

Give The Answer With The Correct Error And Number Of Significant Digits A) 12.480.07+9.710.09= ? B) 19.10.94.80.6=

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Understanding how to approach calculations involving significant digits and errors is fundamental in scientific and mathematical contexts. Properly determining the correct answer with the right number of significant digits ensures accuracy and precision, which are critical in fields like engineering, physics, chemistry, and data analysis. In this article, we will analyze the given problems, explore the rules for significant digits and errors, and demonstrate how to arrive at the correct answers with appropriate precision.

Fundamentals of Significant Digits and Errors

Before solving the provided problems, it's essential to understand the core concepts of significant digits and how errors influence measurements.

What Are Significant Digits?

Significant digits (or figures) in a number are the digits that carry meaningful contributions to its precision. They include all non-zero digits, zeros between non-zero digits, and certain zeros depending on their position.

Key rules for significant digits:

- Non-zero digits are always significant.
- Zeros between non-zero digits are significant.
- Leading zeros (before non-zero digits) are not significant.
- Trailing zeros in a number with a decimal point are significant.
- Trailing zeros in a whole number without a decimal point may or may not be significant, depending on context.

Errors in Measurements and Calculations

Errors can originate from measurement limitations or rounding. When performing calculations:

- Addition and Subtraction: Round to the least precise decimal place.
- Multiplication and Division: Round to the least number of significant digits among the numbers involved.

Understanding and applying these rules ensures that the final results reflect the true precision of the measurements.

Analyzing the Problems

Let's now examine each problem carefully, identify the significant digits, and perform the calculations accordingly.

Problem A: $12.480.07 + 9.710.09 = ?$

At first glance, the notation appears unconventional. It likely indicates two numbers with formatting errors, perhaps intended as:

- First number: 12,480.07
- Second number: 9,710.09

Assuming these are the correct interpretations, the sum is straightforward. If you interpret the numbers differently, please clarify. For this analysis, we'll proceed with the assumption that the numbers are:

- 12,480.07
- 9,710.09

Problem B: $19.10.94.80.6 = ?$

This sequence appears to be a typo or formatting error. It likely represents a single number with misplaced decimal points, perhaps intended as:

- 19,109,480.6

Alternatively, if it's a string of numbers, clarification is needed. Assuming it's 19,109,480.6, the number will be used for further calculations.

Let's now proceed with detailed steps for each problem.

Step-by-Step Solution Approach

Solution for Problem A

Step 1: Identify the numbers and their significant digits

- 12,480.07
- Digits: 1, 2, 4, 8, 0, 0, 7
- The decimal point indicates that zeros after 8 are significant.

- Total significant digits: 8
- 9,710.09
- Digits: 9, 7, 1, 0, 0, 9
- Decimal present; zeros are significant.
- Total significant digits: 6

Step 2: Determine the decimal place for rounding

Since the problem involves addition, the rule is:

> Round the result to the least precise decimal place among the numbers.

- 12,480.07 (precision: hundredths place)
- 9,710.09 (precision: hundredths place)

Both numbers are precise to the hundredths place. Therefore, the sum should be rounded to the hundredths place.

Step 3: Perform the addition

- $12,480.07 + 9,710.09 = 22,190.16$

Step 4: Final answer with correct significant digits

- The sum is 22,190.16, rounded to two decimal places, consistent with the original data.

Step 5: Error analysis

- Since both original measurements are precise to the hundredths place, the error margin should be at least ± 0.01 .

Solution for Problem B

Step 1: Clarify the number's format

Assuming the number is 19,109,480.6 (based on best interpretation):

- Digits: 1, 9, 1, 0, 9, 4, 8, 0, 6
- Decimal point indicates precision to the tenths place.
- Significant digits: 9

Step 2: Determine the precision

- The number is precise to the tenths place; zeros before the decimal are not significant unless specified.

Step 3: Error consideration

- The measurement is accurate to ± 0.1 (the last digit's place).

Final Results and Best Practices

Based on the above analysis, the correctly rounded answers considering significant digits and potential errors are:

- Problem A: 22,190.16 (accurate to two decimal places)
- Problem B: 19,109,480.6 (accurate to one decimal place)

Best practices when solving such problems include:

1. Always identify the significant digits in each number before performing calculations.
2. Use the rules for addition/subtraction (least precise decimal place) and multiplication/division (least number of significant digits).
3. When reporting the final answer, match the precision to the least precise measurement involved.
4. Account for measurement errors and uncertainties, especially when dealing with experimental data.

Importance of Correct Error Calculation and Significant Digits

Properly accounting for errors and significant digits is crucial because it:

- Prevents overestimating the precision of results
- Ensures data integrity and reliability
- Facilitates clear communication of measurement accuracy
- Is essential for scientific reproducibility and validation

Conclusion

Calculations involving significant digits and errors may seem straightforward but require careful attention to detail. In the case of the provided problems, understanding the notation, identifying the precision of each number, and applying the correct rounding rules are fundamental steps. Whether adding, subtracting, multiplying, or dividing, always align your answer with the least precise measurement involved. This approach guarantees that your results are both accurate and scientifically valid. Remember,

precision and error analysis are the backbone of trustworthy scientific computation, and mastering these principles will significantly enhance your analytical skills.

Frequently Asked Questions

What is the correct sum of 12,480.07 and 9,710.09, considering significant digits?

The sum is 22,190.16, rounded to 5 significant digits (since 12,480.07 has 7 significant digits and 9,710.09 has 6), so the answer is 22,190.16.

How many significant digits should be used when adding 12,480.07 and 9,710.09?

Since both numbers have 6 decimal places and the least precise measurement is to 2 decimal places, the result should be rounded to 2 decimal places, giving 22,190.16.

What is the correct interpretation of the expression 19.10.94.80.6= ?

This expression appears to be incorrectly formatted or contains typographical errors. Assuming it's a series of numbers, it may need clarification to provide an accurate answer.

If the intended calculation is $19.10 + 94.80 + 6$, what is the correct result with proper significant digits?

Adding 19.10, 94.80, and 6 yields 119.90. The number with the least decimal places has 0 decimal places (6 has none), so the sum should be rounded to 0 decimal places: 120.

Why is it important to consider significant digits in calculations like these?

Considering significant digits ensures the precision of the result accurately reflects the precision of the original data, preventing overstatement of accuracy.

How do you determine the number of decimal places to

round to in addition operations?

You round the result to match the number of decimal places of the measurement with the fewest decimal places involved in the calculation.

What common errors should be avoided when performing calculations with multiple numbers of different significant digits?

Avoid rounding too early, miscounting significant digits, and misinterpreting the data format or notation.

Given the numbers 12,480.07 and 9,710.09, what is the correct rounded sum considering significant digits?

The sum is 22,190.16, rounded to 2 decimal places, consistent with the least precise measurement, so the final answer is 22,190.16.

How can ambiguous expressions like 19.10.94.80.6 be clarified for proper calculation?

They should be clarified by using proper notation, such as separating numbers with plus signs or commas, to ensure accurate interpretation and calculation.

Additional Resources

Give The Answer With The Correct Error And Number Of Significant Digits A) $12.480.07 + 9.710.09 = ?$ B) $19.10.94.80.6 = ?$

Investigating Significant Figures and Error Propagation in Complex Arithmetic Problems

In scientific and engineering calculations, the precision of the result is as important as the calculation itself. The concept of significant figures (sig figs) and error analysis are fundamental to ensuring that reported results accurately reflect the certainty of the measurements involved. This article delves into two challenging problems involving multiple numbers and the correct application of significant figures and error propagation principles:

- Problem A: $12.480.07 + 9.710.09 = ?$

- Problem B: $19.10.94.80.6 = ?$

We will analyze each problem step-by-step, interpret their structure, clarify

the notation, and demonstrate the correct approach to computing the results with appropriate significant digits and error considerations.

Understanding the Context and Notation

Clarifying the Numerical Inputs

At first glance, the given problems appear ambiguous due to their notation:

- Problem A: ``12.480.07 + 9.710.09``
- Problem B: ``19.10.94.80.6``

In standard decimal notation, numbers are written with a single decimal point. The presence of multiple decimal points suggests potential typographical errors or unconventional formatting. To proceed meaningfully, we must interpret these expressions.

Possible Interpretations

1. Typographical Error: Perhaps the input contains misplaced decimal points, and the intended numbers are:

- For Problem A: ``12,480.07 + 9,710.09``
- For Problem B: ``19,10,94,80,6`` – which appears inconsistent, perhaps intended as a sequence of numbers.

2. Concatenation of Numbers: Maybe the dots are separators or decimal points, and the expression is meant to be:

- Problem A: ``12.480 + 0.07 + 9.710 + 0.09`` (though unlikely)

3. Alternative Format: Possibly the numbers are separated by dots to denote groups or placeholders.

Given that, the most logical interpretation—consistent with standard scientific notation—is:

- Problem A: ``12480.07 + 9710.09``
- Problem B: ``19, 10, 94, 80, 6`` (which is unlikely to be a sum but perhaps a sequence of numbers)

Given the context, the most plausible assumption is:

- Problem A: The sum of 12,480.07 and 9,710.09
- Problem B: The sequence 19.10, 94.80, 6 or perhaps $19.10 + 94.80 + 6$

For clarity, and considering typical significant figure exercises, I will assume:

Final Assumption for Problems

- Problem A: $12480.07 + 9710.09$
- Problem B: Sum of 19.10, 94.80, and 6

Fundamental Principles of Significant Figures and Error Propagation

Before we perform calculations, it's essential to understand the core rules governing significant figures and error handling.

Significant Figures Rules

1. Non-zero digits are always significant.
2. Leading zeros are not significant; they merely locate the decimal point.
3. Captive zeros (zeros between non-zero digits) are significant.
4. Trailing zeros in a number with a decimal point are significant; in numbers without a decimal, they are ambiguous unless specified.
5. In addition/subtraction, the result should be rounded to the least precise decimal place among the numbers.
6. In multiplication/division, the result should have the same number of significant figures as the factor with the fewest sig figs.

Error Propagation in Addition and Subtraction

- The absolute error in the sum/difference is the sum of the absolute errors of the individual terms.
- When errors are unknown, the focus is on decimal places.

Practical Approach

- When combining numbers, identify the least precise decimal place among the inputs.
- For multiplication/division, identify the input with the fewest significant figures.

Problem A: Calculation and Error Analysis

Given:

- 12,480.07
- 9,710.09

Step 1: Determine the precision of each number

- 12,480.07: 8 significant figures (digits: 1, 2, 4, 8, 0, 0, 7)
- 9,710.09: 6 significant figures

Step 2: Perform the addition

Sum:

$$12480.07 + 9710.09 = 22190.16$$

Step 3: Apply significant figures rules

- Since the addition involves decimal numbers, the result should be rounded to the least precise decimal place among the addends.
- 12,480.07 has precision up to two decimal places (hundredths).
- 9,710.09 also has precision up to two decimal places.
- Therefore, the sum should be rounded to two decimal places.

Result: 22190.16

Step 4: Error estimation

- The absolute errors are often unknown unless specified, but assuming measurement errors are negligible or similar, the result can be reported with the same decimal precision.

Final answer for Problem A:

22190.16 with an understanding of the precision based on decimal places.

Problem B: Calculation and Error Analysis

Given:

- 19.10
- 94.80

- 6

Step 1: Determine the significant figures

- 19.10: 4 sig figs

- 94.80: 4 sig figs

- 6: 1 sig fig (assuming no decimal point, but if written as 6.0, then 2 sig figs)

Assuming the number is 6 with 1 significant figure.

Step 2: Sum the numbers

Sum:

$$19.10 + 94.80 + 6 = 119.90$$

Step 3: Apply significant figures rules

- The least precise measurement in terms of significant figures is 6 (1 sig fig).

- Therefore, the sum should be rounded to 1 significant figure.

- 119.90 rounded to 1 sig fig is 100.

Step 4: Error estimation

- With only 1 significant figure, the value is approximate, and the error margin is large.

Final answer for Problem B:

Approximately 100 (or 1×10^2), reflecting the least precise measurement.

Additional Considerations: Addressing the Ambiguity in Notation

The above assumptions are based on logical interpretation. However, if the original notation intended different values, or if the problem involved more complex error analysis, the calculations would need adjusting.

For example, if the numbers were intended to be:

- 12.480.07: possibly 12480.07

- 19.10.94.80.6: perhaps $19.10 + 94.80 + 6$

In either case, the core principles remain the same.

Summary of Key Takeaways

- Always clarify the notation and structure of the numbers involved before performing calculations.
- Use the rules of significant figures to determine the proper rounding of results, especially in addition and subtraction.
- When combining multiple measurements, identify the least precise measurement to determine the final significant figures.
- For multiple inputs with different significant figures, the result should reflect the lowest level of precision.
- Error propagation principles ensure that uncertainties are properly considered, especially in scientific reporting.

Final Remarks

Proper handling of significant figures and error estimation enhances the reliability and credibility of scientific calculations. Whether dealing with straightforward sums or complex sequences, adhering to these fundamental principles ensures that reported results accurately convey the measurement's precision. The interpretations made here serve as a guide, but always verify the notation and context of the data to apply the most appropriate analysis.

Note: For precise and context-specific calculations, always refer to the original data and measurement uncertainties.

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