



FURTHER MATHEMATICS: BRIDGING ACTIVITY

Your task is to complete as much as possible of the three attached challenges. These have been taken from a previous team maths challenge heat. I have included all instructions which will be given along with these challenges below; remember, you may work as a group on any of these questions if you need to!

These questions are designed to be challenging and push you out of your comfort zone, so be prepared to be stumped! All questions are non-calculator, but feel free to research how to solve some of the problems you may not have seen before.

Solutions can be found online, but should only be used for checking your answers if you are unsure.

Information about the Senior Team Mathematics Challenge

- ❓ Each school or college may enter one team.
- ❓ The duration of each heat (and the final) is approximately three hours.
- ❓ There are three rounds, a group round, a cross number round and a mini-relay round.
- ❓ Each team must consist of four students from year 11, 12 or 13 (or equivalent) with no more than two from Year 13.
- ❓ Each team must be accompanied by a responsible adult who must stay throughout the duration of the competition and help with the supervision of a team
- ❓ The winners of the regional heats are invited to the national final in London in February.

The Group Round

Ten questions which the teams have 40 minutes to solve.

Teams can decide upon their own strategy for solving these: in pairs; as a group; individually.

- ❓ 6 marks are awarded for every correct answer,
- ❓ No partial marks are awarded.

The Cross number Round

Teams divide into two pairs to solve a mathematical crossword puzzle in approximately 40 minutes. One pair is given the across clues, the other pair the down clues. Each pair of students solve their clues and write their answer on the master grid. The teacher immediately checks each digit of the answer, correcting if necessary. The correct answer is then shown to

both pairs so that they are working with up-to-date information. They are not allowed to communicate directly with the other pair but they may, through the teacher, ask the other pair to try to work on a particular answer that they need. They cannot share any other information with the other pair or ask any questions about definitions etc.

- ❓ Students can put just one digit at a time if they wish, rather than a whole answer.
- ❓ They can sacrifice a square if they are completely stuck by guessing and then being given the answer.
- ❓ It may sometimes appear that there is more than one answer but every answer is uniquely specified although it may depend on clues the other pair have.
- ❓ *One mark is awarded for every correct digit on the answer grid.*

The Shuttle (mini relay) Round

Teams divide into two pairs to solve four mathematical problems in 8 minutes. The solution to the first problem is required to solve the second problems and so on.

Please note that this round has changed for the 2011/12 and subsequent competitions. Specifically, the time available for each set of questions is now 8 minutes.

- ❓ The teams split into two pairs, A and B with the teacher sitting in between.
- ❓ For the first Shuttle pair A receives Questions 1 and 3 and an Answer Sheet, pair B receives Questions 2 and 4.
- ❓ Pairs can work individually or together on either of their questions at any time after the Shuttle has started.
- ❓ The answer to each question is needed by the other pair in order to solve the next question.
- ❓ The problems are designed so that pair B should be able to do some preparatory work before they receive the answer to the previous question.
- ❓ No communication is allowed between pair A and pair B except that the Answer Sheet is passed from pair to pair via the teacher at any time after the start of the Shuttle. Only answers may be written on the Answer Sheet and it must not be used to ask questions or pass information to the other pair.
- ❓ If a pair realises that they have answered a question incorrectly they may ask the teacher to retrieve the Answer Sheet from the other pair and then change their answer.
- ❓ If a pair realises that the other pair has given them a wrong answer they can return the Answer Sheet with this answer circled.
- ❓ Teams can hand in an Answer Sheet only when they have written an answer for all four questions.
- ❓ The teacher then starts marking at Question 1 and stops marking at the first incorrect answer, ignoring any subsequent answers given. The teacher circles three marks on the Score Sheet by each question for which a correct answer was given. Next to the

question for which the first incorrect answer was given, they cross out the three. The Answer Sheet is then handed back to the pair who answered incorrectly.

- ❑ If the Answer Sheet is handed in again then only one mark is available for the question that was previously answered incorrectly.
- ❑ Teams may have as many attempts as they wish at a question.
- ❑ Correct answers on the first attempt to later questions will still earn three marks each.
- ❑ There will be a whistle after 6 minutes. Handing in an Answer Sheet with four correct answers before this whistle will earn a bonus of three marks for the team in addition to the maximum of 12 marks available for the individual answers. This bonus of three marks should be circled on the Score Sheet.
- ❑ A final whistle will be blown after 8 minutes. Teams must stop working and hand in their Answer Sheet, which will be marked as described above.
- ❑ There are four of these Shuttles alternating as to which pair receives Questions 1 and 3 and which receives Questions 2 and 4.



Senior Team Maths Challenge 2007 Crossnumber Round



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| <p>Across</p> <p>1 Palindrome</p> <p>5 Remainder when forty is divided by a prime less than twenty five</p> <p>8 Fibonacci number whose digit sum is divisible by four</p> <p>9 x^{x-1} where x is an integer</p> <p>10 Divisible by one sixth of 12 Across, but not one third of 12 Across</p> <p>11 Four times the square root of 9 Across, minus one.</p> <p>12 Exterior angle in degrees of a regular polygon with a number of sides divisible by five</p> <p>14 24 Down minus 10 Down; divisible by two but not four</p> <p>17 17 Across minus its digit sum is a square number</p> <p>19 One more than a multiple of nine</p> <p>21 25 Across – 12 Across + 8 Across; it has a digit sum equal to three</p> <p>22 18 Down is five more than the difference between 22 Across and 35 Across</p> <p>23 Odd number whose digit sum is divisible by five</p> <p>25 Square of an odd number</p> <p>28 Triangle number not divisible by three</p> <p>30 Divisible by 2 and 3 but not by 3^2 or $(2^3 + 3^3)$</p> <p>32 2^4 multiplied by a prime number</p> <p>33 One more than 12 Across divided by three eighths</p> <p>34 Twice a prime number and also the sum of two square numbers</p> <p>35 $p^3 + p^2 - 1$ where p is a prime number</p> | <p>Down</p> <p>2 Prime factor of 24 Down</p> <p>3 Palindrome</p> <p>4 Remainder when divided by seven is four</p> <p>6 $x(x+1)$ where x is an integer</p> <p>7 Number divisible by 7 giving remainder 2 when divided by 9</p> <p>10 Twice a prime number; the difference between 24 Down and 14 Across</p> <p>13 x^4 minus three where x is an integer</p> <p>14 Twice a prime number</p> <p>15 Product of two consecutive prime numbers</p> <p>16 Sum of three consecutive Fibonacci numbers</p> <p>18 Five more than the difference between 22 Across and 35 Across</p> <p>20 Exterior angle in degrees of a regular polygon</p> <p>21 One twelfth of the result, two hundred and fifty seven minus 5 Across</p> <p>22 Mean of 11 Across, 21 Down and 34 Across</p> <p>23 2 Down plus three times 7 Down</p> <p>24 Eight times the difference between 15 Down and twice its digit sum</p> <p>26 Highest common factor of the digit sum and digit product is a square not equal to one</p> <p>27 Cube</p> <p>29 27 Down + 16 Down – 14 Down</p> <p>31 Sum of the factors of 20 Down</p> |
|--|--|

1	2		3		4		5	6		7
			8					9		
10					11					
2			12	13		14		15		
		16		17		18	4			
19	20							21		
			22	8						
23		24				25	26			27
				28	29		30		31	4
32	6				33					
		34					35			

GROUP ROUND

Question 1

Consider the result of inserting two multiplication symbols between the digits 2, 2, 3, 3 and 3, in that order.

For example, $223 \times 3 \times 3 = 2007$.

What is the largest number that can be made in this way?

Question 2

A van travels from Leeds to Trowbridge with an average speed of 50 kilometres per hour. What average speed does it need to achieve on the return journey to make the average speed for the whole journey 60 kilometres per hour?

Question 3

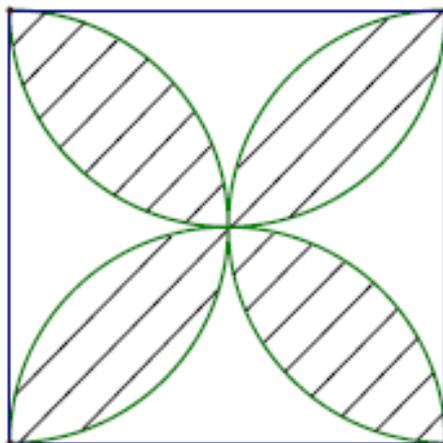
Find all 4 real values of x that satisfy $(x-5)^{x^2-4} = 1$.

Question 4

All the edge lengths of a particular cuboid are integers. It turns out that the cuboid's volume is numerically equal to its surface area. If the shortest edge length is 3cm, what is the maximum possible length of the longest edge?

Question 5

The square in the diagram below has sides of length two units. The shaded sections are enclosed by 4 semi-circles. Calculate the exact value of the total area of the unshaded regions.



[Not to scale]

Question 6

Four playing cards are placed on the table. The suit of each card is recorded. For example the cards might be Diamond, Heart, Heart, Spade in that order or Club, Club, Club, Spade. How many possible different results could have been recorded if we never had all four suits represented in the four cards dealt?

Question 7

$x \bullet y$ is defined to be $xy - 10x - 10y + 110$.

Find a number, x , with the property that $x \bullet y = y$ for any number y .

Question 8

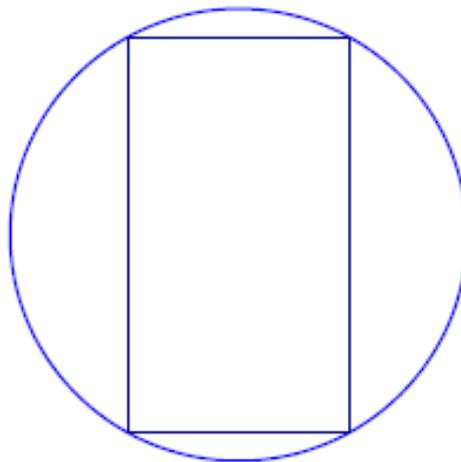
The product of five consecutive integers is 360 360. What is the mean of the integers?

Question 9

I have a number that is less than one million. Putting a 1 after it makes it three times as large as putting a 1 before it. What is my number?

Question 10

The circle in the diagram has radius 6 cm. If the perimeter of the rectangle is 28 cm, what is its area?

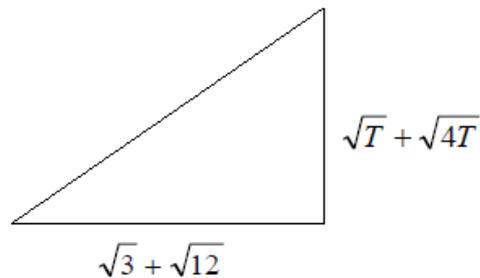


[Not to scale]

Mini Relay Round

A1 How many integer solutions does the inequality $4x^2 - 4x - 35 \leq 0$ have?

A2 T is the number that you will receive



What is the length of the hypotenuse of this right-angled triangle?

A3 T is the number that you will receive

The line l has equation $x + 2y = 7$. The line m is perpendicular to l and passes through the point (T, T) . Line m also passes through point P which has y -coordinate 1.

What is the x -coordinate of point P ?

A4 T is the number that you will receive

What is the value of x that satisfies the equation:

$$\frac{3x-2}{4} - \frac{2x-3}{3} = \frac{x-1}{T} ?$$

B1 The recurring decimal $0.1363636 \dots$ (or $0.1\overline{36}$, using recurring decimal notation) may be written as a fraction in the form $\frac{a}{22}$.

What is the value of the whole number a ?

B2 T is the number that you will receive

$$d = \sqrt{\frac{1 + \frac{4T}{1 + 4T^2}}{1 - \frac{4T}{1 + 4T^2}}}$$

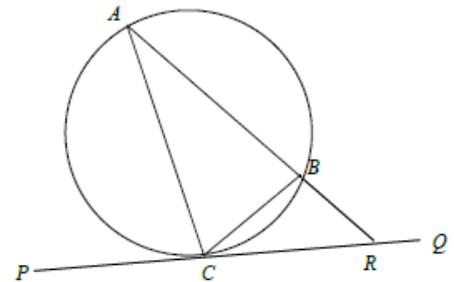
What is the value of $50d$?

B3 T is the number that you will receive

In the diagram, the line PQ is a tangent to the circle. The lengths AB and AC are equal. The line AB produced meets the tangent at the point R .

$$\angle PCA = T^\circ.$$

What is the value, in degrees, of $\angle ARP$?



B4 T is the number that you will receive

H is the highest common factor of T and 700 and L is the lowest common multiple of T and 700. What is the value of $L \div H$?

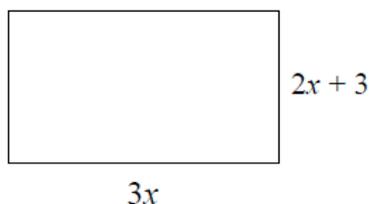
C1 Some students were asked to draw their favourite polygon on a piece of paper. The frequency table below shows information about the number of sides of the resulting selection of polygons.

Number of sides	Frequency
4	2
5	2
6	x

The mean number of sides is 5.4. What is the value of x ?

C2 T is the number that you will receive

The area of this rectangle is T . What is its perimeter?



C3 T is the number that you will receive

x and y satisfy the simultaneous equations:

$$3x + y = T$$

$$9x + 2y = 28$$

What is the value of xy ?

C4 T is the number that you will receive

A sphere with radius T cm has the same total surface area as a closed cylinder which has radius 5 cm. What is the height of the cylinder?