

Junior Puzzle 1

Bill, Joe and Jack were on their way to the fair when they came to a wooden bridge over a stream. As they approached it, out popped a troll. "Be careful, friends," he said, with a slimy smile, "There is a weight limit of 100kg on this bridge. Any more than that on it at once, and it will collapse."

"That's all right," said Bill, "None of us weigh anywhere near 100kg. We'll cross one at a time." "No, wait!" whispered Joe. "It's a trick. He wants to get one of us on the bridge on our own. We must all cross together." "But how do we find out if the three of us weigh over 100kg? We might do," said Bill.

"You can weigh yourselves on the bridge – just stand on that plank in the middle." said the troll in a smarmy voice, and sure enough the boys saw a dial on the wall in the middle of the bridge. "Right," said Joe, "Don't go on alone! We'll weigh ourselves in pairs. So Bill and Joe went cautiously onto the bridge. "72kg for us two" said Joe. Bill and Jack went next, and came to 58kg. Finally Joe and Jack weighed 67kg. "I don't see how that helps us find out how much the three of us weigh together," grumbled Jack.

Can you work it out for them? Is it safe for all three to cross the bridge at once?

Junior Puzzle 2

Alice was on her way to her grandmother's house when she came to a wooden bridge across a stream. As she approached it, out popped a troll. "Halt" he said, "To cross this bridge you must pay my fee."

"How much?" asked Alice. "That depends," said the troll. "The first two people to cross each morning just have to pay me all the money in their pocket. After that, each person has to pay as much as the two previous people added together." "But that could be lots and lots," cried Alice, "I might not have that much. How many people have already crossed today?"

"You will be the sixth – **if** you cross," said the troll smiling to himself. "And the first person only had £2." "It's no use – I still can't work it out," said Alice. "All right," said the troll, "I'll tell you. You'll have to pay £17." Alice looked in her purse, and found she had just enough. "But I'll get here at daybreak next time, with two pence in my pocket!" she thought.

After Alice pays him, how much money will the troll have taken in all today?

Junior Puzzle 3

"How old is grandfather?" David asked. His father replied, "His age, like mine, is one more than six times the sum of its digits." How old is David's grandfather? (Don't just use trial and error - if you call the tens digit x and the units digit y you should be able to use algebra to work this out.)

Junior Puzzle 4

	12m^2
60m^2	

Four rectangular pieces of carpet have been sown together to form a square. Two of the pieces have areas of 12m^2 and 60m^2 , as shown. The area of the square is a whole number. What is it?

[There are at least two answers to this puzzle – see if you can find them both.]

Junior Puzzle 5

Sarah and Penny were playing "guess the number". Sarah gave Penny 4 clues:

1. It is a four-digit number
2. It is an even number
3. It is divisible by 9
4. Each digit is a prime number

After a few minutes, Penny said "You haven't given me enough clues – there is more than one possible answer." Is she correct? How many possible answers are there?

Junior Puzzle 6

I met four of Santa's elves the other day, Annie, Betty, Chloe and Donna. While I was talking to them I found out that their surnames were Adams, Baker, Carpenter and Deacon, but none of them had a repeated initial (Annie was not called Adams for example). Chloe was younger than Miss Baker, but Annie was older than Miss Baker or Miss Deacon. Miss Adams was older than Annie. Can you work out what their full names were?

Junior Puzzle 7

I met two of Santa's elves the other day – Rupert and his sister Ruperta. “We elves have very large families,” Rupert told me. “I have three times as many brothers as sisters.” “And how do you feel about having three times as many brothers?” I asked Ruperta. “Don't be silly – I have **five** times as many brothers as sisters,” she replied. I looked puzzled for a minute. “Surely now you can work out now how many boys and how many girls there are in our family,” she asked. Can you?

Junior Puzzle 8

Gina was admiring Mr Smith's collection of budgerigars, which he kept in large cages in his back garden. “There are so many!” she said. “Between two and three hundred,” said Mr Smith. “I keep the same number in each cage, so as not to overcrowd them.” “How many do you have in each cage?” Gina asked. “If I tell you my exact number of birds, you can work it out,” he replied. “But I don't know how many cages you have either,” said Gina. “You can still do it,” said Mr Smith. And she did. Can you? How many birds in each cage?

Junior Puzzle 9

The teacher wrote a large whole number on the blackboard, and said “I am going round the class and I want each of you to tell me a factor of this number.” Johnny was asked first, so he decided to play safe. “1 is a factor,” he said. Jane said “2 is a factor.” And so it went on round the 30 members of the class, until Zena said “30 is a factor.” The teacher made no comment until they had all answered, then said, “As it happens, only two of you gave wrong answers, and you answered one after another.” Which two numbers were not factors of the large number?

Junior Puzzle 10

Jane has been taking a series of tests, and the last one is coming up. She is really keen to achieve an average of 90 over the whole set of tests, but to do this she works out that she needs to score 97 on the last test. In fact she only scores 73 on the last test, so her overall average ends up as 87. How many tests were there in the series?

Junior Puzzle 11

$$RE \times ME = TTT$$

Can you replace each letter in the above sum by a digit so that the sum is correct.
(Don't just use trial and error - try to work it out logically.)

Junior Puzzle 12

This set of numbers uses each of the digits 1 to 9 once: 43 1 25 79 6 8
Of these numbers, 43 and 79 are prime numbers, but 1, 25, 6 and 8 are not.
Can you use the digits 1 to 9 to make a set of numbers, all of which are prime?

Junior Puzzle 13

Find a five digit number which is 4 times the same number written backwards.

Junior Puzzle 14

	×		+		=	
+		÷		+		
	×		-		=	
=		=		=		

Fill the spaces on the puzzle on the left with the numbers from 1 to 11 so that all the sums reading across and down are correct. Don't just guess - you should be able to work out the position of some numbers logically, and then fit the others round them.

Junior Puzzle 15

Five contestants were competing on a TV show. In the final round they were shown five "mystery photos" and given 5 names, and had to match the photos with the names. Each contestant wrote down their answers, as follows:

Contestant	Photo 1	Photo 2	Photo 3	Photo 4	Photo 5
Annie Adams	Andrew Flintoff	Tony Blair	Robbie Williams	Bob Geldof	Richard Branson
Betty Bean	Bob Geldof	Richard Branson	Andrew Flintoff	Robbie Williams	Tony Blair
Clare Clark	Tony Blair	Bob Geldof	Robbie Williams	Richard Branson	Andrew Flintoff
Dionne Davis	Bob Geldof	Tony Blair	Andrew Flintoff	Robbie Williams	Richard Branson
Ellie Evans	Bob Geldof	Richard Branson	Robbie Williams	Andrew Flintoff	Tony Blair

When the answers were given, it was found that no two contestants had the same number of correct answers. Which contestant went home with the first prize?

Junior Puzzle 16

The grid on the left is to be coloured in so that 4 squares are coloured blue and 3 squares are coloured in each of red, yellow, green and purple. Show how this can be done. (Remember to explain the logic of how you worked it out.).

Junior Puzzle 17

After visiting my Aunt Hilda, I set off home in my old banger. I had filled up with petrol, so I knew I had 10 gallons in my tank. But I also knew that the tank leaked half a gallon of fuel per hour, in addition to the fuel used by the engine. And because the car was stuck in second gear, I could only go at a speed of 30mph, and only travelled 20 miles per gallon of petrol. So all in all I was worried about whether I would get home before the fuel ran out. As it happened it ran out just as I arrived outside my house. How many miles was it from Aunt Hilda's house to mine?

Junior Puzzle 18

Here is a number with two of the digits missing:

8_75_2

The number is divisible by 36. Can you find the two missing digits? Explain how you work it out.

[There are two possible solutions; can you find them both?]

Junior Puzzle 19

Here is a number with two of the digits missing:

498_34_67

The number is divisible by 99. Can you find the two missing digits? Explain how you work it out.

[Hint: There is a test for divisibility by 11; if you do not know it, look it up.]

Extension: Will this always work? In other words, if I make up at random a number with two digits missing, can I always find two digits to place in the gaps so that the resulting number is divisible by 99. If so, explain why; if not, give an example which doesn't work, and explain why it doesn't.

Junior Puzzle 20

Ann, Beth, Carol and Diane each had a different amount of money. Two of them found that if they put their money together, they would have exactly £10. A different pair of girls found that by combining their money they would have £11. Eventually they worked out that by combining in pairs in every possible way, they could make either £10, £11, £12, £13, £14 or £15. What were the four amounts of money?

Junior Puzzle 21

Can you identify three prime numbers a , b , and c (a the smallest, c the largest) given the following clues:

$$c - b - a = 0$$

$$b + c \text{ is a 3 digit square number}$$

Extension: If a does not have to be the smallest number, are there any more possible solutions?

Junior Puzzle 22

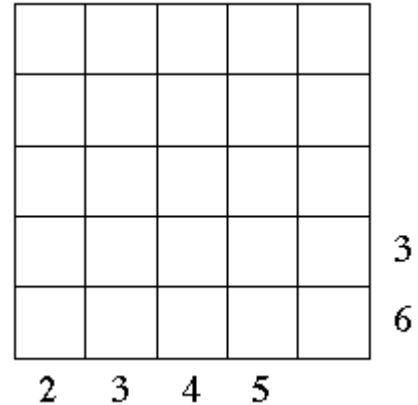
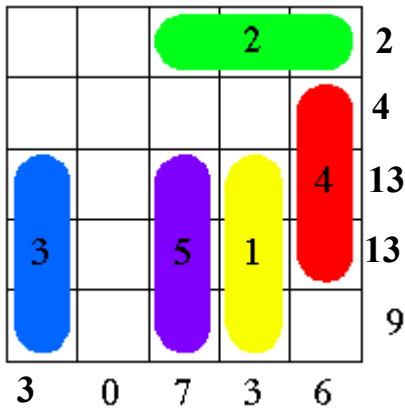
The vertical strips on the left each contain four numbers or symbols. Cut out the strips, and rotate and rearrange them so that four valid equations appear across the rows.

=	=	8	8	2
+	-	2	6	1
=	=	5	2	0
+	+	9	1	9

Junior Puzzle 23

The diagram on the left shows five 3 x 1 ships in the grid, each with a different number from 1 to 5. The numbers below and at the side of the grid give the sum of the numbers on all the ships in that row or column.

On the right is another grid, with the ships hidden, but some of the numbers marked on. Can you work out where the ships are?



Junior Puzzle 24

Ann, Beth, Carol, Diane and Ellie are out shopping. They want to buy a special edition DVD to share between them. Ann, Beth and Carol all say "We'll pay our fair share." "But I've only got £2.40 left" says Diane. "Hmm," says Ellie, "That means I'd have to pay a third of the cost. Oh well - let's go for it!" How much is the DVD?

Junior Puzzle 25

Three teams, A B and C are taking part in a competition. There are no other teams in the competition. There are eight different events, and for each event the winning team is awarded 5 points, the second team 2 points and the third (and last) team 1 point. At the end, team A has 24 points and team B is last with 18 points. But team B protest, demanding to know who decided on the "5,2,1" points system, and pointing out that if it were "4,3,1" then they would win the competition instead of being last. How many firsts, seconds and thirds did team C get?

Extension: State a scoring system which would give all three teams the same number of points (so they are all happy?). Prove that there is no scoring system which would enable team C to win.

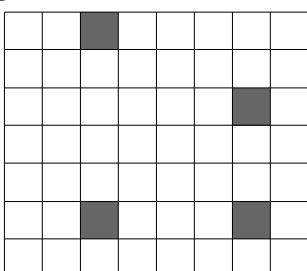
Junior Puzzle 26

T	E	N
E	Y	E
N	E	T

The 3 x 3 square to the left is filled with words reading both across and down. Can you replace each letter by a digit (the same digit everywhere that letter occurs) so that each 3-digit number reading across and down is a **square** number?

Extension: Can you find other ways to fill a 3x3 square with digits so that all the three digit numbers are square numbers? Can you turn these into word puzzles like the one above, with real words?

Junior Puzzle 27



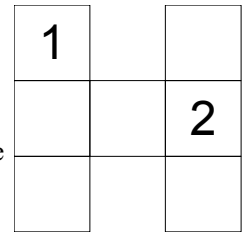
A path is to be drawn on this grid. It should pass through every unshaded square once and only once. The path moves from square to square horizontally or vertically, but not diagonally. It should be a closed path - ie the end of the path should join up to the beginning. Can you find the path?

[Hint: there is no need for trial and error - it is possible to work out the whole path logically by looking for places where there is only one possibility. For example, in the corners the path can only enter and leave in one way. Similarly where it goes around the shaded "blocking" squares.]

Junior Puzzle 28

The numbers from 1 to 7 are to be placed, one per square into the seven squares of the letter H on the right. The totals of the three numbers in the horizontal row, and the three numbers in each of the vertical columns, must be equal.

In how many ways can this be done? You need to justify your answer – ie prove that the ways you find are the **only** possible ways to solve the problem



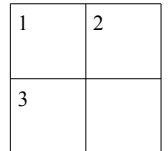
Junior Puzzle 29

The solution to each clue in this cross-number puzzle is a two-digit number. None of these numbers begin with zero.

Explain how you complete the puzzle, stating the order in which you fill in the squares, and why there is only one possibility at each stage.
[No prize for just completing the puzzle!]

Clues Across:
1 A multiple of 3
3 Three times a prime number

Clues Down:
1 A multiple of 25
2 A square number



Junior Puzzle 30

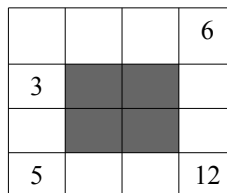
A number like 4679 is called an ascending number because each digit in the number is larger than the preceding one.

(i) How many ascending numbers are there between 1000 and 2000?

(ii) How many ascending numbers are there between 1000 and 10000?

[You need to find a systematic way of counting them – don't just try to list them all!]

Junior Puzzle 31



The diagram above is to be completed in such a way that the white squares contain the numbers 1 to 12, and the sum of the numbers in each horizontal row or column around the edge is the same. Four numbers have already been placed. In how many different ways can the diagram be completed from this stage?

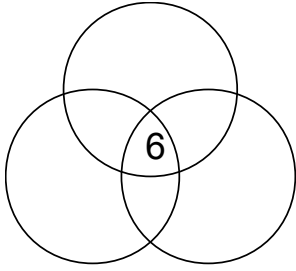
Junior Puzzle 32

$$97 \rightarrow 63 \rightarrow 18 \rightarrow 8$$

An example of particular type of number chain is shown above. The first number can be any positive whole number. Each number after the first is the product of the digits of the previous number. The chain stops when a single-digit number is reached.

Suppose that in such a chain the final number is 6. Find all possible two-digit starting numbers for this chain.

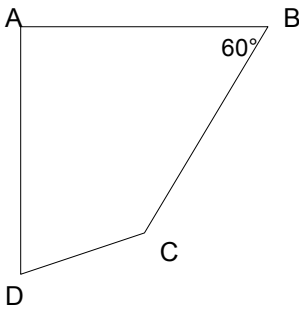
Junior Puzzle 33



The numbers 1 to 7 are to be placed in the regions formed by three overlapping circles, with 6 in the central region as shown, so that there is one number in each region, and the total of the numbers inside each circle is the same number T .

What values of T are possible? (You need to explain how you worked this out.)

Junior Puzzle 34



In this quadrilateral, the sides AB , BC , AC and AD are all equal in length, and BAD is a right angle.

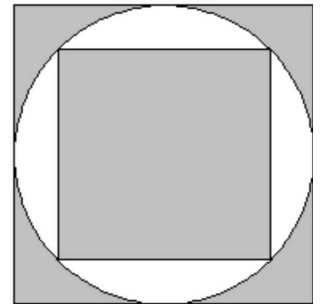
What is the size of angle BDC ?

[You need to explain each step in your method for working this out.]

Junior Puzzle 35

The diagram shows a square inscribed in a circle which is inscribed in a square.

What fraction of the area of the large square is the area of the small square?

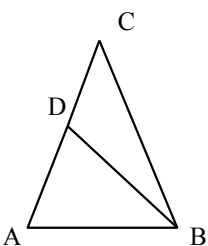


Junior Puzzle 36

Show that there is only one way to arrange the numbers 1 to 12 in a circle in such a way that any two neighbouring numbers differ by either two or three.

[There is a logical way to do this – don't just use trial and error to find a way, otherwise you won't know whether that is the **only** way.]

Junior Puzzle 37



In the diagram on the left (which is not drawn to scale), BD *bisects* (cuts in half) the angle ABC .

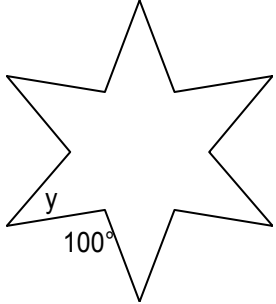
Also, $AC = BC$ and $AB = BD$.

What is the size of angle BDC ?

Junior Puzzle 38

The elves at the Lapland Weather Centre have been keeping records for quite a few days this year. They have found that whenever it snowed in the afternoon, it had been fine in the morning, but whenever it snowed in the morning, it was fine in the afternoon. So far it has snowed on 100 days, and been fine on 39 afternoons and 95 mornings. For how many days have they been keeping a record? Explain how you work it out.

Junior Puzzle 39



In this star, each angle between two of the points is 100° , as shown.

- What is the size of the angle y at each point of the star?
- If the angle between points is x instead of 100° , can you find a formula for y in terms of x ?

You need to explain how you work this out.

Junior Puzzle 40

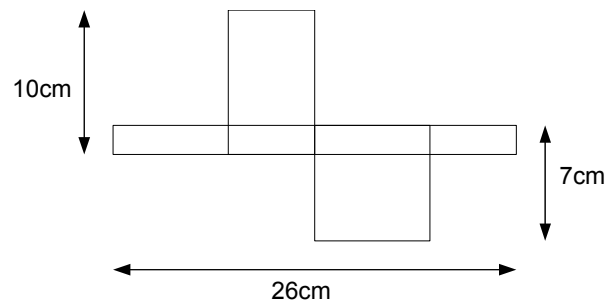
Five children, boys Vince, Will and Zac, and girls Xenia and Yvonne, are sitting at a round table. They come from five different cities, Aberdeen, Belfast, Cardiff, Durham and Edinburgh. Neither of the girls is sitting next to Will. Vince sits between Yvonne and the child from Durham. The child from Aberdeen is sitting between Zac and the child from Edinburgh. Zac is a friend of the child from Cardiff.

Find where each child comes from and the order they are sitting round the table. You must explain how you work this out.

Junior Puzzle 41

The diagram on the right (which is not to scale) is the net of a cuboid.

What is the volume of this cuboid.
Explain how you work this out.



Junior Puzzle 42

7		8
12		13

In the magic square on the left, the sum of the numbers in each row, each column, and each long diagonal is the same. Can you fill in the missing numbers.

You must give a full explanation of how you work this out.

Junior Puzzle 43

Arrange the digits 1 to 9 in a row so that each pair of consecutive digits forms a two-digit number that is the product of two single-digit numbers.

For example, if you started 426..., the 42 would be allowed because $42 = 6 \times 7$, but 26 would not be allowed because it is 2×13 , but 13 is not a single digit.

The solution can be obtained logically, without any trial and error. To get a prize you need to explain how you found your solution.

Junior Puzzle 44

Sarah and Penny were playing “guess the number”. Sarah gave Penny 4 clues:

1. It is a four-digit number
2. It is an even number
3. It is divisible by 9
4. Each digit is a prime number

After a few minutes, Penny said “You haven’t given me enough clues – there is more than one possible answer.” Is she correct? How many possible answers are there?

Junior Puzzle 45

Ann, Beth, Carol, Diane and Ellie are out shopping. They want to buy a special edition DVD to share between them. Ann, Beth and Carol all say “We’ll pay our fair share.” “But I’ve only got £2.40 left” says Diane. “Hmm,” says Ellie, “That means I’ll have to pay a third of the cost. Oh well - let’s go for it!” How much is the DVD? [You must explain how you worked this out.]

Junior Puzzle 46

The sequence 3, 7, 10, 17, 27, 44, 71, 115, 186, ... is formed using the rule that, apart from the first two terms, each term is the sum of the two preceding terms. I notice that if I add together the 6th and the 9th terms, I get twice the 8th term ($44 + 186 = 2 \times 115$).

- Make up a different sequence formed using the same rule, and show that the same thing works.
- Prove using algebra that it will work for **any** sequence formed using this rule.

[Extension: Can you extend this rule further?]