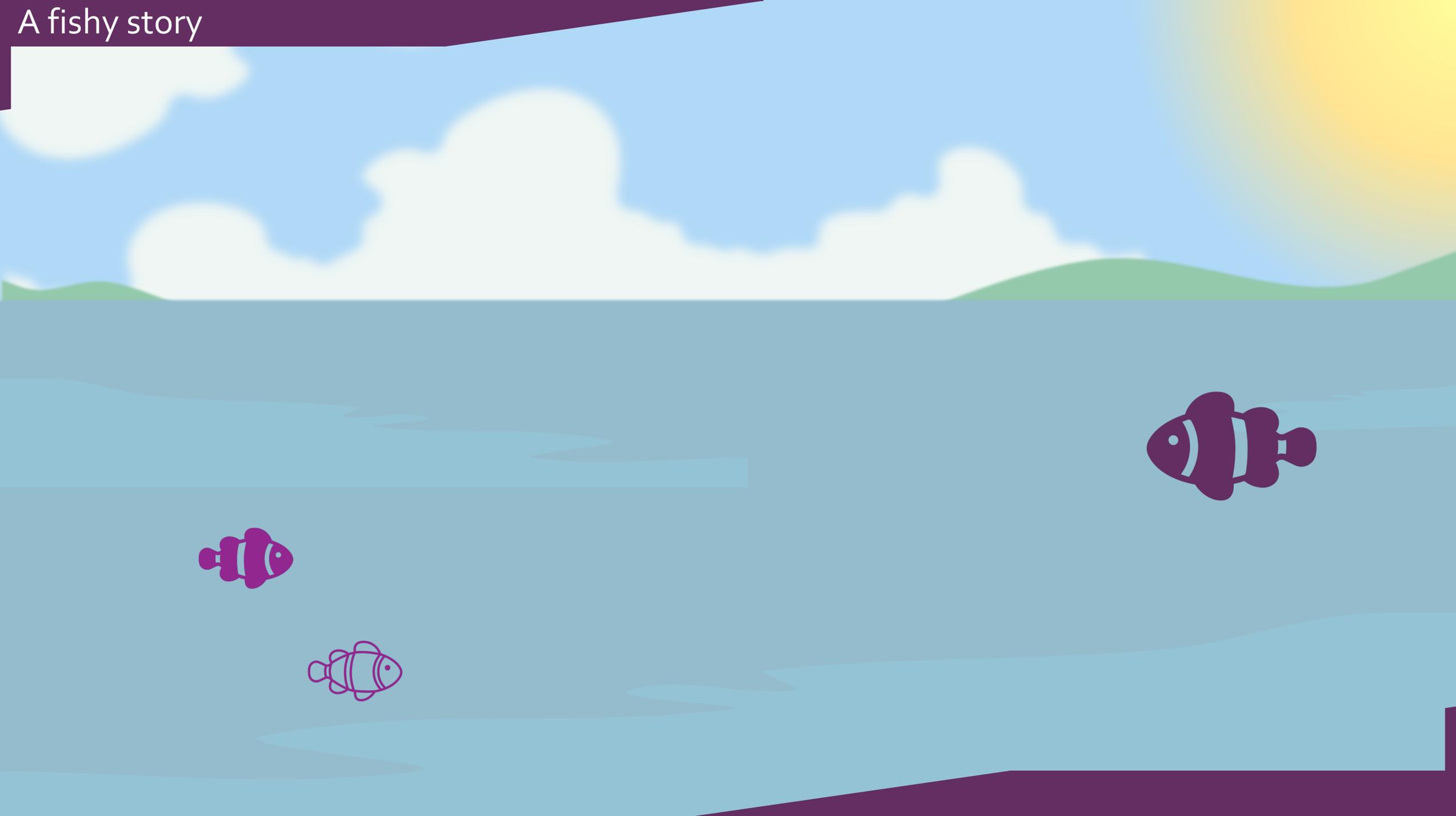


*The*  
Complete  
Mathematics  
*Conference*

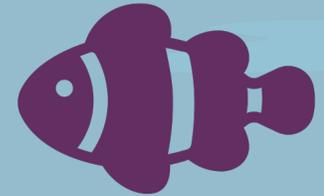
# Nathan Day

Don't Stop  
Interweavin' (Hold On  
to That Feelin')

# A fishy story



What is the *mathematical*  
water our pupils are  
swimming through?



What is the *mathematical*  
water our pupils are  
swimming through?

The Logicalness

The Beauty

The Depth

The Connections

The Applications

The History

What is the *mathematical*  
water our pupils are  
swimming through?

The Logicalness

The Beauty

The Depth

The Connections

The Applications

The History

Maths should be less magical.

What is the *mathematical*  
water our pupils are  
swimming through?

The Logicalness

The Beauty

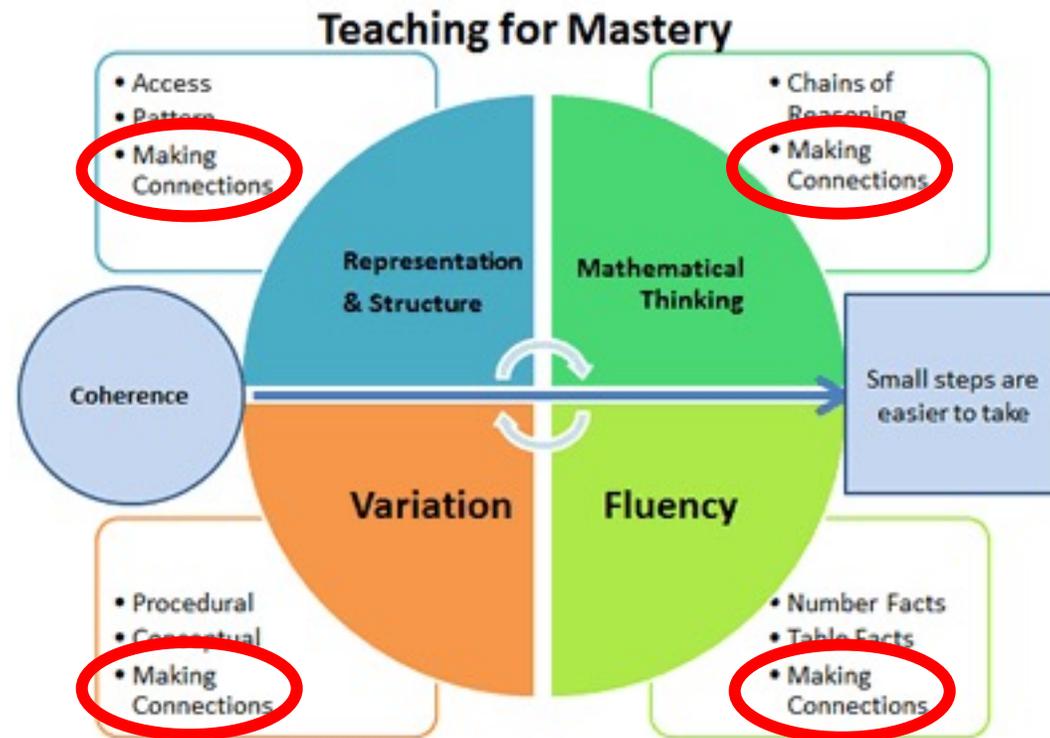
The Depth

The Connections

The Applications

The History

# Maths should feel like *Game of Thrones*. Not *Friends*.



# What?

**Great Maths Teaching Ideas** *Sharing great ideas and resources with maths teachers*

**FOLLOW:**

**THE ELEMENTS- INTERWEAVING**

GOLD PLATO WINNER- TEACHER OF THE YEAR IN A SECONDARY SCHOOL 2016/17

PEARSON TEACHING AWARDS  
UK WINNER

Want to thank a teacher?  
[Nominate a teacher now](#)

NUMERACY NINJAS

INTERWEAVING

Interweaving is my own term for building previously learned skills into questions on the current topic being studied. For example, if your class have previously studied fractions and are now studying perimeter, make sure that they work on some perimeter questions featuring fractional lengths.

Interweaving is related to [interleaving](#) because students need to **identify** the previously learned strategies required to solve a problem in addition to executing strategies taught in the current lesson. Both interleaving and interweaving also give students additional [spaced learning](#) practice benefits. Furthermore, by applying their previous learning in a new context, they also get transferability benefits to the prior learning.

# What?

## **Interweaving:**

Using questions and tasks that bring together multiple different topics from across mathematics.

# Why?

1 – Connections

2 – Retrieval

3 – Depth

4 – Challenge

5 – Purpose

(6 – The Hannah Questions)

19 There are  $n$  sweets in a bag.  
6 of the sweets are orange.  
The rest of the sweets are yellow.

Hannah takes at random a sweet from the bag.  
She eats the sweet.

Hannah then takes at random another sweet from the bag.  
She eats the sweet.

The probability that Hannah eats two orange sweets is  $\frac{1}{3}$

(a) Show that  $n^2 - n - 90 = 0$  (3)

(b) Solve  $n^2 - n - 90 = 0$  to find the value of  $n$ . (3)

# Who? When?

Year 7 Transition

Year 11 Revision

Year 12 Consolidation

# How?

# How?

Inputs

Processes

Contexts

# How?

## Inputs

Fractions

Surds

Standard Form

## Processes

## Contexts

# How?

## Inputs

Fractions

Surds

Standard Form

## Processes

Equations

Ratios

Sequences

## Contexts

# How?

## Inputs

Fractions

Surds

Standard Form

## Processes

Equations

Ratios

Sequences

## Contexts

Geometry

Averages

Rounding

# How?

## Inputs

Fractions

Surds

Standard Form

## Processes

Equations

Ratios

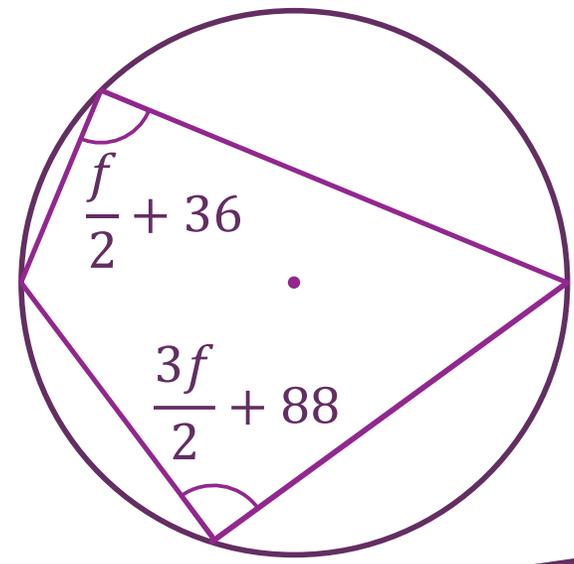
Sequences

## Contexts

Geometry

Averages

Rounding



# How?

## Inputs

Fractions

**Surds**

Standard Form

## Processes

Equations

**Ratios**

Sequences

## Contexts

Geometry

**Averages**

Rounding

An irrational amount of money is shared in the ratio 2 : 3 : 7.

The mean amount shared is £  $\sqrt{128}$ .

What is the size of the smallest share?

# How?

## Inputs

Fractions

Surds

**Standard Form**

## Processes

**Equations**

Ratios

**Sequences**

## Contexts

Geometry

Averages

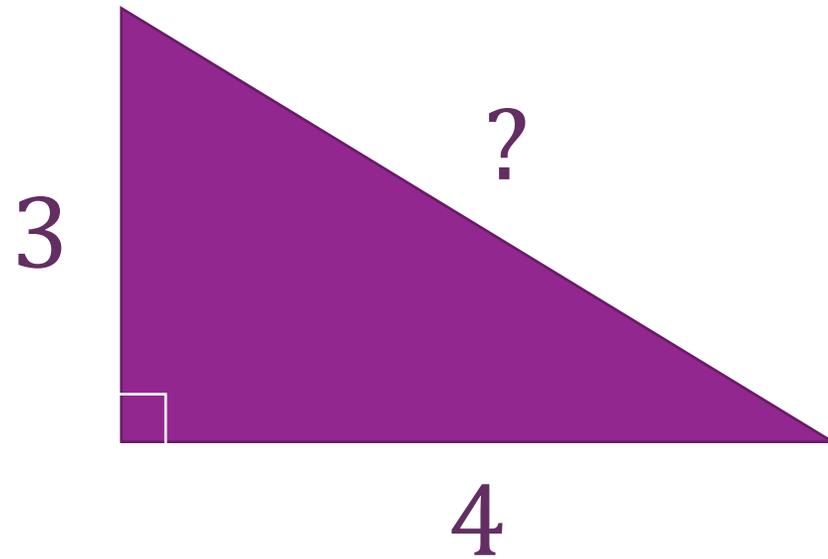
**Rounding**

The first two terms of an arithmetic sequence are  $4 \times 10^{-3}$  and  $4.4 \times 10^{-3}$ .  
Find the position of the first term in the sequence that rounds to 3 to the nearest whole number.

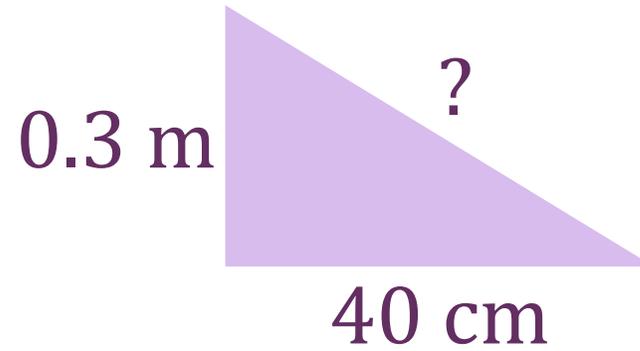
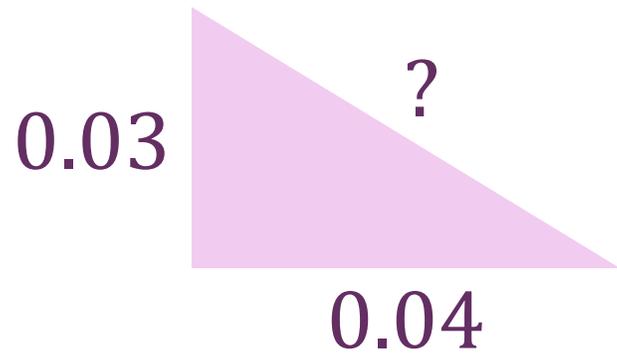
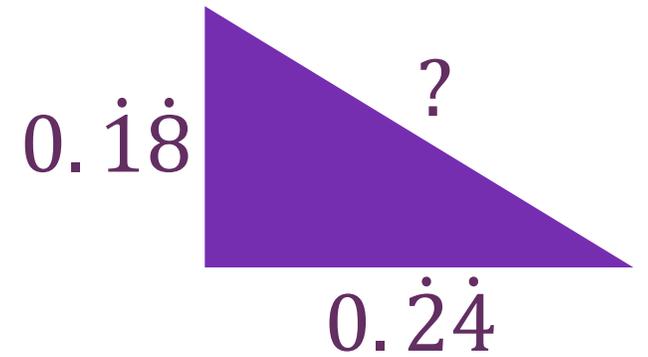
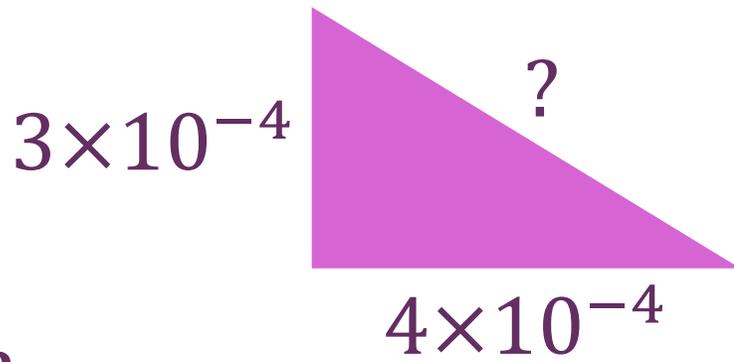
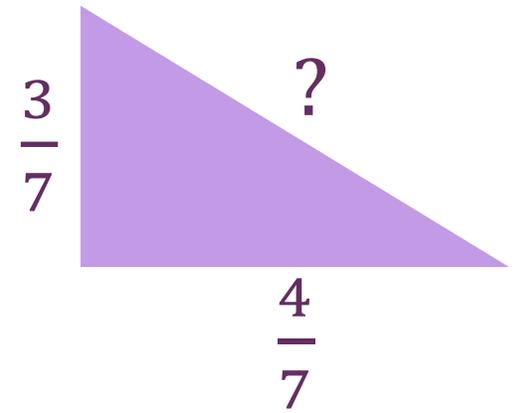
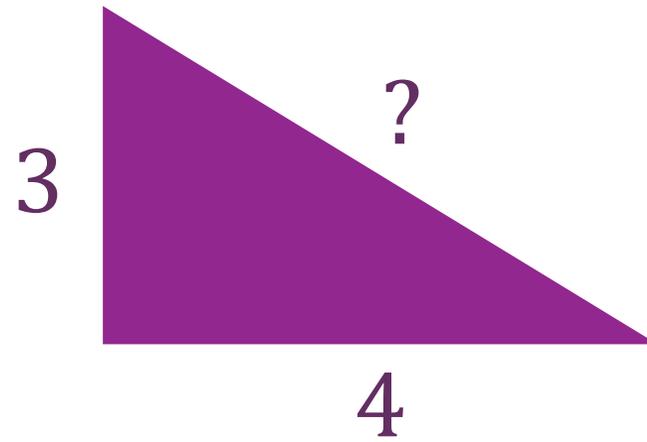
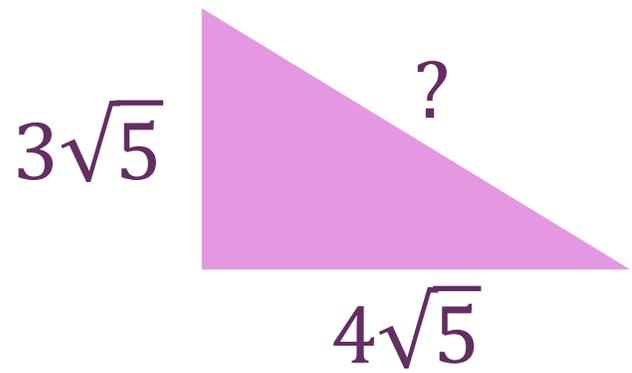
# Considerations

- Overcoming novelty
- Avoiding chaining
- Giving structure

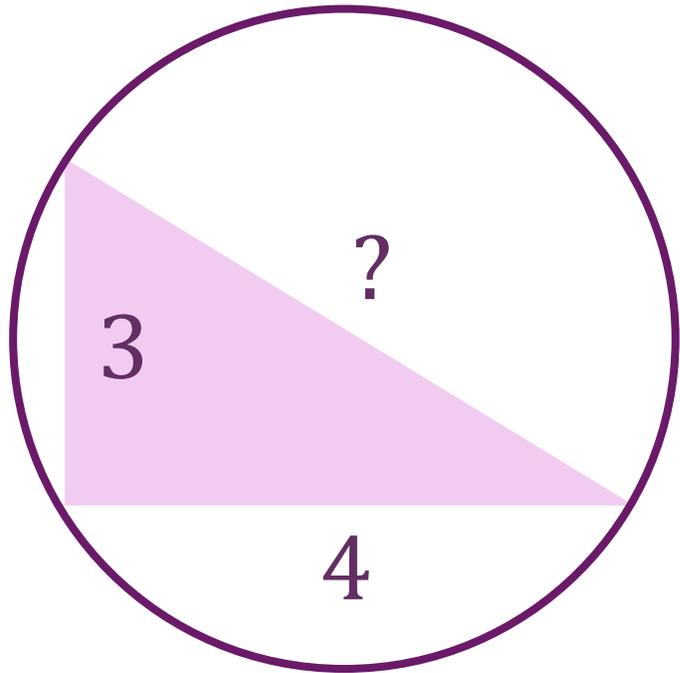
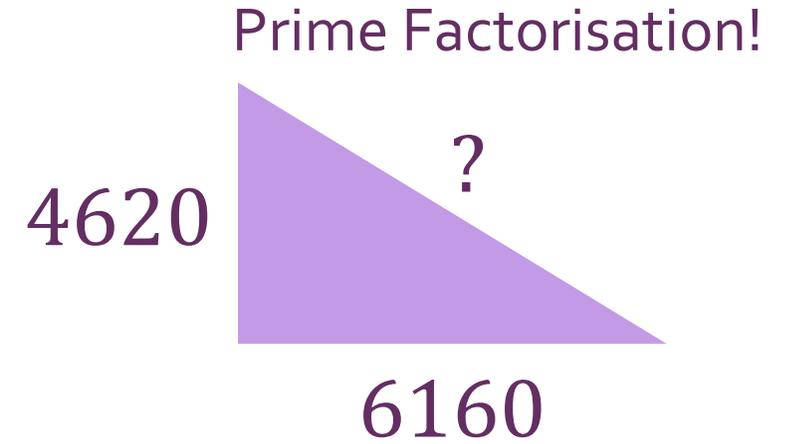
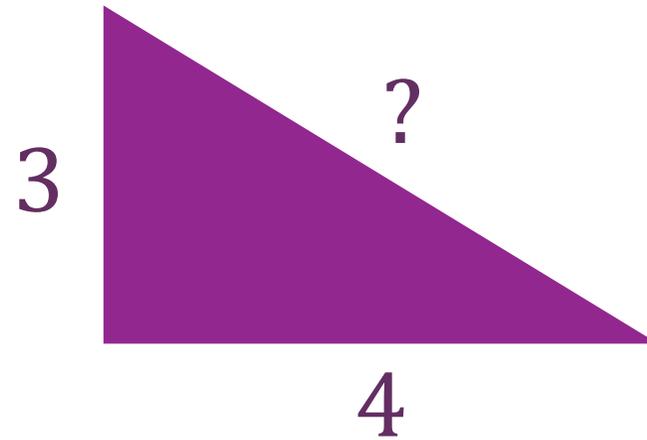
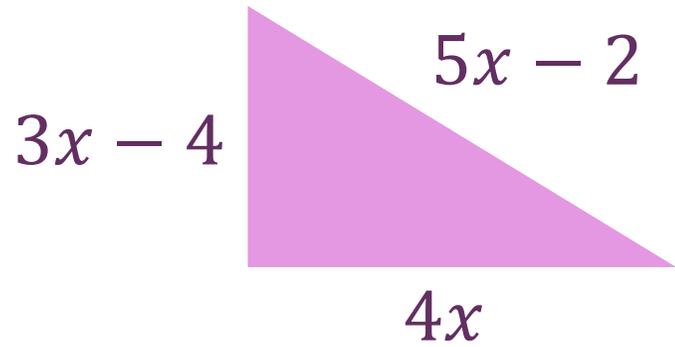
# Interweave this question.



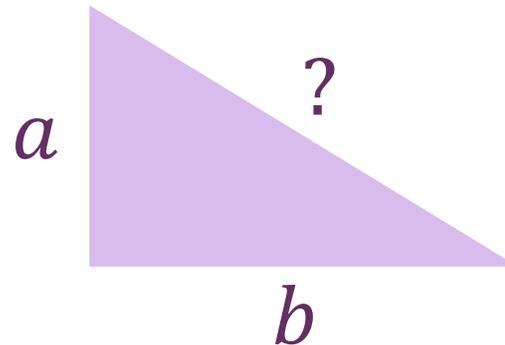
# Creating Interwoven Questions



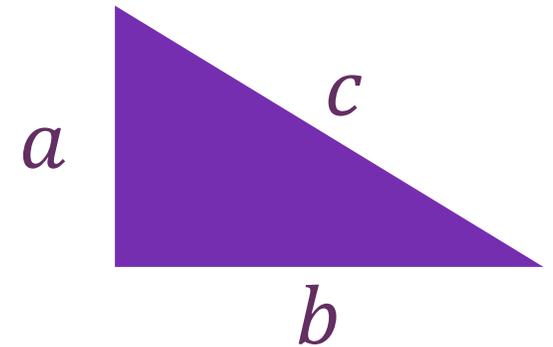
# Creating Interwoven Questions



$$P = 60, a : b = 3 : 4$$



$a$  and  $b$  are randomly chosen integers from 1 to 9.  
Probability  $c$  greater than 5?



# Interweave this question.

Solve

$$3x + 5 = 17$$

# Solving Linear Equations...

...with **Fractions**

...with **Decimals**

...with **Standard Form**

...with **Surds**

...with **Brackets**

...with **Substitution**

...with **Rounding**

...from **Indices**

...from **Areas**

...from **Perimeters**

...from **Percentages**

...from **Ratio**

...from **Probability**

...from **Sequences**

...from **Angle Sums**

...from **Parallel Lines**

...from **Circle Theorems**

...from **Similar Shapes**

...from **Averages**

...from **Functions**

...from **?**

# Solving Linear Equations with... **Standard Form**

1)  $x + 3 \times 10^6 = 5 \times 10^6$

2)  $0.7x + 3.3 \times 10^6 = 5.4 \times 10^6$

3)  $1.3x - 3.7 \times 10^{-3} = 5.4 \times 10^{-3}$

4)  $(2.3 \times 10^3)x = 9.2 \times 10^{-5}$

5)  $(6.1 \times 10^{11})x = 8 \times 10^6 - (3.5 \times 10^{11})x$

6)  $3 \times 10^{-2} + 5x = 3x + 8 \times 10^{-2}$

7)  $(3 \times 10^{-2})x + 5 = 3 + (8 \times 10^{-2})x$

8)  $8x + 2.6 \times 10^8 = 12x + 1.2 \times 10^8$

9)  $x + 3 \times 10^5 = 5 \times 10^6$

10)  $0.7x - 1.1 \times 10^4 = 5.4 \times 10^6$

11)  $1.3x + 5.3 \times 10^{-4} = 9 \times 10^{-7}$

12)  $(9.2 \times 10^3)x = 2.3 \times 10^{-5}$

13)  $(1.2 \times 10^{11})x = 8 \times 10^6 - (5 \times 10^9)x$

14)  $3 \times 10^{-2} + 5x = 3x + 8 \times 10^{-3}$

15)  $(2 \times 10^{-2})x - 7 = 11 + (8 \times 10^{-3})x$

16)  $11x + 2.4 \times 10^8 = 1.2 \times 10^{12} - 13x$

# Solving Trig Equations with... The Factor Theorem

Solve each equation in the given region:

Round answers to 1 decimal place, where appropriate.

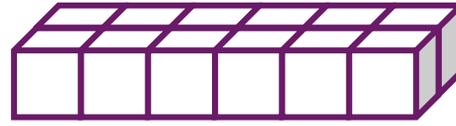
- 1)  $6 \sin^3 x - 5 \sin^2 x - 3 \sin x + 2 = 0$ , for  $0^\circ \leq x < 360^\circ$ ,
- 2)  $12 \cos^4 x - \cos^3 x - 18 \cos^2 x + \cos x + 6 = 0$ , for  $-180^\circ \leq x < 180^\circ$ ,
- 3)  $6 \tan^5 x + 35 \tan^4 x + 62 \tan^3 x + 35 \tan^2 x + 6 \tan x = 0$ , for  $0^\circ \leq x < 180^\circ$ .
  
- 4)  $2 \cos^3 x + 3 \sin^2 x - 8 \cos x - 6 = 0$ , for  $0^\circ \leq x < 720^\circ$ ,
- 5)  $-3 \sin(x) \cos^2 x + 11 \sin^2 x - 16 \sin x + 5 = 0$ , for  $-360^\circ \leq x < 360^\circ$ ,
- 6)  $\tan(x) \sin^2 x - 3 \sin^2 x - 10 \sin(x) \cos x + 24 \cos^2 x = 0$ , for  $-360^\circ \leq x < 0^\circ$ .
  
- 7)  $6 \sin^4 2x - 5 \sin^3 2x - 14 \sin^2 2x - \sin 2x + 2 = 0$ , for  $0^\circ \leq x < 180^\circ$ ,
- 8)  $5 \cos^5 3x - 19 \cos^4 3x - 9 \cos^3 3x + 79 \cos^2 3x - 44 \cos 3x - 12 = 0$ , for  $0^\circ \leq x < 120^\circ$ ,
- 9)  $\tan^4(4x + 5) - 27 \tan^2(4x + 5) - 14 \tan(4x + 5) + 120 = 0$ , for  $0^\circ \leq x < 90^\circ$ .

# Investigation into... Factors and Volumes

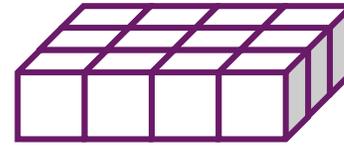
With 12 cubes, you can make 4 different cuboids:



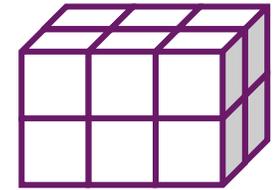
$1 \times 1 \times 12$



$1 \times 2 \times 6$



$1 \times 3 \times 4$



$2 \times 2 \times 3$

12 has 4 non-prime factors: 1, 4, 6, and 12.

*12 has the same number of non-prime factors as there are cuboids made from 12 cubes.*

## Investigation prompts:

a) How many cuboids can be made from 16 cubes? How many non-prime factors does 16 have?

b) Find numbers of cubes that can be made into exactly:

i) 1 cuboid

ii) 2 cuboids

iii) 3 cuboids

iv) 5 cuboids

v) 6 cuboids

How many non-prime factors do each of your answers have?

c) Is it always true that the number of non-prime factors is equal to the number of possible cuboids?

interwovenmaths.com

- 1) Try the questions first
- 2) Model carefully
- 3) Be selective
- 4) Adapt and improve!

interwovenmaths.com



# Interwoven Maths

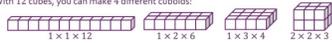
What is Interweaving? All the Tasks Submit Your Own! 

### Investigation into Factors and Volumes

InterwovenMaths.com

Investigation into... **Factors and Volumes**

With 12 cubes, you can make 4 different cuboids:



12 has 4 non-prime factors: 1, 4, 6, and 12.  
12 has the same number of non-prime factors as there are cuboids made from 12 cubes.

**Investigation prompts:**

- How many cuboids can be made from 16 cubes? How many non-prime factors does 16 have?
- Find numbers of cubes that can be made into exactly:
  - 1 cuboid
  - 2 cuboids
  - 3 cuboids
  - 4 cuboids
  - 5 cuboids
  - 6 cuboids
- How many non-prime factors do each of your answers have? It is **not** always true that the number of non-prime factors is equal to the number of possible cuboids. Find an example that shows this.

@mathsday14

In today's Year 8 lesson I discovered a startling fact: the number of cuboids you can make from  $n$  cubes is equal to the number...

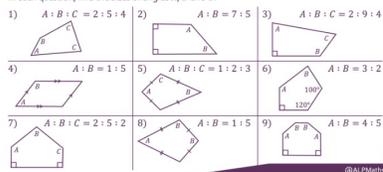
### Using Ratios to Find Angles in Polygons

InterwovenMaths.com

Using ratios to find... **Angles in Polygons**

In each question, find the sizes of angles  $A$ ,  $B$  and  $C$ .

- $A : B : C = 2 : 5 : 4$
- $A : B = 7 : 5$
- $A : B : C = 2 : 9 : 4$
- $A : B : C = 1 : 5$
- $A : B : C = 1 : 2 : 3$
- $A : B = 3 : 2$
- $A : B : C = 2 : 5 : 2$
- $A : B = 1 : 5$
- $A : B = 4 : 5$

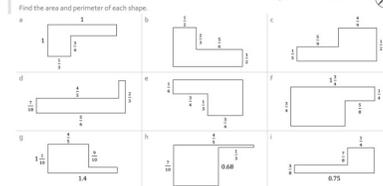


This brilliant task shared by Stephen Gregory (@ALPMaths) feels like the spiritual successor to Sam Blatherwick's wonderful task Using Ratios to Find Angles. I really...

### L-shapes with Fractions

InterwovenMaths.com

Find the area and perimeter of each shape.



This is my second post inspired by Jo Morgan's video about using the KS2 curriculum to inform Year 7 teaching, available here. This task looks...

### Rounding with...

InterwovenMaths.com

Rounding with... **Fractions and Decimals**

Shade all the cells that round to 0.1 to 1 decimal place.

0.02	0.06	0.1	0.14	0.18	0.228 + 0.122	0.122 + 0.128	0.128 + 0.018	0.18 + 0.06	0.06 + 0.08
0.1005	0.105	0.15	0.05	0.055	4 - 3.883	3.883 - 3.712	3.712 - 3.001	3.001 - 1.831	1.831 - 1.654
0.07	0.17	1.17	0.017	0.107	0.6 x 0.4	0.4 x 0.7	0.7 x 0.2	0.2 x 0.95	0.95 x 0.28
0.06	0.05	0.04	0.14	0.094	0.006 + 0.02	0.02 + 0.125	0.125 + 0.5	0.5 + 1.6	1.6 + 8

Shade all the cells that round to 0.5 to 1 decimal place.

1	1	1	2	5	10 + 1	1 + 1	1 + 2	2 + 1	1 + 1
36	44	52	25	33	52 + 41	41 + 52	52 + 4	4 + 52	52 + 33
105	105	105	105	105	87 + 4	4 + 7	7 + 4	4 + 7	7 + 10
33	33	33	33	33	10 + 1	2 + 2	2 + 2	2 + 1	1 + 2
101	100	99	101	99	2 + 1	1 + 3	3 + 10	10 + 28	28 + 57
1	1	1	1	1	2 + 2	1 + 3	3 + 10	10 + 28	28 + 57

- Complete the bottom row of each table in a way that continues the pattern.
- Which answers would change if, instead of rounding to 1 decimal place, you rounded to 1 significant figure?

### Area and Perimeter with Standard Form

InterwovenMaths.com

Area and Perimeter with... **Standard Form**

Fill in the gaps, giving all answers in standard form.

$w$	$h$	Area	Perimeter
1) $3 \times 10^6$	$4 \times 10^5$		
2) $9 \times 10^5$	$1.2 \times 10^6$		
3) $3 \times 10^4$	$2.4 \times 10^3$		
4) $3 \times 10^5$		$6.6 \times 10^6$	
5) $3 \times 10^4$	$6 \times 10^7$		
6) $6 \times 10^{12}$	$1 \times 10^7$		



@blmtn

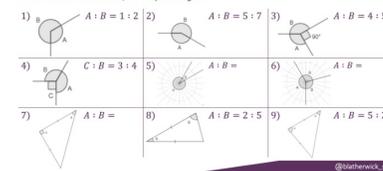
### Using Ratios to Find Angles

InterwovenMaths.com

Using ratios to find... **Angles**

Find the values of  $A$  and  $B$ , and any missing ratios.

- $A : B = 1 : 2$
- $A : B = 5 : 7$
- $A : B = 4 : 5$
- $C : B = 3 : 4$
- $A : B =$
- $A : B =$
- $A : B =$
- $A : B = 2 : 5$
- $A : B = 5 : 2$



This fantastic task kindly shared by