Pg-III
Enzyme

R N. College

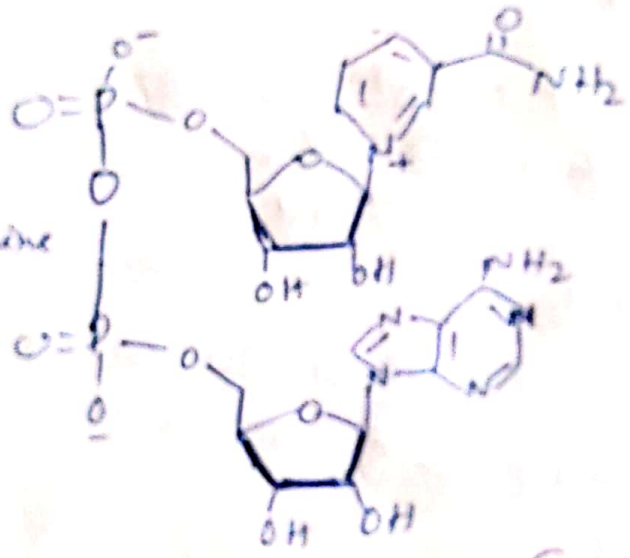
Full form & structures

NAD . NADP, FMN , FAD

Biological function.

✓ NAD = Nicotinamide Adenine dinucleotide

The structure of NAD is given as



Also called diphosphopyridine nucleotide (DPN)

One Nucleotide is Nicotinamide and other is adenine nucleobase which are joined Through phosphate group at 5' carbon

✓ NAD exists in two forms NAD^+ (oxidised form) and NADH reduced form

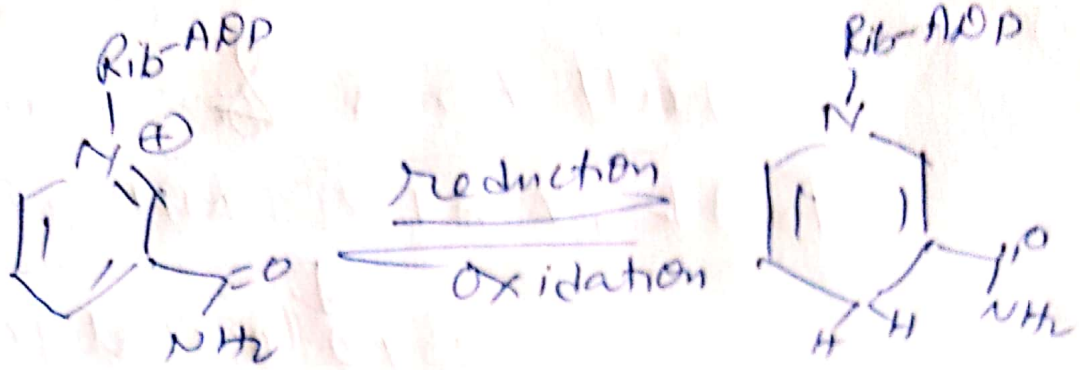
✓ Biological function → NAD has essential role in metabolism

It acts as (i) a Coenzyme in redox reaction

(ii) donors of ADP-ribose moieties

(iii) a precursor of second messenger molecule Cyclic ADP-ribose as well as a substrate for bacterial DNA Ligases and a group of Enzyme (Called Sirtuins) That uses NAD^+ to remove acetyl groups from Proteins

(iv) agents to emerge adenine nucleotide from cells spontaneously and by regulated mechanism.



$NAD^+ + H^+ + 2e \longrightarrow NADH$

Oxidising agent — Reducing agent

$RH_2 + NAD^+ \longrightarrow NADH + H^+ + R$

Reductant — Oxidising agent

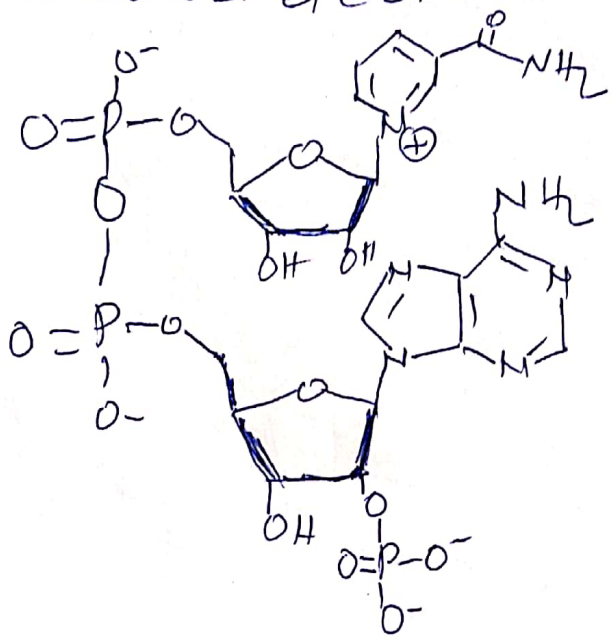
↳ RH_2 molecule is oxidised by NAD^+ and NAD^+ is reduced by transfer of H^- to Nicotinamide ring

- NAD^+ absorbs U/V light with absorption peak of 259 nm and Extinction Coefficient of $18500\ M^{-1}cm^{-1}$
- NADH absorbs wavelength of 339 nm & Extinction Coefficient of $6220\ M^{-1}cm^{-1}$.

NADP = Nicotinamide adenine dinucleotide phosphate

✓ It is a cofactor in anabolic reaction or Cellular electron transfer reactions.

✓ Structure



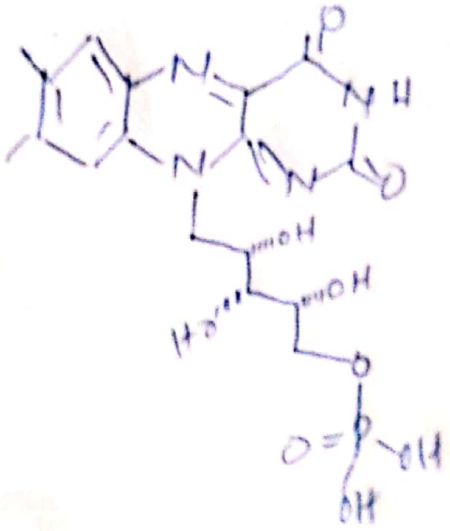
- It Exists as oxidised form $NADP^+$ and reduced form NADPH.

- $NADP^+$ is synthesised from NADPH
- NADH is produced from $NADP^+$
- It Exists in animal & non-photo-synthetic organism
- NADPH provides the reducing Equivalent for biosynthesis and oxidation reduction involved in a protecting against the toxicity of reactive oxygen species, allowing the regeneration of glutathione
- It is used in anabolic Pathway like cholesterol synthesis and fatty acid chain elongation.

FMN = Flavin mononucleotide

It is also known as Vitamin-B_2 Phosphate or riboflavin-5'-phosphate or riboflavin mononucleotide

- riboflavin = ribose + flavin
  (yellow)



- It is stronger oxidising agent than NAD
- It involves both one or two electron transfer

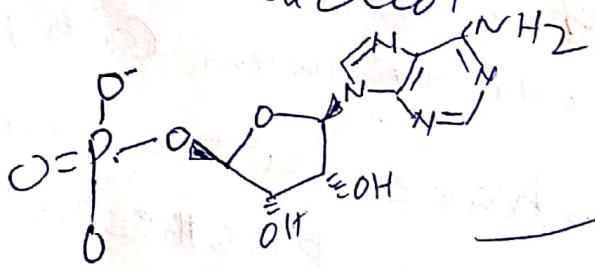
- It acts as a cofactor in blue-light photo receptor
- It is found in tissues (muscles) and cells (Erythrocytes & Platelets)
- FMN forms flavo proteins when conjugated with certain proteins which is used in DNA repair, bioluminescence, photosynthesis & removal of free radicals

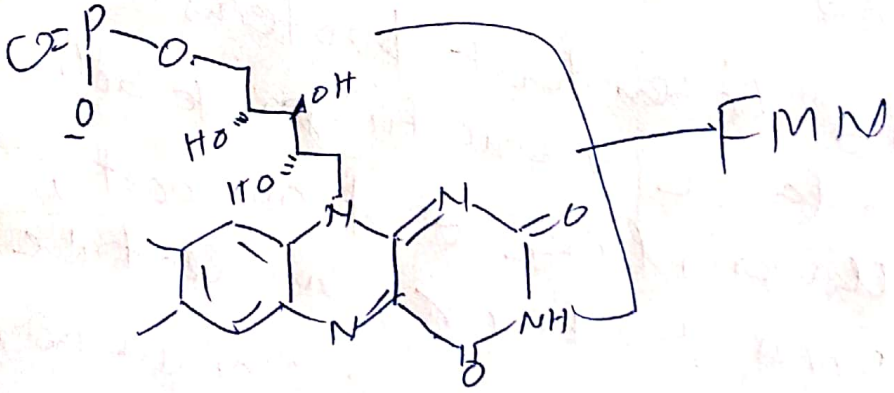
→ When ingested, FMN is digested, liberating free VB_2

→ It is used in food industry as food additive in milk products, sweets, sugar products (Orange red food colour (E 101a Code))

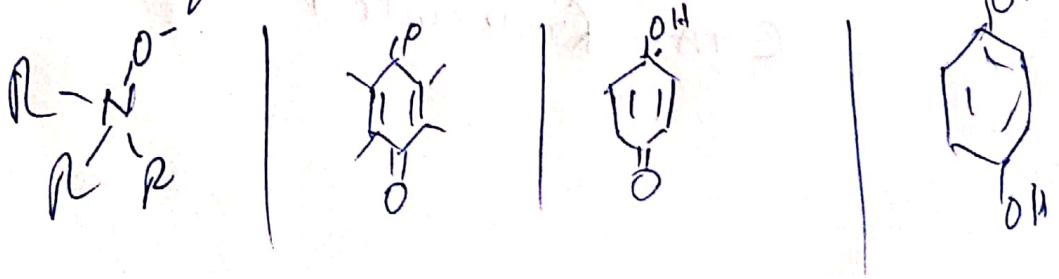
FAD – Flavin adenine dinucleotide

- It is a redox active coenzyme associates with various protein like flavoprotein
- It consists of adenosine monophosphate and flavin mononucleotide bridged Through phosphate groups. Adenine is bound to cyclic ribose at 1 carbon and phosphate is bound to ribose at 5' carbon to form adenine nucleotide.





- FAD exists as four different redox states Flavin-N(5)-oxide, Quinone Semiquinone & Hydroquinone.



- FAD Converted into These Stages by accepting or donating electrons.
- It's oxidised form (quinone) it accepts two e⁻ and two H⁺ to form $FADH_2$ (Hydroquinone) semiquinone ($FADH^{\bullet}$) can be formed either by reduction of FAD or oxidation of $FADH_2$ by accepting or donating one electron & one H⁺
- FAD has more positive reduction potential than NAD⁺ hence is a good oxidising agent.
- FAD can provide structural support for active sites or provide stabilization of intermediates during catalysis
- flavo proteins have either FMN or FAD molecules as prosthetic group.
- FAD dependent proteins function in a large variety of metabolic pathways like e⁻ transport, DNA repair, nucleotide biosynthesis, β-oxidation of fatty acid, amino acid catabolism, citric acid cycle (TCA or Kreb Cycle).