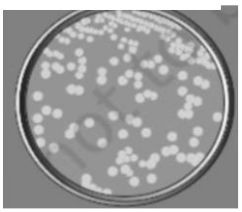
CHAPTER 8



MICROBES IN HUMAN WELFARE

(A) NCERT QUESTIONS & SOLUTIONS

1. Bacteria cannot be seen with the naked eyes, but these can be seen with the help of a microscope. If you have to carry a sample from your home to your biology laboratory to demonstrate the presence of microbes with the help of a microscope, which sample would you Carry and why?

Ans. The most common household product that we would like to carry is curd which common in Lactic acid bacteria *(Lactobacillus sp.).*

2. Give examples to prove that microbes release gases during metabolism.

Ans. Puffed-up appearance of dough which is used for making dosa ,idli and bread due to gas production.

- Methanogens (bacteria) in the biogas plant produce methane and carbondioxide.
- Also large holes in the 'Swiss cheese' are due to production of a large amount of CO_2 during its production.

3. In which food would you find lactic acid bacteria? Mention some of their useful applications.

Ans. The lactic acid bacteria (LAB) are found in curd.

- LAB convert the lactose sugar of milk into lactic acid.
- Lactic acid coagulates the milk protein called casein.
- It also increases the nutritional quality of curd as the curd contains vitamin B_{12} along with other vitamins. They also check the growth of other harmful microbes.

4. Name some traditional Indian foods made of wheat, rice and Bengal gram (or their products) which involve use of microbes.

Ans. 'Dosa' and 'idli' (from rice), bread (from wheat) and 'dhokla' (from Bengal gram) are the traditional Indian foods which involve use of microbes.

5. In which way have microbes played a major role in controlling diseases caused by harmful bacteria? [IMP.]

Ans. The major role of microbes in controlling the diseases is the 'antibiotic production, Antibiotics have been used against pathogenic bacteria, e.g. penicillin from *Penicillium notatum,* streptomycin from *Streptomyces griseus,* etc.

6. Name any two species of fungus, which are used in the production of the antibiotics.

Ans. (i) *Penicillium notatum* (for penicillin production).

(ii) *Aspergilus fumigatus* (for fumagillin production).

7. What is sewage? In which way can sewage be harmful to us?

Ans. Sewage is the municipal waste water containing large quantities of human excreta and other organic wastes.

- ☛ Sewage could be harmful to us as it contains many pathogenic microbes and produces foul smell. It is the cause of many water-borne diseases.
- ☛ It is also the cause of eutrophication of water bodies there by killing many aquatic organisms.

8. What is the key difference between primary and secondary sewage treatment? [IMP.]

Ans. The key difference between primary and secondary treatment of sewage is that primary treatment is the physical process of removing grit and floating debris while secondary treatment is a biological process that involves digestion of organic matter by microbes.

9. Do you think microbes can also be used as source of energy? If yes, how?

Ans. Yes, microbes can be used to produce energy indirectly.

- Methanogens (bacteria) like *Methanobacterium* are involved in the production of biogas which is used as source of energy.

10. Microbes can be used to decrease the use of chemical fertilizers and pesticides. Explain how this can be accomplished. [IMP.]

Ans. Microbes can be used both as fertilizers and pesticides called **biofertilizers** and **biopesticides** respectively.

- ☛ Microbes are used as biofertilisers to enrich the soil nutrients, eg *Rhizobiun, Azotobacter, Azospirillum,* etc. which can fix atmospheric nitrogen in the soil.
- ☛ *Bacillus thuringiensis* bacteria act as biopesticide to control the growth of insect pests.
- ☛ *Trichoderma* , fungal species, is an effective biocontrol agent of several plant pathogens.
- ☛ *Baculoviruses* used as control agents in genus *Nucleopolyhedrovirus* are excellent for species-specific, narrow spectrum insecticidal applications.

11. Three water samples namely river water, untreated sewage water and secondary effluent discharged from a sewage treatment plant were subjected to BOD test. The samples were labelled A, B and C; but the laboratory attendant did not note which was which. The BOD values of the three samples A, B and C were recorded as 20 mg/L, 8 mg/L and 400 mg/L, respectively. Which sample of the water is most polluted? Can you assign the correct label to each assuming the river water is relatively clean?

Ans. Sample C is most polluted (Highest BOD).

Sample A-River water

Sample B- Secondary effluent (Least BOD)

Sample C- Untreated sewage (Highest BOD)

12. Find out the name of the microbes from which cyclosporin A (an im e drug) and statins (blood cholesterol lowering agents) are obtained.

Ans. (a) Cyclosporin A is obtained from *Trichoderma polysporum*.

(b) Statins are obtained from the yeast *Monascus purpureus*.

13. Find out the role of microbes in the following and discuss it with your teacher.

(a) Single cell protein (SCP)

(b) Soil

Ans.(a) Single cell protein (SCP): It is a protein-rich microbial biomass which can be used as food. Microbes are being grown on an industrial scale as source of good protein.

e.g., (i) Blue-green algae like *Spirulina*

(ii) *Methylophilus methylotrophus* bacteria

(iii) Mushrooms

(b) Soil: Soil is the habitat of numerous microbes. Microbes in the soil increase the fertility of soil by decomposing organic matter. Some microbes convert nitrates into free nitrogen that escapes into atmosphere for replenishment.

14. Arrange the following in the decreasing order (most important first) of their importance, for the welfare of human society. Give reasons for your answer. [IMP.]

Ans. Penicillin, Biogas, Curd and Citric acid.

(1) Penicillin:- It is an antibiotic used in curing numerous bacterial diseases.

(2) Biogas :- It is a source of energy in rural areas, produced by anaerobic degradation of organic matter

(3) Curd:- It is vitamin-rich milk preparation which is easily digested.

(4) Citric acid:- It is an organic acid used as preservative in juices, jams and jellies, etc .

15. How do biofertilizers enrich the fertility of the soil? [IMP.]

Ans. Biofertilizers are microorganisms which bring about nutrient enrichment of soil by enhancing the availability of nutrients to crops. They are of following types:

(a) Nitrogen fixing bacteria and cyanobacteria- They form symbiotic association with plants. They get food and shelter from plants and on the other hand, plants get nitrogen fixed by these bacteria. For example *Rhizobium* and *Anabena*.

(b) Mycorrhiza: It is an association between a fungus and roots of higher plants. It takes part in the solubilisation and absorption of nutrients from organic matter. Many members of the genus *Glomus* form *mycorrhiza*.

(c) Manures: They are semi-decayed organic remains of various types-manure, green manure compost and vermicompost.

(B) PREVIOUS YEAR QUESTIONS

1. Given below are the list of the commercially important products and their source organisms. Select the option that gives the correct matches. **[CBSE 2023]**

List-A		List-B	
S. No.	**Bioactive Products**	**S. No.**	**Microbes (Source Organism)**
(A)	Cyclosporin A	(i)	*Streptococcus*
(B)	Statins	(ii)	*Tricoderma polysporum*
(C)	Streptokinase	(iii)	*Penicillium notatum*
(D)	Penicillin	(iv)	*Monascus Purpureus*

Options :

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

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

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

2. Certain specific bacterial spores are mixed in water and sprayed over *Brassica* crop to control butterfly catterpillars. [CBSE 2023]

Name this bacterium and its mode of action on the butterfly catterpillars.

Ans. *Bacillus thuringiensis (Bt).* These are available in sachets as dried spores which are mixed with water and sprayed onto vulnerable plants such as *Brassica* and fruit trees, where these are eaten by the insect larvae. In the gut of the larvae, the toxin is released and the larvae get killed. The bacterial disease will kill the caterpillars, but leave other insects unharmed.

3. (a) (i) Give an example of a genus of fungi that forms mycorrhizial association with plants.

(ii) How does the plant derive benefits from this association? [CBSE 2023]

Ans. (a) (i) *Nucleopolyhedrovirus*

(ii) Baculoviruses are the viruses belong the genus. These viruses attack the arthropods/ insects. These viruses are excellent species specific effective narrow spectrum insecticidal biocontrol agent. This is especially important when treating an environmentally sensitive area or conserving beneficial insects to support an overall integrated pest management (IPM) programme.

4. On spraying *Bacillus thuringiensis* on an infected cotton crop field the pests are killed by the toxin, however the toxin although produced by the bacteria does not affect it. Explain giving reason? [CBSE 2023]

Ans. Because the Bt toxin protein exist as inactive protoxins but once an insect ingest the inactive toxin, it is converted into an active form of toxin due to the alkaline pH of the gut which solubilise the crystals.

5. Farmers are often suggested to use the following organisms in their crop land so as to improve the soil fertility. Explain. [CBSE Term – II 2022]

(i) *Rhizobium*

(ii) *Anabaena*

Ans. (i) *Rhizobium* is a bacterium found in soil that helps in fixing nitrogen in leguminous plants. It attaches to the roots of the leguminous plant and produces nodules. These nodules fix atmospheric nitrogen and convert it into ammonia that can be used by the plant for its growth and development.

(ii) *Anabaena* plays a significant role in farming where it is used as a biofertilizer and soil stabilizer.

6. Organic farmer use *Trichoderma* and *Baculovirus* as biological control age

[CBSE Term – II 2022]

Ans. *Trichoderma* species are free-living fungi that are very common in the root ecosystems. They are effective biocontrol agents of several plant pathogens.

Baculoviruses are pathogens that attack insects and other arthropods. The majority of baculoviruses used as biological control agents are in the genus *Nucleopolyhedrovirus.* These viruses are excellent candidates for species-specific, narrow spectrum insecticidal applications. They have been shown to have no negative impacts on plants, mammals, birds, fish or even on non-target insects.

7. Explain four advantages of mycorrhizal association to plants. [CBSE IMP Question]

Ans. The fungal symbiontin in mycorrhizal associations with plants:

i. absorbs phosphorus from soil and passes it to the plant.
ii. provides resistance to root-borne pathogens,
iii. enhances tolerance to salinity and drought,
iv. induces an overall increase in plant growth and development.

8. A farmer noticed that nematode infection in tobacco plants has resulted in the reduction in the yield. Suggest a strategy which provides cellular defense for providing resistance to this pest. Explain the technique. [CBSE IMP Question]

Ans.
- Strategy based on the process of RNA interference (RNAi) - as a method of cellular defence can be used.
- This method involves silencing of a specific mRNA due to a complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing).
- The source of this complementary RNA can be from an infection by viruses having RNA genomes or mobile genetic elements (transposons) that replicate via an RNA intermediate.
- Using Agrobacterium vectors, nematode-specific genes are introduced into the host plant. The introduction of DNA produces both sense and anti-sense RNA in the host cells.
- Two RNA's being complementary to each other form a double stranded (dsRNA) that initiate RNAi and thus, silence the specific mRNA of the nematode.
- As a consequence, the parasite cannot survive in a transgenic host expressing specific interfering RNA. The transgenic plant therefore gets protected from the parasite.

9. Name the genus of baculovirus that acts as a biological control agent in spite of being a pathogen. Justify by giving three reasons that make it an excellent candidate for the Job.

[CBSE 2020]

Ans. The majority of baculoviruses used as biological control agents are in the genus **Nucleopolyhedrovirus**.

- These viruses are excellent candidates for species-specific, narrow spectrum insecticidal application.
- They have been shown to have no negative impacts on plants, mammals, birds, fish or even on non-target insects

10. What are 'flocs', formed during secondary treatment of sewage?]

Ans. Masses of bacteria associated with fungal filament (to form mesh like structure).

11. Write any two places where methanogens can be found. [CBSE 2019]

Ans. They may found in anaerobic sludge (digester), rumen of cattle (ruminants), stomach of cattle (gut of cattle), marshy area, flooded rice fields, biogas plant**.**

12. Briefly describe the process of secondary treatment given to municipal waste water (sewage) before it can be released into fresh water bodies. Mention another benefit provided by this process. [CBSE 2019]

Ans. **Process of secondary treatment :**

1) Passing of primary effluent into large aeration tank which is constantly agitated mechanically & air is pumped into it that allows vigorous growth of useful aerobic microbes into flocs.

2) Microbes consume major part of organic matter in effluent which significantly reduces BOD

13. Baculoviruses are good example of biocontrol agents. Justify giving three reasons. [CBSE 2018]

Ans. Baculoviruses are pathogens that attack insects and other arthropods.

- Most of these bio control agents belongs to the genus Nucleopolyhedrovirus.
- These are species-specific, narrow spectrum insecticides.
- They do not harm plants, mammals, birds, fish and other non-target insects.
- Baculoviruses are helpful in integrated pest management(IPM) programme, in which beneficial insects are conserved and there is no negative impact on plant mammals, birds, fish or non target insects.

14. (a) Organic farmers prefer biological control of diseases and pests to the use of chemicals for the same purpose. Justify.

(b) Give an example of a bacterium, a fungus and an insect that are used as biocontrol agents. [CBSE 2018]

Ans. (a)

- Reduces dependence on toxic chemicals.
- Protects our ecosystem or environment.
- Protects and conserves non-target organisms / they are species – specific.
- These chemicals being non-biodegradable may pollute the environment permanently.
- These chemicals being non-biodegradable may cause biomagnifications

(b) Bacteria – *Bacillus thuringiensis*

Fungus – *Trichoderma*

Insect – Ladybird / Dragonfly / Moth or any other correct example.

15. Secondary treatment of the sewage is also called Biological treatment. Justify this statement and explain the process. [CBSE 2017]

Ans. Involves biological organism such as aerobic and anaerobic microbes / bacteria and fungi to digest organic waste.

- ☛ Primary effluent is passed into aeration tank where vigorous growth of s (flocs) take place,
- ☛ BOD reduced (microbes consume major part of organic matter),
- ☛ Effluent is passed to settling tank where flocs sediment to produce activated sludge,
- ☛ Sludge is pumped to anaerobic sludge digester to digest bacteria and fungi.

16. How does the application of the fungal genus, *Glomus,* to the agricultural farm increase the farm output? [CBSE 2017]

Ans. *Glomus* forms mycorrhizal association, absorbs phosphorus, provide resistance to root borne pathogens, enhanced to tolerate salinity or drought

17. Describe how do 'flocs' and 'activated sludge' help in Sewage Treatment. [CBSE 2017]

Ans. **Flocs** - Aerobic microbes consume the major part of the organic matter in the effluent, significantly reduces BOD

Activated sludge - Small part of activated sludge is used as inoculum and pumped back to aeration tank and pumped into anaerobic sludge digesters where microbes or bacteria grow anaerobically to produce CH_4 or H_2S or CO_2 or biogas.

18. List the events that reduce the Biological Oxygen Demand (BOD) of a primary effluent during sewage treatment. [CBSE 2017]

Ans. (i) Effluent from the primary settling tank passed into aeration tank.

(ii) It is agitated mechanically and air is pumped into it.

(iii) There is vigorous growth of aerobic microbes into flocs.

(iv) The microbes consume major part of the organic matter in effluent.

(C) MULTIPLE CHOICE QUESTIONS

1. Which gas is responsible for the puffed-up appearance of dough?

(1) CO_2 (2) O_2 (3) SO_2 (4) NO_2

Ans. (1) CO_2

2. Which bacterium helps in the production of 'Swiss cheese'?

(1) *Propionibacterium sharmanii* (2) *Trichoderma polysporum*

(3) *Saccharomyces cerevisiae* (4) *Aspergillus niger*

Ans. (1) *Propionibacterium sharmanii*

3. Microbes are present in

I. soil II. air III. water IV. thermal springs

(1) I, III, IV (2) I, II, III, IV (3) I, II (4) III, IV

Ans. (2) I, II, III, IV

4. *Saccharomyces cerevisiae* is employed in production of

(1) idli (2) beer (3) bread (4) All of the above

Ans. (4) All of the above

5. Lactic acid bacteria convert milk into curd and improve its nutritional quality by enhancing

(1) vitamin A (2) vitamin B (3) vitamin C (4) vitamin D

Ans. (2) vitamin B

6. Cheese and yogurt are products of

(1) pasteurisation (2) fermentation (3) dehydration (4) distillation

Ans. (2) fermentation

7. Microbes are diverse group which include

I. bacteria II. mosses III. protozoans IV. fungi

(1) I, III, IV (2) I, IV (3) I, II (4) III, IV

Ans. (1) I, III, IV

8. *Lactobacillus* mediated change of milk to curd occurs due to

(1) coagulation and partial digestion of milk fats.

(2) coagulation and partial digestion of milk proteins.

(3) coagulation of milk proteins and complete digestion of milk fats.

(4) coagulation of milk fats and complete digestion of proteins.

Ans. (4) coagulation of milk fats and complete digestion of proteins.

9. Baker's yeast is

(1) *Saccharomyces cerevisiae* (2) *S.ludiwigii*

(3) *S.octosporus* (4) *Schizosaccharomyces*

Ans. (1) *Saccharomyces cerevisiae*

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

(1) *Saccharomyces cerevisiae*	**(i)** Production of immunosuppressive agents
(2) *Monascuspurpureus*	**(ii)** Ripening of Swiss cheese
(3) *Trichoderma polysporum*	**(iii)** Commercial production of ethanol
(4) *Propionibacterium sharmanii*	**(iv)** Production of blood cholesterol lowering Agents

	(1)	**(2)**	**(3)**	**(4)**
(1)	(iv)	(iii)	(ii)	(i)
(2)	(iv)	(ii)	(i)	(iii)
(3)	(iii)	(i)	(iv)	(ii)
(4)	(iii)	(iv)	(i)	(ii)

Ans (4) (iii) (iv) (i) (ii)

11. Streptokinase which is used as a 'clot buster' obtained from

(1) *Streptococcus* (2) *Staphylococcus* (3) *Lactobacillus* (4) *Saccharomyces*

Ans. (1) *Streptococcus*

12. Statins, a bioactive molecule, inhibiting the enzyme responsible for synthesis of

(1) carbohydrate (2) protein (3) vitamins (4) cholesterol

Ans. (4) cholesterol

13. Antibiotics are used to treat diseases like

(1) plague (2) whooping cough, diptheria

(3) leprosy (4) All of these

Ans. (4) All of these

14. Which one of the following is not true about antibiotics?

(1) First antibiotic was discovered by Alexander Flemming.

(2) The term 'antibiotic' was coined by S. Waksman in1942.

(3) Some persons can be allergic to a particular antibiotic.

(4) Each antibiotic is effective only against one particular kind of germ.

Ans. (3) Some persons can be allergic to a particular antibiotic.

15. Which one of the following is used in the manufacture of alcohol?

(1) Bacteria (2) Water molds (3) Yeasts (4) Slime molds

Ans. (3) Yeasts

16. Which industrial products are synthesized from microbes?

I. Antibiotics II. Fermented beverages

III. Enzymes and chemicals IV. Bioactive molecules

(1) I, III, IV (2) I, II, III, IV (3) I, III (4) I, II, III

Ans. (2) I, II, III, IV

17. Which one of the following sets includes bacterial diseases?

(1) Tetanus, tuberculosis, measles (2) Diphtheria, leprosy, plague

(3) Cholera, typhoid, mumps (4) Malaria, mumps, poliomyelitis

Ans. (2) Diphtheria, leprosy, plague

18. The large vessels for growing microbes on an industrial scale are called

(1) petridish (2) stores (3) biogas vessel (4) fermenters

Ans. (4) fermenters

19. Antibiotics are drugs commonly used to cure diseases of

(1) fungi (2) viruses (3) protozoans (4) bacteria

Ans. (4) bacteria

20. The first antibiotic to be isolated was

(1) terramycin (2) streptomycin (3) neomycin (4) penicillin

Ans. (4) penicillin

(D) ASSERTION & REASON QUESTIONS

Directions: In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as:

(1) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(2) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(3) If Assertion is true but Reason is false.
(4) If both Assertion and Reason are false.

1. **Assertion:** *Streptococcus thermophilus* increases nutritional value of milk.
Reason: Milk has lesser vitamin content than curd and yoghurt.
Ans. (1)

2. **Assertion:** After 24 hours, toddy becomes unpalatable.
Reason: The fermentation of toddy is continued by naturally occurring yeast.
Ans. (1)

3. **Assertion:** Beer & wine are called soft liquors white gin, rum etc. are hard liquors.
Reason: Beer & wine are made without distillation.
Ans. (2)

4. **Assertion:** Yeasts such as *Saccharomyces cerevisiae* are used in baking industry.
Reason: Carbon dioxide produced during fermentation causes bread dough to rise by thermal expansion.
Ans. (1)

5. **Assertion:** An organ transplant patient if not provided with cyclosporin A may reject the transplanted organ.
Reason: Cyclosporin A inhibits activation of T-cells and interferes with destruction of non-self cells.
Ans. (1)

6. **Assertion:** The kneaded flour shows leavening, when yeast is added to it.
Reason: Enzymes secreted by yeast cause leavening.
Ans. (1)

7. **Assertion :** *Saccharomyces* species are utilized for making alcoholic beverages.
Reason : Yeast has an enzyme, zymase responsible for fermentations.
Ans. (1)

8. **Assertion:** Secondary treatment of sewage is also called biological treatment while primary treatment is called physical treatment.
Reason: Primary sewage treatment depends only upon sedimentation properties of materials present in sewage and filteration.
Ans. (1)

9. **Assertion:** Energy value of biogas is lower than that of organic matter.
Reason: Biogas minimises the chances of spread of fecal pathogens
Ans. (2)

10. **Assertion:** Dragonflies can be used to decrease occurrence of diseases like malaria, dengue, etc.
Reason: Baculoviruses are effective in controlling many insects and other arthropods.
Ans. (2)

(E) VERY SHORT ANSWER TYPE QUESTIONS

1. How is lactic acid bacteria beneficial to us other than helping in curdling the milk ?

Ans. Lactic acid bacteria improves the nutritional quality by increasing Vitamin B_{12}.

2. Give the scientific name of the source organism from which the first antibiotic was produced.

Ans. *Penicillium notatum.*

3. Name the gas released and the process responsible for puffing up of the bread dough when *Saccharomyces cerevisiae* is added to it.

Ans. Gas – Carbon dioxide

Process – Fermentation

4. Name the metabolic pathway associated with the rising of dough in making bread. What makes the dough rise ?

Ans. Metabolic pathway : Alcoholic fermentation by yeast. CO_2 produced in this process is responsible for rising of dough.

5. Write the scientific name of the microbe used for fermenting malted cereals and fruit juices.

Ans. *Saccharomyces cerevisiae*.

6. Which of the following in the baker's yeast is used in fermentation ?

Saccharam barberi*, *Saccharomyces cerevisiae.

Ans. *Saccharomyces cerevisiae.*

7. Name the group of organisms and the substrate that act to produce biogas.

Ans. Name of the group of organisms-*Methanogens*

Substrate-Cellulosic material, cow dung and agricultural waste.

8. Bottled fruit juices are clearer as compared to those made at home. Explain.

Ans. Bottled fruit juices are clearer as compared to those prepared at home because they are treated with enzyme pectinase and protease. This enzymes acts on juices and make them clearer.

9. Name the first antibiotic discovered and by whom ?

Ans. Penicillin, Alexander Fleming.

10. (i) A patient who had an organ transplant was given cyclosporin –

A Mention the microbial source and state the reason for administration of this bioactive molecule.

(ii) Bottled fruit juices bought from the market are clearer as compared to those made at home. Give reason.

Ans. (i) Source – *Trichoderma polysporum.*

Reason – Immuno suppressive agent.

(ii) They are clarified by pectinases and proteases.

11. Name a bioactive molecule, its source organism and the purpose for which it is given to organ transplant patients.

Ans. Cyclosporin A.

Source – *Trichoderma polysporum.*

Purpose – Immuno suppressive agent.

12. Make a list of three household products along with the names of the micro-organism producing them.

Ans. Lactic acid bacteria - curd

Saccharomyces cerevisiae - bread

Propionibacterium shermanii - swiss cheese

13. Name the types of association that the genus *Glomus* exhibits with higher plants.

Ans. Symbiosis/Mycorrhiza/Mutualism.

14. Mention two advantages of adding blue-green algae to paddy fields.

Ans. In paddy fields, cyanobacteria (blue-green algae) add organic matter to the soil and increases its fertility.

15. Mention the information that the health workers derive by measuring BOD of a water body?

Ans. By measuring BOD of a water bodies, health workers find the amount of dissolved O_2. The lesser amount of dissolved O_2, the more polluted the water body will be.

(F) SHORT ANSWER TYPE QUESTIONS

1. Why is *Rhizobium* categorized as a 'symbiotic bacterium' ? How does it act as a biofertiliser?

Ans. *Rhizobium* is a symbiotic bacterium living in the root nodule of leguminous plants, it fixes atmospheric nitrogen into organic forms to be used by plants as nutrient and in turn bacteria get carbohydrate food and shelter from the plant. It is a biofertiliser as it is a living organism that enriches nutrient content of the plant / soil.

2. How do mycorrhizae help the plants to grow better?

Ans. Mycorrhiza refers to symbiotic association between the fungus and the root of higher plants. These fungi in these associations absorb water, phosphorus, nitrogen, potassium, calcium from soil and pass it to the plant. The fungus brings about the solubilization of organic matter of soil humus, release of inorganic nutrients absorption and their transfer to roots. The genus *Glomus* forms a mycorrhizal association with plants.

3. Your advice is sought to improve the nitrogen content of the soil to be used for cultivation of a non-leguminous terrestrial crop.

(a) Recommend two microbes that can enrich the soil with nitrogen.

(b) Why do leguminous crops not require such enrichment of the soil?

Ans. (a) *Azospirillum/ Azotobacter/ Anabaena/ Nostoc / Oscillatoria /Frankia* **(Any two correct names of microbes).**

(b) They can fix atmospheric nitrogen, due to presence of *Rhizobium*/N_2 fixing bacteria in their root nodules.

4. (i) How do organic farmers control pests ? Give two examples.

(ii) State the difference in their approach from that of conventional pest control methods.

Ans. (i) Natural predation / biological control.

Ex. Lady bird used to kill aphids / dragon flies used to kill mosquitoes / *Bacillus thuringiensis* used to kill cotton bollworm / caterpillar / butterfly caterpillar.

S. No.	Conventional Pest Control	Organic farming based pest control
(a)	Use of chemical insecticides and pesticides.	No chemical used.
(b)	Harmful to non target organisms.	Not harmful to non target organisms.
(c)	Cause environment	No adverse impact on environment.

5. Choose any three microbes, from the following which are suited for organic farming which is in great demand these days for various reasons.

Mention one application of each one chosen.

Mycorrhiza, Monascus, Anabaena, Rhizobium, Methanobacterium, Trichoderma.

Ans. ***Mycorrhiza*** : Fungal symbiont of the association, absorb phosphorus from soil.

Anabaena : Fix atmospheric nitrogen / Adds organic matter to the soil.

Rhizobium : It is a symbiotic root nodule bacterium which fixes atmosp n leguminous plants) in organic form which is used by plant as nutrient.

Methanobacterium : They digest cellulosic material and the product / spent slurry can be used as fertilizer.

Trichoderma : Biocontrol agent for several plant pathogens.

6. What are biopesticides ? Give the scientific name and use of the first commercially used biopesticide in the world.

Ans. The biological agent which are used to control weeds, insects and pathogen are called biopesticides. The micro-organisms that are used as biopesticides are some viruses, bacteria, fungi and their products. The bacterium *Bacillus thuringiensis* was the first biopesticide to be used on commercial scale.

7. Organic farmers prefer biological control of diseases and pests to the use of chemicals for the same purpose Justify.

Ans. **(i)** Reduces dependence on toxic chemicals.

(ii) Protects our ecosystem or environment.

(iii) Protects and conserves non-target organisms / they are species – specific.

(iv) These chemicals being non-biodegradable may pollute the environment permanently.

(v) These chemicals being non-biodegradable may cause bio magnification

8. Give an example of a bacterium, a fungus and an insect that are used as biocontrol agents.

Ans. **Bacteria:** *Bacillus thuringiensis*

Fungus: *Trichoderma*

Insect: Ladybird / Dragonfly / Moth or any other correct example.

9. What are biopesticides ? Give the scientific name and use of the first commercially used biopesticide in the world.

Ans. The biological agent which are used to control weeds, insects and pathogen are called biopesticides. The micro-organisms that are used as biopesticides are some viruses, bacteria, fungi and their products. The bacterium *Bacillus thuringiensis* was the first biopesticide to be used on commercial scale.

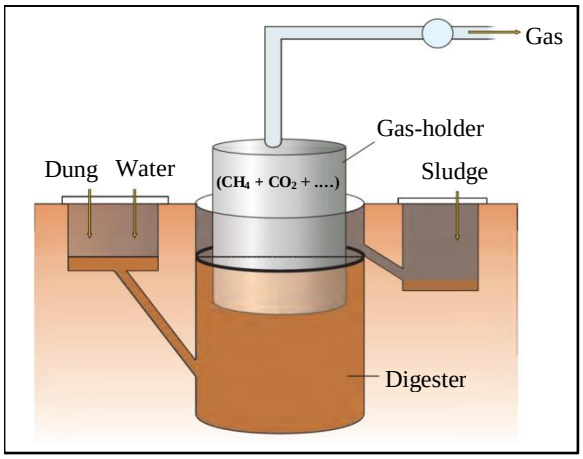
10. Name any one symbiont which serves as a biofertilizer. Mention its specific role.

Ans. *Rhizobium*, a root nodule bacterium of legumes is a symbiont. It fixes nitrogen symbiotically and thus help the plants in obtaining their nitrogen nutrition and therefore serve as a biofertilizer.

11. Which of the following is a cyanobacterium that can fix atmospheric nitro , Oscillatoria, Spirulina.

Ans. *Oscillatoria*

12. In the given diagram the gas X can be:



Ans 1. Hydrogen sulfide 2. Carbon monoxide 3. Ammonia 4. Oxygen

13. Explain the different steps involved during primary treatment phase of sewage.

Ans. Physical removal of particles (large and small), by filtration and sedimentation, forming primary sludge / sedimented solids, forming effluent (supernatant) for secondary treatment.

14. Name the bacterium responsible for the large holes seen in 'Swiss cheese '. What are these holes due to ?

Ans. The large holes in 'Swiss cheese' are due to the production of a large amount of CO_2 by a bacterium named *Propionibacterium shermanii.*

15. Name the microbes that help the production of the following products commercially :

(i) Statin **(ii) Citric acid** **(iii) Penicillin** **(iv) Butyric acid**

Ans. (i) *Monascus purpureus* **(ii)** *Aspergillus niger*

(iii) *Penicillium notatum* **(iv)** *Clostridium butyricum*

(G) LONG ANSWER TYPE QUESTIONS

1. Describe the process of waste-water treatment under the following heads:
(i) Primary treatment. (ii) Secondary treatment.
Explain the process of sewage water treatment before it can be discharged into natural water bodies. Why is this treatment essential?

Ans. (i) Primary treatment

(a) Physical removal of particles like debris, soil, sand or silt through filtration, sedimentation in stages.

(b) Solids settle to form primary sludge, the supernatants form the primary effluent.

(ii) Secondary Treatment: It is the biological treatment.

(a) Effluent passed into aeration tanks.

(b) Vigorous growth of useful aerobic microbes into flocs.

(c) Significant reduction of BOD due to use of organic matter by microorganisms.

(d) After fall in the level of BOD, the effluent is passed on to settling tanks where bacterial flocs settle to form activated sludge.

(e) Activated sludge is passed on to anaerobic sludge digester, where bacteria and fungi are anaerobically digested.

2. (i) How does *Bacillus thuringiensis* act as a biocontrol agent for protecting *Brassica* and fruit trees? Explain.
(ii) (a) List the components of biogas.
(b) What makes methanogens a suitable source for biogas production?

Ans. (i) Bacterium *Bacillus thuringiensis* (Bt) are available in sachets as dried spores, mixed with water and sprayed onto vulnerable plants, these are eaten up by the insect larvae, the toxins are released in the gut and larva gets killed.

(ii) (a) Methane, H_2S, CO_2, H_2.

(b) Methanogens grow anaerobically on cellulosic material, produce large amount of methane, along with CO_2 & H_2.

3. The following flow diagram is the process of formation of curd from milk. Observe it and give the answer of question that follow.

Milk is incubated with curd

↓

Bacteria(A) grow in milk

↓

Production of (B)

↓

Coagulation and digestion of milk protein

↓

Improved nutritional quality (C)

(i) Write the name of bacteria A which grow in milk.

(ii) What is the product (B)?

(iii) Write the name which nutritional quality become improved.

Ans. (i) The bacteria is LAB-Lactic acid bacteria

(ii) The product B is lactic acid

(iii) it is vitamin B_{12}

4. Why should biological control of pests and pathogens be preferred to the conventional use of chemical pesticides? Explain how the following microbes act as biocontrol agents:

(a) ***Bacillus thuringiensis***

(b) ***Nucleopolyhedrovirus***

Ans. Biological control of pests and pathogens is preferred because:

(i) The chemicals cause pollution of water bodies as well as ground water, besides getting stored in the plants.

(ii) The chemicals are toxic thus extremely harmful to human beings and other animals.

(a) ***Bacillus thuringiensis :*** Bacillus thuringiensis is available in sachets as dried spores, which are mixed with water and sprayed onto vulnerable plants. When they are eaten by the insect larvae, the toxin is released in the gut where it become active and kills the laevae.

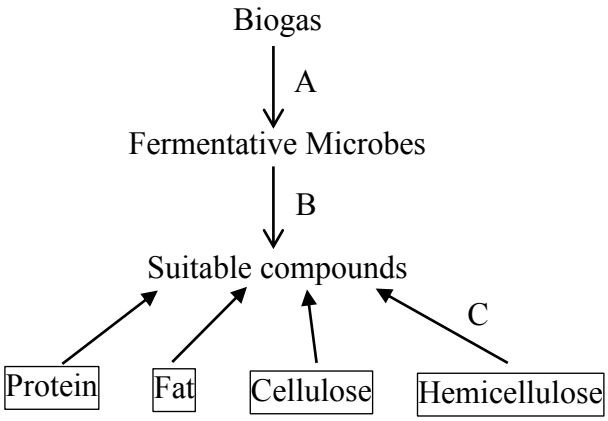
The Bt toxins gene when introduced unto plant develop resistance to attack by insect pests. Specific Bt toxin genes obtained from Bacillus thuringiensis are used in several crop plants which make them resistant to insect pest.

(b) ***Nucleopolyhedrovirus:*** These viruses are excellent candidates for species specific narrow spectrum insecticidal application. This is especially desirable when beneficial insects are being conserved to aid in on overall integrated pest management programme.

(H) CASE BASED TYPE QUESTIONS

1. Read the following and answer the questions given below.

Villager in a place near Chambur started planning to make power supply for agricultural purposes from cow dung.They have started a biogas plant for the purpose. Study the flow chart for biogas production given below and answer the following questions.



(i) Analia developed the technology of producing biogas from coul dung largely due to the efforts of -

Ans. (i) Methanogenic bacteria.

(ii) What is represent by B in the flow chart?

Ans. Organic acid

(iii) Which one produce gas by decomposing the gobar in gober gas.

Ans. Methanogenic bacteria

(iv) Where are methanogenic bacteria not found.

Ans. Activated sludge

2. Read the following and answer the questions given below.

Microorganisms include bacteria, viruses, fungi and protozoa. In our mind, we presume, most of the time, that microbes are always harmful. Microbes are, of course, the causal agents of many infections diseases of plants and animals including humans but they also have lots of beneficial role. Lactic acid bacteria (LAB) are one of this kind of useful group. These are Gram positive, non-sporulating, either rod-shaped or spherical bacteria. They produce lactic acid in milk products as major metabolic end product of carbohydrate fermentation. LAB are considered as natural fermentors. *Lactobacillus* is a common LAB which converts lactose sugar of milk into lactic acid, that causes coagulation and partial digestion of milk protein casein. Milk is then changed into curd, yoghurt and cheese. Lactobacillus is also used in probiotics which have potentially beneficial effect on gut ecosystem of humans. Some other probiotic strain used belong to the Genus Bifidobacterium.

(i) How is lactic acid bacteria beneficial to us other than helping in curdling t

Ans. Lactic acid bacteria improves the nutritional quality by increasing vitamin B_{12}.

(ii) What are probiotics ?

Ans. Probiotics are gut friendly live bacteria.

(iii) Name the microbe used for making bread.

Ans. *Saccharomyces cerevisiae* (Baker's yeast) is used in making bread.

(iv) How is LAB (Lactic Acid Bacillus) helpful for our stomach.

Ans. LAB play very beneficial role in checking disease-causing microbes in our stomach.

(v) How LAB helpful for conversion of milk sugar into Lactic acid.

Ans. They converts lactose sugar of milk into Lactic acid.

3. Read the following and answer the questions given below.

Microbes are also used for commercial and industrial production of certain chemicals like organic acids, alcohols and enzymes. Microbes are also used for the production of enzymes. Lipases are used in detergent formulations and are helpful in removing oily stains from the laundry. Bottled fruit juices bought from the market are clearer as compared to those made at home. Streptokinase produced by the bacterium *Streptococcus* and modified by genetic engineering, another bioactive molecule, cyclosporin A. Statins produced by the yeast has been commercialised used.

(i) Name the microbe used commercially in the production of blood cholesterol lowering statins.

Ans. *Monascus purpureus*

(ii) Name the microbe commonly used as a insecticide

Ans. *Bacillus thuringiensis*

(iii) Name the microbe used commercially in production of citric acid.

Ans. *Aspergillus Niger*

(iv) Name the immune suppressive agent used in organ-transplant patients.

Ans. Cyclosporin A

(v) Name the organism which produced streptokinase.

Ans. Streptococcus