

Student Learning Outcomes

After studying this chapter, students will be able to:

- Investigate chemical tests for the presence of water using anhydrous copper (II) sulphate.
- Explain how to test the purity of water using melting point and boiling point.
- Distinguish between Distilled water and tap water with their applications in practical chemistry.
- State that water from natural sources may contain useful and harmful substances. (Some examples include:
 - a. Dissolved oxygen b. metal compounds c. plastics
 - d. sewage e. harmful microbes f. nitrates from fertilizers
 - g. phosphates from fertilizers and detergents
- Recognize that some naturally occurring substances in water are potentially harmful (some examples include:
 - a. some metal compounds that are toxic
 - b. some plastics that harm aquatic life
 - c. sewage that contains harmful microbes which cause disease
 - d. nitrates and phosphates that lead to deoxygenation of water and damage to aquatic life (details of the eutrophication process are not required)
- Explain the treatment of the domestic water supply; (some examples of this includes:
 - a. sedimentation and filtration to remove solids.
 - b. Use of carbon to remove tastes and odours
 - c. Chlorination to kill microbes
- Describe various water-borne diseases and the steps that can be taken to avoid them
- Identify the negative effects of water pollutants on life and the ways to avoid them.
- Explain water scarcity as an important issue faced by Pakistan and the ways in which it can be resolved.
- State that urea, ammonium salts and nitrates are used as fertilizers.
- Explain the use of NPK fertilizers to provide the elements nitrogen, phosphorus and potassium for improved plant growth.

Subjective Type Questions

Long Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

20.1

Water

20.2

Purity of Water

Q.1: Describe a chemical test for water using anhydrous copper (II) sulphate.

Ans. Test for water:

Testing water is important for food and pharmaceutical industries where the presence of water can affect the product quality and safety.

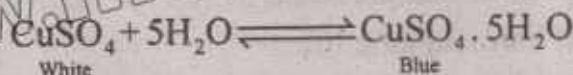
Hydrated copper (II) sulphate:

Hydrated copper (II) sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) is a chemical compound. It is used as a sensitive indicator for the presence of water. It is blue in colour but when it is heated, it loses water molecules to become anhydrous copper (II) sulphate, which is white in colour.



Observation:

A drop of water on anhydrous sample of copper (II) sulphate changes its colour from white to blue.



Sensitivity:

It is a very sensitive test and can detect even a small amount of water.

Q.2: What two physical constants can be used to determine if a sample of water is pure?

Ans. Physical Constant:

A physical constant is a quantity with a fixed numerical value that is universal in nature and does not change.

Boiling point and melting point are the physical constant. They can be used to determine if a sample of water is pure.

Pure water boils at 100°C and freezes at 0°C under standard conditions of temperature and pressure. The impurities present in water will change both these physical constants.

Checking purity of water by determining its boiling point:

The purity of a sample of water can be checked by determining its boiling point at STP. If it boils at 100°C it is pure sample of water. The presence of impurities in water

will slightly increase its boiling point.

Checking purity of water by determining its melting point:

Another test check the purity of water is to determine melting point of the sample. For this purpose, cool the sample of water until it freezes. Observe and record the temperature at which the ice begins to melt. If its melting point is 0°C it is pure water. A melting point below 0°C suggests the presence of impurities in the sample.

Conclusion:

The impurities present in water raise the boiling point but lowers the melting point. Both these constants are specific to standard conditions. At high altitudes or lower pressure, these values will change.

20.3

Difference between distilled water and tap water

20.4

Substances present in water obtained from natural sources

Q.3: Explain difference between distilled water and tap water.

Ans. Tap Water:

Source: Water which is supplied to our homes, shops and offices comes through taps and is readily available for any usage. This water may either come from rivers, lakes and ponds or from underground sources.

Composition: Tap water contains minerals like salts of calcium and magnesium depending upon the source from where it is obtained. It also contains chlorine and fluoride salt which are mixed with it during treatment.

Conductivity: It is a conductor of electricity due to the presence of free ions from dissolved minerals.

pH: Its pH has the range of 6.5 to 8.5 depending upon its source.

Distilled Water:

Source: Water obtained after the process of distillation is called distilled water.

Composition: Distilled water contains only water molecules without any bacteria, ions, gases or other contaminants.

Conductivity: It is a bad conductor of electricity due to absence of ions.

pH: Its pH is 7

Q.4:(a) Discuss dissolved oxygen as a useful substance present in water obtained from natural sources.

Ans. Dissolved Oxygen-Useful Substance:

Oxygen enters the natural water from the atmosphere through the process of diffusion. It is also produced by aquatic plants and algae in the process called photosynthesis.

This absorbed oxygen is then used by the aquatic organisms including fish to breathe and survive. The health and diversity of an ecosystem directly depends upon the amount of dissolved oxygen in a water body.

(b) How do harmful microbes enter in sources of fresh water and affect its quality?

Ans. Harmful Microbes:

Both surface and ground water which are vital sources of fresh water can be contaminated by various human activities.

- Harmful microorganisms like bacteria, viruses and parasites enter into natural water through human and animal wastes, land fills, agricultural runoff and waste water from industries.
- Sewage from waste water treatment plants or from faulty septic tanks can release pathogens directly into nearby water body.

Effects: Microbes can cause such infectious diseases as dysentery, typhoid, hepatitis and cholera.

Q.5(a) How do heavy metals and their compounds enter in natural water and affect its quality?

Ans: Heavy metals and their compounds:

Heavy metals like lead, mercury, cadmium, and chromium and their compounds can enter in natural water through many routes.

- Waste water from factories may contain heavy metals and their compounds, which are eventually released into rivers and other water bodies.
- Mining operations and use of fertilizers and pesticides can contaminate both ground and surface water with heavy metals and their compounds.

Effects: Heavy metals and their compounds not only damage vital organs like liver and kidney, they can also lead to neurological problems. Arsenic and cadmium are known to increase the risk of certain cancers.

(b) Discuss plastics as harmful substances present in water and its effects.

Ans. Plastics:

Very small particles of plastics called micro plastics are present in both tap and bottled water. These tiny particles can enter water through wastewater, rainwater when it carries plastic debris to water sources, and by degradation of plastic waste.

Effects: Plastic tiny particles have been found in some human organs like lungs and blood. These particles can disturb the immune and reproductive systems.

Q.6: How do nitrates and phosphates enter in natural water and affect its quality?

Ans. Nitrates and phosphates :

- Nitrates and phosphates enter natural water through weathering of rocks.
- They can also enter in water through human sources such as agriculture fertilizers, detergents and industrial wastewater.

Effects:

- Nitrates and phosphates are eventual nutrients for plant and animal life. However, if amounts of these compounds exceed a limit they can affect the quality of water and cause eutrophication.

- The excessive amounts of these nutrients cause algae and other aquatic plants to grow excessively. This overgrowth of algae, in turn, can decrease the dissolved oxygen level in water which is not only harmful for aquatic life but can also disrupt the entire ecosystem.

20.5

Treatment of domestic water supply

20.6

Effects of pollutants present in water

Q.7. How domestic water supply can be made fit for drinking?

Ans. Treatment of domestic water supply:

Three types of impurities are mostly present in water obtained from natural sources.

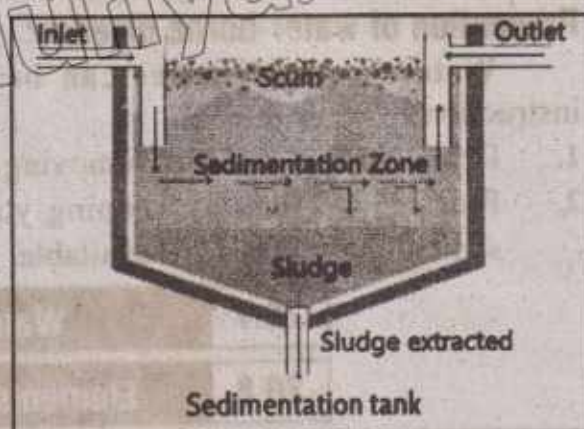
- Dissolved impurities
- Suspended impurities
- Microorganisms

In order to remove these impurities different methods are applied which include sedimentation, filtration, distillation and treatment with liquid chlorine etc.

(i) Sedimentation:

Insoluble impurities present in natural water include soil, pieces of plants and other organic matter and sand. These impurities are bigger in size and are often removed by the process called sedimentation.

Method: In this process water obtained from natural sources is pumped into sedimentation tanks where water is allowed to stand for a few hours. The suspended particles present in water settle down at the bottom of the tank due to gravity and form a layer of sediment. The cleaner water at the top can then be extracted for the next stage.



(ii) Filtration:

This process is used to remove suspended particles of smaller size which are generally not removed in the sedimentation process. For this purpose water is allowed to trickle through layer of sand and gravel filters which trap these solid particles.

(iii) Chlorination:

Water must be sterilized before humans can use it.

Method: For this purpose all harmful bacteria and other microbes, must be killed. Mostly a small amount of liquid chlorine is added which has the power to kill all these germs.

(iv) Removal of odours:

Water is passed through powdered activated carbon in the form of charcoal to remove tastes and odours. Activated carbon removes a wide range of organic compounds responsible for taste and odour through absorption. Odour can also be removed by

exposing water to air in a process called aeration.

Q.8: How can we control the harmful effects of pollutants present in water?

Ans. Controlling the harmful effects of pollutants present in water:

Water Pollutants can disrupt aquatic ecosystems through eutrophication and destruction of habitats. Polluted water can also lower crop yields and contaminate food sources.

Harmful effects due to water pollution can be controlled by taking a number of steps:

- (i) Sewage and industrial wastewater should be treated before it is discharged into water bodies.
- (ii) Plastics must be reused or recycled to minimize their production.
- (iii) Chemical cleaners, fats or oils and grease should never be thrown down the drain.
- (iv) Minimize the use of pesticides and fertilizers in agriculture.
- (v) General public should be made aware of the harmful effects of water pollution through public campaigns.
- (vi) Implement and enforce laws for the strict control of all types of water pollution.

Q.9: What measures should be taken to avoid water-borne diseases?

Ans. Water-borne Diseases:

The World Health Organization (WHO) has estimated that 80% of the sickness and diseases in the world are caused by polluted water and lack of sanitation. Water-borne diseases include cholera, typhoid, malaria, nausea and leprosy.

Prevention of water-borne disease:

Water-borne diseases can be avoided if we strictly follow the following instructions.

1. Drink clean water after removing impurities and boiling to kill the germs.
2. Practice hygiene by keeping your body especially hands clean. Ensure proper sanitation facilities are available.

20.7

Water scarcity in Pakistan

20.8

Elements essential for plant growth

Q.10. Write a note on water scarcity in Pakistan

Ans. Geographical location of Pakistan:

Our world is divided into different regions depending upon the annual rainfall which they receive every year. Pakistan is included in a semi-arid region and hence receives a low rainfall annually.

Regional Rainfall Distribution:

- Northern Pakistan including Punjab generally receives rainfall within the range 250-600 mm per year mostly during monsoon season.
- In southern Pakistan precipitation is scarce, below 200mm per year.

Key Factors Driving Water Scarcity:

Pakistan, at present, is facing a severe water scarcity crisis due to a number of

different factors such as:

- Less rainfall
- Flood irrigation
- Depleting aquifers
- Growth in population
- Climate change
- Poor water management

Future Challenges:

If the current situation continues then Pakistan could face very serious challenges in coming years.

Suggestions:

The problem can be addressed by taking a number of steps which are as follows:

- (i) Collecting rain water especially during monsoon season by constructing water reservoirs and other water storage facilities.
- (ii) Using better crop irrigation techniques.
- (iii) Taking appropriate measures to face effects of climate change.
- (iv) Effective management of water resources.

Q.11: Discuss the elements essential for plant growth.

Ans. Elements essential for plant growth:

Plants need nutrients from the soil for a healthy growth.

Classification of essential elements:

The elements essential for the plant growth can be classified as:

- Micro-nutrients
- Macro-nutrients

Micro-nutrients (Trace elements):

The nutrients which are required in a very small amount for the growth of plants are called micro-nutrients. These include boron, copper, iron, manganese, zinc, molybdenum and chlorine.

Requirement: Only minute amounts of these elements are needed for healthy plant growth and it may be dangerous to add too much quantity because they are poisonous in larger quantities. These are generally required in quantities ranging from 6 grams to 200 grams per acre.

Macro-nutrients: The nutrients which are required in a large amount for the growth of plants, are called macro-nutrients. These include nitrogen, phosphorous, potassium, calcium, magnesium, sulphur, carbon, hydrogen and oxygen.

Requirement: These are generally required in quantities ranging from 5kg to 200kg per acre.

20.9

Fertilizers

20.10

Classification of fertilizers

Q.12: What are fertilizers? Mention the essential qualities of a good fertilizer.

Ans. Fertilizers:

Fertilizers are the substances added to the soil to make up the deficiency of essential elements like nitrogen, phosphorus and potassium (NPK) required for the proper growth of plants.

Importance of fertilizers:

- Fertilizers enhance the natural fertility of the soil.
- Fertilizers also provide the chemical elements taken up from soil by the previous crops.

Essential qualities of a good fertilizer:

The essential requisites of a good fertilizer are:

- (i) The nutrient elements present in it must be readily available to the plants.
- (ii) It must be fairly soluble in water so that it thoroughly mixes with the soil.
- (iii) It should not be injurious to plants.
- (iv) It should be inexpensive.
- (v) It must be stable so that it is available for a longer time to the growing plants.
- (vi) It should not alter the pH of the soil.
- (vii) By rain or water, it should be converted into a form, which the plant can absorb easily.

Q.13: Discuss the classification of fertilizers.

Ans. Classification of fertilizers: Fertilizers are classified into nitrogen, phosphorus and potassium which they provide to the soil. This classification gives the following types of fertilizers.

- (i) Nitrogenous fertilizers
- (ii) Phosphatic fertilizers
- (iii) Potassium fertilizers

Q.14: What are the main functions of nitrogenous, phosphorus and potassium fertilizers?

Ans. Nitrogenous Fertilizers: These fertilizers supply nitrogen to the plants or soil.

Importance of Nitrogen:

- Nitrogen is required during the early stage of plant growth for the development of stem and leaves.
- It is the main constituent of proteins, imparts green colour to the leaves.
- Nitrogen enhances the yield and quality of the plants.

Examples of Nitrogenous Fertilizers:

Some examples of nitrogenous fertilizer are:

- | | |
|---------------------|----------------------|
| • Ammonium sulphate | • Calcium cyanamide |
| • Ammonium nitrate | • Ammonium phosphate |
| • Ammonium chloride | • Ammonia |
| | • Urea |

Urea: Urea is a high quality nitrogenous fertilizer. It contains about 46% nitrogen and is the most concentrated solid nitrogen fertilizer. It is the most widely used nitrogen fertilizer in Pakistan.

Ammonium Nitrate: Ammonium nitrate is a useful fertilizer for many crops except paddy rice because the microbial bacteria in flooded fields decompose it to nitrogen gas. It is also used in combination with limestone. It is hygroscopic in nature.

Phosphatic Fertilizers: These fertilizers provide phosphorus to the plant or soil.

Importance of Phosphorous:

- Phosphorus is required to stimulate early growth and to accelerate the seed and fruit formation during the later stages of growth.
- It also increases resistance to diseases.

Types of Phosphatic Fertilizers: The various phosphatic fertilizers have different compositions, due to which they have different solubilities. The two most important water soluble fertilizers are:

- Super phosphate (calcium super phosphate) $\text{Ca}(\text{H}_2\text{PO}_4)_2$,
- Triple phosphate (diammonium-phosphate) $(\text{NH}_4)_2 \text{HPO}_4$.

Potassium Fertilizers: These fertilizers provide potassium to the plant or soil.

Importance of Potassium:

- Potassium is required for the formation of starch, sugar and fibrous materials of the plant.
- They increase resistance to diseases.
- They make the plants strong by helping in healthy root development.
- They also help in ripening of seeds, fruits and cereals.
- They are especially useful for tobacco, coffee, potato and corn.

Examples of Potassium Fertilizers: Some common examples of potassium fertilizers are:

- Potassium chloride
- Potassium sulphate
- Potassium nitrate

20.1 Quick Check!

1. How purity water can be checked by determining its freezing point?

Ans. To check the purity of water by determining its freezing point cool the sample of water until it freezes. Observe and record the temperature at which the ice begins to melt. If its melting point is 0°C , it is pure water. A melting point below 0°C suggests the presence of impurities in the sample.

20.2 Quick Check!

1. Why tap water is a conductor of electricity whereas distilled water is not?

Ans. Tap water is a conductor of electricity due to presence of free ions from dissolved minerals. On the other hand distilled water is a bad conductor of electricity due to absence of ions.

20.3 Quick Check!

1. Which pollutants are harmful for aquatic life?

Ans. Following pollutants are harmful for aquatic life:

- Microorganisms like bacteria viruses, and parasites.
- Heavy metals like lead, mercury, cadmium and chromium and their compounds.

2. How to identify if water is polluted?

Ans. We can identify if water is polluted by:

- **Appearance:** if the water looks cloudy or has an unusual colour (like green due to algae or brown due to soil), the water is polluted.
- **Smell:** clean water is odourless. If water smells like rotten eggs, chemicals or sewage, it is likely polluted.
- **Biological signs:** The presence of a lot of dead fish, floating debris and foam, a thick layer of green scum (algae) on the surface makes it polluted.

20.4 Quick Check!

1. How can we conserve water at home?

Ans. We can conserve water at home by following the steps given below:

- Turn off the tap while brushing teeth or soaping our hands.
- Take shorter showers.
- Fix leaky pipes and dripping taps.
- Run the washing machine or dishwasher when they are completely full.
- Collect rainwater in buckets or tanks to use for gardening or washing cars.
- Collect the water that drips from the air conditioner and use it for mopping floors, watering plants etc.

20.5 Quick Check!

1. Which is the most concentrated solid nitrogen fertilizer?

Ans. Urea is the most concentrated solid nitrogen fertilizer.

INTERESTING INFORMATION

Biofertilizers are environment friendly. They provide the soil essential nutrients as well as microbes required for the growth of plants. Biofertilizers improve soil health and structure. They also increase biodiversity and reduce the need for harmful chemicals. They also prevent soil degradation.

THINGS TO KNOW

Water from different sources requires different treatment methods.

Objective Type Questions

Additional MCQ's

Multiple Choice Questions prepared in the light of new Examination Techniques
(Knowledge, Understanding, Application, Analytical & Conceptual)

20.1

Water

20.2

Purity of Water

1. What is the colour of hydrated copper (II) sulphate?
(a) White (b) Blue (c) Yellow (d) Green
2. What is the colour of anhydrous copper (II) sulphate?
(a) Brown (b) White (c) Green (d) Blue
3. When blue hydrated copper (II) sulphate is heated, it becomes:
(a) Copper oxide (b) Copper metal
(c) Sulphate oxide (d) Anhydrous copper (II) sulphate
4. Anhydrous copper (II) sulphate turns from white to blue when it comes into contact with:
(a) Water (b) Oil (c) Acid (d) Base

5. Under standard conditions, pure water boils at:
(a) 0°C (b) 50°C (c) 80°C (d) 100°C
6. Under standard conditions, pure water freezes at:
(a) 100°C (b) 80°C (c) 50°C (d) 0°C
7. The presence of impurities in a water sample will cure its boiling point to:
(a) Decrease slightly (b) Increase slightly
(c) Remain the same (d) Drop to 0°C
8. If a water sample has a melting point below 0°C , it suggests:
(a) The presence of impurities (b) The water is pure
(c) The water is boiling (d) None of these

20.3**Difference between distilled water and tap water****20.4****Substances present in water obtained from natural sources**

9. Why is tap water a good conductor of electricity?
(a) Because it contains bacteria (b) Because it has a pH 6.5 to 8.5
(c) Because it is obtained from rivers
(d) Due to the presence of free ions from dissolved minerals
10. Distilled water is the water that is obtained after:
(a) Filtration (b) Chlorination (c) Distillation (d) Sedimentation
11. What is the typical pH range of tap water?
(a) 6.5 to 8.5 (b) 1.0 to 4.0 (c) 9.0 to 12.0 (d) Exactly 7.0
12. The pH of pure distilled water is:
(a) 9.5 (b) 5.5 (c) 6.5 (d) 7.0
13. How does oxygen primarily enter the natural water from the atmosphere?
(a) Through evaporation (b) Through diffusion
(c) Through precipitation (d) Through condensation
14. By which of the following process aquatic plants and algae produce oxygen in water?
(a) Respiration (b) Fermentation (c) Decomposition (d) Photosynthesis
15. What does the health and diversity of an aquatic ecosystem directly depend upon?
(a) The amount of dissolved oxygen (b) The salt concentration
(c) The depth of water (d) All of these
16. Which sources of water can be contaminated by human activities?
(a) Surface water only (b) Ground water only
(c) Both surface and ground water (d) Rain water only
17. Which of the following are examples of harmful microbes?
(a) Bacteria (b) Viruses (c) Parasites (d) All of these

18. What are common sources for pathogens entering water bodies?
 (a) Human and animal wastes (b) Land fills and agricultural runoff
 (c) Waste water from industries (d) All of these
19. The bacterial contents can cure such infectious diseases as dysentery and:
 (a) Typhoid (b) Hepatitis (c) Cholera (d) All of these
20. Heavy metals and their compounds contaminate both ground and surface water through:
 (a) Mining operations (b) Industrial waste
 (c) Fertilizers and pesticides (d) All of these
21. Which vital organs are primarily damaged by heavy metals?
 (a) Head and lungs (b) Skin and bones (c) Liver and kidney (d) Brain and heart
22. What type of health problem can heavy metals cure besides organ damage?
 (a) Respiratory problems (b) Neurological problems
 (c) Digestive problems (d) Skeletal problems
23. Very small particles of plastics are called:
 (a) Micro plastics (b) Microbes (c) Heavy metals (d) Nitrates
24. Micro plastics are present in:
 (a) Tap water (b) Bottled water
 (c) Both tap and bottle water (d) None of these
25. Which human organs have been found to contain tiny plastic particles?
 (a) Brain and lungs (b) Lungs and blood
 (c) Bones and muscles (d) Skin and hair
26. Micro plastics can enter water through:
 (a) Waste water (b) Degradation of plastic waste
 (c) Rain water carries plastic debris (d) All of these
27. Nitrates and phosphates enter natural waters through:
 (a) Weathering of rocks (b) Evaporation
 (c) Volcanic eruptions (d) Photosynthesis

20.5 Treatment of domestic water supply

20.6 Effects of pollutants present in water

28. How many types of impurities are mostly present in water obtained from natural sources?
 (a) Two (b) Three (c) Four (d) Five
29. What method is used to remove impurities from domestic water?
 (a) Sedimentation and filtration (b) Distillation and chlorination
 (c) Both (a) and (b) (d) None of these

30. Insoluble impurities present in natural water are removed through the process of:
 (a) Chlorination (b) Cooling (c) Filtration (d) All of these
31. Which process involves allowing water to stand for a few hours so suspended particles settle due to gravity?
 (a) Filtration (b) Aeration (c) Sedimentation (d) Chlorination
32. It is the water-borne disease that often causes blindness, particularly among children in developing countries.
 (a) Malaria (b) Trachoma (c) Typhoid (d) Leprosy
33. It is a liver disease.
 (a) Nausea (b) Cholera (c) Hepatitis (d) Typhoid

20.7

Water scarcity in Pakistan

20.8

Elements essential for plant growth

34. Depending upon the annual rainfall, Pakistan is included in region called:
 (a) Arid (b) Wet equatorial
 (c) Semi-arid (d) Tropical monsoon
35. In southern Pakistan, precipitation is below:
 (a) 100 mm per year (b) 200 mm per year
 (c) 300 mm per year (d) 400 mm per year
36. Northern Pakistan including Punjab generally receives rainfall within the range:
 (a) 150-300 mm per year (b) 150-400 mm per year
 (c) 250-500 per year (d) 250-600 mm per year
37. Which of the following is not a macro-nutrients?
 (a) Copper (b) Nitrogen (c) Phosphorous (d) Potassium
38. Which of the following is not a micro-nutrients?
 (a) Iron (b) Manganese (c) Molybdenum (d) Oxygen
39. Micro-nutrients are generally required in quantities ranging from 6 grams to:
 (a) 100 grams per acre (b) 200 grams per acre
 (c) 300 grams per acre (d) 400 grams per acre
40. Macro-nutrients are generally required in quantities ranging from 5 kg to:
 (a) 100 kg per acre (b) 200 kg per acre (c) 300 kg per acre (d) 400 kg per acre
41. Which of the fertilizers supply nitrogen to the plants or soil?
 (a) Phosphorous (b) Magnesium (c) Nitrogen (d) Calcium
42. It is an example of nitrogen fertilizer.
 (a) Ammonium chloride and urea (b) Calcium super phosphate
 (c) Potassium chloride (d) Potassium nitrate

43. Which of the following is a high quality nitrogenous fertilizer?
 (a) Ammonium nitrate (b) Calcium cyanamide
 (c) Urea (d) Ammonia
44. Ammonium nitrate is a useful fertilizer for many crops except:
 (a) Maize (b) Wheat (c) Potato (d) Paddy rice
45. Ammonium nitrate contains about:
 (a) 36% nitrogen (b) 46% nitrogen (c) 56% nitrogen (d) 66% nitrogen
46. Which of the most widely used nitrogen fertilizer in Pakistan?
 (a) Calcium cyanamide (b) Ammonium phosphate
 (c) Urea (d) Ammonium chloride
47. It is required for the formation of starch, sugar and the fibrous material of the plants.
 (a) Phosphorus (b) Potassium (c) Nitrogen (d) Both (a) and (b)
48. Potassium fertilizers help in ripening of:
 (a) Seeds (b) Fruits (c) Cereals (d) All of these
49. Which of the following fertilizers are especially useful for tobacco, coffee, potato and corn?
 (a) Potassium (b) Nitrogenous (c) Phosphatic (d) Ammonium
50. Potassium chloride, potassium sulphate and potassium nitrate are some common examples of:
 (a) Nitrogenous fertilizers (b) Potassium fertilizers
 (c) Phosphatic fertilizers (d) None of these
51. These fertilizers supply nitrogen to the plants or soil.
 (a) Phosphatic fertilizers (b) Potassium fertilizers
 (c) Nitrogenous fertilizers (d) Bio fertilizers
52. Which of the following provide phosphorus to the plants or soil?
 (a) Nitrogenous fertilizers (b) Phosphatic fertilizers
 (c) Bio fertilizers (d) Nitrogenous fertilizers
53. The function of bio fertilizers is:
 (a) They increase biodiversity
 (b) They reduce the need for harmful chemicals
 (c) They prevent soil degradation (d) All of these

Answers

- | | | | | | | |
|---------|---------|---------|---------|---------|---------|---------|
| 1. (b) | 2. (b) | 3. (d) | 4. (a) | 5. (d) | 6. (d) | 7. (b) |
| 8. (a) | 9. (d) | 10. (c) | 11. (a) | 12. (d) | 13. (b) | 14. (d) |
| 15. (a) | 16. (c) | 17. (d) | 18. (d) | 19. (d) | 20. (d) | 21. (c) |
| 22. (b) | 23. (a) | 24. (c) | 25. (b) | 26. (d) | 27. (a) | 28. (b) |

29. (c) 30. (c) 31. (c) 32. (b) 33. (c) 34. (c) 35. (b)
 36. (d) 37. (a) 38. (d) 39. (b) 40. (b) 41. (c) 42. (a)
 43. (c) 44. (d) 45. (b) 46. (c) 47. (b) 48. (d) 49. (a)
 50. (b) 51. (c) 52. (b) 53. (d)

Additional Short Questions

Short Answer Questions prepared in the light of new Examination Techniques
 (Knowledge, Understanding, Application, Analytical & Conceptual)

20.1

Water

20.2

Purity of Water

1. Describe the chemical test used to identify the presence of water.

Ans. Add a drop of water on anhydrous sample of copper (II) sulphate. If water is present, the white powder will turn blue.

2. What is the colour of hydrated copper (II) sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$)?

Ans. The colour of hydrated copper (II) sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) is blue.

3. What is colour of copper (II) Sulphate?

Ans. Copper (II) sulphate is white in colour.

4. Name the compound used to chemically test for the presence of water.

Ans. Anhydrous copper (II) sulphate is the compound used to chemically test for the presence of water.

5. Write the chemical equation for the water test using copper (II) sulphate.

Ans.
$$\underset{\text{White}}{\text{CuSO}_4} + 5\text{H}_2\text{O} \rightleftharpoons \underset{\text{Blue}}{\text{CuSO}_4 \cdot 5\text{H}_2\text{O}}$$

6. What are the physical constants of pure water at standard pressure?

Ans. Boiling point and melting point are the physical constants of pure water at standard pressure.

7. How do impurities affect the boiling point of water?

Ans. The presence of impurities will slightly increase its boiling point.

8. How do impurities affect the melting point of water?

Ans. The presence of impurities will decrease the melting point of water.

9. How can you check if a water sample is chemically pure?

Ans. By measuring its boiling point or melting point. If it boils exactly at 100°C and melts exactly of 0°C at STP, it is pure.

10. Are the boiling and melting points of water constant under all conditions?

Ans. No, these constants are specific to standard conditions. At high altitudes or lower pressure, these values will change.

11. What are the common sources of tap water?

Ans. Tap water comes from rivers, lakes and ponds or from underground sources.

12. Which minerals are typically found in tap water?

Ans. Tap water contains minerals like salts of calcium and magnesium.

13. What is the pH range of tap water?

Ans. The pH of tap water ranges from 6.5 to 8.5 depending on its source.

14. Define distilled water.

Ans. Water obtained after the process of distillation is called distilled water.

15. Describe two-step process of distillation.

Ans. Two-step process of distillation are heating and condensation.

- In the first step, the water is heated to get steam.
- In the second step, the steam is condensed back into liquid water.

16. What substances are removed during the distillation process?

Ans. Distillation effectively removes all the dissolved minerals, microorganisms and contaminants from water leaving behind only pure water.

17. Why is distilled water used in laboratories medical procedures and pharmaceutical industry?

Ans. It is because the purity of distilled water ensures accurate scientific measurements, sterilization of medical equipment's and to prevent corrosion.

18. What is the pH of distilled water?

Ans. The pH of distilled water is 7.

19. Is distilled water ideal for drinking?

Ans. Although it is safe to drink but it may not have the necessary minerals needed for the body.

20. What are natural sources of water?

Ans. Natural sources of water are rivers, lakes and aquifers.

21. How does oxygen enter natural water?

Ans. Oxygen enters the natural water from the atmosphere through the process of diffusion.

22. Why is dissolved oxygen important for aquatic ecosystems?

Ans. Aquatic organisms including fish need dissolved oxygen to breathe and survive. The health and diversity of an ecosystem directly depends upon the amount of dissolved oxygen in a water body.

23. Which harmful substances are present in water obtained from natural sources?

Ans. Some harmful substances present in water obtained from natural sources are:

- Harmful microbes
- Nitrates and phosphates

- Heavy metals and their compound
- Plastics

24. Name some infectious diseases caused by bacterial content in water.

Ans. The bacterial contents can cause such infectious diseases as dysentery, typhoid, hepatitis and cholera.

25. Give some examples of heavy metals.

Ans. Lead, mercury, cadmium and chromium are some examples of heavy metals.

26. Which vital organs are damaged by heavy metals and their compounds present in water?

Ans. Heavy metals and their compounds present in water not only damage vital organs like liver and kidney. They can also lead to neurological problems.

27. Which heavy metals are known to increase the risk of certain cancers?

Ans. Arsenic and cadmium are known to increase the risk of certain cancers.

28. What are micro plastics?

Ans. Very small particles of plastics are called micro plastics.

29. How do micro plastics enter water?

Ans. Micro plastics can enter water through waste water, rainwater when it carries plastic debris to water sources, and by degradation of plastic waste.

30. What are harmful effects of micro plastics on humans?

Ans. Micro plastics have been found in some human organs like lungs and blood. These particles can disturb the immune and reproductive systems.

31. How do nitrates and phosphates enter natural waters?

- Ans.**
- Nitrates and phosphates enter natural waters through weathering of rocks.
 - They can also enter in water through human sources such as agriculture fertilizers, detergents and industrial wastewaters.

32. What is eutrophication?

Ans. Eutrophication: Eutrophication is the name of the process which starts in a water body containing excess of phosphorous and nitrogen nutrients.

20.5 Treatment of domestic water supply

20.6 Effects of pollutants present in water

33. Which types of impurities are mostly present in water obtained from natural sources?

Ans. Three types of impurities are mostly present in water obtained from natural sources. These impurities include:

- Dissolved impurities
- Suspended impurities
- Microorganisms

34. Which methods are applied in order to remove impurities present in water sources?

Ans. In order to remove impurities present in water sources include following methods:

- Sedimentation
- Filtration

- Chlorination
- Removal of odours

35. Which insoluble impurities are present in natural water?

Ans. Insoluble impurities present in natural water include soil, pieces of plants and other organic and sand. These impurities are bigger in size.

36. What is sedimentation?

Ans. Sedimentation: It is the process where water is allowed to stand in sedimentation tanks for a few hours so that large, suspended particles settle at the bottom of the tanks due to gravity.

37. What is filtration?

Ans. Filtration is a process used to remove suspended particles of small size which are generally not removed in the sedimentation process.

38. How does the filtration process work?

Ans. For filtration, water is allowed to trickle through layers of sand and gravel filters which trap the solid particles that were not removed during sedimentation.

39. What is the purpose of chlorination?

Ans. The purpose of chlorination is to sterilize the water by killing harmful bacteria and other microbes before humans use it.

40. How is chlorination performed?

Ans. Chlorination is performed by adding a small amount of liquid chlorine to the water, which has the power to kill all harmful bacteria and other microbes.

41. What is aeration?

Ans. Aeration: Aeration is a process of exposing water to air to help remove odours of the water.

42. Which things are affected by water pollution?

Ans. Water pollution affects human health, ecosystems, aquatic organisms and industries that are dependent on good water quality.

43. What is the affect of polluted water on agriculture?

Ans. Polluted water can lower crop yields and contaminate food sources.

44. How should sewage and industrial wastewater be managed?

Ans. Sewage and industrial wastewater should be treated before it is discharged into water bodies.

45. How should household chemicals, fats and oils be disposed off?

Ans. Chemical cleaners, fats or oils and grease should never be thrown down the drain.

46. What agricultural practice can help to reduce water pollution?

Ans. Minimizing the use of pesticides and fertilizers in agriculture reduces the amount of harmful runoff entering natural waters.

47. How should the general public be made aware of the harmful effects of water pollution?

Ans. General public should be made aware of the harmful effects of water pollution through public campaigns.

48. How can the government help control all types of water pollution?

Ans. Government can implement enforce laws for the strict control of all types of water pollution.

20.7

Water scarcity in Pakistan

20.8

Elements essential for plant growth

49. Upon what our world is divided into different regions?

Ans. Our world is divided into different regions depending upon the annual rainfall which they receive every year.

50. In which region of the world is Pakistan included?

Ans. Pakistan is included in a semi-arid region of the world.

51. Why is Pakistan included in semi-arid region of the world?

Ans. Pakistan is included in semi-arid region of the world because it receives a low rainfall annually.

52. How much rainfall does northern Pakistan including Punjab generally receive?

Ans. Northern Pakistan including Punjab generally receives rainfall with the range 250-600 mm per year mostly during monsoon season.

53. What is rainfall range in southern Pakistan?

Ans. In southern Pakistan the rainfall range is below 200 mm per year.

54. How are essential plant nutrients classified?

Ans. Essential plant nutrients are classified into two categories:

- Micro-nutrients (Trace elements)
- Macro-nutrients

55. Differentiate between micro-nutrients and macro-nutrients.

Micro-nutrients	Macro-nutrients
The nutrients which are required in a very small amount for the growth of plants are called micro-nutrients.	The nutrients which are required in a large amount for the growth of plants, are called macro-nutrients.
Examples: Boron, copper, iron, manganese, zinc, molybdenum and chlorine.	Examples: Nitrogen, phosphorous, potassium, calcium, magnesium, sulphur, carbon, hydrogen and oxygen.

20.9

Fertilizers

20.10

Classification of fertilizers

56. What are fertilizers?

Ans. Fertilizers: Fertilizers are the substances added to the soil to make up the deficiency of essential (NPK) required for the proper growth of plants.

57. What are the main functions of fertilizers?

Ans. i. Fertilizers enhance the natural fertility of the soil.

- ii. They provide the chemical elements taken up from soil by the previous crops.
- 58. What physical stability characteristics should a good fertilizer have during storage?**
- Ans.** It should be stable and not absorb moisture or set into hard, stony materials with time.
- 59. How are fertilizers classified?**
- Ans.** Fertilizers are classified according to the nature of the elements like nitrogen, phosphorous and potassium which they provide to the soil.
- 60. Name different types of fertilizers.**
- Ans.** Different types of fertilizers are:
- Nitrogenous fertilizers
 - Phosphatic fertilizers
 - Potassium fertilizers
- 61. Why do nitrogenous fertilizers supply to the plants or soil?**
- Ans.** Nitrogenous fertilizers supply nitrogen to the plants or soil.
- 62. What is the role of nitrogen in plant growth?**
- Ans.** Nitrogen is required during the early stage of plant growth for the development of stem and leaves. It is the main constituent of proteins, imports green colour to the leaves and enhance the yield and quality of the plants.
- 63. Which is a high quality nitrogenous fertilizer?**
- Ans.** Urea is a high quality nitrogenous fertilizers.
- 64. How much nitrogen does urea contain?**
- Ans.** Urea contains about 46% nitrogen.
- 65. Why is ammonium nitrate not suitable for paddy rice?**
- Ans.** Ammonium nitrate is not suitable for paddy rice because the microbial bacteria in flooded fields decompose it to nitrogen gas.
- 66. What is nature of ammonium nitrate?**
- Ans.** Ammonium nitrate is hygroscopic in nature.
- 67. What do phosphatic fertilizers provide to the plants or soil?**
- Ans.** Phosphatic fertilizers provide phosphorus to the plants or soil.
- 68. What is the importance of phosphorus for plants?**
- Ans.** • Phosphorus is required to stimulate early growth and to accelerate the seed and fruit formation during the later stages of growth.
- It also increases resistance to diseases.
- 69. Why do phosphatic fertilizers have different solubilities?**
- Ans.** The various phosphatic fertilizers have different compositions, due to which they have different solubilities.
- 70. Name two important water-soluble phosphatic fertilizers.**
- Ans.** The two most important water-soluble phosphatic fertilizers are:
- Super phosphate (calcium super phosphate) $\text{Ca}(\text{H}_2\text{PO}_4)_2$
 - Triple phosphate (diammonium-phosphate) $(\text{NH}_4)_2 \text{HPO}_4$

71. Give some common examples of potassium fertilizers.

Ans. Some common examples of potassium fertilizers are:

- Potassium chloride • Potassium sulphate • Potassium nitrate

72. What are bio fertilizers?

Ans. **Bio fertilizers:** Bio fertilizers are environmental friendly substances that provide the soil essential nutrients as well as microbes required for the growth of plants.

Exercise Questions (Solved)

A. Multiple Choice Questions

★ Choose and tick the correct answer from the given choices.

1. The pH of distilled water is:
(a) 6.5 (b) 8.5 (c) 7 (d) 7.5
2. The unpleasant odour in water can be removed by:
(a) adding chlorine (b) treating it with activated charcoal
(c) sedimentation (d) filtration
3. The source of harmful microbes in natural water:
(a) human and animal wastes (b) fertilizers used for crops
(c) industrial waste-water (d) microbes in rocks
4. Which gases are dissolved in natural water from the atmosphere through diffusion?
(a) O_2 and CO_2 (b) N_2 and CO_2 (c) O_2 and N_2 (d) O_2 , and CO_2
5. The fertilizer harmful to paddy rice is:
(a) Super phosphate (b) Ammonium nitrate
(c) Urea (d) Potassium sulphate
6. Fertilizers which increase the resistant of plants towards diseases and make plants strong by healthy root development are:
(a) Nitrogenous fertilizers (b) Phosphate fertilizers
(c) Potassium fertilizers (d) Magnesium fertilizers

Answers

1. (c) 2. (b) 3. (a) 4. (d) 5. (b) 6. (c)

B. Short Answer Questions

20.1 Name two methods to check the purity of water.

Ans. We can check the purity of water by determining its melting point and boiling point.

Boiling Point: Pure water boils at $100^\circ C$ and freezes at $0^\circ C$ under standard conditions of temperature and pressure.

Melting Point: Pure water freezes at exactly $0^\circ C$ at standard atmospheric pressure. If there is any impurities present in water, the boiling point will increase and the

freezing point will decrease.

20.2 What is the main difference between tap water and distilled water?

Ans. The main difference between tap water and distilled water is that, tap water is a conductor of electricity due to the presence of free ions from dissolved minerals. While distilled water is a bad conductor of electricity due to absence of ions.

20.3 How water is distilled in the laboratory?

Ans. In the laboratory, water is distilled by the process of distillation which comprises two steps, i.e; heating and condensing.

Heating: Impure water is heated in a flask until it turns into steam.

Condensing: The steam passes through a condenser, turning back into liquid (pure water), that is collected in a separate receiver.

20.4 Name useful and harmful substances present in water.

Ans. Useful substances present in water: Dissolved oxygen (essential for aquatic life) and essential minerals like calcium, magnesium and sodium.

Harmful substances present in water: Microorganisms (like bacteria, viruses and parasites), heavy metals (like lead, mercury cadmium and chromium and their compounds), nitrates and phosphates.

20.5 How would you remove harmful bacteria and other microbes present in water?

Ans. We can remove harmful bacteria and other microbes present in water by two methods:

- Boiling
- Chlorination

Boiling: Boiling water for at least 1-3 minutes kills the harmful bacteria and microbes.

Chlorination: Adding a small amount of chlorine or chlorine tablets in the water can kill all germs.

20.6 What is the difference between sedimentation and filtration?

Ans.	Sedimentation	Filtration
	It is a process used to remove insoluble bigger sized impurities present in natural water. It is done by allowing water to stand for a few hours. The suspended particles present in water settle down at the bottom of the tank due to gravity.	It is a process used to remove suspended particles of smaller size by using a filter. It is done by allowing water to trickle through a layer of sand and gravel filters which trap there solid particles.

20.7 Name any three water-borne diseases.

Ans. Water-borne diseases: Three water-borne diseases are:

- Typhoid
- Cholera
- Malaria

20.8 Why fertilizers containing nitrogen element are added into the soil?

Ans. Fertilizers containing nitrogen element are added into the soil because, nitrogenous

fertilizers supply nitrogen to the plant or soil.

20.9 What is trachoma disease?

Ans. Trachoma: Trachoma is a water-borne disease that often causes blindness. This disease is particularly prevalent among babies and children in developing countries.

C. Constructed Response Questions

20.1 Describe the negative effects of using plastics in every day life.

Ans. Negative effects of using plastics in everyday life:

- **Contamination of water sources:**

Tiny plastic particles (micro plastics) enter water through wastewater, rainwater carrying plastic debris, and the degradation of plastic waste.

- **Presence in Human Organs:**

Recent findings show there tiny particles have been found in human lungs and blood.

- **Health Disruptions:**

Micro plastics can disturb vital internal systems, specifically the immune and reproductive systems.

- **Environmental Impact:**

Reusing and recycling plastics is necessary to minimize production and their harmful environmental footprint.

20.2 Explain one method to remove dissolved impurities present in water.

Ans. Distillation: Distillation is a highly effective method for removing dissolved impurities.

The process involves:

- Heating
- Condensation
- Collection

Heating: The water is heated until it turns into steam (vapor). Dissolved solid impurities do not evaporate and are left behind in the original container.

Condensation: The steam is then condensed (cooled) in a condenser, where it turns back into pure liquid water.

Collection: The resulting distilled water is collected in separate tank. It is free of dissolved minerals and microorganisms.

20.3 Why urea is regarded as a good nitrogenous fertilizer?

Ans. Urea is regarded as a good nitrogenous fertilizer because:

- It contains about 46% nitrogen.
- It is highly soluble in water and is easily absorbed by plants.
- It is generally non-acidic and does not damage the soil pH as much as some other fertilizers.
- It is easy to store, transport, and apply in both solid and spray forms.

20.4 Why Pakistan is facing a severe shortage of water?

Ans. Pakistan is facing a severe shortage of water because of following factors:

Climate change: Rising temperatures are melting glaciers too fast, while this causes floods now, it means our rivers will eventually run dry once the ice is gone. It also makes rainfall patterns very unpredictable.

Population Growth: Pakistan's population is growing very fast. We have the same amount of water we had years ago, but now three are millions more people who need water for drinking, bathing and cooking.

Flood Irrigation: A lot of water is used in agriculture in Pakistan. Farmers use too much water by "flooding" their whole field. This wastes a lot of water that just evaporates in the sun.

Depleting Aquifers: We are pumping out groundwater (from aquifers) using tube wells much faster than the rain can refill them. This causes the water table to drop, making it harder and more expensive to find clean water.

Poor Water Management: Pakistan does not have enough large dams to save or store water. When it rains a lot during the rainy season (Monsoon), most of that fresh water just flows away into the sea. This means we cannot save or store water for the dry month when we need it most.

D. Descriptive Questions

20.1 How domestic water supply can be made fit for drinking?

Ans. For answer see Q7.

20.2 Which measures should be taken to avoid water-borne disease?

Ans. For answer see Q9.

20.3 What are fertilizers? Mention the essential qualities of a good fertilizer.

Ans. For answer see Q12.

20.4 What are the main functions of nitrogenous, phosphatic and potassium fertilizers?

Ans. For answer see Q14.

20.5 How can you avoid the negative effects of pollutants present in water?

Ans. For answer see Q8.