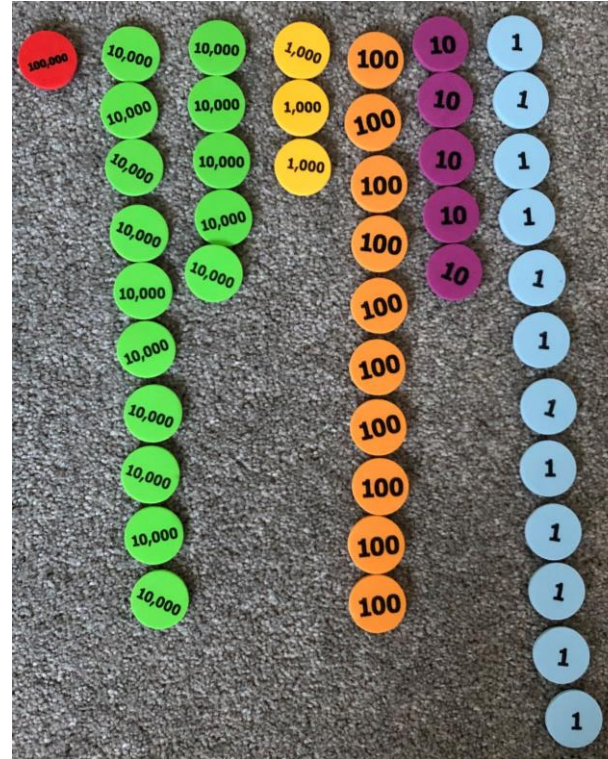


$$798 - 235 = 563$$





=



$$254,062 - 80,625$$

$$(100,000 + 150,000 + 3,000 + 1,000 + 50 + 12) - 80,625$$

$$254,062 - 80,625 = 173,437$$



$$\begin{array}{r} 400 + 60 + 7 \\ - 200 + 20 + 2 \\ \hline 200 + 40 + 5 \end{array}$$

$$\begin{array}{r} 467 \\ - 222 \\ \hline 245 \end{array}$$



$$\begin{array}{r} 754 \\ - 86 \\ \hline \end{array}$$

Partitioning and decomposition

$$\begin{array}{r} 700 + 50 + 4 \\ - \quad \quad 80 + 6 \\ \hline \end{array} \quad \text{step 1}$$

$$\begin{array}{r} 700 + 40 + 14 \\ - \quad \quad 80 + 6 \\ \hline \end{array} \quad \text{step 2}$$

$$\begin{array}{r} 600 + 140 + 14 \\ - \quad \quad 80 + 6 \\ \hline \end{array} \quad \text{step 3}$$

$$600 + 60 + 8 = 668$$



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$$\begin{array}{r} 124,213 \\ - 11,999 \\ \hline \end{array} = \begin{array}{r} 124,213 \\ - 12,000 (+1) \\ \hline 112,213 \end{array}$$

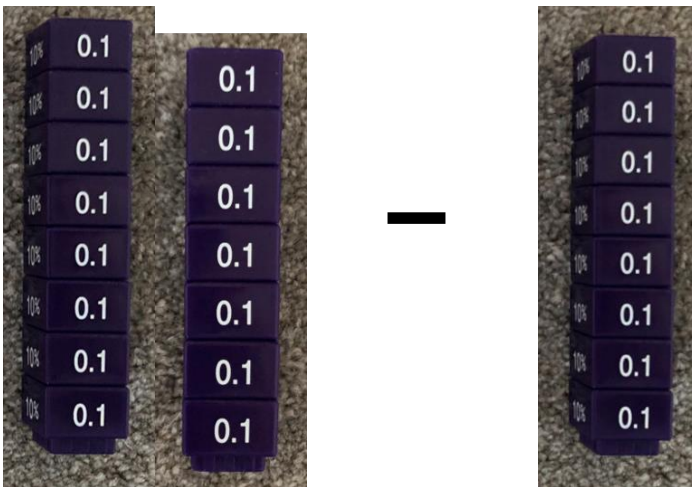
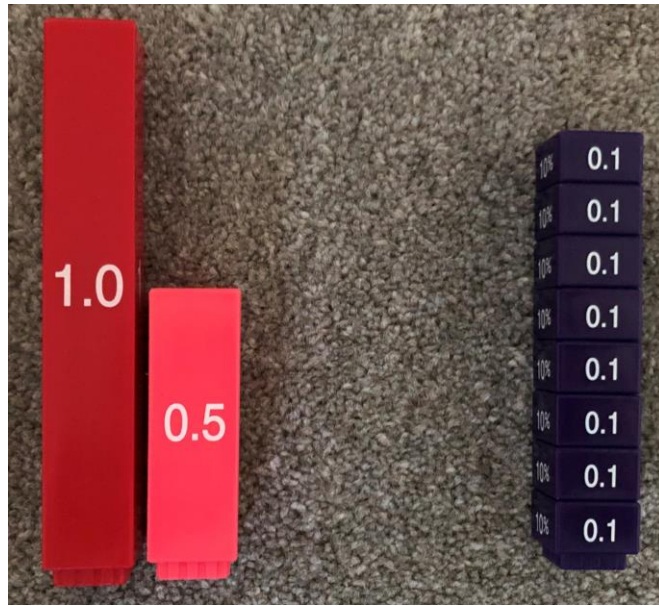
$112,213 + 1 = 112,214$

# Decomposition

$$\begin{array}{r} \overset{6}{\cancel{7}} \quad \overset{14}{\cancel{5}} \quad 14 \\ \hline 2 \quad 8 \quad 6 \\ \hline 4 \quad 6 \quad 8 \\ \hline \end{array}$$



# 1.5 - 0.8



=



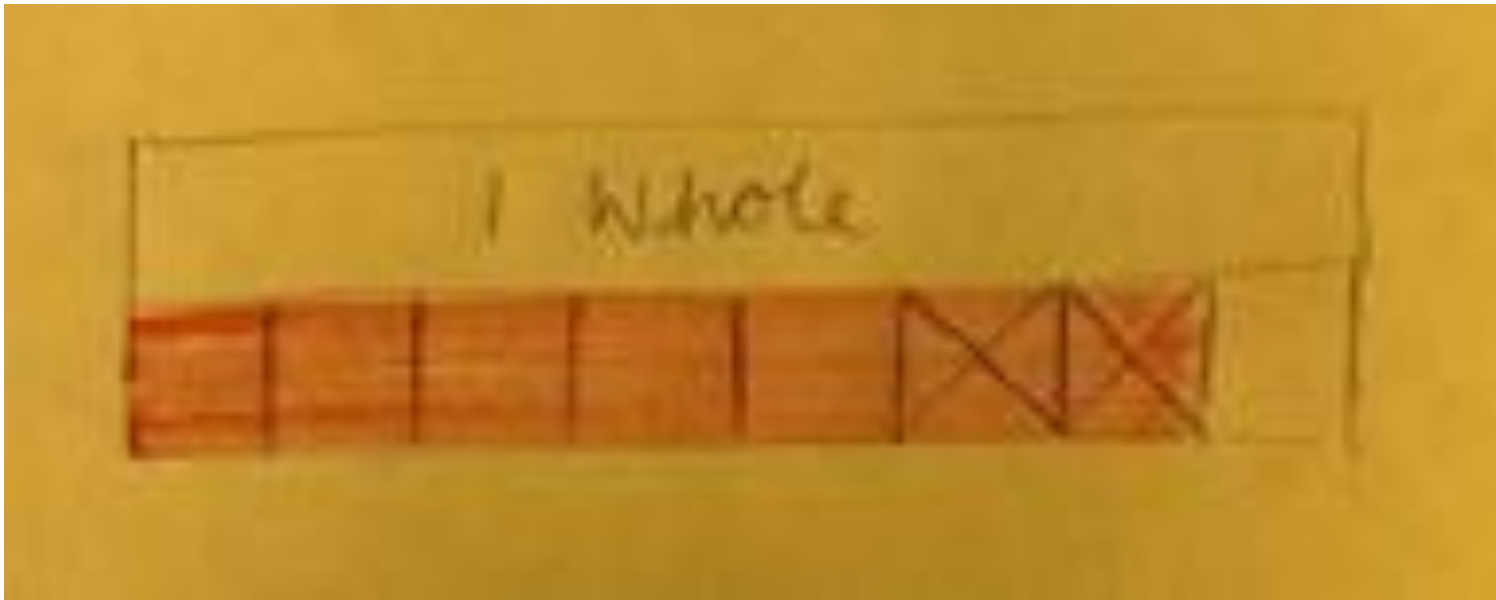
0.7

$$10/10 - 1/10 = 9/10$$

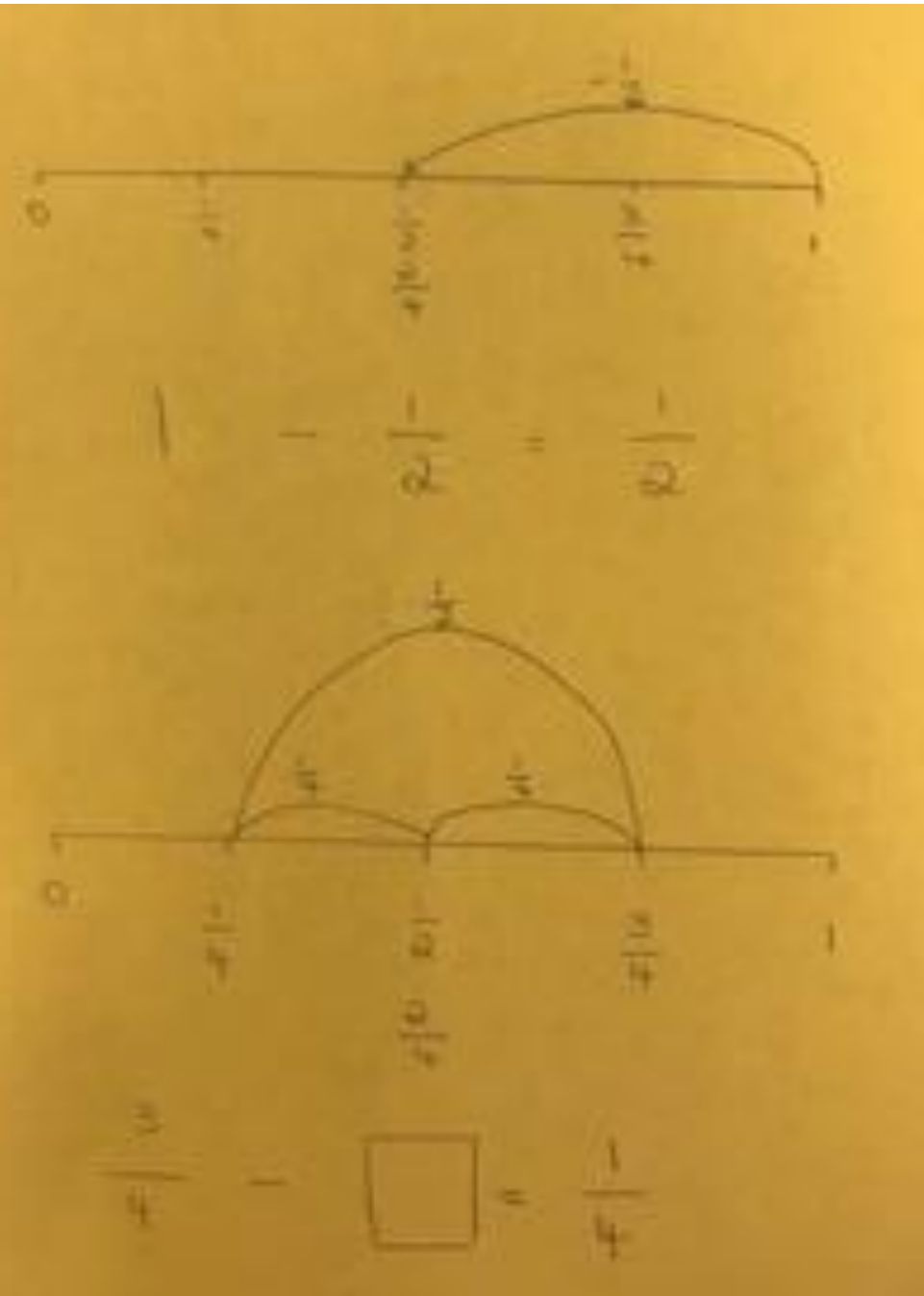
Using a beadstring



$$7/8 - 2/8 = 5/8$$





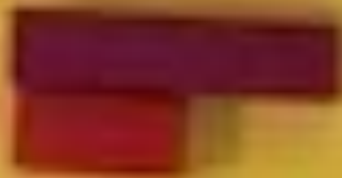


## Subtraction of Fractions



1 whole  
2 halves  
4 quarters

$$\frac{1}{1} - \frac{1}{4}$$



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





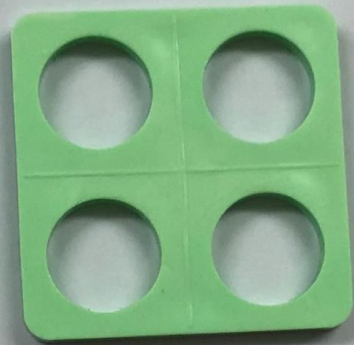
$$\frac{4}{4} - \frac{1}{4} = \frac{3}{4}$$

(1 whole)



# Multiplication

$$4 \times 1 = 4$$



$$1 \times 4 = 4$$



$$6 \times 5 = 30$$



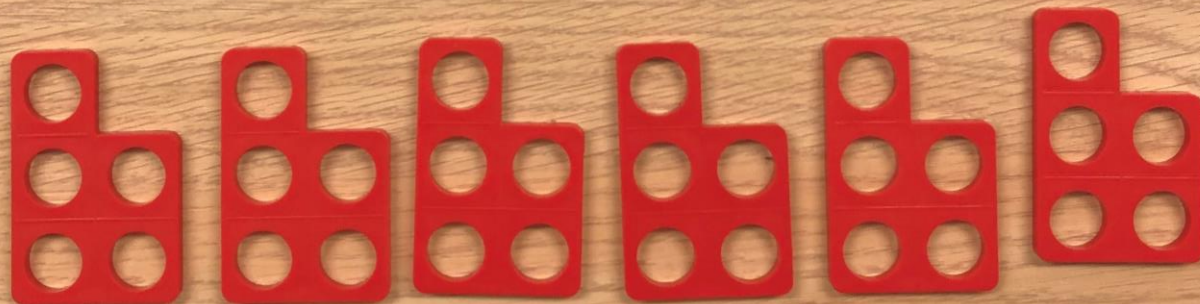
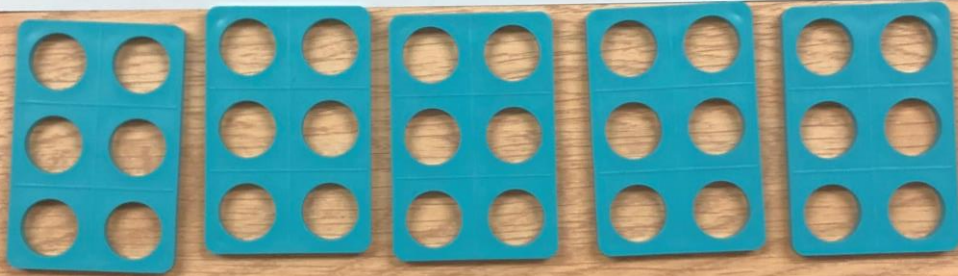
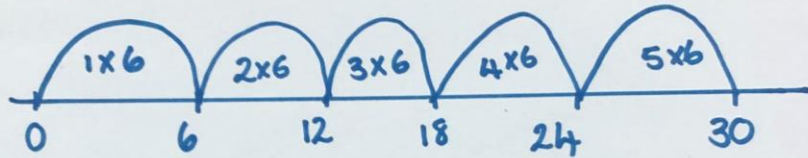
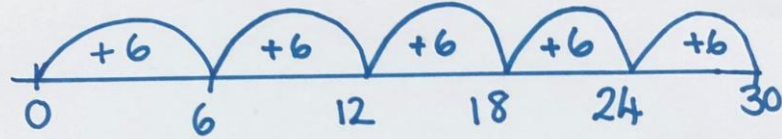
$$5 \times 6 = 30$$

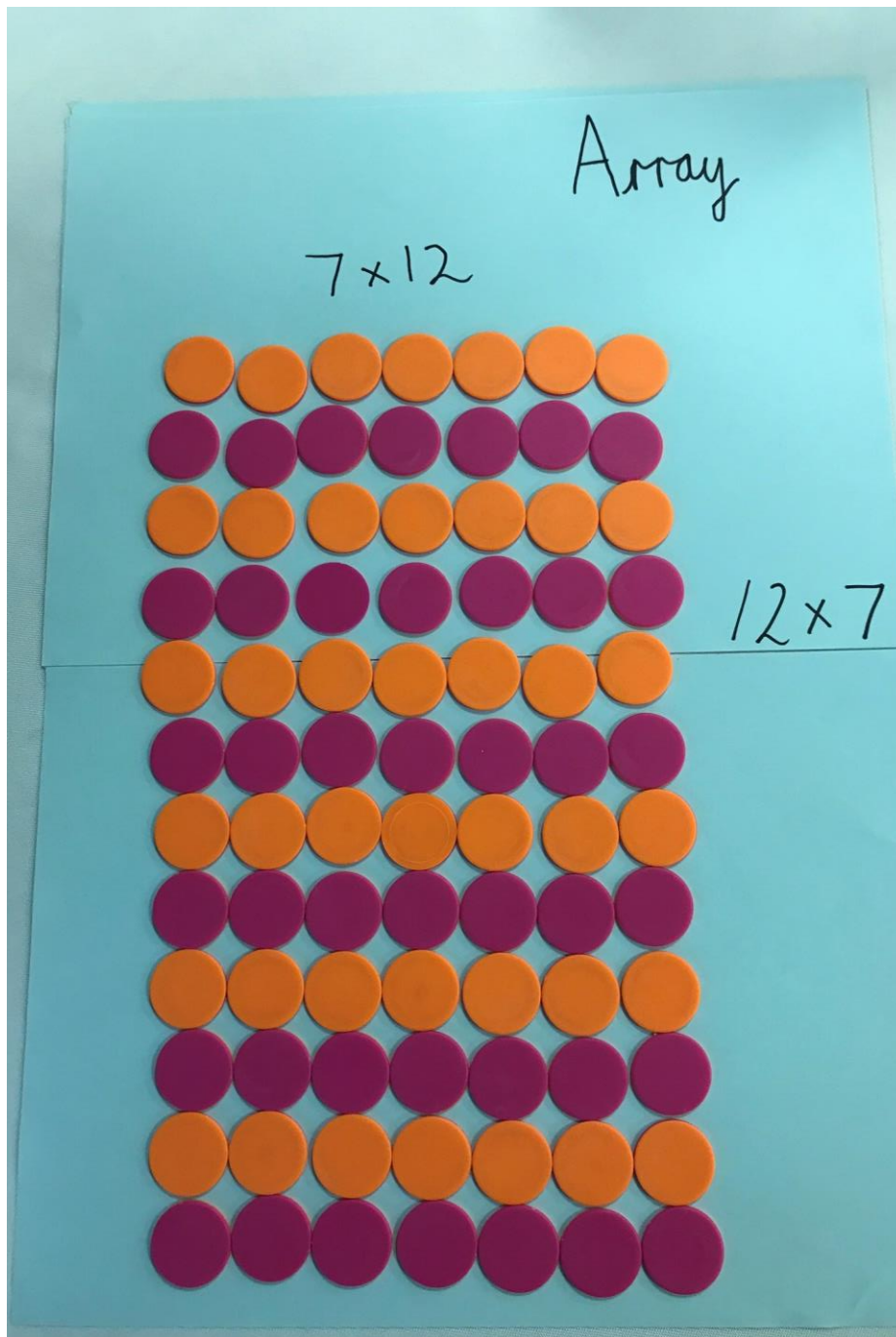


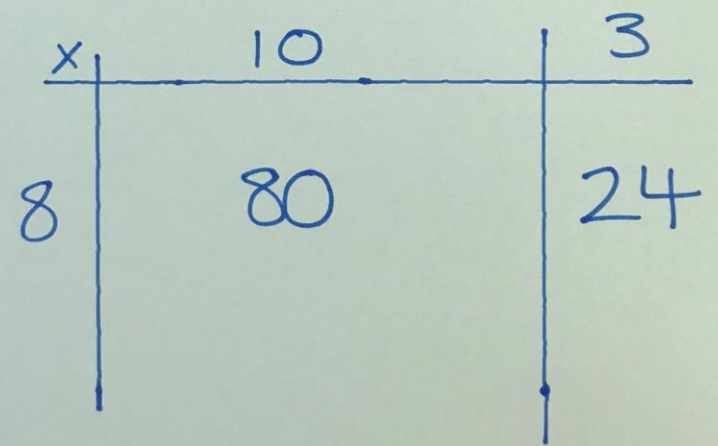
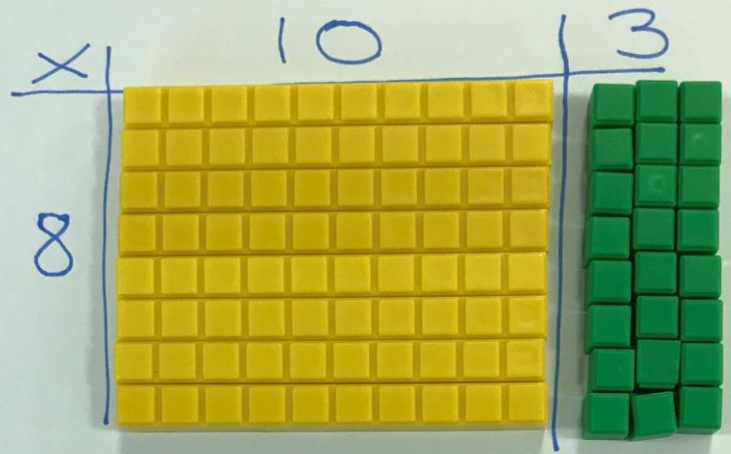




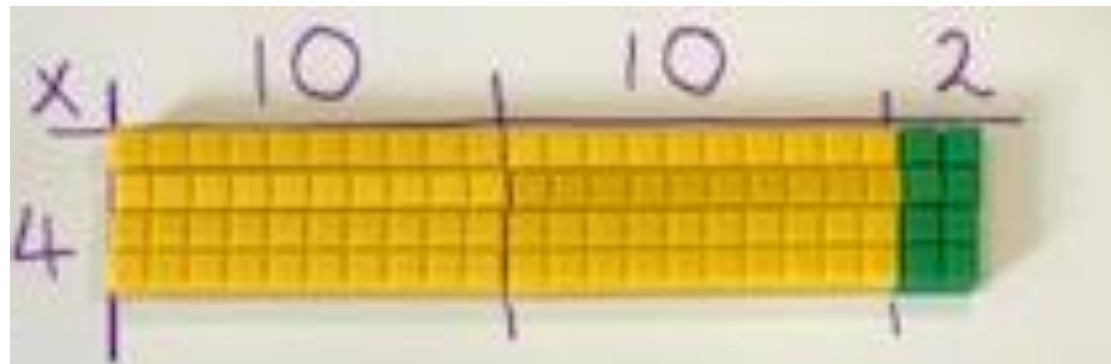
$$6 \times 5 = 30$$









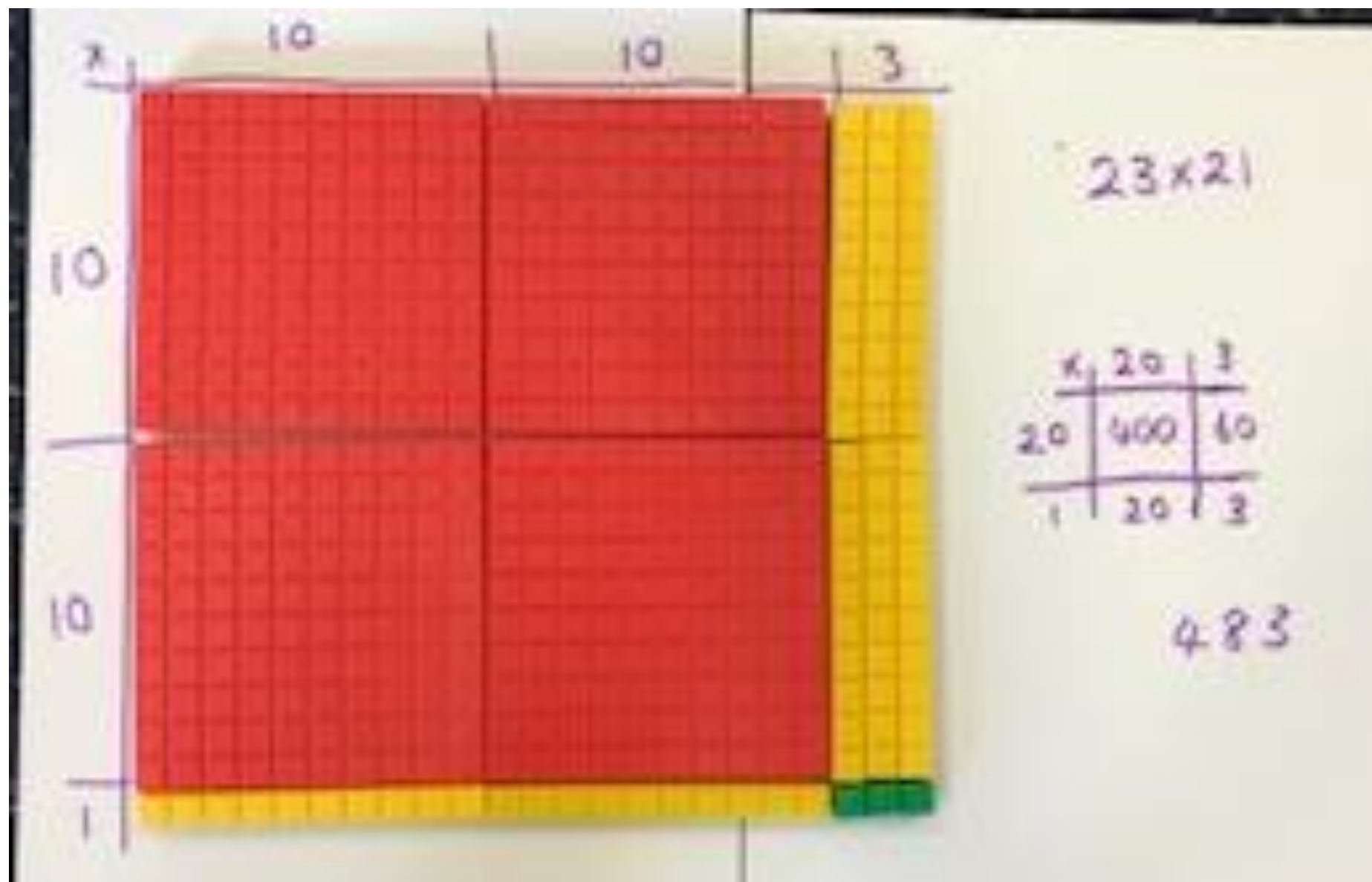


$$22 \times 4 = 88$$

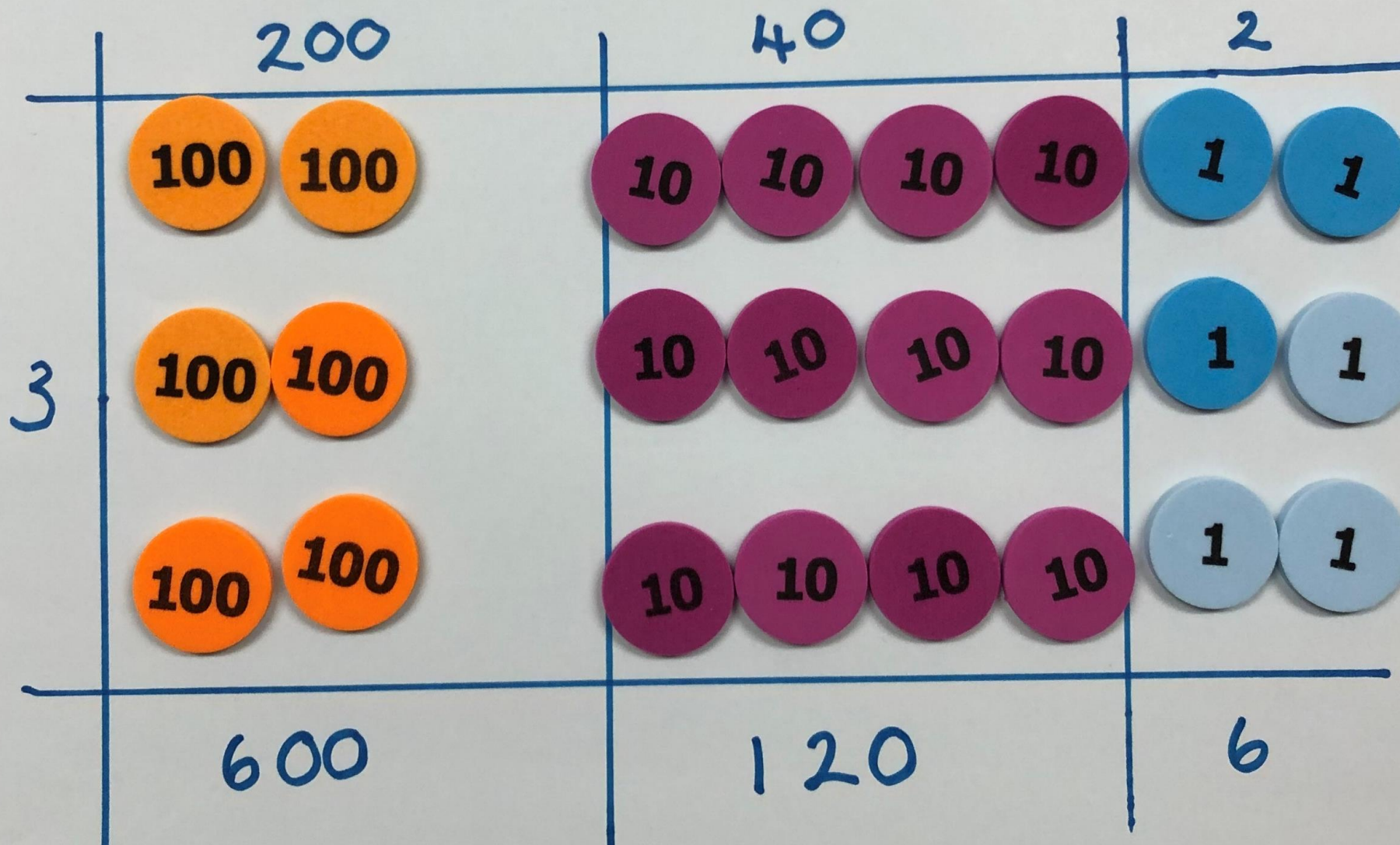
x	10	10	2
4	40	40	8

x	20	2
4	80	8

Proportional grid method



$$242 \times 3 = 726$$







$$326 \times 7 = 2289$$

x	300	20	7
7	2,100	140	49

$$12.5 \times 2.3 = 28.75$$

x	10	2	0.5
2	20	4	1
0.3	3	0.6	0.15

The playground measures 30 metres by 164 metres. Calculate the area of the playground.

$$164\text{m} \times 30\text{m}$$

x	100	60	4
30	3000	1800	120

$$\text{Area} = 4920\text{m}^2$$



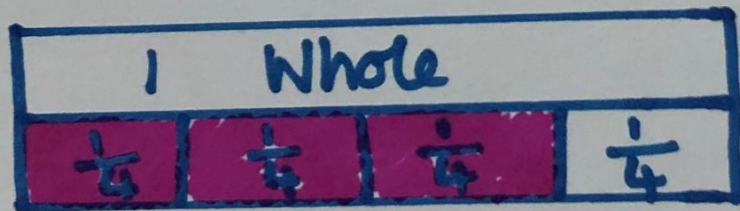
$$\begin{array}{r} \times \quad 242 \\ \quad \quad 3 \\ \hline 726 \\ \hline 1 \end{array}$$

$$\begin{array}{r} \phantom{x} 1242 \\ x \phantom{00} 43 \\ \hline 3726 \\ 49680 \\ \hline 53406 \\ \hline \end{array}$$

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



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





# Multiplying fractions



1 whole

$\frac{2}{4}$

$\times$

$\frac{2}{4}$

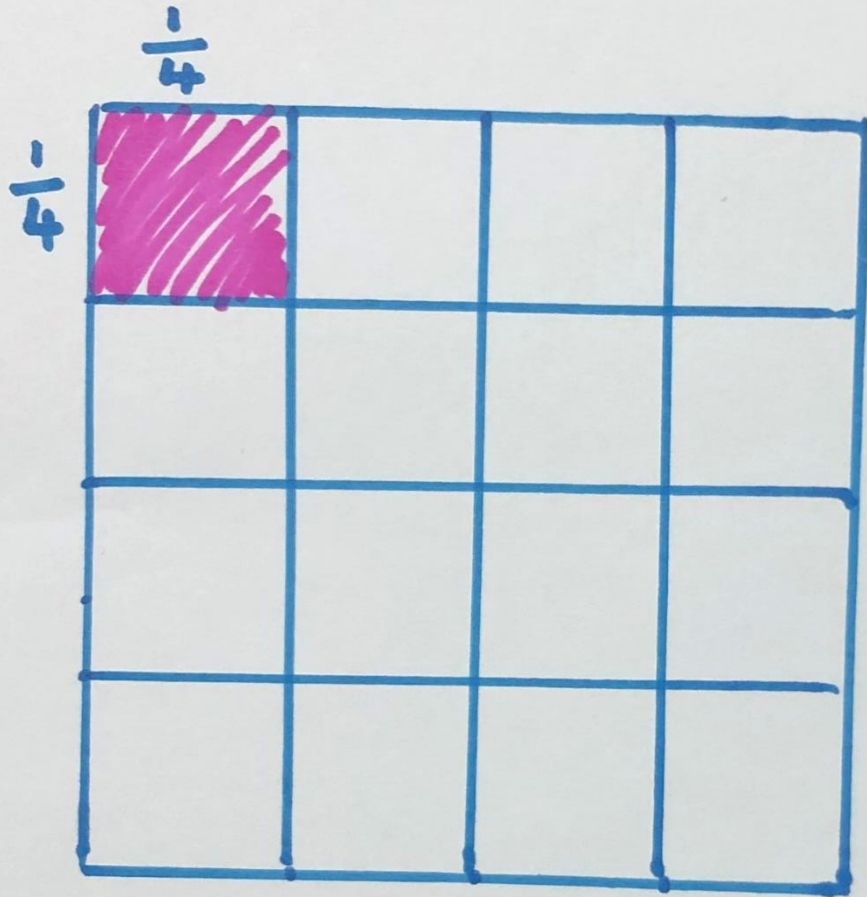


$=$

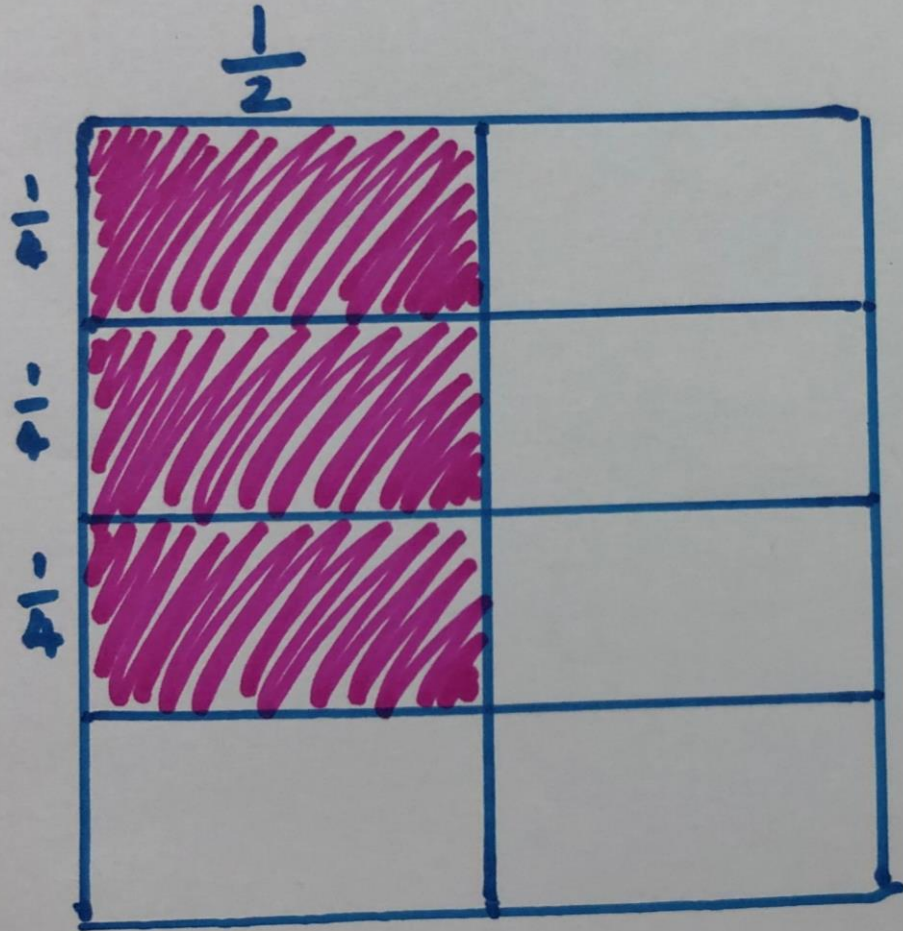
$\frac{1}{2}$



$$\frac{1}{4} \times \frac{1}{4} = \frac{1}{16}$$



$$\frac{1}{2} \times \frac{3}{4} = \frac{3}{8}$$

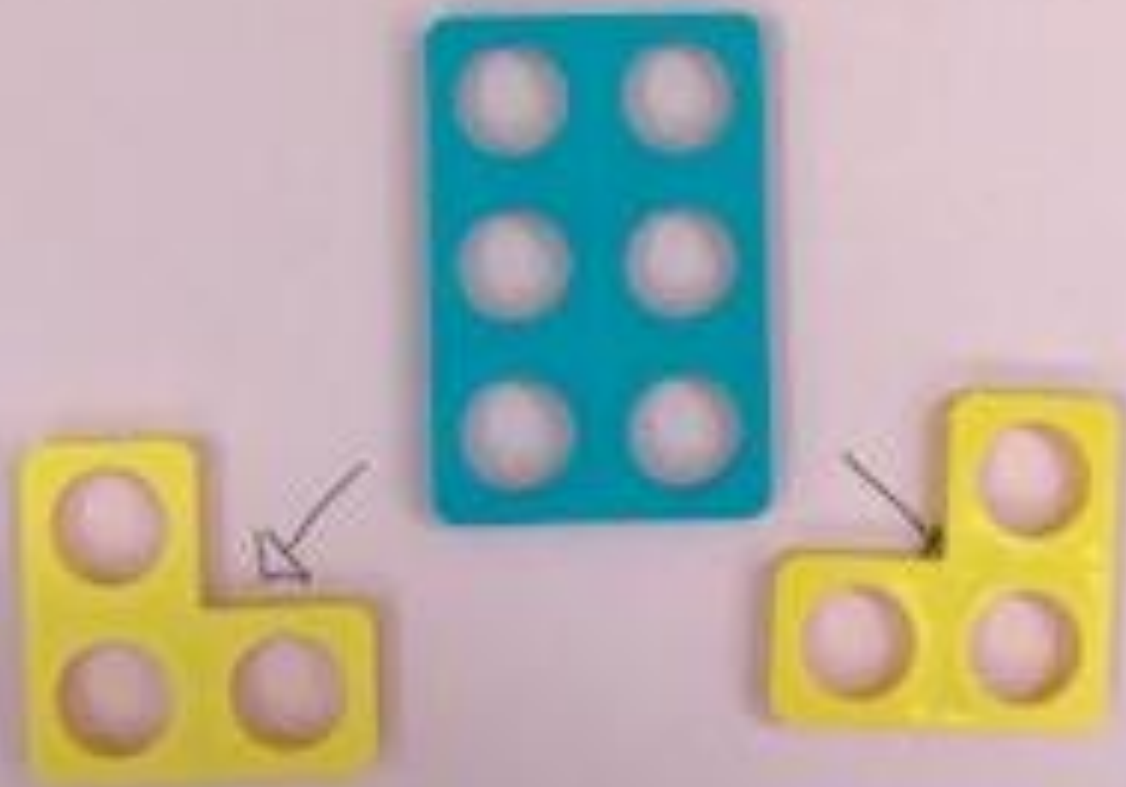




# Division

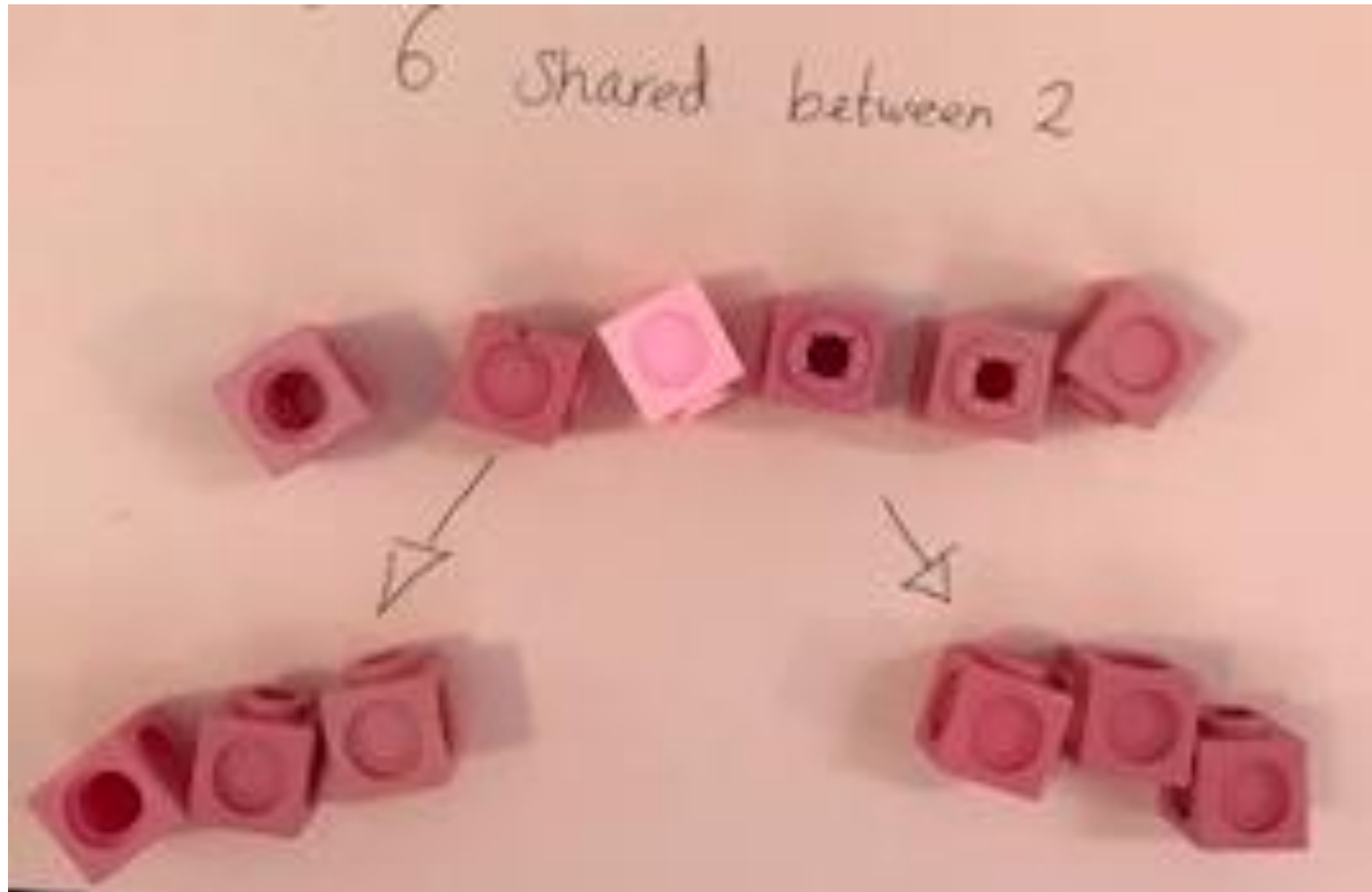
Sharing

6 shared between 2



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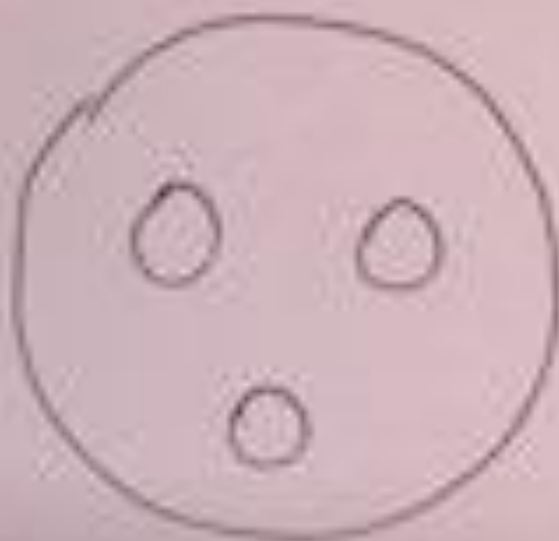
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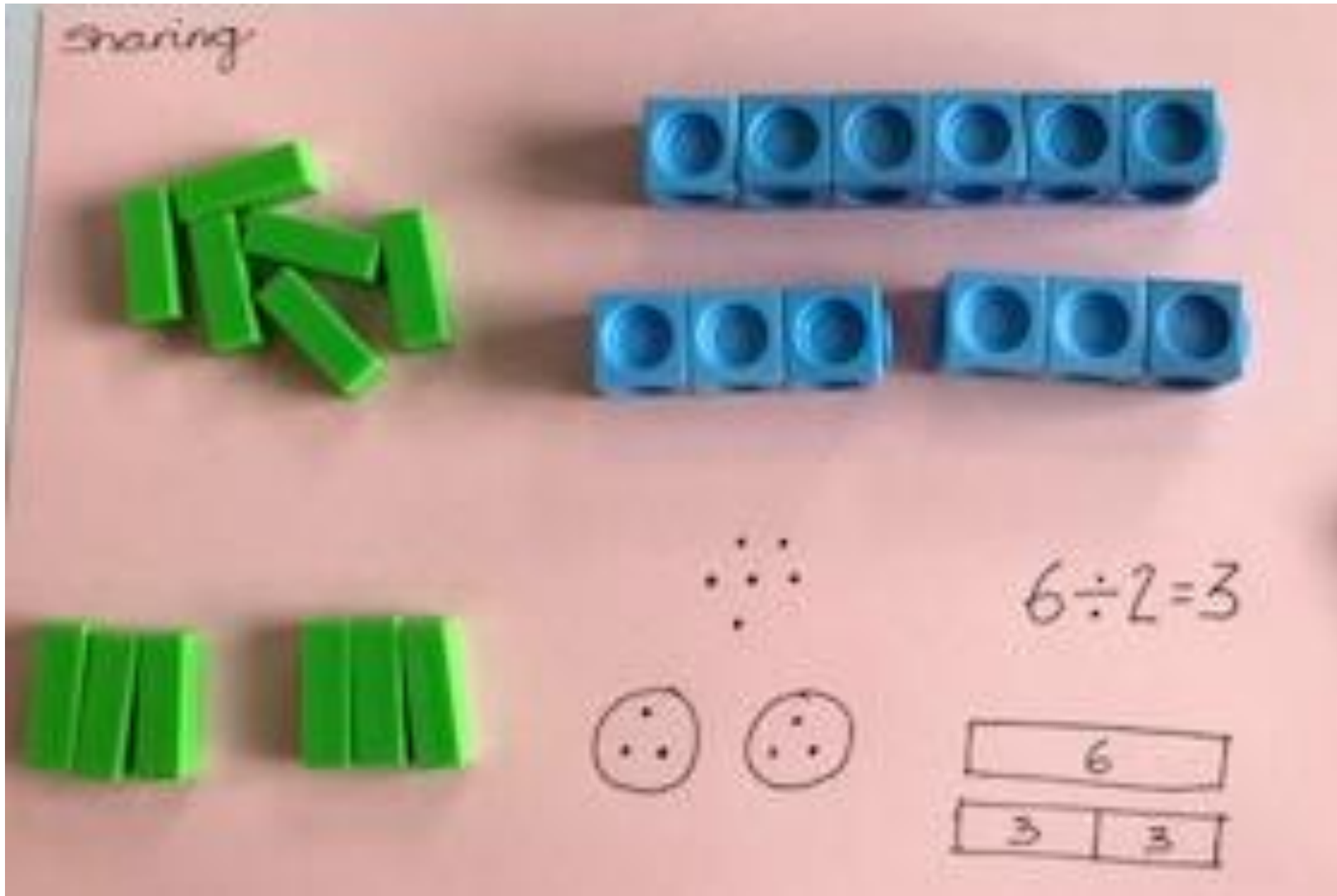
Sharing

6 shared between 2



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Sharing



6 ÷ 2 = 3

6	
3	3

Grouping

$$6 = 2 = 3$$





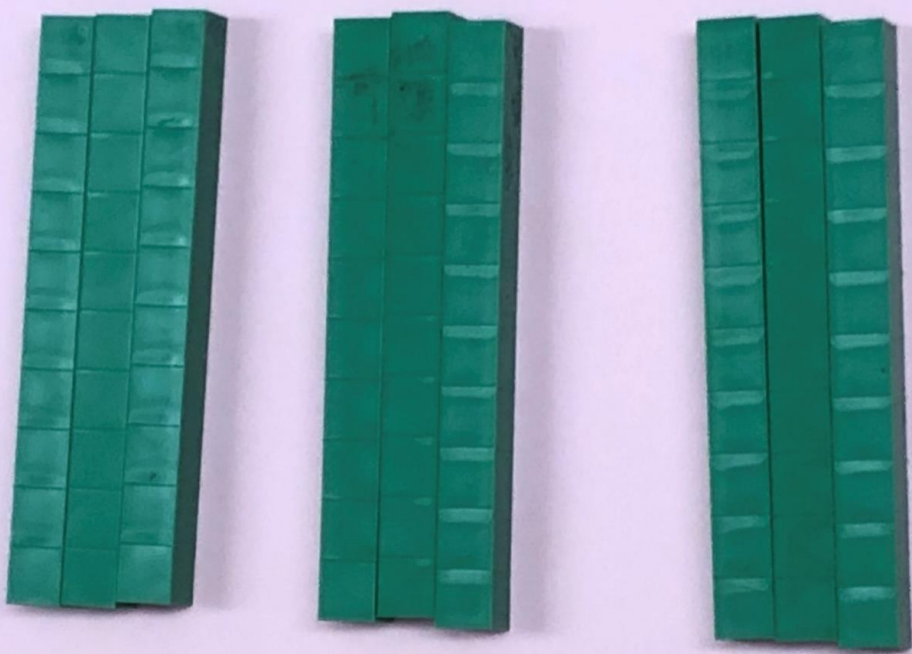
Grouping


$$8 \div 4 =$$



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$$96 \div 3 \quad (\text{sharing})$$

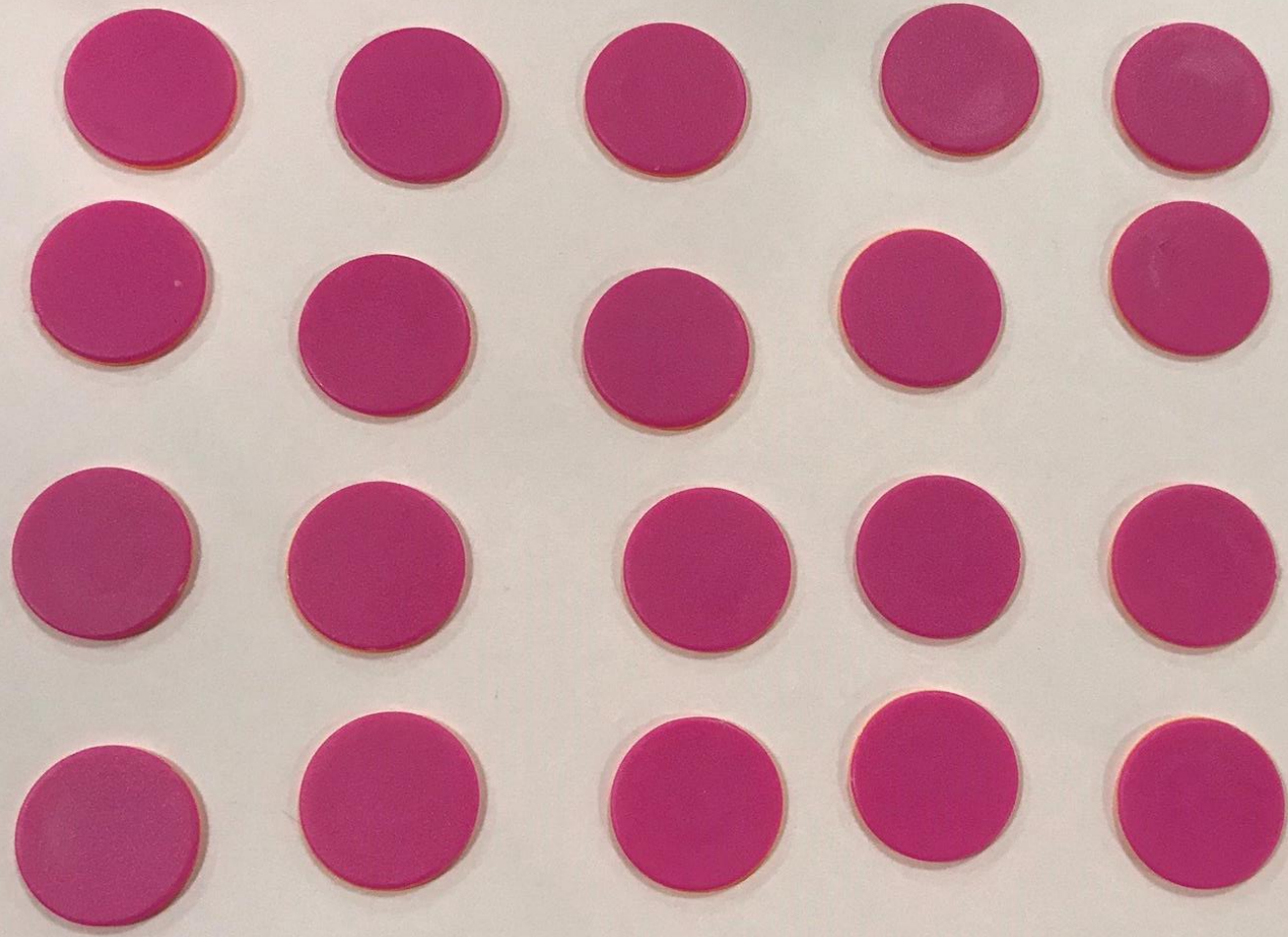




15 ÷ 3 = 5  
15 ÷ 5 = 3

3 × 5 = 15  
5 × 3 = 15





Look at this array. How many different  
division calculations can you create?



24 ÷ 4 = 6  
4 × 6 = 24

Array sharing (grouping)

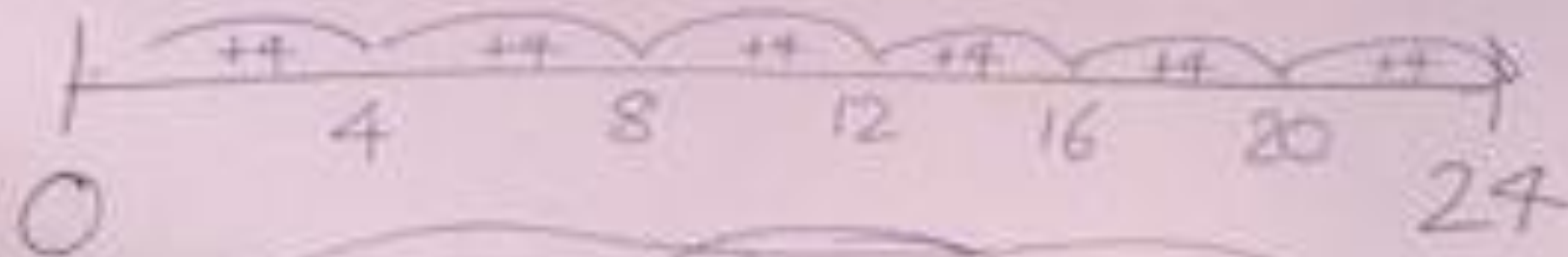
24 ÷ 4 = 6  
6 × 4 = 24

Array (grouping)



## Repeated addition

$$24 \div 4 = 6$$



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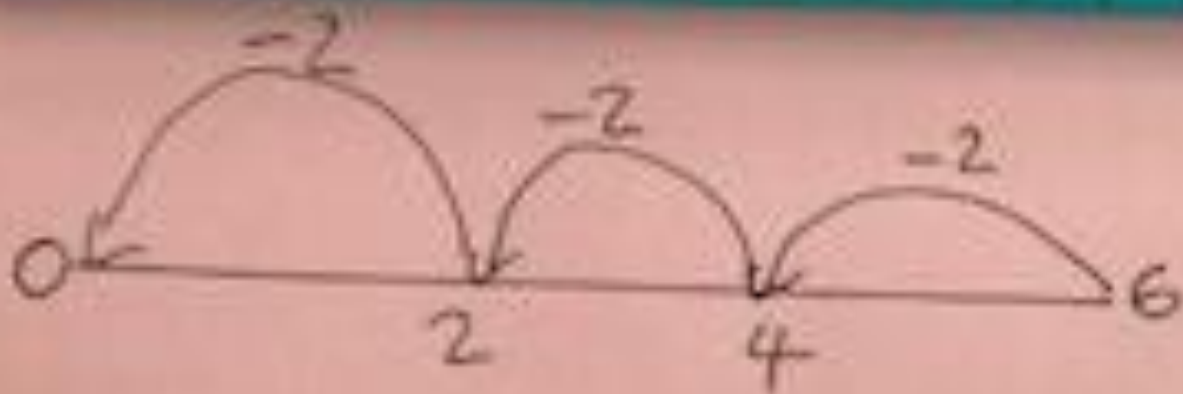
$$17 \div 5 = 3 \text{ r. } 2$$





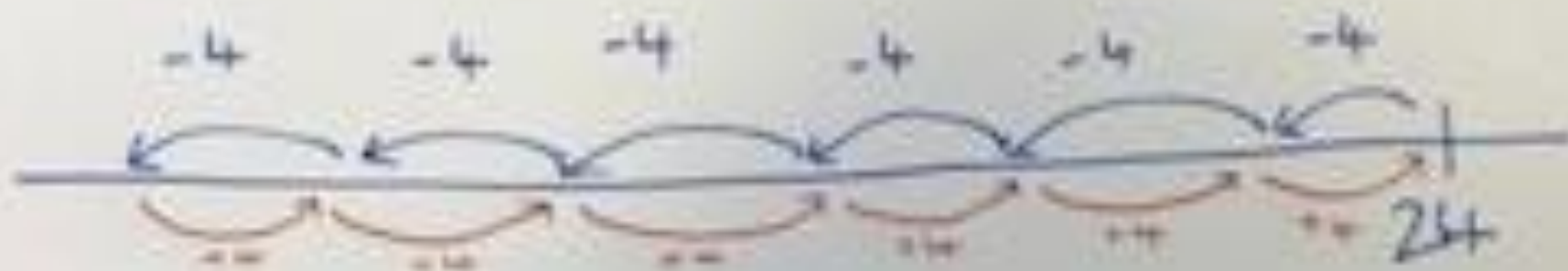
Repeated subtraction

$$6 \div 2 = 3$$





repeated subtraction



repeated addition



# Pictorial sharing

$$593 \div 4 = 123 \text{ r } 1$$

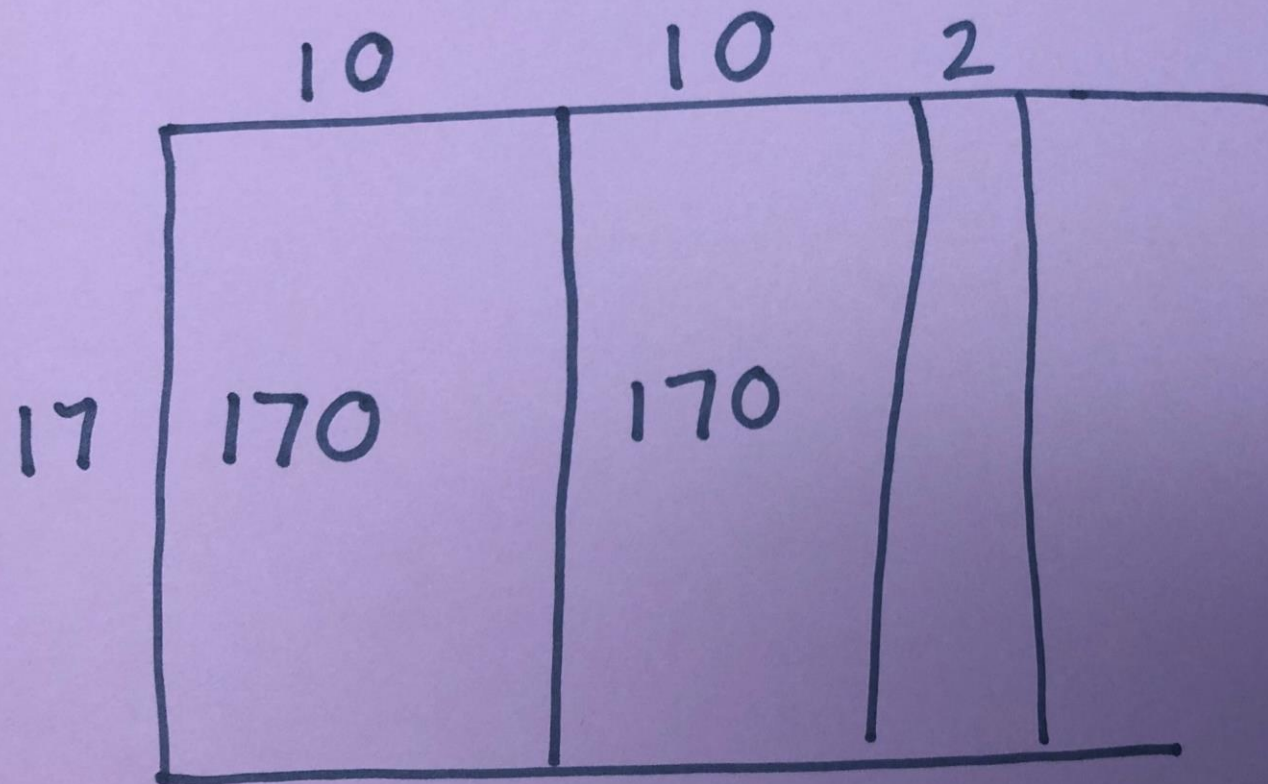
😊	😊	😊	😊		
100	100	100	100	400	
20	20	20	20	80	(480)
3	3	3	3	12	(492)
					(493)
					r 1

123  $\frac{1}{4}$   
123.25



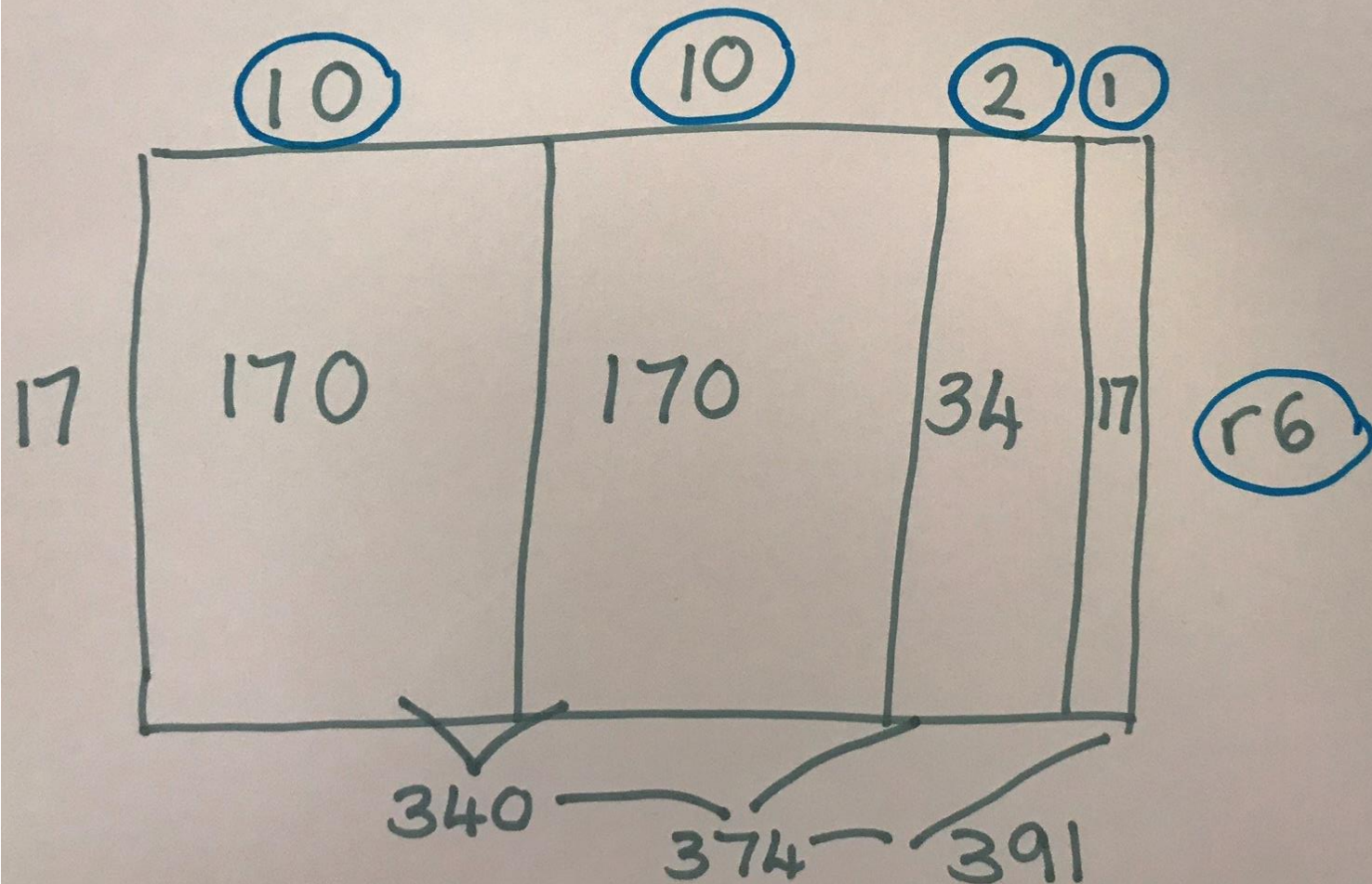
# Reverse Proportional grid

$$397 \div 17 =$$

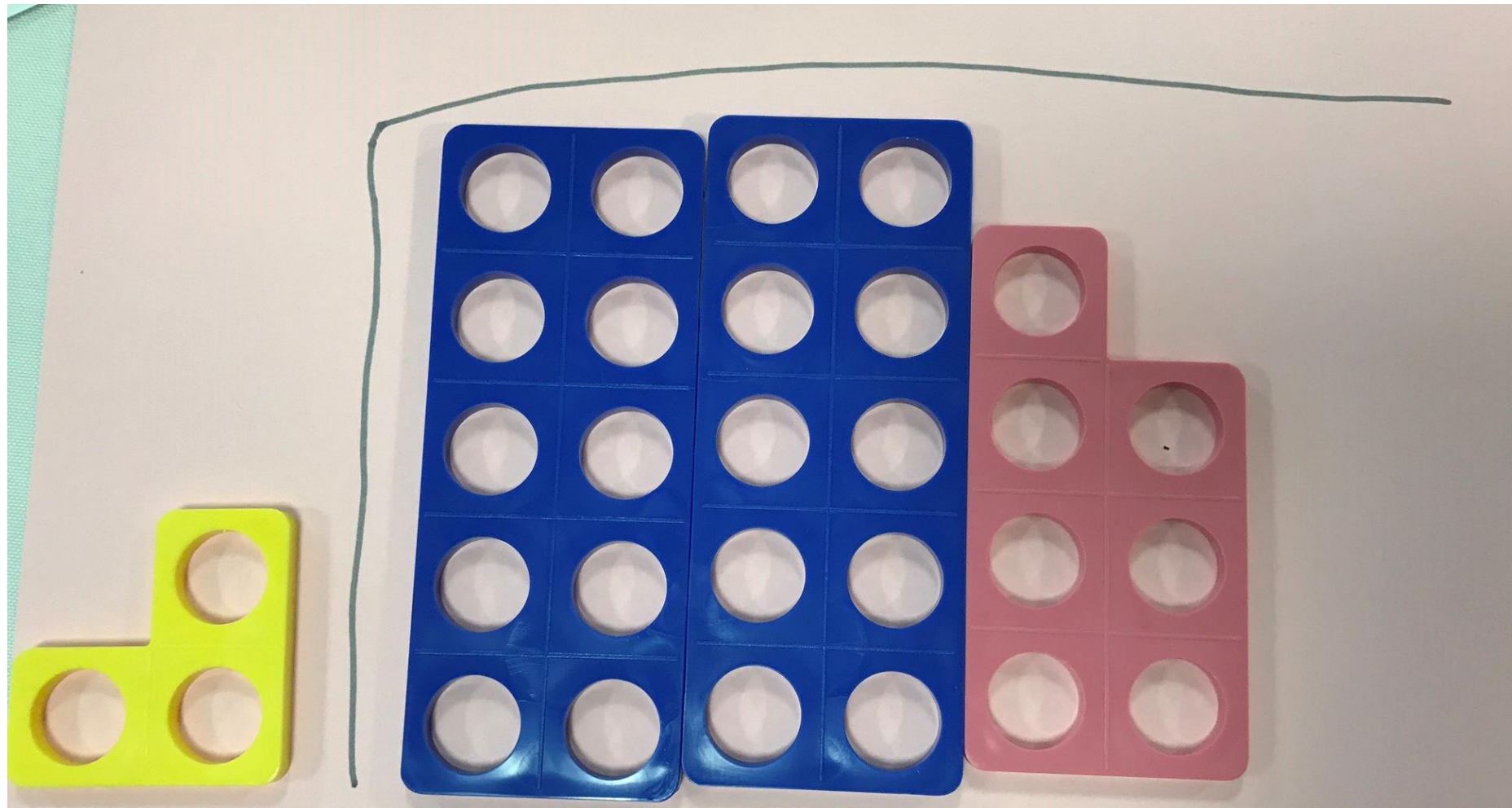


# Reverse proportional Grid

$$397 \div 17 = 23 \text{ r}6 \quad 23\frac{6}{17}$$

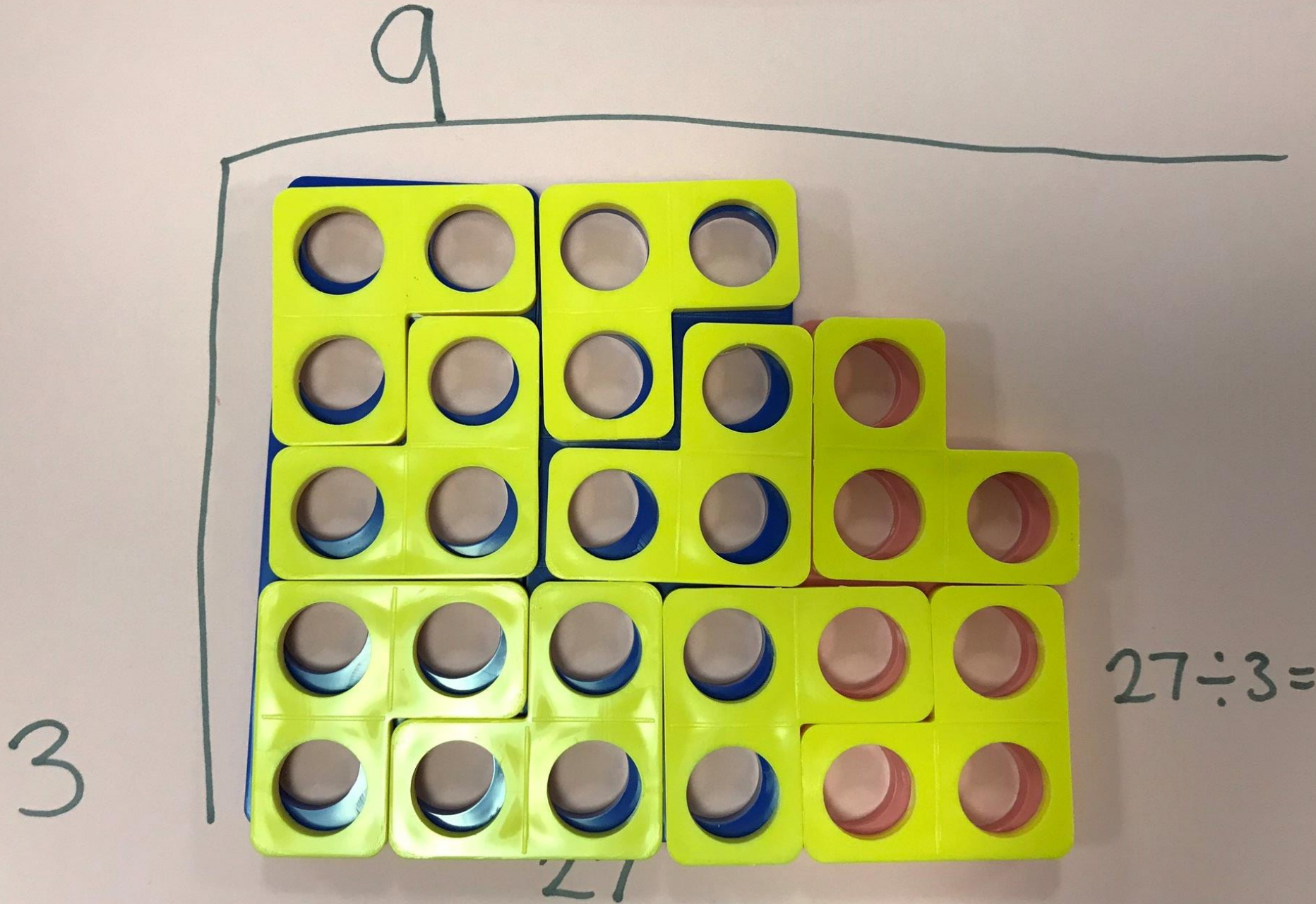






3                      27                       $27 \div 3 =$





Qn. 17

2018 R2

$$8 \text{ litres} = 8000 \text{ ml}$$

$$\text{Cup} = 225 \text{ ml}$$

$$\text{Cup} \times 2 = 450 \text{ ml}$$

$$\text{Cup} \times 4 = 900 \text{ ml}$$

$$\text{Cup} \times 8 = 1800 \text{ ml}$$



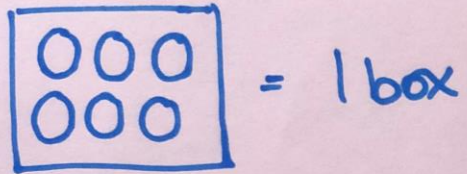
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Qn. 7

2018 R2



$$980 \div 6$$

$$100 \text{ boxes} = 600 \text{ eggs}$$

$$50 \text{ boxes} = 300 \text{ eggs}$$

$$150 \times 6 = 900 \quad 900$$

$$5 \times 6 = 30 \quad 930$$

$$8 \times 6 = 48$$

---

$$163 \times 6 = 978$$

163 full boxes



I know:

$$10 \times 97 = 970$$

$$100 \times 97 = 9700$$

$$50 \times 97 = 4850$$

$$20 \times 97 = 1940$$

$$90 \times 97 = 8730$$

$\div$	90	1	
97	8730	97	

91

$$? \times 97 = 8827$$



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$$97 \overline{) 8827}$$
$$\underline{8730}$$
$$0097$$

$97 \times 100 = 9700$

$97 \times 90 = 8730$

$\times 90$

$\times 1$

# Formal algorithm

- short division (with remainders)

$$\begin{array}{r} 86 \text{ r.} 2 \\ \hline 5 \overline{) 432} \end{array}$$

$$\begin{array}{r} 86 \frac{2}{5} \\ \hline 5 \overline{) 432} \end{array}$$

↑  
Expressing remainder as a fraction

Expressing remainder as a decimal

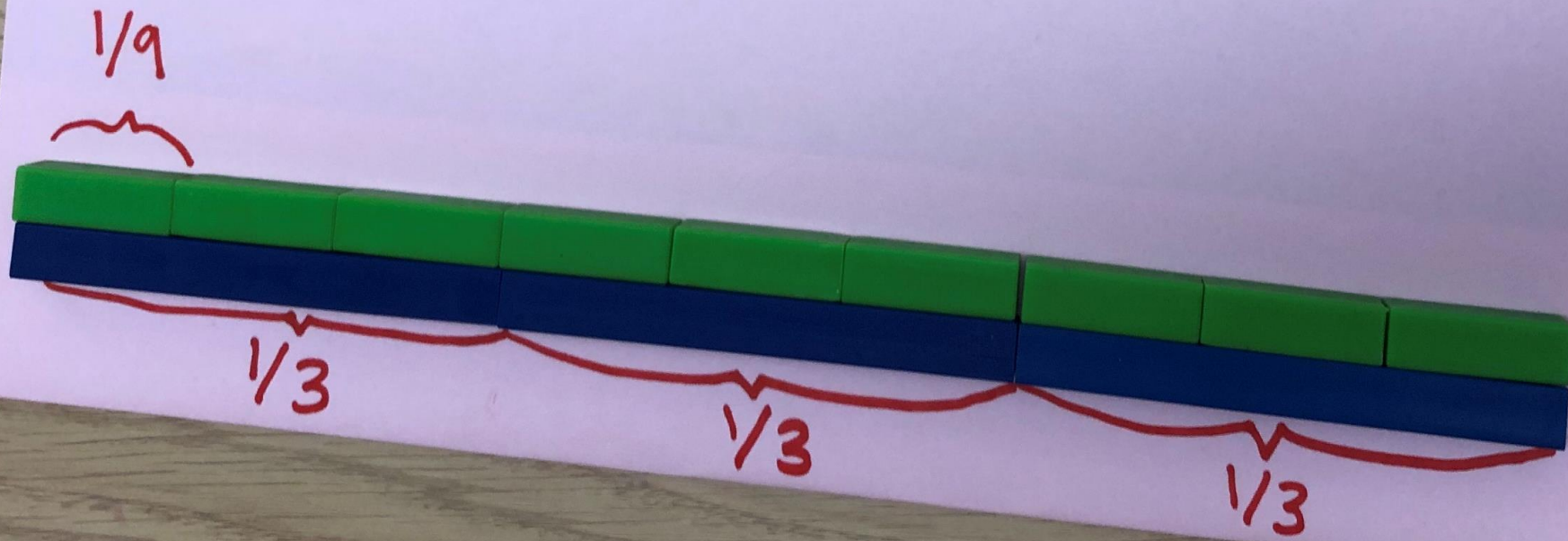
$$\begin{array}{r} 86.4 \\ \hline 5 \overline{) 432.0} \end{array}$$



$$\begin{array}{r} 053 \quad \text{r } 3 \\ \hline 4 \overline{) 215} \\ \underline{8} \phantom{0} \\ 15 \\ \underline{12} \\ 3 \end{array}$$

• 75

$$\frac{1}{3} \div 3$$



# The End



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