KING EDWARD VI
HANDSWORTH GRAMMAR
SCHOOL FOR BOYS

KING EDWARD VI
ACADEMY TRUST
BIRMINGHAM

Year 8

2025 Mathematics 2026

Unit 6 Booklet

HGS Maths

Tasks

Dr Frost Course

Name: _____

Class: _____

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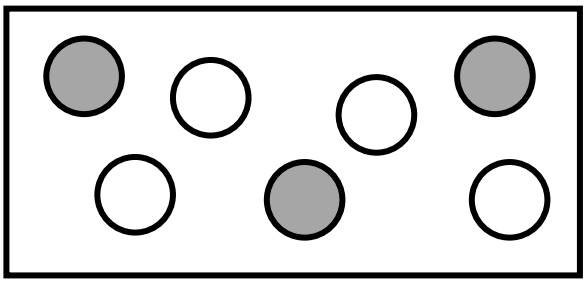
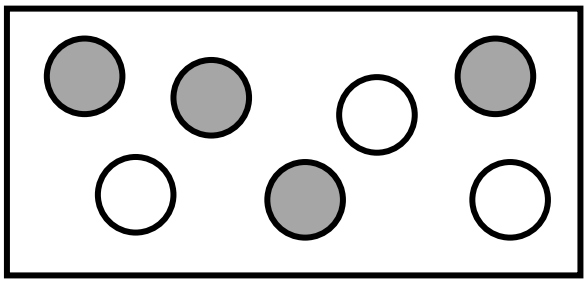
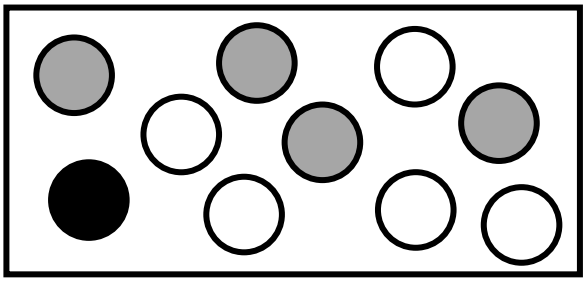
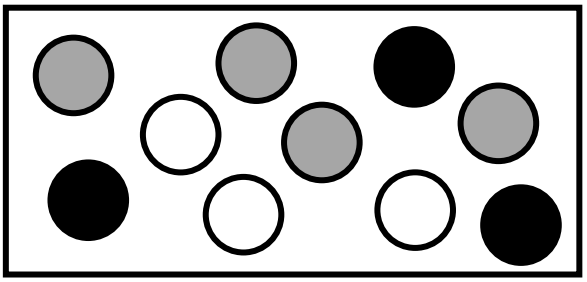
1 Ratio

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. 

Worked Example	Your Turn
There are only yellow counters and orange counters in a bag. There are a quarter as many yellow counters as orange counters. Write the ratio of yellow counters to orange counters.	There are only green counters and orange counters in a bag. There are a third as many green counters as orange counters. Write the ratio of green counters to orange counters.

1.2 Equivalent Ratios

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: $2 : 5$ $__ : 15$ $__ : 30$ $24 : __$ $__ : 0.6$ $__ : 4.8$

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) $450\text{ g} : 1.3\text{ kg}$

Dr Frost 224a, 224b and 224c

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

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?

Your Turn

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?

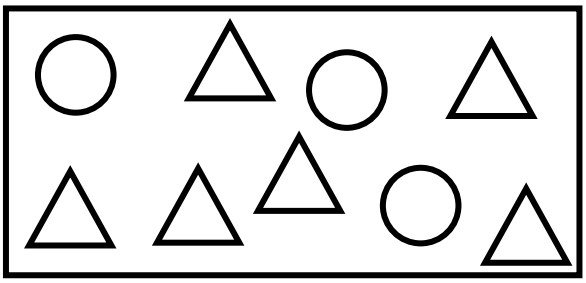
c) What percentage of the counters are yellow?

Worked Example	Your Turn
There are white, black and purple counters in a bag. $\frac{2}{7}$ of the counters are white $\frac{2}{5}$ of the counters are black the rest are purple. State the ratio of white, black and purple counters in the bag.	Freya, Sara and Martina share a sum of money. Freya gets $\frac{1}{10}$ of the money, Sara gets $\frac{3}{7}$ and Martina gets the rest. State the ratio of Freya's share to Sara's share to Martina's share.

1.5 n:1 and 1:n Ratios

Worked Example

The diagram below shows a number of circles and triangles.

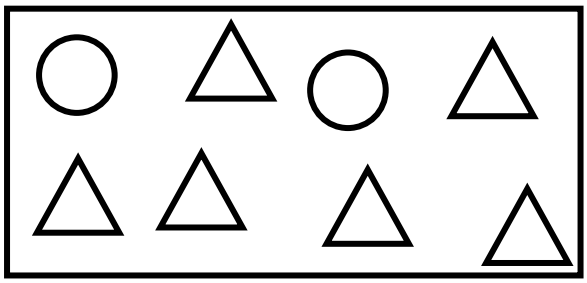


a) Write the ratio of circles to triangles in the ratio $1 : n$

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 $1:n$	a) Write the ratio $4:5$ in the ratio $1:n$
b) Write the ratio $2:5$ in the ratio $n:1$	b) Write the ratio $4:5$ in the ratio $n:1$
c) Write the ratio $12:18$ in the ratio $n:1$	c) Write the ratio $16:24$ in the ratio $n:1$

Fill in the Gaps

Number of Red Counters	Number of Blue Counters	Total Counters	Ratio of Red to Blue Counters	Fraction of Red Counters	Fraction of Blue Counters
2	3	5	2 : 3	$\frac{2}{5}$	$\frac{3}{5}$
5	3				
4	7				
7		11			
		10		$\frac{7}{10}$	
	4				$\frac{4}{5}$
	2			$\frac{3}{5}$	
		11	9 : 2		
5			5 : 11		

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 $n : 1$

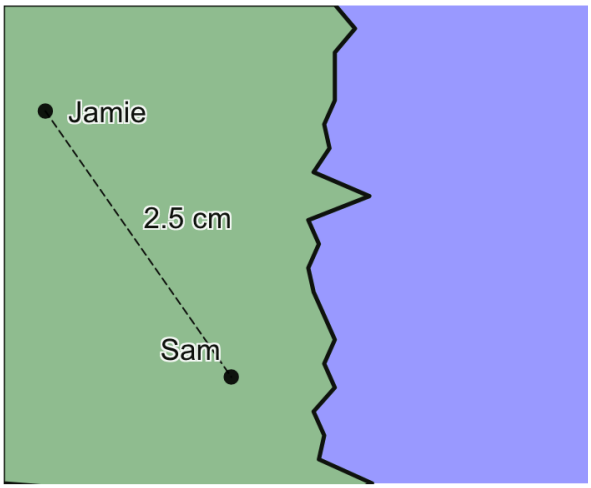
Fill in the Gaps

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
$1 \text{ cm} : 5 \text{ km}$

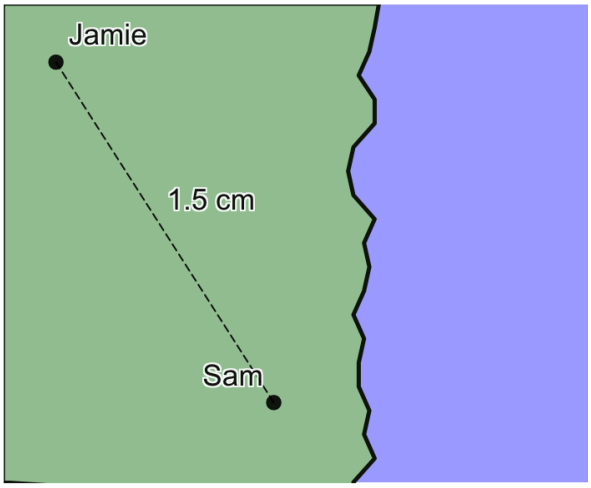


a) Find the actual distance between Jamie and Sam.

b) The actual distance between Jamie and Sam is 17.5 km. Find the distance on the map between Jamie and Sam in cm.

Your Turn

The scale of the map below is
$1 \text{ cm} : 6 \text{ km}$



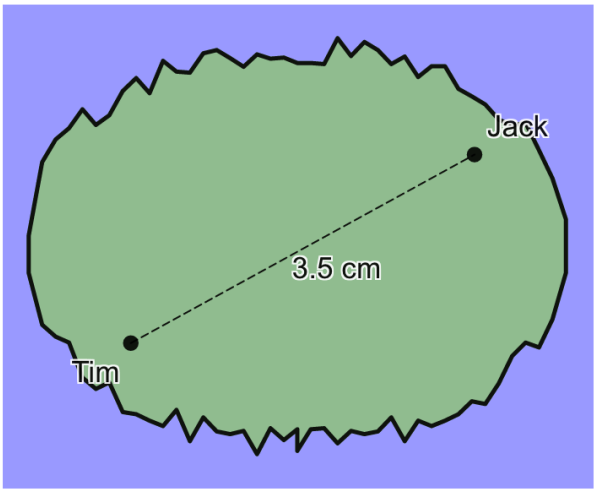
a) Find the actual distance between Jamie and Sam.

b) The actual distance between Jamie and Sam is 15 km. Find the distance on the map between Jamie and Sam in cm.

Dr Frost 283a, 283b, 283f and 283g

Worked Example

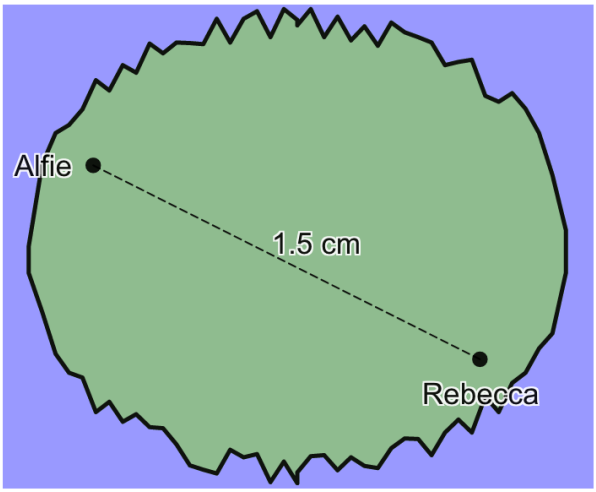
The scale of the map below is $1 : 700000$



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
a) Arjun and Tiago share £30 in the ratio 2 : 3. Find how much money each of them will receive.	a) Arjun and Tiago share £45 in the ratio 8 : 1. Find how much money each of them will receive.
b) Arjun and Tiago share £30 in the ratio 2 : 3 : 5. Find how much money each of them will receive.	b) Arjun and Tiago share £45 in the ratio 6 : 8 : 1. Find how much money each of them will receive.

Dr Frost 225a. 225b, 225c and 225f

Worked Example	Your Turn
There are 840 elephants in a conservation area. Each elephant is either an Asian elephant or an African elephant. The Asian elephants and the African elephants are in the ratio $3 : 2$ 75% of the Asian elephants are male. Work out how many of the Asian elephants are female.	There are 600 elephants in a conservation area. Each elephant is either an Asian elephant or an African elephant. The Asian elephants and the African elephants are in the ratio $3 : 17$ $\frac{3}{5}$ of the Asian elephants are female. Work out how many of the Asian elephants are male.

Worked Example	Your Turn
Noah has a collection of 20p and 50p coins. The ratio of the number of 20p coins to the number of 50p coins is $5 : 3$ Work out the ratio of the total value of the 20p coins : the total value of the 50p coins. Give your answer in its simplest form.	Viraj has a collection of 50p and £1 coins. The ratio of the number of 50p coins to the number of £1 coins is $6 : 7$ Work out the ratio of the total value of the 50p coins : the total value of the £1 coins. Give your answer in its simplest form.

Worked Example	Your Turn
Densy has a collection of 10p, 20p and £1 coins. The ratio of the number of 10p coins to the number of 20p coins to the number of £1 coins is $2 : 3 : 1$ The total value of all the coins is £3.60 Work out how many coins of each type Densy has.	George has a collection of 10p, 20p and 50p coins. The ratio of the number of 10p coins to the number of 20p coins to the number of 50p coins is $10 : 15 : 4$ The total value of all the coins is £18 Work out how many coins of each type George has.

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	

1.12 Combining Ratios

Worked Example

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 $8 : 5$

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 $1 : 3$ 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 $7 : 1$

Dr Frost 227a and 227c

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 $AB : BC : CD$

2 Algebra Recap

2.1 Collecting Like Terms

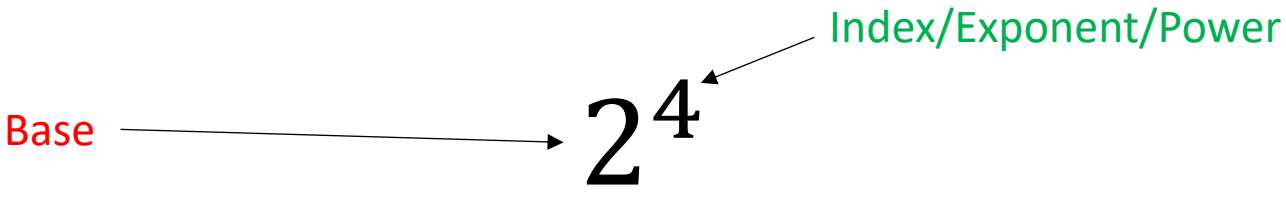
2.2 Multiplying Terms

2.3 Dividing Terms

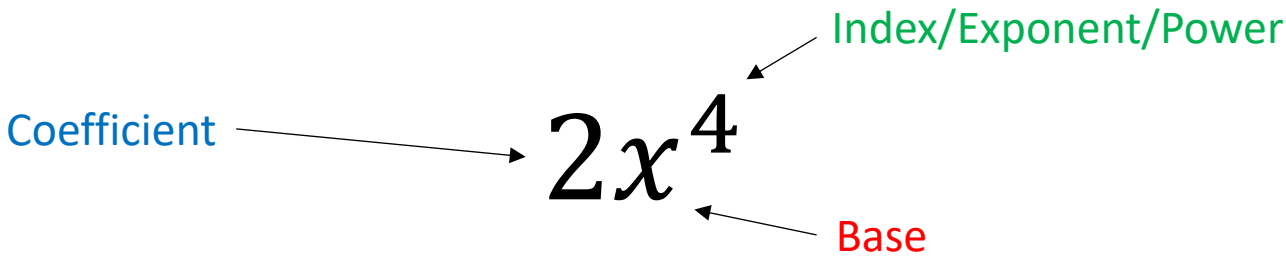
2.4 Substitution

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) $9^5 \times 9^{-2}$ c) $9^a \times 9^{-b}$	Simplify a) $8^6 \times 8^3$ b) $8^6 \times 8^{-3}$ c) $8^{-c} \times 8^{-d}$

Dr Frost 158a and 194b

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) $3x^4 \times 2x^5$ c) $6x^7y^4 \times 9x^8y^5$	Simplify a) $x^9 \times x^2$ b) $4x^3 \times 5x^7$ c) $8x^9y^3 \times 6x^2y^7$

Dr Frost 194a and 194d

3.3 Dividing

Complete the following:

$3^4 \div 3 =$

$3^4 \div 3^2 =$

$3^4 \div 3^3 =$

$3^4 \div 3^n =$

$3^m \div 3^n =$

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) $\frac{5y^{11}}{12y^7}$ d) $21y^{12}z^4 \div 3y^{11}z^7$	Simplify a) $p^{14} \div p^9$ b) $56y^4 \div 8y^2$ c) $\frac{8y^4}{56y^2}$ d) $20y^{14}z^2 \div 4y^4z^9$

Dr Frost 194c and 194e

3.4 The Power Zero

Complete the following:

$3^4 =$

$3^3 =$

$3^2 =$

$3^1 =$

$3^0 =$

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) $\left(\frac{1}{9}\right)^0$

Dr Frost 158f and 194f

3.5 Powers of Powers

Complete the following:

$(3^2)^1 =$

$(3^2)^2 =$

$(3^2)^3 =$

$(3^2)^4 =$

$(3^2)^5 =$

$(3^2)^n =$

$(3^m)^n =$

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) $(-3c^4)^2$ c) $(3c^4d^5)^4$ d) $\left(3c^{\frac{4}{3}}\,d^{\frac{5}{6}}\right)^3$	Simplify a) $(5c^{-4})^2$ b) $(-5c^{-4})^2$ c) $(5c^{-4}d^6)^3$ d) $\left(5c^{-\frac{4}{3}}\,d^{\frac{6}{7}}\right)^3$

Dr Frost 194j and 194k

3.6 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) $(3y^4)^2$ g) $(4a^6b^3)^2$ h) $\frac{8a^5b^3}{4ab^7}$	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) $(5y^4)^3$ g) $(2a^6b^3)^4$ h) $\frac{12a^2b^3}{4ab^7}$

Worked Example	Your Turn
Simplify a) $\frac{9^8}{9^3 \times 9^4}$ b) $\frac{9^8}{(9^3)^4}$	Simplify: a) $\frac{8^{10}}{8^2 \times 8^6}$ b) $\frac{8^{10}}{(8^2)^6}$

Dr Frost 158d and 158e

Worked Example	Your Turn
Simplify a) $\frac{r^{10}}{r^6 \times r^2}$ b) $\frac{q^{\frac{3}{4}}}{q^{\frac{1}{4}} \times q^{\frac{5}{6}}}$ c) $\frac{q^{\frac{3}{5}}}{\left(q^{\frac{5}{4}}\right)^{\frac{2}{5}}}$	Simplify: a) $\frac{x^{10}}{x^4 \times x^3}$ b) $\frac{r^{\frac{5}{2}}}{r^{\frac{1}{2}} \times r^{\frac{2}{3}}}$ c) $\frac{r^{\frac{3}{2}}}{\left(r^{\frac{1}{3}}\right)^{\frac{6}{5}}}$

Dr Frost 194h and 194i

Worked Example

a) Given that $\frac{(3^2)^a}{3^5} = 3^{13}$

Work out out the value of a

b) Given that $\frac{p^5}{p^n \times p^6} = p^{-3}$

Work out the value of n

Your Turn

a) Given that $\frac{(y^a)^5}{y^4} = y^{11}$

Work out out the value of a

b) Given that $\frac{4^5}{4^m \times 4^3} = 4^{-4}$

Work out out the value of m

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Worked Example

Simplify

a) $\dfrac{30x^{10}y^{8}}{5x^{6}y^{5} \times 3x^{\frac{1}{3}}\, y^{\frac{3}{4}}}$

b) $\dfrac{25m^{\frac{3}{2}}\, n^{14}}{\left(5m^{\frac{1}{3}}\, n^{8}\right)^{3}}$

Your Turn

Simplify:

a) $\dfrac{21p^{8}q^{4}}{7p^{6}q^{3} \times p^{\frac{2}{5}}\, q^{\frac{3}{4}}}$

b) $\dfrac{\left(2p^{3}\, q^{\frac{2}{5}}\right)^{3}}{8p^{\frac{3}{2}}\, q^{3}}$

3.7 Negative Indices

Complete the following:

$2^2 =$

$2^1 =$

$2^0 =$

$2^{-1} =$

$2^{-2} =$

$2^{-3} =$

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

Worked Example	Your Turn
Simplify: a) $\left(\frac{3}{10}\right)^{-2}$ b) $\left(-\frac{3}{10}\right)^{-2}$ c) 0.004^{-1}	Simplify: a) $\left(\frac{2}{5}\right)^{-3}$ b) $\left(-\frac{2}{5}\right)^{-3}$ c) 0.02^{-1}