



MATH for SCIENCE

Significant Digits ~ Lesson Plan

- I. Topic: Significant Digits ~
- II. Goals/Objectives:
 - A. Students will understand how to use a measuring instrument to the limit of its precision.
 - B. Students will know which digit in a measured value is the most certain.
 - C. Students will know which digit in a measured value is the uncertain value.
 - D. Students will understand which zeros are significant and which are not significant in a measured number.
 - E. Students will know how to perform mathematical operations and end with correct number of significant digits.
- III. National Education Standards:
 - A. Mathematics.
 1. NM-NUM.9-12.2
Understand meanings of operations & how they relate to one another.
 2. NM-ALG.9-12.3
Use mathematic models to represent and understand quantitative relationships.
 3. NM-MEA.9-12.1
Understand measurable attributes of objects and the units, systems, and processes of measurement.
 4. NM-PROB.PK-12.1
Build new math knowledge through problem solving.
 5. NM-PROB.PK-12.2
Solve problems that arise in mathematics and in other contexts.
 6. NM-PROB.REA.PK-12.4
Select and use various types of reasoning and methods of proof.
 7. NM-PROB.COMM.PK-12.2
Communicate their math thinking coherently and clearly to peers, teachers, and others.
 8. NM-PROB.CONN.PK-12.1
Recognize and use connections among math ideas.
 - B. Science
 1. Standard 12: Level III – Benchmarks 6,8
Level IV – Benchmark 4
- IV. Materials:
 - A. Blackboard with colored chalk or whiteboard with colored markers.
 - B. Overhead projector.
 - C. Clear projection sheets to make overhead sheets of the “Presentation Notes.”
 - D. “Student Notes” copied for each student.
 - E. Pencils, colored pencils, & calculators.
 - F. Significant Digits Worksheet.



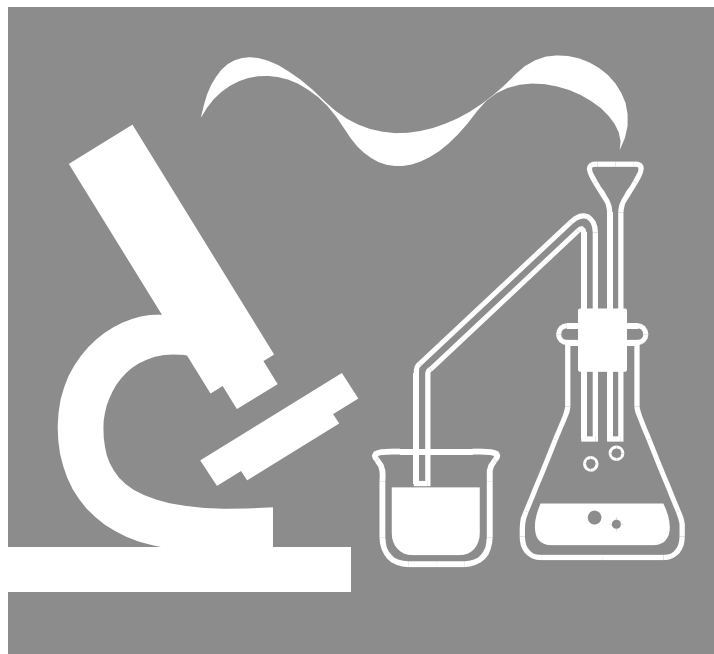
- V. Presentation Outline:
 - A. Introduction.
 - B. Rules for determining the number of Significant Digits.
 - C. Multiplication and Division
 - 1. Rules and practices.
 - 2. Examples.
 - D. Addition and Subtraction
 - 1. Rules and practices.
 - 2. Examples.

- VI. Presentation:
 - A. Use the presentation notes on an overhead projector, or
 - B. Use the power point presentation.

- VII. Significant Digits Presentation: Student Notes ~
Students are to fill in the blank spaces in their notes during the presentation.

- VIII. Independent Practice: Significant Digits Worksheet ~
 - A. Homework: #s 1 – 40.
 - B. Due next day.

- IX. Evaluation/Assessment: Significant Digits Quiz ~
Have students take this the next day after going over any questions about the homework.





MATH for SCIENCE Significant Digits

I. Introduction ~

A. In science different instruments are used to take measurements. There are different scales that can be used to find the mass of an object. For example, a table scale accurate to milligrams may be used for small objects, but a floor scale accurate to just grams may be used for a large object. A micrometer may be used to find the length of a microscopic object, but a kilometer may be used for measuring a road. Thus, the **calibration** of each measuring **instrument** determines the **units** that can be measured accurately.

When taking measurements, the **number of digits** recorded depends on the **precision** of the instrument.

1. The **last** digit is always an estimate and therefore is called the **uncertain or estimated digit**.
2. The digits that **precede** the last digit are considered the **exact or certain digits**.
3. The certain/exact digits and the one uncertain/estimated digit are called the **significant digits**.

Rules for Determining the Number of Significant Digits

Type of Number	# of Digits to Count	Examples	# of Significant Digits
1. Nonzero digits	All nonzero digits	12,345	5 sig. dig.
2. Zeros before nonzero digits (Leading Zeros)	None of the leading zeros	0.00678 0.000089	3 sig. dig. 2 sig. dig.
3. Zeros between two nonzero digits (Captured Zeros)	All of the trapped zeros, plus the nonzero digits	36.0002 14003	6 sig. dig. 5 sig. dig.
4. Zeros following last nonzero digits (Trailing Zeros)	Trailing zeros are counted only if there is a decimal point	700 4000. 0.0200	1 sig. dig. 4 sig. dig. 3 sig. dig.
5. Scientific Notation	All of the digits	5.3×10^4 4.60×10^{-3}	2 sig. dig. 3 sig. dig.

B. When doing **multiplication and division** calculations with measured numbers:

1. The **number of digits** recorded for the answer must **not** indicate more **precision** than the tool/instrument being used is capable of measuring.
2. Also, the result can **not** have **more** significant digits than the measurement with the **fewest** significant digits.
3. For example:
 - a. The length, width and height of a box are each measured to a tenth of a centimeter, $l = 12.3$ cm, $w = 8.7$ cm, $h = 4.8$ cm;
 - b. When these numbers are multiplied together the result is **513.648 cm³**. This would indicate that the instruments were capable of measuring to a **thousandth** of a centimeter.
 - c. To accurately reflect the instrument's level of precision, the answer must





not go past the **tenths place**.

- d. Since two of the numbers have only two significant digits, the answer must have only **two non-zero digits** – 510 cm^3 .

C. Examples:

1. 12.53 m (**4** Sig. dig.) \times 3.7 m (**2** sig. dig.) = 46.361 m^2
This number must be rounded to **2** sig. dig. = 46 m^2

2. 7.19 g (**3** sig. dig.) \times 1.3 ml/g (**2** sig. dig.) = 9.347 ml
This number will be rounded to **2** sig. dig. = 9.3 ml

3. 60.517 ml (**5** sig. dig.) \div 5.73 ml (**3** sig. dig.) = 10.561431
This number will be rounded to **3** sig. dig. = 10.6

D. Counting the number of significant digits when **adding and subtracting**.

- The number of significant digits in the answer is **determined** by the measurement with the **fewest** decimal places.
- When doing the calculations, **carry** all the **places** along until the **end** when the **final** answer is determined.

E. Examples:

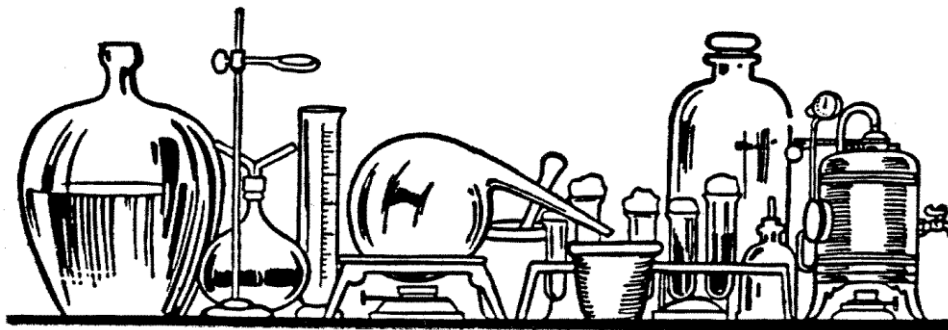
1. $25.341 + 3.68 = 29.021 \rightarrow 29.02$

2. $8.1 + 4.375 = 3.725 \rightarrow 3.7$

3. $348.19674 + 142.256 = 490.45274 \rightarrow 490.453$

Note for Teachers:

The highlighted areas in the “Presentation” are the areas left blank in the “Student Notes.” These highlighted areas act as the grading “key” for the “Student Notes.” It is recommended that each word or numbers the student successfully records on his/her “Notes” sheets be given either one half (0.5) of a point or one point. Giving students points for recording important information encourages them to stay focused during class and helps to ensure that students have complete information to study.



Significant Digits ~ Student Notes





Name: _____ Date: _____ Grade: _____

II. Introduction:

A. In science different instruments are used to take measurements. There are different scales that can be used to find the mass of an object. For example, a table scale accurate to milligrams may be used for small objects, but a floor scale accurate to just grams may be used for a large object. A micrometer may be used to find the length of a microscopic object, but a kilometer may be used for measuring a road. Thus, the _____ of each measuring _____ determines the _____ that can be measured accurately.

When taking measurements, the _____ recorded depends on the _____ of the instrument.

- The _____ digit is always an estimate and therefore is called the _____ **or estimated digit**.
- The digits that _____ the last digit are considered the **exact or _____ digits**.
- The certain/exact digits and the one uncertain/estimated digit are called the _____.

Rules for Determining the Number of Significant Digits

Type of Number	# of Digits to Count	Examples	# of Significant Digits
1. Nonzero digits	All nonzero digits	12,345	5 sig. dig.
2. Zeros before nonzero digits (Leading Zeros)	None of the leading zeros	0.00678 0.000089	3 sig. dig. 2 sig. dig.
3. Zeros between two nonzero digits (Trapped Zeros)	All of the trapped zeros, plus the nonzero digits	36.0002 14003	6 sig. dig. 5 sig. dig.
4. Zeros following last nonzero digits (Trailing Zeros)	Trailing zeros are counted only if there is a decimal point	700 4000. 0.0200	1 sig. dig. 4 sig. dig. 3 sig. dig.
5. Scientific Notation	All of the digits	5.3×10^4 4.60×10^{-3}	2 sig. dig. 3 sig. dig.

B. When doing **multiplication and division** calculations with measured numbers:

- The _____ recorded for the answer must _____ indicate more _____ than the tool/instrument being used is capable of measuring.
- Also, the result can _____ have _____ significant digits than the measurement with the _____ significant digits.
- For example:
 - The length, width and height of a box are each measured to a tenth of a centimeter, $l = 12.3$ cm, $w = 8.7$ cm, $h = 4.8$ cm;
 - When these numbers are multiplied together the result is _____. This would indicate that the instruments were capable of measuring to a _____ of a centimeter.
 - To accurately reflect the instrument's level of precision, the answer must





Name: _____ Date: _____ Grade: _____

A. Determine the number of significant digits for each measurement.

- | | | | | | |
|----|---------|-------|-----|------------|-------|
| 1. | 28,302 | _____ | 6. | 53.0004 | _____ |
| 2. | 0.00635 | _____ | 7. | 0.00070 | _____ |
| 3. | 1.904 | _____ | 8. | 37,800,000 | _____ |
| 4. | 1,200 | _____ | 9. | 8,500. | _____ |
| 5. | 875.0 | _____ | 10. | 49.17 | _____ |

B. For the following problems: a. List the number of significant digits for each number.
b. Do the calculations.
c. Give the answer in the correct number of significant digits.

- | | | | | | |
|-----|------------------------|-----|------------------------|-----|-----------------------|
| 11. | (247.3)(1.23) | 12. | (15)(20.4)(0.66) | 13. | (70)(13.2) |
| 14. | (50.0)(0.0041) | 15. | (33.01)(800) | | |
| 16. | $\frac{30,000}{125.0}$ | 17. | $\frac{9,400.2}{6.33}$ | 18. | $\frac{5.079}{0.015}$ |
| 19. | $\frac{82.16}{9.2}$ | 20. | $\frac{0.0734}{68.03}$ | | |

C. Add or subtract the following problems. Do not round off to the correct number of significant digits until the end.

- | | | | |
|-----|------------------------------------------|-----|---------------------------------|
| 21. | $301.410 + 127.6705 + 48.931 + 1,006.80$ | 22. | $1,374 + 682.15 + 2,900.0$ |
| 23. | $6.013 + 2.04 + 5.628 + 3.0$ | 24. | $841.3 + 96.45 + 610 + 357.075$ |
| 25. | $1,680 + 3,145 + 2,900$ | 26. | $2,376.25 - 1,481.1$ |
| 27. | $24.0184 - 20.08$ | 28. | $4.05 - 2.374$ |
| 29. | $0.575 - 0.3042$ | 30. | $20,362.6 - 16,873.243$ |

D. When doing the following problems: a. Identify the number of significant digits for each number.
b. Do the indicated calculations.
c. Give the answer in the appropriate number of significant digits.

- | | | | |
|-----|--------------------------------------------------------------------|-----|-----------------------------------------------------------------|
| 31. | $3.26 \text{ cm} \times 1.4 \text{ cm}$ | 32. | $483.21 \text{ g} - 13.9 \text{ g}$ |
| 33. | $180.4 \text{ ml} + 72.364 \text{ ml} + 100.09 \text{ ml}$ | 34. | $56.7 \text{ m} \times 13.90 \text{ m} \times 20.1 \text{ m}$ |
| 35. | $\frac{278 \text{ km}}{3.4 \text{ hrs}}$ | 36. | $\frac{619.45 \text{ kg}}{35.5 \text{ m}}$ |
| 37. | $0.0047 \text{ cm} \times 20.07 \text{ cm} \times 40.0 \text{ cm}$ | 38. | $0.0890 \text{ m} \times 300.0 \text{ m} \times 4.35 \text{ m}$ |
| 39. | $\frac{9396.3 \text{ m}}{123.0 \text{ sec}}$ | 40. | $50.06 \text{ mg} + 600.0 \text{ mg} + 2200 \text{ mg}$ |

Significant Digits Worksheet





Answer Key

- A.
- | | | | |
|---------|---------|---------|----------|
| 1. 5 sd | 4. 2 sd | 7. 2 sd | 9. 4 sd |
| 2. 3 sd | 5. 4 sd | 8. 3 sd | 10. 4 sd |
| 3. 4 sd | 6. 6 sd | | |

B.

	Given #s	# Significant Digits	Answer
11.	247.3	4	304
	1.23	3	
12.	15	2	200
	20.4	3	
	0.66	2	
13.	70	1	900
	13.2	3	
14.	50.0	3	0.21
	0.0041	2	
15.	33.01	4	30,000
	800	1	
16.	30,000	1	200
	125.0	4	
17.	9,400.2	5	1490
	6.33	3	
18.	5.079	4	340
	0.015	2	
19.	82.16	4	8.9
	9.2	2	
20.	0.0734	3	0.00108
	68.03		

- C.
- | | | | |
|-------------|------------|----------|-------------|
| 21. 1,484.8 | 24. 1,305. | 27. 3.94 | 29. 0.271 |
| 22. 4,956 | 25. 7,700 | 28. 1.68 | 30. 3,489.4 |
| 23. 16.7 | 26. 895.2 | | |

D.

	Given #s	# Significant Digits	Answer
31.	3.26	3	4.5 cm ²
	1.4	2	
32.	483.21	5	469. g
	13.9	3	
33.	180.4	4	352.9 ml
	72.364	5	
	100.09	5	



D.	Given #s	# Significant Digits	Answer
34.	56.7	3	15,800 m ³
	13.90	4	
	20.1	3	
35.	278	3	82 kg/hr
	3.4	2	
36.	619.45	5	17.4 kg/m
	35.5	3	
37.	0.0047	2	3.8 cm ³
	20.07	4	
	40.0	3	
38.	0.0890	3	116 m ³
	300.0	4	
	4.35	3	
39.	9396.3	5	76.39 m/sec
	123.0	4	
40.	50.06	4	2900 mg
	600.0	4	
	2200	2	

Worksheet Grading Rubric: 105/100 Points

Problems	Correct # Significant Digits (1 pt each) (5 pts Possible)		Problems	Correct # Significant Digits (1 pt each) (10 pts Possible)
A 1.			6.	
2.			7.	
3.			8.	
4.			9.	
5.			10.	

Problems	Correct # of Significant Digits (1 pt each)	Correct Calculations (1 pt each)	Answer with Correct # of Significant Digits (1 pt each)	Total Points (3 pts each) (30 pts Possible)
B 11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				



Problems	Correct Calculations (2 pts each)	Correct # Significant Digits (1 pt each)	Total Points (3 pts each) (30 pts Possible)
C 21.			
22.			
23.			
24.			
25.			
26.			
27.			
28.			
29.			
30.			

Problems	Correct # of Significant Digits (1 pt each)	Correct Calculations (1 pt each)	Answer with Correct # of Significant Digits (1 pt each)	Total Points (3 pts each) (30 pts Possible)
D 31.				
32.				
33.				
34.				
35.				
36.				
37.				
38.				
39.				
40.				





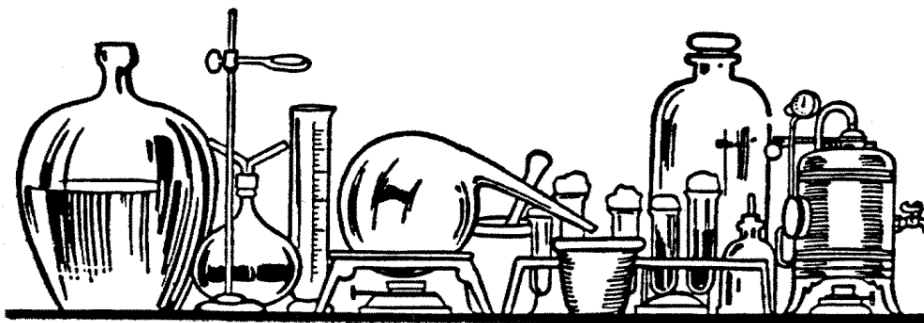
Significant Digits Quiz

Name: _____ Date: _____ Grade: _____

1. _____ Non-zero digits are _____ counted as significant.
A. Always B. Never C. Sometimes
2. _____ Zeros which occur after the last nonzero integer at the end of a number (trailing zeros) are _____ significant.
A. Always B. Never C. Sometimes
3. _____ Zeros that are between two nonzero integers are _____ significant.
A. Always B. Never C. Sometimes
4. _____ Zeros at the beginning of a number or before a nonzero integer are _____ significant.
A. Always B. Never C. Sometimes

For the following problems, give the number of significant digits (sd) for each number.

5. _____ 3200.04
A. 3 sd B. 2 sd C. 5 sd D. 6 sd
6. _____ 781.56
A. 3 sd B. 5 sd C. 1 sd D. 6 sd
7. _____ 0.00081
A. 2 sd B. 3 sd C. 4 sd D. 6 sd
8. _____ 1,700
A. 1 sd B. 2 sd C. 3 sd D. 4 sd
9. _____ 2.480
A. 1 sd B. 2 sd C. 3 sd D. 4 sd
10. _____ 6.735×10^3
A. 7 sd B. 3 sd C. 4 sd D. 0 sd





Significant Digits Quiz Answer Key

Name: _____ Date: _____ Grade: _____

1. A Nonzero digits are _____ counted as significant.
 A. Always B. Never C. Sometimes
2. C Zeros which occur after the last nonzero integer at the end of a number (trailing zeros) are _____ significant.
 A. Always B. Never C. Sometimes
3. A Zeros that are between two nonzero integers are _____ significant.
 A. Always B. Never C. Sometimes
4. B Zeros at the beginning of a number or before a nonzero integer are _____ significant.
 A. Always B. Never C. Sometimes

For the following problems, give the number of significant digits (sd) for each number.

5. D 3200.04
 A. 3 sd B. 2 sd C. 5 sd D. 6 sd
6. B 781.56
 A. 3 sd B. 5 sd C. 1 sd D. 6 sd
7. A 0.00081
 A. 2 sd B. 3 sd C. 4 sd D. 6 sd
8. B 1,700
 A. 1 sd B. 2 sd C. 3 sd D. 4 sd
9. D 2.480
 A. 1 sd B. 2 sd C. 3 sd D. 4 sd
10. C 6.735×10^3
 A. 7 sd B. 3 sd C. 4 sd D. 0 sd

Quiz Grading Rubric: 10/10 Points

Problems	Correct # Significant Digits (1 pt each)	Problems	Correct # Significant Digits (1 pt each) (10 pts Possible)
1.		6.	
2.		7.	
3.		8.	
4.		9.	
5.		10.	



