SAMPLE CONTENT

Absolute

BIOLOGY Vol - II

For all Medical Entrance Examinations held across India.

NEET-UG

2841 MCQs with Hints

Now with more study techniques

Insect Pollination:

When bees visit flowers for collecting nectar, their bodies get a coating of pollengrains. When these bees carrying pollengrains come in contact with the receptive stigma, it brings about pollination.

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Target Publications® Pvt. Ltd.

For all Medical Entrance Examinations held across India.

Absolute

NEET – UG

Biology Vol. II

Now with more study techniques

Salient Features

- Exhaustive theory for every topic.
- Exhaustive subtopic wise coverage of MCQs.
- '2841' MCQs including questions from previous NEET examinations.
- Includes NEET (UG) 2021 Question Paper and Answer Key along with Hints.
- Various competitive exam questions are exclusively covered.
- Neat and labelled authentic diagrams.
- Multiple study techniques to enhance understanding and problem solving.
- Hints are provided wherever deemed necessary.
- Quick Review to build concepts.
- Video links provided via Q.R. codes for boosting conceptual retention.
- Topic test provided at the end of each chapter.

Scan the adjacent Q.R. Code to access solutions/hints to Topic Test.
(tp2012)

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PREFACE

Target's **"Absolute Biology Vol – II"** is a complete guidebook, extremely handy for the preparation of various competitive examinations like NEET (UG). This edition provides an unmatched comprehensive amalgamation of theory with MCQs. The chapters are compiled according to the notified syllabus for NEET-UG. The content of this book is framed after reviewing the format of NCERT textbook**.** The book provides the students with scientifically accurate context, several study techniques and relevant supporting details essential for a better understanding of biology.

The sections of **Theory, Quick Review**, **MCQs** and **Topic Test** form the backbone of every chapter and ensure adequate revision.

In this book the Theoretical Concepts are presented elaborately along with diagrams that enable better preparation of the basics of topics for any competitive examination.

The Multiple Choice Questions in each chapter are a mix of questions based on higher order thinking, theory and multiple concepts. The level of difficulty of these questions is at par with that of various competitive examinations like CBSE, AIIMS, CPMT, AFMC, JIPMER, TS EAMCET (Med. and Engg.), BCECE, AP EAMCET (Med. and Engg.) and likes. Also to keep students updated, questions from most recent examinations of NEET 2020 are covered exclusively.

NEET (UG) 2021 Question Paper and Answer Key has been provided so that students can get a glimpse of the complexity of questions asked in entrance examination. The paper has been split unit-wise to let the students know which of the units were more relevant in the latest examination.

Topic Test has been provided at the end of each chapter to assess the level of preparation of the student on a competitive level.

All the features of this book pave the path of a student to excel in their examinations. The features are designed keeping the following elements in mind: Time management, easy memorization or revision and non-conventional yet simple methods for MCQ solving.

We are confident that this book will cater to needs of students across a varied background and effectively assist them to achieve their goal.

We hope the book benefits the learner as we have envisioned.

A book affects eternity; one can never tell where its influence stops.

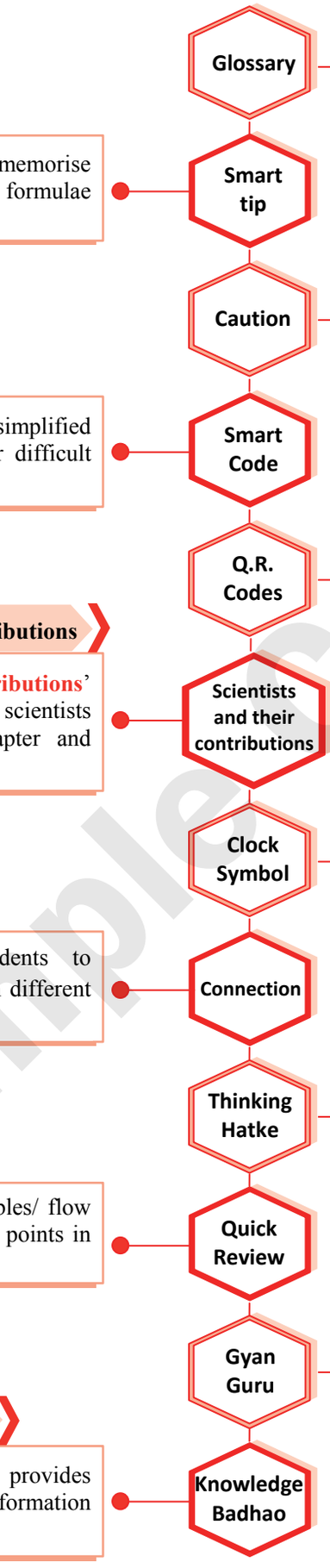
\- Publishe

Edition: Sixth

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

Please write to us on: mail@targetpublications.org

KEY FEATURES



Glossary

'**Glossary**' provides the simplified explanations of certain difficult words encountered in the chapter.

Smart tip

'**Smart tip**' can be used to memorise or revise the key points and formulae at a glance.

Caution

'**Caution**' helps students to clarify the difference between two related words or homophones.

Smart Code

'**Smart Code**' provides simplified mnemonics for important or difficult concepts.

QR code

'**QR code**' provides:

i. Access to a video/PDF in order to boost understanding of a concept or activity

ii. Hints to Topic Test of each chapter and NEET (UG) 2021.

Scientists and their contributions

'**Scientists and their contributions**' provide a list of renowned scientists studied throughout the chapter and their discoveries/ inventions.

Clock Symbol

'**Clock Symbol**' instructs students that the given MCQ can be solved apace by applying either smart tips, smart codes or thinking hatke.

Connection

'**Connection**' enables students to interlink concepts covered in different chapters.

Thinking Hatke

'**Thinking Hatke**' section provides the students with tricks to arrive at the correct answer in a more non-conventional yet simple way.

Quick Review

'**Quick Review**' includes tables/ flow charts to summarize the key points in chapter.

Gyan Guru

'**Gyan Guru**' illustrates real life applications or examples related to the concept discussed.

Knowledge Badhao!

'**Knowledge Badhao**' provides students with additional information relevant to the concept.

Frequently Asked Questions

➢ **Why Absolute Series?**

Gradually, every year the nature of competitive entrance exams is inching towards conceptual understanding of topics. Moreover, it is time to bid adieu to the stereotypical approach of solving a problem using a single conventional method.

To be able to successfully crack the NEET (UG) examinations, it is imperative to develop skills such as data interpretation, appropriate time management, knowing various methods to solve a problem, etc. With Absolute Series, we are sure, you'd develop all the aforementioned skills and take a more holistic approach towards problem solving. The way you'd tackle advanced level MCQs with the help of Hints, Smart tips, Smart codes and Thinking Hatke would give you the necessary practice that would be a game changer in your preparation for the competitive entrance examinations.

➢ **What is the intention behind the launch of Absolute Series?**

The sole objective behind the introduction of Absolute Series is to cater to needs of students across a varied background and effectively assist them to successfully crack the NEET (UG) examinations. With a healthy mix of MCQs, we intend to develop a student's MCQ solving skills within a stipulated time period.

➢ **What do I gain out of Absolute Series?**

After using Absolute Series, students would be able to:

a. assimilate the given data and apply relevant concepts with utmost ease.
b. tackle MCQs of different pattern such as match the columns, diagram based questions, multiple concepts and assertion-reason efficiently.
c. garner the much needed confidence to appear for competitive exams.
d. apply easy and time saving methods to tackle tricky questions which will help ensure that time consuming questions do not occupy more time than you can allot per question.

➢ **How to derive the best advantage of the book?**

To get the maximum benefit of the book, we recommend :

a. Go through the detailed theory at the beginning of a chapter for concept clarity. Commit Smart Tips and Smart Codes into memory and pay attention to Caution.
b. Using subtopic wise segregation as a leverage, complete MCQs in each subtopic at your own pace. Questions from exams such as NEET-UG are tagged and placed along the flow of subtopic. Mark these questions specially to gauge the trends of questions in various exams.
c. Be extra receptive to Thinking Hatke and application of Smart Tips and Smart Codes. Assimilate them into your thinking.

Best of luck to all the aspirants!

CONTENTS

Note:  symbol along with the question indicates there exists either an unconventional way or use of either Smart tip / Thinking hatke / Smart Code / any other short ways of solving that MCQ.

 symbol after a word in theory indicates that the meaning of the word in provided in the glossary section.

Solving previous year papers is the best way to work on your strength, weaknesses, and time management.
Scan the adjacent QR Code to know more about our ***"34 Years NEET Biology PSP (Previous Solved Papers)"*** book for the NEET UG Entrance examination.

Get an overall idea of the type of questions that are asked in the NEET UG Examination.
Scan the adjacent QR Code to know more about our ***"Previous 9 Years NEET solved papers with Solutions"*** book for the NEET UG Entrance examination.

Practice test Papers are the only way to assess your preparedness for the Exams.
Scan the Adjacent QR code to know more about our ***"NEET (UG) Biology Test Series with Answer Keys & Solutions"*** book for the NEET UG Entrance examination.

Do you want to improve your score of NEET-UG Examination?
Scan the Adjacent QR code to know more about our ***"NEET UG 10 Full Syllabus Mock Tests"*** book.

10 Microbes in Human Welfare

10.0 Introduction

Microbes are the major components of biological systems on this earth other than macroscopic plants and animals. These microbes are present everywhere - in soil, water, air, inside our bodies and in plants and animals.
They also exist at sites where no other living form can exist. e.g. Deep inside the geysers at temperature of 100 °C or more, deep in the soil, under the layers of snow with thickness of several meters, in highly acidic environments.
Microbes are diverse and include fungi, bacteria, protozoans, microscopic plant viruses, viroid and prions which are proteinaceous infectious agents.
Microbes like bacteria and fungi can be grown on nutritive media[G] which form colonies. These colonies are visible to naked eyes. Cultures are useful for studying micro-organisms.
Microbes are harmful as well as useful for human beings. Harmful microbes cause various infectious diseases to human beings, plants and animals.
However, all microbes are not harmful. There are number of microbes which help in human welfare by carrying out important processes.

10.1 Microbes in Household products

In our day to day life we use microbes or even their products. Some of them are:

i. Curd:
Curd is produced by action of micro-organisms such as *Lactobacillus* and other Lactic Acid Bacteria (LAB).
LAB produces lactic acid that coagulates and partially digests the milk proteins during their growth.
A small amount of curd called inoculum or starter is added to the milk which contains millions of lactic acid bacteria which multiply and initiate the curdling of the milk at suitable temperature.
This improves the nutritional quality by increasing vitamin B_{12} content.
LAB present in our stomach plays an important role in checking disease causing micro-organisms.

ii. Idli:
Dosa and idli are prepared by fermentation of dough.
The bubbles of CO_2 released during fermentation process gives a puffy appearance to the dough.

iii. Bread:
Dough for bread is fermented by adding Baker's yeast called *Saccharomyces cerevisiae*.

iv. Traditional drinks and food:
Traditional drinks and foods are prepared by fermentation[G] using microbes.
"Toddy" is a traditional drink of southern India. It is made by fermentation of sap from palm trees.
Fish, soybean and bamboo shoots are fermented with the help of microbes.

v. Cheese:
There are several varieties of cheese with different texture, flavor and taste.
It is one of the oldest items where microbes were used.
Cheese is produced by using microbes. Specific texture, flavor and taste are given to the cheese by the specific microbe that is used to prepare it.
In Swiss cheese, the large holes are due to production of large amount of CO_2 by *Propionibacterium shermanii.*
Roquefort cheese is ripened by specific fungi grown on them, giving a particular flavor to it.

10.2 Microbes in Industrial Products

In industries, microbes are used to synthesize varied number of products that are valuable to human beings.
e.g. Beverages and antibiotics.
Large vessels called fermentors are required to grow microbes on an industrial scale.

CAUTION

Fermentor refers to the fermentation vessel, whereas **fermenter** refers to the agent causing fermentation (e.g. Yeast)

➢ **Fermented Beverages:**

i. Yeasts have been used to produce beverages like wine, beer, whisky, brandy or rum since ancient times.
ii. Alcoholic beverages containing ethanol are formed by fermenting malted cereals and fruit juices with *Saccharomyces cerevisiae* or brewer's yeast.
iii. Various alcoholic drinks are produced depending upon the raw material used and the nature of processing i.e. with or without distillation.Ⓖ
iv. Alcoholic beverages produced with distillation are whisky, rum and brandy whereas without distillation are wine and beer.

SMART CODE - 1

Alcoholic drinks produced with distillation

Bran Wants Revenge

Bran – Brandy, W - Whisky, R – Rum

SMART CODE - 2

Alcoholic drinks produced without distillation

Belgian Waffle

B – Beer, W - Wine

CAUTION

Saccharomyces cerevisiae is known as Baker's yeast as well as Brewer's yeast.

➢ **Antibiotics:**

i. In 20th century, the antibiotics produced by microbes were considered as one of the most significant discoveries. It contributed towards the welfare of humans.
ii. In Greek, 'anti' means 'against' and 'bio' means 'life' in the context of disease-causing organisms and to humans they are 'pro-life' and not against.
iii. Antibiotics are chemical substances which are produced by some microbes and can kill or retard the growth of other disease causing microbes.
iv. Penicillin was the first antibiotic discovered by Alexander Fleming.
While working on *Staphylococci* bacteria, he observed a mould growing on one of his unwashed culture plates around which *Staphylococci* did not grow. He observed that chemical produced by the mould inhibit the growth of other bacteria. This chemical is named after the mould *Penicillium notatum*.
v. The establishment of Penicillin as antibiotics was done much later by Ernest Chain and Howard Florey. It was used to treat American soldiers wounded in World War II.
vi. The Nobel Prize for discovery of Penicillin was shared by Fleming, Chain and Florey in 1945.
vii. Some other antibiotics were also purified from other microbes. Deadly diseases like plague, whooping cough (*kali khansi*), diphtheria (*gal ghotu*) and leprosy (*kusht rog*) can be treated with antibiotics which killed millions over the globe.
***[Note:** Penicillium notatum* is now known as *Penicillium chrysogenum.]*

➢ **Chemicals, Enzymes and other Bioactive Molecules:**

i. Microbes are utilized for commercial and industrial production of certain chemicals like organic acids, alcohols and enzymes.

ii. Microbes along with acids they produce are given below:
Citric acid is produced by *Aspergillus niger* (fungus), **Acetic acid** is produced by *Acetobacter aceti* (bacterium), **Butyric acid** is produced by *Clostridium butylicum* (bacterium), **Lactic acid** is produced by *Lactobacillus* (bacterium).

iii. **Ethanol** is produced from yeast *Saccharomyces cerevisiae*.

iv. Microbes are also used in production of enzymes. Following are the enzymes produced by microbial species:
   a. Enzyme **lipase** produces by microbes is used to remove oily stains. It is used in detergent formulations.
   b. Microbial enzymes like **pectinase** and **protease** are used to clarify bottled juices.
   c. A bioactive molecule, **Cyclosporin A** is used as immunosuppressive agent for organ transplants. It is produced by fungus *Trichoderma polysporum*.
   d. **Statins** produced by the yeast *Monascus purpureus* are commercial blood-cholesterol lowering agents. The mechanism of action is to inhibit the enzyme responsible for synthesis of cholesterol.
   e. **Streptokinase** produced by the bacterium *Streptococcus* and modified by genetic engineering is used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack.

10.3 Microbes in Sewage Treatment

i. Large quantities of wastewater are generated in cities and towns every day. Human excreta is a major component of wastewater. This municipal wastewater is called sewage.

ii. Large amount of organic matter and microorganisms are present in the sewage. Many of these microbes are pathogenic (disease causing). This waste water cannot be let out into natural water bodies like rivers and streams.

iii. Sewage is thus treated in sewage treatment plants (STPs) before disposal, which makes it less polluting.

iv. Treatment of wastewater is done by the heterotrophic microbes that are present in sewage naturally.

v. It is carried out in two steps:

A. Primary treatment (Physical process):

1. It involves physical removal of small and large particles from sewage through filtration and sedimentation.
2. Sequential filtration is used for removing floating objects.
3. The grit i.e. sand and small pebbles is removed by the method of sedimentation.Ⓖ
4. The sediment is called primary sludge and the supernatant is called effluent.
5. The effluent is taken for secondary treatment.

B. Secondary treatment (Biological process):

1. The primary effluent is passed into large aeration tanks with constant mechanical agitation and air supply.
2. The mechanical agitation and air supply allow useful aerobic microbes to grow rapidly and form flocs.
3. Flocs are masses of bacteria associated with fungal filaments to form mesh-like structure.
4. The growing microbes consume organic matter and thus reduce the biochemical oxygen demand (BOD).
5. BOD refers to the amount of oxygen that would be consumed if all the organic matter in one litre of water were oxidized by bacteria.
6. When BOD of sewage has reduced, the effluent is passed into settling tank.
7. The bacterial flocs settle and the sediment is called activated sludge.
8. A part of this activated sludge is used as an inoculum which is pumped back into the aeration tanks.
9. The remaining part is passed into large tanks called anaerobic sludge digesters.
10. In the digesters, anaerobic microbes digest the bacteria and fungi in the sludge and produces mixture of gases such as methane, hydrogen sulphide and carbon dioxide which form the biogas.
11. It can be used as a source of energy as it is inflammable.
12. After this treatment, the effluent is released into natural water bodies like streams and rivers.

vi. This technique is practiced for more than a century now; no man-made technology has been able to compete with microbial treatment of sewage.

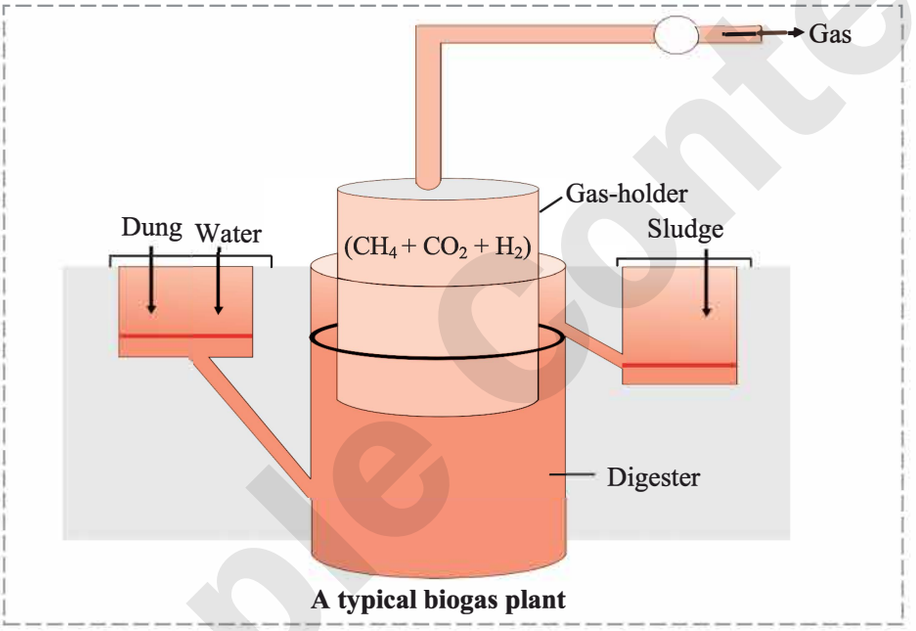
vii. With an increase in urbanization, sewage has also increased than before. But, sewage treatment plants have not increased in comparison. Hence, the untreated sewage is directly released into rivers leading to pollution and spread of water-borne diseases.

viii. An initiative of **Ganga Action Plan** and **Yamuna Action Plan** is taken by Ministry of Environment and Forests. These plans are proposed to build a large number of sewage treatment plants so as to discharge only treated sewage and save these major rivers.

10.4 Microbes in Production of Biogas

i. Biogas is a mixture of gases containing highest percentage of methane produced by microbial activity and which is a potent fuel.
ii. Various gases are produced during growth and metabolism of microbes. Depending upon the types of organic substrate utilized, microbes produces different gases.
iii. During the process of fermentation of dough, cheese making and production of beverages, main gas produced was CO_2.
iv. Bacteria which grow anaerobically on a cellulose material produce methane in large amounts, with CO_2 and H_2. These bacteria are called methanogens. e.g. *Methanobacterium*.
v. Methanogens are found in anaerobic sludge during sewage treatment. These bacteria are present in rumen of cattle. Rumen majorly contains cellulosic material which is present in the food of cattle. Bacteria breakdown this cellulose and provide nutrition to the cattle.
vi. Bacteria which are able to digest cellulose are not found in humans. Hence, they are unable to digest cellulose. The excreta of cattle (dung) called gobar is rich in these bacteria. Gobar gas is generated from the dung of cattle.

➢ **Biogas Plant**



A typical biogas plant

i. Biogas plant is a concrete tank which is 10-15 feet deep in which bio-wastes are collected and slurry of dung is fed. A floating cover is placed on the slurry. The slurry is digested in following manner.
ii. Due to the gas produced by microbial action in tank, the floating cover placed over the slurry rises.
iii. The biogas plant is provided with an outlet which supplies biogas through a pipe.
iv. Through another outlet, the utilized slurry is removed which can be used as fertilizer.
v. Availability of cattle dung in large proportions is seen in rural areas. Thus the produced biogas produced is used for cooking and lighting in such areas.
vi. Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC) developed the technology of biogas production in India.

10.5 Microbes as Biocontrol Agents

i. The use of biological methods for controlling plant diseases and pests is termed as **biocontrol**.
ii. Due to modernization, use of chemicals has increased to tackle the diseases. These chemicals are toxic and harmful to humans as well as animals.
iii. They lead to pollution of environment, fruits, vegetables and crops. Also, the use of weedicides to remove weeds has increased soil pollution.

Biocontrol of pests and diseases:

i. This method relies on controlling pests by natural predation. It does not use conventional practices which include use of chemicals.

ii. Organic farmers believe that biodiversity furthers health. Thus, they work to create a system in which pests are not completely eradicated but managed to a certain level by a complex system of checks and balances within the ecosystem.
iii. It is based on holistic approach which aims to establish an understanding of webs of interaction between the large number of organisms that constitute the flora and fauna.
iv. Organic farmers are of an opinion that complete eradication of pests is impossible. It is also undesirable as many of the predators and parasitic insects depend on them as food or hosts.
v. Use of biocontrol results in decrease in use of insecticides and pesticides.
vi. The main part of biological farming approach is to know the various life forms inhabiting the field, their predators and pests and also their life cycles, feeding pattern, preferred habitats.
vii. Ladybird beetle (with red and black markings) and dragonflies control aphids and mosquitoes respectively.
viii. Microbial biocontrol agents e.g. bacteria *Bacillus thuringiensis* (Bt) controls butterfly caterpillars. They are available as dry spores in sachets. Vulnerable plants such as *Brassica* and fruit trees are sprayed with spores mixed in water.
ix. When these are consumed by insect larvae, toxins get released in the gut thereby killing the larvae. By these methods only caterpillars will be killed and other insects will remain unaffected.
x. Advances in the methods of genetic engineering led to the introduction of *B. thuringiensis* toxin genes into plants. These plants are resistant to insect pests. e.g. Bt cotton.
xi. Fungus *Trichoderma* are used in the treatment of plant disease. They are free-living in root ecosystems. They are effective on several plant pathogens.
xii. Nucleopolyhedrovirus (part of the family of Baculovirus), are majorly used as biological agents. They attack insects and other arthropods. Viruses are excellent candidates in genetic engineering due to following characteristics:
    a. Species specific
    b. Narrow spectrum insecticidal applications
    c. No negative impacts on plants, mammals, fishes or even on other insects.
xiii. These characteristics are advantageous to conserve beneficial insects and it helps in Integrated Pest Management (IPM) programme. It is also useful while treating ecologically sensitive area.

Knowledge Badhao!

Toxin of *Bacillus thuringiensis* target insect larvae when eaten. The toxin is activated in their gut. The alkaline pH of the gut triggers the activation of protoxin to active Bt toxin. The activated toxin breaks down in the gut which causes infection and starvation ultimately leading to death of an insect.

10.6 Microbes as Biofertilizers

i. Use of chemical fertilizers to increase the agricultural production has contributed largely to environmental pollution.
Due to the long lasting effects of these fertilizers, there was a need to switch to organic farming.
ii. Organic farming involves the use of biofertilizers. The micro-organisms which enrich the nutrient quality of the soil are called biofertilizers.
iii. The main sources of biofertilizers are bacteria, cyanobacteria and fungi.

A. Bacteria as nitrogen fixer

1. *Rhizobium* during symbiotic association with leguminous plants forms nodules. These bacteria are capable of fixing atmospheric nitrogen into organic forms, which is utilized for plant nutrition.
2. Other bacteria like *Azospirillum* and *Azotobacter* are free-living in soil. They can fix atmospheric nitrogen which thereby enriches nitrogen content of the soil.

B. Fungi

1. Mycorrhiza is a symbiotic association between fungus and plants. Such association is formed by many members of genus *Glomus*.
2. The fungal symbiont absorbs phosphorus from soil and transports it to other parts of plant.
3. Benefits of symbiotic association to plants: Resistance to root-borne pathogens, tolerance to salinity and drought, plant growth and development

C. Cyanobacteria

1. Cyanobacteria are autotrophic organisms found in terrestrial and aquatic habitats.
2. Many of them can fix atmospheric nitrogen.
3. The common examples of biofertilizers are *Oscillatoria*, *Nostoc, and Anabaena* etc.

4. Cyanobacteria act as an important biofertilizer in paddy fields.
5. Blue green algae add organic matter to the soil and increases fertility.

iv. A variety of biofertilizers are available in market for commercial purposes. Farmers use these biofertilizers in order to replenish the nutrients of soil and to reduce the use of chemical fertilizers.

Glossary

Word	Meaning
Distillation	It is a process of purification.
Fermentation	A metabolic process which involves conversion of carbohydrate to alcohol or acid.
Nutritive media	Growth medium for microorganisms.
Sedimentation	Tendency of particles to settle down.

Quick Review

MICROBES IN HUMAN WELFARE

Microbes in Food Production

- **Curd** → Lactobacilli
- **Idlis and Dosas** → Yeast and bacteria
- **Bread** → *Saccharomyces cerevisiae*
- **Swiss Cheese** → *Propionibacterium shermanii*
- **Roquefort Cheese** → Fungi

Microbes in Industrial Production

- **Alcoholic Beverages** → *Sachharomyces cerevisiae*
- **Antibiotics**
  - **Penicillin** → *Penicillium notatum*
- **Organic acids**
  - **Acetic acid** → *Acetobacter aceti*
  - **Citric Acid** → *Aspergillus niger*
  - **Butyric acid** → *Clostridium butylicum*
  - **Lactic acid** → *Lactobacillus*
- **Enzymes**
  - **Streptokinase** → *Streptococcus*
- **Bioactive molecules**
  - **Cyclosporin A** → *Trichoderma polysporum*
  - **Statins** → *Monascus purpureus* (yeast)

Microbes in Sewage Treatment

- **Primary Treatment** → (Physical) → Large pieces of floating debris and oily substances are removed by filtration and sedimentation.
- **Secondary Treatment** → (Biochemical) → Flocs (Masses of bacteria + fungal filaments) digest the organic matter in effluents and reduce the BOD.

Microbes in Biogas Production

- **Methanogen** → *Methanobacterium*
- Produces CH_4 along with CO_2 + H_2.
- Slurry is used as fertilizer and biogas is used as source of energy.

Microbes as Biofertilizers

- **Bacterial** → *Rhizobium*, *Azotobacter*, *Azospirillum*
- **Cyanobacterial** → *Anabaena*, *Nostoc, Oscillatoria.*
- **Fungal** Mycorrhizae *(Glomus)*

Microbes as Biocontrol agents

Lady Bird & Dragonflies → aphids and mosquitoes.
Bacillus thuringiensis → butterfly caterpillars.
Trichoderma → Treatment of plant disease.
Baculovirus → Insects and other arthropods.

Multiple Choice Questions

10.0 Introduction

1. Match the Column A with Column B and choose the CORRECT option.

	Column A		Column B
i.	Adenovirus	a.	Cause Respiratory infections
ii.	Prions	b.	Proteinaceous infectious agents
		c.	Colonies visible on Petri dish

(A) i – a, ii – b (B) i – a, ii – c
(C) i – c, ii – b (D) i – b, ii – c

2. Which one of the following statement is INCORRECT?
(A) Microbes are the minor components of biological systems on earth.
(B) Microbes also exist at sites where possibly no other life forms are present.
(C) Microbes can survive in acidic environments.
(D) Prions are proteinaceous infectious agents.

3. Which of the following statements is INCORRECT? **[NEET (UG) 2019]**
(A) Infective constituent in viruses is the protein coat.
(B) Prions consist of abnormally folded proteins.
(C) Viroid lacks a protein coat.
(D) Viruses are obligate parasites.

4. Identify the INCORRECT statement with reference of Biocontrol agents: **[KCET 2019]**
(A) They do not show any negative impact on crop plants.
(B) They help to increase the use of synthetic pesticides.
(C) They are significant in treating ecologically sensitive area.
(D) They do not affect non-target pests.

10.1 Microbes in Household Products

1. Milk is fermented or curdled by
(A) *Rhizobium* (B) *Lactobacillus*
(C) *Azotobacter* (D) *Clostridium*

2. *Lactobacillus* mediated conversion of milk to curd results because of
(A) coagulation and partial digestion of milk fats
(B) coagulation and partial digestion of milk proteins
(C) coagulation of milk proteins and complete digestion of milk fats
(D) coagulation of milk fats and complete digestion of milk proteins

3. A small amount of curd added to the milk to initiate the curdling is called
(A) inoculum (B) initiator
(C) buffer (D) floc

4. The vitamin whose content increases following the conversion of milk into curd by lactic acid bacteria is **[NCERT Exemplar]**
(A) vitamin C (B) vitamin D
(C) vitamin B_{12} (D) vitamin E

5. Conversion of milk to curd improves its nutritional value by increasing the amount of **[NEET (UG) 2018]**
(A) Vitamin B_{12} (B) Vitamin A
(C) Vitamin D (D) Vitamin E

6. Which is INCORRECT regarding fermentation?
(A) Puffy appearance of dough is due to entrapment of CO_2 gas.
(B) Fermentation is performed by bacteria, yeast and fungi.
(C) Microbes are used to ferment fishes and soybean.
(D) *Candida albicans* is commonly known as baker's yeast

10.2 Microbes in Industrial Products

1. Baker's yeast is
(A) *Saccharomyces cerevisiae*
(B) *Propionibacterium shermanii*
(C) *Lactobacillus*
(D) *Methanobacterium*

2. Toddy is prepared by the fermenting
(A) wheat flour
(B) sap from palm trees
(C) grape juice
(D) sugarcane juice

3. Read the following statements and select the CORRECT option.
Statement I: Distinct varieties of cheese are known by their texture, flavour and taste.
Statement II: Specific microbes give particular texture, taste and flavour to cheese.
(A) Statement I is true.
(B) Statement II is true.
(C) Both the statements are true.
(D) None of the statements are true.

4. Big holes in Swiss cheese are made by a **[NCERT Exemplar]**
   (A) a machine.
   (B) a bacterium that produces methane gas.
   (C) a bacterium producing a large amount of carbon dioxide.
   (D) a fungus that releases a lot of gases during its metabolic activities.

5. Swiss cheese is ripened by
   (A) *Propionibacterium shermanii*
   (B) Fungi
   (C) Yeast
   (D) *Trichoderma*

6. Ethanol is commercially produced through a particular species of
   (A) *Clostridium* (B) *Trichoderma*
   (C) *Aspergillus* (D) *Saccharomyces*

7. Which of the following is TRUE about fermented beverages?
   (A) Fermenting malted cereals and fruits juices produce methanol.
   (B) Type of alcoholic drink obtained depends upon raw material and process used.
   (C) Wine is produced with distillation.
   (D) Rum is produced without distillation

8. Which one of the following alcoholic drinks is produced without distillation? **[NCERT Exemplar]**
   (A) Wine (B) Whisky
   (C) Rum (D) Brandy

9. Which one of the following processes involved in alcohol production is NOT involved in wine production? **[MHT CET 2016]**
   (A) Malting (B) Mashing
   (C) Fermentation (D) Distillation

10. **Assertion:** Antibiotics means against life.
    Reason: With reference to humans, they are against life.
    (A) Both assertion and reason are true and reason is the correct explanation of assertion.
    (B) Both assertion and reason are true but reason is not the correct explanation of assertion.
    (C) Assertion is true but reason is false.
    (D) Both assertion and reason are false.

11. Read the following statements and select CORRECT option.
    Statement I: Alexander Fleming was working on *Streptococci* bacteria.
    Statement II: *Streptococci* could not grow on cultured plates due to a chemical produced called ampicillin.
    (A) Statement I is true.
    (B) Statement II is true.
    (C) Both the statements are true.
    (D) None of the statements are true.

12. Which of the following is INCORRECT about antibiotics?
    (A) *Penicillium notatum* was the first antibiotic to be discovered.
    (B) With reference to human beings, antibiotics are 'pro-life'.
    (C) They are chemical in nature.
    (D) They are produced by certain microbes and can be used against other microbes.

13. Read the following statements and select for appropriate conclusion.
    Statement I: Antibiotics retard the growth of disease causing organisms.
    Statement II: Antibiotics are used to treat lethal diseases like plague, diphtheria, whooping cough and leprosy.
    (A) Statement I is true.
    (B) Statement II is true.
    (C) Both statements are true.
    (D) None of the statements are true.

14. Microbes are utilized for commercial and industrial production of
    (A) organic acids, alcohols
    (B) antibiotics, enzymes
    (C) bio-active molecules
    (D) all of the above

15. Match the Columns.

	Column I		Column II
i.	Diphtheria	a.	Kali Khasi
ii.	Leprosy	b.	Gal ghotu
iii.	Whooping Cough	c.	Black Death
iv.	Plague	d.	Kushtrog

    (A) i-a, ii-b, iii-c, iv-d
    (B) i-b, ii-c, iii-d, iv-a
    (C) i-b, ii-d, iii-a, iv-c
    (D) i-b, ii-a, iii-d, iv-c

16. Which one of the following is the producer of citric acid? **[MH CET 2014]**
    (A) *Aspergillus niger*
    (B) *Rhizopus arrhizus*
    (C) *Acetobacter aceti*
    (D) *Saccharomyces cerevisiae*

17. For the commercial and industrial production of Citric Acid, which of the following microbes is used? **[NEET (UG) P-II 2020]**
    (A) *Lactobacillus sp.*
    (B) *Saccharomyces cerevisiae*
    (C) *Clostridium butylicum*
    (D) *Aspergillus niger*

18. Match the following list of bacteria and their commercially important products:

	Bacterium		Product
i.	*Aspergillus niger*	a.	Lactic acid
ii.	*Acetobacter aceti*	b.	Butyric acid
iii.	*Clostridium butylicum*	c.	Acetic acid
iv.	*Lactobacillus*	d.	Citric acid

Choose the CORRECT match.

[NCERT Exemplar]

(A) i – b, ii – c, iii – d, iv – a
(B) i – b, ii – d, iii – c, iv – a
(C) i – d, ii – c, iii – b, iv – a
(D) i – d, ii – a, iii – c, iv – b

19. A good producer of citric acid is **[NEET 2013]**
(A) *Aspergillus*
(B) *Pseudomonas*
(C) *Clostridium*
(D) *Saccharomyces*

20. **Assertion:** Fruit juices prepared at home are not as clear as the bottled ones.
Reason: Bottled juices are clarified using enzymes pectinases and proteases.
(A) Both assertion and reason are true and reason is the correct explanation of assertion.
(B) Both assertion and reason are true but reason is not the correct explanation of assertion.
(C) Assertion is true but reason is false.
(D) Both assertion and reason are false.

21. Which one of the following has been commercialized as blood-cholesterol lowering agent? **[KCET 2017]**
(A) Streptokinase
(B) Cyclosporin-A
(C) Statins
(D) α-Trypsin-A

22. Cyclosporin A, used as immunosuppression agent, is produced from **[NEET (UG) P-II 2020]**
(A) *Saccharomyces cerevisiae*
(B) *Penicillium notatum*
(C) *Trichoderma polysporum*
(D) *Monascus purpureus*

23. Match the following list of bioactive substances and their roles.

	Bioactive Substance		Role
i.	Statins	a.	Removal of oil stain
ii.	Cyclosporin A	b.	Removal of clots from blood vessels
iii.	Streptokinase	c.	Lowering of blood cholesterol
iv.	Lipase	d.	Immuno-suppressive agent

Choose the CORRECT match:

[NCERT Exemplar]

(A) i – b, ii – c, iii – a, iv – d
(B) i – d, ii – b, iii – a, iv – c
(C) i – d, ii – a, iii – b, iv – c
(D) i – c, ii – d, iii – b, iv – a

24. Which of the following is WRONGLY matched in the given table? **[NEET P-I 2016]**

	Microbe	Product	Application
(A)	*Streptococcus*	Streptokinase	Removal of clot from blood vessel
(B)	*Clostridium butylicum*	Lipase	Removal of oil stains
(C)	*Trichoderma polysporum*	Cyclosporin A	Immuno-suppressive drug
(D)	*Monascus purpureus*	Statins	Lowering of blood cholesterol

25. Match Column I with Column II and select the CORRECT option using the codes given below:

	Column-I		Column-II
i.	Citric acid	a.	*Trichoderma*
ii.	Cyclosporin A	b.	*Clostridium*
iii.	Statins	c.	*Aspergillus*
iv.	Butyric acid	d.	*Monascus*

[NEET P-II 2016]

(A) i – c, ii – d, iii – a, iv – b
(B) i – c, ii – a, iii – b, iv – d
(C) i – c, ii – a, iii – d, iv – b
(D) i – a, ii – d, iii – b, iv – c

26. Which of the following is CORRECTLY matched for the product produced by them? **[NEET (UG) 2017]**
(A) *Acetobacter aceti* : Antibiotics
(B) *Methanobacterium* : Lactic acid
(C) *Penicillium notatum* : Acetic acid
(D) *Saccharomyces cerevisiae*: Ethanol

27. Match the following list of microbes and their importance:

	Column I		Column II
i.	*Saccharomyces cerevisiae*	a.	Production of immunosuppressive agents
ii.	*Monascus purpureus*	b.	Clot buster
iii.	*Trichoderma polysporum*	c.	Commercial production of ethanol
iv.	*Streptococcus*	d.	Production of blood cholesterol lowering agents

[AIPMT Re-Test 2015]

	i	ii	iii	iv
(A)	c	a	d	b
(B)	c	d	a	b
(C)	d	c	b	a
(D)	d	b	a	c

28. Anaerobic respiration of yeast produces
(A) alcohol
(B) carbon dioxide
(C) alcohol, carbon dioxide and beverages
(D) none of the above

29. An alga which can be employed as food for a human being is **[NEET 2014]**
(A) *Ulothrix* (B) *Chlorella*
(C) *Spirogyra* (D) *Polysiphonia*

30. Which of the following is a commercial blood cholesterol lowering agent? **[NEET (UG) 2019]**
(A) Streptokinase (B) Lipases
(C) Cyclosporin A (D) Statin

31. Match the following organisms with the products they produce:

	Column I		Column II
i.	*Lactobacillus*	a.	Cheese
ii.	*Saccharomyces cerevisiae*	b.	Curd
iii.	*Aspergillus niger*	c.	Citric Acid
iv.	*Acetobacter aceti*	d.	Bread
		e.	Acetic Acid

Select the correct option. **[NEET (UG) 2019]**
(A) i – c, ii – d, iii – e, iv – a
(B) i – b, ii – a, iii – c, iv – e
(C) i – b, ii – d, iii – e, iv – c
(D) i – b, ii – d, iii – c, iv – e

32. Match the following columns and select the correct option. **[NEET (UG) P-I 2020]**

	Column - I		Column - II
(a)	*Clostridium butylicum*	(i)	Cyclosporin-A
(b)	*Trichoderma polysporum*	(ii)	Butyric Acid
(c)	*Monascus purpureus*	(iii)	Citric Acid
(d)	*Aspergillus niger*	(iv)	Blood cholesterol lowering agent

	(a)	(b)	(c)	(d)
(A)	(ii)	(i)	(iv)	(iii)
(B)	(i)	(ii)	(iv)	(iii)
(C)	(iv)	(iii)	(ii)	(i)
(D)	(iii)	(iv)	(ii)	(i)

10.3 Microbes in Sewage Treatment

1. Large quantity of waste water containing domestic waste and microbes, generated every day in cities and towns is called
(A) sludge (B) sewage
(C) effluent (D) flocs

2. Sewage water cannot be discharged directly into river because
(A) it contains high level of organic matter.
(B) it contains pathogenic microbes.
(C) it may destroy the flora and fauna of river.
(D) all of the above

3. What is TRUE about primary treatment?
(A) It is a physical process.
(B) It involves aerobic microbes.
(C) It involves removal of large pieces of floating debris, oily substances through filtration and sedimentation.
(D) Both (A) and (C)

4. The primary treatment of waste water involves the removal of **[NCERT Exemplar]**
(A) dissolved impurities
(B) stable particles
(C) toxic substances
(D) harmful bacteria

5. Which of the following in sewage treatment removes suspended solids? **[NEET (UG) 2017]**
(A) Tertiary treatment
(B) Secondary treatment
(C) Primary treatment
(D) Sludge treatment

6. In the treatment of waste water discharge, which treatment stage involves biological treatment?
(A) Primary treatment
(B) Secondary treatment
(C) Tertiary treatment
(D) Reverse osmosis stage

7. During secondary treatment,
   (A) primary effluent is continuously agitated in aeration tank.
   (B) there is vigorous growth of useful aerobic microbes into flocs.
   (C) reduction in BOD level.
   (D) all of the above

8. Masses of bacteria associated with fungal filaments which form mesh-like structures are called
   (A) activated sludge (B) flocs
   (C) sediment (D) inoculum

9. The microorganisms involved in floc formation during sewage treatment are **[KCET 2018]**
   (A) anaerobic bacteria and fungus
   (B) aerobic bacteria and fungus
   (C) autotrophic bacteria and yeast
   (D) fungus and algae

10. BOD is
   (A) Biochemical oxygen demand
   (B) Biological oxygen deficit
   (C) Biochemical oxygen deficit
   (D) Botanical oxygen demand

11. BOD of waste water is estimated by measuring the amount of **[NCERT Exemplar]**
   (A) total organic matter
   (B) biodegradable organic matter
   (C) oxygen evolution
   (D) oxygen consumption

12. During secondary treatment, the bacterial flocs sediment in the sedimentation tank, this sediment is called
   (A) flocs
   (B) activated sludge
   (C) inorganic sludge
   (D) none of the above

13. Wastewater treatment generates a large quantity of sludge, which can be treated by **[NCERT Exemplar]**
   (A) anaerobic digesters
   (B) floc
   (C) chemicals
   (D) oxidation pond

14. Treated sewage water has
   (A) maximum BOD (B) moderate BOD
   (C) no BOD (D) least BOD

15. High value of BOD (Biochemical Oxygen Demand) indicates that **[AIPMT 2015]**
   (A) water is pure.
   (B) water is highly polluted.
   (C) water is less polluted.
   (D) consumption of organic matter in the water is higher by the microbes.

16. BOD refers to **[KCET 2015]**
   (A) The oxygen required for bacteria to grow in 1 litre of effluent.
   (B) The amount of oxygen consumed if all the organic matter in 1000 ml of water were oxidized by bacteria.
   (C) The amount of oxygen released if all the organic matter in 1000 ml of water were oxidized by bacteria.
   (D) The amount of oxygen released when all the organic matter was consumed by bacteria in 1 litre of water.

17. When huge amount of sewage is dumped into a river, the BOD will
   (A) increase
   (B) remain unchanged
   (C) slightly decrease
   (D) decrease

18. Which of the following is put into Anaerobic sludge digester for further sewage treatment? **[NEET (UG) P-I 2020]**
   (A) Floating debris
   (B) Effluents of primary treatment
   (C) Activated sludge
   (D) Primary sludge

19. What gases are produced in anaerobic sludge digesters? **[AIPMT 2014]**
   (A) Methane and CO_2 only
   (B) Methane, hydrogen sulphide and CO_2
   (C) Methane, hydrogen sulphide and O_2
   (D) Hydrogen sulphide and CO_2

20. What would happen if oxygen availability to activated sludge flocs is reduced? **[NCERT Exemplar]**
   (A) It will slow down the rate of degradation of organic matter.
   (B) The center of flocs will become anoxic, which would cause death of bacteria and eventually breakage of flocs.
   (C) Flocs would increase in size as anaerobic bacteria would grow around flocs.
   (D) Both (A) and (B)

21. Activated sludge should have the ability to settle quickly so that it can **[NCERT Exemplar]**
   (A) be rapidly pumped back from sedimentation tank to aeration tank
   (B) absorb pathogenic bacteria present in waste water while sinking to the bottom of settling tank
   (C) be discarded and anaerobically digested
   (D) absorb colloidal organic matter

22. Identify the WRONG statement regarding the process in sewage treatment. **[MHT CET 2018]**
(A) Primary treatment is a physical process.
(B) Secondary treatment is a biological process.
(C) The BOD of effluent increases after secondary treatment.
(D) The tanks used for tertiary treatment are anaerobic sludge digesters.

23. Which plan has been initiated by Ministry of Environment and Forests to save major rivers of India?
(A) Ganga Action Plan
(B) Yamuna Action Plan
(C) Narmada Action Plan
(D) Both (A) and (B)

10.4 Microbes in Production of Biogas

1. Biogas mainly consists of
(A) C_2H_6 (B) CO_2
(C) H_2 (D) CH_4

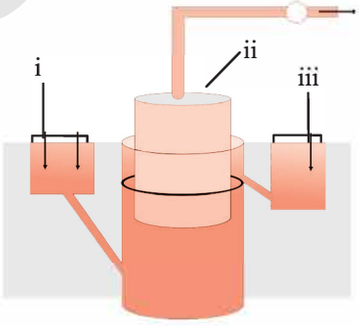
2. The main component of raw material used for biogas production is
(A) vegetable waste (B) cow dung
(C) agricultural waste (D) domestic waste

3. Methanogens do not produce **[NCERT Exemplar]**
(A) oxygen (B) methane
(C) hydrogen sulphide (D) carbon dioxide

4. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the **[NEET P-I 2016]**
(A) methanogens
(B) eubacteria
(C) halophiles
(D) thermoacidophiles

5. The guts of cow and buffalo possess **[AIPMT 2015]**
(A) Methanogens (B) Cyanobacteria
(C) *Fucus* sp. (D) *Chlorella* sp.

6. Identify the i, ii and iii and select the correct option.



(A) i – Sludge; ii – Dung water; iii – Digester
(B) i – Gas holder; ii – Dung water; iii – Sludge
(C) i – Dung water; ii – Sludge; iii – Gas holder
(D) i – Dung water; ii – Gas holder; iii – Sludge

7. Which of the following is NOT an advantage of biogas?
(A) It is cheap.
(B) Large quantity of raw material is required.
(C) It does not cause pollution.
(D) It is used for cooking and lighting.

8. The residue left after methane production from cattle dung is **[NCERT Exemplar]**
(A) burnt
(B) buried in land fills
(C) used as manure
(D) used in civil construction

9. The technology of biogas production from cow dung was developed in India largely due to the efforts of **[NCERT Exemplar]**
(A) Gas Authority of India
(B) Oil and Natural Gas Commission
(C) Indian Agricultural Research Institute and Khadi and Village Industries Commission
(D) Indian Oil Corporation

10. Which one of the following pairs is WRONGLY matched?
(A) Yeast – Ethanol
(B) *Streptomyces* – Antibiotic
(C) *Clostridium* – Vinegar
(D) Methanogens – Gobar gas

11. Match the contents of List I, II and III and choose the CORRECT option.

List-I		List-II		List-III	
a.	BOD	i.	Supernatant as effluent	I.	Useful aerobic microbes
b.	Flocs	ii.	Measure of Organic Matter	II.	All settled solids
c.	Primary sludge	iii.	Masses of bacteria associated with fungus	III.	Methane, hydrogen sulphide, carbon dioxide
d.	Biogas	iv.	Anaerobic sludge digester	IV.	Polluted water has more BOD

The correct match is:

	a	b	c	d
(A)	ii, IV	iii, I	i, II	iv, III
(B)	ii, I	i, III	iv, II	iii, IV
(C)	i, IV	iii, II	iv, I	ii, III
(D)	iii, III	ii, IV	iii, I	i, II

12. Methanogenic bacteria are not found in [NCERT Exemplar]
(A) rumen of cattle
(B) gobar gas plant
(C) bottom of water-logged paddy fields
(D) activated sludge

13. During sewage treatment, biogases are produced which include [NEET 2013]
(A) Methane, hydrogen sulphide, carbon dioxide
(B) Methane, oxygen, hydrogen sulphide
(C) Hydrogen sulphide, methane, sulphur dioxide
(D) Hydrogen sulphide, nitrogen, methane

10.5 Microbes as Biocontrol Agents

1. Ladybird beetle is a predator of
(A) moths (B) beetles
(C) bacteria (D) aphids

2. Which of the following is bio–insecticide?
(A) Ladybirds beetle (B) Dragonflies
(C) Bees (D) Both (A) and (B)

3. Which is a microbial insecticide?
(A) *Bacillus thuringiensis*
(B) *Saccharomyces cerevisiae*
(C) *Methanobacterium*
(D) *Propionibacterium shermanii*

4. Which one of the following statements is WRONG in relation to transgenic Bt cotton plant? [WB JEEM 2015]
(A) Crop yield loss due to attack by *Bacillus thuringiensis* bacterium is reduced.
(B) Crop yield loss due to attack by insect pests is reduced.
(C) The use of chemical insecticides in the cotton field is minimized.
(D) Better quality cotton is produced.

5. The free-living fungus *Trichoderma* can be used for [NCERT Exemplar]
(A) killing insects
(B) biological control of plant diseases
(C) controlling butterfly caterpillars
(D) producing antibiotics

6. A biocontrol agent to be a part of an integrated pest management should be [NEET Odisha 2019]
(A) species-specific and inactive on non-target organisms
(B) species-specific and symbiotic
(C) free living and broad spectrum
(D) narrow spectrum and symbiotic

7. IPM stands for
(A) International Population Management
(B) Integrated Pest Management
(C) International Plant Management
(D) Integrated Plant Management

10.6 Microbes as Biofertilizers

1. The microorganisms which enrich the nutrient quality of soil are called
(A) biofertilizers (B) bioherbicides
(C) bioinsecticides (D) biofungicides

2. Bacterium associated with legume roots is
(A) *Rhizobium* (B) *Saccharomyces*
(C) *Azospirillum* (D) *Clostridium*

3. Nitrogen fixing bacterium *Rhizobium* is
(A) parasitic (B) free living
(C) symbiotic (D) mycorrhizal

4. Which one of the following statement is CORRECT?
(A) Legumes are incapable of fixing nitrogen.
(B) Legumes fix nitrogen only through specialized bacteria living in their nodulated roots.
(C) Legumes fix nitrogen independent of the bacteria that live in their roots.
(D) Legumes fix nitrogen only through bacteria forming nodules on any part of plant.

5. *Azotobacter* and *Azospirillum* are
(A) decomposers
(B) non-symbiotic nitrogen fixers
(C) symbiotic nitrogen fixers
(D) pathogenic bacteria

6. Mycorrhiza is helpful in
(A) synthesis of food.
(B) getting nutrients from soil.
(C) providing resistance against different regulators.
(D) increasing the fertility of soil.

7. Mycorrhiza is an example of
(A) Parasitism (B) Symbiosis
(C) Saprophytism (D) None of these

8. Mycorrhiza is [MHT CET 2016]
(A) Alga (B) Fungus
(C) Bacteria (D) Virus

9. Mycorrhiza does not help the host plant in [NCERT Exemplar]
(A) enhancing its phosphorus uptake capacity
(B) increasing its tolerance to drought
(C) enhancing its resistance to root pathogens
(D) increasing its resistance to insects.

10. Select the MISMATCH: [NEET (UG) 2017]
(A) *Frankia* – *Alnus*
(B) *Rhodospirillum* – Mycorrhiza
(C) *Anabaena* – Nitrogen fixer
(D) *Rhizobium* – Alfalfa

11. **Assertion(A):** Plants association with symbiotic species show benefits such as resistance to root-borne pathogens, tolerance to drought.
Reason (R): Fungal symbionts in plant-fungal symbiotic associations facilitate absorption of phosphorous by the plant from the soil.
Which of the following is TRUE? **[TS EAMCET 2018]**
(A) Both (A) and (R) are true, but (R) is the correct explanation of (A).
(B) Both (A) and (R) are true and (R) is not the correct explanation of (A).
(C) (A) is true, but (R) is false.
(D) (A) is false, but (R) is true.

12. The term 'Cyanobacteria' is applied to
(A) symbiotic bacteria
(B) blue-green algae
(C) nitrogen fixers
(D) bacteria with blue colour

13. Yield of paddy field can be increased by application of
(A) iron bacteria
(B) Cyanobacteria
(C) archaebacteria
(D) symbiotic bacteria

14. Some blue-green algae are used as biofertilizer as they
(A) fix nitrogen
(B) are mucilaginous
(C) can grow everywhere
(D) are deficient in nutrient

15. Match the items in Column 'A' and Column 'B' and choose the CORRECT answer.

	Column A		Column B
i.	Lady bird	a.	*Methanobacterium*
ii.	Mycorrhiza	b.	*Trichoderma*
iii.	Biological control	c.	*Aphids*
iv.	Biogas	d.	*Glomus*

[NCERT Exemplar]
(A) i – b, ii – d, iii – c, iv – a
(B) i – c, ii – d, iii – b, iv – a
(C) i – d, ii – a, iii – b, iv – c
(D) i – c, ii – b, iii – a, iv – d

16. Which one of the following is NOT a nitrogen-fixing organism? **[NCERT Exemplar]**
(A) *Anabaena* (B) *Nostoc*
(C) *Azotobacter* (D) *Pseudomonas*

17. Among the following pairs of microbes, which pair has both the microbes that can be used as biofertilizers? **[NEET (Odisha) 2019]**
(A) *Aspergillus* and Cyanobacteria
(B) *Aspergillus* and *Rhizopus*
(C) *Rhizobium* and *Rhizopus*
(D) Cyanobacteria and *Rhizobium*

18. A farmer has applied chemical fertilizers in his crop field for many successive seasons. In the next season, the crop growth was poor as soil lost its fertility. Suggest the suitable micro-organism that replenishes the fertility of soil in his field. **[KCET 2019]**
(A) *Spirulina* (B) *Nostoc*
(C) *Chlorella* (D) *Spirogyra*

19. Match the following columns and select the correct option: **[NEET (UG) P-II 2020]**

	Column I		Column II
i.	Dragonflies	a.	Biocontrol agents of several plant pathogens
ii.	*Bacillus thuringiensis*	b.	Get rid of Aphids and mosquitoes
iii.	Glomus	c.	Narrow spectrum insecticidal applications
iv.	Baculoviruses	d.	Biocontrol agents of lepidoteran plant pests
		e.	Absorb phosphorus from soil

(A) (i)-(b), (ii)-(a), (iii)-(c), (iv)-(d)
(B) (i)-(b), (ii)-(c), (iii)-(d), (iv)-(e)
(C) (i)-(b), (ii)-(d), (iii)-(e), (iv)-(c)
(D) (i)-(c), (ii)-(e), (iii)-(d), (iv)-(a)

Answers to MCQs

10.0 : 1. (A) 2. (A) 3. (A) 4. (B)

10.1 : 1. (B) 2. (B) 3. (A) 4. (C) 5. (A) 6. (D)

10.2 : 1. (A) 2. (B) 3. (C) 4. (C) 5. (A) 6. (D) 7. (B) 8. (A) 9. (D) 10. (C)
11. (D) 12. (A) 13. (C) 14. (D) 15. (C) 16. (A) 17. (D) 18. (C) 19. (A) 20. (A)
21. (C) 22. (C) 23. (D) 24. (B) 25. (C) 26. (D) 27. (B) 28. (C) 29. (B) 30. (D)
31. (D) 32. (A)

10.3 :	1.	(B)	2.	(D)	3.	(D)	4.	(B)	5.	(C)	6.	(B)	7.	(D)	8.	(B)	9.	(B)	10.	(A)
	11.	(D)	12.	(B)	13.	(A)	14.	(D)	15.	(B)	16.	(B)	17.	(A)	18.	(C)	19.	(B)	20.	(D)
	21.	(A)	22.	(C)	23.	(D)														
10.4 :	1.	(D)	2.	(B)	3.	(A)	4.	(A)	5.	(A)	6.	(D)	7.	(B)	8.	(C)	9.	(C)	10.	(C)
	11.	(A)	12.	(D)	13.	(A)														
10.5 :	1.	(D)	2.	(D)	3.	(A)	4.	(A)	5.	(B)	6.	(A)	7.	(B)						
10.6 :	1.	(A)	2.	(A)	3.	(C)	4.	(B)	5.	(B)	6.	(B)	7.	(B)	8.	(B)	9.	(D)	10.	(B)
	11.	(B)	12.	(B)	13.	(B)	14.	(A)	15.	(B)	16.	(D)	17.	(D)	18.	(B)	19.	(C)		

Hints to MCQs

10.0 Introduction

2. Microbes are one of the major components of biological systems on the earth.
3. Infective constituent in viruses is their genetic material (DNA/ RNA).
4. Biocontrol agent is the method of controlling pest by using biological organisms which shows natural predation and parasitism against the weeds. This method does not involve the use of synthetic pesticides.

10.1 Microbes in Household Products

1. *Lactobacillus acidophilus* and *Lactobacillus lactis* are involved in curdling of milk.
2. During *Lactobacillus* mediated conversion of milk to curd, acids produced by *Lactobacillus* coagulate and partially digest milk proteins.
6. *Saccharomyces cerevisiae* is known as baker's yeast.

10.2 Microbes in Industrial Products

5. Swiss cheese is characterized by large holes formed due to large amount of CO_2 released by *Propionibacterium shermanii.*
7. Fermenting malted cereals and fruit juices produces ethanol. Wine and beer are obtained without distillation, whereas brandy and rum with distillation.
8. Refer ***Smart code – 1, 2***
10. Antibiotics mean 'against life' with reference to disease causing organisms. With reference to humans, they are 'pro-life'.
11. Alexander Fleming while working on *Staphylococci* bacteria observed a growth of mould *Penicillium notatum* that produced a chemical substance called Penicillin, inhibiting the growth of *Staphylococci.*
12. Penicillin, a chemical produced by the mould *Penicillium notatum* was the first antibiotic to be discovered.
15. **Thinking Hatke - Q. 15**
The hindi word '*khasi*' is 'cough'. Hence, (iii-a) can be easily matched. Thus, option (C) is correct and all the other options can be eliminated.
18. **Thinking Hatke - Q. 18**
One can easily identify that butyric acid is produced by *Clostridium butylicum.* Thus, (iii – b) is the correct match. Therefore, the correct answer is option (C).
23. **Thinking Hatke - Q. 23**
Lipids can be easily related to oils. Hence, it can be deduced that lipase will be used to digest oil/ fats (lipids). Thus, (iv-a) is the correct match. This appears only in option (D). Hence, the possibility of any other option being correct can be eliminated.
24. Butyric acid is produced by fermentative activity of *Clostridium butylicum.*
26. *Acetobacter aceti* – Acetic acid
Methanobacterium – Methane
Penicillium notatum – Penicillin

10.3 Microbes in Sewage Treatment

15. If pollution increase, BOD is high, as microbes requires more O_2 for biochemical oxidation of organic pollutants.

20. Activated sludge flocs consist of aerobic microbes. They need oxygen for oxidation of wastes so as to obtain energy. Lack of O_2 availability would slow down their growth or ultimately kill them. It would ultimately break the flocs. Also, growth of anaerobic microbes would take place due to lack of O_2.

21. Activated sludge should have the ability to settle quickly to pump it back rapidly from sedimentation tank to the aeration tank. It is done by using a small amount of the sludge as inoculum in the aeration tank and the part remaining in the anaerobic sludge digesters.

22. The BOD of effluent decreases significantly after secondary treatment.

10.4 Microbes in Production of Biogas

3. Methanogens are anaerobic bacteria.

10. Vinegar (Acetic Acid) is produced by the bacteria *Acetobacter aceti*.

12. Methanogenic bacteria are anaerobic. Activated sludge consists of aerobic bacteria that form flocs.

10.5 Microbes as Biocontrol Agents

2. Lady birds beetle control aphids, whereas dragon flies control mosquito.

4. *Bacillus thuringiensis* does not attack cotton plants and hence cannot reduce crop yield loss.

10.6 Microbes as Biofertilizers

7. Mycorrhiza forms symbiotic association with roots of higher plants.

10. *Mycorrhiza* shows symbiotic relationship between fungi and roots of higher plants.

13. *Nostoc, Oscillatoria, Anabaena etc.* are the nitrogen-fixing Cyanobacteria. They increase nitrogen content of moist soil and water bodies, which can be useful in increasing paddy yield.

18. *Nostoc* and spirulina both are cyanobacteria. *Nostoc* helps in increasing soil fertility by adding organic matter in the soil and replenishes the barren land by fixing nitrogen for plants. *Spirulina* is rich in protein and is used as dietary supplement.

19.

Thinking Hatke - Q. 19

Out of the given microbes in Column I, all have insecticidal properties or are biocontrol agents. Only Glomus is used as a biofertilizer. Hence, the match (iii-e) can be easily identified. This match appears only in option (C). Thus the possibility of any other option being correct can be eliminated.

Topic Test

1. Which one of the following bacterial groups are exploited in biogas production?
   (A) Methanogens (B) Methanotrophs
   (C) Organotrophs (D) Eubacteria

2. Which one is a biofertilizer?
   (A) NPK mixture
   (B) *Rhizobia* in legume roots
   (C) *Aspergillus* in farmyard manure
   (D) DDT

3. Mycorrhiza is a symbiotic association of
   (A) algae and fungi
   (B) bacteria and fungi
   (C) fungi and roots of higher plants
   (D) blue-green algae and roots of higher plants

4. Which bacterial strain is used in vinegar/ acetic acid production?
   (A) *Aspergillus niger*
   (B) *Rhizobium*
   (C) *Acetobacter aceti*
   (D) *Saccharomyces cerevisiae*

5. Identify the micro-organism which are commercially exploited as the source of bioinsecticides?
   (A) *Nostoc*
   (B) *Anabaena*
   (C) *Bacillus thuringiensis*
   (D) both (A) and (C)

6. Enzyme which is used as a 'clot buster' to cure patient suffering from myocardial infarction is
   (A) Statin (B) Streptokinase
   (C) Proteases (D) Lipases

7. The bacterial species used in genetic engineering as biocontrol agent is
   (A) *Acetobacter aceti*
   (B) *Bacillus thuringiensis*
   (C) *Lactobacillus lactis*
   (D) *Pseudomonas putida*

8. Yeast is used for the production of
   (A) Curd (B) Cheese
   (C) Acetic acid (D) Ethyl alcohol

9. Match the items in Column 'A' and Column 'B' and choose the CORRECT answer.

	Column A		Column B
i.	*B. thuringiensis*	a.	Baculovirus
ii.	Nucleopolyhedrovirus	b.	Bacterial species
iii.	*Trichoderma* sp.	c.	Cellulose
iv.	Methanogens	d.	Fungal species

(A) i – b, ii – a, iii – d, iv – c
(B) i – d, ii – b, iii – c, iv – a
(C) i – a, ii – c, iii – d, iv – b
(D) i – c, ii – b, iii – a, iv – d

10. Read the following statements and select the CORRECT option.
Statement I: Biological farming involves knowing the life forms in the field, their predators and pests.
Statement II: Biocontrol measures eradicate useful as well as harmful life forms.
(A) Statement I is true.
(B) Statement II is true.
(C) Both the statements are true.
(D) None of the statements are true.

11. **Assertion:** According to organic farming, complete eradication of pests is undesirable.
Reason: Without the organisms that are considered as pests, their predators and parasites could not survive.
(A) Both assertion and reason are true and reason is the correct explanation of assertion.
(B) Both assertion and reason are true but reason is not the correct explanation of assertion.
(C) Assertion is true but reason is false.
(D) Both assertion and reason are false.

12. Match the column A with Column B according to the microbes and their products.

	Column A		Column B
i.	Bread	a.	Fungus
ii.	Curd	b.	*Saccharomyces cerevisiae*
iii.	Swiss cheese	c.	Lactic acid bacteria
iv.	Roquefort cheese	d.	*Propionibacterium shermanii*

(A) i – a, ii – c, iii – d, iv – b
(B) i – b, ii – c, iii – d, iv – a
(C) i – a, ii – b, iii – d, iv – c
(D) i – b, ii – a, iii – d, iv – c

Answers

1. (A) 2. (B) 3. (C) 4. (C)
5. (C) 6. (B) 7. (B) 8. (D)
9. (A) 10. (A) 11. (A) 12. (B)

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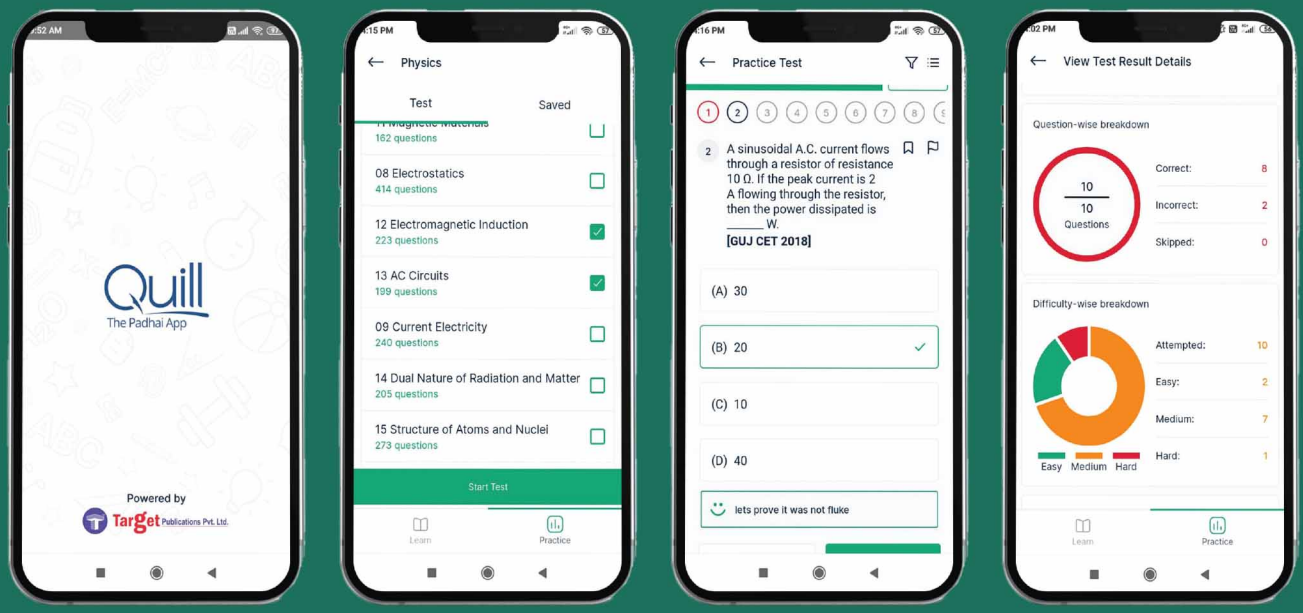

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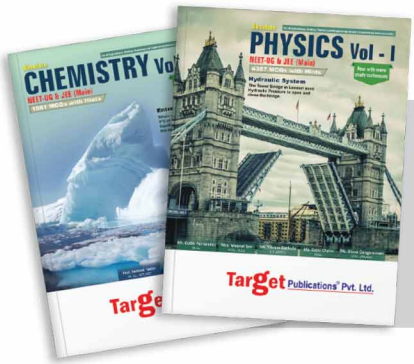

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