BioTecNika Presents

KONCEPT TABLE

for CSIR NET Life Sciences

Biotecnika Presents

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for CSIR NET Life Sciences

PREFACE

Prestigious exams like CSIR NET, GATE, DBT, ICMR, etc play a crucial role in the life of an aspiring researcher of India. Scoring a good rank in these exams is a matter of pride and achievement. Biotecnika is dedicated to make every aspirant's dream a reality by providing the best assistance and suitable study aids that will not only help you crack the exam but also deepen your knowledge base.

CSIR NET Exam is a tough nut to crack but not impossible. To tackle this exam one has to develop analytical skills and have a strong understanding of the concepts. Along with these students also need to develop time management skills to manage the 3hrs examination. Biotecnika has been helping students develop these skills and implement them during the examination

Our latest tool, the Koncept Table is another great addition to Biotecnika's Konceptika range of study tools, aiming to make preparation for the CSIR NET and GATE Exams easy and effective. This book is loaded with important topics and changes the way you learn a concept.

Main features of Koncept table:

- Information Presented in the form of a Table showing the differences
- 300+ Important topics covered
- A lucid explanation for quick understanding of concepts.
- Colorful representation for a longer retention

We have designed the Koncept Table keeping in mind that CSIR NET aspirants come from different backgrounds. Each student has a stronghold of certain subjects and is not very comfortable with the others. The Koncept table book will help you understand each topic easily and the tabular form of studying will make sure you never forget the concepts.

The Koncept Table book is dedicated to every CSIR NET Life Science aspirant who is determined to become a successful researcher of our country

Your suggestions will be heartily welcomed.

Shekhar Suman

CEO - MD , BIOTECNIKA & RASAYANIKA

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UNIT 1

MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY

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DIFFERENCE BETWEEN MOLECULES AND HYDROPHOBIC MOLECULES

HYDROPHILIC MOLECULES	HYDROPHOBIC MOLECULES
Water loving ('philia' : love) ; relating to, or having a strong affinity for water	Water fearing ('phobia' : fear) ; resistant to or avoiding association with water
Ability to mix well or to be attracted to water or other polar molecules	Prefers to stay away from water and aggregate with other hydrophobic molecules
Have polar covalent bonds where the atoms have more difference of electronegativity	Have non polar covalent bonds where the atoms have no or less difference of electronegativity
Polar groups in such molecules are partially charged and act as dipoles; eg - N-H, O-H bonds	Non polar groups in such molecules have no partial charges; eg C-C, C-H bonds
Need protein carriers for facilitated diffusion through membrane	Can cross membrane directly through simple passive diffusion
Get absorbed or dissolved in water	Only dissolve in oil-based substances
Plays role in forming ionic or a hydrogen bond with water molecules and also with other polar molecules to stabilize macromolecule structures	Plays the most critical roles in the formation of the lipid bilayer of the cell membrane and thefolding of proteins and nucleic acids
When added to water, Gibbs free energy gets a negative value while entropy is increased	When added to water, Gibbs free energy getsa positive value while entropy is decreased
Dissolving them in water is an exothermic reaction	Dissolving them in water is an endothermic reaction
Located preferably on the surface of macromolecules in aqueous environment	Located preferably in the core of macromolecules in aqueous environment
E.g - Salts, ions	E.g - Fats/Oils/Waxes

DIFFERENCE BETWEEN COVELENT AND NON COVALENT

COVALENT	NON COVALENT
Formed when two or more non metals react with each other by the sharing of electrons	Formed either by transfer of electrons from metal to nonmetal, or through weak interactions between charges
Have high melting and boiling point and can be separated only by complex chemical reactions	Have low melting and boiling point and can be easily separated
Strong bonds	Weak bonds
Types : Polar (Equal sharing of electrons) and Non Polar (Unequal sharing of electrons)	Types : Van der Waals interactions, hydrogen bonding, and electrostatic interactions (also called ionic bonding)
Need protein carriers for facilitated diffusion through membrane	Can cross membrane directly through simple passive diffusion
Example : H_2O, as it is formed by the share of electrons of hydrogen and oxygen(both non metals)	Example : NaCl, formed between Na+ and Cl- after transfer of electrons
Monomers are held together as polymers through covalent bonds	Multiple non covalent bonds stabilizes large molecules such as proteins and nucleic acids

My Notes

DIFFERENCE BETWEEN ALPHA DECAY , BETA DECAY AND NON GAMMA DECAY

ALPHA DECAY	BETA DECAY	GAMMA DECAY
Alpha decay forms new element with two fewer protons and two fewer neutrons	Beta decay forms new element with one more proton(-decay) and one fewer neutron(+decay)	Gamma decay forms NO new element, but the new element has less energy because energy is released as gamma rays
Lowest penetration power	Intermediate penetration power	Highest penetration power
Propagating speed very less than velocity of light	Beta particles carry a negative charge	Gamma rays are neutral
Alpha particles carry a positive charge	Propagating speed less than velocity of light	Propagating speed equal to velocity of light
Mass - $6.65*10^{-27}$ Kg	Mass - $9.10*10^{-31}$ Kg	Mass - 0
Size : Quite Large	Size : Moderate	Size : High
Particle consisting of two protons and two neutrons bound together, identical to a helium nucleus	Beta particles are high energy electrons	Gamma rays are waves of electromagnetic energy, or photons
Outside layer of the human skin, for example, can block these particles	Able to pass through thicker materials such as paper	The only substances that can absorb this radiation are thick lead and concrete
Very high ionizing power	Intermediate ionization power	Very low ionizing power
Radiotherapy in cancer treatment uses alpha particles to kill the cancerous cells	Beta particles get used as tracers for medical imaging. They also have therapeutic uses in bone and eye cancer treatment	There is some application of gamma rays in oncology, and for sterilizing medical instruments

DIFFERENCE BETWEEN POLAR AMINO ACIDS , AND NON POLAR AMINOACIDS

POLAR AMINO ACIDS	NON POLAR AMINO ACIDS
Side chain contains polar functional group, thus posses polarity	Side chain contains non polar functional group, does possess polarity
Hydrophilic in nature	Hydrophobic in nature
Can be found participating in the hydrogen bond formation in protein molecules and with water	Tends to stay away from polar molecules s uch as water, forms hydrophobic interactions with other
Can be present as positively charged, negatively charged and neutral at physiological pH	Always neutral at physiological pH
Generally found on surface of globular water-soluble proteins	Generally found buried in the interior/core of globular water soluble proteins or membranes
Create hydrophilic channels within plasma membrane,positioned at active site of enzymes (specificity)	Positioned at the interior of proteins providing structural stability
Long side chains with mostly carbon and hydrogen atoms	Either short side chains or side chain with hydrophilic groups
Small dipole moment	Large dipole moment
Example : Lysine, Arginine, Histidine, Aspartate, Glutamate, Serine, Threonine, Tyrosine	Example : Glycine, Proline, Alanine, Valine, Methionine, Leucine, Isoleucine, Phenylalanine

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DIFFERENCE BETWEEN KEESOM FORCES , DEBYE FORCES LONDON DISPERSION FORCES

KEESOM FORCES	DEBYE FORCES	LONDON DISPERSION FORCES
Attractions/Repulsions between opposite/same charges in polar molecules	Attractions between a polar molecule & any other molecule which has been induced to be a dipole temporarily	Results when the electrons in two adjacent atoms occupy positions that make the atoms form temporary dipoles
Dipole-Dipole Van der Waals forces	Dipole- induced dipole Van der Waals forces	Fluctuating/Instantaneous dipoles
Forces between permanent dipoles	Forces between a permanent dipole and an induced dipole	Can be formed between any pair of molecules
Both attractive or repulsive	Always attractive	Always attractive
Strength of attraction moderately strong	Strength of attraction weak	Strength of attraction extremely low
High boiling point and freezing points	Intermediate boiling point and freezing points	Extremely low boiling point and freezing points
Strength proportional to r^{-3}	Strength proportional to r^{-6}	Strength proportional to r^{-6}
Energy : 5-25 kJ/mol	Energy : 2-10 kJ/mol	Energy : 0.05-40 kJ/mol
Example : Forces between 2 HCl molecules	Example : Forces between a HCl molecule and a Cl molecule	Forces between two fluorine molecules

DIFFERENCE BETWEEN A DNA , B DNA AND Z DNA

A DNA	B DNA	Z DNA
Right-handed helix, shortest and broadest	Right-handed helix, longer and thinner	Left-handed helix with zig-zag sugar phosphate linkage, elongated and narrowest
Rise per base pair : 2.3 Å	Rise per base pair : 3.4 Å	Rise per base pair : 3.8 Å
Helix diameter : 26 Å	Helix diameter : 23.7 Å	Helix diameter : 18.4 Å
Glycosidic bond : anti	Glycosidic bond : anti	Glycosidic bond : alternating anti and syn
Sugar puckering : C3' endo	Sugar puckering : C2' endo	Sugar puckering : C : C2' endo, G : C2' exo
Base pairs per turn of helix : 11	Base pairs per turn of helix : 10.4	Base pairs per turn of helix : 12
Pitch per turn of helix : 25.3 Å	Pitch per turn of helix : 35.4 Å	Pitch per turn of helix : 45.6 Å
Rotation/bp : 33.6°	Rotation/bp : 35.9°	Rotation/bp : 60°/2 (repeating unit in Z DNA : 2bp)
Tilt of base pairs from normal to helix axis : 19°	Tilt of base pairs from normal to helix axis : 1°	Tilt of base pairs from normal to helix axis : 9°
Major groove : Narrow and very deep	Major groove : Wide and quite deep	Major groove : Flat, no groove
Minor groove : Very broad and shallow	Minor groove : Narrow and quite deep	Minor groove : Very narrow and deep

My Notes

DIFFERENCE BETWEEN PHI(Φ) TORSIONAL ANGLE AND PSI(Ψ) TORSIONAL ANGLE

PHI(Φ) TORSIONAL ANGLE	PSI(Ψ) TORSIONAL ANGLE
Torsion angle rotation about the N-Cα bond	Torsion angle rotation about the Cα-C Bond
Value for antiparallel β strand : -139	Value for antiparallel β strand : +135
Value for parallel β strand : -119	Value for parallel β strand : +113
Value for R.H α-helix : -57	Value for R.H α-helix : --47
Value for L.H α-helix : +57	Value for L.H α-helix : +47
Value for 3_{10} helix : -49	Value for 3_{10} helix : -26
Value for π helix : -57	Value for π helix : -70
Value for Collagen triple helix : -51	Value for Collagen triple helix : +153
Value for β turn type I i+1 : -60	Value for β turn type I i+2 : -30
Value for β turn type I i+2 : -90	Value for β turn type I i+2 : 0
Value for β turn type I i+1 : -60	Value for β turn type I i+1 : +120
Value for β turn type I i+2 : +80	Value for β turn type I i+2 : 0
Value for Polyproline I : -83	Value for Polyproline I : +158
Value for Polyproline II : -78	Value for Polyproline II : +149

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DIFFERENCE BETWEEN PARALLEL β-SHEET AND ANTI-PARALLEL β-SHEET

PARALLEL β-SHEET	ANTI-PARALLEL β-SHEET
Strands run in one direction, N to C terminal of adjacent strands match	Strands run in opposite direction, N to C terminal of adjacent strands doesn't match
Each hydrogen bonded ring in a parallel beta sheet has 12 atoms in it	The number of atoms in hydrogen bonded rings alternate between 14 and 10
Hydrogen bonds are oriented at an angle	Straight orientation of hydrogen bonds
Less stable	More stable
(Generally) found buried inside the protein	Can withstand greater distortions (twisting and beta-bulges) and greater exposure to solvent
Needs a crossover connection which has a right handed sense	Needs a crossover connection which has a right handed sense
7.0 Å between pleats on the sheet	6.5 Å between pleats on the sheet
Rise per residue: 3.47 Å	Rise per residue: 3.25 Å

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DIFFERENCE BETWEEN MM PLOT AND LB PLOT

MM PLOT	LB PLOT
Graph is plotted by taking initial rate of an enzyme reaction(V_0) on the y-axis and substrate concentration([S]) on the x-axis	Graph is plotted by taking reciprocal of initial rate of an enzyme reaction($1/V_0$) on the y-axis and reciprocal of substrate concentration(1/[S]) on the x-axis
Michaelis-Menten plots can only approximate Vmax and Km	Lineweaver-Burk plots can more accurately determine Vmax and Km
Hyperbolic shape of curve in the graph	Straight line graph
Equation : V_0 = Vmax [S] / Km + [S]	Equation : $1/V_0$ = Km/Vmax [S] + 1/Vmax
Inaccurate Vmax obtained by estimating where V_o curve levels-off and approaches Vmax	Accurate Vmax obtained from y intercept (1/Vmax)
Inaccurate Km since Km obtained from extrapo-lating ½ Vmax point to [S[concentration	Accurate Km obtained from X-intercept (-1/Km)
----	Slope of the straight line curve = km/Vmax
Equation derived by assuming steady state assumption ([ES] remains constant) in a simple enzymatic reaction	Equation obtained by taking reciprocal of the MM equation, also known as double reciprocal plot

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DIFFERENCE BETWEEN MM PLOT AND LB PLOT

K_m	Kcat	Vmax
Michaelis constant	Turnover number	Maximum Velocity
Unit = M	Unit = s^{-1} or min^{-1} (first order rate constant)	Unit = $M.s^{-1}$ or $M.min^{-1}$
Measured by (k_2 x k^$_{-1}$)/k_1; equivalent to k_d	Is the rate constant of the rate limiting step)	Is a measure of the velocity at a saturating concentration of [S]
Km is a measure of the affinity of E for S	Is a measure of the catalytic activity of the enzyme	Can be calculated by multiplying Kcat with [Et]
The lower the Km value, the greater the affinity of E for S	The greater is the Kcat value, the faster is the reaction	The greater is the Vmax value, greater is the rate of reaction
Is also the substrate concentration at which the enzyme operates at one half of its maximum velocity	Is a measure of how many bound substrate mole-cules turnover or form product in 1 second or minute	Velocity at which all the enzymes are saturated with substrate. Vmax value does not change with increasing [S]

My Notes

DIFFERENCE BETWEEN NAD+ PLOT AND FAD

NAD+	FAD
Nicotinamide adenine dinucleotide, derived from vitamin B3	Flavin adenine dinucleotide, derived from vitamin B2
Comprises of 2 nucleotides : Adenine and nicotinamide	Comprises of 2 nucleotides : Adenine and flavin mononucleotide (core component : riboflavin)
Is a cofactor for most metabolic reactions, used up during both glycolysis and Krebs cycle	Act as cofactor only in a few metabolic reactions, used up only during Krebs cycle
Accepts $1H^+$ and $2e^-$	Accepts $2H^+$ and $2e^-$
Reduced NAD+ (NADH) transfers its electrons to the Cytochrome complex I of the ETC	Reduced FAD ($FADH_2$) transfers it electrons to the Succinate dehydrogenase complex II of the ETC
Reduced NAD+ (NADH) generates 2.5 ATP through oxidative phosphorylation	Reduced FAD ($FADH_2$) generates 1.5 ATP through oxidative phosphorylation
NADH does not react well with dioxygen, hence NAD+ is picked up by the enzyme during the reaction	Tightly bound to enzymes which use them, as $FADH_2$ is susceptible to reaction with dioxygen
Used as a coenzyme in metabolic reactions where a C=O bond is generated	Used as a coenzyme in metabolic reactions where a C=C bond is generated
NAD(P)+/NAD(P)H typically oxidizes alcohols to aldehydes/ketones or vice versa	$FAD/FADH_2$ typically operates on alkenes/alkanes

DIFFERENCE BETWEEN NAD+ PLOT AND NADP+

NAD+	NADP+
Coenzyme that occurs in many living cells and functions as an electron acceptor	Coenzyme that functions as a universal electron carrier, accepting electrons and hydrogen atoms to form NADPH
Does not contain any additional phosphate groups on ribose rings	Contains a phosphate group on the 2' carbon of the ribose ring, which bears the adenine moiety
Reduced state : NADH	Reduced state : NADPH
Generally involved in catabolic reactions	Generally involved in anabolic reactions
Serves as a coenzyme in cellular respiration	Serves as a coenzyme in photosynthesis
Reduces to NADH in both glycolysis and TCA cycle and the reducing power of NADH is used to generate ATP in the ETC	Reduces in the light reaction of photosynthesis and the reducing power of NADPH is used to assimilate carbon dioxide in the dark reaction
NAD+ to NADH ratio is high inside the cell, oxidised form is the most abundant	NADP+ to NADPH ratio is low inside the cell, reduced form is the most abundant
Used in glycolysis, Krebs cycle, fatty acid synthesis and sterol synthesis	Used in Calvin cycle, Pentose Phosphate Pathway, lipid and cholesterol synthesis, fatty acid chain elongation

My Notes

DIFFERENCE BETWEEN AEROBIC RESPIRATION AND ANAEROBIC RESPIRATION

AEROBIC RESPIRATION	ANAEROBIC RESPIRATION
Process of breakdown of food in the presence of oxygen	Process of breakdown of food in the absence of oxygen
End products are CO_2 and H_20	End products of anaerobic respiration can be lactic acid or CO_2 or alcohol
Takes longer time to release energy	Fast process as compared to aerobic respiration
Produces large amounts of energy(32 ATP)	Relatively small energy is liberated
Occurs in most plants and animals	Occurs in yeast, bacteria, human muscle cells during strenuous exercise
Complete oxidation of glucose takes place	Glucose molecule is incompletely oxidised
Gases are exchanged in this form of respiration	Gases are not exchanged in this form of respiration
Pyruvate gets oxidised to acetyl Co-A	Pyruvate gets reduced to lactate or ethanol
Reduces NAD+ to NADH	Oxidises NADH to NAD+ (regeneration of NAD+ to continue glycolysis)
2.5 ATP is produced in the regeneration of NAD+	No ATP is produced in the regeneration of NAD+

My Notes

DIFFERENCE BETWEEN CATABOLISM AND ANABOLISM

CATABOLISM	ANABOLISM
Breaks down big complex molecules into smaller, easier to absorb molecules	Builds molecules required for the body's functionality
Destructive phase of metabolism	Constructive phase of metabolism
The process of catabolism releases energy (net result)	Anabolic processes require energy (overall)
Hormones involved in the processes are adrenaline, cytokine, glucagon, and cortisol	Hormones involved in the process are estrogen, testosterone, growth hormones and insulin
Examples of catabolic processes are proteins becoming amino acids, glycogen breaking down into glucose and triglycerides breaking up into fatty acids	Examples include the formation of polypeptidesfrom amino acids, glucose forming glycogen and fatty acids forming triglycerides
Kinetic energy is converted into potential energy	Potential energy is changed into kinetic energy
Required to perform different activities in living entities	Required for maintenance, growth, and storage
Burns calories and fats. Additionally, it uses the food stored within cells to generate energy	Repairs and furnishes tissues and subsequently increases the muscle mass
Usually aerobic	Often anaerobic
Net result : ADP ---> ATP NAD+ ----> NADH	Net result : ATP ---> ADP NADPH ----> NADP+

My Notes

DIFFERENCE BETWEEN KINASES AND PHOSPHATASES

KINASES	PHOSPHATASES
Refers to an enzyme that catalyzes the transfer of a phosphate group from ATP to a specific molecule	Refers to an enzyme that catalyzes the hydrolysis of organic phosphates in an acidic or alkaline medium
Catalyzes phosphorylation reaction	Catalyzes dephosphorylation reaction
Specific towards substrates (requires OH functional group; Serine, Threonine, Tyrosine)	Relatively non-specific towards substrate
A type of phosphotransferases	A type of hydrolases
Uses ATP to obtain phosphate groups	Uses water molecules to transfer hydroxyl groups
The addition of phosphate groups acts as a switch. For most protein, kinases activates protein function	The removal of phosphate groups acts as a switch. For most proteins, phosphatases deactivate protein function
Examples include CDKs, MAPKs, phosphatidylinositol kinases, and hexokinases	Examples include PP2A, PP2B, and nucleotidases

My Notes

DIFFERENCE BETWEEN OXIDATION AND REDUCTION

OXIDATION	REDUCTION
Loss of electrons	Gain of electrons
Increase in the oxidation number	Decrease in the oxidation number
In organic chemistry, oxidation is the process of bonding C with a more electronegative atom than itself, mostly O	In organic chemistry, reduction is the process of bonding C with a less electronegative atom than itself, mostly H
A given molecule is oxidised by an oxidising agent(which itself undergoes reduction)	A given molecule is reduced by a reducing agent(which itself undergoes oxidation)
Generally, the reaction releases energy	Generally, the reaction stores energy
Disulphide linkages in protein molecules (S-S) are in the oxidised form	Sulfydryl groups (SH) in cysteine amino acid is in the reduced form
NAD+, NADP+, FAD are in oxidised form	NADH, NADPH, $FADH_2$ are in reduced form

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