KING EDWARD VI
HANDSWORTH GRAMMAR
SCHOOL FOR BOYS

KING EDWARD VI
ACADEMY TRUST
BIRMINGHAM

Year 8

2023 Mathematics 2024

Unit 6 Booklet

HGS Maths

Tasks

Dr Frost Course

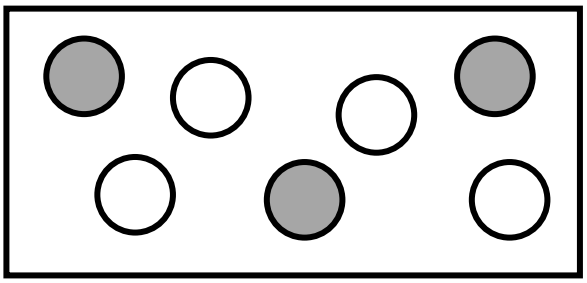
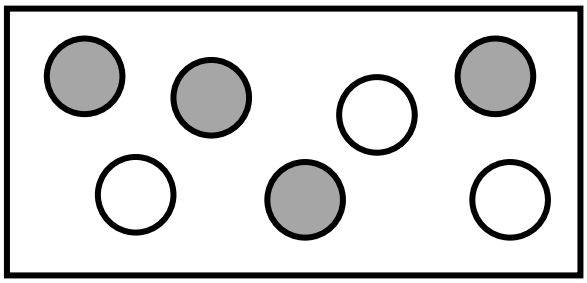
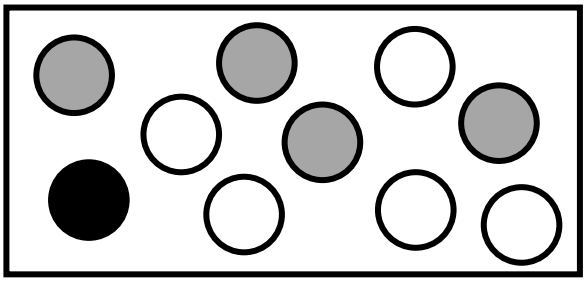
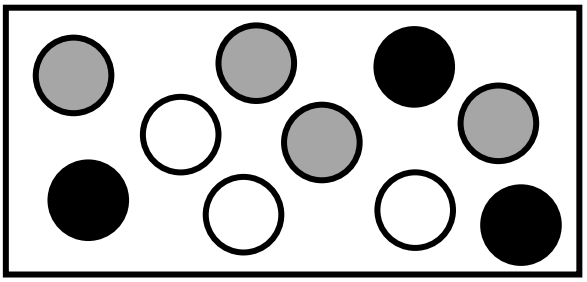
Name: _____

Class: _____

Contents

1 Ratio

1.1 Writing Ratios

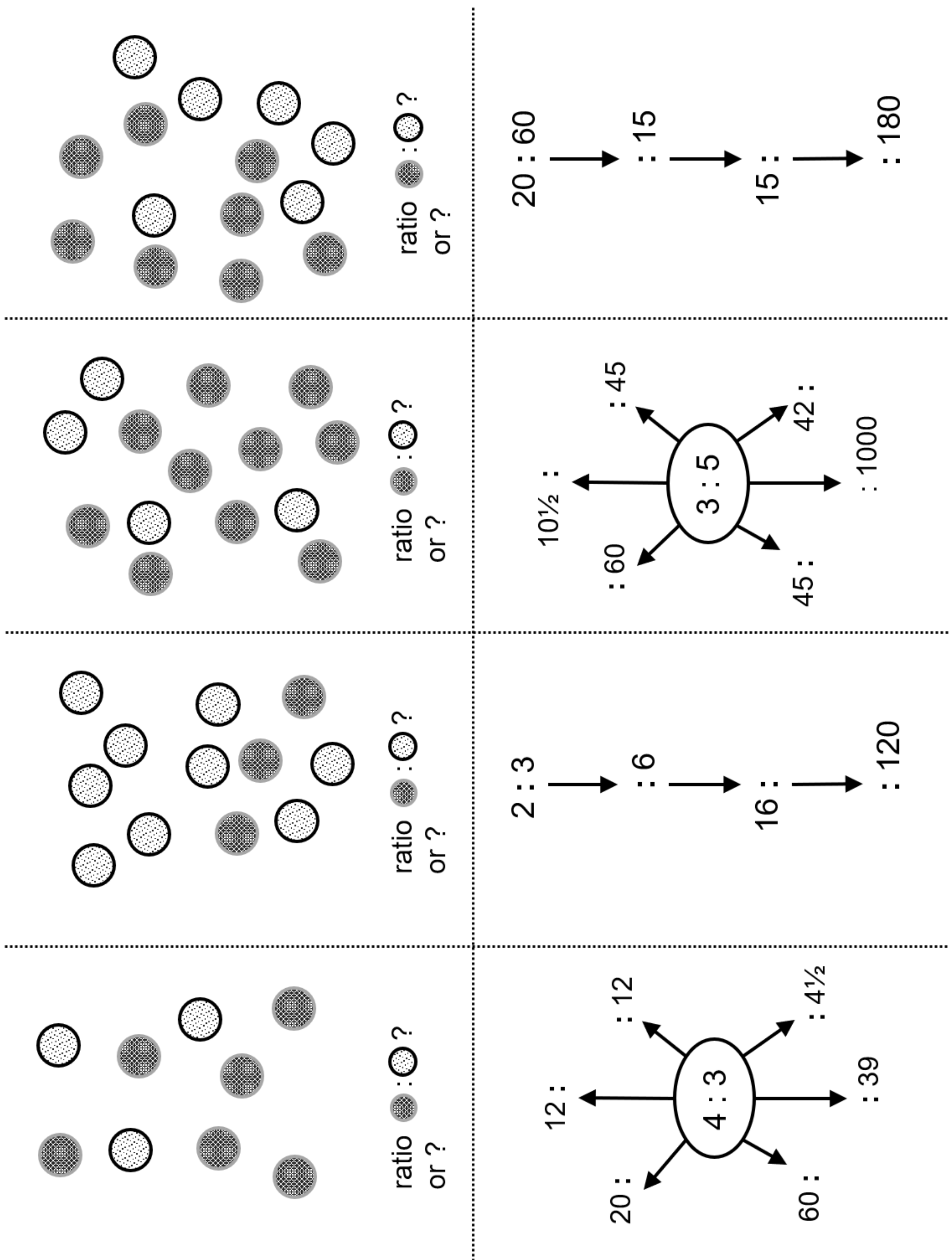
Worked Example	Your Turn
a) Write down the ratio of shaded circles to unshaded circles in the diagram below. 	a) Write down the ratio of shaded circles to unshaded circles in the diagram below. 
b) Write down the ratio of White : Grey : Black in the diagram below. 	b) Write down the ratio of White : Grey : Black in the diagram below. 

1.2 Equivalent Ratios

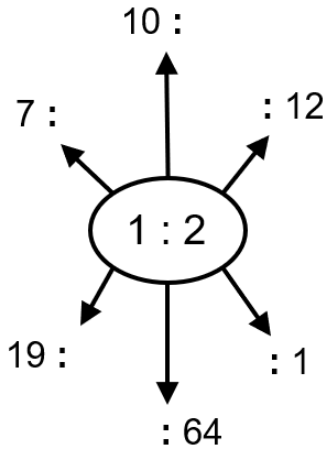
Worked Example	Your Turn
All the ratios below are equivalent. Complete the gaps below: $1 : 3$ $\_\_ : 6$ $\_\_ : 12$ $24 : \_\_$ $\_\_ : 36$ $\_\_ : 3.6$	All the ratios below are equivalent. Complete the gaps below: $1 : 4$ $\_\_ : 8$ $\_\_ : 16$ $12 : \_\_$ $\_\_ : 12$ $\_\_ : 1.2$

Worked Example	Your Turn
All the ratios below are equivalent. Complete the gaps below: $2 : 3$ $\_\_ : 9$ $\_\_ : 18$ $24 : \_\_$ $\_\_ : 54$ $\_\_ : 0.54$	All the ratios below are equivalent. Complete the gaps below: $2 : 5$ $\_\_ : 15$ $\_\_ : 30$ $24 : \_\_$ $\_\_ : 0.6$ $\_\_ : 4.8$

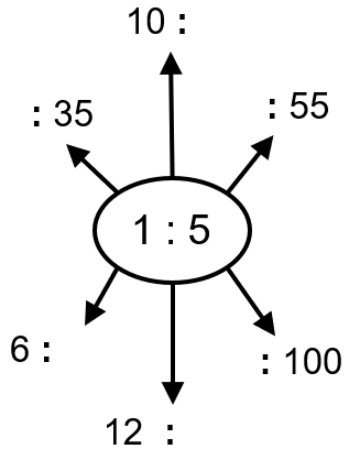
Fluency Practice



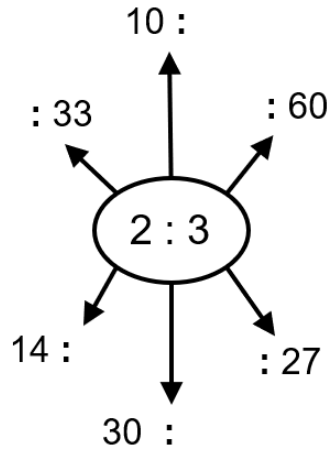
Fluency Practice



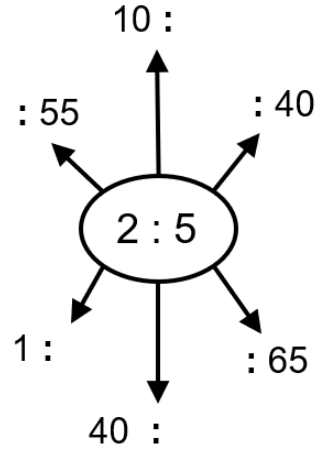
ratio £1 for me, £2 for you



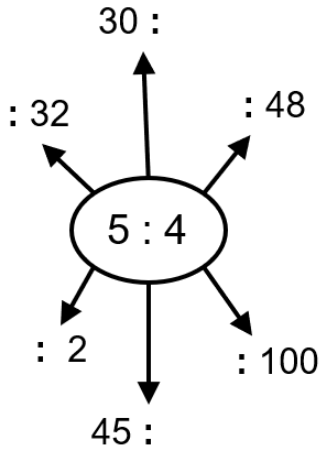
ratio £1 for me, £5 for you

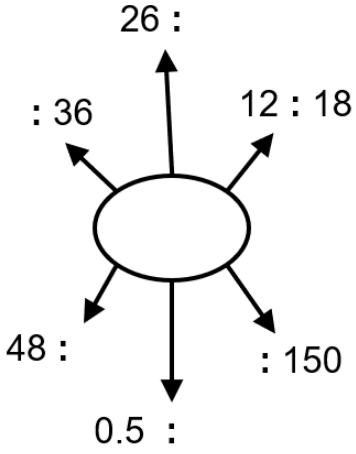


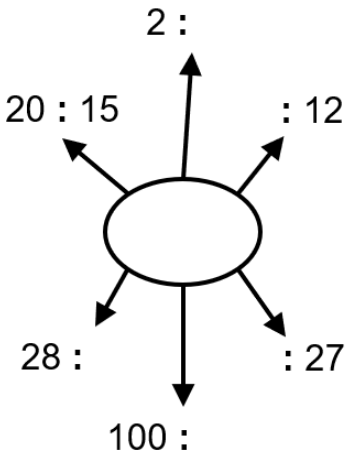
ratio £2 for me, £3 for you

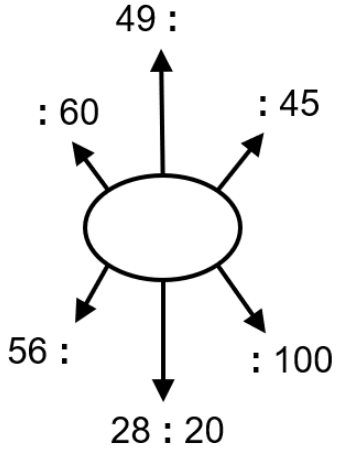


ratio £2 for me, £5 for you

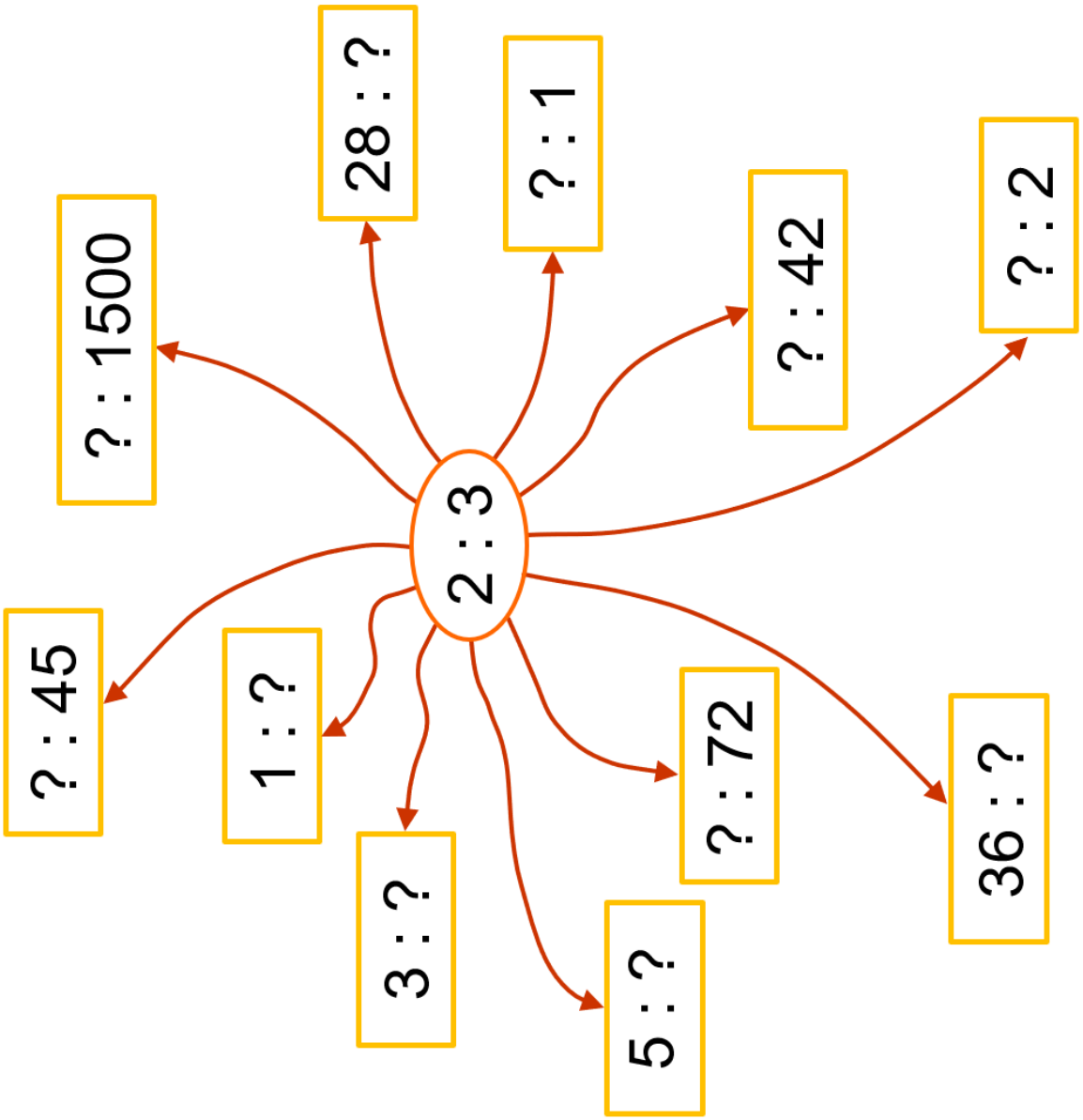








Fluency Practice



pair off the equivalent ratios

(1)

5 : 20

10 : 25

1½ : 2½

9 : 12

3 : 12

6 : 7½

24 : 40

3 : 7½

15 : 20

20 : 25

(2)

10½ : 7

2½ : 1

2 : 1½

½ : 0.3

1½ : 1

12½ : 7½

7½ : 3

10 : 7½

(3)

27 : 72

28 : 63

24 : 84

66 : 121

24 : 64

42 : 77

24 : 54

16 : 56

(4)

96 : 88

75 : 70

81 : 72

98 : 91

132 : 121

108 : 96

70 : 65

90 : 84

1.3 Simplifying Ratios

Worked Example	Your Turn
Simplify: a) $25 : 30$ b) $45 : 75$ c) $15 : 20 : 35$ d) $150\ \text{cm} : 1\ \text{m}$	Simplify: a) $42 : 35$ b) $24 : 60$ c) $16 : 32 : 72$ d) $450\ \text{g} : 1.3\ \text{kg}$

Worked Example	Your Turn
Simplify: a) 15300 mm : 45 cm b) 140000 g : 300 kg c) 96000 cl : 360 litres	Simplify: a) 60 cm : 13000 mm b) 100 kg : 80000 g c) 1530 litres : 108000 cl

1.4 Ratios to Fractions and Percentages

Worked Example	Your Turn
a) The ratio of $p : q$ is $3 : 4$ p is $\frac{?}{?}$ of the whole b) The ratio of $p : q$ is $3 : 4$ p is $\frac{?}{?}$ of q	a) The ratio of $p : q$ is $5 : 4$ p is $\frac{?}{?}$ of the whole b) The ratio of $p : q$ is $5 : 4$ p is $\frac{?}{?}$ of q

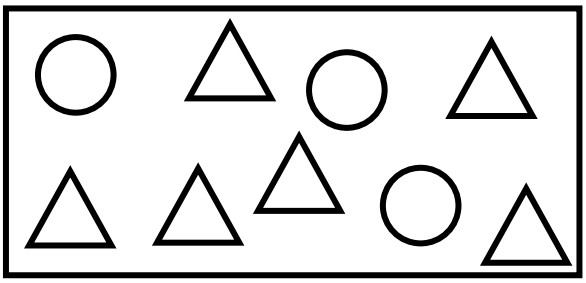
Worked Example	Your Turn
The ratio of blue and red counters in a bag is $4:3$ a) What fraction of the counters are blue? b) What fraction of the counters are red?	The ratio of blue and red counters in a bag is $5:7$ a) What fraction of the counters are blue? b) What fraction of the counters are red?

Worked Example	Your Turn
The ratio of blue, red and yellow counters in a bag is $4 : 3 : 13$ a) What percentage of the counters are blue? b) What percentage of the counters are red? c) What percentage of the counters are yellow?	The ratio of blue, red and yellow counters in a bag is $5 : 7 : 13$ a) What percentage of the counters are blue? b) What percentage of the counters are red? c) What percentage of the counters are yellow?

1.5 n:1 and 1:n Ratios

Worked Example

The diagram below shows a number of circles and triangles.

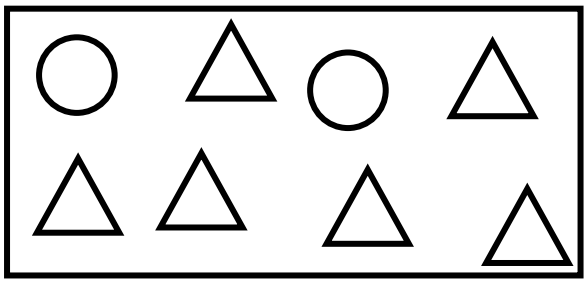


a) Write the ratio of circles to triangles in the ratio $1 : n$

b) Write the ratio of circles to triangles in the ratio $n : 1$

Your Turn

The diagram below shows a number of circles and triangles.



a) Write the ratio of circles to triangles in the ratio $1 : n$

b) Write the ratio of circles to triangles in the ratio $n : 1$

Worked Example	Your Turn
a) Write the ratio $2:5$ in the ratio $1:n$ b) Write the ratio $2:5$ in the ratio $n:1$	a) Write the ratio $4:5$ in the ratio $1:n$ b) Write the ratio $4:5$ in the ratio $n:1$

1.6 Ratio in Different Forms

Worked Example	Your Turn
$a : b$ $7 : 1$	$a : b$ $8 : 1$
a as a fraction of the whole	a as a fraction of the whole
a as a fraction of b	a as a fraction of b
In the form $1 : n$	In the form $1 : n$
In the form $n : 1$	In the form $n : 1$

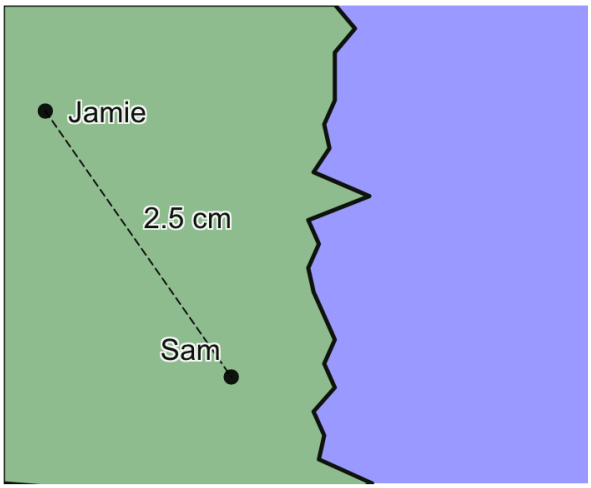
Fill in the Gaps

Ratio $a : b$	a as a fraction of the whole	a as a fraction of b	In the form $1 : n$	In the form $n : 1$
$1 : 3$				
	$\frac{1}{3}$			
		$\frac{2}{5}$		
			$1 : 5$	
$5 : 1$				
	$\frac{5}{7}$			
		$\frac{5}{7}$		
			$1 : 0.7$	
				$1\frac{4}{7} : 1$
				$\frac{7}{11} : 1$
$x : y$				

1.7 Scale Drawings

Worked Example

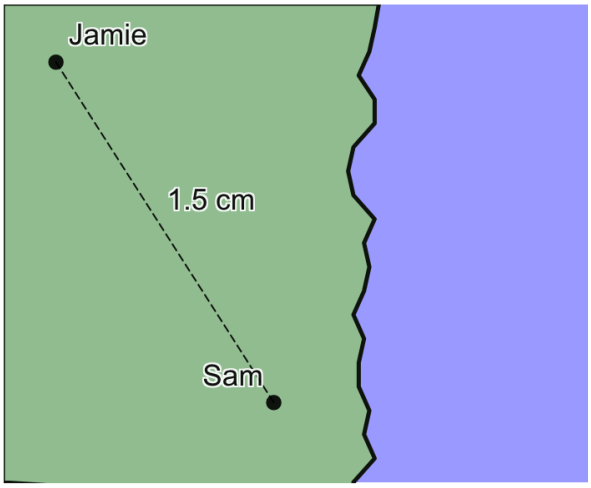
The scale of the map below is
1 cm : 5 km



Find the actual distance between Jamie and Sam.

Your Turn

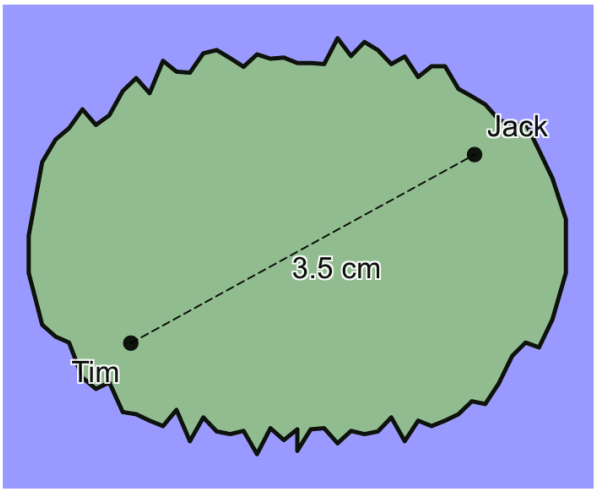
The scale of the map below is
1 cm : 6 km



Find the actual distance between Jamie and Sam.

Worked Example

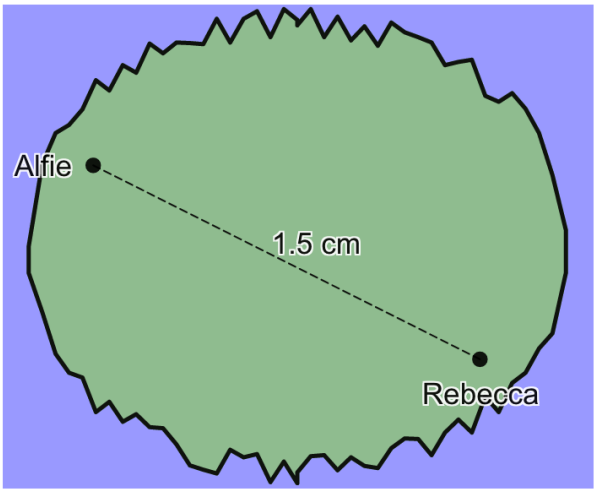
The scale of the map below is $1 : 700000$



Find the actual distance between Tim and Jack. Give your answer in kilometres.

Your Turn

The scale of the map below is $1 : 300000$



Find the actual distance between Alfie and Rebecca. Give your answer in kilometres.

1.8 One Quantity Given

Worked Example	Your Turn
Anju and Kieran share some money in the ratio $5:2$. Anju receives £30. How much does Kieran receive?	Anju and Kieran share some money in the ratio $5:3$. Anju receives £30. How much does Kieran receive?

1.9 Difference Given

Worked Example	Your Turn
Zach and Olivia share some money in the ratio $2:5$. Olivia receives £30 more than Zach. How much do they each receive?	Zach and Olivia share some money in the ratio $2:5$. Olivia receives £15 more than Zach. How much do they each receive?

1.10 Total Given

Worked Example	Your Turn
Divide 30 in the ratio $2:3$	Divide 45 in the ratio $8:1$

1.11 Mixed Ratios

Worked Example	Your Turn
Jenny and Ben share £12 in the ratio $2:1$ Jenny's amount Ben's amount Jenny gets ____ more Jenny gets $\frac{?}{?}$ of the whole	Jenny and Ben share £12 in the ratio $3:1$ Jenny's amount Ben's amount Jenny gets ____ more Jenny gets $\frac{?}{?}$ of the whole

Fill in the Gaps

Ratio Jenny : Ben	Amount to share	Jenny's amount	Ben's amount	Jenny gets ? more/less	Jenny's amount as a fraction of the whole
3 : 2	£30				
3 : 2		£24			
		£24		£8 less	
	£40		£32		
3 : 4				£5 less	
	£33	£9			
__ : 8	£33			The same	
8 : __			£8		$\frac{?}{?}=\frac{2}{3}$
				£12 less	$\frac{?}{?}=\frac{2}{7}$
__ : 7	£28	£15.75			

Fill in the Gaps

Amount	Ratio	Number of Parts	Amount per Part	First Share	Second Share
£50	4 : 1	5	£10	£40	£10
£100	3 : 2	5	£20		
£100	3 : 7	10			
£100	1 : 4				
£60	2 : 1				
£60	5 : 1				
£60	5 : 7				
£72	7 : 5				
£48	3 : 5				
	:		£5	£25	£15
	:	7		£100	£75
£20	:	10			£6
£90	:	9		£20	
£64	5 :		£8		
	: 1			£35	£7
	3 :	8		£7.50	

Fill in the Gaps

	Simplest Form	Fractions		Decimals		Total = 24	Total = 1	Total $= \frac{2}{3}$	Difference = 30	Difference $= \frac{3}{4}$
		$1:n$	$n:1$	$1:n$	$n:1$					
e.g.	$3:5$	$1:\frac{5}{3}$	$\frac{3}{5}:1$	$1:1.\dot{6}$	$0.6:1$	$9:15$	$\frac{3}{8}:\frac{5}{8}$	$\frac{1}{4}:\frac{5}{12}$	$45:75$	$\frac{9}{8}:\frac{15}{8}$
1.	$2:3$									
2.	$5:4$									
3.	$9:10$									
4.		$1:\frac{1}{3}$								
5.					$1.2:1$					
6.						$20:4$				
7.							$\frac{5}{13}:\frac{8}{13}$			
8.								$\frac{1}{3}:\frac{1}{3}$		
9.									$60:30$	
10.										$\frac{45}{4}:12$

1.12 Combining Ratios

Worked Example	Your Turn
The ratio of $a : b$ is $2 : 3$ The ratio of $b : c$ is $1 : 4$ What is the ratio of $a : c$?	The ratio of $a : b$ is $2 : 5$ The ratio of $b : c$ is $1 : 4$ What is the ratio of $a : c$?

Worked Example	Your Turn
There are red, yellow and blue counters in a bag. Find the ratio Red : Yellow : Blue if (a) The ratio of Red : Yellow is $1:2$ and the ratio of Yellow : Blue is $2:3$ (b) The ratio of Red : Yellow is $1:5$ and the ratio of Yellow : Blue is $10:7$ (c) The ratio of Red : Yellow is $1:3$ and the ratio of Yellow : Blue is $8:5$	There are red, yellow and blue counters in a bag. Find the ratio Red : Yellow : Blue if (a) The ratio of Red : Yellow is $1:3$ and the ratio of Yellow : Blue is $3:4$ (b) The ratio of Red : Yellow is $2:5$ and the ratio of Yellow : Blue is $10:3$ (c) The ratio of Red : Yellow is $2:5$ and the ratio of Yellow : Blue is $7:1$

Worked Example	Your Turn
A pencil case contains pens, pencils and crayons. The ratio of pens to pencils is $11n : 8$. The ratio of pencils to crayons is $6 : 7n$. Work out the ratio of pens to crayons. Give your answer in its simplest form.	A biscuit tin contains shortbread, cookies and bourbons. The ratio of shortbread to cookies is $11n : 12$. The ratio of cookies to bourbons is $8 : 3n$. Work out the ratio of shortbread to bourbons. Give your answer in its simplest form.

Worked Example	Your Turn
In a school, The ratio of Year 7 to Year 8 to Year 9 is $6 : 7 : 3$ The ratio of Year 9 to Year 10 to Year 11 is $2 : 8 : 7$ Find the ratio Year 7 : Year 11 Give your ratio in its simplest form.	In a school, The ratio of Year 7 to Year 8 to Year 9 is $2 : 5 : 6$ The ratio of Year 9 to Year 10 to Year 11 is $5 : 2 : 5$ Find the ratio Year 8 : Year 10 Give your ratio in its simplest form.

Worked Example	Your Turn
A pencil case contains only red, green and blue pencils. The ratio of red pencils to green pencils is $20 : 3$. The ratio of green pencils to blue pencils is $1 : 9$. Calculate the percentage of pencils that are green.	A box contains only blue, purple and pink pens. The ratio of blue pens to purple pens is $4 : 9$. The ratio of purple pens to pink pens is $3 : 4$. Calculate the percentage of pens that are blue.

Worked Example	Your Turn
In a pencil case, number of blue pencils : purple pencils $= 3 : 4$ number of purple pencils : green pencils $= 5 : 3$ There are 90 blue pencils in the pencil case. Work out the number of green pencils in the pencil case.	In a bag, number of red marbles : green marbles $= 1 : 6$ number of green marbles : blue marbles $= 5 : 3$ There are 36 blue marbles in the bag. Work out the number of red marbles in the bag.

Worked Example	Your Turn
A pencil case contains pens, pencils and crayons. The ratio of pens to pencils is $2:1$. The ratio of pencils to crayons is $3:4$. There are less than 70 items in the pencil case. Find the greatest possible number of pens in the pencil case.	A bag contains jellies, mints and toffees. The ratio of jellies to mints is $6:5$. The ratio of mints to toffees is $2:3$. There are less than 112 sweets in the bag. Find the greatest possible number of mints in the bag.

Worked Example	Your Turn
The points A, B, C and D lie in order on a straight line. $AB : BD = 5 : 9$ $AC : CD = 6 : 1$ Work out $AB : BC : CD$	The points A, B, C and D lie in order on a straight line. $AB : BD = 10 : 11$ $AC : CD = 5 : 2$ Work out $AB : BC : CD$

Worked Example	Your Turn
Green shapes and purple shapes are used in a game. Some of the shapes are triangles. All the other shapes are hexagons. The ratio of triangles to hexagons is $5 : 2$ The ratio of green triangles to purple triangles is $3 : 5$ Work out the fraction of shapes that are green triangles.	Blue shapes and red shapes are used in a game. Some of the shapes are circles. All the other shapes are squares. The ratio of circles to squares is $4 : 5$ The ratio of blue circles to red circles is $3 : 2$ Work out the fraction of shapes that are red circles.

Worked Example	Your Turn
White shapes and black shapes are used in a game. Some of the shapes are circles. All of the other shapes are squares. The ratio of the number of white shapes to the number of black shapes is $4 : 5$ The ratio of the number of white circles to the number of white squares is $3 : 4$ The ratio of the number of black circles to the number of black squares is $2 : 1$ Work out what fraction of all the shapes are circles.	Blue shapes and red shapes are used in a game. Some of the shapes are circles. All of the other shapes are squares. The ratio of the number of blue shapes to the number of red shapes is $4 : 1$ The ratio of the number of blue circles to the number of blue squares is $3 : 4$ The ratio of the number of red circles to the number of red squares is $3 : 2$ Work out what fraction of all the shapes are circles.

2 Algebra Recap

2.1 Collecting Like Terms

Like Terms

$3p$	p	Like	Unlike
x^2	$3x^2$	Like	Unlike
x^2	$2x$	Like	Unlike
$-3\sqrt{x}$	$27\sqrt{x}$	Like	Unlike
$7a$	$7b$	Like	Unlike

$3a$	$3a$	Like	Unlike
a	$2a$	Like	Unlike
$2a$	$2A$	Like	Unlike
$-3a$	$2a$	Like	Unlike
$4a$	$4b$	Like	Unlike
$3a$	$3a^2$	Like	Unlike
$2a^2$	$7a^2$	Like	Unlike
$-3a^2$	$7a^2$	Like	Unlike
$2a^2$	$2a^{-2}$	Like	Unlike
2^a	a^2	Like	Unlike
x	$\sqrt{x}$	Like	Unlike
1	2	Like	Unlike

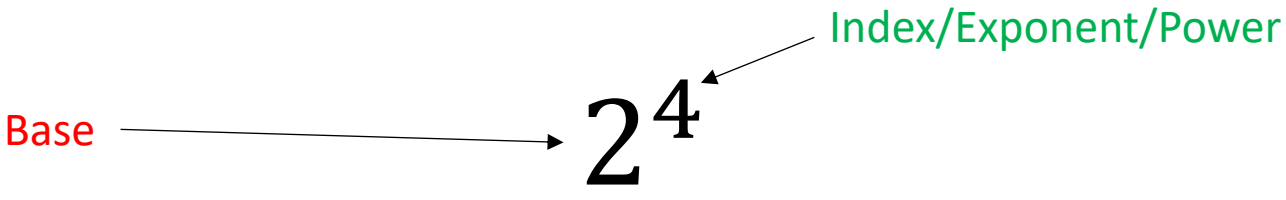
2.2 Multiplying Terms

2.3 Dividing Terms

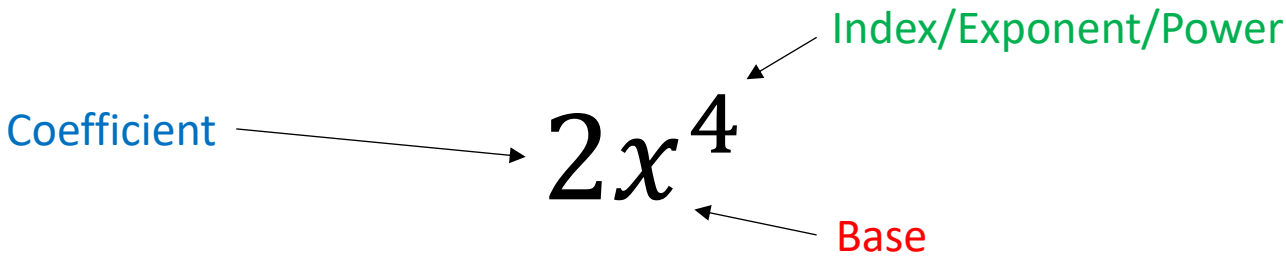
2.4 Substitution

3 Index Laws

3.1 Notation



We say, ‘two to the power of four’.



We say, ‘two x to the power of four’.

Fill in the Gaps

We say	We write	We work out	Answer
2 to the power of 4	2^4	$2 \times 2 \times 2 \times 2$	
3 to the power of 4		$3 \times 3 \times 3 \times 3$	
	4^4		256
5 to the power of 2			
	6^5		7776
		$8 \times 8 \times 8 \times 8$	
		$9 \times 9 \times 9$	
	3^9		
10 to the power of 2			
2 to the power of 10			

3.2 Multiplying

Complete the following:

$3^4 \times 3 =$

$3^4 \times 3^2 =$

$3^4 \times 3^3 =$

$3^4 \times 3^n =$

$3^m \times 3^n =$

Worked Example	Your Turn
Simplify a) $9^5 \times 9^2$ b) $9^5 \times 9^{-2}$	Simplify a) $8^6 \times 8^3$ b) $8^6 \times 8^{-3}$

Multiplying

Complete the following:

$x^3 \times x^2 =$

$x^3 \times x^3 =$

$x^3 \times x^4 =$

$x^3 \times x^n =$

$x^m \times x^n =$

Worked Example	Your Turn
Simplify a) $x^7 \times x^8$ b) $3x^4 \times 2x^5$	Simplify a) $x^9 \times x^2$ b) $4x^3 \times 5x^7$

3.3 Dividing

Complete the following:

$2^4 \div 2 =$

$2^4 \div 2^2 =$

$2^4 \div 2^3 =$

$2^4 \div 2^n =$

$2^m \div 2^n =$

Worked Example	Your Turn
Simplify a) $9^5 \div 9^2$ b) $9^5 \div 9^{-2}$	Simplify a) $8^{12} \div 8^3$ b) $8^{12} \div 8^{-3}$

Dividing

Complete the following:

$x^5 \div x =$

$x^5 \div x^2 =$

$x^5 \div x^3 =$

$x^5 \div x^n =$

$x^m \div x^n =$

Worked Example	Your Turn
Simplify a) $y^{12} \div y^4$ b) $12y^{11} \div 6y^7$ c) $\frac{5y^{11}}{12y^7}$	Simplify a) $p^{14} \div p^9$ b) $56y^4 \div 8y^2$ c) $\frac{8y^4}{56y^2}$

3.4 The Power Zero

Complete the following:

$2^4 =$

$2^3 =$

$2^2 =$

$2^1 =$

$2^0 =$

Worked Example	Your Turn
Simplify a) 7^0 b) $-(7)^0$ c) $\left(\frac{1}{7}\right)^0$ d) $(7x)^0$ e) 0^7	Simplify a) $(9xy)^0$ b) 0^9 c) $(-9)^0$ d) 9^0 e) $\left(\frac{1}{9}\right)^0$

3.5 Combined

Worked Example	Your Turn
Simplify a) $\frac{15x^9 \times 2x^3}{10x^4}$ b) $\frac{10x^4}{15x^9 \times 2x^3}$	Simplify a) $\frac{24x^{10}}{13x^5 \times 4x^2}$ b) $\frac{13x^5 \times 4x^2}{24x^{10}}$

3.6 Powers of Powers

Complete the following:

$(2^2)^1 =$

$(2^2)^2 =$

$(2^2)^3 =$

$(2^2)^4 =$

$(2^2)^5 =$

$(2^2)^n =$

$(2^m)^n =$

Worked Example	Your Turn
a) Simplify $(2^4)^3$ b) Write $(8^7)^9$ in the form 8^k where k is an integer to be found	a) Simplify$(3^4)^9$ b) Write $(8^9)^6$ in the form 8^k where k is an integer to be found

Powers of Powers

Complete the following:

$(y^3)^1 =$

$(y^3)^2 =$

$(y^3)^3 =$

$(y^3)^4 =$

$(y^3)^5 =$

$(y^3)^n =$

$(y^m)^n =$

Worked Example	Your Turn
Simplify a) $(c^4)^2$ b) $-(c^4)^2$ c) $(-c^4)^2$	Simplify a) $(c^4)^3$ b) $-(c^4)^3$ c) $(-c^4)^3$

Worked Example	Your Turn
Simplify a) $(3c^4)^2$ b) $(-3c^4)^2$	Simplify a) $(5c^{-4})^2$ b) $(-5c^{-4})^2$

3.7 Mixed Indices

Worked Example	Your Turn
Simplify a) $y^{11} \times y^5$ b) $6y^3 \times 2y^5$ c) $y^5 \div y^2$ d) $8y^3 \div 2y$ e) $(y^3)^7$ f) $(3y^4)^2$	Simplify: a) $x^5 \times x^{-2}$ b) $7x^5 \times 8x^{-3}$ c) $y^5 \div y^4$ d) $15y^3 \div 3y$ e) $(y^7)^8$ f) $(5y^4)^3$

Worked Example	Your Turn
Simplify a) $\frac{a^6 \times a^4}{a^2}$ b) $(4a^6b^3)^2$ c) $\frac{8a^5b^3}{4ab^7}$	Simplify a) $\frac{a^6 \times a^{-4}}{a^2}$ b) $(2a^6b^3)^4$ c) $\frac{12a^2b^3}{4ab^7}$