SCIENCE 1206 **UNIT 3: MOTION**
WORKSHEET #3: Significant Figures

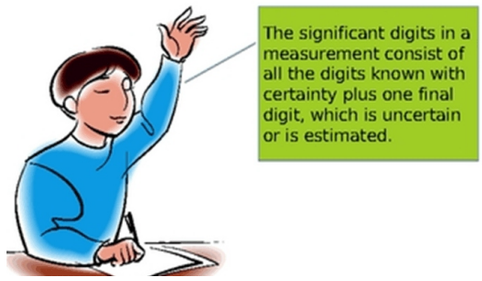
Accuracy refers to the closeness of measurements to is how close a measured value is to the actual (true) value.

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

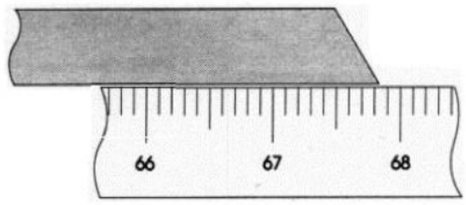
Low Accuracy **High Precision**	**High Accuracy** Low Precision	**High Accuracy High Precision**

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?



_____ =
50

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. Determine what your rounding digit is and look to the right side of it. If the digit is 0, 1, 2, 3, or 4 do not change the rounding digit. All digits that are on the right hand side of the requested rounding digit will become 0.

   Ex: Rounding 1.2151 to 3 significant figures gives 1.22

2. Determine what your rounding digit is and look to the right of it. If the digit is 5, 6, 7, 8, or 9, your rounding digit rounds up by one number. All digits that are on the right hand side of the requested rounding digit will become 0.

   Ex: Rounding 1.2143 to 3 significant figures gives 1.21

PART A: MULTIPLE CHOICE

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) Helps with estimation
(B) Indicates the precision of a measurement
(C) It is an exact number
(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) Numbers 1 to 9 are not significant digits
(C) Counted numbers are 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) One
(B) Two
(C) Three
(D) Four

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

(A) three
(B) four
(C) five
(D) six

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

(A) one
(B) two
(C) three
(D) four

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

(A) one
(B) two
(C) three
(D) four

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

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

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

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

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

PART B: FILL IN THE BLANK

Word List 1: [5]

accuracy	decimal points	estimated	known
precision	quality	reliability	significant figures

When collecting data for an experiment, it is important to note certain qualities of that data. The _____of the data is a measure of how close the results are to an expected or accepted true value. The _____ of the data is how close the results are to each other and is a measure of the repeatability of the results. The precision of an instrument is reported by using ____ _____; these consist of all the digits of a measurement that are ____ _____for certain plus one _____digit.

Word List 2: [4]

are	are not	decimal point	five
non-zero	zero		

To determine the number of significant figures in a measurement, a set of rules is followed. All _____ digits are significant. Zeroes between non-zero digits _____ significant. Leading zeroes before non-zero digits _____ significant. Zeroes that end a measurement are significant only if there is a _____ in the number

PART C : WRITTEN RESPONSE

1. For each of the following questions, write the number of significant figures present in the given number. **[16]**

a)	0.00002340 m	_____	b)	12 000. cm	_____
c)	1.234 g	_____	d)	3.7 mm	_____
e)	10 000 cm	_____	f)	674 000.mol	_____
g)	23.445 J	_____	h)	815 000 000 m	_____
i)	45 000 101 s	_____	j)	0.000 000 010 h	_____
k)	998 min	_____	l)	31 702 561 kg	_____
m)	2.000 km	_____	n)	170 mg	_____
o)	320.00 cm	_____	p)	760. km	_____

2. Round each of the following measurements to the number of significant figures shown in parentheses. **[13]**

a)	53.31 cm	***(2)***_____	b)	0.67856 m	***(3)***_____
c)	18.3kg	***(2)***_____	d)	145.786 m/s	***(4)***_____
e)	13259 ml	***(4)***_____	f)	0.34654 s	***(3)***_____
g)	2676.8756 cm^3	***(3)***_____	h)	5.877 hr	***(4)***_____
i)	678.94 N	***(4)***_____	j)	45.8 km/hr	***(2)***_____
k)	9.147 cm	***(3)***_____	l)	245 786 m/s	***(4)***_____
m)	55.8 s	***(1)***_____	n)	26 753 km/hr	***(2)***_____