Significant Figures Worksheet

When doing calculations, we have to know how many significant figures (sig figs) we have so that we can report our answer with the proper amount of precision. There are a few rules to learn to be able to figure out which numbers are significant:

Rule	Example	Number of Sig Figs
A number is significant if it is:		
not a zero	4.6 mg 345.12 lb	2 5
a zero between nonzero numbers	308 L 3.012 kg	3 4
a zero to the right of a decimal	2.0 cm 92.0 K 871.00 g	2 3 5
all digits of the number when written in scientific notation	7.0×10^{3} lb 9.30×10^{-2} nm	2 3
A zero is not significant of it is:		
at the beginning of a decimal number (since the zero is simply acting as a place holder)	0.00003 g 0.028 m	1 2
A zero may or may not significant of it is:		
used as a placeholder in a large number without a decimal point – in these cases it is best to write the number in scientific notation so that sig figs are clear	920000 K 2820 lb	2-6 3 or 4

Now, try some on your own! List the number of significant figures.

1. 384 m ___3___
2. 405,000 mg ___3 to 6, unclear___
3. 69.00 K ___4___
4. 3.8×10^{4} lb ___2___
5. 0.0005 L ___1___
6. 234.02 nm ___5___

When multiplying and dividing with significant figures, the answer will have the same amount of numbers as the number with the *fewest* significant figures. For example:

$2.5 \times 120.73 = 301.825$ gives a final answer of 3.0×10^{2}
(2 sig figs times 5 sig figs means our final answer can only have 2 sig figs since 2 < 5)

$101 \times 82.06 = 8288.06$ gives a final answer of 8.29×10^{3}
(3 sig figs times 4 sig figs means our final answer can only have 3 sig figs since 3 < 4)

$12.00 \times 16.0 = 192$ gives a final answer of 192
(4 sig figs times 3 sig figs means our final answer can only have 3 sig figs since 3 < 4)

$801 \div 89 = 9$ gives a final answer of 9.0
(3 sig figs divided by 2 sig figs means our final answer can only have 2 sig figs since 2 < 3)

Your turn! Calculate the answers to the below problems. Then, report the answer with the correct number of significant figures.

	answer	w/sig figs		answer	w/sig figs
7. 92.2×293.00	27014.6	2.70×10^{4}	10. $2.73 \div 458$	0.0059607	0.00596
8. 0.0023×0.4800	0.001104	0.0011	11. 18.00×351	6318	6.32×10^{3}
9. $546 \div 97.25$	5.614396	5.61	12. 827×0.01	8.27	8

When adding and subtracting with significant figures, the answer will have the same amount of numbers to the right of the decimal as the number with the *fewest* amount of number to the right of the decimal. For example:

75.346 + 4212.2 = 4387.546 gives a final answer of 4387.5

Since we have 3 decimal places plus 1 decimal place, our final answer can only have 1 decimal place because 1 < 3. It is easier to determine sig figs with addition and subtraction when we rewrite the problem as shown below. Then, we can draw a line indicating where the numbers switch from being significant to not being significant.

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   75.3|46
+ 4312.2|
  4387.5|46
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Let's look at another example:

$2.34\times10^{-1} - 1.9\times10^{-3} = 2.339\times10^{-1}$ gives a final answer of 2.34×10^{-1}

At first glance this answer might surprise you. However, we have a number with 3 decimal places having a number with 4 decimal places being subtracted from it. Thus, our final answer can only have 3 significant figures. It is better to rewrite numbers in scientific notation so that they are either written to the same power of ten or written out in standard notation. This way, you can easily see which number truly has fewer decimals. Look at the problem rewritten below.

```
   2.34×10^-1          2.34|×10^-1          0.234|
–  1.9×10^-3        – 0.01|9×10^-1        – 0.001|9
   2.339×10^-1         2.33|9×10^-1         0.233|9
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With the first way of writing, we can't draw a line indicating where the numbers switch from being significant to not being significant. With the second two ways of rewriting, it is easy to draw the line to see where the digits switch from significant or not. To convert to the final answer of 2.34×10^{-1} we just have to remember our rounding rules.

It's your turn again! Compute the answers with the correct number of significant figures.

	answer	w/sig figs		answer	w/sig figs
13. 92.201 + 293.00	385.201	385.20	16. 27.31 – 0.589	26.721	26.72
14. 0.0023 – 0.480	- 0.4777	- 0.478	17. $9.583\times10^{-2} + 4.28\times10^{-4}$	0.096258	0.09626
15. 654 + 79.5	733.5	734	18. $3.46817\times10^{-13} + 8.43\times10^{-18}$	3.4682543×10^{-13}	3.46825×10^{-13}

Work for 13: 92.201 + 293.00 = 385.201

Work for 14: 0.0023 - 0.480 = -0.4777

Work for 15: 654 + 79.5 = 733.5

Work for 16: 27.31 - 0.58 = 26.721

Work for 17: 0.09583 + 0.000428 = 0.096258

Work for 18: $3.46817\times10^{-13} + 0.0000843\times10^{-13} = 3.4682543\times10^{-13}$

Now that you have learned the major rules for calculations with significant figures, try these problems! Remember to follow the proper computation order!

	work with calculator given answer	answer with proper sig figs
19. $\frac{3.12+546.1}{62.101}$	$= \frac{549.22}{62.101} = 8.843979968$	8.844
20. 305.75 ÷ 546	= 0.56	0.560
21. $54.2\times\frac{6.022\times10^{23}}{14.60}$	$= 2.235564384\times10^{24}$	2.24×10^{24}
22. 15.3 × (0.1296 + 0.549) ÷ 1.2	= 15.3 × 0.6786 ÷ 1.2 = 8.65215	8.7
23. $\frac{9.583\times10^{-2}}{4.23\times10^{-4}}$	= 226.5484634	227
24. $10.59602 + 2.109867\times10^{-3}$	10.59602 + 0.002109867 = 10.59812 98	10.59813
25. $\frac{5.55+6.03\times10^{-8}}{1.239\times10^{3}}$	$= \frac{5.5500000603}{1.239\times10^{3}} = 0.004479418$	4.48×10^{-3}
26. 12.01 + 5.20 × 0.00310	= 12.01 + 0.01612 = 12.02612	12.03

The last rule about significant figures deals with logarithms. First when we take the logarithm of a number, there are special names for the result: the number to the left of the decimal is called the characteristic and the number to the right is called the mantissa. The significant figures rule says that the mantissa needs to have the same number of significant figures as the original number. Let's look at some examples:

log 34.7 = 1.540329 gives a final answer of 1.540
(our original number has 3 sig figs, so our final answer must have 3 decimal places)

ln 4.3 = 1.458615 gives a final answer of 1.46
(our original number has 2 sig figs, so our final answer must have 2 decimal places)

$10^{-87.6} = 2.51189\times10^{-88}$ gives a final answer of 3×10^{-88}
(the mantissa only had 1 decimal place, so the final answer can only have 1 significant figure)

$e^{1.687} = 5.403247$ gives a final answer of 5.40
(the mantissa had 3 decimal places, so the final answer must have 3 significant figures)

Now it's your turn again.

	answer	w/sig figs		answer	w/sig figs
27. log 5.89×10^{-3}	-2.229884705	-2.230	29. $10^{-2.22}$	0.006025595	6.0×10^{-3}
28. ln 3.591	1.278430715	1.2784	30. $e^{56.1}$	2.311641×10^{24}	2×10^{24}