PHYSICS 2204
UNIT 1: KINEMATICS
WORKSHEET #3: SIGNIFICANT DIGITS

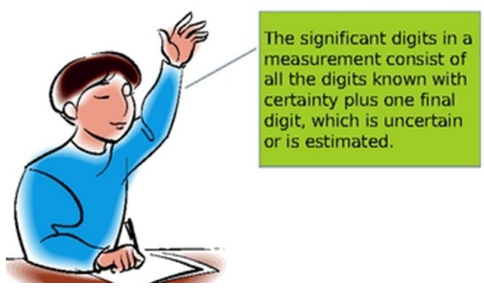
STUDENT NAME:_____

Accuracy refers to the closeness of measurements to is how close a measured value is to the actual (true) value.

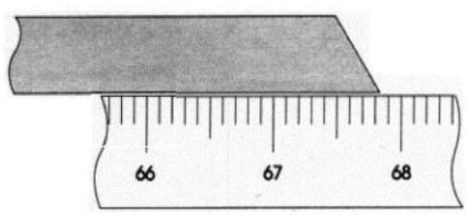
Precision is how close the measured values are to each other.

Significant Digits (Significant figures) are digits that are statistically significant. You can only be as precise, as your least precise instrument of measurement.

- An indication of the certainty of a measurement
- The number of certain digits plus one estimated (uncertain) digit in a measurement
- The greater the number of significant digits the greater the certainty of the measurement



How many significant digits can the ruler below measure to?



Four students make the following measurements

Student 1:	67.80 cm
Student 2:	67.81 cm
Student 3:	67.82 cm
Student 4:	67.83 cm

The 6,7,and 8 are definitely significant digits because they are known for certain in the measurement. However, the value for the hundredths place is uncertain. The four students recorded numbers of 0, 1, 2, 3. Although the hundredths place is estimated, it is still considered to be significant. Therefore, this ruler is measuring to four significant digits.

RULES FOR SIGNIFICANT DIGITS:

1. Non-significant digits:

- Zeroes at the beginning of a measured value eg. 0.0012 has 2 significant digits

2. Significant digits:

- All non-zero digits included in a measured value eg. 23.5 g, 0.642 m, 436 m all have 3 significant digits
- Zeroes between non-zero digits eg. 204 g has 3 significant digits
- Zeroes following non-zero digits in values that have a decimal eg. 20.00 g has 4 significant digits.
- Zeroes at the end of a number and to the right of the decimal point are significant eg. 26.00m, 2.000m, 2.010m all have 4 significant digits

Note: Terminal zeroes in a number without an explicit decimal point may or may not be significant. Eg. 400 m.

- It is not certain whether this value has 1,2, or 3 significant digits (it depends on whether the measurement is an approximate value or one that is taken carefully)
- Uncertainty can be removed by using scientific notation ie. 4.00×10^2 m or by including the decimal at the end ie. 400. m

3. Counted or Defined Values = Exact Values

- Exact values have an infinite (unlimited) number of significant digits
- Eg: table 2, p.345

ROUNDING

Often when doing arithmetic on a pocket calculator, the answer is displayed with more significant figures than are really justified.

How do you decide how many digits to keep?

RULES TO BE USED IN ROUNDING

1. If the leftmost digit is 5 or greater, add 1 to the last digit to be kept and drop all other digits farther to the right.

   Ex: Rounding 1.2151 to 3 significant figures gives 1.22

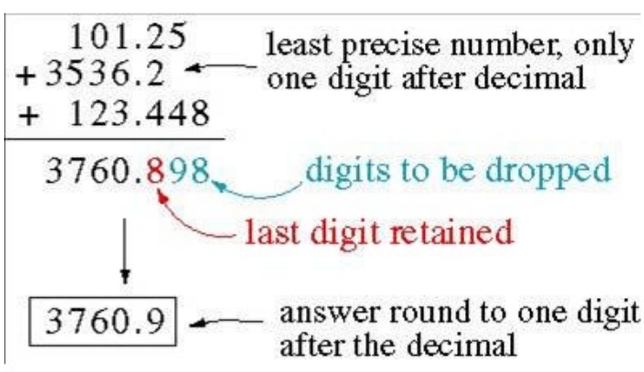
2. If the digit is less than 5, simply drop it and all digits farther to the right.

   Ex: Rounding 1.2143 to 3 significant figures gives 1.21

RULES TO BE USED IN ADDING AND SUBTRACTING

When adding or subtracting significant figures, the answer should have the same number of decimal places as the smallest number of decimal paces in the numbers that were added or subtracted.

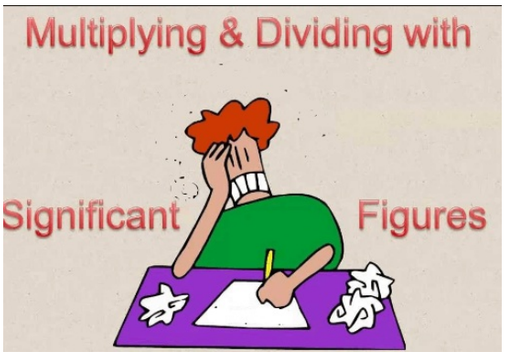
Example:



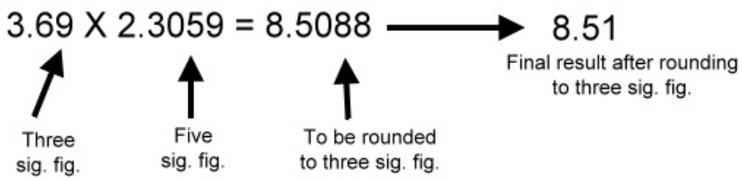
_____ =
20

RULES TO BE USED IN MULTIPLYING AND DIVIDING

When multiplying and dividing significant figures. the answer will contain the same number of digits as in the original number with the least number of digits



Example :



There are at least two reasons for being familiar with scientific notation.

1) Method of writing numbers that are very big and very small. It works like this:

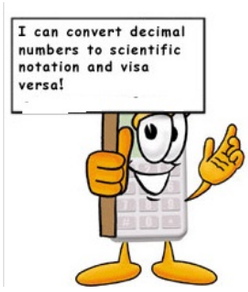
a big number

Speed of light => 300,000,000m/s = 3.0×10^{8} m

a small number

Charge on an electron => 0.00000000000000000001602 C = 1.602×10^{-19} C

2) helpful for indicating how many significant figures are present in a number



100 cm as 1.00×10^{2} (3 sig fig)cm
1.0×10^{2} (2 sig fig)cm
1×10^{2} (1 sig fig)cm.

PART A: MULTIPLE CHOICE

Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided

1. Use the picture below to describe accuracy and precision:

	Accuracy	Precision
(A)	Low	Low
(B)	Low	High
(C)	High	Low
(D)	High	High

2. Which of the following best describes significant digits?

(A) Indicates the precision of a measurement
(B) It is an exact number
(C) Helps with estimation
(D) Used for counting of numbers

3. Which of the following is true for significant digits?

(A) An exact number has a finite (limited) number of significant digits
(B) Counted numbers are significant digits
(C) Numbers 1 to 9 are not significant digits
(D) Zeroes at the beginning of a measured value are not significant digits

4. How many significant digits can the ruler below measure to?

(A) 1
(B) 2
(C) 3
(D) 4

5. How many significant figures are in the measurement 102.400 meters?

(A) 3
(B) 4
(C) 5
(D) 6

6. The measurement, 206 cm, has how many significant (measured) digits?

(A) 1
(B) 2
(C) 3
(D) 4

7. The measurement, 206.0 ºC, has how many significant digits?

(A) 1
(B) 2
(C) 3
(D) 4

8. Which of the following numbers does NOT have 2 significant figures?

(A) 0.000030
(B) 30.
(C) 51.0
(D) 2300

9. How many significant figures are there in 0.0503 grams?

(A) 2
(B) 3
(C) 4
(D) 5

10. How many significant digits are there in 1200 L?

(A) 1
(B) 2
(C) 3
(D) 4

11. How would you round 23.564 cm to three significant digits?

(A) 23.5 cm
(B) 23.50 cm
(C) 23.56 cm
(D) 23.6 cm

12. How would you round 12 567 ml to four significant digits?

(A) 1 256 ml
(B) 1 257 ml
(C) 12 570 ml
(D) 12 570. ml

13. Solve: 3.12 g + 0.8 g + 1.033 g = ?

(A) 5.0 g
(B) 4.953 g
(C) 5 g
(D) 4.9 g

14. When performing the calculation 34.530 g + 12.1 g + 1 222.34 g, the final answer must have:

(A) Three decimal places
(B) Three significant figures
(C) Only one decimal place
(D) Units of g^3

15. Solve: 345.009 g - 23.009 g = ?

(A) 322g
(B) 322.00g
(C) 322.000g
(D) 322 g

16. Solve: 13.004 m + 3.09 m + 112.947 m

(A) 129.0 m
(B) 129.04 m
(C) 129 m
(D) 129.041 m

17. Subtract: 7.987 m - 0.54 m

(A) 7.447 m
(B) 7.4 m
(C) 7.5 m
(D) 7.45 m

18. Solve: 1.23 m x 0.89 m = ?

(A) 1.0947 m^2
(B) 1.0 m^2
(C) 1.09 m^2
(D) 1.1 m^2

19. Solve: 923 g divided by 20 312 cm^3 = ?

(A) 0.04 g/cm^3
(B) 0.0454 g/cm^3
(C) 0.045 g/cm^3
(D) 4.00×10^{-2} g/cm

20. Multiply the following three numbers and report your answer to the correct number of significant figures:

0.020 cm x 50 cm x 11.1 cm = ?

(A) 10 cm^3
(B) 11 cm^3
(C) 11. cm^3
(D) 11.1 cm^3

21. Divide the following three numbers and report your answer to the correct number of significant figures:

0.530 g / 0.1010 mL = ?

(A) 5.2 g/mL
(B) 5.3 g/mL
(C) 5.25 g/mL
(D) 5.248 g/mL

22. How many significant figures should the answer have if we multiply:
5.60 m/s x 3.2 s?

(A) 2
(B) 3
(C) 4
(D) 5

23. Which of the following is equal to 3.26 x 10^4 m?

(A) 0.000326 m
(B) 0.00326 m
(C) 32600m
(D) 326000 m

24. Which of the following is equal to 7.01 x 10^{-3} C?

(A) 0 .00701 C
(B) 0.0701C
(C) 7.01 C
(D) 701 C

25. Which of the following is not correctly expressed in scientific notation?

(A) 27.01 x 10^3s
(B) 4.2 x 10^9s
(C) 3.09 x 10^{-2}s
(D) 6.1 x 10^4s

26. Which of the following is the largest number ?

(A) 3.9 x 10^6 kg
(B) 3.99 x 10^{-7} kg
(C) 3.1 x 10^{10} kg
(D) 4 x 10^6 kg

27. Which of the following is the smallest number?

(A) 1.1 x 10^6 s
(B) 9.6 x 10^{-10}s
(C) 4.2 x 10^3s
(D) 4.9 x 10^{-6}s

28. Mr. Smith construction company was contracted to build a building that ended up having a mass of 7400 kg. How would you express this in scientific notation ?

(A) 7.4×10^2 kg
(B) 74×10^2 kg
(C) 7.4×10^3 kg
(D) 740×10^1 kg

29. A satellite is measured at 205,000 km away from the Earth. How would you express this in scientific notation?

(A) 205×10^3 km
(B) 20.5×10^4 km
(C) 2.05×10^5 km
(D) 2.05×10^4 km

30. How would you express 6.28×10^{-4} m in standard form?

(A) -0.000628 m
(B) -62800 m
(C) 62800 m
(D) 0.000628 m

31. How many significant digits is in 5.98×10^{24} kg?

(A) 3
(B) 4
(C) 5
(D) 6

32. How would you express 213.49 ºC in scientific notation:

(A) 2.1349×10^2 ºC
(B) 0.21349×10^3 ºC
(C) 2.13×10^2 ºC
(D) 2.1349×10^{-2} ºC

33. What is the measurement 101 000 grams in scientific notation?

(A) 1.01×10^5 g
(B) 1.0100×10^{-5} g
(C) 1.01000×10^5 g
(D) 10.1×10^4 g

34. Solve: 123 000 m x 3 234 m = ?

(A) 39800000 m^2
(B) 3.98×10^8 m^2
(C) 3.97×10^{-7} m^2
(D) 398 m^2

PART B: WRITTEN RESPONSE

1. State the # of significant figures in each of the following measurements.

   a) 2300. m _____

   b) 27.00 s _____

   c) 0.00013 km/s _____

   d) 2.4×10^5 km/hr _____

2. Round off each measurement to 3 significant digits and then 2 significant digits.

   a) 64.02 m _____ _____

   b) 7.667 mg _____ _____

   c) 2.568×10^{-3} min _____ _____

   d) 4.007 mm _____ _____

3. Do the following operations and give the answer to the correct number of significant digits and units:

   a) 1.23 m + 3.674 m + 8.2 m _____

   b) 74.372 g - 23.4 g _____

   c) 6.43 m x 0.27 m _____

   d) 0.474s x 2.5s _____

   e) 0.020 ml - 0.005 ml _____

4. Convert each of the following into scientific notation with only 2 significant digits:

a) 3200 cm _____

b) 0.000855s _____

c) 47 045 m _____

d) 4.05 hr _____

e) 25 g _____

f) 0.0305 l _____

g) 0.0082 m/s _____

h) 243 ml _____