

PROBLEM SOLVING



Academic Scholars 2020-21

Puzzle Selection



GCHQ

GIRLS CONTEMPLATING HARD QUESTIONS

nacecymru
National Association for
Able Children in Education



Challenge Award
FOR EXCELLENCE IN PROVISION FOR
MORE ABLE AND TALENTED PUPILS
JUNE 2017



HOWELL'S CO-ED COLLEGE
Llandaff

Academic Scholars 2020-21 Puzzle Selection

This selection of puzzles has been compiled by
the year 12 academic scholars group.

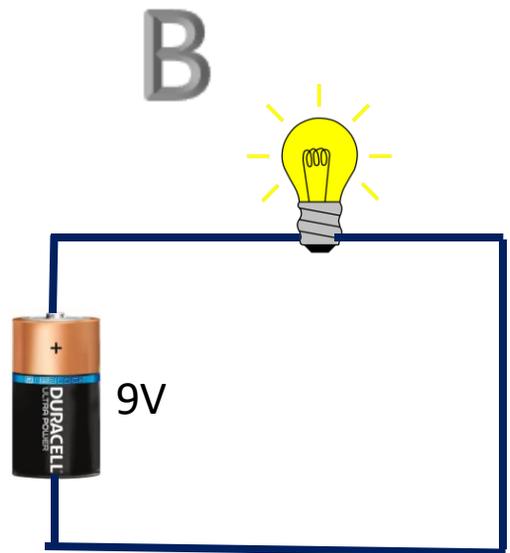
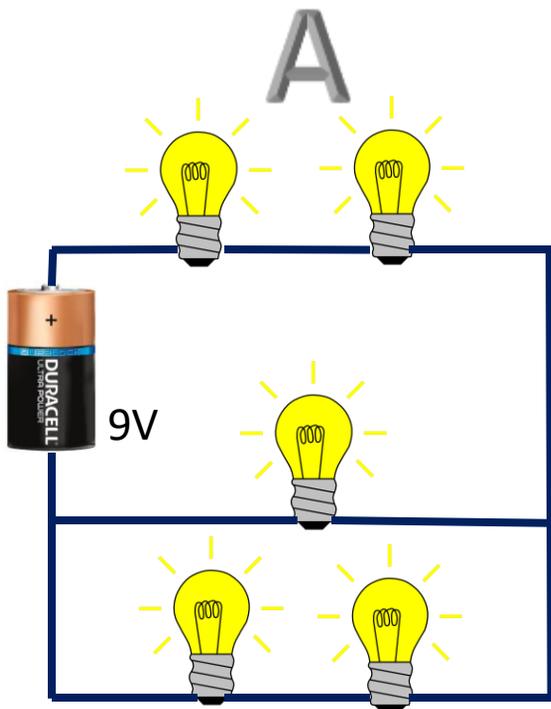
Each student has shared some of their
favourite puzzles, along with some hints on
how to solve them.

We hope you enjoy them



Engineering Challenge

All bulbs are identical. Which circuit will produce more light?



I really like this puzzle from Brilliant, because I think it makes you think about concepts we learn about in Physics in a different way. I've always liked using Brilliant because it challenges you to rethink the way you understand STEM subjects. These problems are a great way to apply what you learn in school and I hope you enjoy it as much as I did!

- Auvni P. 12AF



Tips and Hints

- The answer may seem obvious when you first look at it but remember to take your time!
- Try using electricity equations you already know or have learnt in GCSE Physics, like $P=IV$ or $V=IR$, to prove your answer- this way you'll be sure if you're correct :)

Solution

Circuit A.

Parallel Circuit

$$\frac{1}{R_{1,2}} = \frac{1}{R} + \frac{1}{2R}$$

$$\frac{1}{R_{1,2}} = \frac{2}{2R} + \frac{1}{2R}$$

$$= \frac{3}{2R}$$

$\therefore R_{1,2} = \frac{2R}{3}$ ← flip it. $R_3 = 2R$

Total R

$$R_{1,2,3} = \frac{2R}{3} + 2R$$

$$= \frac{8R}{3}$$

Current

$$I = \frac{V}{R}$$

$$I = \frac{9}{\frac{8R}{3}}$$

$$I = \frac{27}{8R}$$

Total Power of A

$$P = I \times V$$

$$= \frac{27}{8R} \times 9$$

$$= \frac{243}{8R} \approx \frac{30}{R}$$

Circuit B

$$I = \frac{V}{R}$$

$$= \frac{9}{R}$$

Total Power of B:

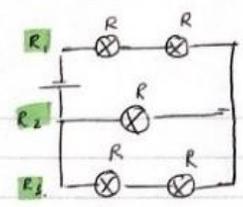
$$P = I \times V$$

$$= \frac{9}{R} \times 9$$

$$= \frac{81}{R}$$

\therefore As $P_A < P_B$

CIRCUIT B SHINES BRIGHTER.



Ill and Injured

The four 12-year-old lads who live in Dormitory B4 at St Keigh's Boarding School love sport and always look forward to Games lessons. Except when it has been raining for some time and the only option open to the teachers is to send them on a cross-country run. As the rain beat down, our four friends hatched plans to avoid the boring run by feigning illness and injury. From the clues, can you work out what illness, what injury and what prop each boy used in their attempt to be excused the session?

Clues:

1.) 'I'm sorry I can't run, sir,' said Ben Barton, hobbling. 'It's my knee, you see, it's disconnected.'

2.) As Chris Cockroft hobbled into the room using a hockey stick as a crutch (he had to bend over a bit, but he was doing the best he could), he heard another lad explaining 'It's my toe sir, it's in traction.'

3.) 'Hazel, what is that boy doing with the broom under his arm?' asked the teacher. 'I'm not sure exactly what's wrong, sir,' replied Hamish, 'but he told me this morning that he had malaria.'

4.) Martin Masters had heard about 'man-flu' so had decided to claim it as his illness as it usually made his dad stay in bed all day.

5.) 'What's the matter with you?' Asked the teacher of a boy who was standing with his eyes closed. 'I've got sleeping sickness, sir,' came the reply, 'I'd be fast asleep right now if it wasn't for the pain from my displaced hip.'

6.) 'Why are you using a cricket bat as a walking stick?' asked the teacher. 'I've got an unlocated ankle sir,' came the reply. 'Really?' replied the teacher. 'And I suppose you're going to tell me you've got bubonic plague,' he added dismissively. 'Oh no, sir,' said the boy, 'that would be silly, there wouldn't be two of us with the plague.'

		Illness				Injury			Prop				
		Malaria	Man Flu	Plague	Sleeping Sickness	Ankle	Hip	Knee	Toe	Billiards Cue	Broom	Cricket Bat	Hockey Stick
Boy	Ben Barton												
	Chris Cock												
	Hamish Hazel												
	Martin Masters												
Prop	Billiards Cue												
	Broom												
	Cricket Bat												
	Hockey Stick												
Injury	Ankle												
	Hip												
	Knee												
	Toe												

Boy	Illness	Injury	Prop

I really enjoy logic puzzles I think they are a great way to engage your brain and can often be quite funny.

- Eleanor J. 12HJH

Tips and Solution →



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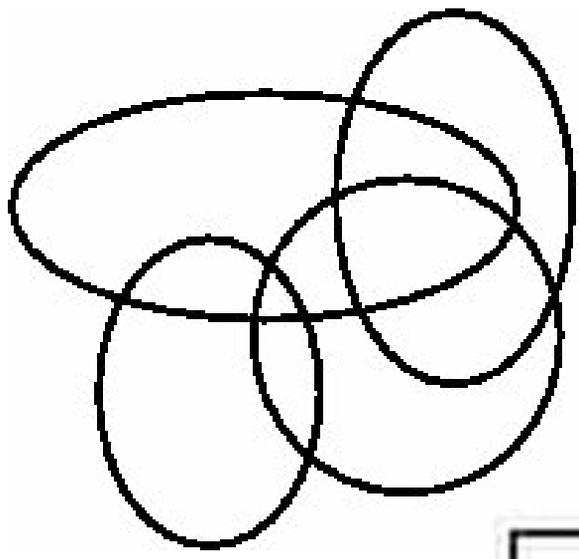
Tips and Hints

- *Martin Masters was claiming man flu and Chris Cockroft was using a hockey stick as a crutch, so the lad who was using the broom and claiming a sudden attack of malaria, who wasn't Hamish Hazel must have been Ben Barton.*
- *The lad with the cricket bat had an unlocated ankle, so Chris Cockroft with his hockey stick, who didn't have a bad toe must have a bad hip so therefore also sleeping sickness.*

Solution

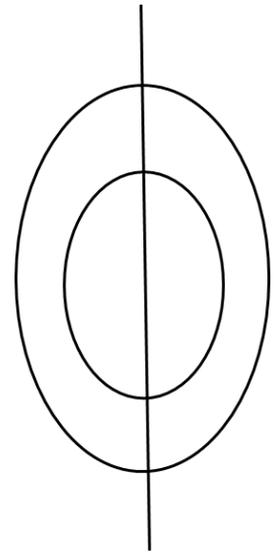
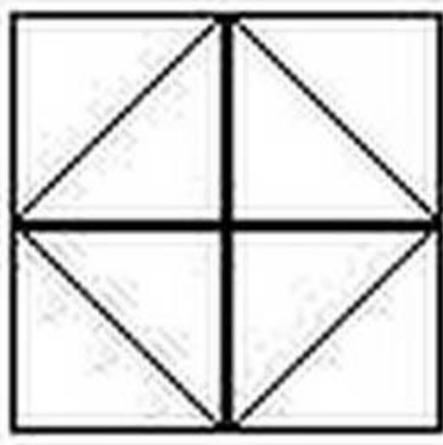
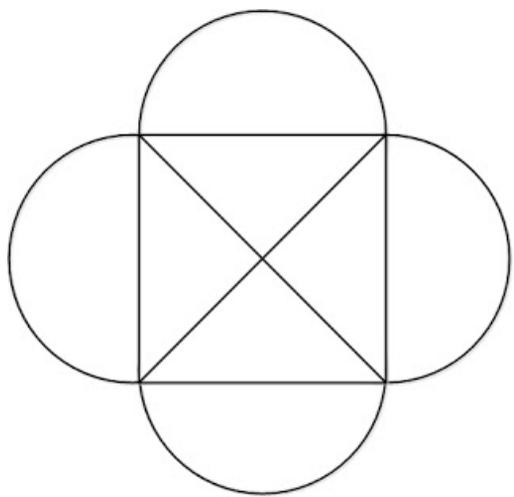
Boy	Illness	Injury	Prop
Ben Barton	Malaria	Knee	Broom
Chris Cockroft	Sleeping Sickness	Hip	Hockey Stick
Hamish Hazel	Bubonic Plague	Toe	Billiard Cue
Martin Masters	Man-flu	Ankle	Cricket Bat

Drawing puzzles



Rules:

- Don't lift your pencil off the page
- Draw each line once (not going over any lines)



When I was younger, the only game I had on my phone was an app for puzzles like this. I used to sit there for hours trying to figure out how to draw the shapes, hopefully you can have some fun with them too.

- Rhianne H. 12AF

Bonus tongue twister (say this superfast)
Two witches were watching two watches but which witch was watching which watch?

Tips and Solution →

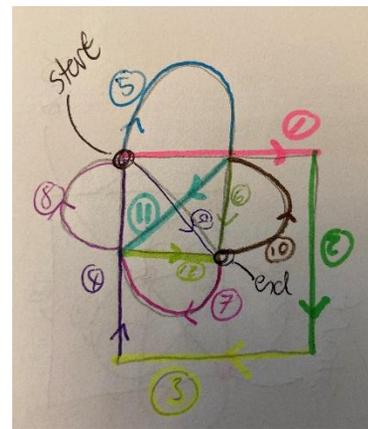
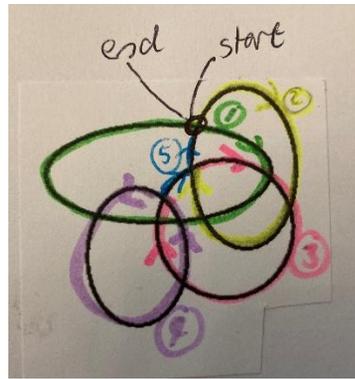
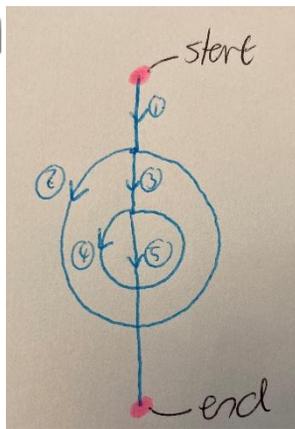


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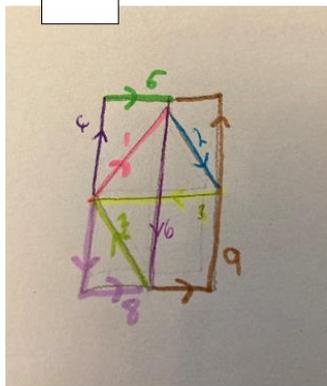
Tips and Hints

- *Get a piece of paper and draw them out instead of trying to visualise them in your head.*
- Just start randomly drawing lines without planning/thinking about how to do it (this used to help me)
- No-one said the page had to stay flat.
- Was there a rule that said you couldn't draw any additional lines?

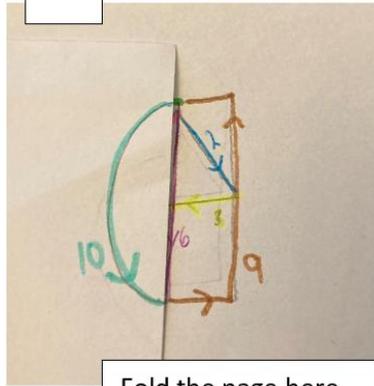
Solution



1

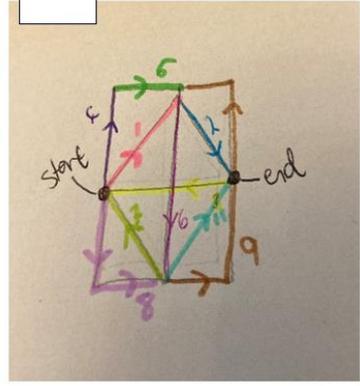


2



Fold the page here.

3



Breaking the code

Tell me the answer to this:

D fodvwlfxccoh. Lw lv txlwh frro.
Wublqj wklqnlqj vroylqj. Vr pdqb
shrsoh wub. Wr vxffhhg. Brx nqrz.
Sxccoh lw. Vwxgb. Lw. Wklqnlqj lw rxw.
Kdssb. Vr L kdyh irxqg. L. Hqmrbr
vroylqj. Dovr hqmrbr gudjrqv. Vrxqglqj
lw. Wub vshdnlqj. Lw iodvkhv lq dlu.
Brx nqrz. Wklv lv ixq. Vr yhub. pxfk ixq
vshdnlqj orqjhu pljkw khos.

I absolutely love ciphers and the moment when you solve them! I went as far as making my own complicated code that even with the cheat sheet I still struggle with!

- Grace E. 12ML

Tips and Solution →



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Breaking the code

Tips and Hints

- *Hint 1: The Romans might like this one.*
- *Hint 2: If I could just add three things...*
- *Hint 3: If you don't find that this one is short and it's taking too long, stop to have a break.*
- *Tip: If you don't know the code off by heart you can look up its alphabet.*

Solution

Use a +3 Caesar cipher. Then you will get these words:

A classic puzzle. It is quite cool. Trying thinking solving. So many people try. To succeed. You know. Puzzle it. Study. It. Thinking it out. Happy. So I have found. I. Enjoy solving. Also enjoy dragons. Sounding it. Try speaking. It flashes in air. You know. This is fun. So very. much fun speaking longer might help.

Then count the syllables, one means a dot, two mean a dash and a full stop means a new word. This is morse code for "Who painted the Mona Lisa?"
The answer to that being Leonardo Da Vinci.

Stupidly simple riddles

1. I have keys but no locks, I have a space but no room. You can enter, but you can't go outside. What am I?

2. what comes once in a minute, twice in a moment and never in a thousand years?

3. what gets bigger the more you take away?

I always used to love riddles when I was younger because they really test your brain even. And sometimes they're so obvious it makes them impossible!

- Sophie V. 12CJS

Tips and Solution →



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Tips and Hints

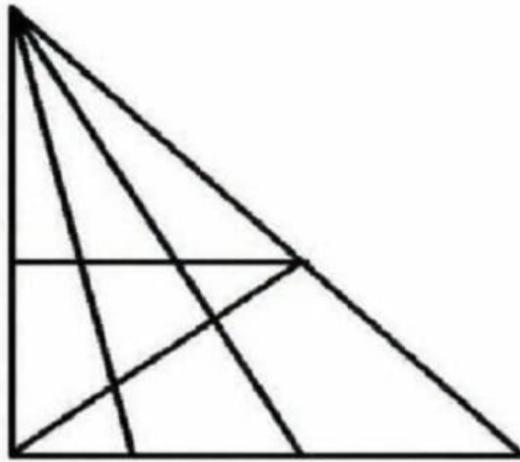
- 1. you might use it everyday, especially now were working from home*
- 2. think about the alphabet*
- 3. think outside the box, maybe even on the ground*

Solution

- 1. A keyboard*
- 2. The letter M*
- 3. A hole*

How many triangles?

How Many Triangles Can You See?



I saw this puzzle a few years ago and will always remember how the number of triangles I could see kept increasing and increasing. Once you find the answer, start again and see if you can find anymore, I can assure you, you will.

- Ellora M. 12HJH

Tips and Solution →



Tips and Hints

Use different colours to highlight which triangles you have counted for. I would suggest keeping a tally on the side to mark down your progress.

Solution

The answer is 24 triangles.

Cracking the code

WHICH MATHEMATICIAN IS HIDING IN THIS SEQUENCE?

8, 34, 1, 610, 377, 1, 2, 2, 34

When I was younger my friends and I, would always create codes so we could pass notes and letters to make plans in secret. It was always super satisfying knowing that we were the only ones who could read these special notes.

SZEV UFM!

- Ayesha C. 12RM

Tips and Solution →



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Cracking the code

Tips and Hints

Think of a famous sequence, you may have been taught in maths.

Here are the first few letters with corresponding numbers if you're still stuck

A-1

B-1

C-2

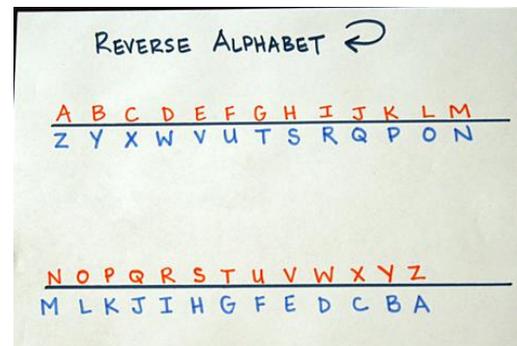
D-3

Solution

FIBONACCI

The letters are replaced by the Fibonacci sequence:

A=1, B=1, C=2, D=3, E=5, F=8,
G=13, H=21, I=34, J=55, K=89,
L=144, M=233, N=377, O=610...



The code at the end of my explanation says, "HAVE FUN!". To do this I reversed the alphabet. Were you able to figure this out?

Rebus Puzzles

1.

**META META
META META**

4.

**TRAVEL
—————
CCCCCCCCC**

2.

**SK8
—————
IIIIIII**

5.

**TALIR
RIALT
AIRTL
IRLAT**

3.

**Try Stand
2**

4.



These puzzles remind me of catchphrase. Sometimes, you really can't tell what it is supposed to be telling you, but when you realise, it makes so much sense!

- Havana I. 12AF

Tips and Solution →



Rebus Puzzles

Tips and Hints

- Think about the positions of the words ie. Where are they in relation to other words
- Count the words or letters, how many there are is often part of the answer
- Look at the size, width, etc of the words

Solution

1. Meta- four
2. Skating on thin "l"s
3. Try '2' understand
4. Travel over Cs
5. Trail mix
6. Apple Pi



Sudoku

	9		1	2				
7				6		1		
4					3			
3		6		9		8		
							2	4
				2	1	9		5
							3	7
6			7					
	8							

I always enjoyed doing Sudoku puzzles because of the way all the numbers fit together in the end. There are so many different types, from having all numbers multiply to make a certain number, or like the one above having only one of each number in each box and line, but finding the solution is always satisfying.

- Kailua. P-T 12SLJ

Tips and Solution →



Sudoku

Tips and Hints

some things to help when doing this puzzle-

1. *first eliminate numbers from rows*
2. *choose one space at a time to find out*
3. *it can be very helpful to find out a whole row or 3x3 block, before moving onto the next*
4. *writing down possible solutions always helps the elimination process*

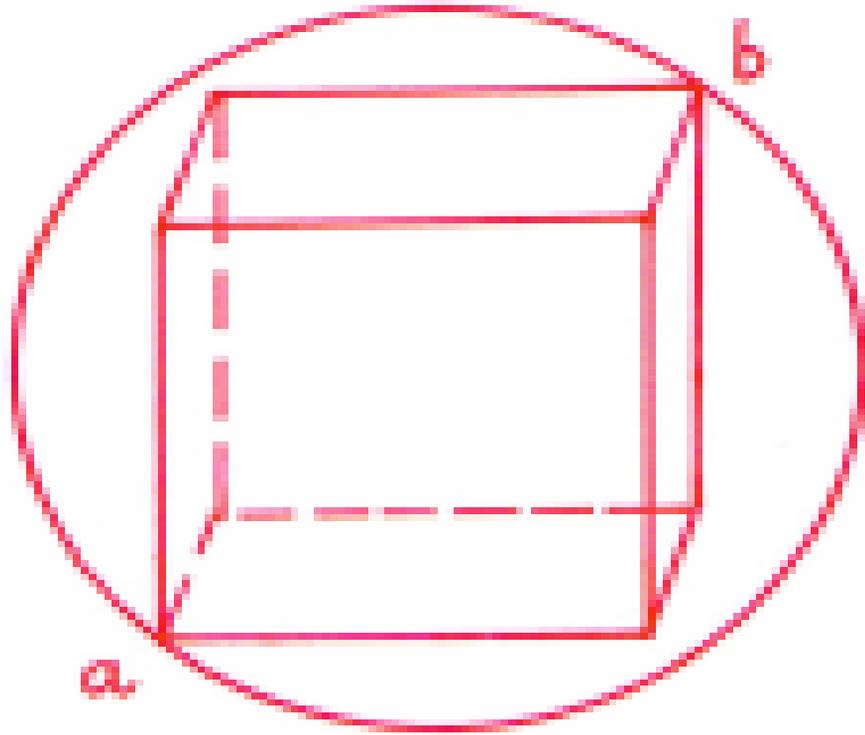
5 8	9	5 8	1	4 5 7 8	2	4 5 6 7	4 5 6 7 8	3 6
7	2 3 5	2 3 5 8	4 5 8 9	6	4 5 8 9	1	4 5 8 9	2 3
4	1 2 5 6	1 2 5 8	5 8 9 7 8	5	3	2 7	5 6 7 8 9	2 6 8 9
3	1 2 4 5 7	6	4 5	9	4 5 7	8	1 7	1
1 5 8 9 7	1 5 7 8 9	1 5 7 8 9	3 5 6 7 8	3 5 6 7 8	5 6 7 8	3 6 7	2 4	4
8	4 7	4 7 8	4 6 8	2 1	9	7 6	5	
1 2 5 9	1 2 4 5	1 2 4 5 9	2 4 5 6 8 9	1 4 5 6 8	2 4 5 6 8 9	2 4 5 6 8 9	3 7	7
6	1 2 3 4 5	1 2 3 4 5 9	7	1 3 4 5 8	4 5 8 9	2 4 5 8 9	1 4 5 8 9	1 2 8 9
1 2 5 9	8	1 2 3 4 5 7 9	2 3 4 5 6 9	1 3 4 5	4 5 6 9	2 4 5 6 9	1 4 5 6 9	1 2 6 9

Solution

5	9	8	1	7	2	6	4	3
7	3	2	4	6	8	1	5	9
4	6	1	9	5	3	7	8	2
3	2	6	5	9	4	8	7	1
9	1	5	6	8	7	3	2	4
8	7	4	3	2	1	9	6	5
2	4	9	8	1	6	5	3	7
6	5	3	7	4	9	2	1	8
1	8	7	2	3	5	4	9	6

Geometry Challenge

What is the volume of the largest cube that fits entirely within a sphere of unity volume?

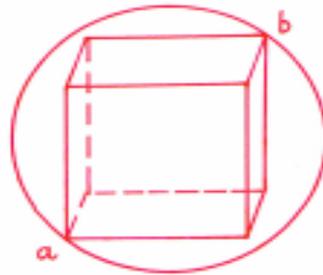


This was the first question I understood in a pack full of problems. I like these questions as the answers are usually pages long to show that there are many ways to obtain the same solution. They showed me that it's not always about the result but the way you get there.

It's still nice to get it right though :) Jen E

Geometry Challenge

What is the volume of the largest cube that fits entirely within a sphere of unity volume ?



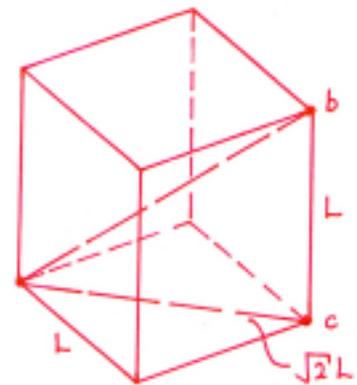
Hint

From the geometry of the cube, using Pythagoras' theorem

$$|ab|^2 = (\sqrt{2}L)^2 + L^2$$

where L is the length of the side of the cube. Thus

$$|ab| = \sqrt{3}L = D$$



The volume of the cube is thus given by

Solution

$$V_C = L^3 = \frac{D^3}{3^{3/2}}$$

All that remains is to substitute for D^3 using the equation for the volume of the sphere, $V_S = (4/3)\pi r^3 = \pi D^3/6 = 1$. Rearranging $D^3 = 6/\pi$. The volume of the cube within the sphere is given by

$$V_C = \frac{2}{\pi\sqrt{3}} \approx 0.368$$

Optical illusions



At first glance you hardly notice any different, but the more attention you pay to it, the clearer it becomes

- *charlotte west*

Tips and Solution →

Optical Illusions

Tips and Hints

Look carefully

Solution

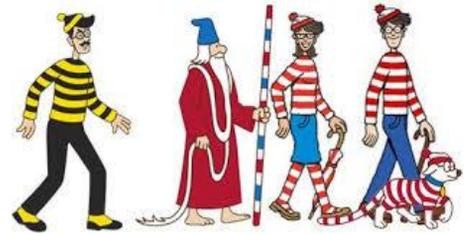
Did you notice the cat?

There are more.



Where's Wally

Find the following characters:



Where's Wally is a classic puzzle that always reminds me of my childhood. It's one of the first real puzzles that I remember doing, and it never gets old!

- Sri O. 12AF

Tips and Solution →



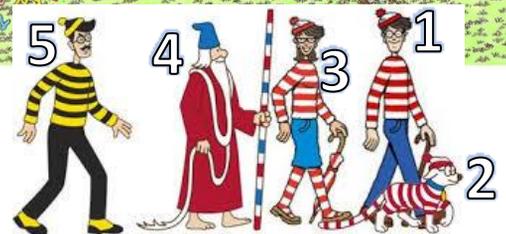
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Where's Wally

Tips and Hints

- *Try searching for the characters by separating the image into smaller sections, and work your way through each section.*
- *Identify specific features/characteristics for each character that you can use to make it easier when you try and look for them.*

Solution



Dingbats

Puzzle

EASY **DINGBATS 14** **EASY**
www.quizmasters.biz www.quizmasters.biz

COTAXME	KK CC UU TT SS WORDS WORDS WORDS WORDS	INSULT + INJURY	NO WAYS IT WAYS
01	02	03	04
R Y S	LOV	GESG SEG GEGS GGES	NNNNNNN AAAAAAA CCCCCCC
05	06	07	08

I like these puzzles because we used to do these in my old school when we would do quizzes. I enjoy working these out as it makes you think outside the box to what the image means!

Georgina C. 12AF

Tips and Solution →

Dingbats

Tips and Hints

- 1. think about what words are in between other words*
- 2. how many 'stucks' are there? What way are they facing? How many 'words' are there?*
- 3. what two words are you adding together?*
- 4. how many 'no' and 'ways' are there? Can you think of a phrase?*
- 5. what way is the word 'syr' facing... therefore what is the word?*
- 6. there is a letter missing, therefore what is the love?*
- 7. what word can u make from these SCRAMBLED letters*
- 8. it is a drink...*

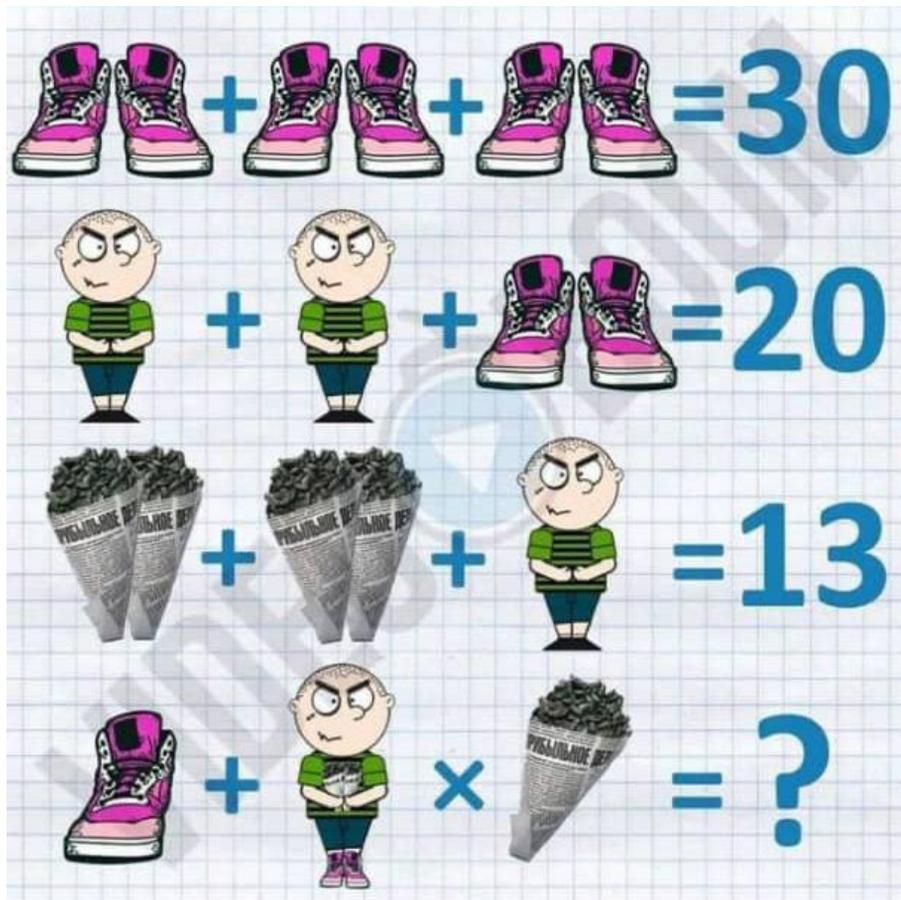
Further hint – how many cans are there? What way are they facing?

Solution

- 1. income tax*
- 2. too stuck up for words*
- 3. adding insult to injury*
- 4. no two ways about it*
- 5. syrup*
- 6. endless love*
- 7. scrambled eggs*
- 8. 7 up cans*



Picture maths puzzle



I like these puzzles as the answer isn't always the first thing you come to. You've got to look at the closet details in order to work the answer out – Catrin P. 12CJS

Tips and Solution →

Picture maths puzzle

Tips and Hints

1. Work out what each item is worth
2. Look carefully to see how many of each item there is
3. On the last line, look closer at the boy to see what he is wearing and holding
4. Include all of the items when getting to the answer
5. Always multiply first before adding

Solution

$$\text{Shoes} = 30/3 = 10$$

$$\text{Boy} = (20-10)/2 = 5$$

$$\text{Two newspapers} = (13-5)/2 = 4$$

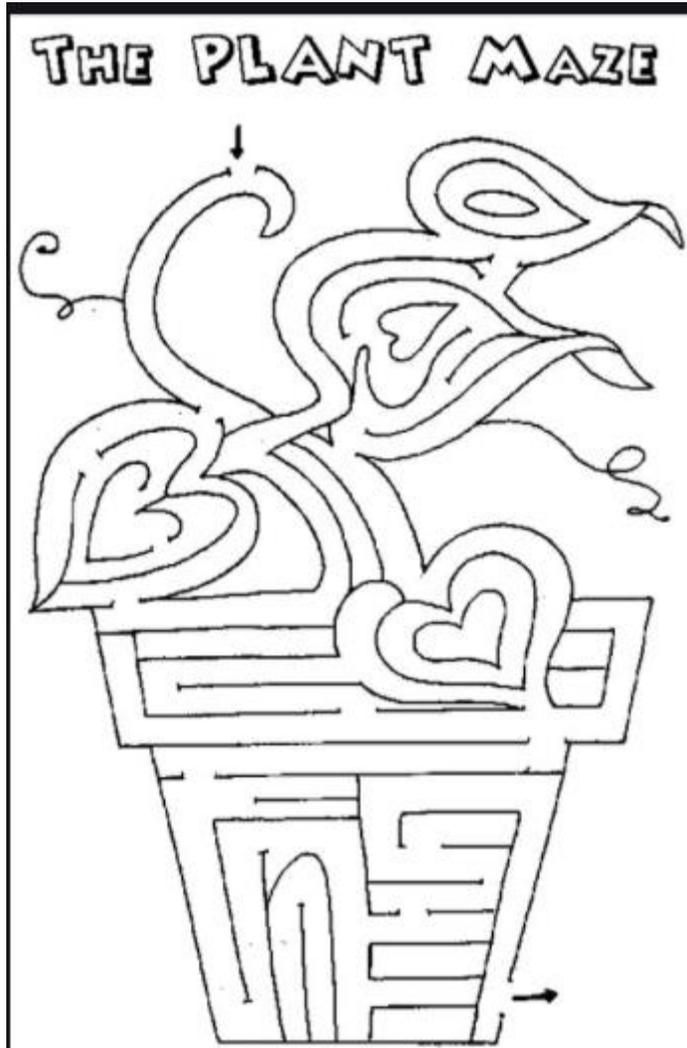
Final answer = one shoe + boy wearing shoes and holding two newspapers x one newspaper

$$= (10/2) + (5+10+4) \times (4/2)$$

$$= 5 + 19 \times 2$$

$$= 43$$

The plant maze



i love maze puzzles because they are often quite tricky and make you think ! I also love plants :)

Serena D 12slj

Tips and Solution →



