Neutron Activation Analysis : (NA

Introduction :

① NAA → Imp method for finding trace, m

②. Main advantage of NAA →
 ① Accurate & sensitive.
 ②. Independent method. (i.e no systematic error

①. NAA is a sensitive analytical technique u
quantitative of multi element analysis of major,
in sampe in concⁿ < 0.01 %

②. NAA is different from other spectroscopic analy
based on nuclear transition & not electronic tran

→ NAA was discoved in 1936 by Hevesy &
observed that samples cantaining rare earth elements
radioactive. when they were exposed to a source o

③. NAA is a nuclear process used for detecting
with great sensitivity of most chemical element
the sample to be analysed.

④ It allows discrete sampling of elements as it
chemical form of sample but focuses completely on

② Principle of NAA :

$^{?}_{-}X + ^{1}_{0}n$ —

A)

inor & ultratrace elements.

)

sed. for qualitative &
minor & trace element

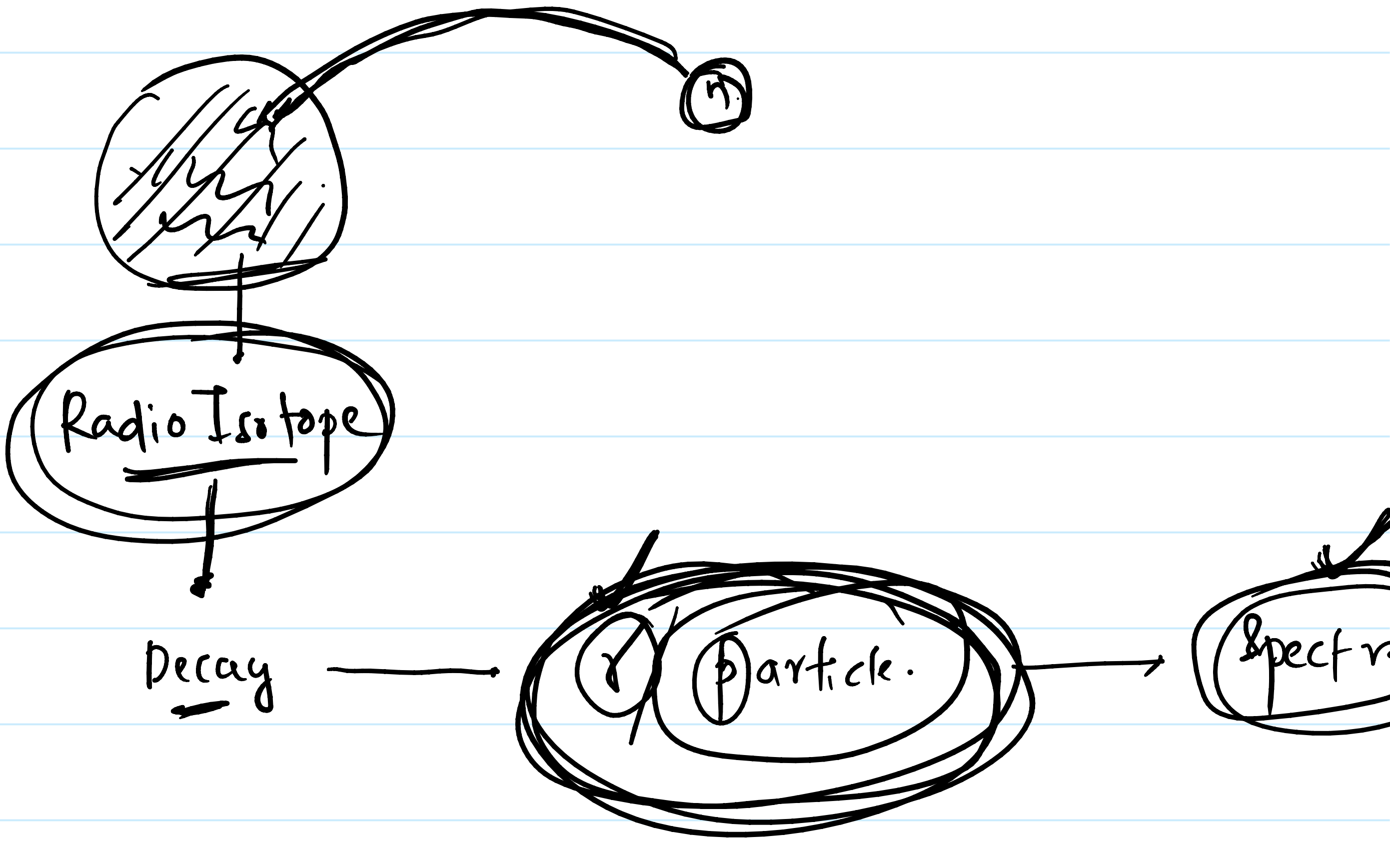
tical method as it is
sition.

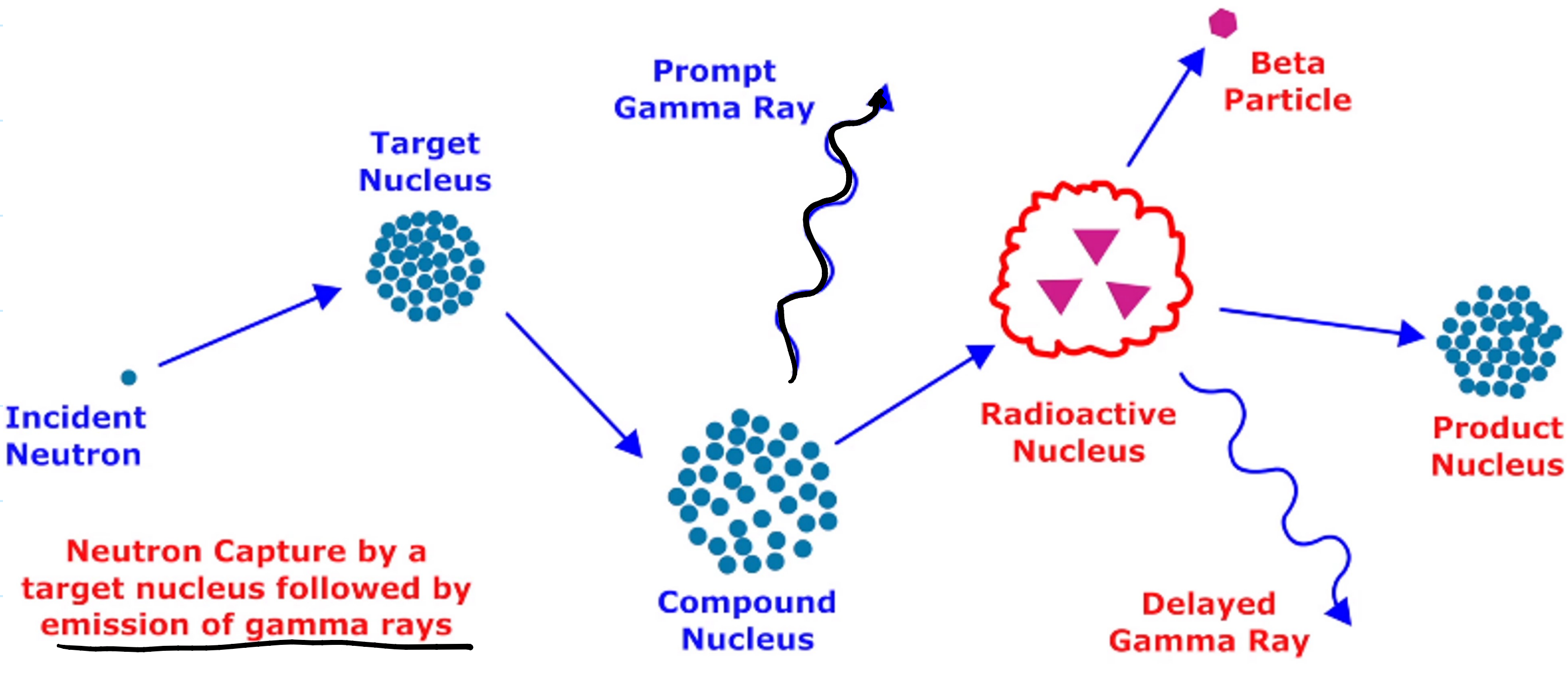
devi. when they
become highly
of neutrons.

presence & concentration.
without destroying

does not consider the
nucleus.

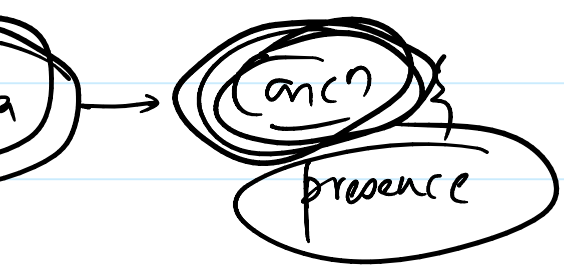
-





① Elements which is to be estimated in a sample
transmutation reaction to produce radio isotopes.

②. Then by measuring activity of radioisotopes pr
with the activity of a known amount of element s
flux. for same periods the unknown content of elemen
determined.



is subjected to (n, γ)

rduced by comparing
ubjected to same neutron.
t in the sample can be

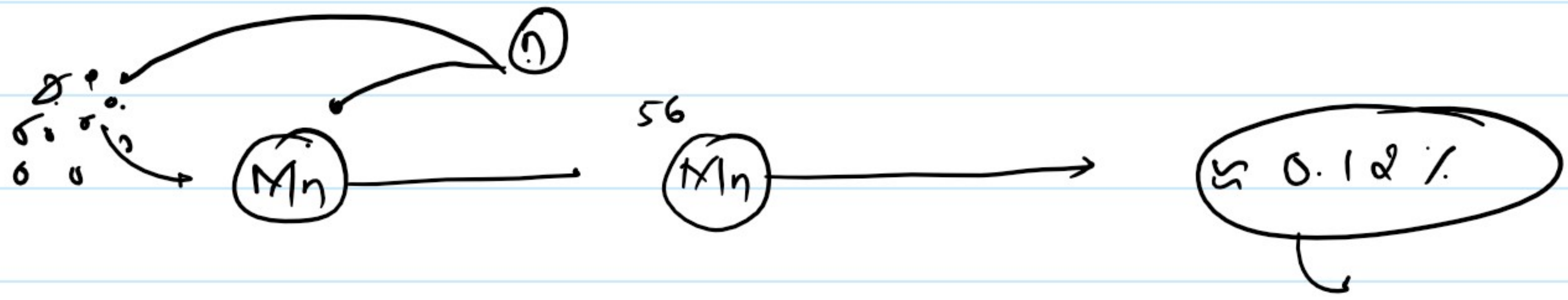
③. This technique is highly promising for the large neutron capture cross section.

$$\frac{\text{Wt. of element (say X) in unknown sample}}{\text{Wt of element X in the standard sample}} = \frac{\text{Activity at time t in unknown sample}}{\text{Activity at t time in standard sample}}$$

Some Ex of this method :

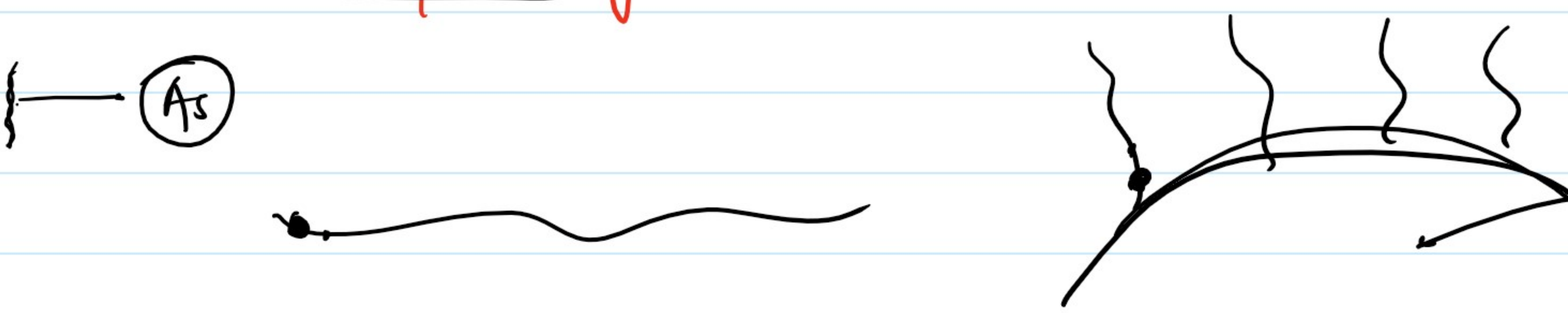
① **Mn content in tea leaves ;**

Nuclear transmutation : $^{55}Mn\ (n, \gamma)\ ^{56}Mn$; ^{56}Mn →
($t_{1/2}$ =



From activity measurement in calcined tea leaves, & sample, the percentage of Mn- content can be esti

② . **As content in hair, a dignostic test of As poisoning :—**

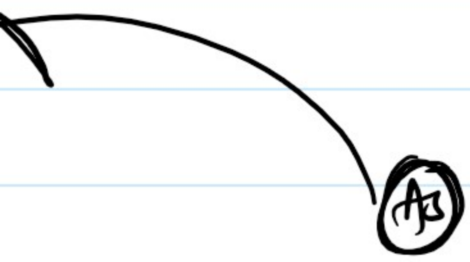


element having a

Radioisotope.
2.6 hr

in a series of standard.
mated is 0.12 %.

slow
As. poisoning



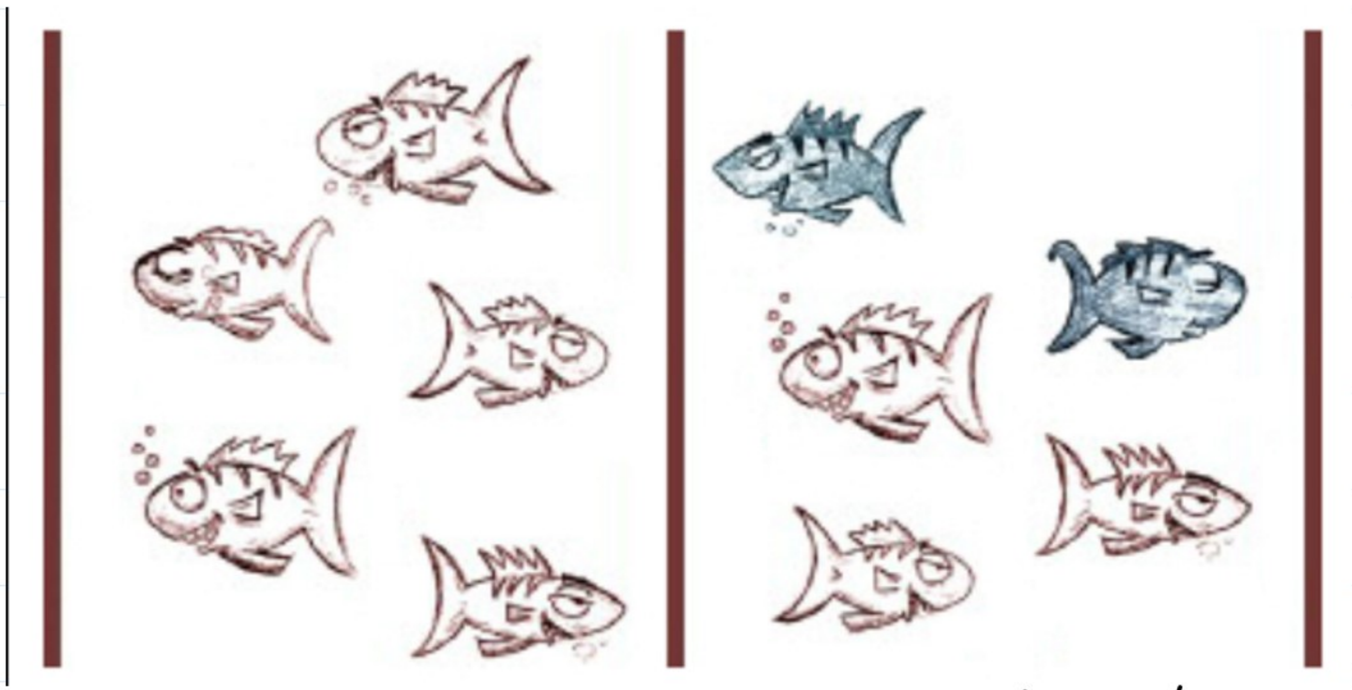
Advantages of NAA :

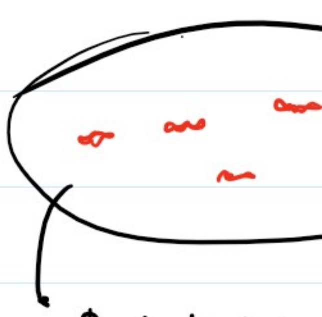
1. Relative freedom from matrix effect & interfer
2. High accuracy.
3. Very low or zero blank contribution.
4. Nuclear reactions & decay process are virtua chemical & physical structure of the material irradiation.

② . Isotopic Dilution Analysis : (IDA)

Is a method of determining the quantity

Isotopic Dilution Analysis :- Analogous to ma used in ecology size.





Red fishes in lake.

1st visit → Ecologist adds =

. Ecologist captures fishes → Ratio of Red to Bl

total no. of fish native to the lake can be ca

$$n_A = n_B \times \frac{10}{1} = \underline{50}$$

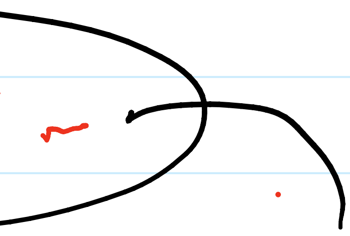
Principle : $_1H^1$, $_1H^2$, $_1H^3$

ences.

lly unaffected by
during & after.

y of Chemical Substances.

ark & capture method,
to estimate population



= (n_A)

5 Blue fish. = n_B

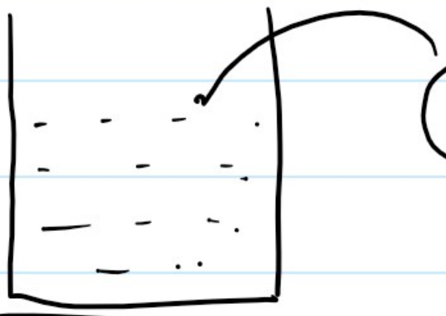
ue ; 10 : 1
Red Blue

lculated.

Principle : $_1H^1$, $_1H^2$, $_1H^3$

Non radioactive ($_1H^1$, $_1H^2$) — Radioactive ($_1H^3$).

Sample



Overall sample

$_1H^3$ + Adding more Radioactive isotop

- ① Its mass is known
- ② Specific activity is k

Now total sample radioactivity changes ∴ We · I radioactivity & with these, we can calculate ma already present in the soln.

IDA : 2 types

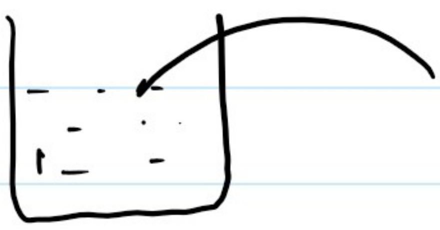
① **Direct IDA**

We add Radioactive isotope (spike)

② ...

We add

① . **DIDA** :



Adding Radioactive isotope

Specific

Mass of Radioactive isotope (spike) = m^* ——— S_{AS}

Mass of original Radioactive isotope = M.

e $({}_1H^3)$.

(m*)

nown

know initial & final

of the sample. i.e

) Indirect IDA

(Reverse IDA).

non radioactive nuclei

ctivity:

Radioactive isotope

Mass of total mixture = M_m ——— S_{AM}

Relatⁿ betⁿ specific activity & activity.

① $S = \frac{A}{M}$

$S_{AS} = \frac{A_S}{M^*}$

$S_{AM} = \frac{A_m}{M_m}$

$A_S = S_{AS} \times M^*$

$A_m = S_{AM} \times M_m$

Activity remain same

$\therefore \quad A_S = A_m$

$S_{AS} \times M^* = S_{AM}(M + M^*)$

$$M = m^* \left(\frac{S_{AS} - S_{AM}}{S_{AM}} \right)$$

② IIDA :

$A_m = A^*$

$S_{Am}(m + m^*) = A^*$

$\frac{A_m}{M_m}(m + m^*) = A^*$

$$M^* = \frac{A^* M_m}{A_m} - M$$

$$\frac{4m}{m+m^*}$$

$$8Am(m+m^*)$$

Q. In a direct isotopic dilution method for determin
of $^{32}PO_4^{-3}$ (Specific activity = 3100 dis s^{-1} m
of sample solution, the 30 mg of phosphate isola
overall activity of 3000 dis s^{-1}. The % mass of

$S_{AS} = 3100$ dis s^{-1} mg^{-1} $A_m = 3000$

$M^* = 2$ mg $M_m = 30$ mg

$$m = M^* \left(\frac{S_{AS} - S_{AM}}{S_{AM}} \right) \qquad S_{AM} = \frac{3000}{30}$$

$$= 2 \times \left(\frac{3100 - 100}{100} \right)$$

$$= 2 \times \frac{3000}{100} = 60 \text{ mg}$$

$$\% \text{ Mass of phosphate} = \frac{60}{1000} \times 100 =$$

Thank you. ☺

ation of phosphate, 2mg
g⁻¹) was added to 1g
ted from it has an
PO_4^{3-} in sample is :

dis./s.
(n+m*)

= 100 dis s^{-1} mg^{-1}!

6 %