KING EDWARD VI
HANDSWORTH GRAMMAR
SCHOOL FOR BOYS

KING EDWARD VI
ACADEMY TRUST
BIRMINGHAM

Year 8

2024 Mathematics 2025

Unit 7 Booklet

HGS Maths

Tasks

Dr Frost Course

Name: _____

Class: _____

Contents

1 Prime Factorisation

1.1 Prime Factors

3 is a prime factor of 36 (True / False)

9 is a prime factor of 36 (True / False)

1 is a prime factor of 36 (True / False)

2 is a prime factor of 36 (True / False)

7 is a prime factor of 36 (True / False)

Intelligent Practice

7 is a prime factor of 12 (True / False)

6 is a prime factor of 12 (True / False)

5 is a prime factor of 12 (True / False)

4 is a prime factor of 12 (True / False)

3 is a prime factor of 12 (True / False)

2 is a prime factor of 12 (True / False)

1 is a prime factor of 12 (True / False)

1 is a prime factor of 27 (True / False)

2 is a prime factor of 27 (True / False)

3 is a prime factor of 27 (True / False)

7 is a prime factor of 27 (True / False)

9 is a prime factor of 27 (True / False)

13 is a prime factor of 27 (True / False)

13 is a prime factor of 26 (True / False)

3 is a prime factor of 26 (True / False)

2 is a prime factor of 26 (True / False)

2 is a prime factor of 25 (True / False)

5 is a prime factor of 25 (True / False)

12.5 is a prime factor of 25 (True / False)

1.2 Product of Prime Factors

Product of Prime Factors	Yes / No ?
9×11	
19×11	
19×11^2	
$2 \times 19 \times 11^2$	
$2 \times 19 \times 101^2$	

Intelligent Practice

Product of Prime Factors	Yes / No ?
$5 + 7$	
5×7	
4×7	
3×7	
2×7	
1×7	
$1 \times 7 \times 9$	
$2 \times 7 \times 9$	
$2 \times 7 \times 11$	
$2 \times 7 + 11$	
$2 \times 7 \times 11 \times 21$	
$2 \times 7 \times 11 \times 31$	
$1 \times 2 \times 7 \times 11 \times 31$	
$2 \times 7 \times 7 \times 11 \times 31$	
$2 \times 7^2 \times 11 \times 31$	
$2^2 \times 7^2 \times 11 \times 31$	
$2^3 \times 7^2 \times 11 \times 31$	
$2^3 \times 7^2 \times 11^5 \times 31^4$	
$1^3 \times 7^2 \times 11^5 \times 31^4$	
$2^3 \times 7^2 \times 11^5 \times 41^4$	

Worked Example	Your Turn
Express 24 as a product of prime factors	Express 48 as a product of prime factors

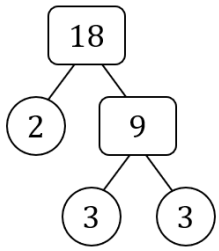
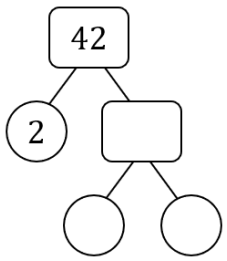
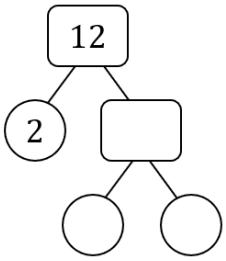
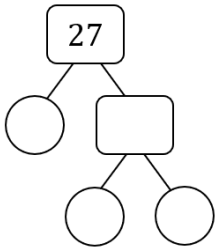
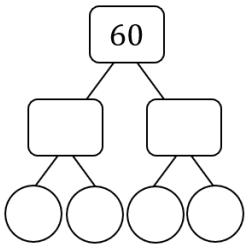
Worked Example	Your Turn
Express 924 as a product of prime factors	Express 588 as a product of prime factors

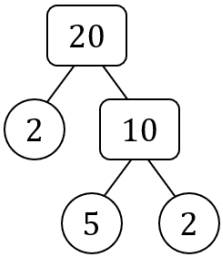
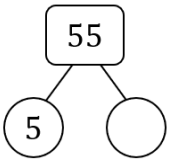
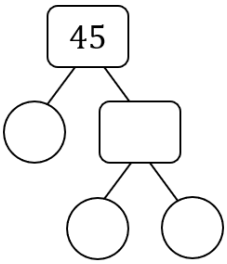
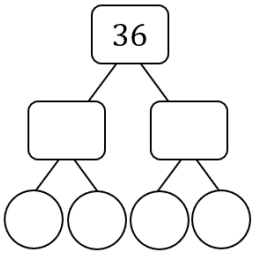
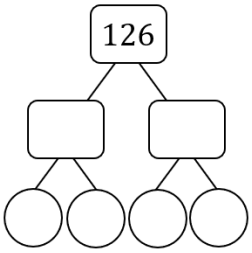
Worked Example	Your Turn
Express $2^3 \times 3$ as an ordinary number	Express $3^2 \times 5$ as an ordinary number

Fill in the Gaps

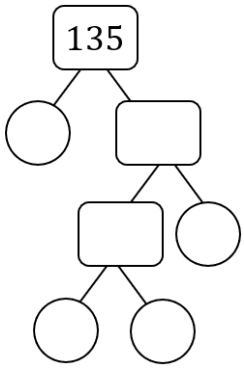
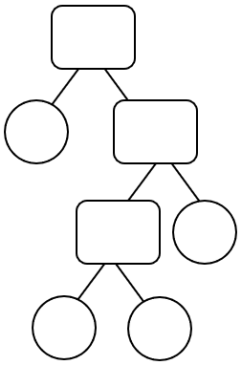
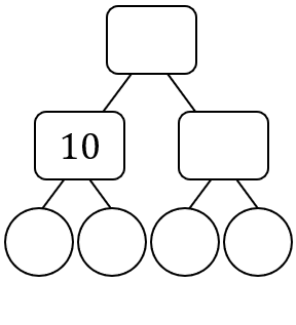
Number	Prime Factor Decomposition	Index Form
6		
	$2 \times 2 \times 3$	
48		
240		
		$2^4 \times 3^2 \times 5$
	$2 \times 2 \times 2 \times 3 \times 3$	
216		
		$2^2 \times 3^2$
	$2 \times 2 \times 3 \times 3 \times 5 \times 5$	
		$2 \times 3 \times 5$
420		
12 600		

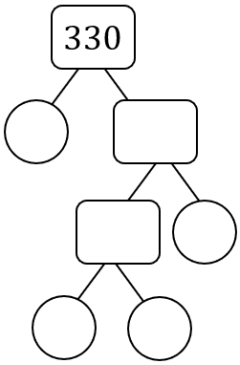
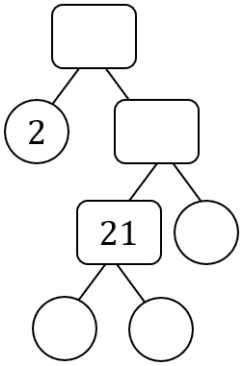
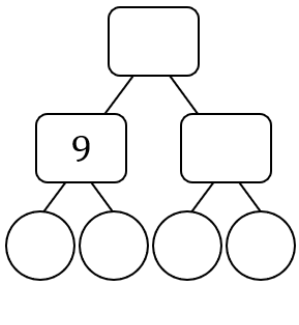
Fill in the Gaps

Number	Factor Tree	Product of Prime Factors
18		$2 \times 3 \times 3$ 2×3^2
42		
12		
27		
60		

Number	Factor Tree	Product of Prime Factors
20		
55		
45		
36		
126		

Fill in the Gaps

Factor Tree	Product of Prime Factors
	135
	$3 \times 3 \times 3 \times 5$
	$3^3 \times 5$
	220
	
	$2 \times 2 \times 5 \times 5$
	
	$\square \times \square^3$

Factor Tree	Product of Prime Factors
	330
	525
	
	$\square \times \square \times 7^2$
	
	$\square \times \square^2 \times 13$

1.3 Using Product of Prime Factors

Worked Example	Your Turn
$84 = 2^2 \times 3 \times 7$ How is 840 written as its product of prime factors?	$84 = 2^2 \times 3 \times 7$ How is 504 written as its product of prime factors?

Worked Example	Your Turn
$X = 378 \times 12^4$ Write X as a product of its prime factors.	$N = 242 \times 15^2$ Write N as a product of its prime factors.

Worked Example	Your Turn
$C = \mathbf{3}^{\boldsymbol{a}} \times \mathbf{5}^{\boldsymbol{b}}$ a) $3C$ b) $5C$ c) $25C$	$D = \mathbf{3}^{\boldsymbol{e}} \times \mathbf{7}^{\boldsymbol{f}}$ a) $3D$ b) $7D$ c) $27D$

Fill in the Gaps

a	b	$a+b$	$a-b$	$a\times b$	$a\div b$
$2^5\times3^8\times5^3$	$2^4\times3^8\times5^3$	$(2+1)\times2^4\times3^8\times5^3$ $=2^4\times3^9\times5^3$	$(2-1)\times2^4\times3^8\times5^3$ $=2^4\times3^8\times5^3$	$2^9\times3^{16}\times5^6$	2
$2^4\times3^9\times5^3$	$2^4\times3^8\times5^3$				
	$2^4\times3^8\times5^3$	$2^5\times3^9\times5^3$			
	$2^4\times3^8\times5^3$		$2^4\times3^9\times5^3$		
	$2^4\times3^8\times5^3$			$2^9\times3^{17}\times5^6$	
	$2^4\times3^8\times5^3$				3^2

1.4 Factors from Prime Factors

10 is a factor of $2 \times 5 \times 7 \times 11 \times 17$ (True / False)

10 is a factor of $2 \times 5^3 \times 7 \times 11 \times 17$ (True / False)

15 is a factor of $2 \times 5^3 \times 7 \times 11 \times 17$ (True / False)

25 is a factor of $2 \times 5^3 \times 7 \times 11 \times 17$ (True / False)

22 is a factor of $2 \times 5^3 \times 7 \times 11 \times 17$ (True / False)

Intelligent Practice

2 is a factor of $2 \times 3 \times 7 \times 13$ (True / False)

3 is a factor of $2 \times 3 \times 7 \times 13$ (True / False)

5 is a factor of $2 \times 3 \times 7 \times 13$ (True / False)

7 is a factor of $2 \times 3 \times 7 \times 13$ (True / False)

4 is a factor of $2 \times 3 \times 7 \times 13$ (True / False)

6 is a factor of $2 \times 3 \times 7 \times 13$ (True / False)

14 is a factor of $2 \times 3 \times 7 \times 13$ (True / False)

21 is a factor of $2 \times 3 \times 7 \times 13$ (True / False)

15 is a factor of $2 \times 3 \times 7 \times 13$ (True / False)

15 is a factor of $2 \times 3 \times 5 \times 7 \times 13$ (True / False)

30 is a factor of $2 \times 3 \times 5 \times 7 \times 13$ (True / False)

Intelligent Practice

9 is a factor of $2 \times 3 \times 5 \times 7 \times 13$ (True / False)

9 is a factor of $2 \times 3^2 \times 5 \times 7 \times 13$ (True / False)

9 is a factor of $2 \times 3^2 \times 5 \times 7 \times 23$ (True / False)

4 is a factor of $2 \times 3^2 \times 5 \times 7 \times 23$ (True / False)

4 is a factor of $2^3 \times 3^2 \times 5 \times 7 \times 23$ (True / False)

8 is a factor of $2^3 \times 3^2 \times 5 \times 7 \times 23$ (True / False)

16 is a factor of $2^3 \times 3^2 \times 5 \times 7 \times 23$ (True / False)

2 is a factor of $2^3 \times 3^2 \times 5 \times 7 \times 23$ (True / False)

28 is a factor of $2^3 \times 3^2 \times 5 \times 7 \times 23$ (True / False)

28 is a factor of $2^2 \times 3^2 \times 5 \times 7 \times 23$ (True / False)

28 is a factor of $2 \times 3^2 \times 5 \times 7 \times 23$ (True / False)

Fluency Practice

Number	Prime Factor Decomposition	Factor	Yes/No
2520	$2^3 \times 3^2 \times 5 \times 7$	$15 = 3 \times 5$	Yes
2520		8	
2520		25	
2520		45	
1320		22	
1320		45	
1320		88	
20250		12	
20250		27	
20250		15	
20250		75	
15120		16	
15120		21	
15120		70	
15120		18	

1.5 Types of Numbers from Prime Factors

- Square numbers have even powers in their prime factorisation.
- Cube numbers have powers which are multiples of 3.

Product of Prime Factors	Square Number	Cube Number	Neither
$5^2 \times 11$			
$5^2 \times 11^8$			
$5^6 \times 11^8$			
$5^6 \times 11^9$			
$5^6 \times 11^9 \times 17^{13}$			

Intelligent Practice

Product of Prime Factors	Square Number	Cube Number	Neither
2×3			
3×3			
3^2			
3^3			
$3^3 \times 7$			
$3^3 \times 7^2$			
$3^3 \times 7^3$			
$3^2 \times 7^2$			
$5^2 \times 7^2$			
$2 \times 5^2 \times 7^2$			
$2^2 \times 5^2 \times 7^2$			
$2^3 \times 5^2 \times 7^2$			
$2^3 \times 5^3 \times 7^3$			

Intelligent Practice

Product of Prime Factors	Square Number	Cube Number	Neither
$2^4 \times 5^4 \times 7^4$			
$2^5 \times 5^5 \times 7^5$			
$2^6 \times 5^6 \times 7^6$			
$2^7 \times 5^7 \times 7^7$			
$2^8 \times 5^8 \times 7^8$			
$2^9 \times 5^9 \times 7^9$			
$2^9 \times 5^9 \times 7^6$			
$2^2 \times 5^9 \times 7^6$			
$2^3 \times 5^9 \times 7^6$			
$2^6 \times 5^{18} \times 7^{12}$			
$2^6 \times 5^{18} \times 7^{12} \times 11$			
$2^6 \times 5^{18} \times 7^{12} \times 11^2$			
$2^6 \times 5^{18} \times 7^{12} \times 11^3$			

1.6 Using Prime Factorisation to Simplify Fractions

Worked Example	Your Turn
Simplify $\frac{693}{1925}$	Simplify $\frac{693}{1155}$

1.7 Using Prime Factorisation to Find Roots

Worked Example	Your Turn
a) Find $\sqrt{784}$ b) Find $\sqrt[3]{216}$	a) Find $\sqrt{324}$ b) Find $\sqrt[3]{512}$

1.8 Number of Factors

To get the number of factors of a number in prime factorised form, add one to each power and times the powers together.

Worked Example	Your Turn
a) How many factors does 36 have? b) How many factors does 37 have? c) How many factors does 38 have?	a) How many factors does 72 have? b) How many factors does 73 have? c) How many factors does 74 have?

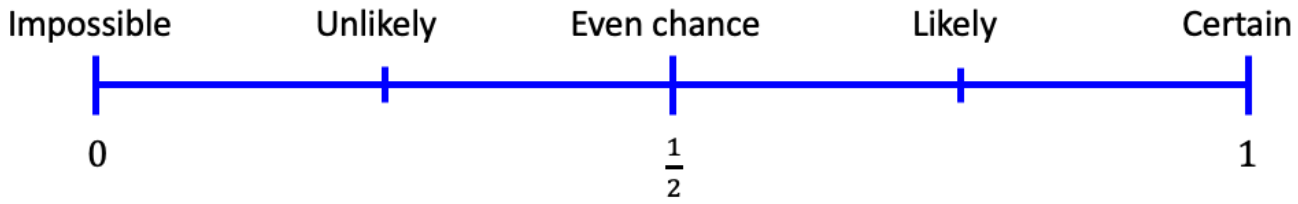
2 Probability

2.1 Probability Scale

- Probability is a numerical measure of how likely or unlikely an event is to occur.

- Probabilities are usually written as fractions, but can be written in any form equivalent to that fraction, e.g., $\frac{3}{4} = 0.75 = 75\%$

- Probabilities can be anywhere between 0 (impossible) and 1 (certain):

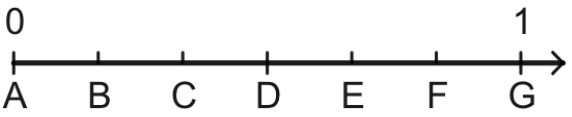
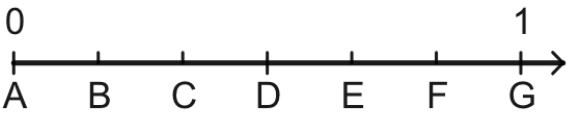


Worked Example	Your Turn
Place a probability of $\frac{3}{8}$ on a line, and state how likely it is.	Place a probability of $\frac{6}{8}$ on a line, and state how likely it is.

Worked Example	Your Turn
Describe using impossible, unlikely, even chance, likely or certain the probability that: a) You will walk to Mars. b) The day after Monday is Tuesday. c) You roll a three on a fair die. d) You flip a tails on a fair coin.	Describe using impossible, unlikely, even chance, likely or certain the probability that: a) You roll an even number on a fair die. b) The day after Monday is Wednesday. c) You roll a number between 1 and 6 on a fair die. d) You will go to space in your life.

2.2 Probability of Single Events

Worked Example	Your Turn
A bag of sweets contains only 4 red sweets, 2 yellow sweets and 4 green sweets. a) What is the probability of choosing a red sweet? b) What is the probability of choosing a red or yellow sweet? c) What is the probability of choosing a mint?	A bag of sweets contains only 8 red sweets, 4 yellow sweets and 8 green sweets. a) What is the probability of choosing a red sweet? b) What is the probability of choosing a red or yellow sweet? c) What is the probability of choosing a mint?

Worked Example	Your Turn
Albert throws a fair six-sided dice. Select the letter that matches the probability of the dice landing on a number which is 2 or more.  	Spencer throws a fair six-sided dice. Select the letter that matches the probability of the dice landing on a number which is 5 or more. 

2.3 Mutually Exclusive Events

Frayer Model – Mutually Exclusive Events

Definition	**Characteristics**
Examples	**Non-Examples**

2.4 Exhaustive Events

Worked Example

There are green, red and blue counters in a bag.

The chance of picking a green counter is 0.1.

The chance of picking a red counter is 0.3.

What is the chance of picking a blue counter?

Your Turn

It is either raining or not raining.

The chance that it rains tomorrow is 0.55.

What is the chance that it does not rain?

Worked Example

The sides of a spinner are labelled with colours. The spinner is biased. The table shows the probability that the spinner will land on each of the colours red, black, purple or blue. The probability for Black is twice as likely as for Purple. Work out the probability the spinner will land on black.

Colour	Red	Black	Purple	Blue
Probability	0.1			0.3

Your Turn

The table shows each of the probabilities that a counter taken at random will be red, green, yellow, blue or black. The probability for Green is twice as likely as for Red. Work out the probability that a counter taken at random will be red.

Colour	Red	Green	Yellow	Blue	Black
Probability			0.15	0.25	0.3

2.5 Expectation

Worked Example

The table shows each of the probabilities that a counter taken at random will be white, black, yellow or purple.

Colour	White	Black	Yellow	Purple
Probability	0.2	0.2	0.2	0.4

Amelia selects a counter at random 50 times. Work out an estimate for the total number of times the counter will be white.

Your Turn

The sides of a spinner are labelled with colours. The spinner is biased. The table shows the probability that the spinner will land on each of the colours black, blue, red or white.

Colour	Black	Blue	Red	White
Probability	0.15	0.2	0.2	0.45

Harry spins the spinner 60 times. Work out an estimate for the total number of times the spinner will land on red.

Worked Example	Your Turn
Keith designs a game. It costs $£1.60$ to play the game. The probability of winning the game is $\frac{2}{5}$ The prize for each win is $£3$ 80 people play the game. Work out an estimate of the profit that Keith should expect to make.	Bob designs a game. It costs $50p$ to play the game. The probability of winning the game is $\frac{1}{4}$ The prize for each win is $£1.50$ 100 people play the game. Work out an estimate of the profit that Bob should expect to make.

2.6 Relative Frequency

Worked Example	Your Turn
A coin is flipped 30 times. The results are: H T H H H H H H T T T H H T T T T T H H H T T H H T H T H H a) What are the relative frequencies for heads and tails? b) The coin is flipped 300 times. Estimate how many times the coin will land on tails.	A coin is flipped 20 times. The results are: T H T T T T T H H H H H T H T H H H H H a) What are the relative frequencies for heads and tails? b) The coin is flipped 100 times. Estimate how many times the coin will land on tails.

Dr Frost 251a and 251e

2.7 Listing Outcomes

Outcomes and Events

When we roll a six-sided die there are 6 outcomes.
The outcomes are the results we could get from rolling the die.

Outcomes: 1, 2, 3, 4, 5, 6.

An event is one or more outcomes.

Event	Outcome(s)
A square number	
A 3	
A factor of 8	
A multiple of 3	

Here is a spinner numbered 1 to 8.
List the outcome(s) for each event.

Event	Outcome(s)
An even number	
A number less than 3	
A number greater than 7	
An integer	
A 5	
A 2-digit number	

Worked Example	Your Turn
List all the ways of arranging the letters in the word: CAT	List all the ways of arranging the letters in the word: DOG

Worked Example	Your Turn
I flip a coin and then roll a six-sided die. List the possible outcomes.	I flip a coin and then roll a 4-sided die. List the possible outcomes.

Worked Example	Your Turn
The first five positive integers are $1, 2, 3, 4, 5$. I choose two numbers from this list without repeats. Write down all possible combinations of two numbers I can choose.	The four square numbers are $1, 4, 9, 16$. I choose two numbers from this list without repeats. Write down all possible combinations of two numbers I can choose.

2.8 Sample Space Diagrams

HORSE RACE

Choose a horse to win! Roll two dice and total the score.
Move that horse forwards by making an **X** in the next box.
Play again. Can you explain why some horses do better than others?

Which horse will win?

							FINISH
1	Nowt Ashance						
2	Lucky Larry						
3	Shoe-In Sarah						
4	Maybe May						
5	Hopeful Harry						
6	Sometimes Sam						
7	Average Adam						
8	Unlikely Lucy						
9	Probable Polly						
10	Golden Glen						
11	Definite Dan						
12	Yul Blucky						

Activity

HORSE RACE

1) Who won the race(s)?
2) Who did you expect to win?
3) Do some horses have a higher chance of winning? Why?

4) How many ways can you score a **2**?
5) How many ways can you score a **12**?
6) How many ways can you score a **4**?
7) How many ways can you score a **10**?
8) How many ways can you score a **7**?

We can make this easier by using a Sample Space Diagram.

Score on the 2nd Dice

+	**1**	**2**	**3**	**4**	**5**	**6**
1	2					
2			5			
3						9
4						
5						
6				10		

Score on the 1st Dice

Fill the table with the totals from 2 dice.

a) How many ways to score a **6**?

b) How many ways to score a **5**?

c) How many outcomes are there in total?

Remember, $Probability = \frac{number\ of\ ways\ outcome\ can\ happen}{total\ number\ of\ possible\ outcomes}$

Use this to find: d) Probability(**12**) = e) Probability(**8**) =

f) P(**4**) = g) P(**9**) = h) P(**7**) = i) P(**1**) =

If you ran the horse race again, which horse would you pick?

Worked Example	Your Turn
Elisa throws a spinner with faces labelled R, G, B and Y and a four-sided dice numbered -1, -2, -3 and -4 at the same time. Draw a sample space diagram.	Elisa throws a spinner with faces labelled R, G, B and Y and a four-sided dice numbered 2, 4, 6 and 8 at the same time. Draw a sample space diagram.

Worked Example	Your Turn
Noel throws a four-sided dice and a four-sided dice at the same time and adds up the scores. Draw a sample space diagram.	Kayleigh throws a four-sided dice numbered 2, 4, 6 and 8 and a four-sided dice at the same time and adds up the scores. Draw a sample space diagram.

Worked Example	Your Turn
Carolina throws a four-sided dice numbered 1, 3, 5 and 7 and a four-sided dice numbered -1, -2, -3 and -4 at the same time and multiplies the scores. Draw a sample space diagram.	Carolina throws a six-sided dice and a four-sided dice numbered -1, -2, -3 and -4 at the same time and multiplies the scores. Draw a sample space diagram.

Worked Example

Paul throws a four-sided dice numbered 2, 4, 6 and 8 and a four-sided dice numbered 1, 3, 5 and 7 at the same time and find the difference between the scores.

Draw a sample space diagram.

Your Turn

Kayleigh throws a four-sided dice and a six-sided dice at the same time and find the difference between the scores.

Draw a sample space diagram.

Worked Example

Lisa throws a four-sided dice and a six-sided dice at the same time and find the difference between the scores. The sample space diagram below shows all the possible outcomes.

	1	**2**	**3**	**4**
1	0	1	2	3
2	1	0	1	2
3	2	1	0	1
4	3	2	1	0
5	4	3	2	1
6	5	4	3	2

Find the probability that Lisa gets a difference which is 3 or more.

Your Turn

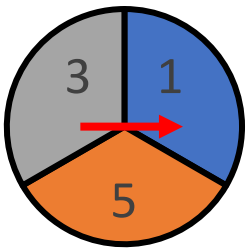
Joel throws a four-sided dice numbered 2, 4, 6 and 8 and a four-sided dice at the same time and find the difference between the scores. The sample space diagram below shows all the possible outcomes.

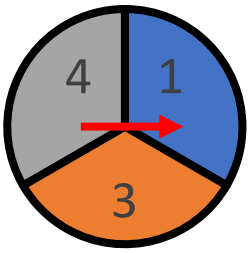
	2	**4**	**6**	**8**
1	1	3	5	7
2	0	2	4	6
3	1	1	3	5
4	2	0	2	4

Find the probability that Joel gets a difference which is 4 or less.

Worked Example

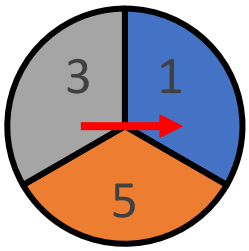
I spin these two spinners then add the numbers together to get a score.
Work out the probability that I get a score of 4.

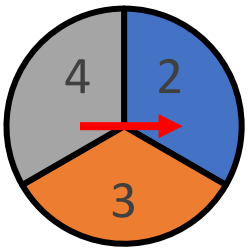




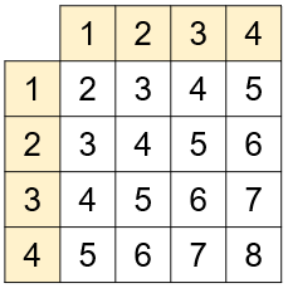
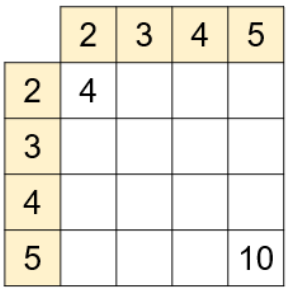
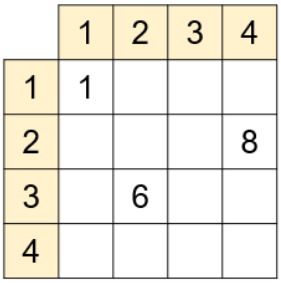
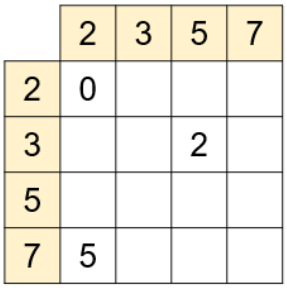
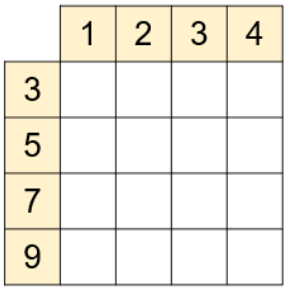
Your Turn

I spin these two spinners then add the numbers together to get a score.
Work out the probability that I get a score of 4.





Fill in the Gaps

Sample Space		Probability Questions	
A fair four-sided spinner is numbered 1 to 4. The spinner is spun twice, and the two scores added together.		Find the probability that the total score is 7.	
		Find the probability that the total score is greater than 4.	
		Find the probability that the total score is a multiple of 3.	
A fair four-sided dice is numbered 2, 3, 4 and 5. The spinner is spun twice, and the two scores added together.		Find the probability that the total score is 8.	
		Find the probability that the total score is less than 7.	
		Find the probability that the total score is a multiple of 4.	
A fair four-sided dice is numbered 1, 2, 3 and 4. The spinner is spun twice, and the two scores multiplied together.		Find the probability that the total score is even.	
		Find the probability that the total score is greater than 6.	
		Find the probability that the total score is prime.	
A fair four-sided spinner is numbered 2, 3, 5 and 7. The spinner is spun and the difference between the two scores recorded.		Find the probability that the difference is zero.	
		Find the probability that the difference is odd.	
		Find the probability that the difference is two or more.	
Two fair four-sided spinners are spun, and the scores added together. The first spinner is numbered 1, 2, 3 and 4 and the second spinner is numbered 3, 5, 7 and 9.		Find the probability that the total score is 10.	
			$\frac{5}{16}$
			$\frac{3}{8}$

3 Expanding Single Brackets

3.1 Distributive Law

Frayer Model – Distributive Law

Definition	**Characteristics**
Examples	**Non-Examples**

Worked Example	Your Turn
Use the distributive property to calculate: a) $7 \times (80 + 3)$ b) $(70 + 8) \times 3$ c) $8 \times (30 - 7)$	Use the distributive property to calculate: a) $3 \times (80 + 7)$ b) $(30 + 8) \times 7$ c) $-8 \times (70 - 3)$

3.2 Expanding Single Brackets without Powers

Worked Example	Your Turn
Expand: a) $2(x-3)$ b) $-2(x-3)$	Expand: a) $2(3-x)$ b) $-2(3-x)$

3.3 Expanding Single Brackets with Powers

Worked Example	Your Turn
Expand: a) $2x(x-3)$ b) $-2x(x-3)$	Expand: a) $2x(3-x)$ b) $-2x(3-x)$

3.4 Expanding Single Brackets with Index Laws

Worked Example	Your Turn
Expand and simplify: a) $a^3bc(10b^2c^2 + 9a^2)$ b) $4a^5b^2(3a^4b^4 - 5b^2)$	Expand and simplify: a) $a^3b^5(3a^3b + 7ab^4c)$ b) $7x^5y^4(6x^2y + 5x^4y)$

3.5 Expanding and Simplifying Single Brackets

Worked Example	Your Turn
Expand and simplify: a) $4 + 7(6x - 5)$ b) $8x + 6 + 7(5x + 9)$	Expand and simplify: a) $-5 + 2(4y - 1)$ b) $6z + 3 + 5(7z + 2)$

Worked Example	Your Turn
Expand and simplify: a) $2(x-1)+3(x-4)$ b) $2(x-1)-3(x-4)$	Expand and simplify: a) $2(x-1)+5(x-4)$ b) $2(x-1)-5(x-4)$

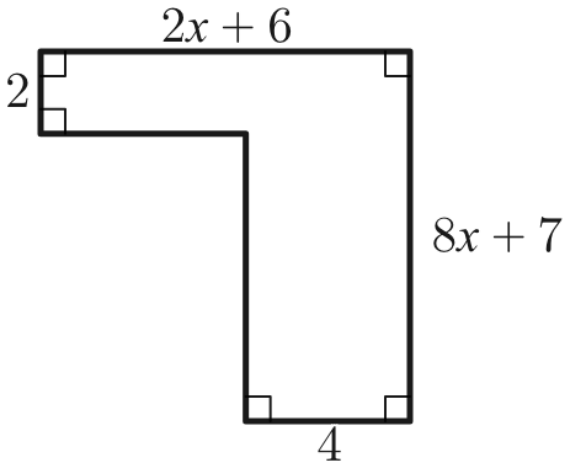
Dr Frost 252g and 252h

Worked Example	Your Turn
Expand and simplify: a) $2x(x-1)-3x(x-4)$ b) $2x(x-1)-3(x-4)$	Expand and simplify: a) $2x(x-1)-5x(x-4)$ b) $2x(x-1)-5(x-4)$

Worked Example	Your Turn
Expand and simplify: a) $5-(2-3x)$ b) $3x(5x+4)-(2x-1)$	Expand and simplify: a) $5x-(x-6)$ b) $5(1-5x)-(x+3)$

Worked Example

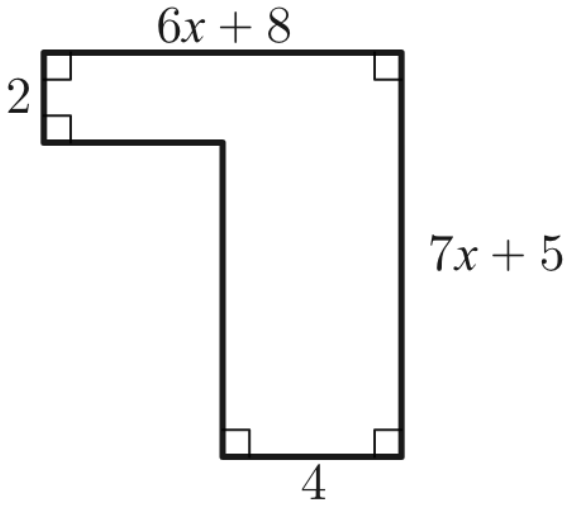
Find an expression for the area of the shape below.



Give your answer in its simplest form.

Your Turn

Find an expression for the area of the shape below.



Give your answer in its simplest form.