10

Microbes in Human Welfare

Multiple Choice Questions (MCQs)

Q. 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-B_{12} (d) vitamin-E

Ans. *(c)* Microorganisms such as *Lactobacillus* and others commonly called Lactic Acid Bacteria (LAB) grow it milk and convert into curd. During growth, the LAB produce acids that coagulate and partially digest the milk proteins.

A small amount of curd added to the fresh milk as inoculum or starter contain millions of LAB, which at suitable temperature multiply, thus, converting milk to curd, which also improves its nutritional quality by increasing vitamin-B_{12} .

Note *In our stomach, the LAB play other options are not related with LAB bacteria beneficial role in checking disease causing microbes.*

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

(a) an aerobic digesters (b) floc
(c) chemicals (d) oxidation pond

Thinking Process

The treatment of waste water is divided into three phases-pre treatment, primary treatment and secondary treatment.

Ans. *(a)* Sludge is further treated by unaerobic digesters. These are large heated tanks in which its chemical decomposition is catalysed by microorganisms.

The liquid is treated by bacteria which breakdown the organic matter remaining in solution. It is then sent to **oxidation ponds** where heterotrophic bacteria continue the breakdown of the organics and solar UV light destroys the harmful bacteria. Chemical are not used in fhere treatments.

Q. 3 Methanogenic bacteria are not found in

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

Ans. ***(d)*** Methanogenic bacteria (that produce methane) are not found in activated sludge. The microbes present in the activated sludge are aerobic bacteria that grow rapidly and form flocs.

During secondary treatment of wastewater it is in the digestors where other kinds of bacteria which grow anaerobically, digest the bacteria and the fungi in the sludge producing mixture of gases such as methane, hydrogen sulphide and CO_2 which form the biogas.

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

	Column I (Bacterium)		**Column II** (Product)
A.	*Aspergillus niger*	1.	Lactic acid
B.	*Acerobacter aceti*	2.	Butyric acid
C.	*Clostridium butylicum*	3.	Acetic acid
D.	*Lactobacillus*	4.	Citric acid

Codes

	A	B	C	D
(a)	2	3	4	1
(c)	4	3	2	1

	A	B	C	D
(b)	2	4	3	1
(d)	4	1	3	2

Ans. ***(c)*** *Following is the list of bacteria and their commercially important products*

	Column I (Bacterium)	**Column** (Product)
A.	*Aspergillus niger*	Citric acid
B.	*Acetobacter aceti*	Acetic acid
C.	*Clostridium butylicum*	Butyric acid
D.	*Lactobacillus*	Lactic acid

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

	Column I (Bioactive Substance)		**Column II** (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.	Immuno-suppressive agent

Choose the correct match

Codes

	A	B	C	D
(a)	2	3	1	4
(c)	4	1	3	2

	A	B	C	D
(b)	4	2	1	3
(d)	1	2	3	4

Ans. ***(d)*** *Following is the column of bioactive substances and their roles*

Column I (Bioactivesubstances)	Column (Role)
A. Statin	Lowering of blood cholesterol
B. Cyclosporin-A	Immuno-suppressive agent
C. Streptokinase	Removal of clots from blood vessels
D. Lipase	Removal of oil stains

Statins produced by the yeast *Monascus purpureus* have been commercialised as blood cholesterol lowering agents.

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

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 infaction leading to heart attack.

Lipases are used in detergent formulations and are helpful in removing oily stains from the laundry.

Q. 6 The primary treatment of waste water involves the removal of

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

Ans. ***(b)*** The primary treatment of waste water involves physical removal of both larger and small particles (stable particles) from the sewage through filtration and sedimentation. These are removed in stages; initially, floating debris is removed by sequential filtration.

Then the grit (soil and small pebbles) are removed by sedimentation. All solids that settle form the primary sludge and the supernatant forms the effluent. The effluent is taken for the secondary treatment.

The primary treatment does not remove the dissolved impurities (a), toxic substances (c) and harmful bacteria (d).

Q. 7 BOD of waste water is estimated by measuring the amount of

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

Ans. ***(d)*** BOD (Biochemical Oxygen Demand) refers to the amount of the oxygen that would be consumed if all the organic matter in one litre of water were oxidised by bacteria. Other options (a) (b) and (c) are incorrect.

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

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

Ans. ***(a)*** Wine and beer are produced without distillation whereas whisky, brandy and rum are produced by distillation of the fermented broth.

Q. 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)*** Cattle dung is used for the production of biogas, commonly called gobar gas.

The technology of biogas production from cowdung was developed in India mainly due to the efforts of Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC). Other options (a), (b) and (d) did not play any role is this.

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

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

Ans. ***(b)*** *Trichoderma* species are free-living fungi that are very common in soil. They are effective biocontrol agents of several soil borne plant pathogens other options are incorrect

Q. 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 bacterial would grow around flocs
(d) Protozoa would grow in large numbers

Thinking Process

During secondary treatment, the primary effluent is passed into large aeration tanks where it is constantly agitated mechanically and air is pumped into it. This allows vigorous growth of useful aerobic microbes into flocs (masses of bacteria associated with fungal filaments to form mesh like structures).

Ans. ***(b)*** Activated sludge microorganisms need oxygen as they oxidise wastes to obtain energy for growth. Insufficient oxygen will slow down or kill off aerobic microorganisms, make facultative organisms work less efficiently and ultimately lead to the breakage of flocs.

It will also result in the production of the foul-smelling byproducts of anaerobic decomposition. So, sufficient oxygen must always be maintained in the aeration tank to ensure complete waste stabilisation.

Q. 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)*** Fungi form symbiotic association with the roots of higher plants called mycorrhiza (VAM) *e.g, Glomus.*

The fungal hyphae symbiont in these associations absorb phosphorus from soil and passes it to the plant. Plants having such associations show other benefits also, such as resistance to root-borne pathogens, tolerance to salinity and draught, and an overall increase in plant growth and development. Mycorrhiza does not help the host plant in increasing its resistance to insects.

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

(a) *Anabaena* (b) *Nostoc*

(c) *Azotobacter* (d) *Pseudomonas*

Ans. ***(d)*** *Pseudomonas* is a dentrifying bacteria, which convert ammonia and nitrates into free nitrogen, *i.e.,* these denitrifying bacteria are responsible to liberate free nitrogen in the environment through nitrogen in the environment through nitrogen cycle.

Other options (a), (b) and (c) show nitrogen fixing organisms.

Azospirillum and *Azotobacter* are free-living bacteria, which absorb free nitrogen from soil, air and convert it into salts of nitrogen like amino acids and enrich soil nutrients.

Cyanobacteria are autotrophic microbes widely distributed in aquatic and terrestrial environments, many of which can fix atmospheric nitrogen, *e.g*., *Nostoc*, *Anabaena*, *Oscillatoria*, etc.

Q. 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

Thinking Process

Different varieties of cheese are known by their characteristic texture, flavour and taste, the specificity coming from the microbes used.

Ans. ***(c)*** The large holes in 'Swiss cheese' are due to production of a large amount of CO_2 by a bacterium named *Propionibacterium sharmanii*. Other options are in correct.

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

(a) burnt

(b) burried in land fills

(c) used as manure

(d) used in civil construction

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

A floating cover is placed over the slurry, which keeps on rising as the gas is produced in the tank due to the microbial activity. *Methanobacterium* in the dung act on the bio-wastes to produce bio-gas. The gas produced is supplied to nearby houses by an outlet. Through another outlet, the spent slurry is removed to be used as manure.

Q. 16 Methanogens do not produce

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

Ans. ***(a)*** In the digesters (during secondary treatment of waste water), heterotrophic microbes (methanogens) anaerobically digest bacteria and fungi in sludge producing mixture of gases such as methane, hydrogen sulphide and CO_2 which form the biogas. The O_2 is not produced by methanogens.

Q. 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)*** In the secondary treatment of waste water, when BOD of sewage has reduced, the effluent is passed into setting tank. Here, the bacterial flocs settle and the sediment is called activated sludge.

A small part of the sludge is used as an inoculum in the aeration tank and the remaining part is passed into large tanks called anaerobic sludge digesters. That's why activated sludge should have the ability to settle quickly.

Q. 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*

Codes

	A	B	C	D
(a)	2	4	3	1
(c)	4	1	2	3

	A	B	C	D
(b)	3	4	2	1
(d)	3	2	1	4

Ans. ***(b)***

	Column I	Column II
A.	Lady bird	*Aphids*
B.	Mycorrhiza	*Glomus*
C.	Biological control	*Trichoderma*
D.	Biogas	*Methanobacterium*

Ladybird is the very familiar beetle with red and black markings, used to get rid of *Aphids*.

Fungi form symbiotic association, with the roots of higher plants called mycorrhiza, *e.g.*, *Glomus*.

A biological control being developed for use in the treatment of plant disease is the fungus *Trichoderma*.

Methanogens, particularly *Methanobacterium*, are found in cowdung. These bacteria grow anaerobically on cellulosic material and produce large amount of methane along with CO_2 and H_2.

Very Short Answer Type Questions

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

Thinking Process

Different varieties of bakery like bread and cheese are known by their characteristic texture, flavour and taste, the specificity coming from the microbes used.

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

Q. 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.

Fermentors

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

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 synthesis of cholesterol.

Q. 4 Why do we prefer to call secondary waste water treatment as biological treatment?

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

Q. 5 What for nucleopolyhedro viruses are being used now a-days?

Ans. Several methods of biological control are being used in the pest management to keep the pollution-free environment 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 Nucleopolyhedro virus.

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.

Q. 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 towards the welfare of the human society.

Anti is a Gk. 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, which 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.

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

Ans. Depending on the type of the 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.

Q. 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.

Q. 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 stomach) of cattle, collectively called methanogens, are capable of digesting cellulose as they have cellulase enzyme.

Q. 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 vector to introduce foreign DNA segment in desired organisms.

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

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

Q. 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 ball worm). These are developed by introducing a gene from *Bacillus thuringiensis* which produces toxin is plants which is lethat to insects.

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

Ans. Blue-green algae add organic matter to the soil and increase its fertility still 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.

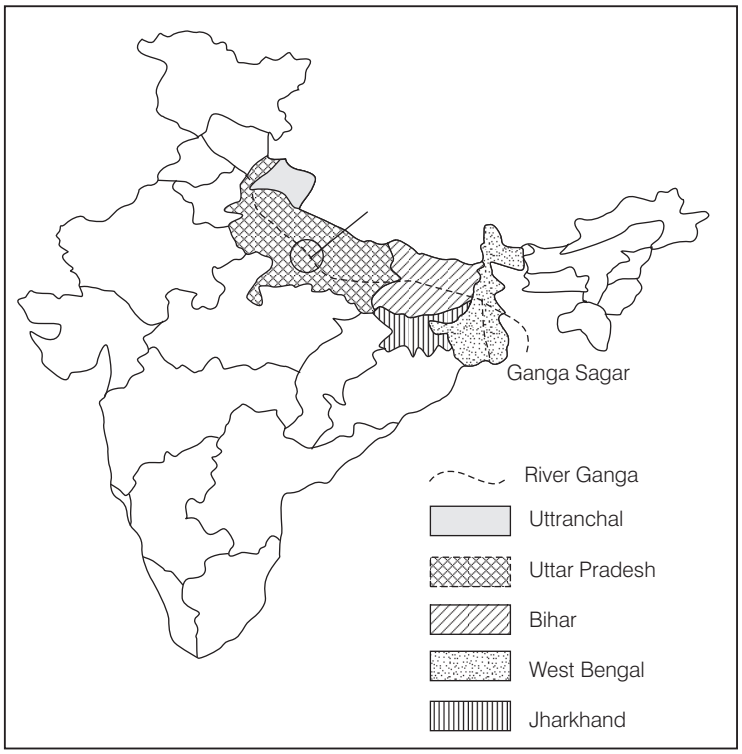
Q. 14 Which species of *Penicillium* produces Roquefort cheese?

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

Q. 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 in order to reduce the pollution load on the River Ganga.

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



Q. 16 Name any two industrially important enzymes.

Ans. **(i)** Lipases are used in detergent formulations and are helpful in removing oily stains from the laundry.

(ii) Pectinases and proteases that are used as clarifying agents in making commercial fruit and vegetable juices.

Q. 17 Name an immune immunosupressive agent?

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

Q. 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.

Q. 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 stomach) of cattles, thus providing nutrition to cattles.

Q. 20 Name a microbe used for the production of swiss cheese.

Ans. Cheese is formed by partial degradation of milk by different microorganisms. Swiss cheese is formed by the bacterium *Propionibacterium sharmanii.* Its characteristic feature is formation of large holes due to production of large amount of CO_2.

Short Answer Type Questions

Q. 1 Why are flocs important in biological treatment of waste water?

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

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

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

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

Ans. The mycorrhizal fungi absorb phosphorus from the soil and transfer them to the host cells. They also impart resistance to host plants against root pathogens. They also show tolerance to salinity and draught as well as increases overall growth and development of plant.

Hence, fungal hyphae help in synthesising organic food and also recieve/get shelter and nourishment from the higher plant.

Q. 4 Why are cyanobacteria considered useful in paddy fields?

Ans. Cyanobacteria like *Anabaena, Nostoc, 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.

Q. 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 mould inhibited the growth of *Staphylococcus*. Later the antibiotic was isolated from this fungus and named penicillin after the mould *Penicillium notatum*.

Q. 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 *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.

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

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

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

Q. 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 which formulations, cause breakdown of oils and thus help in removing oily and greasy stains from the clothes in laundry.
These are obtained from *Candida lipolytica* and *Geotrichum candidum*.

Q. 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.

Q. 10 How do microbes reduces the environmental degradation causes 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, fungal species, is effective bicontrol agent of several plant pathogens. Baculovirus used as biological control agents in genus *Nucleopolyhedrovirus* are excellent for species-specific, narrow spectrum insecticidal applications.

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

Ans. A broad spectrum antibiotic is one which can inhibit the growth of both Gram positive and Gram negative bacteria

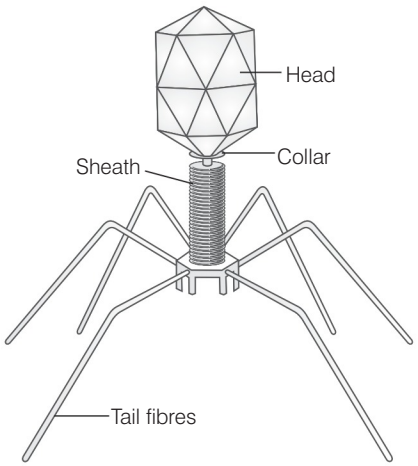
e.g.,Tetracyclines, phenicols, fluoroquinolones, third-generation and fourth-generation antibiotivcs is cephalosporins.

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

Thinking Process

*The word **phage** means 'to eat'.*

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



Bacteriophage

Q. 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 attack in these patients that can otherwise occur because of occlusion by the clots.

Q. 14 What are biofertilisers? Give two examples.

Ans. Biofertilisers are organisms that enrich the nutrient quality of the soil. The main source 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*, *Occilatoria* add organic matter to the soil and responsible for increase its fertility.

Long Answer Type Questions

Q. 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 waste water 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.

Q. 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 implication with respect to pollution of this river.

Ans. **(a)** Prior to year 1985, only 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. 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 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 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 in order to reduce the pollution load on the river. A steering committee of the National River Conservation Authority reviewed the progress of the GAP and necessary correction.

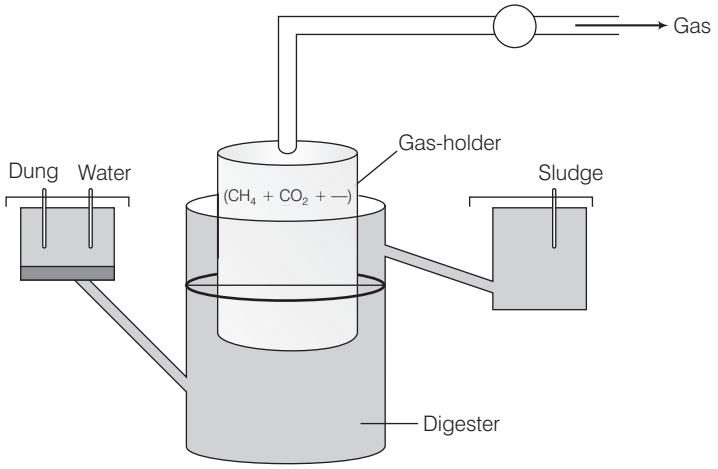
Scientists and religious leaders have speculated on the causes of the river's apparent self-purification effect, in which water-borne diseases such as dysentery and cholera are eliminated by killing thin caused organisms. Thus preventing large-scale epidemics.

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.

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 Ganges as the National, river of India.

Q. 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 excreta (dung) of cattle. The biogas plant has a concrete tank (10-15 feet deep) in which bio-wastes and slurry of dung is collected.



A typical biogas plant

The tank has a floating cover which rises on production of gas in the tank. *Methanobacterium* in the dung act 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 fertiliser. Biogas is used as fuel for cooking and lighting.

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

Ans. It's a natural and eco-friendly concept. If employs the use of organisms to control the population of pathogens and pests in an ecosystem. Classical examples are *Trichoderma* which is 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 antibiotic to control many human bacterial pathogens. *Bacillus thuringiensis* acts as biopesticide to control insect.

Baculovirus used as biological control agents in genus Nucleo-polyhedrovirus are excellent for species-specific-narrow spectrum insecticidal application. The overall biological control of pest is considered much more beneficial in an ecological sensitive area.

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

(b) In what way anaerobic sludge diagestion is important in sewage treatments?

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 diseaser.

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 source of energy as it is inflammable.

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

Ans. The most common food item 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 starter multiply at suitable temperature and convert milk into curd.

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

Application of LAB

(i) Improves nutritional quality of milk by increasing vitamin-B_{12}.

(ii) Checks disease-causing microbes in stomach.