Adding and Subtracting with Significant Figures

Grade 10 – 11 science · calculations

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A different rule entirely

Addition and subtraction do not use significant figures. They use **decimal places**, and the answer is rounded to the fewest decimal places of any number going in.

The reason shows up when the numbers are written in a column with their decimal points lined up. If one measurement stops at the first decimal place, nothing is known about the second decimal place of the total, however many digits the other measurements have. The answer has to stop where the shortest column stops.

This leads to a result that looks wrong and is not: subtracting two close numbers destroys significant figures. 100.0 − 99.8 = 0.2 turns four figures into one. The digits the two numbers agreed on have cancelled, and no rule can bring them back.

The rules

- Addition and subtraction are governed by **decimal places**, not by significant figures.
- The answer is rounded to the **fewest decimal places** of any input.
- Write the numbers in a column with the **decimal points aligned** and the rule becomes visible.
- For whole numbers, the answer stops at the **coarsest place**: 1200 + 15 is 1200 if the 1200 is only good to the hundreds.
- Subtracting close numbers **destroys** figures. It is not a mistake when it happens.
- In a **mixed** calculation, do each operation by its own rule and round once at the end.

Part A — Add and subtract say which value set the limit (20 marks)

Calculate	Which value limits it?	Answer
128.1 + 1.72 + 0.457		
12.11 + 18.0 + 1.013		
2.5 − 0.896		
100.0 − 99.8		
45.678 + 2.1		

0.0045 + 0.123		
1250 + 3.7		
6.08 + 12.1 − 0.904		
88.0 − 87.95		
0.000470 + 0.00012		

Part B — Mixed operations each rule in turn, round once (4 marks)

1. 12.13 + 1.72 × 3.4

2. (4.52 − 1.3) × 2.00

Part C — Explain (2 marks)

1. A student adds 128.1 and 1.72 and writes 130, explaining that 128.1 has four significant figures and 1.72 has three, so the answer gets three. Explain the mistake and give the correct answer.

2. A balance gives 100.0 g for a beaker and 99.8 g for the same beaker after some liquid evaporates. Find the mass lost and explain why the answer looks so imprecise.

Adding and Subtracting with Significant Figures — Answer Key

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Part A — Add and subtract

1. 128.1 + 1.72 + 0.457 = **130.3**
   128.1 has only 1 d.p.
2. 12.11 + 18.0 + 1.013 = **31.1**
   18.0 has only 1 d.p.
3. 2.5 − 0.896 = **1.6**
   2.5 has only 1 d.p.
4. 100.0 − 99.8 = **0.2**
   both have 1 d.p.; only one figure survives
5. 45.678 + 2.1 = **47.8**
   2.1 has only 1 d.p.
6. 0.0045 + 0.123 = **0.128**
   0.123 has 3 d.p.
7. 1250 + 3.7 = **1250**
   the 1250 is good only to the tens
8. 6.08 + 12.1 − 0.904 = **17.3**
   12.1 has only 1 d.p.
9. 88.0 − 87.95 = **0.1**
   88.0 has 1 d.p.
10. 0.000470 + 0.00012 = **0.00059**
    0.00012 has 5 d.p.

Part B — Mixed operations

1. 12.13 + 1.72 × 3.4 = **18.0**
   Multiply first: 1.72 × 3.4 = 5.848, limited to 2 s.f., so it is good to the first decimal place. 12.13 + 5.848 = 17.978, rounded to 1 d.p. gives 18.0.
2. (4.52 − 1.3) × 2.00 = **6.4**
   4.52 − 1.3 = 3.22, but 1.3 has 1 d.p., so that is 3.2 with 2 s.f. 3.2 × 2.00 = 6.44, limited to 2 s.f., giving 6.4.

Part C — Explain

1. **They used the multiplication rule on a sum.**
   Addition is governed by decimal places. 128.1 is given to one decimal place and 1.72 to two, so the answer is rounded to one decimal place: 129.8. Counting significant figures here is the wrong question.
2. **0.2 g, with only one significant figure.**
   Both readings are good to one decimal place, so the difference is too. The two numbers agree in their first three digits and those digits cancel, leaving one. Nothing has gone wrong: this is why lab methods avoid measuring a small difference between two large readings, and why a mass loss is better measured directly where possible.