Chemistry H

Exercise 2.3a(H)

Significant Figures/Digits (Sig Figs) – Answers

Name: _____

Date: _____ Per: _____

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 digits 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) Digits other than zero are always significant – thus **123.45** contains five significant digits.
3) Zeros between non-zero digits are always significant – thus **1002.05** contains six significant digits.
4) Leading zeros (zeros to the left of the first non-zero) are never significant. These zeros are place holders to put digits in the right decimal places – thus **0.00123** has three significant digits (e.g., **0.00123 grams** = **1.23 milligrams** ; since **1.23** has three significant digits, **0.00123** must also have three significant digits).
5) Trailing zeros (zeros following the last non-zero) are significant when the measurement contains a decimal point – thus **921000** contains three significant digits, **921000.** has six significant digits, and **0.012300** and **25.000** both contain five significant digits. These zeros indicate to what decimal place the measurement was made.

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

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

DIRECTIONS: Round off the following numbers to three significant digits.

19. 1225000 --	1220000	21. 0.0008769 --	0.000877	23. 43.659 --	43.7
20. 5.457 --	5.46	22. 4.53619 --	4.54	24. 876493 --	876000

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 measurement with the **FEWEST** significant digits.

Thus: **5.282 x 3.42 = 18.06444** **Rounded off to 18.1**

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

25. 23.4 x 14	=	(327.6) 330	30. 0.2 ÷ 0.0005	=	400
26. 7.895 + 3.4	=	(11.295) 11.3	31. $3.5 \times 10^{3} \div 2.75$	=	(1272.72..) 1300
27. 0.0945 x 1.47	=	(0.138915) 0.139	32. $8.25 \times 10^{12} \times 2.11 \times 10^{-17}$	=	($1.740..\times 10^{-4}$) 1.74×10^{-4}
28. 0.005 - 0.0007	=	(0.0043) 0.004	33. 67.89 x 23.6 / 42.8	=	(37.4346..) 37.4
29. 7.895 / 34	=	(0.232205..) 0.23	34. 0.0012 + 1.3 + 0.0184	=	(1.3196) 1.3

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Significant Figures in Multi-Step Calculations

Multi-step calculations that involve different types of operations require tracking of significant digits from one step to another until the final answer is derived. The normal order of operations should be used.

- At each step, consider the appropriate rounding position for that type of operation.
- Underline the rounding position and keep one additional unrounded decimal place. *Do NOT round after each step.*
- Round at the end according to the final operation and the underlined uncertain digits.

Example: Solve the following for x: x = ((9.751 + 0.0136)/49.2) – (0.004739)

x = (9.7646/49.2) – (0.004739) *Addition: Round to least precise decimal place.*

x = (0.1984) – (0.004739) *Division: Round to match fewest sig figs.*

x = 0.1936 *Subtraction: Round to least precise decimal place.*

x = 0.194 *Final answer.*

DIRECTIONS: Perform the following operations giving the proper number of significant figures in the answer. Write the final answer in the box.

35. (4×972) + (76.4 × 29.3) – (12 × 7)

PEMDAS requires the multiplication steps to be completed first. Rounding positions are underlined based on multiplication/division rule.

3888 + 2238.52 – 84

Keeping one extra digit beyond the rounding position, the addition step is completed. The final answer is rounded based on addition/subtraction rule.

3800 + 2238 – 84 = 5954 ⇒ 6000

6000

36. (8.71 × 0.0301)/0.056

Because all operations are multiplication/division, the calculation can be completed without tracking rounding positions at each step.

(8.71 × 0.0301)/0.056 = 4.68

4.7

37. $\dfrac{9.5 + 4.1 + 2.8 + 3.175}{4}$

(average ∴ 4 is exact number)

Addition/subtraction rule determines rounding position of numerator.

$\dfrac{19.575}{4} \Rightarrow \dfrac{19.57}{4} = 4.8925$

Keeping one extra digit beyond the rounding position, the division step is completed. Because 4 is a count of items, it has infinite significance and final rounding is based on sig figs in numerator.

4.89

38. $\dfrac{8.925 - 8.905}{8.925} \times 100$

(% error ∴ 100 is exact number)

Addition/subtraction rule determines rounding position of numerator.

$\dfrac{0.020}{8.925} \times 100$ 0.002240 x 100 = 0.224%

The numerator should be rounded to the 1000ths place. In the division step, the numerator determines the sig figs in the quotient. Because 100 is par to the % representation, it has infinite significance and final rounding is based on sig figs in numerator.

0.22%