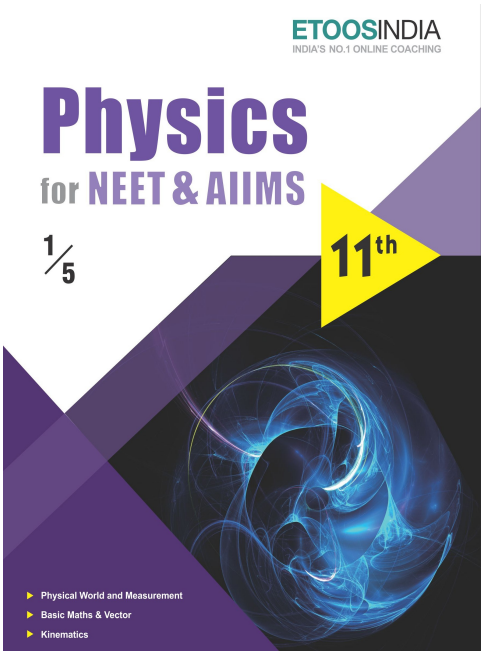
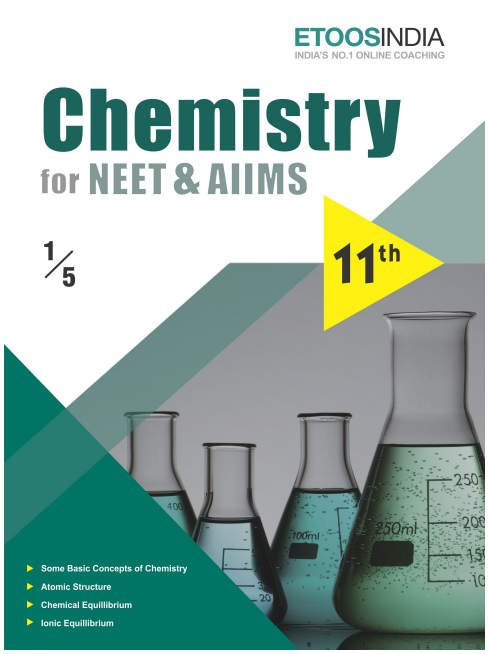
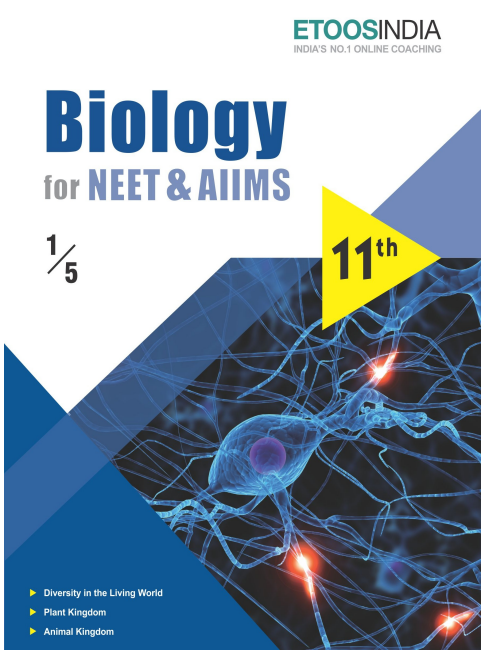
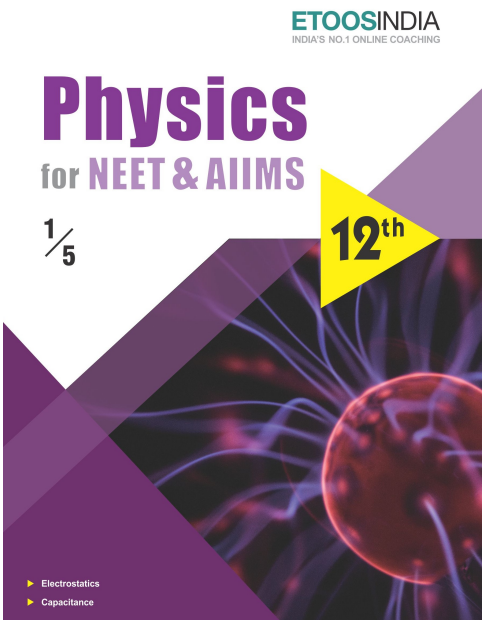
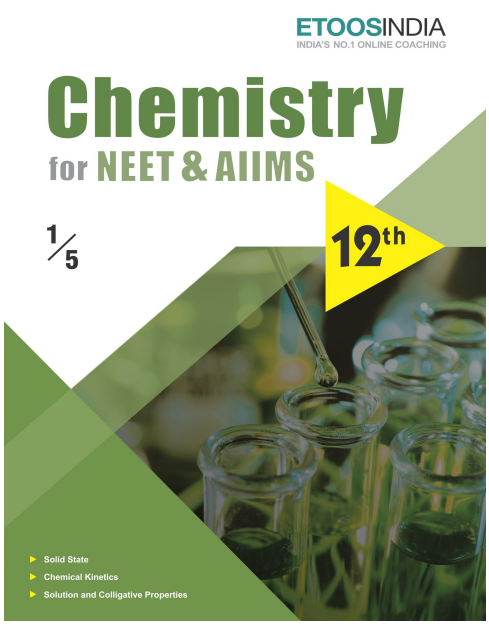
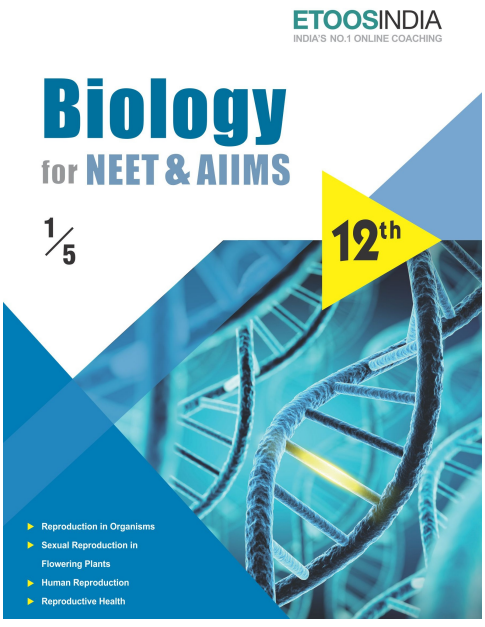












CHAPTER 13

RESPIRATION IN PLANTS

"Biochemistry has an important bearing on the progress of medicine. But because of this, it must itself remain a pure science, whose initiates are inspired by a craving for understanding and by nothing else."

" OTTO FRITZ MEYERHOF (1884-1951)"

INTRODUCTION

Why is breathing so essential for life? What happens when we breathe? When it comes to life, respiration is considered as one of the basic freatures which helps the organism to survive. Respiration provides energy for carrying out daily life activities, be it absorption, transport, movement, reproduction or even breathing.

The process of breathing is very much connected to the process of release of energy from food. All the enrggy required for 'life process' is obtained by oxidation of some macromolecules that w call as 'food'. The gaseous exchange i..e., intake of oxygen and release of carbon dioxide is calld breathing while respiration includes biological oxidation of organic molecules i.e. breaking of C–C bonds by using enzymes and results in the release of energy in the form of ATP. The oxidation of macromolecules that takes place inside the body us called as "**FOOD**". Only green plants prepare their own food through photosynthesis but only those cells which conain chloroplast show photosynthesis. In eukarytoes, photosynthesis takes place in chloroplast and respiration in cytoplasm and mitochondria. The compounds subjected to biologiccal oxidation is called **Respiratory substrate**. These may be carbohydrates, fats, protiens or organic acids.

ENZYME

Enzymes are proteinaceous, biocatalysts.

Term **enzyme** was given by **Kuhne.**

First of all isolated & discovered by **Buchner**

Zymase (from yeast) was the **first discovered enzyme. (Buchner)**

The first purified and crystalized enzyme was **urease** (by **J.B.Sumner**) from Canavalia/Jack Bean (Lobia plant).

Proteinaceous nature of enzyme was suggested by **Northrop** and **Sumner.**

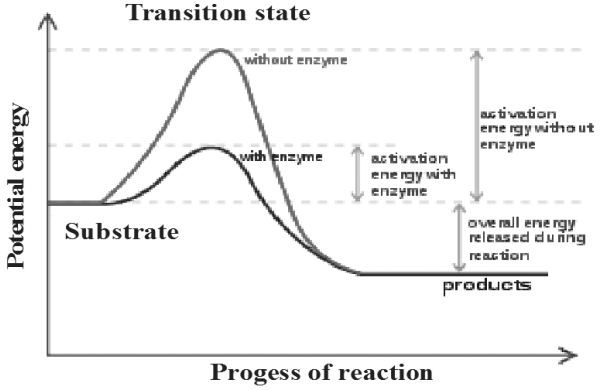
DEFINITION

Enzymes are biocatalysts made up of proteins (except ribozyme), which increases the rate of bio-chemical reactions by lowering down the activation energy.

First discovered **ribozyme** was **L19 RNAase** by **T.Cech** from rRNA of a protozoan **Tetrahymena thermophila** and **RNAase P** or **Ribonuclease P** by **Altman** in prokaryotic cell (Nobel prize).

CHARACTERISTICS OF ENZYMES

1. All enzymes are proteins, but all proteins are not enzymes.
2. Enzymes accelerate the rate of reaction, without undergoing any change in themselves.
3. Molecular weight of enzymes ranges from 6000 (bacterial fd) to 46 lakh (Pyruvate dehydrogenase comp.)
4. Enzymes are colloidal substances, which are very sensitive to **pH** & **temperature**. Optimum temperature for enzymes is 20-35°C.
5. Most of enzymes are active at neutral pH, **hydrolytic enzymes** of lysosomes are active on acidic pH (5).
6. All enzymes are **tertiary** & **globular proteins** (Isoenzymes quarternary protein)
7. Enzymes **lower down the activation energy** of substrate or reactions.
8. Enzymes are required in very minute amount for bio-chemical reactions. Their catalytic power is represented by **Michaelis Menten** constant or **Km constant** and **turn over number.**
   "The number of substrate molecules converted into products per unit time by one molecule of the enzyme in favourable conditions is called **turn over number.**" The maximum turn over number is of **Carbonic anhydrase,** is 360 lakh, for **Catalase** is 50 lakh, for **flavoprotein** is 50 & for **lysozyme** is 30 per minute.
9. Enzymes are very specific to their substrate or reactions.
10. Enzymes are **macromolecules of amino acids,** which are **synthesized on ribosomes** under the control of genes.



Concept of activation energy

Etoos Tips & Formulas

→ In cellular respiration, carbohydrates are primary respiratory substrates. Others are Fats, organic acids and proteins. Organic acids are used in CAM plants.

→ Cellular respiration is an multistep process so that energy released in some steps can be used for ATP synthesis. If it occurs in single step, all the energy may released as heat.

→ ATP - energy currency of the cell .

→ Reasons behind absence of specialised respiratory organs in plants -

→ Very little transport of gases required as each plant part takes care of its own gas exchange needs.

→ Plants have slow respiration rate.

→ In plants, most of the living cells located quite close to the surface of the plants.

1. Glycolysis - Greek words Glycos = Sugar, Lysis = Splitting.

→ Also called EMP pathway (E = Embden, M = Meyerhof, P = Parnas)

→ Common in both aerobic and anaerobic respiration.

→ Occurs in cytoplasm and it is the partial oxidation of hexose (glucose or fructose) into two molecules of pyruvic acid.

→ No use of O_2 and no release of CO_2.

→ Net or total ATP gain - 6 ATP or 8 ATP (2 $NADH_2$ = 4 or 6 ATP + 2 ATP by SLP = Substrate level

→ Direct gain of ATP = 2 ATP (by SLP) [Not count the ATP from $NADH_2$]

→ In glycolysis during anaerobic respiration, net or total or direct gain of ATP= 2 ATP [as $NADH_2$ not enter into the ETS]

Conversion of pyruvic acid to Acetyl CoA (Link reaction) is an oxidative decarboxylation catalysed by pyruvic dehydrogenase. (Occurs in the matrix of the mitochondria)

2. Krebs Cycle -

→ Also called TCA (Tri Carboxylic Acid) Cycle or CA (Citric Acid) Cycle.

→ Occurs in the matrix of the mitochondria.

→ Involve 4 dehydrogenations (3 $NADH_2$ and 1 $FADH_2$) and 2 decarboxylations (2 CO_2).

→ Net or total ATP gain - 12 ATP (3 $NADH_2$ = 9 ATP+ 1 $FADH_2$ = 2 ATP+ 1 GTP = 1 ATP).

[If Question is asked for 1 glucose or fructose - in above point no. - (iii) and (iv) calculation will be double as Krebs cycle occurs two times during complete oxidation of 1 molecule of glucose or fructose.]

→ Cycle has single 5 carbon compound - oc-ketoglutaric acid.

3. Electron transport system (ETS) and oxidative phosphorylation -

→ ETS is present in the inner mitochondrial membrane.

→ Five complexes - NADH dehydrogenase (I), $FADH_2$ (II), Cytochrome bc1 (III), Cytochrome a, a_3 & 2 C centres (IV) and ATP synthase (V).

→ In respiration the energy of oxidation - reduction utilised in production of proton gradient t synthesis ATP (Oxidative phosp!iorylation).

→ Molecular Oxygen (O_2) act as the final/ ultimate hydrogen (electron) acceptor and it get reduce, to water.

→ Mobile electron carrier - Cytochrome C and ubiquinone (UQ) / CoQ.

In aerobic respiration, net or total gain of ATP from one glucose or fructose - 36 ATP or 38 ATP.

In aerobic respiration in prokaryotes - 38 ATP.

Respolaration is an amphibolic pathway (involved in both anabolism and catabolism).

SOLVED EXAMPLE

Ex.1 The energy releasing process in which the substrate is oxidised without an external electron acceptor is called

(A) Aerobic respiration **(B)** Glycolysis

(C) Fermentation **(D)** Photorespiration

Sol. **(C)**

Ex.2. How many ATP molecules are obtained from fermentation of 1 molecule of glucose

(A) 2 **(B)** 4

(C) 3 **(D)** 5

Sol. **(A)**

Ex.3 During cellulose fermentation by anaerobic bacteria in remen and reticulum, cellulose is majority converted into

(A) Lactic acid **(B)** Ethyl alcohol

(C) Volatile fatty acids **(D)** CO_2

Sol. **(C)**

Ex.4 Aerobic respiratory pathway is appropriately termed

(A) Catabolic **(B)** Parabolic

(C) Amphibolic **(D)** Anabolic

Sol. **(C)**

Ex.5 How many ATP molecules will be generated in a plant system during complete oxidation of 40 moles of glucose ?

(A) 190 **(B)** 380

(C) 1520 **(D)** 3040

Sol. **(C)**

Ex.6 How much of the energy released during aerobic respiration is approximately conserved in the form of ATP

(A) 20 % **(B)** 40 %

(C) 60 % **(D)** 100 %

Sol. **(B)**

Ex.7 Chemiosmotic theory of ATP synthesis in the chloroplasts and mitochondria is based on

(A) Proton gradient

(B) Accumulation of K ions

(C) Accumulation of Na ions

(D) Membrane potential

Sol. **(A)**

Ex.8 Which of the option is correct for photorespiration

(A) In chloroplast, glycerate forms glycine

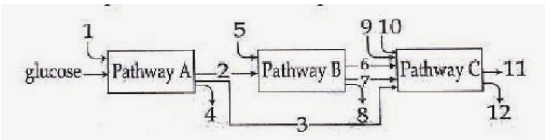
(B) In peroxisome, glycerate forms phosphoglycolate

(C) In mitochondria, glycine forms serine

(D) In bundle sheath, serine form glycine

Sol. **(C)** : Two molecules of glycine form a molecule of serine, CO_2 and NH_3 in mitochondria.

Ex.9 The three boxes in this diagram represent the three major biosynthetic pathway in aerobic respiration. Arrows represent net reactants or products.



Arrow numbered 4, 8 and 12 can all be

(A) FAD^+ or $FADH_2$ **(B)** Unused

(C) ATP **(D)** H_2O

Sol. **(C)**

Ex.10 How many ATP are formed from $NADPH^+$ to NAD^+

(A) 2 ATP **(B)** 3 ATP

(C) 6 ATP **(D)** 4 ATP

Sol. **(B)**

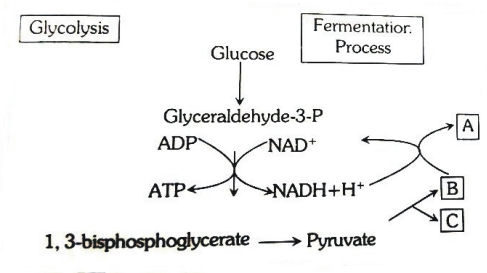
Ex.11 The net gain of energy from one gram molecule of glucose when oxidized is

(A) 2 ATP **(B)** 36 ATP

(C) 38 ATP **(D)** 15 ATP

Sol. **(C)**

Ex.12 Choose the correct combination of labelling the molecules involved in the pathway of anaerobic respiration in yeast



(A) A - EthanolB - CO_2 C - Acetaldehyde

(B) A - CO_2B - Ethanol C - Acetaldehyde

(C) A - CO_2B - Acetaldehyde C - Ethanol

(D) A - AcetaldehydeB - CO_2C - Ethanol

(E) A - EthanolB - Acetaldehyde C - CO_2

Sol. **(E)**

Exercise # 1 SINGLE OBJECTIVE NEET LEVEL

1. The end products of respiration in plants are
(A) CO_2, H_2O and energy (B) Starch and O_2
(C) Sugar and oxygen (D) H_2O and energy

2. The incomplete breakdown of sugars in anaerobic respiration results in the formation of
(A) Fructose and water
(B) Glucose and carbon dioxide
(C) Alcohol and CO_2
(D) Water and CO_2

3. Common immediate source of energy in cellular activity is
(A) glucose (B) aldohexose
(C) ATP (D) NAD

4. Different steps in respiration are controlled by
(A) Enzymes (B) Auxins
(C) Sugars (D) Kinins

5. A.T.P. is
(A) A hormone
(B) A protein
(C) An enzyme which brings about oxidation
(D) A molecule which contain high energy bond

6. In anaerobic respiration seeds respire
(A) In presence of O_2 (B) In presence of CO_2
(C) In absence of O_2 (D) In absence of CO_2

7. The following is required both by the process of respiration and photosynthesis
(A) Carbohydrates (B) Sunlight
(C) Chlorophyll (D) Cytochromes

8. The net gain of ATP molecules by glycolysis is
(A) Zero (B) Two
(C) Four (D) Eight

9. Which one of the following is not true for iso enzymes ?
(A) iso enzymes are quartenary proteins
(B) all forms synthesized by different genes'
(C) increase activation energy of substrate.
(D) All the above

10. Number of every cytochrome molecule require for transfer of $2e^-$ in ETS :
(A) 2 (B) 4 (C) 1 (D) 10

11. The respiration in germinating seeds produces energy, which can be deflected in the form of
(A) water (B) O_2
(C) Heat (D) CO_2

12. In respiration pyruvic acid is
(A) Formed only when oxygen is available
(B) One of product of Krebs cycle
(C) Broken down into Acetyl Co-A and CO_2
(D) a result of protein break down

13. Most of the energy of the carbohydrates is released by oxidation when
(A) Pyruvic acid is converted into CO_2 and H_2O
(B) Pyruvic acid is converted into acetyl Co-A
(C) Sugar is converted into pyruvic acid
(D) Glucose is converted into alcohol and CO_2

14. Glycolysis takes place in
(A) Cytoplasm (B) Chloroplast
(C) Ribosome (D) Mitochondria

15. The end product of fermentation when sugar are used as raw materials are
(A) Alcohol and CO_2 (B) Alcohol, Pyruvate
(C) CO_2 (D) Alcohol

16. Fermentation is conducted by
(A) All bacteria
(B) All fungi
(C) Some fungi and some bacteria
(D) All microorganism

17. In the process of Respiration in plants 180 gm of Glucose plus 192 gm of oxygen produce –
(A) 132 gm of CO_2, 54 gm of H_2O & 483 Cal .E.
(B) 264 gm of CO_2, 216 gm of H_2O, & 686 K.Cal E.
(C) 200 gm of C_2H_5OH, 72 gm of H_2O & 21 K. Cal E.
(D) None

18. Respiration is an
(A) Exothermic proces
(B) Endothermic process
(C) Anabolic process
(D) None of these

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

1. What is the importance of respiration in organisms?
(A) It provides oxygen to plant
(B) It liberates energy
(C) It liberates CO_2
(D) All the above

2. An indispensible role in energy metabolism is played by
(A) Phosphorus (B) Lithium
(C) Sodium (D) Calcium

3. Which component of ETS is mobile, e^- carrier ?
(A) UQ (CO-Q) (B) Cyto a
(C) Cyto - b (D) Cyto - f

4. Which of the following is the source of respiration?
(A) Stored food (B) RNA
(C) DNA (D) ATP

5. R.Q. is less than one at the time of respiration of –
(A) Starch (B) Sugarcane
(C) Glucose (D) Ground nut

6. In succulent plants R.Q. is less than one because of
(A) Complete oxidation
(B) Complete Reduction
(C) Incomplete reduction
(D) Incomplete oxidation

7. The link between Glycolysis and Krebs cycle is
(A) Citric acid (B) Malic acid
(C) Fumaric acid (D) Acetyl co-enzyme

8. Aerobic respiration of glucose produces energy
(A) 637 K.Cal (B) 640 K.cal
(C) 686 K.cal (D) 693 K.cal

9. Succinyl Co-A is related to :
(A) Krebs cycle (B) Calvin cycle
(C) Glycolate cycle (D) HMP-cycle

10. According to chemiosmotic theory of P. Mitchell (1978), ATPs are synthesised on membranes due to the :
(A) Proton gradient (B) Electron gradient
(C) Osmosis (D) From H_2SO_4

11. A reduction of NADP to $NADP.H_2$ is associated with
(A) EMP-pathway (B) HMP-shunt
(C) Calvin cycle (D) Glycolysis

12. Cut surfaces of fruits and vegetables often become dark because
(A) Dirty knife makes it dark
(B) Oxidation of tannic acid in the presence of trace of iron from the knife makes it dark
(C) Dust of the air makes it dark
(D) None of the above

13. An example of competitive inhibition of an enzyme is the inhibition of :
(A) Succinic dehydrogenase by malonic acid
(B) Cytochrome oxidase by cyanide
(C) Hexokinase by glucose - 6 phosphate
(D) Carbonic anhydrase by carbon - dioxide

14. If the temperature is increased above 35°C
(A) Rate of decline of respiration will be earlier than decline of photosynthesis
(B) Rate of decline of photosynthesis will be earlier than decline of respiration
(C) Both decline simultaneously
(D) Both do not show any fixed pattern

15. In hexose monophosphate shunt the number of CO_2 molecules evolved is
(A) Same as in glycolysis
(B) Less than glycolysis
(C) More than glycolysis
(D) Much less than glycolysis

16. Conversion of pyruvic acid into ethyl alcohol is mediated by –
(A) Phosphatase
(B) Dehydrogenase
(C) Decarboxylase & dehydrogenase
(D) Catalase

17. The formation of Acetyl Co-A from pyruvic acid is the result of its
(A) Reduction
(B) Dehydration
(C) Phosphorylation
(D) Oxidative decarboxylation

Exercise # 3 PART - 1 MATRIX MATCH COLUMN

1. Match Column - I with Column - II and select the correct option from the codes given below.

Column - I	Column - II
A. Wine	(i) Apples
B. Cider	(ii) Grapes
C. Beer	(iii) Molasses
D. Rum	(iv) Cereals

(A) A-(ii), B-(iv), C-(iii), D-(i) (B) A-(ii), B-(i), C-(iv), D-(iii)
(C) A-(iv), B-(iii), C-(ii), D-(i) (D) A-(iv), B-(ii), C-(iii), D-(i)

2. Match Column - I with Column - II and select the correct option from the codes given below.

Column - I	Column - II
A. Fats made of three fatty-acid	(i) Glycogen chains attached to glycerol
B. Glycolysis metabolite made	(ii) Glyceraldehyde from glycerol
C. Storage form of glucose	(iii) Triglycerides
D. Result of running reactions	(iv) Glucose of glycolysis in reverse

(A) A-(iv), B-(ii), C-(i), D-(iii) (B) A-(iii), B-(ii), C-(i), D-(iv)
(C) A-(iv), B-(iii), C-(i), D-(ii) (D) A-(i), B-(ii), C-(iii), D-(iv)

3. Match Column-I with Column-II and select the correct option from the codes given below.

Column-I	Column - II
A. TCA cycle	(i) Inner mitochondrial membrane
B. $F_0 - F_1$ particles	(ii) Hans Krebs
C. End product of	(iii) Oxidative decarboxylation glycolysis
D. Pyruvate	(iv) Pyruvic acid dehydrogenase

(A) A-(ii), B-(i), C-(iv), D-(iii) (B) A-(i), B-(ii), C-(iv), D-(iii)
(C) A-(ii), B-(iii), C-(iv), D-(i) (D) A-(iii), B-(ii), C-(i), D-(iv)

4. Match Column - I with Column - II and select the correct option from the codes given below.

Column - I	Column - II
A. R.Q	(i) Chemiosmotic ATP synthesis
B. Mitchel	(ii) Muscle fatigue
C. Cytochromes	(iii) Inner mitochondrial membrane
D. Lactic acid	(iv) Alcoholic fermentation
E. Yeast	(v) Respirometer

(A) A-(v), B-(i), C-(iii), D-(ii), E-(iv) (B) A-(v), B-(i), C-(iii), D-(iv), E-(ii)
(C) A-(i), B-(v), C-(ii), D-(iii), E-(iv) (D) A-(v), B-(ii), C-(iv), D-(iii), E-(i)

5. Match Column-I with Column-II and select the correct option from the codes given below.

Column-I	Column-II
A. Glycolysis	(i) Inner mitochondrial membrane
B. TCA cycle	(ii) Mitochondrial matrix
C. ETS	(iii) Cytoplasm

(A) A-(iii), B-(i), C-(ii) (B) A-(iii), B-(ii), C-(i)
(C) A-(i), B-(ii), C-(iii) (D) A-(ii), B-(i), C-(iii)

Exercise # 4

PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. How many ATP molecules produced by Aerobic oxidation of one molecule of glucose : - [CBSE AIPMT 2002]
(A) 2 (B) 4
(C) 38 (D) 34

2. In which one of the following do the two names refer to one and the same thing : - [CBSE AIPMT 2003]
(A) Tricarboxylic acid cycle and urea cycle
(B) Kreb's cycle and Calvin cycle
(C) Tricarboxylic acid cycle and citric acid cycle
(D) Citric acid cycle and Calvin cycle

3. Which one of the following concerns photophosphorylation : - [CBSE AIPMT 2003]
(A) AMP + Inorganic $PO_4 \xrightarrow{\text{Light energy}}$ ATP
(B) ADP + AMP $\xrightarrow{\text{Light energy}}$ ATP
(C) ADP + Inorganic $PO_4 \xrightarrow{\text{Light energy}}$ ATP
(D) ADP + Inorganic $PO_4 \longrightarrow$ ATP

4. In alcoholic fermentation : - [CBSE AIPMT 2003]
(A) Oxygen is the electron acceptor
(B) Triose phosphate is the electron donor while acetaldehyde is the electron acceptor
(C) Triose phosphate is the electron donor while pyruvic acid is the electron acceptor
(D) There is no electron donor

5. In glycolysis, during oxidation electrons are removed by - [CBSE AIPMT 2004]
(A) ATP
(B) Glyceraldehyde-3-phosphate
(C) NAD^+
(D) Molecular oxygen

6. Chemiosmotic theory of ATP synthesis in the chloroplasts and mitochondria is based on [CBSE AIPMT 2005]
(A) Membrane potential
(B) Accumulation of Na^+ ions
(C) Accumulation of K^+ ions
(D) Proton gradient

7. During which stage in the complete oxidation of glucose are the greatest number of ATP molecules formed from ADP - [CBSE AIPMT 2005]
(A) Glycolysis
(B) Krebs cycle
(C) Conversion of pyruvic acid to acetyl Co - A
(D) Electron transport chain

8. How many ATP molecules could maximally be generated from one molecule of glucose, if the complete oxidation of one mole of glucose to CO_2 and H_2O yields 686 kcal and the useful chemical energy available in the high energy phosphate bond of one mole of ATP is 12 kcal ? [CBSE AIPMT 2006]
(A) 30 (B) 57
(C) 1 (D) 2

9. All enzymes of TCA cycle are located in the mitochondrial matrix except one which is located in inner mitochondrial membranes in eukaryotes and in cytosol in prokaryotes. This enzyme is: [CBSE AIPMT 2007]
(A) lactate dehydrogenase
(B) isocitrate dehydrogenase
(C) malate dehydrogenase
(D) succinate dehydrogenase

10. The overall goal of glycolysis, Krebs cycle and the electron transport system is the formation of: [CBSE AIPMT 2007]
(A) ATP is small stepwise units
(B) ATP in one large oxidation reaction
(C) Sugars
(D) Nucleic acids

11. The chemiosmotic coupling hypothesis of oxidative phosphorylation proposes that Adenosine Tri-Phosphate (ATP) is formed because: [CBSE AIPMT 2008]
(A) High energy bonds are formed in mitochondrial proteins
(B) ADP is pumped out of the matrix into the intermembrane space
(C) A proton gradient forms across the inner membrane
(D) There is a change in the permeability of the inner mitochondrial membrane toward Adenosine Di-Phosphate (ADP)

MOCK TEST

1. Which enzyme helps in transfer of phosphate group from ATP to a carbohydrate?
(A) Phosphatase (B) ATPase (C) Phosphorylase (D) Catalase

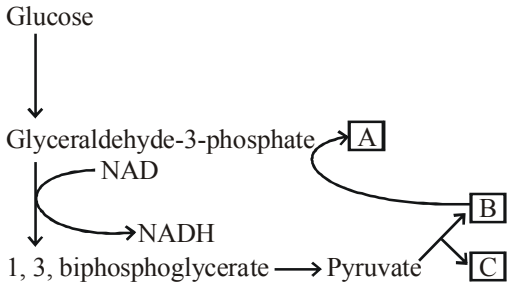
2. During glycolysis, fructose 1, 6-bisphosphate is split into
(A) dihydroxyacetone phosphate and 2-phosphoglyceraldehyde
(B) dihydroxyacetone phosphate and 1-phosphoglyceraldehyde
(C) dihydroxyacetone phosphate and 2-phosphoglycerate
(D) dihydroxyacetone phosphate and 3-phosphoglyceraldehyde

3. Select the correct order of reactions in glycolysis.
A. Conversion of 3-phosphoglyceraldehyde to 1,3-bisphos-phoglycerate
B. Conversion of 3-phosphoglyceric acid to 2-phospho-glycerate
C.Conversion of BPGA to 3-phosphoglyceric acid
D. Splitting of fructose 1,6-bisphosphate into dihydroxy acetone phosphate and 3-phosphoglyceraldehyde
(A) D, C, A, B (B) B, C, A, B (C) B, D, A, C (D) A, D, C, B
(E) D, A, C, B

4. In glycolytic pathway which of the following steps shows reduction of co-enzyme?
(A) 1, 3-diphosphoglycerate to 3-phosphoglycerate
(B) Glucose 6-phosphate to fructose 6-phosphate
(C) Glyceraldehyde 3-phosphate to 1, 3-diphospho-Glycerate
(D) 3-phsophoglycerate to 2-phosphoglycerate

5. Conversion of pyruvic acid into ethyl alcohol is facilitated by the enzymes
(A) carboxylase (B) phosphatase
(C) dehydrogenase (D) decarboxylase and dehydrogenase

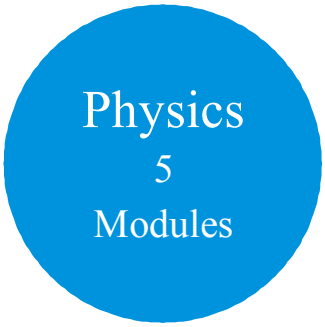
6. Choose the correct combination of labelling the molecules involved in the pathway of anaerobic respiration in Yeast.

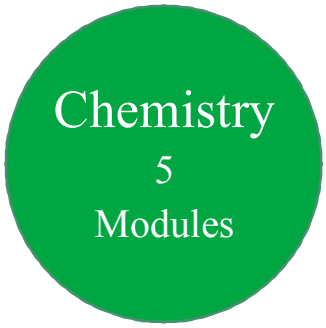


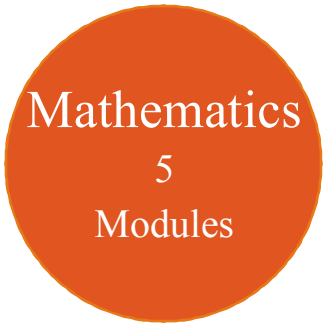
(A) A- Acetaldehyde, B- CO_2, C - Ethanol
(B) A - Ethanol, B-CO_2, C-Acetaldehyde
(C) A - Ethanol, B-Acetaldehyde, C - CO_2
(D) A - CO_2, B - Ethanol, C - Acetaldehyde

7. During alcoholic fermentation by yeast two molecules of glucose produce
(A) 2 molecules of ethanol + 2 molecules of CO_2 (B) 4 molecules of ethanol + 4 molecules of CO_2
(C) 6 molecules of ethanol + 6 molecules of CO_2 (D) 3 molecules of ethanol + 3 molecules of CO_2

11th Class Modules Chapter Details

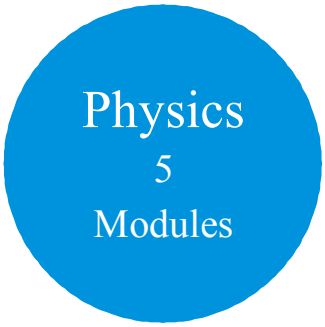


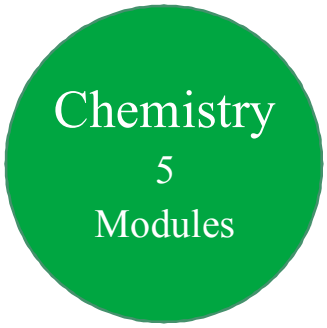


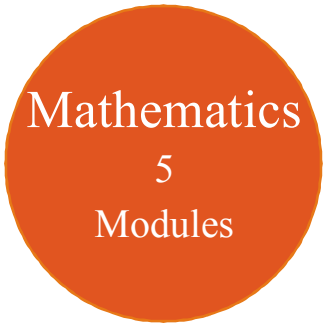


PHYSICS	CHEMISTRY	BIOLOGY
Module-1 1. Physical World & Measurements 2. Basic Maths & Vector 3. Kinematics **Module-2** 1. Law of Motion & Friction 2. Work, Energy & Power **Module-3** 1. Motion of system of particles & Rigid Body 2. Gravitation **Module-4** 1. Mechanical Properties of Matter 2. Thermal Properties of Matter **Module-5** 1. Oscillations 2. Waves	**Module-1(PC)** 1. Some Basic Conceps of Chemistry 2. Atomic Structure 3. Chemical Equilibrium 4. Ionic Equilibrium **Module-2(PC)** 1. Thermodynamics & Thermochemistry 2. Redox Reaction 3. States Of Matter (Gaseous & Liquid) **Module-3(IC)** 1. Periodic Table 2. Chemical Bonding 3. Hydrogen & Its Compounds 4. S-Block **Module-4(OC)** 1. Nomenclature of Organic Compounds 2. Isomerism 3. General Organic Chemistry **Module-5(OC)** 1. Reaction Mechanism 2. Hydrocarbon 3. Aromatic Hydrocarbon 4. Environmental Chemistry & Analysis Of Organic Compounds	**Module-1** 1. Diversity in the Living World 2. Plant Kingdom 3. Animal Kingdom **Module-2** 1. Morphology in Flowering Plants 2. Anatomy of Flowering Plants 3. Structural Organization in Animals **Module-3** 1. Cell: The Unit of Life 2. Biomolecules 3. Cell Cycle & Cell Division 4. Transport in Plants 5. Mineral Nutrition **Module-4** 1. Photosynthesis in Higher Plants 2. Respiration in Plants 3. Plant Growth and Development 4. Digestion & Absorption 5. Breathing & Exchange of Gases **Module-5** 1. Body Fluids & Its Circulation 2. Excretory Products & Their Elimination 3. Locomotion & Its Movement 4. Neural Control & Coordination 5. Chemical Coordination and Integration

12th Class Modules Chapter Details







PHYSICS

Module-1

1. Electrostatics
2. Capacitance

Module-2

1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3

1. Electromagnetic Induction
2. Alternating Current

Module-4

1. Geometrical Optics
2. Wave Optics

Module-5

1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)

1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)

1. Electrochemistry
2. Surface Chemistry

Module-3(IC)

1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)

1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)

1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1

1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2

1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3

1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4

1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5

1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues