Chemistry: *Significant Digits*

In an attempt to get away from the mathematical burden of uncertainties, scientists have gone to the use of established rules for significant digits that have greatly simplified calculations. These rules are:

1. Significant numbers are always measurements and thus should always be accompanied by the measurement's unit. For simplicity, units are not included in the following examples.

2. Any numbers (that are measurements) other than zero are significant. (Many times the zeros are also significant as you will see below.) Thus **123.45** contains five significant digits.

3. Any zeros between numbers are significant, thus **1002.05** contains six significant digits.

4. Unless told differently, all zeros to the left of an understood decimal point (a decimal that is not printed) but to the right of the last number are not significant. The number **921000** contains three significant digits.

5. Any zeros to the left of a number but to the right of a decimal point are not significant. **921000.** has six significant digits.

6. These zeros are present merely to indicate the presence of a decimal point (they are used as place holders), (these zeros are not part of the measurement). The number **0.00123** has three significant digits. The reason that these zeros are not significant is that the measurement **0.00123 grams** is equal in magnitude to the measurement **1.23 milligrams**. **1.23** has three significant digits, thus **0.0123** must also have three significant digits.

7. Any zeros to the right of a number and the right of a decimal point are significant. The value **0.012300** and **25.000** both contain five significant digits. The reason for this is that significant figures indicate to what place a measurement is made. Thus the measurement 25.0 grams tells us that the measurement was made to the tenths place. (The accuracy of the scale is to the tenths place.)

Give the number of significant digits in each of the following measurements:

1. 1278.50 _____	**7. 8.002** _____	**13. 43.050** _____
2. 120000 _____	**8. 823.012** _____	**14. 0.147** _____
3. 90027.00 _____	**9. 0.005789** _____	**15. 6271.91** _____
4. 0.0053567 _____	**10. 2.60** _____	**16. 6** _____
5. 670 _____	**11. 542000.** _____	**17. 3.47** _____
6. 0.00730 _____	**12. 2653008.0** _____	**18. 387465** _____

Round off the following numbers to three significant digits:

19. 120000 _____	**22. 4.53619** _____
20. 5.457 _____	**23. 43.659** _____
21. 0.0008769 _____	**24. 876493** _____

Chemistry: *Significant Digits (continued)*

Significant figures in derived quantities (Calculations)
In all calculations, the answer must be governed by the least significant figure employed.

ADDITION AND SUBTRACTION: The answer should be rounded off so as to contain the same number of decimal places as the number with the *least number of decimal places*. In other words, *an answer can be only as accurate as the number with the least accuracy*.
Thus: **11.31 + 33.264 + 4.1 = 48.674 Rounded off to 48.7**

MULTIPLICATION AND DIVISION: The answer should be rounded off to contain the same number of digits as found in the **LEAST** accurate of the values.
Thus: **5.282 x 3.42 = 18.06444 Rounded off to 18.1**

Perform the following operations giving the proper number of significant figures in the answer:

25. 23.4 x 14 _____

26. 7.895 + 3.4 _____

27. 0.0945 x 1.47 _____

28. 0.005 - 0.0007 _____

29. 7.895 / 34 _____

30. 0.2 / 0.0005 _____

31. 350.0 - 200 _____

32. 27.68 - 14.369 _____

33. 3.08 x 5.2 _____

34. 0.0036 x 0.02 _____

35. 4.35 x 2.74 x 3.008 _____

36. 35.7 x 0.78 x 2.3 _____

37. 3.76 / 1.62 _____

38. 0.075 / 0.030 _____

39. 65 000(0.08 x 200 x 0.004) / (800 x 300) _____

40. [(11.34 − 9.63) / 11.34] × 100.00 _____

41. [(2.0265 − 2.02) / 2.0265] × 100.00 _____

Answers to Significant Digit Worksheet:

Give the number of significant digits in each of the following measurements:

1.	**1 278.50**	**6**	7.	**8.002**	**4**	13.	**43.050**	**5**
2.	**12**0 000	**2**	8.	**823.012**	**6**	14.	0.**147**	**3**
3.	**90 027.00**	**7**	9.	0.00**5789**	**4**	15.	**6271.91**	**6**
4.	0.00**53567**	**5**	10.	**2.60**	**3**	16.	**6**	**1**
5.	**67**0	**2**	11.	**542 000.**	**6**	17.	**3.47**	**3**
6.	0.00**730**	**3**	12.	**2 653 008.0**	**8**	18.	**387 465**	**6**

Round off the following numbers to three significant digits:

19. 120 000 = **1.20×10^5**
20. 5.457 = **5.46**
21. 0.0008769 = **0.000877** or **8.77×10^{-4}**
22. 4.53619 = **4.54**
23. 43.659 = **43.7**
24. 876 493 = **876 000** or **8.76×10^5**

Perform the following operations giving the proper number of significant figures in the answer.

25. 23.4 x 14 — 327.6 = **330** or **3.3×10^2**
26. 7.895 + 3.4 — 11.295 = **11.3**
27. 0.0945 x 1.47 — 0.138 915 = **0.139**
28. 0.005 - 0.0007 — 0.0043 = **0.004**
29. 7.895 / 34 — 0.232 205 882 = **0.23**
30. 0.2 / 0.0005 — 400 = **400**
31. 350.0 - 200 — 150 = **200**
32. 27.68 - 14.369 — 13.311 = **13.31**
33. 3.08 x 5.2 — 16.016 = **16**
34. 0.0036 x 0.02 — 0.000072 = **0.00007**
35. 4.35 x 2.74 x 3.008 — 35.852352 = **35.9**
36. 35.7 x 0.78 x 2.3 — 64.0458 = **64**
37. 3.76 / 1.62 — 2.320987654 = **2.32**
38. 0.075 / 0.030 — 2.5 = **2.5**
39. 65 000(0.08 x 200 x 0.004) / (800 x 300) — 0.01666666667 = **0.02**
40. [(11.34 − 9.63) / 11.34] × 100.00 — 15.079365079 = **15.1**
41. [(2.0265 − 2.02) / 2.0265] × 100.00 — 0.3207500617 = **0.5**

Converting between two sets of units never changes the number of significant figures in a measurement. Remember, data are only as good as the original measurement, and no later manipulations can clean them up.