

Microbes in Human Welfare- Exemplar Solutions

Multiple Choice Questions (MCQs)

1. The vitamin whose content increases following the conversion of milk into curd by lactic acid bacteria is

- (a) vitamin-C
- (b) vitamin-D
- (c) vitamin-B12
- (d) vitamin-E

Ans. (c) vitamin-B12

2. Waste water treatment generates a large quantity of sludge, which can be treated by

- (a) an aerobic digester
- (b) flocculation
- (c) chemicals
- (d) oxidation pond

Ans. (a) an aerobic digester

3. Methanogenic bacteria are not found in

- (a) rumen of cattle
- (b) gober gas plant
- (c) bottom of water-logged paddy fields
- (d) activated sludge

Ans. (d) activated sludge

4. Match the following column of bacteria and their commercially important products.

(Bacterium)	(Product)
A. <i>Aspergillus niger</i>	1. Lactic acid
B. <i>Aerobacter aceti</i>	2. Butyric acid
C. <i>Clostridium butylicum</i>	3. Acetic acid
D. <i>Lactobacillus</i>	4. Citric acid

- (a) A-2, B-3, C-4, D-1
 - (b) A-2, B-4, C-3, D-1
 - (c) A-4, B-3, C-2, D-1
 - (d) A-4, B-1, C-3, D-2
- Ans. (c) A-4, B-3, C-2, D-1

5. Match the following column of bioactive substances and their roles.

(Bioactive Substance)	(Role)
A. Statin	1. Removal of oil stains
B. Cyclosporin A	2. Removal of clots from blood vessels
C. Streptokinase	3. Lowering of blood cholesterol
D. Lipase	4. Immunosuppressive agent

Choose the correct match

- (a) A-2, B-3, C-1, D-4
 - (b) A-4, B-2, C-1, D-3
 - (c) A-4, B-1, C-3, D-2
 - (d) A-1, B-2, C-3, D-4
- Ans. (d) A-1, B-2, C-3, D-4

6. The primary treatment of wastewater involves the removal of

- (a) dissolved impurities
 - (b) stable particles
 - (c) toxic substances
 - (d) harmful bacteria
- Ans. (b) stable particles

7. BOD of wastewater is estimated by measuring the amount of

- (a) total organic matter
- (b) biodegradable organic matter
- (c) oxygen evolution
- (d) oxygen consumption

Ans. (d) oxygen consumption

8. Which one of the following alcoholic drinks is produced without distillation?

- (a) Wine
- (b) Whisky
- (c) Rum
- (d) Brandy

Ans. (a) Wine

9. The technology of biogas production from cow dung was developed in India largely due to the efforts of

- (a) Gas Authority of India
- (b) Oil and Natural Gas Commission
- (c) Indian Agricultural Research Institute, Khadi and Village Industries Commission
- (d) Indian Oil Corporation

Ans. (c) Indian Agricultural Research Institute, Khadi and Village Industries Commission

10. The free-living fungus *Trichoderma* can be used for

- (a) killing insects
- (b) biological control of plant diseases
- (c) controlling butterfly caterpillars
- (d) producing antibiotics

Ans. (b) biological control of plant diseases

11. What would happen if oxygen availability to activated sludge flocs is reduced?

- (a) I 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) Protozoa would grow in large numbers

Ans. (b) The center of flocs will become anoxic, which would cause death of bacteria and eventually breakage of flocs

12. Mycorrhiza does not help the host plant in

- (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

Ans. (d) increasing its resistance to insects

13. Which one of the following is not a nitrogen-fixing organism?

- (a) *Anabaena*
- (b) *Nostoc*
- (c) *Azotobacter*
- (d) *Pseudomonas*

Ans. (d) *Pseudomonas*

14. Big holes in Swiss cheese are made by a

- (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

Ans. (c) a bacterium producing a large amount of carbon dioxide

15. The residue left after methane production from cattle dung is

- (a) burnt
- (b) buried in landfills
- (c) used as manure
- (d) used in civil construction

Ans. (c) used as manure

16. Methanogens do not produce

- (a) oxygen
- (b) methane
- (c) hydrogen sulphide
- (d) carbon dioxide

Ans. (a) oxygen

17. Activated sludge should have the ability to settle quickly so that it can

- (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 the settling tank

(c) be discarded and anaerobically digested

(d) absorb colloidal organic matter

Ans. (a) be rapidly pumped back from sedimentation tank to aeration tank

18. Match the following columns.

Column I	Column II
A. Lady bird	1. Methanobacterium
B. Mycorrhiza	2. Trichoderma
C. Biological control	3. Aphids
D. Biogas	4. Glomus

(a) A-2, B-4, C-3, D-1

(b) A-3, B-4, C-2, D-1

(c) A-4, B-1, C-2, D-3

(d) A-3, B-2, C-1, D-4

Ans. (b) A-3, B-4, C-2, D-1

Very Short Answer Type Questions

1. Why does 'Swiss cheese' have big holes?

Ans. The large holes in 'Swiss cheese' are due to the production of a large amount of CO₂ by a bacterium named *Propionibacterium sharmanii*.

2. What are fermentors?

Ans. For large-scale production of biotechnological products, e.g., antibiotics, beverages. In industries, microbes are grown in very large vessels called fermentors or bioreactors.

3. Name a microbe used for statin production. How do statins lower blood cholesterol levels?

Ans. Statins are bioactive molecules produced by the yeast *Monascus purpureus*. These bioactive molecules have been commercialised as blood-cholesterol-lowering agents. It acts by competitively inhibiting the enzyme responsible for the synthesis of

cholesterol.

4. Why do we prefer to call secondary wastewater treatment as biological treatment?

Ans. Secondary wastewater treatment is called biological treatment because microorganisms are involved in the breakdown of organic matter in this phase of wastewater treatment.

The primary effluent is passed into large aeration tanks where the organic matter in it is consumed by aerobic microbes, which are later themselves digested by anaerobic bacteria and fungi in anaerobic sludge digesters.

5. What for nucleopolyhedron viruses are being used nowadays?

Ans. Several methods of biological control are being used in pest management to keep the environment pollution-free and yield clean, non-toxic, and good quality products for human consumption.

Baculoviruses are a group of viruses used as biological control agents that occur naturally and are specific to some insects. Most of the baculoviruses belong to 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.

This is especially desirable when beneficial insects are being conserved to aid in an overall Integrated Pest Management (IPM) Programme or when an ecologically sensitive area is being treated.

6. How has the discovery of antibiotics helped mankind in the field of medicine?

Ans. Antibiotics produced by microbes are regarded as one of the most significant discoveries of the twentieth century and have greatly contributed to the welfare of human society.

Anti is a Gk. A word that means 'against' and bio means 'life', together they mean 'against life' (in the context of disease-causing organisms); whereas with reference to human beings, they are 'pro life' and not against. Antibiotics are chemical substances that are produced by some microbes and can kill or retard the growth of other (disease-causing) microbes.

Antibiotics have greatly improved our capacity to treat deadly diseases such as plague, whooping cough (Kali khansi), diphtheria (Gal ghotu), and leprosy (Kusht rog), which

had killed millions all over the globe. Today, we can not imagine a world without antibiotics.

7. Why is distillation required for producing certain alcoholic drinks?

Ans. Depending on the type of raw material used for fermentation and the type of processing (with or without distillation), different types of alcoholic drinks are obtained.

Wine and beer are produced without distillation, whereas whiskey, brandy, and rum are produced by distillation of the fermented broth.

Distillation increases the alcohol content in alcoholic drinks. That's why, for producing certain alcoholic drinks, distillation is required.

8. Write the most important characteristic that *Aspergillus niger*, *Clostridium butylicum*, and *Lactobacillus* share.

Ans. Their common characteristic is that they produce organic acids as part of their metabolism and are therefore used for commercial and industrial production of the same.

- (i) *Aspergillus niger* (a fungus) for citric acid.
- (ii) *Clostridium butylicum* (a bacterium) for butyric acid.
- (iii) *Lactobacillus* (a bacterium) for lactic acid.

9. What would happen if our intestine harbours microbial flora exactly similar to that found in the rumen of cattle?

Ans. If our intestine harbors microbial flora exactly similar to that found in the rumen of cattle, we would be able to digest the cellulose present in our foods because the microbes present in the rumen (a part of the stomach) of cattle, collectively called methanogens, are capable of digesting cellulose as they have cellulase enzyme.

10. Give any two microbes that are useful in biotechnology.

Ans. Two microbes that are useful in biotechnology are

- (i) *Bacillus thuringiensis*, a gene isolated from this bacterium is introduced in cotton plants to make them able to kill butterfly caterpillars.
- (ii) *Escherichia coli* is a bacterium that is used in many biotechnology procedures. Their plasmid is used as a vector to introduce foreign DNA segments into desired organisms.

11. What is the source organism for Eco RI, restriction endonuclease?

Ans. *Escherichia coli* strain RY 13 is the source organism for Eco RI.

12. Name any genetically modified crop.

Ans. Bt cotton is a genetically modified plant that has been modified to resist attack by insect pests, e.g., cotton bollworm. These are developed by introducing a gene from *Bacillus thuringiensis*, which produces toxins in plants which is lethal to insects.

13. Why are blue-green algae not popular as biofertilisers?

Ans. Blue-green algae add organic matter to the soil and increase its fertility, but these are not popular as biofertilisers. This is due to several constraints that limit the application or implementation of the biofertiliser technology. The constraints may be environmental, technological, infrastructural, financial, unawareness, quality, marketing, etc.

14. Which species of *Penicillium* produces Roquefort cheese?

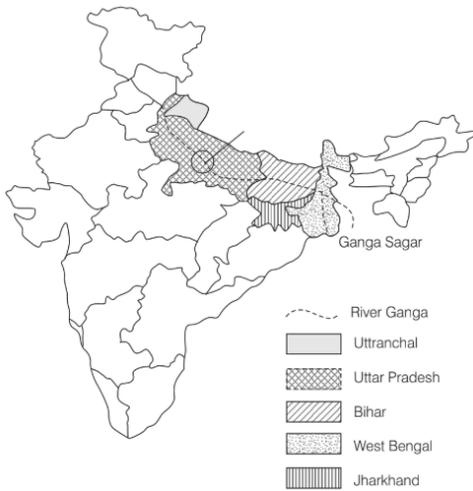
Ans. Roquefort cheese is formed by the ripening of cheese with the fungi *Penicillium roqueforti* for a particular flavour.

15. Name the states involved in Ganga Action Plan.

Ans. Ganga runs from Gangotri in the Himalayas to Ganga Sagar in the Bay of Bengal. The Ganga Action Plan (GAP) was a program launched in April 1986 to reduce the pollution load on the River Ganga.

The states involved in the Ganga Action Plan are— Uttaranchal, UP, Bihar, West Bengal, and Jharkhand.

BioSmartNotes



16. Name any two industrially important enzymes.

Ans.

- (i) Lipases are used in detergent formulations and help remove oily stains from the laundry.
- (ii) Pectinases and proteases that are used as clarifying agents in making commercial fruit and vegetable juices.

17. Name an immune immunosuppressive agent?

Ans. Cyclosporin-A, produced by the fungus *Trichoderma polysporum*, is used as an immunosuppressive agent in organ transplant patients.

18. Given an example of a rod-shaped virus.

Ans. Tobacco mosaic virus is a rod-shaped virus. This is the first plant virus to be discovered.

19. What is the group of bacteria found in both the rumen of cattle and sludge of sewage treatment?

Ans. Methanogens (Methanobacterium), anaerobically break down cellulosic material to produce CO_2 and H_2 , and are found in

- (i) Anaerobic sludge in sewage treatment plants.
- (ii) Rumen (a part of the stomach) of cattle, thus providing nutrition to cattle.

20. Name a microbe used for the production of Swiss cheese.

Ans. Cheese is formed by the partial degradation of milk by different microorganisms. Swiss cheese is formed by the bacterium *Propionibacterium sharmanii*. Its characteristic feature is the formation of large holes due to the production of large amounts of CO₂.

Short Answer Type Questions

1. Why are flocs important in biological treatment of wastewater?

Ans. Flocs are masses of bacteria associated with fungal filaments that form a mesh-like structure. These are important in biological treatment of wastewater, as they help in the digestion of organic matter, remove pathogens, and release nutrients in the sewage effluent.

2. How has the bacterium *Bacillus thuringiensis* helped us in controlling caterpillars of insect pests?

Ans. *Bacillus thuringiensis* produces an endotoxin which, when ingested and released in the gut of the larvae of insect pests, disrupts the insect gut lining, thereby killing them.

3. How do mycorrhizal fungi help the plants harbouring them?

Ans. The mycorrhizal fungi absorb phosphorus from the soil and transfer it to the host cells. They also impart resistance to host plants against root pathogens. They also show tolerance to salinity and drought, as well as increase the overall growth and development of plants. Hence, fungal hyphae help in synthesising organic food and also receive/get shelter and nourishment from the higher plant.

4. Why are cyanobacteria considered useful in paddy fields?

Ans. Cyanobacteria like *Anabaena*, *Nostoc*, and *Oscillatoria* serve as an important biofertiliser in paddy fields as they fix atmospheric nitrogen and add organic matter to the soil, and increase its fertility.

5. How was penicillin discovered?

Ans. Penicillin was the first antibiotic to be discovered, and it was a chance discovery. Sir Alexander Fleming observed that in unwashed culture plates of *Staphylococcus*, a mould, *Penicillium*, was growing.

This mold inhibited the growth of *Staphylococcus*. Later, the antibiotic was isolated

from this fungus and named penicillin after the mold *Penicillium notatum*.

6. Name the scientists who were credited for showing the role of penicillin as an antibiotic?

Ans. Penicillin was discovered by Sir Alexander Fleming while working on the *Staphylococci* bacteria. However, its full potential as an effective antibiotic was established much later by Ernst Chain and Howard Florey.

This antibiotic was extensively used to treat American soldiers wounded in World War II. Fleming, Chain, and Florey were awarded the Nobel Prize in 1945 for this discovery.

7. How do bioactive molecules of fungal origin help in restoring the good health of humans?

Ans. Some bioactive molecules of fungal origin have been reported for their role in restoring the good health of humans.

Cyclosporin-A, which is used as an immunosuppressive agent in organ transplant patients, is produced by the fungus *Trichoderma polysporum*. Statins produced by the yeast *Monococcus purpureus* have been commercialised as blood cholesterol-lowering agents.

8. What roles do enzymes play in detergents that we use for washing clothes? Are these enzymes produced from some unique microorganisms?

Ans. Enzymes like lipases are used in detergent formulations, causing the breakdown of oils and thus helping to remove oily and greasy stains from clothes in laundry. These are obtained from *Candida lipolytica* and *Geotrichum candidum*.

9. What is the chemical nature of biogas? Name an organism which is involved in biogas production?

Ans. The chemical nature of biogas is CH_4 , CO_2 , H_2 and a trace amount of H_2S . Methanobacteria, a type of methanogen, is employed for biogas production.

10. How do microbes reduce the environmental degradation caused by chemicals?

Ans. Chemicals from fertilisers and pesticides are highly toxic to human beings and animals alike, and have been polluting our environment. To reduce the environmental degradation caused by chemicals, microbes can be used both as fertilisers and pesticides and can be called biofertilisers and biopesticides, respectively.

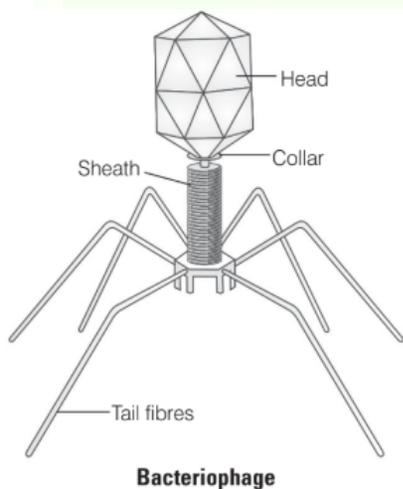
Microbes are used as biofertilisers to enrich the soil nutrients, e.g., *Rhizobium*, *Azotobacter*, *Azospirillum*, etc., which can fix atmospheric nitrogen in the soil. *Bacillus thuringiensis* bacteria act as biopesticides to control the growth of insect pests. *Trichoderma*, a fungal species, is an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

11. What is a broad-spectrum antibiotic? Name one such antibiotic.

Ans. A broad-spectrum antibiotic can inhibit the growth of both Gram-positive and Gram-negative bacteria. e.g., Tetracyclines, phenicols, fluoroquinolones, third-generation, and fourth-generation antibiotics are cephalosporins.

12. What are viruses parasitising bacteria called? Draw a well-labelled diagram of the same.

Ans. Viruses parasitising bacteria are called bacteriophages. These viruses do not actually eat bacteria. They infect and replicate within the bacteria.



artNotes

13. Which bacterium has been used as a clot buster? What is its mode of action?

Ans. The bacterium *Streptococcus* that produces streptokinase is used as a 'clot buster'. This enzyme has a fibrinolytic action that breaks down the clots formed in the blood vessels of patients who have undergone myocardial infarction. This prevents heart attacks in these patients that can otherwise occur because of occlusion by the clots.

14. What are biofertilisers? Give two examples.

Ans. Biofertilisers are organisms that enrich the nutrient quality of the soil. The main sources of biofertilizers are bacteria, fungi, and cyanobacteria. e.g.,

- (i) *Azospirillum*, *Rhizobium*, and *Azotobacter* can fix atmospheric nitrogen in the soil.
- (ii) Blue-green algae like *Anabaena*, *Nostoc*, and *Oscillatoria* add organic matter to the soil and are responsible for increasing its fertility.

Long Answer Type Questions

1. Why is aerobic degradation more important than anaerobic degradation for the treatment of large volumes of wastewaters rich in organic matter? Discuss.

Ans. Aerobic degradation is more important as naturally occurring aerobic and facultative microbes (bacteria, fungi, Protozoa, and others) in the wastewater can rapidly oxidise soluble organic and nitrogenous compounds.

Mechanical addition of oxygen makes the process faster, and most of the pathogenic content of the effluent is removed.

2. (a) Discuss about the major programs that the Ministry of Environment and Forests, Government of India, has initiated for saving major Indian rivers from pollution.

(b) Ganga has recently been declared the national river. Discuss the implications with respect to pollution of this river.

Ans. (a) Before 1985, only a few cities and towns had sewage treatment plants. Most of the sewage water of urban as well as rural areas was discharged directly into rivers, resulting in their pollution. The importance of microbial treatment of sewage was then realised, and more sewage treatment plants were established.

Still, they are not sufficient due to increasing urbanisation and the production of much larger quantities of sewage as compared to earlier days. Realising the importance of microbes in pollution control, the Ministry of Environment and Forests has initiated the development of sewage treatment plants under the National River Conservation Authority. e.g., Ganga Action Plan (GAP) and Yamuna Action Plan (YAP) to save these major rivers of our country from pollution.

(b) The Ganga Action Plan (GAP) was a program launched in April 1986 to reduce the pollution load on the river. A steering committee of the National River Conservation

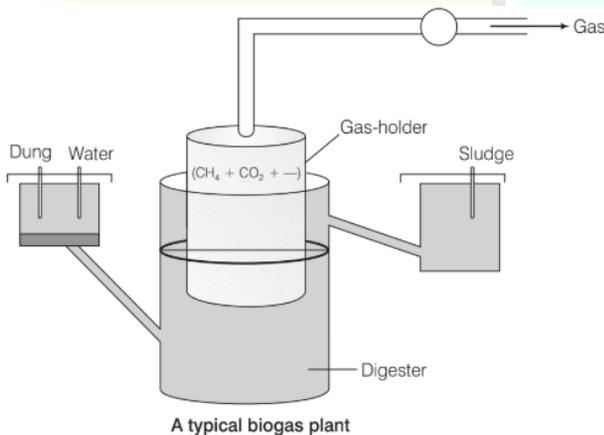
Authority reviewed the progress of the GAP and the necessary corrections. Scientists and religious leaders have speculated on the causes of the river's apparent self-purification effect, in which water-borne diseases such as dysentery and cholera are eliminated by killing the causative organisms. Thus preventing large-scale epidemics.

Some studies have reported that the river retains more oxygen than is typical for comparable rivers; this could be a factor leading to fewer disease agents being present in the water.

The National River Ganga Basin Authority (NRGBA) was established by the Central Government of India, on 20th February 2009 Under Section 3(3) of The Environment Protection Act, 1986. It also declared the Ganges as the National river of India.

3. Draw a diagrammatic sketch of biogas plant and label its various components given below: gas holder, sludge chamber, digester, dung + water chamber.

Ans. The raw material for biogas production is the excreta (dung) of cattle. The biogas plant has a concrete tank (10-15 feet deep) in which bio-wastes and slurry of dung are collected.



The tank has a floating cover that rises on production of gas is produced in the tank. Methanobacterium in the dung acts on the bio-wastes to produce biogas. The gas produced is supplied to nearby houses by an outlet. Through another outlet, the spent slurry is removed to be used as fertilizer. Biogas is used as fuel for cooking and lighting.

4. Describe the main ideas behind the biological control of pests and diseases.

Ans. It's a natural and eco-friendly concept. It employs the use of organisms to control

the population of pathogens and pests in an ecosystem. Classical examples are *Trichoderma*, which is an antagonist, i.e., against many soil-borne plant pathogens. Similarly, *Penicillium* inhibits the growth of *Staphylococcus* and, therefore, has been successfully used in the production of penicillin antibiotics to control many human bacterial pathogens. *Bacillus thuringiensis* acts as a biopesticide to control insects. Baculovirus used as a biological control agent in the genus Nucleo-polyhedrovirus is excellent for species-specific, narrow-spectrum insecticidal application. The overall biological control of pests is considered much more beneficial in an ecologically sensitive area.

5. (a) What would happen if a large volume of untreated sewage is discharged into a river?

(b) In what way anaerobic sludge digestion is important in sewage treatment?

Ans.

- (a) If untreated sewage is discharged directly into rivers, it will lead to serious pollution of the waters with organic matter and pathogenic bacteria, Protozoa, and many other diseases. This water, if used, will cause outbreaks of water-borne diseases.
- (b) In anaerobic sludge digestion, anaerobic bacteria digest the aerobic bacteria and the fungi in the sludge and the remaining organic matter. During this digestion, bacteria produce a mixture of gases such as methane, hydrogen sulphide, and carbon dioxide. These gases (biogas) can be used as a source of energy as it is inflammable.

6. Which type of food would have lactic acid bacteria? Discuss their useful application.

Ans. The most common food items that are curd and yoghurt contain Lactic Acid Bacteria (LAB) of *Lactobacillus* species. Curd is formed by adding a small amount of curd to milk, which acts as a starter. Microbes present in the starter multiply at a suitable temperature and convert milk into curd.

Acids released by LAB during the growth coagulate and partially digest milk protein, casein, thus increasing the digestibility of milk protein.

Application of LAB

- (i) Improves the nutritional quality of milk by increasing vitamin B12.
- (ii) Check disease-causing microbes in the stomach.