

2022 Digits Problem

11	$(20 + 2) \div 2$
12	$20 \div 2 + 2$
13	
14	$(2 + 0!)! \times 2 + 2$
15	$(2 + 2)^2 - 0!$

No solution found yet

Digits in year order 2022

Digits not in year order

2	+	0	+	2	+	2
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$202^{(2)}$
$20^{(22)}$
$20 \times (22!)$
$2022!$
$20^{(2 + 2)}$
$20!^{(2 + 2)}$

2022: Digits Problem

A Spire Maths Activity

<https://spiremaths.co.uk/2022/>

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2022 Digits Problem

Answers are on page 4. Colour pupil sheet on page 5, black pupil sheet on page 6

1. Make integers using the 4 digits of 2022 each once only, using add, subtract, multiply and divide, with brackets for clarity.
2. After about 5 minutes extend to allow Concatenation
3. After another 5 minutes allow Powers and Factorials noting that

by convention any number to the power 0 is 1
also by convention $0! = 1$

4. Most numbers (72%) up to 50 can be made keeping the digits 2022 in that order.
5. Those that can't be made (16%) are: 13, 29, 31, 33, 35, 36, 37 and 41
6. Those not in order are: 15, 17, 43, 45, 47, 49
7. Some very large numbers can be made using just these rules and some expressions created will 'break' the calculator or spreadsheet.

PowerPoint slides available (Similar also for ActivInspire)

Read down the first column, then down the second:

<p>2022 Digits Problem</p> <p>A Variation on a Classic Problem</p> <p>SPIRE MATHS</p> <p>Stimulating, Practical, Interesting, Relevant, Enjoyable Maths For All</p> <p>https://spiremaths.co.uk/2022/</p>	<p>Use the four digits 2, 0, 2 and 2 exactly once each to make as many numbers as you can.</p> <p>You should check each answer on a calculator. Some numbers, such as 6 shown here can be made by keeping the four numbers of 2022 in that order.</p> <div><div>2</div><div>+</div><div>0</div><div>+</div><div>2</div><div>+</div><div>2</div></div> <p>What other numbers can you find?</p> <p><small>(spend about 5 minutes on this, before going to the next slide)</small></p>																
<p>2022 Digits Problem</p> <div><div><table><tr><td>11</td><td>$(20 + 2) \div 2$</td></tr><tr><td>12</td><td>$20 \div 2 + 2$</td></tr><tr><td>13</td><td></td></tr><tr><td>14</td><td>$(2 + 0!) \times 2 + 2$</td></tr><tr><td>15</td><td>$(2 + 2)^2 - 0!$</td></tr></table><p>No variation found yet</p><p>Digits in year order 2022</p><p>Digits not in year order</p></div><div><div>2</div><div>+</div><div>0</div><div>+</div><div>2</div><div>+</div><div>2</div></div><div><table><tr><td>$202^{(2)}$</td></tr><tr><td>$20^{(22)}$</td></tr><tr><td>$20 \times (22!)$</td></tr><tr><td>$2022!$</td></tr><tr><td>$20^{(2 + 2)}$</td></tr><tr><td>$20^{(2^2 + 2)}$</td></tr></table></div></div> <p>Answers, worksheet and support documentation provided, see website below.</p> <p>Excel file lets you find solutions and shows answers.</p> <p>https://spiremaths.co.uk/2022/</p> <p>2022: Digits Problem</p>	11	$(20 + 2) \div 2$	12	$20 \div 2 + 2$	13		14	$(2 + 0!) \times 2 + 2$	15	$(2 + 2)^2 - 0!$	$202^{(2)}$	$20^{(22)}$	$20 \times (22!)$	$2022!$	$20^{(2 + 2)}$	$20^{(2^2 + 2)}$	<p>Concatenation is allowed and is needed to make some of the answers. This allows:</p> <div><div>2</div><div>0</div><div>+</div><div>2</div><div>-</div><div>2</div></div> <div><div>=</div><div>2</div><div>0</div></div> <p>So:</p> <div><div>2</div><div>0</div><div>+</div><div>2</div><div>2</div></div> <div><div>=</div><div>4</div><div>2</div></div> <p>But we do not allow:</p> <div><div>2</div><div>+</div><div>0</div><div>2</div><div>-</div><div>2</div></div> <p><small>See next slide for more.</small></p>
11	$(20 + 2) \div 2$																
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$20^{(2 + 2)}$																	
$20^{(2^2 + 2)}$																	
<p>You may want to open the Excel file now</p> <p>Have the spreadsheet open and ready for your use.</p> <p>Each mouse click in this PowerPoint file reveals more</p> <p>All resources for this activity found at:</p> <p>https://spiremaths.co.uk/2022/</p>	<p>Powers are allowed and used to make some of the answers. This allows:</p> <div><div>2</div><div>-</div><div>0</div><div>+</div><div>2</div><div>^</div><div>2</div></div> <div><div>=</div><div>6</div></div> <p>So:</p> <div><div>2</div><div>+</div><div>0</div><div>^</div><div>2</div><div>+</div><div>2</div></div> <div><div>=</div><div>4</div></div> <p>Note that</p> <div><div>2</div><div>^</div><div>0</div></div> <div><div>=</div><div>1</div></div> <p>In fact: any number to the power of 0 is 1</p>																

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The unitary operator **FACTORIAL** is needed to make some of the answers. **!**
Where

$$4! = 1 \times 2 \times 3 \times 4$$

$$= 24$$

$$3! = 6 \quad 2! = 2 \quad 1! = 1$$

And by international agreement
(and important here):

$$0! = 1$$

What other numbers can you find?

2022 Digits Problem

Here are some ideas for larger numbers that can be made.
Which do you think will be the largest?

Which will 'break' your calculator?

$202^{(2)}$	40804
$20^{(22)}$	4.1943E+28
$20 \times (22!)$	2.248E+22
2022!	#NUM!
$20^{(2+2)}$	160000
$20!(^{2+2})$	3.50347E+73

2022 Extras

Here are the numbers we have found so far up to 50 and beyond:

No.	Expression	No.	Expression	No.	Expression
1		26		60	
2		27		72	
3		28		80	
4		29		101	
5		30		118	
6		31		122	
7		32		200	
8		33		204	
9		34		204	
10		35		240	
11		36		224	
12		37		398	
13		38		402	
14		39		404	
15		40		440	
16		41		480	
17		42		484	
18		43			
19		44			
20		45			
21		46			
22		47			
23		48			
24		49			
25		50			

No solution yet for
13, 29, 31, 33, 35, 36, 37 and 41

Solution not in 2022 order
15, 17, 43, 45, 47, 49

All others have been found
in the order of 2022

2022 Digits Problem

Four 4s is the more well-known activity similar to this 2022
Use to support order of operations work.

<https://spiremaths.co.uk/four4s/>

Similar Activity

No.	Expression	No.	Expression	No.	Expression
1	$2 \times 0 \times 2 \times 2$	26	$2 \times 0 \times (2 \times 2)$	60	$(2 \times 0 \times 2) \times 2$
2	$2 \times 0 \times 2 \times 2$	27	$2 \times 0 \times (2 \times 2)$	72	$(2 \times 0 \times 2) \times 2$
3	$2 \times 0 \times 2 \times 2$	28	$0 \times 0 \times 0 \times 0$	80	$0 \times (2 \times 2) \times 2$
4	$2 \times 0 \times 2 \times 2$	29		101	$0 \times 2 \times 2 \times 2$
5	$0 \times (2 \times 2)$	30	$(2 \times 0 \times 2) \times (2 \times 2)$	118	$(2 \times 0 \times 2) \times 2$
6	$2 \times 0 \times 2 \times 2$	31		122	$(2 \times 0 \times 2) \times 2$
7	$2 \times 0 \times 2 \times 2$	32	$0! \times 2 \times 2$	200	$0 \times 2 \times 2 \times 2$
8	$2 \times 0 \times (2 \times 2)$	33		204	$0 \times 2 \times 2 \times 2$
9	$(2 \times 0 \times 2) \times 2$	34	$(2 \times 0 \times 2) \times 2$	240	$0 \times 2 \times 2 \times 2$
10	$(2 \times 0 \times 2) \times 2$	35		240	$(2 \times 0 \times 2) \times 2$
11	$0 \times 2 \times 2 \times 2$	36		324	$(0! \times 2) \times 2$
12	$0 \times 2 \times 2 \times 2$	37		398	$0! \times 2 \times 2$
13		38	$0 \times 2 \times 2 \times 2$	402	$0! \times 2 \times 2$
14	$(2 \times 0 \times 2) \times 2 \times 2$	39		404	$0 \times 2 \times 2 \times 2$
15	$(2 \times 2) \times 0$	40		440	$0 \times 2 \times 2 \times 2$
16	$0 \times 2 \times 2 \times 2$	41		480	$0 \times 2 \times (2 \times 2)$
17	$(2 \times 2) \times 0$	42	$0 \times 2 \times 2$	484	$(0! \times 2) \times 2$
18	$(2 \times 0 \times 2) \times (2 \times 2)$	43	$0! \times 2 \times 2$		
19	$0 \times (2 \times 2)$	44	$0 \times (2 \times 2)$		
20	$0 \times 2 \times 2 \times 2$	45	$0 \times 2 \times 2 \times 2$		
21	$0 \times (2 \times 2)$	46	$0 \times (2 \times 2)$		
22	$0 \times 0 \times 2 \times 2$	47	$2 \times (0 \times 2) \times 2$		
23	$0 \times 0 \times 2 \times 2$	48	$(2 \times 0 \times 2) \times 2$		
24	$0 \times 0 \times 2 \times 2$	49	$2 \times (2 \times 2) \times 0$		
25	$0 \times 0 \times 2 \times 2$	50	$0 \times (0 \times (2 \times 2))$		

2022 Some solutions

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No.	Expression	No.	Expression	No.	Expression
1	$2 \times 0 \times 2 + 2$	26	$2 + 0 + (2 + 2)!$	60	$(2 + 0! + 2)! \div 2$
2	$2 + 0 + 2 - 2$	27	$2 + 0! + (2 + 2)!$	72	$((2 + 0!)^2)! \times 2$
3	$2 + 0 + 2 \div 2$	28	$(2 + 0)! + 22$	80	$20 \times (2 + 2)$
4	$2 \times 0 + 2 + 2$	29		101	$202 \div 2$
5	$20 + (2 + 2)$	30	$(2 + 0!)! + (2 + 2)!$	118	$(2 + 0! + 2)! - 2$
6	$2 + 0 + 2 + 2$	31		122	$(2 + 0! + 2)! + 2$
7	$2 + 0! + 2 + 2$	32	$2^{(0! + 2 + 2)}$	200	$202 - 2$
8	$(2 + 0) \times (2 + 2)$	33		204	$202 + 2$
9	$((2 \times 0)! + 2)^2$	34	$((2 + 0!)^2)! - 2$	204	$202 + 2$
10	$(2 + 0!)! + 2 + 2$	35		240	$(2 + 0! + 2)! \times 2$
11	$(20 + 2) \div 2$	36		324	$(20 - 2)^2$
12	$20 \div 2 + 2$	37		398	$20^2 - 2$
13		38	$(20 \times 2) - 2$	402	$20^2 - 2$
14	$(2 + 0!)! \times 2 + 2$	39		404	202×2
15	$(2 + 2)^2 - 0!$	40		440	20×22
16	$20 - 2 - 2$	41		480	$20 \times ((2 + 2)!)!$
17	$(2 + 2)^2 + 0!$	42	$20 + 22$	484	$(20 + 2)^2$
18	$-(2 + 0!)! + (2 + 2)!$	43	$22 \times 2 - 0!$		
19	$20 - (2 \div 2)$	44	$20 + (2 + 2)!$		
20	$20 + 2 - 2$	45	$22 \times 2 + 0!$		
21	$20 + (2 \div 2)$	46	$2 \times (0! + 22)$		
22	$2 \times 0 + 22$	47	$2 \times (2 + 2)! - 0!$		
23	$2 - 0! + 22$	48	$(2 + 0) \times (2 + 2)!$		
24	$2 + 0 + 22$	49	$2 \times (2 + 2)! + 0!$		
25	$2 + 0! + 22$	50	$2 \times (0! + (2 + 2)!)!$		

Make these numbers using the digits 2, 0, 2 and 2 exactly once each

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18		43					
19		44					
20		45					
21		46					
22		47					
23		48					
24		49					
25		50					

No solution found yet	Digits in year order 2022	Digits not in year order	Add your own numbers
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