JACK PETCHEY FOUNDATION

COUNT ON US

Secondary Maths Challenge

In partnership with The Maths Zone

STUDENT WORKBOOK

GET ENGAGED IN MATHS!

1. INTRODUCTION

Welcome to your **Count on Us Secondary Challenge** student workbook.

This book contains two parts:

1. An introduction to tell you about the activities and the tournament, together with a tracker to help you find where the challenge activities fit with the maths topics you are learning in class.
2. Details about tournament activities, with rules and how it works in a tournament setting, together with activities for preparing for the tournament and to help you with your key stage 3 mathematics.

The **Count on Us Secondary Challenge** is a maths tournament involving over 4000 young people from across London, delivered by The Maths Zone in partnership with the Jack Petchey Foundation. We hope that by taking part, you will become more confident in maths, will develop your problem solving skills and boost your maths skills too.

The **Secondary Challenge** is made up of four rounds in different areas of maths. We hope you will find them really good fun and you'll want to practice lots to get really good at them! In the summer term, your school will select a team of 5 people to represent you in the regional heats.

This book will explain how all the activities work and give you everything you need to try them out, practice them and get really good at puzzling, problem solving and fast paced number skills. You will work on statistics and probability, geometry, algebra and different number skills, so everything that you do will help you with your ordinary maths lessons too.

The national curriculum in maths also expects you to develop three skills which are developed specifically in mathematics:

(i) Fluency: you can do maths quickly and accurately, mostly in your head (NO reaching for a calculator when you see simple numbers!)
(ii) Reasoning: you can see and describe how things work mathematically.
(iii) Problem Solving: you can find a mathematical way to solve problems.

The tournament has 5 rounds and a bonus round:

These cover the four main areas of the National Curriculum, with Statistics and Probability in separate round labelled 1a and 1b, with the bonus round being beyond normal curriculum work, but not containing any maths you will not know.

1a	Statistics	Teams play the game of hedgehog, a strategic dice game needing thoughtful probabilistic thinking.
1b	Probability	You will receive a card set for Data-Chart-Analysis, a matching activity looking at statistical data, illustrated with charts and analysed.
2	Geometry	You will play the game of GridLines Geometry, solving geometric problems in different categories using randomly dealt number cards.
3	Number	You will play the 24®Game. A card game requiring mental number manipulation in a variety of categories: whole numbers, integers and fractions and decimals.
4	Algebra	Your team will solve a series of algebra problems in a story based context.
B	Puzzles	You will receive a selection of traditional mathematical puzzles with your Data-Chart-Analysis pack. During GridLines and The 24®Game some of your team will not be involved, so you have these puzzles to solve!

Tracker

Use the tracker to choose activities that match what you are learning in class.
Look in the tracker for the topic you are studying in class, then read which tournament round will help you with that topic (R1a, R1b, R2, R3 or R4, meaning round 1a, 1b 2, 3 or 4).
The Round 2, (R2) activities are given in more detail. That is because the cards in the GridLines Geometry game are coded by topic. M=Mensuration (Area and Perimeter), V=Volume (and similarity), P=Pythagoras and A=Angles. So, if you see R2V look for the V cards in the GridLines card pack and so on.
The tracker covers all of the content of the Key Stage 3 National Curriculum. It has been simplified to include only those things you can work on independently.

Number	**R**
1. Place value for decimals, measures and integers of any size.	
2. Order positive and negative integers, decimals and fractions; on a number line and with symbols =, ≠, <, >, ≤, ≥	
3. Prime numbers, factors (or divisors), multiples, common factors, common multiples, HCF, LCM and prime factorisation.	
4. Use the four operations with formal written methods.	
5. Use the four operations with integers (+ve and -ve numbers).	R3
6. Use the four operations with decimals.	R3
7. Use the four operations with fractions.	R3
8. Use priority of operations: brackets, powers, roots and reciprocals.	R3
9. Integer powers & real roots (square, cube, 4, 5) as decimals and surds.	R3
10. Standard form $A \times 10^n$ $1 \leq A < 10$, where n is +ve, -ve integer or 0.	
11. Convert decimals and fractions and percentages	R3
12. Fraction Operations.	
13. Percentage; definition, calculation, comparison, change, operation.	
14. Round numbers and measures to appropriate degrees of accuracy.	
15. Round to estimate & calculate possible resulting errors as $a < x \leq b$	
Algebra	
1. Algebraic notation: $ab, 3y, a^2, a^3, a^2b, \frac{a}{b}$, coefficients, brackets.	R4
2. Substitute numerical values into formulae and expressions.	R4
3. Use vocab: expressions, equations, inequalities, terms and factors.	R4
4. Algebraic manipulations: collect like terms, multiply out brackets, take out common factors, expand products of binomials.	R4
5. Rearrange formulae to change the subject.	
6. Use algebraic methods to solve linear equations in one variable.	R4
7. Work with co-ordinates in all four quadrants.	R4
8. Graphs of linear and quadratic functions of one variable.	R4
9. Reduce linear equations to $y = mx + c$; gradients and intercepts.	
10. Use linear and quadratic graphs to estimate values and to find approximate solutions of simultaneous linear equations.	
11. Find approximate solutions to contextual problems from graphs, including piece-wise linear, exponential and reciprocal graphs.	R4
12. Terms of arithmetic, geometric and other sequences; nth terms with term-to-term or a position-to-term rules.	R4

Ratio, proportion and rates of change	
1. Standard units e.g. time, length, area, volume/capacity, mass and compound units e.g. speed, unit pricing and density to solve problems.	
2. Use scale factors, scale diagrams and maps.	
3. Use ratio notation, including reduction to simplest form.	
4. Divide quantities as part:part or part:whole ratio; express as a ratio.	
5. Direct and inverse proportion; graphical and algebraic.	
Geometry and measures	
1. Use perimeter, area and volume formulae for triangles, parallelograms, circles, trapezia, cuboids, other prisms.	R2M
2. Ruler and compass constructions.	
3. Use conventional geometric terms and notations.	R2
4. Criteria for congruence of triangles and similarity by enlargement.	R2V
5. Properties of triangles, quadrilaterals, circles, and other plane figures.	
6. Translations, rotations and reflections applied to given figures.	
7. Angles at a point, angles at a point on a straight line, vertically opposite angles, alternate and corresponding angles.	R2A
8. Angle sum in any polygon, and properties of regular polygons.	R2A
9. Use angle facts, similarity/congruence, Pythagoras' Theorem to obtain simple proofs.	
10. Use Pythagoras' Theorem and trigonometric ratios.	R2P
11. Solve problems in 3-D using the properties of solid shapes.	
Probability	
1. Record, describe and analyse probability experiments.	R1a
2. Understand that the probabilities of all possible outcomes sum to 1.	
3. Calculate theoretical probabilities using sample spaces.	
Statistics	
1. One variable statistics: central tendency (mean, mode, median) and spread (range, consideration of outliers).	R1b
2. Statistical tables, charts and diagrams: frequency tables, bar charts, pie charts, pictograms and vertical line (or bar) charts.	R1b
3. Two variables statistics using scatter graphs.	R1b

2. TOURNAMENT ACTIVITIES

Professional mathematicians explore mathematics, having no idea what the outcome might be. This needs them to be prepared to carry on even when they have no idea at all. They never give up. You need to develop this skill!

The English mathematician Andrew Wiles describes what this feels like in a BBC Horizon programme 'Fermat's Last Theorem', which can easily be found with an internet search. Just watch the first two minutes and you'll be hooked.

The first round consists of two independent activities. The first is to play the Game of Hedgehog, which needs you to decide on strategy using probability. In the second you will match sets of cards showing data sets, statistic charts and analysis.

ROUND 1a: The Game of Hedgehog

The Game of Hedgehog:

1. Two players or teams take turns.
2. In your turn: roll an ordinary die. If you roll 2 ,3, 4 or 5 then you score that amount. You can now choose to pass the turn to the other player or roll again. If you pass, you score the total you have made in this turn. If you roll again, you can add to your score if you roll 2, 3, 4 or 5. If you roll 1 then your turn over (but you can add the 1 to your score for this round). If you roll a 6, then you score zero for this round and your turn is over.
3. The first player (or team) to reach 30 points is the winner.

Example game:

Player 1 rolls 5 then 1 turns ends turn score 6	Player 1: 6	
Player 2 rolls 4 then 5 then 6 turn ends turn score 0	Player 1: 6	Player 2: 0
Player 1 rolls 4 then 3 then 1 turn ends turn score 8	Player 1: 14	Player 2: 0
Player 2 rolls 4 then 5 and passes turn score 9	Player 1: 14	Player 2: 9
Player 1 rolls 4 then 3 and passes turn ends turn score 7	Player 1: 19	Player 2: 9
Player 2 rolls 4 then 2 then 5 and passes turn score 11	Player 1: 19	Player 2: 20
Player 1 rolls 5 then 3 and passes turn score 8	Player 1: 27	Player 2: 20
Player 2 rolls 3 then 5 then 3 and wins(!) turn score 11	Player 1: 27	Player 2: 31

In team play (and in the tournament) a team of 5 plays as one player, playing in turn within their team. They roll the dice in turn. They can either roll or pass. They must not communicate with each other in any way.

You should play this game many times. Try to decide on a strategy. When should you carry on rolling and when should you pass? Think about the level of risk and the reward. In the tournament, some points are awarded for winning the round, but most points are awarded for your score. So, even if you lose, you will score well if you have a high score like Player 1 in the example game.

Team play is much harder than individual play. So, we will use this version of the game in the tournament. When you have fully learned this version, for individual play you can move on to the 2-dice game, which is a much better game for one versus one.

Two Dice Hedgehog:

1. Two players take turns.
2. In your turn: roll two ordinary die. If you roll any of 1, 2 ,3, 4 or 5 on both dice then you score the total amount rolled. You can now choose to pass the turn to the other player or roll again. If you pass, you score the total you have made in this turn. If you roll again, you can add to your score if you again roll 1, 2, 3, 4 or 5 on both dice. If you roll a 6 on either of the dice then you score zero for this round and your turn over. If you roll a double 6, then your total score is reset to zero and your turn is over.
3. The first player to reach 100 points (or more) is the winner.

Playing these games should help you get a sense for probability. You can find many more probability games here: https://nrich.maths.org/8494

ROUND 1b: Data-Chart-Analysis

In this round, you will receive an envelope containing 18 mixed up cards. They will show 6 different situations. For each situation there is a set of data, a chart illustrating that data and some summary analysis showing, for example, the average and spread of the data. Your job will be to find the 6 sets each with data, chart and analysis.

To prepare for this way of thinking, we suggest you try these activities from Nrich:

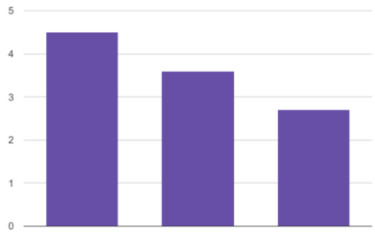
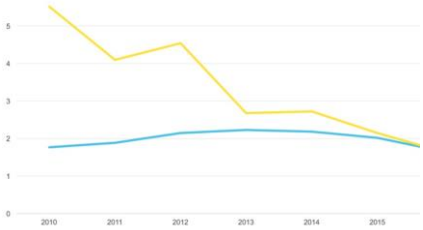
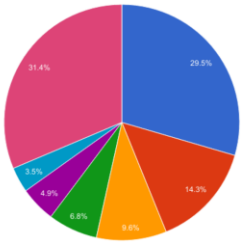
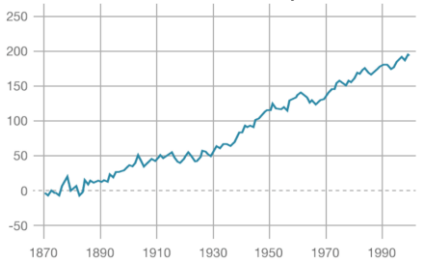
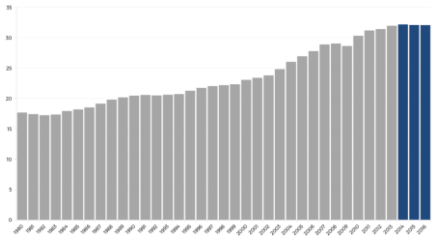
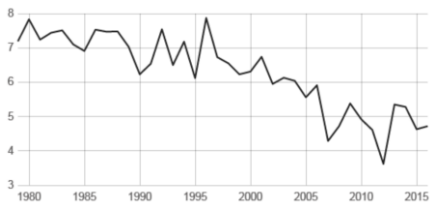
Data
What's the Weather Like? https://nrich.maths.org/whatstheweatherlike
Chart
Olympic records https://nrich.maths.org/records
Statistics
About Average https://nrich.maths.org/10995

In the tournament you will look at data from real world situations. In the news, in books on social media writers will make statements about information. They draw a conclusion (the Analysis) based on the data and often illustrate this with a chart. The relationship between these things is how statistics is used in practice.

You should search online for reports about things you are interested in, where charts and graphs have been used. Look at the relationship: Data-Chart-Analysis. This book from the European Union gives lots of examples to get you started: https://bit.ly/3EhgV8R.

Now try to match this sample set. Write an explanation to describe why you think the sets match. The answers are at the very end of this book. DO NOT look until you have thought hard to complete the matches!

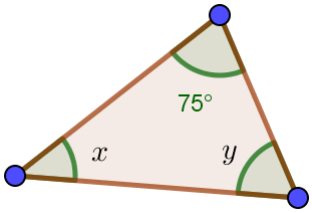
Data-Chart-Analysis Sample Card Set

Data Card D1 Coastal tide gauges showing sea levels.	Chart Card C1 	Analysis Card A1 “Renewable energy is getting cheaper.”
Data Card D2 The minimum amount of ice recorded in the Arctic each year.	Chart Card C2 	Analysis Card A2 “The Paris Agreement could make a huge difference to world temperatures.”
Data Card D3 The amount of energy-related carbon dioxide emissions across the world.	Chart Card C3 	Analysis Card A3 “Arctic ice caps are melting.”
Data Card D4 The cost of renewable energy in emerging-market economies.	Chart Card C4 	Analysis Card A4 “CO2 emissions are finally starting to level off.”
Data Card D5 The breakdown of carbon emissions by country.	Chart Card C5 	Analysis Card A5 “Sea levels are rising.”
Data Card D6 Forecast data compiled by Climate Analytics, ECOFYS, and others.	Chart Card C6 	Analysis Card A6 “China and the USA are responsible for the most carbon emissions.”

ROUND 2: Gridlines Geometry

In this round you will play a card game, designed especially for this tournament called *Gridlines Geometry*. It has lots of geometric situations in; (i) angle relationships, (ii) using Pythagoras' theorem, (iii) finding perimeters and areas, (iv) finding volumes and lengths in similar figures.

In this game, you must find particular solutions to general situations, using some of the ten number cards you will have been dealt.
For example, here is a situation:



You know that $x + y = 180 - 75 = 105^o$
So, you would try to make for two numbers that fit.
E.g. 50° and 55°, or 20° and 85°, or 37° and 68° etc.
If you cannot find numbers to fit, there will always be two more problems to work on.

To prepare for this round, you should get lots of practice solving standard geometry problems in the three areas.

1. Practice your geometric problem solving.
    a. www.bbc.com/bitesize/guides/zrck7ty/revision/1
    b. www.bbc.com/bitesize/guides/z3g9q6f/revision/1
    c. www.bbc.com/bitesize/guides/z2mtyrd/revision/1
    d. www.bbc.com/bitesize/guides/zc9wxnb/revision/1

2. Get confident using variables in geometry
    a. Try this activity: nrich.maths.org/perimeterexpressions
    b. Work through this: www.ocr.org.uk/Images/222109-topic-check-in-6.01-algebraic-expressions.pdf
    c. Solve these: www.somerset.k12.ky.us/userfiles/103/Word%20Problems%20Perimeter%20and%20Age.pdf

3. Take the level 0 cards in the *Gridlines Geometry* game pack (look for a 0 in the blue circle on the card). Work with a partner. Take turns to find a set of numbers that fits the situation. Find as many sets as you can. Now find level 1 cards and repeat. Now, level 2. These are quite hard! Finally, find level 3 cards and repeat. These are very hard – you would be best working together.

4. Now play a game of *Gridlines Geometry*. Read the rules on the next two pages, so you are clear about how it works.

Gridlines Geometry Rules

Gridlines Geometry is a card game played with two 56 card decks consisting of:

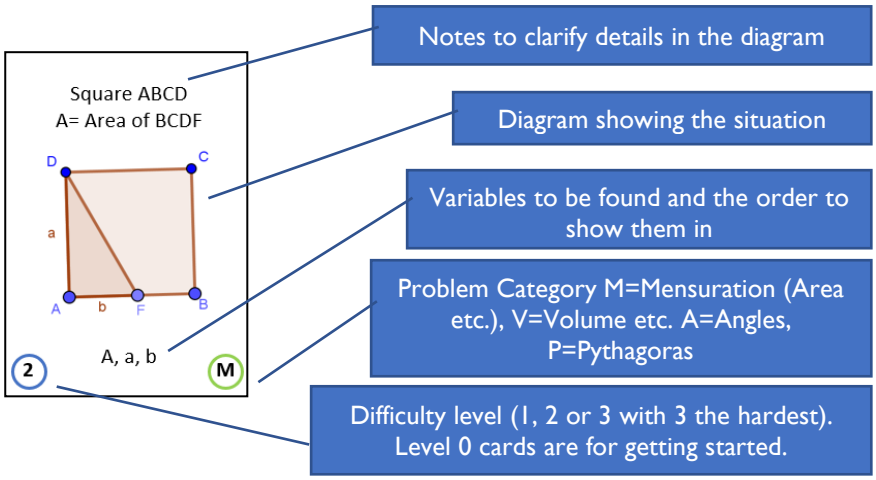
- 6 Rules cards (to remind you of the rules in play).
- 3 'I give up' cards (to use when you cannot find solutions to any problem).
- 44 Number cards.
- 9 Level 0 problems cards for getting started practice.
- 50 Geometric Problem cards.

The aim of the game is to find solutions to situations shown on **Problem Cards**, using numbers made from **Number Cards**. There are many possible solutions to each card. You must find numbers that can fit **all** the variables in the given situation.

Playing the Game Summary

1. Take the 3 'I Give Up' cards to use later.
2. Shuffle Number & Problem Card packs and place them separately face down.
3. Place top 10 Number Cards in 2 rows of 5 face up & 3 problem cards face up.
4. Solve Problem Cards using the Number Cards on the table. (Look at the *Example Solution* on the next page).
5. Take, keep and replace correctly solved Problem Cards. Return and replace used Number Cards.
6. Play an 'I Give Up' card at any time to replace any or all the number and/or Problem Cards.
7. Keep solving until the agreed time is up. Score 1 for each solved card.

The Problem Cards



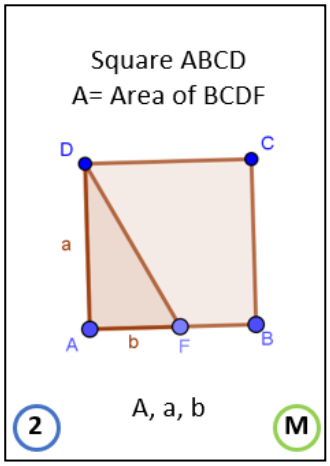
The Number Cards

Number Cards can be organised into groups or played individually. Put the cards on top of one another to make a new number. When placed on the table, ONLY the required number can be visible.

Examples

Use:			To Make	Or	Or
90	5		9 5	5 90	5 0
5	100	2	2100	1 2 5	210 5

Example Solution



I choose a=10 and b=4 because I can make 4 and 10 from the number cards.

- The area of the triangle AFD is $\frac{1}{2} \times 4 \times 10 = 20$
- The area of the square ABCD is $10^2 = 100$
- So, the area of BCDF is $100 - 20 = 80$

If I can make 80 from the number cards, then I can show my solution.

(If not, choose different values for a and b and try again).

I show A, a, b using the number cards for 80, 10, 4

You must use separate number cards for all the numbers.

A judge should check that the solution is correct.

Notes

1. In competitive play, you must explain, step-by-step to the judge how your variables fit the situation. You can show important calculations you have made in your notebook if this helps.
2. When you play one 'I give up!' card you can swap as many cards as you like. All of the problem **and** number cards or some number and/or some problem cards. Replace the cards taken to return to ten number cards and three problem cards face up on the table. Now resume play.
3. Experienced players may wish to count the total number of points from the cards solved. (These are shown in the blue circle on each card as 1, 2 or 3, where 3 is the hardest).

ROUND 3: The 24®Game. Whole Numbers, Fractions & Decimals, Algebra & Exponents

Ask an adult to do a calculation in their head and they'll run away! Everyone is scared of mental arithmetic. This round is designed to make sure YOU are not. All it needs is practice, practice, practice. (And a fun game to practice with …)

The 24® Game is a card game. Each card has 4 numbers on it. You have to combine the numbers using +, -, × or ÷ in any way you can to make an answer of 24. You MUST use all four numbers once and once only!

See if you can do it with these numbers:

4 5 8 4

Hints

- Try to find key number bonds: 6 x 4, 8 x 3, 16 + 8 …
- Try pairing the numbers up to make the parts you need.
- Try finding numbers to make 1 (to multiply and make no difference).
- Keep it all in your head!

Now try these:

1 5 2 6

2 3 6 2

2 6 2 8

1 5 3 9

2 5 4 6

Don't forget … we won't tell you the answers, so don't tell anyone else.

Use the next four pages to practice then use the 24®Game cards.

Different 24®Game Cards

There are different types of 24®Game cards with different number types. You will have some cards of the different types to practice, they are:

- Single Digits: 4 single digit numbers.
- Double Digits: one or more of the numbers will be a two digit number.
- Fractions and Decimals: one or more of the numbers will be expressed as a fraction or a decimal.
- Integers: one or more of the numbers will be negative.
- Algebra and Indices:
    - Algebra cards have one or more of the spaces replaced with an algebraic expression with variable x and/or y. You choose any number(s) for the variable(s) (not zero) and use the value of the expression(s) to complete the 24.
    - Indices cards have four index expressions (always $x^2, x^3, \sqrt{x}, \sqrt[3]{x}$). You choose one of these and apply one of the numbers on the card to make a new number, then use this and the others to complete the 24.

You should practice using each of the sets separately, then make sure you can still solve puzzles when the different types come up randomly. (Shuffle different types together to practice, but make sure to separate the packs to put them away!)

TORTURE SQUARES

Practice your fractions calculations with these ***torture squares***.

Complete each square using the operation shown: +, -, × or ÷

Do them at different times.

Allow 10 minutes max to complete each square.

+	3	$\frac{1}{2}$		4	$\frac{3}{4}$
$\frac{1}{3}$					
		$\frac{4}{5}$			
					$1\frac{1}{4}$
5			$6\frac{1}{2}$		
$\frac{2}{3}$					

×	8	0.1	2	$\frac{1}{4}$	
$\frac{1}{2}$					
0.3					
			0		
0.8					3.2
$\frac{1}{3}$					

first number					
-	4		$\frac{1}{4}$	7	0.3
1					
1.2					
			$2\frac{3}{4}$		
$\frac{1}{5}$		2.2			
2					

first number					
÷	6			$\frac{2}{3}$	0.5
2		0			
0.2					
$\frac{1}{4}$			4		
5					
$\frac{1}{3}$					

Make up more Torture Squares like these to test your friends.

FIND 24: THE BOARD GAME

1. You will need sets of counters of two different colours; one for each player.
2. Take turns to find 24 using any four numbers on the board.

   For example (On board 1 on the next page): Use $4, \frac{1}{2}, 10, 1.2$ make $4 \times \frac{1}{2} = 2$ and $10 \times 1.2 = 12$ then $2 \times 12 = 24$

   Use a timer to give a maximum of one minute per turn.
3. If you succeed, place 4 counters on the number you found.
4. If you fail, your opponent takes a turn.
5. Numbers cannot be used more **t**han once.
6. When neither player can make 24 in two consecutive rounds, play ends and the winner is the player who has placed the most counters.

Alternative Rules:

1. Both players look for sets to make 24 at the same time.
2. If you find a set tap the table and play stops. Place your counters.
3. Score 1if all 4 numbers are whole numbers, add one for each fraction or decimal you used.
4. Play until both players agree they cannot find any more sets OR agree a time limit in advance.
5. For an even harder game, the set of four numbers must be next to each other on the board (horizontally, vertically or diagonally).

***Exponents Version*:**

You **must** substitute *one* of your numbers (**but NOT the number 1**) into one of the following expressions: $x^2, x^3, \sqrt{x}, \sqrt[3]{x}$

***Algebra Version*:**

You must substitute one or two of your numbers into one of these expressions before making 24 (when an expression has been used it cannot be used again):

$x^2 + 1$	$x(x + 1)$	$x^2 + y$	$\frac{x^2}{y}$
$2x(1 - x)$	$\frac{x^2}{y^2}$	$x^2 + 2y^2$	$y(x^2 - 3)$
$x(x^2 + 2y)$	$\frac{x + 2y}{x}$	$x(3 - y^2)$	$\frac{3x - y}{2y}$

FIND 24 BOARD 1 (BEGINNER)

4	$\frac{1}{4}$	6	$\frac{1}{6}$	0.1	1
12	$\frac{1}{8}$	3	9	$\frac{1}{2}$	0.75
2	4	0.5	2	3	20
8	$\frac{2}{3}$	1	3	$\frac{1}{3}$	0.5
$\frac{1}{4}$	9	$\frac{3}{4}$	0.5	2	1
6	$\frac{1}{2}$	4	10	0.25	6

FIND 24 BOARD 2 (INTERMEDIATE)

6	$\frac{1}{4}$	3	1	$\frac{1}{3}$	8
$\frac{1}{4}$	2	0.5	$\frac{1}{2}$	9	$\frac{1}{2}$
12	$\frac{1}{8}$	0.1	4	0.5	20
3	0.2	$\frac{2}{3}$	3	$\frac{1}{6}$	10
$\frac{1}{12}$	9	4	$\frac{5}{6}$	2	$\frac{3}{4}$
1.5	$\frac{2}{3}$	4	6	0.5	6

FIND 24 BOARD 3 (EXPERT)

7	$-\frac{1}{2}$	3	0.8	$\frac{3}{5}$	1.5
$\frac{1}{3}$	2	0.5	$\frac{1}{4}$	8	$\frac{1}{12}$
$2\frac{1}{4}$	$\frac{2}{3}$	1.2	$1\frac{1}{3}$	2.5	11
4	0.4	$\frac{3}{8}$	2	$\frac{1}{6}$	$1\frac{3}{4}$
$\frac{1}{2}$	9	1.3	$-\frac{2}{3}$	1.4	$\frac{5}{12}$
0.3	$\frac{5}{6}$	3	$1\frac{1}{2}$	0.8	5

ROUND 4: The Algebra Problem Solving Challenge.

Algebra is at the heart of all mathematics. It is the language that mathematicians use. You must speak it fluently! Also, you live in London, one of the world's greatest cities and you need to know it well. In this round, you need to use your fast-paced skill in algebra to decode messages to solve a problem about the city.

1. Read about your great city online to get an idea of the things that people think are important, but don't worry, all of the information you need will be given to you in the round.
   - Go for a walk in London looking at maths: www.themathszone.com/?p=641
   - Read about London at: en.wikipedia.org/wiki/London
2. You will need to practice your algebra. This list shows all the algebra problems you will need to know. Use it to decide what to practice.
   - Algebraic notation: $ab, 3y, a^2, a^3, a^2b, \frac{a}{b}$, coefficients, brackets.
   - Substitute numerical values into formulae and expressions.
   - Use vocabulary: expressions, equations, inequalities, terms and factors.
   - Algebraic manipulations: collect like terms, multiply out brackets, take out common factors, expand products of binomials.
   - Use algebraic methods to solve linear equations in one variable.
   - Work with co-ordinates in all four quadrants.
   - Graphs of linear and quadratic functions of one variable.
   - Reduce linear equations to $y = mx + c$; gradients and intercepts.
   - Terms of arithmetic, geometric and other sequences; nth terms with term-to-term or a position-to-term rules.

Practice algebra by making and solving Tarsia puzzles.

- First you will need to download the free Tarsia software at: www.mmlsoft.com/index.php/products/tarsia
- Then download the Algebra set of puzzles (scroll down to find them) at: www.mrbartonmaths.com/jigsaw.htm
- When the software is installed, choose one of the puzzles. Look at the examples on the algebra page (later in this booklet) to guide your choice. Open the file. Make sure the 'output' tab is selected. Print out the sheets. Cut them out. Put them together to make a large hexagon so that edges match with question and answer. ONLY when you have finished click the 'solution' tab.
- We recommend you work with a partner to solve these puzzles.

Practice algebra by using GeoGebra.

- Go to https://www.geogebra.org/
- Click the **Start Calculator** button. Try some things. Type exactly what it says!
    - Type … solve(3x+17=5x+3) … then press ENTER
        - Get GeoGebra to solve different types of equations. Solve each one yourself. How did it do that?
    - Type … simplify(17x+5x-9x) … then press ENTER
        - Simplify different expressions. What is it doing?
    - Type … factor(3x^2+6xy) … then press ENTER
        - Factor means factorise. What is it doing?
    - Type … y=3x+1 … then press ENTER
        - Explore graphs of different functions like this.
        - Explore graphs if different types of functions.
- In GeoGebra always use x, y and z for your variables.
- Try different functions, equations and expressions. Experiment. Explore!

BONUS ROUND: Classic Maths Puzzles

Puzzles that need mathematical thinking have been popular for thousands of years! Some people would say that the whole of mathematics is about the making and solving of puzzles. Aside from writing Alice in Wonderland, Lewis Carrol was a professional mathematician. He loved puzzles and you can still buy his own puzzle books, for example, Lewis Carroll's Games and Puzzles. Perhaps the most famous puzzler is Martin Gardener, who wrote the puzzle pages in the Scientific American magazine. He published dozens of books of puzzles. This web site is devoted to preserving his legacy. It will give you plenty to try: www.gathering4gardner.org/category/puzzles. Finally, here are two web sites with a huge collection of classic maths puzzles:

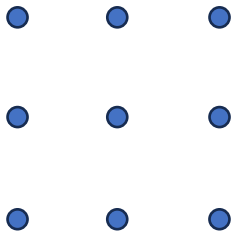
1. www.mathsisfun.com/puzzles
2. www.transum.org/Software/Puzzles

We hope that you will have fun exploring these resources. Certainly, you will see the great array of different types of puzzles. In the Count on us Challenge you will find a collection of puzzles packed with the Data-Chart-Analysis cards that your substitutes will be working on from the start of the GridLines Geometry round. These will be available until the end of the 24®Game round and there will be an answer sheet to submit your answers. Of course you will score bonus points for each puzzle correctly solved.

Here are some example puzzles to try. But be warned, the ones you get will be different, so develop your puzzling skills, but don't worry about being able to solve any specific puzzle! We are not going to give you the solutions. Good puzzles may take a long time to solve and you should never give up!

1. Make 100. Write the digits 1 to 9 in order. Combine them into single, double or multiple digit numbers, put an arithmetic symbol between each number and brackets if needed, such that the answer is 100. For example, this follows the rules but the answer is wrong – it makes 38, yours must make 100!
   $1 \times (2 + 34) + 56 + 7 - 89$

2. Without taking your pen off the paper, draw four straight lines that pass through all nine points.



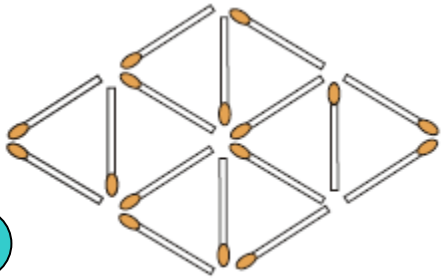
3. Replace each letter A, B and C with a digit to make this sum correct. (Of course, all of the As are the same and the Bs and the Cs!)

	A	B	C
	A	B	C
+	A	B	C
	B	B	B

4. A squash racket and a ball together cost £12.80. The racket cost £12 more than the ball. How much did they each cost?

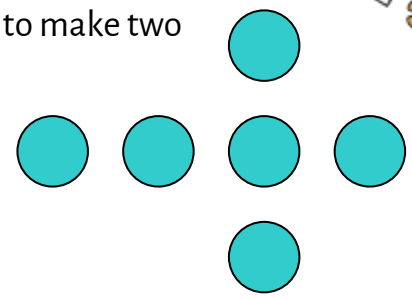
5. Matchstick puzzles:

   a. Move 3 of these matches to make exactly 5 triangles



   b. Remove 4 of these matches to leave exactly 4 triangles

6. A Coin Puzzle. Move one of these coins to make two rows with 4 coins in each row

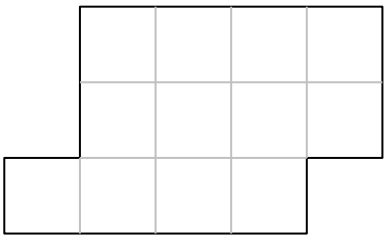


7. A large tank contains more than enough of water. You have a 5 litre jug and a 3 litre jug. Describe (either with words or diagrams or both) how you would measure exactly 4 litres of water. You are allowed to pour water back into the tank.

8. Fill in the gaps and describe the rule for the sequence:

   a. 1, …. , 7, …. , …. , 16
   b. 1, …. , …. , 7 , …. , 16
   c. 1, …. , …. , …. , 7 , 16

9. Cut this shape into two identical pieces.



10. A frog fell down a well 30 metres deep. Every day it managed to climb up 3m, but, exhausted, it then fell down 2m. How many days did it take the frog to get out of the well?

Data-Chart-Analysis Answers

These are the answers for the card set on page 7

D6	C1	A2
D4	C2	A1
D5	C3	A6
D1	C4	A5
D3	C5	A4
D2	C6	A3

Source for the data used in the card set, with acknowledgement:
https://www.channel4.com/news/factcheck/climate-change-in-ten-graphs