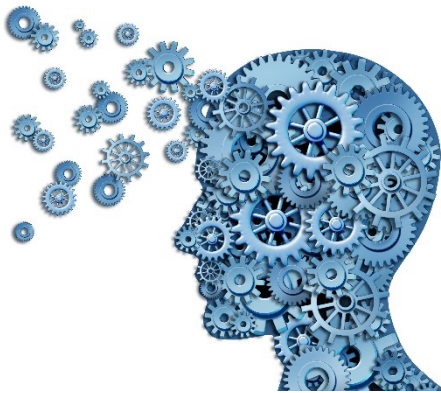


Name:

Set:



Unit	Topic	Complete
1	Integers and place value	
2	Decimals	
3	Indices and roots	
4	Factors, multiples and primes	
5	Standard Form	
6	Algebra basics	
7	Expanding and factorising	
8	Substitution	
9	Equations	
10	Transformations: rotations and translations	
11	Transformations: reflections and enlargements	
12	Fractions	
13	Fractions decimals and percentages	
14	Understanding probability	
15	Using probability diagrams	
16	Ratio	
17	Shapes and angle facts	
18	Angles in polygons	

# Pi Unit 1: Integers and Place Value

## Prior Knowledge

Order positive and negative numbers.

E.G.

-7, -3, -1, 0, 4, 9

Calculate with the four operations, written and mentally. That is to add, subtract, multiply and divide.

Write numbers in figures and words.

E.G.

Write three thousand and thirty two in figures = 3032

## Order of Operations

Use BIDMAS to help you remember the order you need to complete the operations.

E.g.  $3 \times (5 + 6) - 4$   
 $= 3 \times 11 - 4$   
 $= 33 - 4$   
 $= \underline{29}$

<b>B</b>	<b>Brackets</b>
<b>I</b>	<b>Indices</b>
<b>D</b>	<b>Division</b>
<b>M</b>	<b>Multiplication</b>
<b>A</b>	<b>Addition</b>
<b>S</b>	<b>Subtraction</b>

## Calculating with directed numbers:

For Multiplying follow the rules below, dividing uses the same rules.

$$\begin{array}{l} (+) \times (+) = (+) \\ (-) \times (-) = (+) \\ (+) \times (-) = (-) \\ (-) \times (+) = (-) \end{array}$$

E.G.

$$\begin{array}{l} -3 \times 9 = -27 \\ -28 \div -4 = 7 \end{array}$$

When adding and subtracting use a number line

To add: positive number move right, negative numbers move left

To subtract: positive numbers move left, negative move right

E.G.  $-3 + 7 = 4$

$2 + -5 = -3$



## Rounding to powers of 10

Rounding gives an approximation of a number.

E.G. if a town has 54,785 inhabitants you could say the population is approximately 55,000.

Problem solving:

230 has been rounded to the nearest ten, what is the smallest integer it could have been?

225 is the smallest that rounds to 230 to the nearest ten so 235.

## Literacy

Write the definition of rounding.

Use the word rounding within a sentence.

## Reasoning

Explain how to round to the nearest 100, you can use the number 3456 as an example.

Explain why we round numbers.

## Fluency

Calculate the following without a calculator

- 1)  $3 - 7$       2)  $5 - 9$       3)  $-3 + 4$       4)  $-5 + 3$       5)  $5 - -7$

Complete the following table about rounding to powers of 10

Number	Nearest 10	Nearest 100	Nearest 1000
3425			
7832			
2893			
8994			

Calculate the following without a calculator

- 1)  $5 + 2 \times 3$       2)  $3 + 4 \times (3 + 2)$       3)  $(7 - 3) \times (2 + 4 \times 2)$

## Problem Solving

- 1) The temperature at 2pm is  $5^{\circ}\text{C}$ , by 9pm the temperature has fallen by  $8^{\circ}\text{C}$ , what is the temperature at 9pm?
  
- 2) On a different day the temperature at 3pm is  $2^{\circ}\text{C}$  and at 3am it is  $-7^{\circ}\text{C}$ . What is the difference in temperature between 3pm and 3am?

## Pi Unit 2: Decimals

### Prior Knowledge

To order decimals, put zeros on the end to have the same number of decimal places to compare the place value of the decimal places.

E.G. 3.680, 3.688, 3.800, 3.866

To add or subtract decimals use the column method and line up the decimal points for place value.

To multiply decimals multiply the numbers as whole numbers, then use estimation to change the place value of your answer at the end.

To divide decimals use short division.

### Related calculations

You can be given the answer for a large calculation and asked to use this fact to adapt the place value for related calculations.

E.G. Given that  $367 \times 248 = 91016$

Use this to work out  $3.67 \times 248$ . 3.67 is 100 times smaller than 367 so the answer should also be 100 times smaller, therefore  $3.67 \times 248 = 910.16$

$91016 \div 24.8 = 910160$  (the divisor is 10 times smaller, so the answer is 10 times bigger).

### Rounding to significant figures

A way of rounding numbers is to count only the first few digits (maybe 1, 2, or 3 figures) that have a value attached to them. This method of rounding is called **significant figures** and it's often used with larger numbers, or very small numbers.

E.G.

	26548	19.2731	0.006518
1 significant figure	30000	20	0.007
2 significant figures	27000	19	0.0065
3 significant figures	26500	19.3	0.00652

### Estimating

A calculation can be approximated, or estimated, by rounding the values within it before performing the operations.

E.G. Estimate  $38 \times 74 \approx 40 \times 70 = 2800$

## Literacy

Write the definition of integer.

Use the word integer within a sentence.

## Reasoning

James calculates  $4.5 \times 3.2$  as 144.

Without doing the calculation explain how you know James is incorrect.

## Fluency

Calculate the following without a calculator

1) *Given that  $34 \times 567 = 19278$  what is  $3.4 \times 5.67$ ?*

Complete the following table about rounding to the given significant figure.

Number	1 significant figure	2 significant figures	3 significant figures
43289			
234			
0.0005673			
34.21			

Estimate the following

1)  $5 + 2 \times 3$

2)  $3 + 4 \times (3 + 2)$

3)  $(7 - 3) \times (2 + 4 \times 2)$

## Problem Solving

1) Mr Greenwood wants to buy pens for his class of 27 students, each pen costs 67p. A) Estimate how much this will cost Mr Greenwood.

Is your answer an overestimate or underestimate, you must explain your reasoning

# Pi Unit 3: Indices and Roots

## Prior Knowledge

Square numbers up to  $15^2$

1, 4, 9, 16, 25, 36, 49,  
64, 81, 100, 121, 144,  
169, 196, 225

Cube numbers up to  $5^3$  and  $10^3$

1, 8, 27, 64, 125, 1000

Apply BIDMAS to all calculations with more than 1 operation.

Brackets  
Indices  
Divide  
Multiply  
Add  
Subtract

## Laws of indices

Indices show how many times a number or letter has been multiplied by itself. The laws of indices make complex calculations easier, if they have the same base.

When multiplying, add the indices.

E.G.  $b^7 \times b^4 = b^{11}$

When dividing, subtract the indices.

E.G.  $t^5 \div t^2 = t^3$

With brackets, multiply the indices.

E.G.  $(n^4)^3 = n^{12}$

## Standard form

**Standard form** is a system of writing very large or small values based on using powers of 10. **Standard form** is written in the form of  $a \times 10^n$ , where  $a$  is a number bigger than or equal to 1 and less than 10;  $n$  can be any positive or negative whole number.

E.G.  $46,000,000 = 4.6 \times 10^7$

$0.0000277 = 2.77 \times 10^{-5}$

## Adding and Subtracting in Standard form

E.G.  $4.6 \times 10^7 + 3.2 \times 10^6$

Step 1: Convert to ordinary numbers.  $46000000 + 3200000$

Step 2: Add/Subtract using a column method.

$$\begin{array}{r} 4 \ 6 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \\ + \quad 3 \ 2 \ 0 \ 0 \ 0 \ 0 \ 0 \\ \hline 4 \ 9 \ 2 \ 0 \ 0 \ 0 \ 0 \ 0 \end{array}$$

Step 3: Convert back to standard form.  $4.6 \times 10^7 + 3.2 \times 10^6 = 4.92 \times 10^7$

### Literacy

Explain the meaning of the word “power” in maths.

Write a sentence containing the word “power”.

### Reasoning

a) Use a calculator to evaluate  $(3.6 \times 10^4) \times (8 \times 10^5)$

b) Use index laws to work out  $(1.44 \times 10^7) \times (2 \times 10^3)$

c) Explain why your answers to (a) and (b) are the same.

### Fluency

Use index laws to evaluate

$$4^6 \times 4^3 =$$

$$4^6 \div 4^3 =$$

$$4^5 \times 4^6 \times 4 =$$

$$(4^6)^3 =$$

$$\frac{4^6}{4^2} =$$

$$\frac{4^6 \times 4^4}{4^5} =$$

Write these numbers in standard form

$$200 =$$

$$0.6 =$$

$$5300 =$$

$$0.45 =$$

$$38500 =$$

$$0.008 =$$

$$4670000 =$$

$$0.00789 =$$

Write these as ordinary numbers

$$3.9 \times 10^2 =$$

$$1.866 \times 10^4 =$$

$$5.06 \times 10^{-3} =$$

### Problem Solving

1) A large rock has a weight of  $3.1 \times 10^4$  grams. Find, in standard form, the weight of 12 of these large rocks.

2) The area of the Pacific Ocean is  $3.61 \times 10^8$  km<sup>2</sup>. The area of the Atlantic Ocean is  $8.51 \times 10^7$  km<sup>2</sup>. Find the total area of both oceans. Give your answer in standard form.

# Pi Unit 4: Factors, Multiples and Primes

## Prior Knowledge

Understand prime numbers: These numbers have only 2 factors, themselves and 1.

The first ten prime numbers are: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29.

Understand factors: A factor is an integer which when multiplied by another integer, gives the value.

E.G. the factors of 24 are 1, 24, 2, 12, 3, 8, 4 and 6.

Understand multiples: A multiple of a number is a number which is created from multiplying that number by an integer.

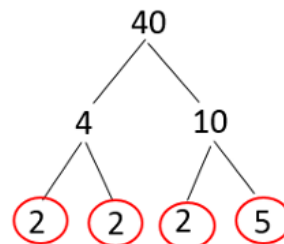
E.G. the first 5 multiples of 6 are 6, 12, 18, 24, 30.

## Product of Primes

Write the number as a product of primes (prime numbers that multiply together to make the number)

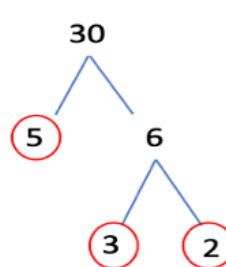
E.G.

$$40 = 2 \times 2 \times 2 \times 5 = 2^3 \times 5$$

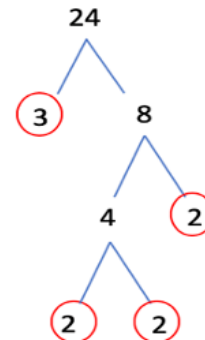


## Highest Common Factor and Lowest Common Multiple

Step 1: Express as a product of prime factors.

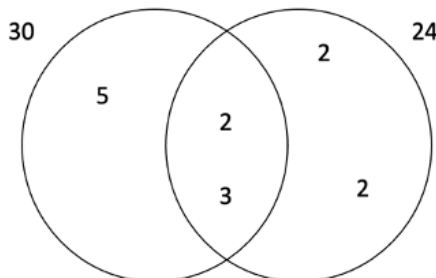


$$30 = 2 \times 3 \times 5$$



$$24 = 2 \times 2 \times 2 \times 3$$

Step 2: Construct a Venn Diagram using the prime factors.



HCF = Intersection multiplied together (middle section) =  $2 \times 3 = 6$

LCM = Union multiplied together (all numbers) =  $2 \times 2 \times 2 \times 3 \times 5 = 120$



### Literacy

Explain what a factor of a number is.

Write a sentence to describe what a prime number is.

### Reasoning

Stephen thinks that 39 is a prime number. Is he correct?

Give a reason for your answer.

### Fluency

1) Write these numbers as a product of their prime factors

40

125

280

2) Use a Venn diagram to find the highest common factor and lowest common multiple of 40 and 125.

### Problem Solving

1) The HCF of two numbers is 20 and the LCM is 200. What could the two numbers be?

2) A bell rings every thirty minutes. Another bell rings every 40 minutes. If both bells ring at 10.00am, when is the next time that both bells will ring at the same time?

## Pi Unit 5: Standard Form

### Prior Knowledge

Multiply and divide by powers of 10.

E.G.

$$3.4 \times 10 = 34$$

$$5.8 \times 1000 = 5800$$

Use index laws of multiplication and division.

E.G.

$$10^5 \times 10^7 = 10^{12}$$

$$10^{-3} \times 10^9 = 10^6$$

$$10^8 \div 10^3 = 10^5$$

$$10^{-3} \div 10^6 = 10^{-9}$$

Calculate with decimals, including multiplication.

E.G.

$$1.5 \times 2 = 3$$

$$2.4 \times 1.6 = 3.84$$

### Writing in standard form

Standard form can be used to write very large or very small values more efficiently. Numbers in standard form must be **between 1 and 10**.

Large Numbers (positive powers)

E.G.  $3400000000000 = 3.4 \times 10^{12}$

$$6.43 \times 10^7 = 64300000.$$

Small Numbers (negative powers)

E.G.  $0.0000045 = 4.5 \times 10^{-6}$

$$5.67 \times 10^{-3} = 0.00567.$$

Note the following are **not** standard form:  $5.4^3$ ,  $32.5 \times 10^7$ ,  $6.2 \div 10^8$ .

### Calculate with Numbers in Standard Form

When adding and subtracting standard form numbers, an easy way is to convert the numbers from standard form into decimal form or ordinary numbers, complete the calculation, convert the answer back into standard form.

E.G.

Calculate  $4.5 \times 10^4 + 6.45 \times 10^6$ .

$$= 45,000 + 6,450,000 = 6,495,000 = 6.495 \times 10^6$$

When multiplying and dividing you can use the Laws of Indices. First multiply or divide the first numbers, second apply the Laws of Indices to the powers of 10, third make sure your answer is in standard form.

E.G.

Calculate  $(3 \times 10^3) \times (5 \times 10^9)$ .

$$3 \times 5 = 15, 10^3 \times 10^9 = 10^{12}. \text{ Meaning } (3 \times 10^3) \times (5 \times 10^9) = 15 \times 10^{12} = 1.5 \times 10^{13}.$$

## Literacy

Explain what standard form is used for.

Explain how to change a large number into standard form.

## Reasoning

1 googol is  $1 \times 10^{100}$

Danesh says,

"When I multiply  $1.496 \times 10^{11}$  by  $6.68 \times 10^9$  I get nearly 1 googol because  $1.496 \times 10^{11} \times 6.68 \times 10^9 = 9.99 \times 10^{99}$ "

Is Danesh correct?

## Fluency

Write the following numbers in standard form.

(a) 40000

Work out, giving each answer in standard form.

(a)

$$(4 \times 10^5) \times (2 \times 10^4)$$

(b) 5600

(b)

$$(5 \times 10^6) \times (7 \times 10^8)$$

(c) 41200000

## Problem Solving

The number of visitors to some tourist attractions is shown in the table below.

The King's Palace	5.4 million
Castle	923,840
Theme Park	$1.43 \times 10^7$
Science Museum	4,192,900

(a) Write the number of visitors to the Theme Park as an ordinary number.

.....

(b) Write the number of visitors to the Castle in standard form.

.....

(c) How many more people visited the Theme Park than the Science.

## Pi Unit 6: Algebra

### Prior Knowledge

Dividing expressions:

$$\frac{8a^3}{2a} = 4a^2$$

Key Algebraic facts:

$$\begin{aligned}y + y + y &= 3y \\ r \times r &= r^2 \\ 3a + 5a + a &= 9a \\ 2d \times 6d &= 12d^2\end{aligned}$$

### Index Laws

When multiplying indices you add the powers:  $a^m \times a^n = a^{m+n}$ .

E.G.

$$a^5 \times a^6 = a^{11}$$

When dividing indices you subtract the powers:  $b^m \div b^n = b^{m-n}$ .

E.G.

$$b^8 \div b^2 = b^6$$

When using brackets with indices you multiply the powers:  $(c^m)^n = c^{mn}$ .

E.G.

$$(c^5)^3 = c^{15}$$

### Simplifying expressions (adding/subtracting):

'Collect like terms', you cannot collect terms that are not the same.

E.G. x and y.

Always include the sign in front of the term.

$$\boxed{7h} + \boxed{2m} - \boxed{3h} + \boxed{4m} = 4h + 6m$$

### Term, Expression, Equation, Formula and Identity

**Term:** a single number or variable, or the product of several numbers or variables.

E.G. these are terms 3, 5a, b, and 7rg.

**Expression:** A collection of terms added or subtracted from one another.

E.G.  $4a + 5b - 7$

**Equation:** A statement that two expressions are equal, which only occurs when a variable takes a set value.

E.G.  $4a + 5 = 2a - 5$

**Formula:** A collection of expressions used to show the relationship between variables.

E.G.  $A = L \times W$

**Identity:** An equation which is true no matter what values are chosen for the variable.

E.G.  $4 + a \equiv a + 4$

## Literacy

Explain what a “term” is in algebra.

Write a sentence that uses the word “expression”.

## Reasoning

Sarah says that  $p^2 + p^2 = p^4$ . Is she correct?  
Explain your answer.

## Fluency

1) Simplify these expressions:

a)  $g + g + g + g$

b)  $a + 4a + 3a + 2a$

c)  $7m + 6y + 3m + 4y + m$

d)  $8k + 4j - 2k + 5j + 2k - 7j$

e)  $3a + a^2 - 2c + 5a - 3a^2 + 5c$

2) Use laws of indices to simplify these expressions:

$$t^6 \times t^3 =$$

$$v^6 \div v^5 =$$

$$f^5 \times f^6 \times f = (h^4)^2$$

$$(3e^4)^3 =$$

$$\frac{4d^7}{2d^2} =$$

$$\frac{12m^6 \times 3m^4}{4m^5} =$$

$$2d^2$$

$$4m^5$$

## Problem Solving

1) Tom is one year younger than Jill and Jill is twice as old as Mark. Write an expression in  $x$  for the total of their ages.

2) a) Write  $2^3 \times 4^2$  as a single power of 2.

b) Write  $5^4 \times 25^2$  as a single power of 5.

c) Write  $10^3 \times 100^2 \times 1000$  as a single power of 10.

# Pi Unit 7: Expanding and Factorising

## Prior Knowledge

Be able to multiply two terms together.

Simplifying algebra by collecting like terms.

Recognise common factors.

## Multiplying algebraic expressions

To multiply two, or more, algebraic expressions together we multiply the coefficients.

Examples

$$3a \times 5b = 15ab$$

$$2c \times 3d \times 10e = 60cde$$

$$4h \times 7h = 28h^2$$

## Expanding Brackets

Use the grid method to multiply everything inside the bracket by the term in front of the bracket:

E.G.

$$3(5a - 2) = 15a - 6$$

	5a	-2
3	15a	-6

## Forming expressions

An expression is formed when algebra is used to represent a statement or situation.

E.G.

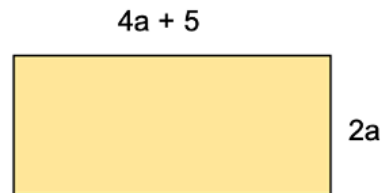
A shop sells 6 pens at x pence each. The same shop sells 10 rulers at y pence each.

Write an expression for the total cost of the 6 pens and 10 rulers:

$$\text{Pens} = 6x \quad \text{Rulers} = 10y \quad \text{Total} = 6x + 10y.$$

E.G.

Form an expression for the perimeter of the rectangle



To find the perimeter you need to add all sides and collect the like terms.

$$\text{Perimeter} = 4a + 5 + 2a + 4a + 5 + 2a = 12a + 10.$$

## Factorising

Find the **highest common factor** of the expression to put the brackets back in:

E.G.

$$24h + 16 = 8(3h + 2)$$

(8 is the HCF of 24h and 16)

$$12x^2 - 9x = 3x(4x - 3)$$

(3x is the HCF of  $12x^2$  and 9x)

## Literacy

Explain what is meant by “expand the bracket” in maths.

Use the word “factorise” in a sentence.

## Reasoning

Nicola says  $6(4b + 2) - 3(b - 1) = 21b + 9$

Is she correct?

Give a reason for your answer.

## Fluency

1) *Expand:*

(a)  $3(n - 2)$

(b)  $4(5g + 7)$

(c)  $6(4h - 2f + e)$

(d)  $2(9 - 3k)$

(e)  $4st(3s + 6t)$

3) *Factorise these expressions:*

(a)  $4r + 6$

(b)  $15m - 12$

(c)  $14 + 7y$

(d)  $t^2 + 4t$

(e)  $20j - 10j^2$

2) *Expand and simplify:*

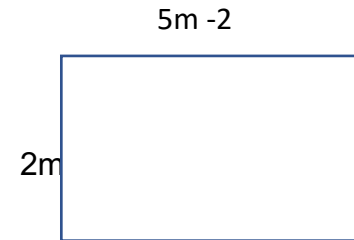
(a)  $6(m + 4) + 2(3m + 2)$

(b)  $8(3j + 3) - (4j + 2)$

(c)  $5(9c - 2) - 3(5c + 1)$

## Problem Solving

Write expressions for the perimeter and area of the rectangle below.



## Pi Unit 8: Substitution

### Prior Knowledge

Work with negative numbers

Substitute into:

- Simple expressions
- Expressions involving brackets
- Expressions involving indices
- A given formula
- A worded formula

### Worded Formula

E.G.

There are 4 batteries in a small pack of batteries.

There are 12 batteries in a large pack of batteries.

Write down a formula for  $T$  in terms of  $x$  and  $y$ .

$4x$  Batteries from small pack  
 $12y$  batteries from large packs

So the total  $T = 4x + 12y$ .

If Lottie buys 5 small packs and 8 large packs, how many batteries will she have?

$$T = 4 \times 5 + 12 \times 8 = 20 + 96 = 116$$

### Formula based exam question:

E.G.

This formula works out the tax you pay.

$$T = 0.2(E - 10\,600)$$

$T$  is the tax you pay in pounds.

$E$  is the amount you earn in pounds.

- a) How much tax do you pay if you earn £20 000?

Substitute  $E = 20000$

$$T = 0.2(20000 - 10600) = 0.2 \times 9400 = 1880$$

- b) What is the most you can earn without paying tax?

10600 (below this would produce negatives)

### Substitution

Substitution is replacing a letter with a value. Remember when a letter and number are written next to one another it means they are multiplied together.

Remember to use BIDMAS.

E.G. if  $a = 3$  and  $b = 5$ , find the value of  $9a + 2b$ .

$$9a = 9 \times 3 = 27$$

$$2b = 2 \times 5 = 10$$

$$9a + 2b = 27 + 10 = 37$$



## Literacy

Explain what a “formula” is in maths.

Write a sentence containing the word “substitute”.

## Reasoning

John substitutes the value  $a = 3$  into the formula  $c = 3a^2$ . He gets the answer 81. Do you agree with John? Give a reason for your answer.

## Fluency

1) If  $x = 4$  and  $y = -2$ , find the value of :

- (a)  $4x$                       (b)  $2x + y$                       (c)  $x^3$                       (d)  $y^2$
- (e)  $4x + y$                       (f)  $5x + 3y$                       (g)  $2x - 3y$                       (h)  $5x^2$

2) Work out the value of these formulae if  $p = 2$ ,  $q = 5$  and  $r = 3$

- (a)  $T = 3q$                       (b)  $M = 5p + 3q - r$                       (c)  $E = pqr$
- (d)  $U = 2q^2$                       (e)  $D = r^2 - p^2$                       (f)  $H = \frac{3pq}{2r}$

## Problem Solving

- 1) Brian is a plumber. He charges a £20 call-out fee and £30 per hour.
- (a) Write a formula to show the total cost (**C**) charged for a job lasting **h** hours.
- C** =
- (b) How much would Brian charge for a job lasting 5 hours?
- (c) Brian charges £380 for a job. How many hours did the job last?

# Pi Unit 9: Equations

## Prior Knowledge

Understand inverse operations.

Simplify expressions.

Expand single brackets.

E.G.

$$3(5a - 2) = 15a - 6$$

$$\begin{array}{r|l} & 5a & -2 \\ \hline 3 & 15a & -6 \end{array}$$

## Solving 1-step equations

Do the inverse to balance the equation to solve:

E.G.

$$\begin{array}{r} e + 5 = 7 \\ -5 \quad -5 \\ \hline e = 2 \end{array}$$

## Solving 2-step equations

Do the inverse to balance the equation to solve:

$$\begin{array}{r} \text{E.G. } 2h - 7 = 11 \\ \quad +7 \quad +7 \\ \hline 2h = 18 \\ \quad \div 2 \quad \div 2 \\ \hline h = 9 \end{array}$$

## Solving equations with brackets

Expand the bracket then do the inverse to balance the equation to solve:

$$\begin{array}{r} \text{E.G. } 2(3k + 4) = 46 \\ 6k + 4 = 46 \\ \quad -4 \quad -4 \\ \hline 6k = 42 \\ \quad \div 6 \quad \div 6 \\ \hline k = 7 \end{array}$$

## Rearranging Formula

A formula gives a rule for calculating one unknown, you can rearrange this to make x the 'subject', this means you want the formula to start with x.

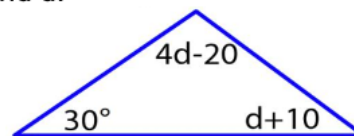
E.G. Make x the subject in  $3x + y = p$

$$\begin{array}{r} 3x + y = p \\ \quad -y \quad -y \\ \hline 3x = p - y \\ \quad \div 3 \quad \div 3 \\ \hline x = \frac{p-y}{3} \end{array}$$

## Form and Solve Equations

When we are given a context we need to form an equation, which we then solve.

E.G. Here is triangle, find d.



Step 1: Form an expression by adding the angles together:  $4d - 20 + 30 + d + 10 = 5d + 20$

Step 2: We know angles in a triangle equal  $180^\circ$ , so we can form an equation and then solve.

$$\begin{array}{r} 5d + 20 = 180, \text{ now we solve} \\ \quad -20 \quad -20 \\ \hline 5d = 160 \\ \quad \div 5 \quad \div 5 \\ \hline d = 32 \end{array}$$

## Literacy

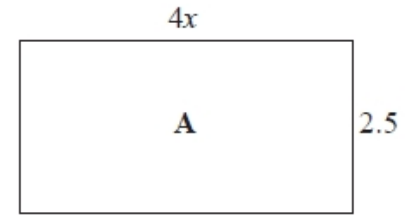
Explain the difference between an equation and an expression

What does 'solve' mean?

## Reasoning

The diagram shows the plan of a floor.  
The area of the floor is  $50\text{m}^2$ .

What would the perimeter of the shape be?  
Explain how you know.



## Fluency

Solve the following:

a)  $d + 7 = 9$

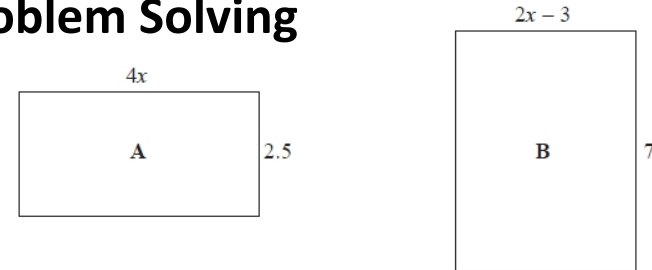
b)  $2w - 1 = 13$

c)  $18 - 4a = 2$

d)  $3(y + 4) = 24$

e)  $4(2x - 5) = 5x + 4$

## Problem Solving



All measurements are in centimetres.

The area of rectangle **A** is equal to the area of rectangle **B**.

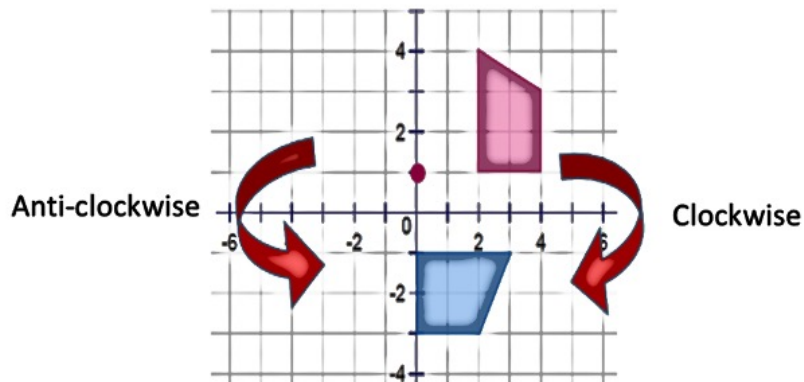
Work out the perimeter of rectangle **B**.

# Pi Unit 10: Transformations 1: Rotations and Translations

## Prior Knowledge

Know how to do rotations around a point.

E.G. Rotate the pink shape 90° clockwise around the point (1,2).



Steps:

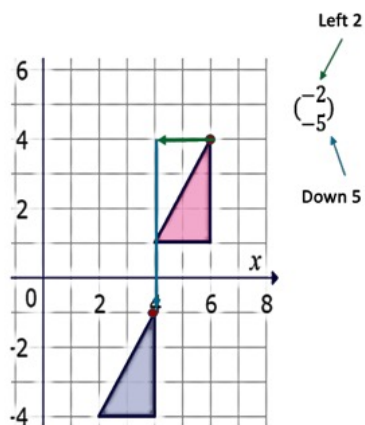
1. Plot the centre point.
2. Use tracing paper to turn the shape the correct angle in the given direction.

Know how to perform translations using column vectors.

E.G.

Translate the pink

shape by the vector  $\begin{pmatrix} -2 \\ -5 \end{pmatrix}$

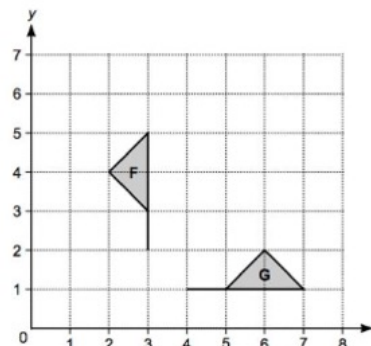


## Describe a Rotation

To describe a rotation your sentence must include three pieces of information; Direction, centre and degrees of turn.

E.G.

Describes the single transformation that maps F onto G.



A rotation of 90° clockwise around centre (2,1).

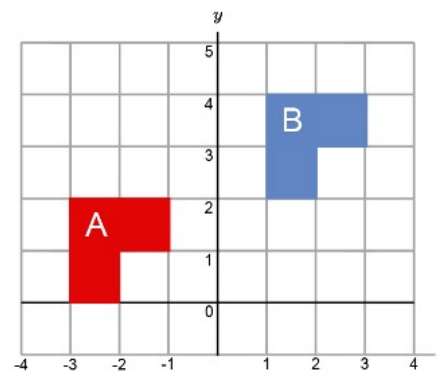
## Describe a Translation

To describe a translation your sentence must contain a vector.

E.G.

Describes the single transformation that maps A onto B

A translation by the vector  $\begin{pmatrix} 4 \\ 2 \end{pmatrix}$ .



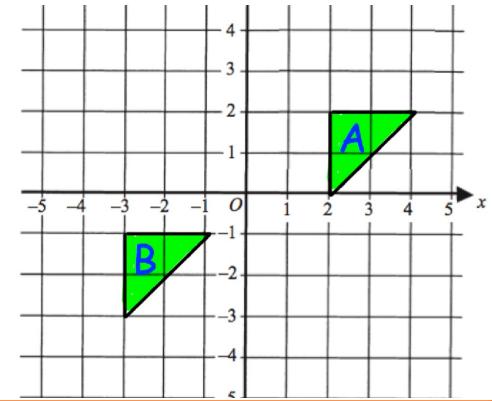
## Literacy

Write the definition of similarity

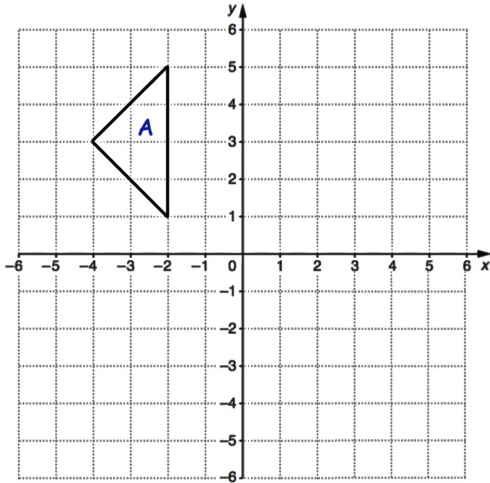
Write the definition of a vector

## Reasoning

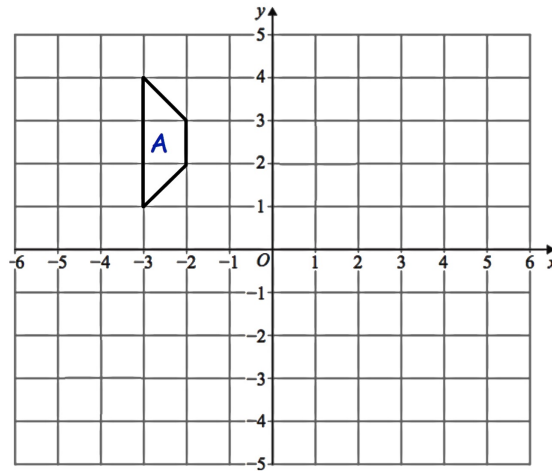
Describe fully the single transformation that maps shape A to shape B.



## Fluency



Translate triangle A by  $\begin{pmatrix} 5 \\ -6 \end{pmatrix}$ .



Rotate trapezium A  $90^\circ$  anticlockwise about the origin.

## Problem Solving

Here is a square.



(a) On the square, draw all the lines of symmetry.

Here is a rectangle.



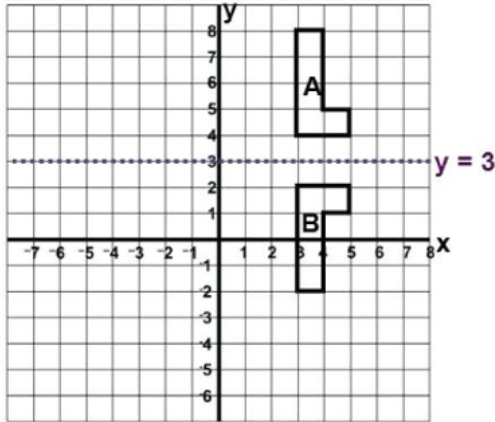
(b) Write down the order of rotational symmetry of the rectangle.

.....

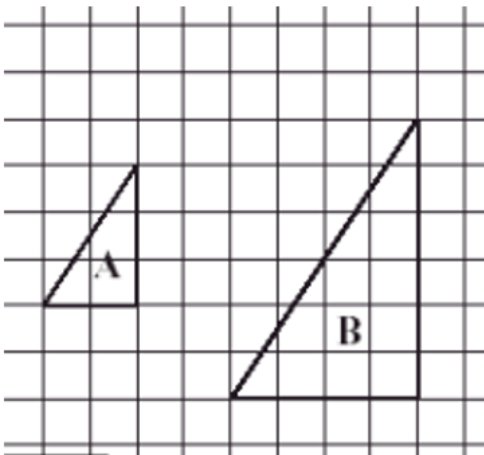
# Pi Unit 11: Transformations 2: Reflections and Enlargements

## Prior Knowledge

Know how to do a reflection.  
E.G. Reflect shape A in the line  $Y = 3$ .



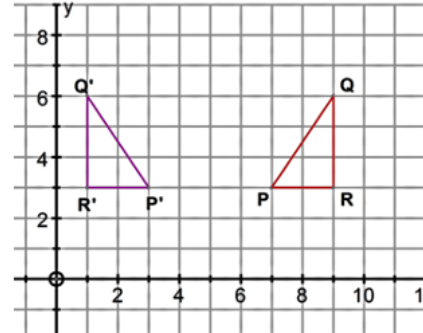
Perform a basic enlargement.  
E.G. Enlarge shape A by Scale factor 2.



## Describe a Reflection

To describe a reflection you need to find the mirror line.

E.G.  
Describes the single transformation that triangle PQR onto P'Q'R'.



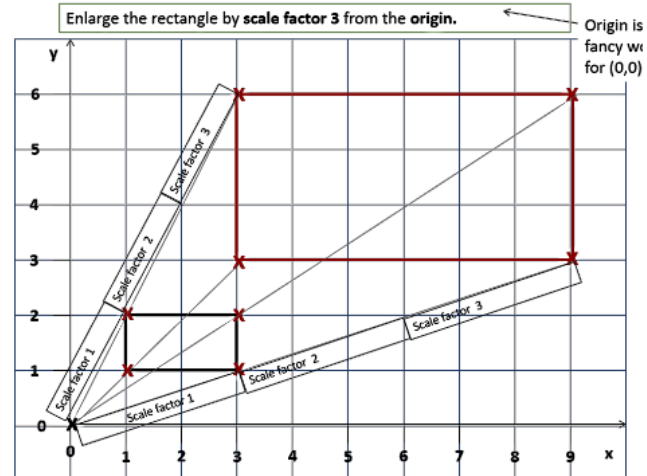
A reflection in the line  $x = 5$ .

## Enlargement from centre

When enlarging a shape from a given centre, you must count out from the centre to each point and then enlarge this distance by the given scale factor.

In order to describe an enlargement you need 2 pieces of information in the sentences

- Scale factor
- Centre of enlargement



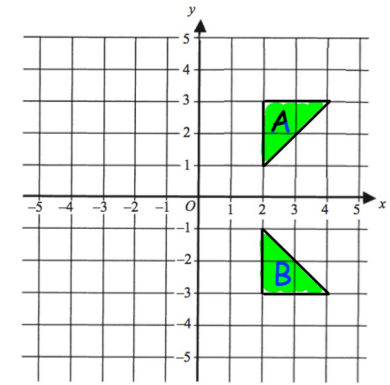
## Literacy

Write the definition of congruent.

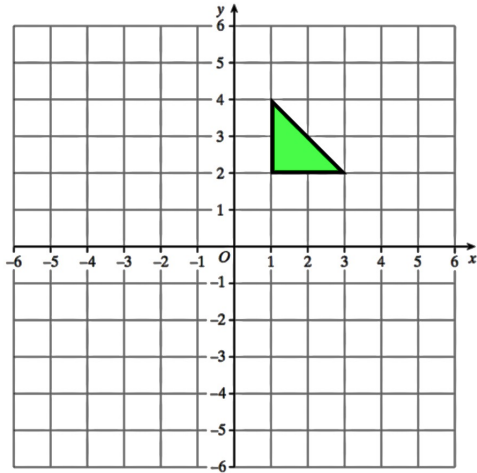
If you are asked to describe the single transformation, what does this mean?

## Reasoning

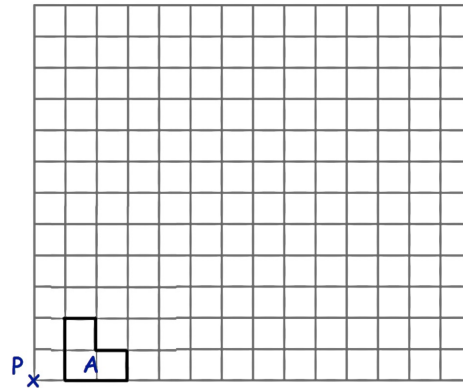
Describe fully the single transformation that maps shape A to shape B.



## Fluency



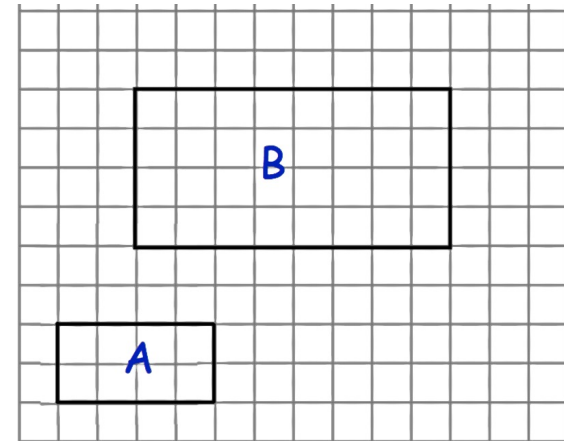
Reflect the triangle in the line  $y = -1$ .



Enlarge the shape by a scale factor 4, using point P as the centre of enlargement.

## Problem Solving

Work out the area of rectangle A.



Rectangle B is an enlargement of rectangle A. What is the scale factor of the enlargement?

# Pi Unit 12: Fractions

## Prior Knowledge

Simplify fractions.

Convert between improper fractions to mixed numbers.  
To convert to a mixed number you need to see how many times the denominator fits into the numerator.

E.G.

$$\frac{14}{5} = 2\frac{4}{5} \qquad 3\frac{2}{7} = \frac{23}{7}$$

Compare/ order fractions, by finding a common denominator.

Add/subtract fractions with the same denominator or different denominators.

E.G.

Multiply the first fraction by 5.  
Multiply the second fraction by 3.

$$\frac{2}{3} + \frac{1}{5} = \frac{10}{15} + \frac{3}{15} = \frac{13}{15}$$

LCM of 3 and 5 is 15.

Multiply and divide fractions.

When multiplying: multiply numerators together, multiply denominators together.

When dividing: use the reciprocal of the second fraction, then multiply.

E.G.

Multiply numerators.  
Reciprocal of 4/7.  
Multiply denominators.

$$\frac{2}{3} \div \frac{4}{7} = \frac{2}{3} \times \frac{7}{4} = \frac{14}{12} = \frac{7}{6}$$

## Four operations with Mixed Numbers

The four operations with mixed numbers work the same as ordinary fractions, however you need to convert the mixed numbers to improper fractions first.

E.G. Work out  $3\frac{3}{4} \times 4\frac{2}{3}$

Step 1:

Convert to improper fractions =  $\frac{15}{4} \times \frac{14}{3}$

Step 2:

Calculate as before  $\frac{15}{4} \times \frac{14}{3} = \frac{15 \times 14}{4 \times 3} = \frac{210}{12} = \frac{35}{2}$

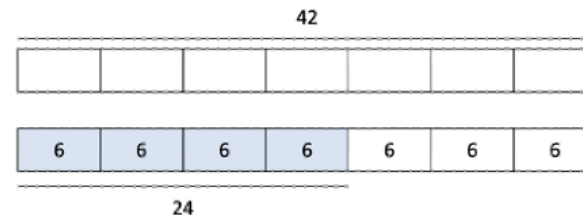
Step 3:

Convert to mixed number if necessary  $\frac{35}{2} = 17\frac{1}{2}$

## Finding fractions of amounts

E.G. Find  $\frac{4}{7}$  of 42

$$\frac{1}{7} \text{ of } 42 = 42 \div 7 = 6$$



$$\frac{4}{7} \text{ of } 42 = 4 \times 6 = 24$$



## Literacy

Create a fraction of amount question that you might be asked to work out.

## Reasoning

Write these five fractions in order of size.

Start with the smallest fraction.

$$\frac{3}{4} \quad \frac{1}{2} \quad \frac{3}{8} \quad \frac{2}{3} \quad \frac{1}{6}$$

## Fluency

(a) Work out  $\frac{1}{7} \times \frac{2}{3}$

(b) Work out  $\frac{3}{5} - \frac{1}{3}$

A school has 1200 pupils.  
575 of these pupils are girls.

$\frac{2}{5}$  of the girls like sport.

$\frac{3}{5}$  of the boys like sport.

Work out the total number of pupils in the school who like sport.

## Problem Solving

Suha has a full 600 ml bottle of wallpaper remover.  
She is going to mix some of the wallpaper remover with water.

Here is the information on the label of the bottle.

**Wallpaper remover**  
600 ml  
Mix  $\frac{1}{4}$  of the wallpaper remover  
with 4500 ml of water

Suha is going to use 750 ml of water.

How many millilitres of wallpaper remover should Suha use?  
You must show your working.

# Pi Unit 13: Fractions, Decimals and Percentages

## Prior Knowledge:

Basic equivalent fraction, decimals and percentages.

Fraction	Decimal	Percentage
$\frac{1}{2}$	0.5	50%
$\frac{1}{4}$	0.25	25%
$\frac{3}{4}$	0.75	75%
$\frac{1}{10}$	0.1	10%
$\frac{1}{5}$	0.2	20%

Convert between percentages to decimals.

E.G.

Percentage to Decimal      Decimal to Percentage  
 $34\% = 0.34$                        $0.54 = 54\%$

Convert between fractions to decimals.

E.G.

Fraction to Decimal

$$\frac{1}{4} = 1 \div 4 \text{ (use long division)} = 0.25$$

Decimal to Fraction

$$0.2 = \text{check the column (2 tenths)} = \frac{2}{10} = \frac{1}{5}$$

Order decimals.

Find prime factors of a number.

## Using decimals for easier calculations

Calculations can be made easier by converting fractions to decimals.

E.G.

$$\frac{1}{4} \times 8 = 0.25 \times 8 = 2$$

$$\frac{3}{5} \times 20 = 0.6 \times 20 = 12$$

## Recurring decimals from fractions

Some fractions become recurring decimals.

Fractions will be recurring decimals, when the denominator has prime factors other than 2 or 5.

E.G.

$\frac{1}{10}$  will terminate (0.1) as  $10 = 2 \times 5$

$\frac{4}{15}$  will recur (0.26̇) as  $15 = 3 \times 5$

## Ordering fraction decimals and percentages

Convert all to decimals and then compare.

E.G. Put the following in ascending order.

$$40\% \quad 0.38 \quad \frac{1}{4} \quad 68\% \quad 0.3 \quad \frac{1}{8}$$

Convert all numbers in to decimals:

$$0.40 \quad 0.38 \quad 0.25 \quad 0.68 \quad 0.30 \quad 0.125$$

Now you can order the numbers from lowest to highest:

$$0.125 \quad 0.25 \quad 0.30 \quad 0.38 \quad 0.40 \quad 0.68$$

## Literacy

Explain the difference between a recurring and terminating decimal.

What does ascending mean?

## Reasoning

Jenny scores 72% in a mathematics test. Ken scores 30 marks out of a possible 40. Who got the best score? You must explain your answer.

## Fluency

Complete the following table

Fraction	Decimal	Percentage
$\frac{1}{2}$		
	0.25	
		10%
$\frac{1}{4}$		
	0.3	
		60%

## Problem Solving

Write these numbers in order of size.  
Start with the smallest number.

0.82       $\frac{4}{5}$       85%       $\frac{2}{3}$        $\frac{7}{8}$

# Pi Unit 14: Probability 1

## Prior Knowledge

Language of probability:  
Impossible, unlikely, even chance, likely, certain

Probability scale goes from 0 to 1:

- 0 meaning impossible.
- 1 meaning certain.

Write the theoretical probability of an event occurring.

E.G.

A bag has 5 red counters, 4 green counters and 7 blue counters.

- a) The probability of picking a red is  $\frac{5}{16}$ .
- b) The probability of **not** picking a blue is  $\frac{9}{16}$ .
- c) The probability of picking an orange is 0.

## Combinations: Listing Outcomes

Listing all the possible outcomes for two or more combined events enables you to calculate the probability of any particular event occurring. The outcomes for an event can be listed in an organised or systematic way to make sure that none of the possible outcomes is missed out.

E.G.

A menu has 3 starters: soup, prawns, or melon and 3 mains; chicken, pasta, pizza. List all the different combinations you could choose for a meal.

Soup, chicken	Soup, pasta	Soup, pizza
Prawns, chicken	Prawns, pasta	Prawns, pizza
Melon, chicken	Melon, pasta	Melon, pizza

## Mutually Exclusive Events

Two events are mutually exclusive if they cannot occur at the same time.

Example: An experiment has four mutually exclusive outcomes A,B,C or D. The table shows the probability of each outcome:

$$0.1 + 0.2 + 0.3 = 0.6$$
$$1 - 0.6 = 0.4$$

A	B	C	D
0.1	0.4	0.2	0.3

Estimating outcomes is found using the probability of an event x amount of trials.

E.G. How many times will outcome A happen in 200 trials?

$$0.1 \times 200 = 20$$

## Literacy

Explain what “probability” means.

Write a sentence containing the words “probability” and “certain”.

## Reasoning

There are 30 passengers on a bus. 13 of them are **male**.  
At the next stop 8 people get off the bus and nobody gets on.  
The probability that a passenger, picked at random, is **male** is now 0.5.  
How many of the people who got off the bus were **female**?  
Explain your answer.

## Fluency

1) A bus can be early, on time or late.  
The probability that the bus is early is 0.1  
The probability that the bus is on time is 0.6  
Work out the probability that the bus is late.

2) *Two numbers are picked at random from the numbers 12, 15, 16, 17, 23.*  
*Work out the probability that the total of the two numbers is **more than 30**.*

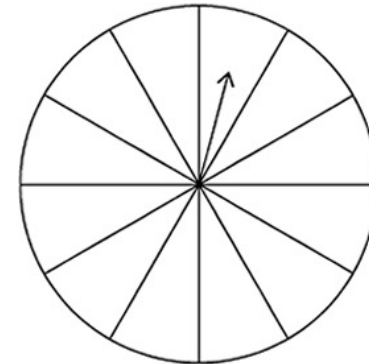
3) Here are three events for an ordinary fair dice.  
A Roll an odd number  
B Roll a number greater than 6  
C Roll an even number less than 3

Draw and label arrows to show the probabilities of events B and C on the probability scale.



## Problem Solving

A fair spinner has 12 equal sections.  
Label each section A, B, C or D so that  
when  
the arrow is spun,  
the probability it lands on A is  $\frac{1}{6}$ ,  
the probability it lands on B is **equal** to the  
probability it lands on C,  
the probability it lands on D is **double** the  
probability it lands on A.



# Pi Unit 15: Probability 2

## Prior Knowledge

Sample space diagram  
E.G. find the total when 2 dice are rolled together:

+	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

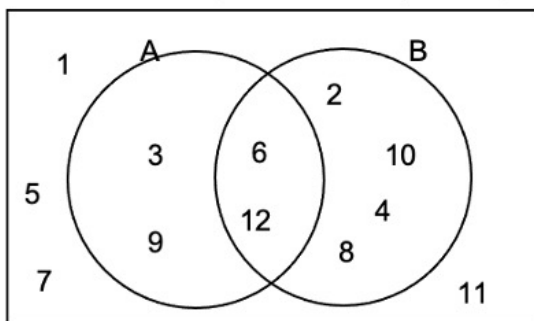
## Relative Frequency

E.G. a coin is flipped 300 times, the table shows the outcomes:

	H	T
Outcomes	127	273
Relative frequency	$\frac{127}{300}$	$\frac{273}{300}$

## Venn diagrams:

E.G.



SET NOTATION:

$\varepsilon = \{ \}$  shows all of the elements included in the set,  $\varepsilon = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$

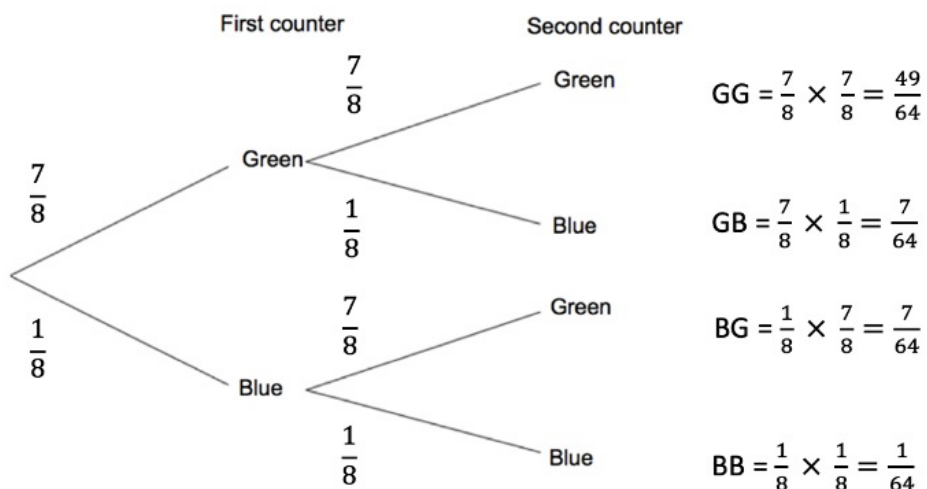
$A \cap B$  is the **intersection** of A and B {6, 12}

$A \cup B$  is the **union** set of A or B i.e. everything included in A or B {2, 3, 4, 6, 8, 9, 10, 12}

## Probability Tree diagrams:

E.G.

Jack is picking a counter from a bag. He then puts it back in the bag before picking a second counter. There are 7 green counters, and 1 green counter in the bag.



## Literacy

Explain what the word “outcome” means in probability theory.

Write a sentence listing the outcomes when a normal dice is thrown.

## Reasoning

A biased dice is thrown 200 times.

The table shows the probability of each score.

Work out the expected number of times the score will be odd.

Score	1	2	3	4	5	6
Probability	0.25	0.05	0.15	0.05	0.3	0.2

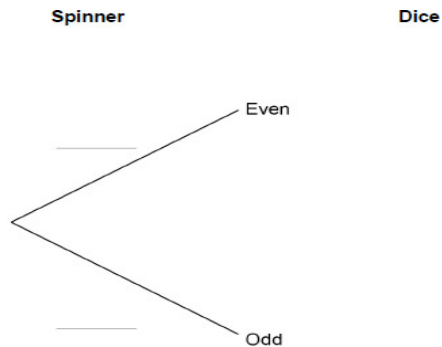
## Fluency

A fair spinner has five equal sections numbered 1, 2, 3, 4 and 5

A fair six-sided dice has five red faces and one green face.

The spinner is spun and the dice is thrown.

- (a) Complete the tree diagram for the spinner and the dice.  
(b) Work out the probability of getting an even number AND the colour green.

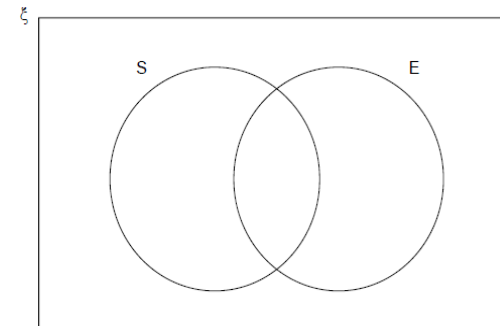


## Problem Solving

$$\xi = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$$

S = square numbers              E = even numbers

- (a) Complete the Venn diagram.  
(b) One of the numbers is chosen at random.  
Write down  $P(S \cap E)$



# Pi Unit 16: Ratio

## Prior Knowledge

Understand what a ratio is.

Simplify a ratio using highest common factors.

E.G.

15: 21 becomes 5:7.

Share in a ratio.

E.G.

Share £40 into the ratio 5:3 ↖ Total parts = 8

1 PART: £40 ÷ 8 = £5

£5 x 5 = £25    £5 x 3 = £15

£25:£15

Write a ratio as fractions.

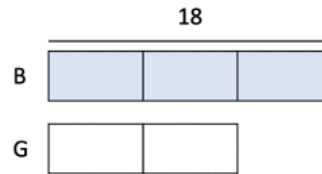
$$4 : 3 = \frac{4}{7} : \frac{3}{7}$$

↖  
 $4 + 3 = 7$

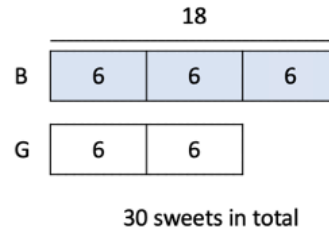
## Using ratios when one part is known

E.G.

Barry and George share sweets in the ratio 3:2.  
Barry has 18 sweets, how many do they have all together?



Find 1 part for Barry and use this to find how many sweets each has.



## Ratios as Scales

Ratios are sometimes used for scales.

E.G.

On a map with ratio 1:200000, what does 3cm represent in KM?

$$1 : 200000$$

$$3\text{cm} : 600000\text{cm}$$

$$3\text{cm} : 6000\text{m}$$

$$3\text{cm} : 6\text{km}$$

## Ratio exam question

E.G.

Talil is going to make some concrete mix. He needs to mix cement, sand and gravel (1: 3:5) by weight. Talil wants to make 180 kg of concrete mix. He has 15 kg of cement, 85 kg of sand, 100 kg of gravel. Does he have enough to make the concrete?

First work out how much he would need of each ingredient. Each part is  $180 \div 9 = 20$ , so he needs:

Cement	Sand	Gravel
$20 \times 1 = 20\text{kg}$	$20 \times 3 = 60\text{kg}$	$20 \times 5 = 100\text{kg}$

Conclusion for full marks: He does not have enough cement, he needs 20kg, but only has 15kg.



## Literacy

Explain what a scale drawing is.

Write a sentence containing the word “ratio”.

## Reasoning

On a map the scale is 1 : 400000.

The distance on the map between London and Oxford is 15cm.

James says “this means the actual distance from London to Oxford is 6km”. Is he correct? Explain your reasoning.

## Fluency

1) Write these ratios in their simplest form

(a)  $2 : 8$                       (b)  $15 : 5$                       (c)  $0.5 : 2.5$                       (d)  $20\text{cm} : 1\text{m}$

2) Write these ratios in the form  $n : 1$

(a)  $45 : 15$                       (b)  $60 : 40$

3) (a) Share £200 in the ratio  $3 : 5$                       (b) Share 420km in the ratio  $2 : 5$

4) The exchange rate is  $\text{£}1 = 1.14$  euros

(a) Change £45 to euros                      (b) Change 68 euros to pounds sterling

## Problem Solving

1) There are 34 students in a class.  
18 of the students are boys.

(a) Write the number of girls as a fraction.

(b) Write the ratio of boys to girls as a ratio in its simplest form.

2) Sarah, Julia and Maisie share some money in the ratio  $2 : 3 : 5$ .

Maisie gets £15 more than Sarah.  
How much does Julia get?

## Pi Unit 17: Shape and Angle Facts

### Prior Knowledge

Know names of shapes both 2D and 3D.

Be able to use shape notation.

Basic angle facts:

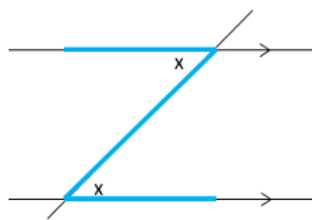
- Angles on a straight line sum to  $180^\circ$ .
- Angles round a point sum to  $360^\circ$ .
- Angles in a triangle sum to  $180^\circ$ .
- Angles in a quadrilateral sum to  $360^\circ$ .
- Base angles in an isosceles triangle are equal.
- Vertically opposite angles are equal.

Angles in parallel lines

- Alternate angles are equal.
- Corresponding angles are equal.
- Co-interior angles sum to  $180^\circ$ .

### Angles in parallel lines

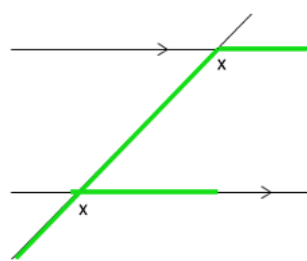
Parallel lines never cross each other; the diagonal line across them (the transversal) has special angle properties with the parallel lines.



ALTERNATE ANGLES

(Z SHAPE)

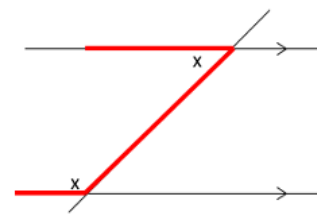
ARE EQUAL



CORRESPONDING ANGLES

(F SHAPE)

ARE EQUAL



COINTERIOR ANGLES

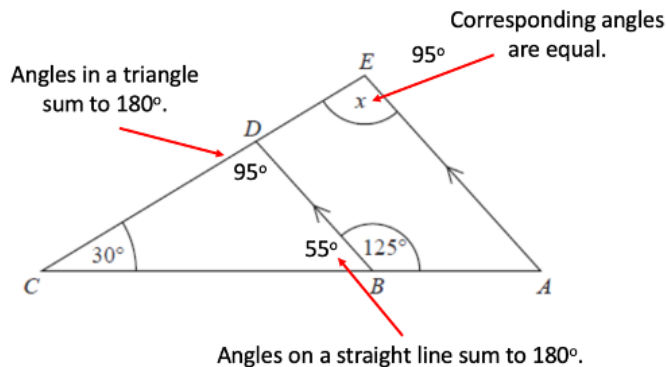
(C SHAPE)

SUM TO  $180^\circ$

### Multi-step angle problems

You must show every step of working and give a full written reason for each angle you calculate.

E.G.

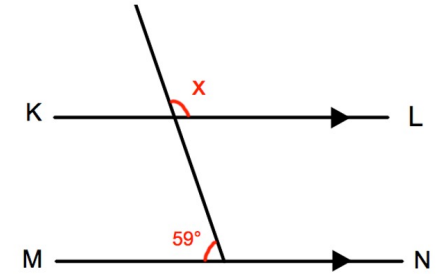


## Literacy

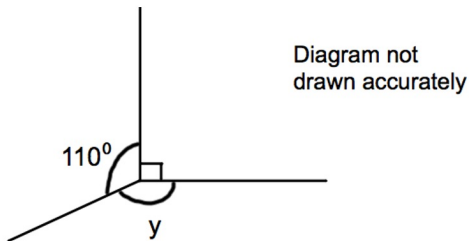
Describe the difference between an equilateral and isosceles triangle.

## Reasoning

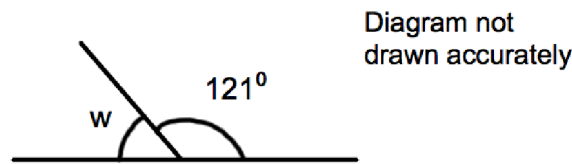
Work out the size of the angle marked  $x$ .  
Give reasons for your answer.



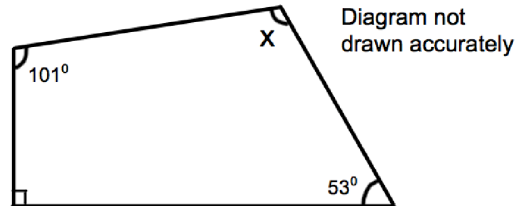
## Fluency



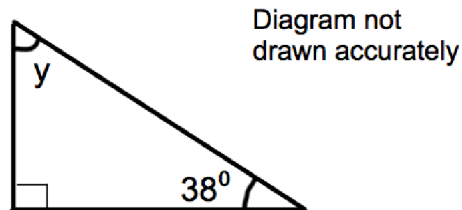
Work out the size of the angle marked  $y$ .



Work out the size of the angle marked  $w$ .

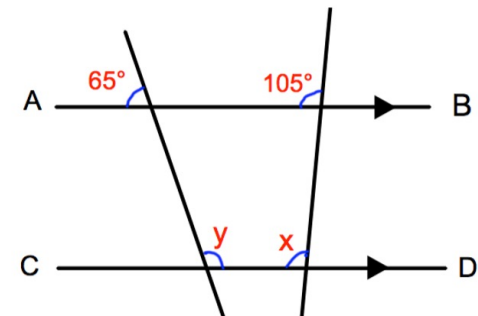


Work out the size of the angle marked  $x$ .



Work out the size of angle  $y$ .

## Problem Solving



AB is parallel to CD.

(a) Work out the size of the angle marked  $x$ .

Give a reason for your answer.

.....  
.....

(b) Work out the size of the angle marked  $y$ .

# Pi Unit 18: Angles in Polygons

## Prior Knowledge

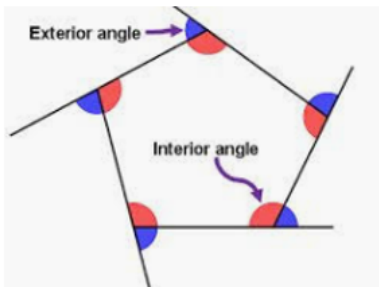
Names of regular polygons.

Exterior angles of all polygons sum to  $360^\circ$

The sum of the interior angles in a polygon can be found by:

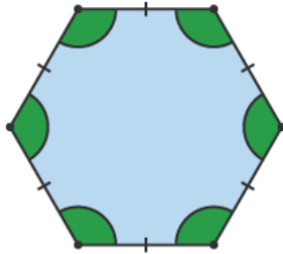
$$(\text{no.sides} - 2) \times 180^\circ$$

Exterior and interior angles lie on a straight line so sum to  $180^\circ$



## Angles in regular polygon

Regular polygons means all sides and angles equal.



For a regular hexagon:

$$\text{Exterior} = 360 \div 6 = 60^\circ$$

$$\text{Interior} = 180 - 60 = 120^\circ$$

Problem solving:

How many sides does a regular polygon with interior angles of  $30^\circ$  have?

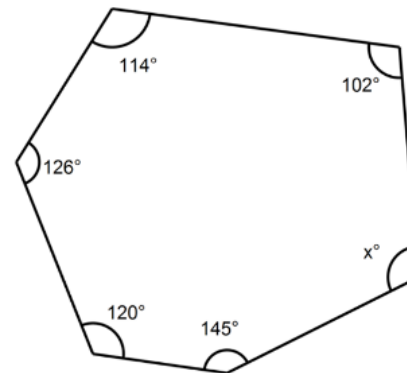
$$360 \div 30 = 12 \text{ so } 12 \text{ sides}$$

## Irregular polygons

Irregular polygon means sides and angles vary.

6 sides (hexagon)  
Sum of the interior angles:  
 $(6 - 2) \times 180 = 720^\circ$

Missing angle:  
 $102^\circ + 114^\circ + 126^\circ + 120^\circ + 145^\circ = 607^\circ$   
 $720^\circ - 607^\circ = 113^\circ$   
 $x = 113^\circ$

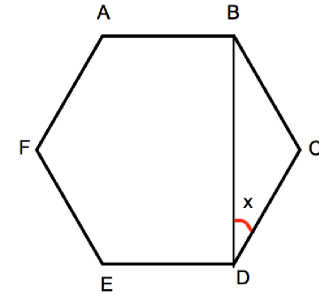


## Literacy

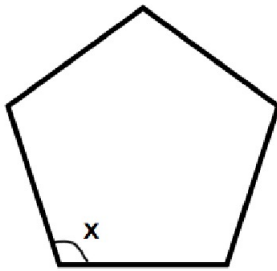
Explain the difference between an interior and exterior angle.

## Reasoning

Shown is a regular hexagon.  
Calculate angle  $x$ .  
Give reasons for your working.



## Fluency



Find the size of each interior angle.

A regular polygon has 12 sides.

Work out the size of each interior angle.

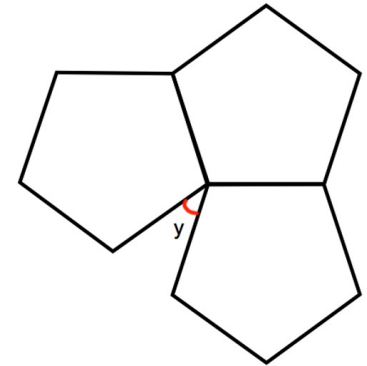
Each exterior angle of a regular polygon is  $20^\circ$ .

Work out the number of sides of the polygon.

A regular polygon has 24 sides.

Work out the size of each exterior angle.

## Problem Solving



Three identical regular pentagons are joined as shown above.

(b) Work out the size of angle  $y$ .