

MICROBES IN HUMAN WELFARE

| Q.No | Question | Marks |
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| Multiple Choice Question | | |
| Q.170 | <p>Industrial production of which of these products can be negatively affected by the presence of <i>Saccharomyces cerevisiae</i>?</p> <p>A. Beer B. Wine C. Fruit juice D. Wheat bread</p> | 1 |
| Q.171 | <p>A pharmaceutical industry aims to develop a chemical that can induce immune system modulation in patients with autoimmune diseases and help in alleviating symptoms.</p> <p>Which of the following microbes should they consider utilizing?</p> <p>A. <i>Aspergillus niger</i> B. <i>Staphylococcus aureus</i> C. <i>Trichoderma polysporum</i> D. <i>Saccharomyces cerevisiae</i></p> | 1 |
| Q.172 | <p>A pharmaceutical company is working on a drug based on statin and is searching for appropriate candidates for clinical tests so as to evaluate its safety, efficacy, and potential therapeutic benefits in a controlled and monitored setting and obtain potential regulatory approval.</p> <p>Which of the following would serve as suitable candidates to obtain samples?</p> <p>A. A professional swimmer. B. A person who recently recovered from dengue. C. A gym trainer who consumes protein in higher quantities. D. A person who consumes saturated fats in higher quantities.</p> | 1 |
| Q.173 | <p>An industry aims to transition from a small-scale experimental bioreactor to a large bioreactor for the production of an enzyme.</p> <p>Which of the following parameters would be CONSTANT during the scaling-up process?</p> <p>P) pH profile Q) Reactor capacity</p> | 1 |



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| | <p>R) Volume of inoculum</p> <p>S) Temperature profile</p> <p>T) Initial nutrient concentration</p> <p>A. Only P, R and S</p> <p>B. Only P, Q and R</p> <p>C. Only Q, T and R</p> <p>D. Only P, S and T</p> | |
| Q.174 | <p>Certain micro-organisms such as <i>Pseudomonas</i>, <i>Bacillus</i>, and <i>Burkholderia</i> species are administered in regions in the oceans where accidental oil spills occur.</p> <p>Which of the following enzymes could the above micro-organisms be producing for them to be helpful in the scenario?</p> <p>A. Streptokinases</p> <p>B. Proteases</p> <p>C. Amylases</p> <p>D. Lipases</p> | 1 |
| Q.175 | <p>Read the following statements:</p> <p>(A) BOD and polluting potential are inversely related.</p> <p>(B) BOD and polluting potential are directly related.</p> <p>(C) More the BOD, the easier it is to treat the water.</p> <p>(D) More the BOD, more will the harm if released in a water body.</p> <p>Which of these is true?</p> <p>A. (A) and (C) are true and (C) is the reason for (A)</p> <p>B. (B) and (C) are true and (C) is not related to (B)</p> <p>C. (A) and (D) are true and (D) is not related to (A)</p> <p>D. (B) and (D) are true and (D) is the reason for (B)</p> | 1 |
| Q.176 | <p>'Some groups of microbes release secondary metabolites that are harmful to other groups of organisms and not to the groups releasing it.'</p> <p>For which of the following applications of human welfare is this microbial feature significant?</p> <p>P) Biopesticides</p> <p>Q) Fertilizers</p> | 1 |



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| | R) Fermentation S) Antibiotics T) Sewage treatment A. only P and Q B. only P and S C. only P, S and T D. only Q, R, S and T | |
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| Q.177 | <p>A biologist inoculated bacteria A, fungus B, and both bacteria A and fungus B on 3 different sterile petri dishes 1,2 and 3 respectively. After 24 hours, he observed growth in all 3. These are his observations:</p> <table border="1"> <thead> <tr> <th>Plate</th><th>Organisms</th><th>Observation</th></tr> </thead> <tbody> <tr> <td>1</td><td>bacteria A</td><td>46 small round colonies</td></tr> <tr> <td>2</td><td>fungus B</td><td>9 medium round colonies</td></tr> <tr> <td>3</td><td>bacteria A + fungus B</td><td>4 small round colonies + 10 medium round colonies</td></tr> </tbody> </table> <p>What can the biologist conclude from this?</p> <p>Y) The fungus inhibits the growth of the bacteria.</p> <p>Z) The bacterium causes the fungus to grow better.</p> <p>A. only Y B. only Z C. both Y and Z D. neither Y nor Z</p> | Plate | Organisms | Observation | 1 | bacteria A | 46 small round colonies | 2 | fungus B | 9 medium round colonies | 3 | bacteria A + fungus B | 4 small round colonies + 10 medium round colonies | 1 |
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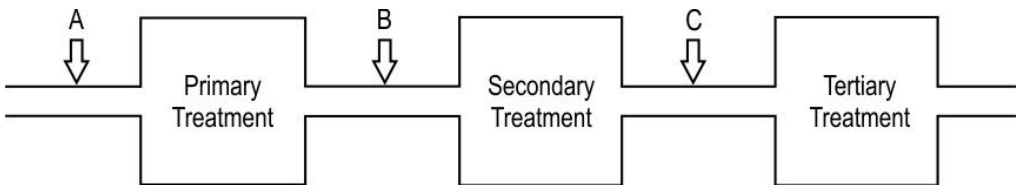
Free Response Questions/Subjective Questions

| Q.178 | <p>To understand the effectiveness of the broad-spectrum antibiotics produced by <i>Acremonium</i> fungi, a group of scientists grow it on nutrient media plates along with various disease-causing microbes. The observations related to their growth patterns is tabulated as follows -</p> <table><tr><th>Micro-organism</th><th>Growth pattern with <i>Acremonium</i> fungi</th></tr><tr><td><i>Staphylococcus aureus</i></td><td>Both the fungi and bacterial colonies appear.</td></tr><tr><td><i>Enterococcus faecalis</i></td><td>Only the fungi grows.</td></tr></table> | Micro-organism | Growth pattern with <i>Acremonium</i> fungi | <i>Staphylococcus aureus</i> | Both the fungi and bacterial colonies appear. | <i>Enterococcus faecalis</i> | Only the fungi grows. | 5 |
|------------------------------|---|----------------|---|------------------------------|---|------------------------------|-----------------------|---|
| Micro-organism | Growth pattern with <i>Acremonium</i> fungi | | | | | | | |
| <i>Staphylococcus aureus</i> | Both the fungi and bacterial colonies appear. | | | | | | | |
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| | <table><tr><td><i>Klebsiella pneumoniae</i></td><td>Both the fungi and bacterial colonies appear.</td></tr><tr><td><i>Pseudomonas aeruginosa</i></td><td>Only the fungi grow.</td></tr></table> | <i>Klebsiella pneumoniae</i> | Both the fungi and bacterial colonies appear. | <i>Pseudomonas aeruginosa</i> | Only the fungi grow. | |
| <i>Klebsiella pneumoniae</i> | Both the fungi and bacterial colonies appear. | | | | | |
| <i>Pseudomonas aeruginosa</i> | Only the fungi grow. | | | | | |
| | <p>(a) Antibiotics produced by the <i>Acremonium</i> fungi can be used to treat the diseases caused by which of the above microorganisms?</p> <p>(b) Mention any THREE advantages of using microbes for large-scale antibiotic production compared to chemical synthesis.</p> | | | | | |
| Q.179 | Pectinases are used in the textile industry as well as in wastewater treatment. Identify how pectinase can help in each of these industries. | 2 | | | | |
| Q.180 | <p>A patient who has been undergoing chemotherapy is suffering from blood coagulations around central venous catheters that have been used to administer the related drugs.</p> <p>(a) Suggest one possible enzyme that could be considered for administration, with the aim of potentially restoring proper blood flow.</p> <p>(b) Based on (a), mention the micro-organism that it is produced from.</p> | 2 | | | | |
| Q.181 | <p>A water treatment plant primarily receives wastewater from an industry that discharges fungicides as a waste byproduct.</p> <p>Mention any THREE ways the above situation might influence the water treatment procedure.</p> | 3 | | | | |
| Q.182 | While both biological pesticides and chemical pesticides are designed to protect plants and control pests, mention any FIVE advantages that biological pesticides offer over their chemical counterparts. | 5 | | | | |
| Q.183 | <p>Two farmers A and B primarily grow rice. Farmer A practices crop rotation with legumes and rice, and farmer B does not rotate crops.</p> <p>If crops are not rotated, replenishment of nutrients does not occur which degrades soil fertility. Justify your answer</p> | 2 | | | | |
| Q.184 | <p>Given below are three chemical equations. Suggest specific microorganisms that can be used as inoculants for synthesizing the desired products.</p> <p>(a) $C_6H_{12}O_6 \rightarrow 2 C_2H_5OH + 2 CO_2$</p> <p>(b) $N_2 + 3 H_2 \rightarrow 2 NH_3$</p> <p>(c) $(C_6H_{10}O_5)_n + H_2O \rightarrow CO_2 + H_2 + CH_4$</p> | 3 | | | | |
| Q.185 | <p>A wastewater sample containing a higher concentration of calcium chloride, potassium chloride, aluminium and copper will always have a higher BOD value.</p> <p>Mark the above statement as true or false and justify your answer.</p> | 2 | | | | |



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| Q.186 | <p>Correct the wrong information (in bold) in the steps of the sewage treatment plant and then arrange the sentences in chronological order.</p> <ol style="list-style-type: none"> 1. Agitation in the aeration tank leads to the formation of suspended organic waste matters called flocs. 2. During primary treatment, aerobic bacteria degrade waste matter in the sewage. 3. When the BOD is significantly reduced, the effluent is passed from the aeration tank to the settling tank. 4. The primary sludge is taken for secondary treatment. 5. Anaerobic sludge digesters degrade bacteria and fungi in the sludge and produce oxygen. | 3 |
| Q.187 | Explain any THREE reasons behind using cow dung for biogas production. | 3 |
| Q.188 | <p>In a wastewater treatment plant, sampling was done thrice at various stages in the treatment process indicated by A, B and C in the following diagram</p>  <p>Each time the sample was taken, its BOD was measured, resulting in the following recorded values: 30 mg/L, 300 mg/L, 250 mg/L</p> <p>(a) Define BOD and determine which of these BOD values correspond to stages A, B, and C in the treatment process.</p> <p>(b) Based on (a), justify your answer for each value.</p> | 5 |
| Q.189 | <p>Alex, Ross and Jane are trying to standardise and identify the best way to make curd. They followed different methods as follows:</p> <ul style="list-style-type: none"> - Alex took a bowl of lukewarm milk and rested it overnight at room temperature. - Ross took boiling milk, added some curd to it and maintained the temperature high overnight. - Jane took a bowl of lukewarm milk, added some curd to it and rested it overnight at room temperature. <p>(a) What are the possible end products that each one of them will obtain?</p> <p>(b) Based on (a), whose method will yield the best quality curd? Give reasons to support your answer.</p> | 3 |
| Q.190 | A scientific group aims to compare the quality of water from various water bodies. They collected samples from 3 water bodies and calculated their BOD amongst other parameters and tabulated them as follows. | 3 |

| | <table><tr><th>Sample Name</th><th>BOD Value (ppm)</th></tr><tr><td>A</td><td>100</td></tr><tr><td>B</td><td>2</td></tr><tr><td>C</td><td>11</td></tr></table> <p>(a) Arrange the sample names with respect to their level of pollution (highest to lowest).</p> <p>(b) Explain how BOD can indicate the level of pollution in water and hence the water quality.</p> | Sample Name | BOD Value (ppm) | A | 100 | B | 2 | C | 11 | |
|-------------|---|-------------|-----------------|---|-----|---|---|---|----|--|
| Sample Name | BOD Value (ppm) | | | | | | | | | |
| A | 100 | | | | | | | | | |
| B | 2 | | | | | | | | | |
| C | 11 | | | | | | | | | |
| Q.191 | Some bacteria such as <i>Lactobacillus</i> aids in the conversion of milk to curd. How does the pH of the system change during this conversion? Justify your answer. | 2 | | | | | | | | |
| Q.192 | Carbon dioxide is produced as a by-product during the fermentation process of various food items and beverages. Explain any two ways by which this can be beneficial. | 2 | | | | | | | | |



Answer key and Marking Scheme

| Q.No | Answers | Marks |
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| Q.170 | C. Fruit juice | 1 |
| Q.171 | C. <i>Trichoderma polysporum</i> | 1 |
| Q.172 | D. A person who consumes saturated fats in higher quantities. | 1 |
| Q.173 | D. Only P, S and T | 1 |
| Q.174 | D. Lipases | 1 |
| Q.175 | D. (B) and (D) are true and (D) is the reason for (B) | 1 |
| Q.176 | B. only P and S | 1 |
| Q.177 | A. only Y | 1 |
| Q.178 | <p>(a) <i>Enterococcus faecalis</i> and <i>Pseudomonas aeruginosa</i></p> <p>[1 mark each for each organism]</p> <p>(b) [1 mark each for any THREE of the following points]</p> <p>Large-scale antibiotic production by microbes offers the following advantages as compared to the chemical synthesis</p> <ul style="list-style-type: none"> - follows pathways that are biologically relevant and efficient. - involves less hazardous chemical reactions compared to traditional chemical synthesis and results in a smaller environmental footprint and reduced use of harsh chemicals. - renewable and sustainable due to usage of previous inoculum. - cost-effective. - less energy-intensive and faster. - a vast array of secondary metabolites can also be obtained. <p>[Accept any other valid answers]</p> | 5 |
| Q.179 | Textiles made from plant sources, such as cotton, will contain plant material such as pectin which will need to be degraded. | 2 |



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| | Waste water will also contain pectinaceous material where pectinase can act to clarify water reducing plant wastes. | |
| Q.180 | (a) Streptokinase (b) <i>Streptococcus</i> spp. | 2 |
| Q.181 | <i>[1 mark each for the following THREE points]</i> - fungicides can interfere with the formation and stability of activated sludge flocs and might result in slower settling, and reduced solid-liquid separation. - they can be toxic to other microorganisms such as bacteria, which are essential for the breakdown of organic matter in wastewater. - they could form harmful byproducts in combination with other chemicals during treatment. <i>[Accept any other valid answer]</i> | 3 |
| Q.182 | <i>[1 mark each for any FIVE of the following]</i> Unlike chemical pesticides, biological pesticides - are derived from living organisms or natural substances, making them relatively less environmentally harmful - degrade faster and leads to lower residual levels in food and water - target specific pests or groups of pests. This precision reduces the impact on beneficial insects, pollinators, and other non-target organisms, helping to maintain a more balanced ecosystem. - pose fewer risks of acute toxicity or long-term health effects associated with exposure for the farmers and farm animals. - play a key role in IPM strategies, which aim to balance pest control and ecosystem health. - make less impact on crop and non-crop plants. - cause reduced aquatic and soil pollution <i>[Accept any other valid answers]</i> | 5 |
| Q.183 | <i>[1 mark each for each of the following points]</i> - Farmer A - Legumes with nitrogen-fixing bacteria called Rhizobia that reside in nodules on roots and convert atmospheric nitrogen (N ₂) into a form that plants can utilize, | 2 |



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| | <p>such as ammonia (NH_3) and nitrates (NO_3^-) and aid in better yield when crops are rotated.</p> <p>OR</p> <p>No crop rotation does not replenish nutrients in the soil degrading soil fertility.</p> | |
| Q.184 | <p>(a) <i>Saccharomyces cerevisiae</i></p> <p><i>[Accept any other valid answers]</i></p> <p>(b) <i>Rhizobium spp.</i></p> <p><i>[Accept any other valid answers]</i></p> <p>(c) <i>Methanobacterium spp.</i></p> <p><i>[Accept any other valid answers]</i></p> | 3 |
| Q.185 | <p>- False</p> <p>- BOD is influenced by the presence of organic compounds that microbes need to break down and not by inorganic compounds and metals such as calcium chloride, potassium chloride, aluminium and copper.</p> | 2 |
| Q.186 | <p>1. Agitation in the aeration tank leads to the formation of mesh-like structures of bacteria associated with fungal filaments called flocs.</p> <p>2. During primary treatment, filtration and sedimentation are used for the physical removal of particles like debris and grit.</p> <p>3. The primary effluent is taken for secondary treatment.</p> <p>4. Anaerobic sludge digesters degrade bacteria and fungi in the sludge and produce methane, hydrogen sulphide, and carbon dioxide.</p> <p><i>[0.5 mark each for each of the above corrected statements]</i></p> <p>Correct order: 2, 4, 1, 3, 5</p> | 3 |
| Q.187 | <p><i>[1 mark each for any THREE of the following points]</i></p> <p>- cow dung contains a significant amount of methane-producing bacteria (methanogens) due to their presence in the cow's digestive system and aids in the production of methane which is a major component of biogas.</p> <p>- it is rich in organic matter such as cellulose, other carbohydrates, and proteins, that serves as a food source for the microorganisms responsible for anaerobic digestion.</p> | 3 |



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| | <ul style="list-style-type: none"> - easily accessible in rural areas and is a waste product on farms that needs recycling and proper disposal. - biogas derived from cow dung is a renewable energy source, contributing to reducing reliance on non-renewable fossil fuels. - the leftover material post-production of biogas can be used as an organic nutrient-rich fertilizer that helps in recycling nutrients back into the soil, improving soil fertility and agricultural productivity. <p><i>[Accept any other valid answers]</i></p> | |
| Q.188 | <p>(a)</p> <ul style="list-style-type: none"> - BOD or Biological Oxygen Demand, is a measure of the amount of dissolved oxygen consumed by microorganisms while breaking down organic matter in water, indicating its pollution level. - A: 300 mg/L - B: 250 mg/L - C: 30 mg/L <p><i>[0.5 marks for each of the above points]</i></p> <p>(b)</p> <p>A - Influent will have the highest organic pollutants and hence the highest BOD. (300 mg/L)</p> <p>B - Primary treatment will reduce the organic matter and hence the BOD to some extent with sedimentation and screening. (250 mg/L)</p> <p>C - Secondary treatment involves biological processes like activated sludge or trickling filters, which reduce BOD levels to the largest extent. (30 mg/L)</p> <p><i>[1 mark for each of the above points]</i></p> | 5 |
| Q.189 | <p>(a) 0.5 marks each for the following:</p> <ul style="list-style-type: none"> - The milk in Alex's bowl might not have gotten converted into curd. - The milk in Ross's bowl may not turn into curd completely or may get spoilt. - The milk in Jane's bowl would turn into curd. <p><i>[Accept any other valid answer]</i></p> <p>(b) 0.5 marks each for the following:</p> | 3 |

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| | <p>- Jane would have made the best quality curd.</p> <p>- For proper curd formation, she added the necessary <i>Lactobacilli</i> inoculum into the milk.</p> <p>- Along with the above, she maintained the milk at the ambient temperature needed for the growth of the <i>Lactobacilli</i>.</p> <p><i>[Appropriate marks to be deducted for missing any one of the reasons]</i></p> | |
| Q.190 | <p>(a) The level of pollution in these samples - Sample A > Sample C > Sample B. <i>[Appropriate marks to be deducted even if any one is incorrect]</i></p> <p>(b) BOD (Biological Oxygen Demand) measures the amount of oxygen consumed by microorganisms for oxidizing the organic matter present in water. <i>[1 mark]</i></p> <p>Microorganisms need more oxygen to break down organic matter in the polluted water, hence increasing the value of BOD, and indicating the poor quality of water. <i>[1 mark]</i></p> | 3 |
| Q.191 | <p>During the process of curd formation, a decrease in the pH occurs in the system.</p> <p><i>0.5 marks each for the following:</i></p> <p>- The Lactic acid bacteria present in the curd inoculum, when added to milk, converts the lactose of the milk to lactic acid.</p> <p>- This acid formation lowers the pH of the milk, thereby coagulating the milk proteins and forming curd.</p> | 2 |
| Q.192 | <p>1 mark each for mentioning any two of the following:</p> <p>- It increases the shelf life of some products by inhibiting the growth of spoilage organisms along with preventing the oxidation of certain compounds.</p> <p>- It enhances the taste and aroma of some products.</p> <p>- It enhances the texture of some products by making them fluffy.</p> <p><i>[Accept any other valid answer and provide marks for the same]</i></p> | 2 |