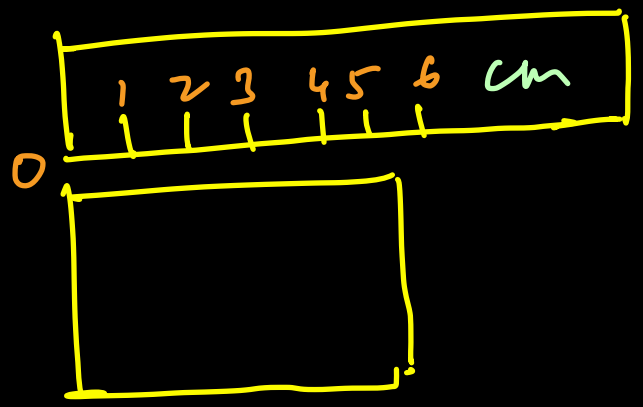
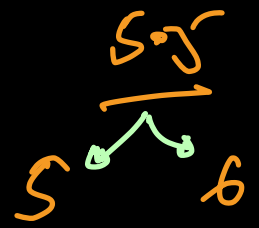
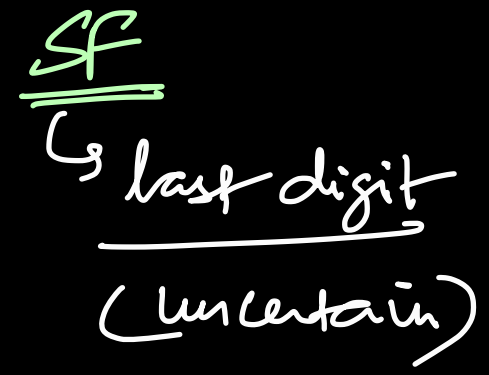
Some Basic Concepts of Chemistry

Uncertainty in Measurement

Many a time in the study of chemistry, one has to deal with experimental data as well as theoretical calculations. There are meaningful ways to handle the numbers conveniently and present the data realistically with certainty to the extent possible.







Rules for determining Significant Figures

① Non zero digits are all significant (SF)

2.3456 — (5SF)

② Zeroes :—

ⓐ Zeroes at the beginning are never SF.

$0.0005 \equiv 5 \times 10^{-4}$

↳ location of decimal point.

(b) Zeroes in between are always SF.

230307 = 6SF

(c) Zeroes at the end are SF only when they are present at the right side of the decimal point.

23.300 (5SF)

0.0230300 (6SF)

230.300 (6SF)

23.000 (5SF)

10 (1SF)

100 (1SF)

10.50 (4 SF)

③ Exact counting of objects does not involve any uncertainity. These have infinite SF.

10 apples

15 Oranges

5 Keys

6 Ants.

#Q. The number of significant figure in 0.0045 are

2 SF

A Two ✓

B Three

C Four

D Five

#Q. The number of significant figure in 5.041 are

4SF

A 1

B 2

C 3

D 4 ✓

#Q. The number of significant figures in the given numbers are respectively given in

(a) 2.305 4SF

(b) 20.00 4SF

(c) 0.0210 3SF

(d) 10000 1

A 4, 4, 4, 5

B 4, 4, 3, 1 ✓

C 3, 1, 2, 1

D 4, 1, 3, 1

#Q. The number of significant figures for the three numbers 161 cm, 0.161 cm, 0.0161 cm are [1998]

A 3, 4 and 5 respectively

B 3, 4 and 4 respectively

C 3, 3 and 4 respectively

D 3, 3 and 3 respectively

#Q. The value of Plank's constant is 6.62618×10^{-34} Js The number of significant figures in it is

A Six

B Five

C Three

D Thirty Four

Rounding Off

Check the last digit

(i) last digit ≥ 5

The preceding number is added by 1

$125.6 \equiv 126$

(ii) last digit < 5

The last digit is dropped off and no change to the preceding digit.

$125.3 \equiv 125$

$6.023 \equiv 6.02$

(iii) last digit = 5 ⊛

↳ check the preceding digit.

if odd, then add (+1)

if even, drop off the last digit and no change to the preceding digit.

$2.\overset{0}{5}\not{5} \equiv 2$

$1.\overset{+1}{5}\not{5} \equiv 2$

$6.023\overset{+1}{5}\not{5} \equiv 6.024$

$7.785\overset{+1}{5}\not{5} \equiv 7.786$

#Q. Round up the following upto three significant figures :

A 34.216 → 34.22 → 34.2

B 10.4107 → 10.411 → 10.41 → 10.4

C 0.04547 → 0.0455

D 2808 → 2810

In Scientific notation, there is only 1 digit to the left of the decimal point.

$2808 \longrightarrow 2.808 \times 10^{3}$

$2.81 \times 10^{3} \longrightarrow (2810)$

$96502 \longrightarrow 9.6502 \times 10^{4}$

9.650×10^{4}

9.65×10^{4}

$10.795 \longrightarrow 1.0795 \times 10^{1} \longrightarrow 1.08 \times 10^{1}$ (+1)

1.080×10^{1}

$10 \times \left(\frac{23}{10}\right) \longrightarrow 2.3 \times 10$

$\left(\frac{100.56}{100}\right) \times 100$

1.0056×10^{2}

$10.785 \longrightarrow 10.78 \longrightarrow \underline{10.8}$

Mathematical operations of Significant figures

(i) Multiplication / Division

(ii) Addition / Subtraction

(i) Multiplication / Division

The result cannot have more no. of SF than any of the original numbers.

The no. of SF in the result will be equal to the SF in the original number having the least SF.

$$\frac{2.3}{2SF} \times \frac{5.6575}{5SF} \times \frac{10.89623}{7SF}$$

Result has 2SF

$$\frac{\overset{2SF}{2.3} \times \overset{4SF}{8.314} \times \overset{3SF}{375}}{6.023 \times 1.2}$$

6.023 (4SF) $\times$ 1.2 (2SF)

(ii) Addition / Subtraction :-

The result cannot have more no-of digits to the right hand side of the decimal point than any of the original numbers

(i) $2.303 + 1.62 = 3.923$ → 3.92 Result

How many SF in the Result of the given addition.

SF = 3

(ii)

$$\begin{array}{r} 2.303 \\ 1.62 \\ 8.23 \\ \hline 12.153 \end{array} \longrightarrow (12.15) \quad (4SF)$$

(iii)

$$\begin{array}{r} 10.2 \\ 6.3 \\ \hline 16.5 \end{array}$$

(iv)

$$\begin{array}{r} 9.9 \\ 1.1 \\ \hline 11.0 \end{array} \quad (3SF)$$

(v)

$$\begin{array}{r} 9.0 \\ 1.1 \\ \hline 10.1 \end{array}$$

#Q. How many significant figures should be present in the answer of the following calculations respectively?

(i) $298.15 \times 0.0285 \times 0.112$

(ii) 5.2×1.364

(iii) $1.15 + 0.78 + 0.2$

A. 5, 4, 4

B. 4, 4, 3

C. 3, 2, 3

D. 3, 2, 2

1.15

0.78

0.2

2.13

2.0 1

2SF

Precision and Accuracy in experiments

Precision refers to the closeness of our measurements

(It has nothing to do with true value)

10m (9.4, 9.5) (Precise)

Accuracy refers to the agreement of the measurement to the true value of the product.

(10m)

(9.4, 9.5) Precise ✓

Accurate ✗

(9.9, 10) Precise ✓

Accurate ✓

(9.5, 10.5) Precision ✗

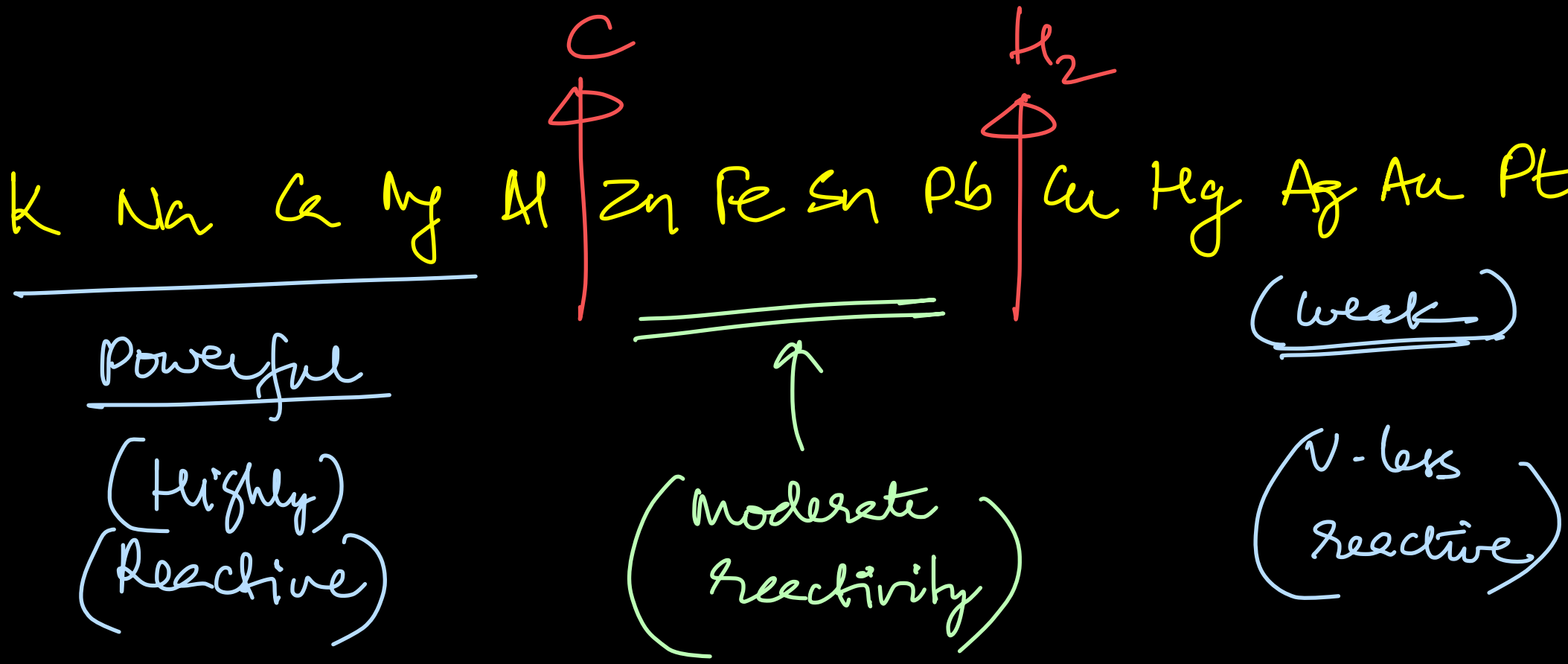
Avg (10) Accuracy ✗✗

Note:-

There can no accuracy without Precision

#Q. True value for a result is 4.00 g. Three students carry out different experiments to measure the value and their results are tabulated below. What can be said about their precision and accuracy?

Measurements (g)					
	Expt. 1	Expt. 2	Average(g)	Precision	Accuracy
Student A	3.95	3.93	3.94	✓	X (?)
Student B	3.94	4.04	3.99	X	X
Student C	3.99	4.01	4.00	✓	✓


C
H_2
K Na Ca Mg Al Zn Fe Sn Pb Cu Hg Ag Au Pt
Powerful
(Highly Reactive)
Moderate reactivity
(weak)
V-less reactive