

## AQA (GCSE Notes)

### Chapter 1: Cell Biology

**Q1. Describe the key differences between eukaryotic and prokaryotic cells.**

**Answer:** Eukaryotic cells have a nucleus that contains their genetic material, while prokaryotic cells do not have a nucleus and their genetic material is found freely in the cytoplasm. Eukaryotic cells also have membrane-bound organelles like mitochondria, but prokaryotic cells do not. Eukaryotes include plant, animal, and fungal cells, while prokaryotes include bacteria.

**Q2. What structures are found in both animal and plant cells?**

**Answer:** Both animal and plant cells contain a nucleus, cytoplasm, a cell membrane, mitochondria, and ribosomes. These structures perform similar functions in both types of cells. The nucleus controls cell activities, the cytoplasm is where most reactions take place, the cell membrane controls what enters and leaves the cell, mitochondria provide energy, and ribosomes make proteins.

**Q3. Explain why bacterial cells are classified as prokaryotic.**

**Answer:** Bacterial cells are classified as prokaryotic because they do not have a true nucleus. Instead, their genetic material is found as a single loop of DNA in the cytoplasm. They also lack membrane-bound organelles like mitochondria and chloroplasts, which are found in eukaryotic cells. Their simple structure is what makes them prokaryotic.

**Q4. Name the structure in plant cells that stores cell sap.**

**Answer:** The structure in plant cells that stores cell sap is called the permanent vacuole. It is filled with a fluid called cell sap, which contains water, sugars, and salts. The vacuole helps maintain the shape of the cell and stores important substances the plant may need.

**Q5. How does the genetic material in a bacterial cell differ from that in a plant cell?**

**Answer:** In a bacterial cell, the genetic material is a single circular loop of DNA that floats freely in the cytoplasm, and it may also have small rings of DNA called plasmids. In a plant cell, the genetic material is found in chromosomes inside a nucleus, protected by a nuclear membrane. This difference is a key distinction between prokaryotic and eukaryotic cells.

**Q6. What is the function of the mitochondria in animal cells?**

**Answer:** The mitochondria in animal cells are the site of respiration. They release energy from glucose and oxygen through a process called aerobic respiration. This energy is needed by the cell to carry out essential activities like movement, growth, and repair. The more active a cell is, the more mitochondria it will contain.

**Q7. Describe the role of the nucleus in a eukaryotic cell.**

**Answer:** The nucleus in a eukaryotic cell controls all the activities of the cell. It contains the genetic material in the form of chromosomes, which are made of DNA. These chromosomes carry the instructions needed for

making proteins. The nucleus also controls how and when the cell divides, grows, and responds to its environment.

## **Q8. What is the function of plasmids in bacterial cells?**

**Answer:** Plasmids are small, circular pieces of DNA found in bacterial cells. They carry extra genes that are not found in the main loop of DNA. These genes can provide advantages, such as antibiotic resistance. Bacteria can also pass plasmids to each other, helping them adapt quickly to new conditions.

## **Q9. Explain why chloroplasts are only found in some plant cells and not in animal cells.**

**Answer:** Chloroplasts are found only in plant cells, especially those in green parts like leaves, because they are the site of photosynthesis. They contain chlorophyll, which absorbs light needed to make food from carbon dioxide and water. Animal cells do not carry out photosynthesis, so they do not need chloroplasts.

## **Q10. What is the purpose of the cell membrane in cells?**

**Answer:** The cell membrane controls what enters and leaves the cell. It acts like a barrier, allowing useful substances like oxygen and glucose in, while keeping harmful substances out. It also helps remove waste products. The membrane is partially permeable, meaning it allows only certain substances to pass through.

## **Q11. How is the function of a ribosome related to proteins?**

**Answer:** Ribosomes are responsible for making proteins. They follow instructions from the DNA to link amino acids in the correct order to make specific proteins. These proteins are used for growth, repair, and many functions within the cell. Without ribosomes, cells would not be able to produce the proteins they need.

## **Q12. Why do plant cells have a cell wall but animal cells do not?**

**Answer:** Plant cells have a cell wall made of cellulose that provides strength and structure. It supports the cell, helps maintain its shape, and protects it from bursting when water enters. Animal cells do not have cell walls because they have a flexible shape and rely on other support systems like skeletons.

## **Q13. What material is the plant cell wall made of?**

**Answer:** The plant cell wall is made of cellulose. Cellulose is a strong, rigid material that helps give the plant cell structure and strength. It supports the plant cell and protects it while allowing water and dissolved substances to pass through.

## **Q14. Describe the structure and function of the cytoplasm in cells.**

**Answer:** The cytoplasm is a jelly-like substance that fills the inside of the cell. It contains enzymes and other chemicals needed for chemical reactions. Organelles like ribosomes and mitochondria are suspended in the cytoplasm. Most of the cell's vital processes, such as respiration and protein synthesis, happen in the cytoplasm.

## **Q15. How does the presence of mitochondria benefit a cell?**

**Answer:** Mitochondria supply the cell with energy. They perform aerobic respiration, converting glucose and oxygen into energy in the form of ATP. This energy is used for processes like muscle contraction, active transport, and cell division. Cells that need a lot of energy, like muscle cells, have many mitochondria.

**Q16. What are the roles of sub-cellular structures in plant cells during photosynthesis?**

**Answer:** During photosynthesis, chloroplasts play the main role by capturing sunlight with chlorophyll. The cell wall helps maintain shape under the pressure of water and supports the plant. The cytoplasm supports chemical reactions, and the vacuole helps keep the cell firm. The nucleus controls these activities by giving the necessary instructions.

**Q17. How does a permanent vacuole support a plant cell?**

**Answer:** The permanent vacuole contains cell sap, a mixture of water, sugar, and salts. It helps maintain turgor pressure, which keeps the cell firm and supports the plant. It also stores substances the cell might need and helps maintain the internal environment of the cell by controlling water balance.

**Q18. Why is the genetic material in prokaryotic cells not found in a nucleus?**

**Answer:** Prokaryotic cells are simpler in structure and do not have a nucleus. Their DNA is found freely floating in the cytoplasm as a single circular loop. They lack the membrane-bound organelles that eukaryotic cells have, which is why their DNA is not enclosed in a separate compartment.

**Q19. What are plasmids, and why are they important in bacteria?**

**Answer:** Plasmids are small, extra loops of DNA found in bacteria. They often carry genes that help bacteria survive in difficult conditions, like genes for antibiotic resistance. Plasmids can be exchanged between bacteria, allowing traits to spread quickly through a population, which can be useful for survival and adaptation.

**Q20. Estimate the size of a bacterial cell and compare it with a typical animal cell.**

**Answer:** A typical bacterial cell is about 1 to 5 micrometres in size, while an animal cell is usually around 10 to 30 micrometres. This means bacterial cells are much smaller than animal cells—roughly 10 times smaller. This small size helps them reproduce quickly and survive in various environments.

**Q21. Why is it important for students to understand the scale of sub-cellular structures?**

**Answer:** Understanding the scale helps students grasp how small and complex cells and their parts are. It also helps them compare different types of cells and their functions. Knowing the size of structures like mitochondria or ribosomes allows for a better understanding of how cells carry out processes vital to life.

**Q22. How would you explain the use of prefixes like micro and nano in measuring cell sizes?**

**Answer:** Prefixes like micro ( $\mu\text{m}$ ) and nano (nm) are used to describe very small units. One micrometre is one-millionth of a metre, and one nanometre is one-billionth of a metre. These prefixes help scientists measure and describe tiny structures, like cells and organelles, accurately when normal units are too large.

**Q23. What is meant by a 'loop of DNA' in bacterial cells?**

**Answer:** A loop of DNA in bacterial cells refers to the circular arrangement of the bacterial chromosome. Unlike eukaryotic cells that have linear chromosomes inside a nucleus, bacteria have their DNA in a single, circular loop floating freely in the cytoplasm. This loop contains all the instructions the cell needs.

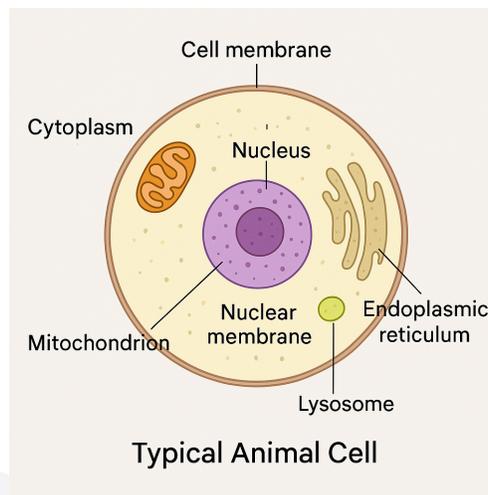
**Q24. Why are standard form and order of magnitude calculations useful in cell biology?**

**Answer:** Standard form and order of magnitude make it easier to work with and compare very large or very small numbers. In cell biology, where sizes are often in micrometres or nanometres, standard form allows scientists and students to write and calculate values clearly and accurately without long strings of zeros.

**Q25. Draw and label the main parts of a typical animal cell.**

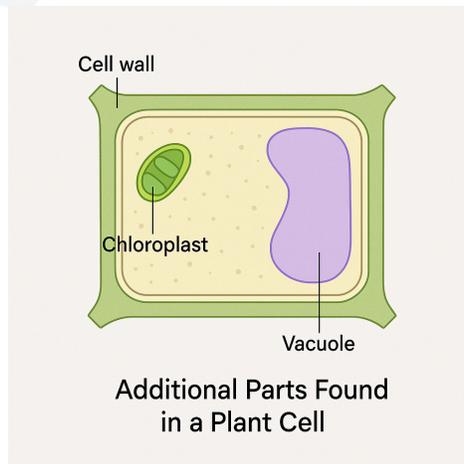
**Answer:**

**Solution:** In a typical animal cell, you should include and label the following: nucleus (controls the cell), cytoplasm (where reactions occur), cell membrane (controls what goes in and out), mitochondria (release energy), and ribosomes (make proteins). Each part plays an important role in keeping the cell functioning properly.



**Q26. Draw and label the additional parts found in a plant cell that are not in animal cells.**

**Solution:** In addition to the structures found in animal cells, plant cells also have a cell wall made of cellulose (which provides strength and support), a large permanent vacuole filled with cell sap (which helps maintain cell shape), and chloroplasts (which carry out photosynthesis). These extra parts help the plant cell perform functions that animal cells do not need.



**Q27. How would you explain the function of the nucleus to a younger student?**

**Answer:** The nucleus is like the control centre of the cell. It tells the rest of the cell what to do by sending out instructions. These instructions come from something called DNA, which is like a recipe book for making everything the cell needs to live and grow. Without the nucleus, the cell wouldn't know how to work properly.

**Q28. In what way do the functions of chloroplasts differ from mitochondria?**

**Answer:** Chloroplasts are found only in plant cells and are used to carry out photosynthesis. They take in sunlight and carbon dioxide to make food for the plant in the form of glucose. Mitochondria, found in both plant and animal cells, release energy by breaking down glucose during respiration. So, chloroplasts make food, while mitochondria release energy from it.

**Q29. Why is it helpful to compare drawings and micrographs when studying cells?**

**Answer:** Drawings help simplify and highlight the main structures of a cell, making them easier to learn and understand. Micrographs are actual images taken under a microscope, showing the true appearance and arrangement of cell parts. Comparing the two helps students see both the real detail and the simplified model, improving their understanding of what each part looks like and does.

**Q30. Describe a method to estimate the size of a sub-cellular structure in an image.**

**Answer:** To estimate the size, measure the length of the structure in the image using a ruler. Then use the scale provided (for example, 1 mm on the image = 10  $\mu\text{m}$  in real life). Divide the measured size by the magnification to get the actual size. This helps students understand how small cells and their parts really are and practice working with measurements.

**Q31. Explain the process of cell specialisation and its link to gene expression.**

**Answer:** Cell specialisation happens when a cell changes to perform a specific job, like a muscle or nerve cell. All cells have the same DNA, but not all genes are used in every cell. As a cell becomes specialised, only the genes needed for its job are turned on, while others are turned off. This is called gene expression, and it controls what the cell becomes and how it works.

**Q32. Why are stem cells considered valuable in medicine?**

**Answer:** Stem cells can turn into many different types of cells, which means they could be used to replace damaged or diseased tissues. For example, they could help people with conditions like diabetes or spinal cord injuries. Scientists hope to grow healthy tissues using stem cells to repair organs. However, using stem cells also raises ethical and medical concerns that must be considered.

**Q33. What must happen to a cell before it divides by mitosis?**

**Answer:** Before mitosis, the cell must grow and prepare. It increases the number of sub-cellular structures like mitochondria and ribosomes. The DNA in the nucleus is copied so that each new cell will have a full set of instructions. The cell checks that everything is correct before starting to divide. This preparation ensures both new cells are healthy and identical.

## **Q34. How are new cells produced during growth?**

**Answer:** New cells are produced through a process called mitosis. First, the cell grows and its DNA is copied. Then, during mitosis, the chromosomes are pulled apart so each new cell gets a full set of genes. The cytoplasm and membrane then divide, forming two identical cells. This allows an organism to grow, repair itself, or replace old cells.

## **Q35. Why are stem cells collected before they become too specialised?**

**Answer:** Once a stem cell becomes specialised, it cannot change into other types of cells. Collecting them early, when they are still unspecialised, means they can be turned into many different kinds of cells. This is important in medicine and research because scientists can use them to grow tissues or study how diseases develop.

## **Q36. What is meant by the term 'cell differentiation'?**

**Answer:** Cell differentiation is the process where a cell changes to become specialised for a specific job. This involves changes in its structure and the way it works. For example, a stem cell might become a red blood cell or a nerve cell. Differentiation allows cells in the body to perform different tasks efficiently, helping the organism function properly.

## **Q37. How does the nucleus control the function of a cell?**

**Answer:** The nucleus contains the cell's DNA, which holds the instructions for making proteins. These proteins control everything the cell does. By controlling which proteins are made and when, the nucleus directs the activities of the cell, such as growth, repair, and responding to changes. Without the nucleus, the cell would not know what to do.

## **Q38. What happens during mitosis?**

**Answer:** During mitosis, the cell divides to make two identical cells. First, the DNA is copied. Then the chromosomes line up in the middle of the cell and are pulled to opposite ends. Next, the nucleus divides, followed by the cytoplasm and the cell membrane. The result is two new cells, each with the same genetic material as the original cell.

## **Q39. What is the importance of producing genetically identical cells in mitosis?**

**Answer:** Producing genetically identical cells ensures that each new cell has the exact same instructions to do its job. This is important for growth, repair, and maintaining the body. If the new cells were not identical, they might not work properly, which could cause problems like diseases or malfunctioning organs.

## **Q40. How is the function of a chloroplast linked to its internal structure?**

**Answer:** The chloroplast contains structures called thylakoids, which hold chlorophyll. Chlorophyll captures sunlight, which is needed for photosynthesis. The large surface area of the thylakoids helps absorb more light. The chloroplast also contains enzymes and spaces for the chemical reactions to happen. All these features help the chloroplast make food for the plant.

**Q41. Explain how cell structures enable plant cells to support the plant body.**

**Answer:** The cell wall gives strength and helps keep the plant upright. The large vacuole stores water and keeps the cell firm by pressing against the cell wall. Chloroplasts allow the plant to make its own food through photosynthesis. These structures work together to keep the plant supported, healthy, and able to grow.

**Q42. Why is it useful for students to recognise sub-cellular structures in videos and images?**

**Answer:** Recognising these structures helps students understand what each part of the cell looks like and where it is found. Seeing real images or videos gives a clearer idea of how cells are organised and how they function. It also helps in learning how to identify different cell types and supports exam questions that use images.

**Q43. What are some practical ways to measure or estimate cell size in a classroom setting?**

**Answer:** Students can use a microscope with a scale or graticule to measure cells. By comparing what they see to a known scale, they can estimate the size of the whole cell or its parts. If they know the magnification, they can use formulas to calculate actual sizes. Drawing cells to scale also helps practise these skills.

**Q44. Why is understanding sub-cellular structure size important in biology?**

**Answer:** Knowing the size helps scientists understand how cells work and interact. It also helps in diagnosing diseases, developing treatments, and designing experiments. For students, it makes it easier to compare cell parts and understand how big or small they really are. This understanding is key to making sense of biological processes.

**Q45. Explain the structural advantage of the cellulose cell wall in plant cells.**

**Answer:** The cellulose cell wall is strong and rigid. It supports the plant cell and prevents it from bursting when water enters by osmosis. It also helps the plant stand upright and maintain its shape. Because it is made of tough fibres, the cell wall protects the cell and provides a stable framework for growth.

**Q46. How can observing real cell images help improve understanding of theoretical models?**

**Answer:** Real cell images show how cells actually look, which can be very different from simple textbook diagrams. They reveal real shapes, sizes, and arrangements of structures. By comparing real images to models, students can see how theory matches reality and develop a better understanding of how cells function in real life.

**Q47. What differences in sub-cellular structures would you expect to see between a leaf cell and a root cell?**

**Answer:** Leaf cells contain chloroplasts because they carry out photosynthesis, while root cells do not have chloroplasts since they are underground and do not get sunlight. Root cells may have more structures for absorbing water and minerals, like a larger surface area, while leaf cells are adapted to capture light and exchange gases.

**Q48. Describe the function of ribosomes and where they are found in cells.**

**Answer:** Ribosomes are responsible for making proteins by joining amino acids together in the correct order.

They follow the instructions from the DNA. Ribosomes can be found floating freely in the cytoplasm or attached to a structure called the rough endoplasmic reticulum. They are found in both animal and plant cells.

**Q49. Why might a bacterial cell have multiple plasmids?**

**Answer:** Multiple plasmids give bacteria extra advantages. Each plasmid can carry different useful genes, such as resistance to different antibiotics or the ability to survive in harsh environments. Having more plasmids means the bacteria can adapt more easily and survive in a wider range of conditions, making them more successful.

**Q50. What features of a bacterial cell help it survive in different environments?**

**Answer:** Bacterial cells have a tough cell wall that protects them. Their DNA floats freely, and they often have plasmids with useful genes. Some have flagella to help them move. Their small size helps them reproduce quickly, and their simple structure lets them survive in many environments, including extreme ones like hot springs or salty lakes.

**Q51. Why is cell differentiation important in multicellular organisms?**

**Answer:** Cell differentiation is important because it allows cells to become specialised for specific functions. In multicellular organisms, different types of cells are needed to perform different tasks. For example, muscle cells help movement, while red blood cells carry oxygen. Differentiation makes sure each cell type is suited to its role, helping the body work properly.

**Q52. At what stage do most animal cells become specialised?**

**Answer:** Most animal cells become specialised at an early stage of development, usually during the embryo stage. Once they have specialised, they usually cannot change into another type of cell. This early specialisation helps the organism develop its tissues and organs as it grows.

**Q53. What does it mean when a cell becomes specialised?**

**Answer:** When a cell becomes specialised, it changes to perform a specific function. This means it develops certain features and structures that help it do its job better. For example, a nerve cell develops long extensions to send signals, while a sperm cell grows a tail to help it swim.

**Q54. Give one reason why mature animal cells do not differentiate as often as plant cells.**

**Answer:** Mature animal cells do not differentiate as often because most of their tissues are already formed and specialised early in life. In animals, once a cell has become specialised, it usually stays that way. This limits their ability to form new cell types later on.

**Q55. Why can many plant cells differentiate throughout life?**

**Answer:** Many plant cells can differentiate throughout life because they have special tissues called meristems. Meristem cells remain unspecialised and can divide and change into different cell types when needed. This allows plants to grow new leaves, roots, and stems even when they are fully grown.

**Q56. How does a sperm cell's structure help it to carry out its function?**

**Answer:** A sperm cell is specialised to reach and fertilise an egg. It has a long tail (flagellum) that helps it

swim. It also contains many mitochondria to give it energy. The head of the sperm carries enzymes to break through the egg and contains half the DNA needed to form a new organism.

**Q57. What adaptations help a nerve cell transmit electrical signals?**

**Answer:** Nerve cells, or neurons, have long extensions called axons to carry messages over long distances. They are insulated with a fatty layer called myelin, which speeds up the signal. They also have many branches to connect with other cells, allowing fast and efficient communication in the body.

**Q58. Describe how muscle cells are specialised for contraction.**

**Answer:** Muscle cells contain lots of mitochondria to provide the energy needed for movement. They also have long, flexible fibres that can shorten (contract) to create movement. These adaptations allow muscle cells to work together to move parts of the body or pump blood in the case of heart muscle.

**Q59. What structural features help root hair cells absorb water and minerals?**

**Answer:** Root hair cells have a long, thin extension that increases their surface area. This helps them absorb more water and mineral ions from the soil. They also have a thin cell wall to allow easier movement of substances and many mitochondria to supply energy for active transport of minerals.

**Q60. Explain how xylem cells are adapted to transport water.**

**Answer:** Xylem cells are long and hollow, forming continuous tubes. They have no end walls, so water can flow easily. The walls are strengthened with lignin, which gives them support and prevents them from collapsing. These adaptations help them carry water and minerals from the roots to the leaves.

**Q61. What is the function of phloem cells, and how are they adapted for it?**

**Answer:** Phloem cells transport sugars and other food substances made by photosynthesis from the leaves to the rest of the plant. They are adapted by having sieve plates, which allow substances to pass easily between cells. They also have companion cells that help with energy and control the transport.

**Q62. How does cell specialisation help tissues and organs work effectively?**

**Answer:** Specialised cells are grouped together to form tissues that do a particular job. These tissues then work together as organs. Because each cell is suited to its role, the tissue or organ can perform its function better. For example, specialised heart muscle cells help the heart pump blood properly.

**Q63. Describe what happens to sub-cellular structures during cell differentiation.**

**Answer:** During differentiation, a cell develops new sub-cellular structures that help it perform a specific function. For example, a cell might grow more mitochondria if it needs a lot of energy or develop a tail if it needs to move. These changes are controlled by which genes are switched on or off.

**Q64. Explain the role of cell differentiation in forming organ systems.**

**Answer:** Differentiated cells with specific functions form tissues. Different tissues work together to form organs, and organs work together to form systems like the digestive or respiratory system. This organisation makes the body more efficient, with each part specialised to do its job well.

**Q65. What does it mean for a cell to acquire new sub-cellular structures?**

**Answer:** When a cell acquires new sub-cellular structures, it means it develops parts inside it that are needed for a new function. This is part of the differentiation process. For example, a muscle cell will form more mitochondria to provide energy, while a sperm cell forms a tail to move.

**Q66. Why is cell division mainly used for repair and replacement in mature animals?**

**Answer:** In mature animals, most cells are already specialised and formed. So, cell division is not needed for growth anymore but is used to replace worn-out or damaged cells. For example, skin cells or blood cells divide to make new ones, helping the body repair itself and stay healthy.

**Q67. What is a tissue and how does it relate to specialised cells?**

**Answer:** A tissue is a group of similar specialised cells that work together to do a specific function. For example, muscle tissue is made of muscle cells that contract. The way the cells are specialised helps the tissue work properly, and different tissues come together to form organs.

**Q68. Give an example of how a specialised plant cell contributes to the function of a plant organ.**

**Answer:** In a leaf, the palisade cells are specialised for photosynthesis. They are packed with chloroplasts to absorb sunlight. This helps the leaf produce food for the plant. Their structure supports the leaf's role as an organ for making energy through photosynthesis.

**Q69. How does a group of specialised cells form an organ?**

**Answer:** Specialised cells form tissues, and different tissues combine to make an organ. For example, in the stomach, muscle tissue moves the food, gland tissue makes digestive juices, and lining tissue protects the inside. Each tissue does its part, and together they make the organ work.

**Q70. Why is cell differentiation necessary in a developing embryo?**

**Answer:** In an embryo, all the cells start out the same. Differentiation is needed so they can become different cell types, like skin, nerve, or blood cells. This helps form all the parts of the body. Without differentiation, the embryo could not develop into a functioning organism.

**Q71. What does high magnification allow scientists to do when using microscopes?**

**Answer:** High magnification lets scientists see very small details inside cells, like the parts inside a nucleus or the structure of bacteria. It helps them study how cells work, what goes wrong in disease, and how different cell types compare. It's important for learning about life at a small scale.

**Q72. How does an electron microscope differ from a light microscope in terms of magnification?**

**Answer:** An electron microscope can magnify much more than a light microscope. While light microscopes can magnify up to around 1,500 times, electron microscopes can go up to millions of times. This allows scientists to see much smaller things, like the tiny parts inside a cell or a virus.

**Q73. Why is higher resolution important in microscopy?**

**Answer:** Higher resolution means being able to see two points separately instead of as one blurry spot. It

lets scientists see fine details clearly. This is important for understanding how parts of a cell are arranged and for spotting small changes that could mean something is wrong or diseased.

**Q74. Explain how the electron microscope helped scientists understand cells better.**

**Answer:** The electron microscope let scientists see tiny structures inside cells that couldn't be seen before. It revealed things like the detailed structure of mitochondria and ribosomes. This helped scientists learn more about how cells work and how different parts do their jobs in the cell.

**Q75. What is the benefit of being able to see smaller sub-cellular structures?**

**Answer:** Seeing smaller sub-cellular structures helps scientists understand the functions of each part of the cell. It also allows them to study diseases that affect these parts, such as damaged mitochondria. By seeing these small structures, researchers can develop better treatments and learn more about how cells live and grow.

**Q76. How has the development of microscopy affected biology?**

**Answer:** The development of microscopy has helped scientists explore the structure of cells in much more detail. It allowed the discovery of cell organelles and understanding of how cells function. With electron microscopes, scientists can now study viruses, DNA, and sub-cellular parts like ribosomes, which are too small to see with light microscopes. This has led to better knowledge in health, genetics, and disease treatment.

**Q77. Describe one advantage and one disadvantage of using an electron microscope.**

**Answer:** One advantage of an electron microscope is that it has a much higher magnification and resolution than a light microscope, so it can show very small structures in great detail. A disadvantage is that it is expensive and large, and it cannot be used to observe living cells because the sample has to be in a vacuum and often coated with metal.

**Q78. Write the formula used to calculate magnification.**

**Answer:**

**Magnification = Size of image  $\div$  Real size of object**

**Q79. How would you rearrange the magnification formula to calculate the real size?**

**Answer:**

**Real size = Size of image  $\div$  Magnification**

**Q80. If the image size is 10 mm and magnification is  $\times 1000$ , what is the real size?**

**Answer:**

**Real size =  $10 \text{ mm} \div 1000 = 0.01 \text{ mm}$ .** This means the actual size of the object is 0.01 mm, or 10 micrometres. This shows how small real cells are, even when they look large under the microscope.

**Q81. If a real cell is 0.002 mm long and appears 4 mm in an image, what is the magnification?**

**Answer:**

**Magnification = Image size ÷ Real size = 4 mm ÷ 0.002 mm = ×2000.** The magnification used to see the cell was 2000 times larger than its actual size.

**Q82. Explain how to convert millimetres to micrometres.**

**Answer:** To convert millimetres to micrometres, multiply the value in millimetres by 1000 to get micrometres. For example, 1 mm = 1000 µm. This is useful in microscopy when measuring tiny structures, as micrometres are more suitable units for very small sizes.

**Q83. What is the prefix used for one thousandth of a metre?**

**Answer:** The prefix is "milli". One millimetre (mm) is one thousandth of a metre. That means 1 mm = 0.001 m. This prefix is commonly used in measuring small things like cells and tissues.

**Q84. What does the prefix "nano" mean in terms of measurement?**

**Answer:** The prefix "nano" means one-billionth of a metre (1 nm = 0.000000001 m or  $10^{-9}$  m). It is used to measure very tiny things like viruses or molecules, especially in fields like nanotechnology and electron microscopy.

**Q85. A structure is 500 nm wide. Convert this to micrometres.**

**Answer:**

**500 nm = 0.5 µm** because 1 micrometre (µm) = 1000 nanometres (nm). You divide the nanometre value by 1000 to get the value in micrometres. So,  $500 \div 1000 = 0.5 \mu\text{m}$ .

**Q86. A real object is 0.01 mm long. Express this in standard form.**

**Answer:**

**0.01 mm =  $1 \times 10^{-2}$  mm** in standard form. This format is useful when dealing with very small or very large numbers in science, especially for clarity in calculations and comparisons.

**Q87. Why is it important to express microscope measurements in standard form?**

**Answer:** Standard form helps make very small or large numbers easier to read, compare, and use in calculations. In microscopy, sizes of cells and structures can be extremely tiny, and writing them in standard form helps avoid mistakes and makes scientific communication clearer.

**Q88. A microscope image shows a bacterium as 2 mm long. The actual bacterium is 2 µm. What is the magnification?**

**Answer:**

Convert both units to the same scale first: 2 mm = 2000 µm. Then:

**Magnification =  $2000 \mu\text{m} \div 2 \mu\text{m} = \times 1000$**

**Q89. A nucleus appears 3.6 mm in a micrograph. If the magnification is ×1800, what is the real size?**

**Answer:**

**Real size =  $3.6 \text{ mm} \div 1800 = 0.002 \text{ mm}$  or  $2 \mu\text{m}$**

This shows how magnified the image is compared to the actual size of the structure.

**Q90. Convert 0.045 mm to micrometres.**

**Answer:**

$$0.045 \text{ mm} \times 1000 = 45 \text{ } \mu\text{m}$$

So, 0.045 mm is equal to 45 micrometres. This kind of conversion is often needed when comparing image sizes and real sizes under a microscope.

**Q91. Give one reason for using light microscopes in a school lab.**

**Answer:** Light microscopes are affordable, easy to use, and safe, making them ideal for use in school labs. They can help students see basic cell structures like the nucleus and cell wall. They also allow viewing of living samples, which helps in observing movement and processes like cell division.

**Q92. Why might a scientist choose an electron microscope instead of a light microscope?**

**Answer:** A scientist might choose an electron microscope to see much smaller structures, such as the detailed internal parts of organelles or viruses, which light microscopes cannot show clearly. Electron microscopes offer much greater magnification and resolution than light microscopes.

**Q93. What improvements in technology have made modern microscopes more effective?**

**Answer:** Improvements include better lenses, digital imaging, higher resolution, and computer software for processing images. Electron microscopes have also improved, allowing clearer and more detailed images. These advances let scientists study cells and molecules in greater depth.

**Q94. Explain why resolving power is more important than magnification in some cases.**

**Answer:** Magnification only makes an image larger, but if the resolution is low, the image will still be blurry. Resolving power refers to how clearly two close points can be seen as separate. In many cases, scientists need sharp images of fine details, which depends on resolution more than magnification.

**Q95. A student measures a cell image as 4.8 mm wide and the real cell is 12  $\mu\text{m}$  wide. What is the magnification?**

**Answer:**

First convert 4.8 mm to micrometres:  $4.8 \text{ mm} = 4800 \text{ } \mu\text{m}$

$$\text{Magnification} = 4800 \text{ } \mu\text{m} \div 12 \text{ } \mu\text{m} = \times 400$$

**Q96. How has the use of electron microscopy helped identify parts of mitochondria?**

**Answer:** Electron microscopy has allowed scientists to see the folded inner membrane (cristae) and other internal features of mitochondria, which are not visible with light microscopes. This helped researchers understand how mitochondria produce energy and their role in cell function.

**Q97. What is one structural feature that can now be studied due to improved microscope resolution?**

**Answer:** Ribosomes are a key example. They are tiny structures that make proteins, and their details were hard to see before electron microscopes. Now, scientists can study their shape, location, and how they work inside the cell, improving our understanding of protein synthesis.

**Q98. How can knowing real sizes of sub-cellular structures help in medical research?**

**Answer:** Knowing the actual size of sub-cellular structures helps scientists detect abnormal growth or damage, like in cancer cells or diseased tissues. It also helps when developing treatments like drugs that need to reach specific targets inside cells, making medicine more effective.

**Q99. A mitochondrion is measured at 1.5  $\mu\text{m}$ . Write this in standard form.**

**Answer:**

$$1.5 \mu\text{m} = 1.5 \times 10^0 \mu\text{m}$$

Since it is already a simple number, we express it as  $1.5 \times 10^0$ , which means 1.5 in standard form.

**Q100. Why do scientists need to know both the magnification and real size of a structure when studying cells?**

**Answer:** Knowing both allows scientists to understand the true scale of what they are observing. Without the real size, magnification alone doesn't tell you how big the object really is. This information is essential when comparing cells, diagnosing diseases, or designing treatments that target specific parts of the cell.

**Q101. What is the process called by which bacteria divide?**

**Answer:** The process by which bacteria divide is called **binary fission**. In binary fission, one bacterial cell splits into two identical cells. This is a form of asexual reproduction, and it allows the bacteria to multiply rapidly when conditions are suitable. Each new cell contains a copy of the original cell's genetic material.

**Q102. How often can bacteria divide under ideal conditions?**

**Answer:** Under ideal conditions, such as warm temperatures and a good supply of nutrients, bacteria can divide approximately **every 20 minutes**. This rapid rate of reproduction can lead to large populations in a short time if conditions remain favourable.

**Q103. What two conditions are necessary for bacteria to multiply rapidly?**

**Answer:** The two key conditions needed for bacteria to multiply rapidly are: **a suitable temperature** (usually warm, around  $37^\circ\text{C}$  for many species) and **plenty of available nutrients**. These allow the bacteria to grow, replicate their DNA, and divide efficiently through binary fission.

**Q104. Describe how bacteria can be grown in a laboratory.**

**Answer:** In a lab, bacteria can be grown using **nutrient broth** (a liquid medium) or **agar gel plates** (a solid medium). A small sample of bacteria is transferred using sterile tools onto the medium. The culture is then incubated at a suitable temperature, and the bacteria multiply to form colonies that can be observed or tested.

**Q105. Why are uncontaminated cultures important in scientific investigations?**

**Answer:** Uncontaminated cultures are crucial because **they ensure that only the intended bacteria are present**, allowing accurate results. Contamination from other microorganisms could affect the outcome, especially when testing the effectiveness of antibiotics or disinfectants, leading to unreliable or misleading results.

**Q106. Explain how to prepare an uncontaminated culture of bacteria.**

**Answer:** To prepare an uncontaminated culture, **sterilise all equipment** before use, such as Petri dishes and nutrient agar. **Flame the inoculating loop** before transferring the bacteria. **Work near a flame or in sterile conditions**, and seal the Petri dish with **adhesive tape**. Store it **upside down** to prevent condensation from dripping onto the culture.

**Q107. Why must Petri dishes and culture media be sterilised before use?**

**Answer:** Petri dishes and culture media must be sterilised to **kill any unwanted microorganisms** that may be present. This prevents contamination, ensuring that only the desired bacterial strain is grown, which is important for getting reliable experimental results.

**Q108. What is the purpose of passing an inoculating loop through a flame?**

**Answer:** Passing an inoculating loop through a flame **sterilises the loop** by killing any microbes on it. This prevents contamination of the culture with other bacteria or fungi and ensures the transfer of only the required microorganisms.

**Q109. Why should Petri dish lids be secured with adhesive tape?**

**Answer:** The lid of a Petri dish should be secured with adhesive tape to **prevent microorganisms from the air getting in** and contaminating the culture. It also helps to protect people from being exposed to potentially harmful bacteria growing inside the dish.

**Q110. Why are Petri dishes stored upside down?**

**Answer:** Petri dishes are stored upside down to **stop condensation from forming on the lid and dripping onto the agar surface**. This prevents the spread of bacteria across the plate and helps maintain separate colonies.

**Q111. What is the maximum temperature at which cultures should be incubated in schools?**

**Answer:** In school laboratories, cultures should be incubated at a **maximum temperature of 25°C**. This temperature is safe and prevents the growth of harmful pathogens that might grow at higher temperatures.

**Q112. Why is a temperature of 25°C recommended for school incubations?**

**Answer:** 25°C is recommended because it is **warm enough to allow bacteria to grow**, but **not so high as to encourage the growth of dangerous microbes**. It helps ensure safety while still producing visible results for study.

**Q113. What is binary fission?**

**Answer:** Binary fission is the process by which **a single bacterial cell splits into two identical daughter cells**. Before dividing, the cell replicates its DNA. This is how bacteria reproduce asexually and rapidly increase in number under suitable conditions.

**Q114. If one bacterium divides every 20 minutes, how many will there be after one hour?**

**Answer:** After one hour (60 minutes), the bacteria will divide **three times** (once every 20 minutes). So, starting with one bacterium:

1 → 2 → 4 → 8

**Answer:** 8 bacteria will be present after one hour.

**Q115. How do you calculate the number of bacteria in a population given mean division time?**

**Answer:** To calculate the number of bacteria, first determine **how many divisions occur** using the formula:

**Time total ÷ Mean division time = Number of divisions**

Then use the formula:

**Final number of bacteria = Starting number × 2<sup>n</sup>**, where n = number of divisions.

**Q116. Why must cultures be kept free from contamination?**

**Answer:** Cultures must be free from contamination to **make sure the results of experiments are reliable and valid**. Contamination could introduce harmful microbes, skew test results (such as antibiotic effectiveness), and pose health risks.

**Q117. What is a nutrient broth?**

**Answer:** Nutrient broth is a **liquid culture medium** that contains **nutrients such as proteins, salts, and sugars** that bacteria need to grow. It is often used in laboratories to grow bacterial populations in a test tube or flask.

**Q118. What is an agar gel plate used for?**

**Answer:** An agar gel plate is a **solid surface used to grow bacteria in the lab**. Nutrients are mixed with agar (a jelly-like substance) and poured into a Petri dish. Bacteria are then transferred onto the surface and incubated to grow colonies.

**Q119. Why are clear areas around colonies measured in an antibiotic investigation?**

**Answer:** Clear areas, or **zones of inhibition**, show where bacteria have been killed or prevented from growing by the antibiotic. Measuring these zones helps determine the **effectiveness of the antibiotic** being tested.

**Q120. How can you calculate the cross-sectional area of a bacterial colony?**

**Answer:** To calculate the area, use the formula for the area of a circle:

**Area =  $\pi \times r^2$** , where r is the radius of the colony. This gives the total surface area the colony covers, helping to quantify growth or inhibition.

**Q121. What formula is used to calculate the area of a clear zone around a colony?**

**Answer:** The formula is:

**Area =  $\pi \times \text{radius}^2$**

This measures the zone of inhibition and helps compare how effective different antibiotics or disinfectants are against bacterial growth.

**Q122. A clear zone has a radius of 7 mm. What is its cross-sectional area?**

**Answer:** Using the formula **Area =  $\pi \times r^2$** :

Area =  $3.14 \times (7 \times 7) = 3.14 \times 49 = 153.86 \text{ mm}^2$ .

This is the size of the clear zone where bacteria did not grow.

**Q123. Why is it important to sterilise all equipment before use in microbiology?**

**Answer:** Sterilising equipment ensures that **no unwanted microorganisms** are present during experiments. This prevents contamination and ensures that any observed bacterial growth comes only from the sample being studied, making results accurate.

**Q124. What is the function of adhesive tape on a Petri dish?**

**Answer:** The tape **secures the lid of the Petri dish**, preventing accidental opening and **stopping airborne microorganisms from entering** the culture. This helps keep the culture uncontaminated and safe to handle.

**Q125. Explain how bacterial colonies form on agar plates.**

**Answer:** When a single bacterium is placed on an agar plate under suitable conditions, it **reproduces by binary fission**. As it multiplies, it forms a **visible colony** of identical cells. Each colony usually originates from one bacterium, allowing scientists to study or test it easily.

**Q126. What factors can limit the growth of bacteria in a lab culture?**

**Answer:** Factors that can limit bacterial growth include a lack of nutrients, unsuitable temperature, waste build-up, limited oxygen (if aerobic respiration is needed), and pH changes. If any of these conditions are not ideal, the bacteria may stop growing or even die, reducing the size of the bacterial population.

**Q127. What are antiseptics used for in bacterial investigations?**

**Answer:** Antiseptics are used to kill or slow the growth of bacteria on living tissues or surfaces. In bacterial investigations, they can be applied to discs on agar plates to observe the clear zones formed, which indicate how effective the antiseptic is at preventing bacterial growth.

**Q128. What are antibiotics and how do they affect bacterial growth?**

**Answer:** Antibiotics are substances that kill bacteria or stop them from growing. They are used in medicine to treat bacterial infections. In lab experiments, antibiotics can be used to test how well they prevent bacteria from forming colonies, by measuring the clear zones around antibiotic discs on agar plates.

**Q129. What is the zone of inhibition?**

**Answer:** The zone of inhibition is the clear area around an antibiotic or antiseptic disc on an agar plate where bacteria have not grown. This zone shows the effectiveness of the substance in stopping bacterial growth. A larger zone means the substance is more effective at killing or stopping bacteria.

**Q130. How can the effectiveness of different antibiotics be compared using agar plates?**

**Answer:** To compare antibiotics, place discs soaked in different antibiotics on an agar plate covered with bacteria. After incubation, measure the diameters of the zones of inhibition around each disc. The antibiotic with the largest clear zone is the most effective at stopping bacterial growth.

**Q131. What safety precautions must be followed during bacterial practicals?**

**Answer:** Safety precautions include sterilising all equipment, working near a flame to prevent contamination, not sealing Petri dishes fully (to allow air in and prevent harmful bacteria from growing), incubating cultures below 25°C in schools, and washing hands before and after the experiment.

**Q132. A bacteria population doubles every 30 minutes. How many bacteria will there be after 3 hours?**

**Answer:** 3 hours = 180 minutes.

Number of divisions =  $180 \div 30 = 6$

Final population =  $1 \times 2^6 = 64$

**Answer: There will be 64 bacteria after 3 hours if starting with one.**

**Q133. If the initial number of bacteria is 200 and they double every 20 minutes, how many are there after 2 hours?**

**Answer:** 2 hours = 120 minutes

Number of divisions =  $120 \div 20 = 6$

Final population =  $200 \times 2^6 = 200 \times 64 = 12,800$

**Answer: There will be 12,800 bacteria after 2 hours.**

**Q134. Why should you never fully seal a Petri dish?**

**Answer:** A Petri dish should never be fully sealed because this creates anaerobic (oxygen-free) conditions that can encourage the growth of harmful bacteria. Sealing with tape on two opposite sides allows air in while still preventing contamination.

**Q135. What is meant by the term 'mean division time'?**

**Answer:** Mean division time is the average time it takes for one bacterial cell to divide into two. It's used to estimate how quickly a bacterial population can grow, especially in controlled conditions where growth rate stays consistent over time.

**Q136. Why must care be taken not to incubate cultures above 25°C in schools?**

**Answer:** Incubating cultures above 25°C can promote the growth of dangerous pathogens that are harmful to humans. To reduce the risk of growing harmful bacteria, school experiments use 25°C as a safe temperature limit.

**Q137. How can you calculate the number of divisions in a certain time period?**

**Answer:** Divide the total time by the mean division time.

Number of divisions = Total time  $\div$  Mean division time.

This gives the number of times the bacteria double during that time period.

**Q138. Explain why high temperatures may be dangerous when growing microorganisms in schools.**

**Answer:** High temperatures can allow harmful pathogens, such as those that cause disease in humans, to grow. To ensure student safety, school laboratories keep temperatures low enough to avoid encouraging the growth of these dangerous microorganisms.

## Q139. What is the role of genes in chromosomes?

**Answer:** Genes are sections of DNA on a chromosome that carry instructions for making proteins. These proteins determine the structure and function of cells. Each gene controls a specific characteristic or activity in the body, like eye colour or enzyme production.

## Q140. Where are chromosomes found in the cell?

**Answer:** Chromosomes are found inside the **nucleus** of a cell. They are made of long strands of DNA and contain all the genetic information needed for the organism to grow, function, and reproduce properly.

## Q141. How many chromosomes are normally found in human body cells?

**Answer:** Human body cells normally contain **46 chromosomes**, arranged in **23 pairs**. Each pair includes one chromosome from the mother and one from the father. These chromosomes carry the genetic instructions for the body.

## Q142. What are chromosomes made of?

**Answer:** Chromosomes are made of **DNA (deoxyribonucleic acid)**, which is tightly coiled into a compact structure. DNA contains genes, and proteins called histones help organise and package the DNA within the chromosome.

## Q143. What is a gene?

**Answer:** A gene is a **section of DNA** that contains the code for making a specific protein. Proteins carry out functions in cells and determine traits. Genes are found on chromosomes and are passed from parents to offspring.

## Q144. Why are chromosomes important in cell division?

**Answer:** Chromosomes ensure that **genetic information is copied and passed correctly** during cell division. When a cell divides, each new cell needs a complete set of chromosomes to function. They help maintain genetic consistency between cells.

## Q145. Describe the appearance of chromosomes during cell division.

**Answer:** During cell division, chromosomes **become tightly coiled and visible under a microscope**. Each chromosome is made of two identical strands (called chromatids) joined at the centre by a structure called the centromere.

## Q146. Why do body cells have chromosomes in pairs?

**Answer:** Body cells have chromosomes in pairs because **one chromosome of each pair comes from the mother and the other from the father**. This pairing ensures that offspring inherit genetic information from both parents and maintain the correct number of chromosomes.

## Q147. How do chromosomes behave during the process of mitosis?

**Answer:** In mitosis, each chromosome is copied. The copies are pulled apart and move to opposite ends of the cell. This ensures each new cell gets a full set of chromosomes identical to the parent cell, preserving genetic information.

**Q148. What is the relationship between DNA and chromosomes?**

**Answer:** DNA is the molecule that makes up chromosomes. A single chromosome contains one long strand of DNA, which is coiled tightly to fit inside the nucleus. DNA carries genes, which are the instructions for building and maintaining the organism.

**Q149. Explain how chromosomes ensure that new cells are identical to the parent cell.**

**Answer:** Before a cell divides, each chromosome is copied. During mitosis, these copies are separated so that each new cell receives a full, identical set of chromosomes. This guarantees that both daughter cells are genetically identical to the original cell.

**Q150. Why is it useful to use models and analogies to understand chromosomes and cell division?**

**Answer:** Models and analogies help students **visualise things they cannot see directly**, like chromosomes and DNA. They simplify complex ideas, making it easier to understand how chromosomes behave during cell division and how genetic material is passed on.

**Q151. What is the purpose of the cell cycle in multicellular organisms?**

**Answer:** The purpose of the cell cycle in multicellular organisms is to produce new cells for growth, repair of damaged tissues, and replacement of old or dead cells. It ensures that each new cell gets an identical set of genetic material, allowing the body to function properly and maintain its structure.

**Q152. Describe what happens to the genetic material during the cell cycle.**

**Answer:** During the cell cycle, the genetic material (DNA) is first copied so that each chromosome has two identical strands. During mitosis, these chromosomes are separated and pulled to opposite ends of the cell. After the cell divides, each new cell ends up with a full and identical set of chromosomes.

**Q153. Before a cell divides, what sub-cellular structures must increase in number?**

**Answer:** Before a cell divides, it must grow and increase the number of important sub-cellular structures such as ribosomes, mitochondria, and other organelles. This ensures that the new cells will have all the necessary parts to survive and function properly after division.

**Q154. Why does DNA replicate before mitosis begins?**

**Answer:** DNA replicates before mitosis so that each new cell formed after division receives a complete copy of the genetic material. This ensures the two new cells are genetically identical and can carry out the same functions as the original parent cell.

**Q155. What is mitosis?**

**Answer:** Mitosis is a part of the cell cycle where the cell divides to produce two new cells that are genetically identical to the original. During mitosis, chromosomes are separated into two sets, and the nucleus divides, followed by the division of the rest of the cell.

**Q156. During mitosis, what happens to the chromosomes?**

**Answer:** During mitosis, each chromosome, which has already been copied, is split so that one copy goes to

each end of the cell. This ensures that both new cells will receive an exact copy of the original set of chromosomes, maintaining genetic consistency.

**Q157. What happens to the nucleus during mitosis?**

**Answer:** The nucleus divides during mitosis. After the chromosomes have been separated and moved to opposite ends of the cell, a new nucleus forms around each set of chromosomes, creating two identical nuclei in preparation for the final stage of cell division.

**Q158. How does the cytoplasm and membrane change after mitosis?**

**Answer:** After mitosis, the cytoplasm and cell membrane divide in a process called cytokinesis. This separates the two nuclei into two individual cells, each with its own complete set of organelles and genetic material, allowing them to function as independent cells.

**Q159. What is the final result of mitosis?**

**Answer:** The final result of mitosis is two new cells that are genetically identical to each other and to the original parent cell. Each new cell contains the same number of chromosomes and has all the sub-cellular structures needed to survive and function properly.

**Q160. How many cells are produced at the end of one full cell cycle?**

**Answer:** One full cell cycle produces two new cells from one original cell. These two daughter cells are genetically identical to each other and to the parent cell, having the same number of chromosomes and structure.

**Q161. What is meant by genetically identical cells?**

**Answer:** Genetically identical cells are cells that have exactly the same DNA. They have the same number of chromosomes and the same genetic information, which means they will function in the same way and carry out the same roles in the body.

**Q162. How does mitosis help in the repair of damaged tissue?**

**Answer:** Mitosis helps in the repair of damaged tissue by producing new cells that replace the old or damaged ones. Because the new cells are genetically identical, they match the surrounding tissue, allowing the body to heal while keeping the tissue structure and function the same.

**Q163. Why is mitosis important during the early development of an organism?**

**Answer:** During early development, mitosis allows the single fertilised egg to divide and grow into a complex organism made of many cells. It ensures each new cell has the same genetic information, which is crucial for forming tissues, organs, and body systems correctly.

**Q164. In which parts of the body is mitosis most likely to occur regularly?**

**Answer:** Mitosis regularly occurs in areas where cells are frequently replaced, such as the skin, blood, digestive lining, and hair roots. These areas require constant renewal due to damage, wear and tear, or natural cell death.

**Q165. Give an example of a situation where mitosis is occurring in the human body.**

**Answer:** One example is skin repair after a cut. The cells near the wound divide by mitosis to produce new cells that fill in the damaged area, helping the skin heal while maintaining the same structure and function as before the injury.

**Q166. Describe a situation in plants where mitosis would be occurring.**

**Answer:** Mitosis occurs in the tips of plant roots and shoots, where cells divide to allow the plant to grow. This region, called the meristem, produces new cells that later specialise to form different parts of the plant like leaves or roots.

**Q167. Why do cells need to grow before dividing?**

**Answer:** Cells need to grow before dividing to ensure they have enough organelles, nutrients, and energy to support both the original and the new cells. Without growing first, the resulting cells would be too small and might not function properly.

**Q168. What is the first stage of the cell cycle?**

**Answer:** The first stage is the growth phase, where the cell increases in size and produces more sub-cellular structures like ribosomes and mitochondria. The DNA is also copied during this phase to prepare for mitosis.

**Q169. What happens during the second stage of the cell cycle?**

**Answer:** The second stage is mitosis. During this phase, the copied chromosomes are separated and moved to opposite ends of the cell. The nucleus also divides, ensuring each new cell will receive an identical set of chromosomes.

**Q170. What is the third and final stage of the cell cycle?**

**Answer:** The third stage is cytokinesis, where the cytoplasm and cell membrane divide to form two separate cells. Each of the new cells now has a complete set of organelles and genetic material, ready to function independently.

**Q171. How is DNA organised in a cell before and after replication?**

**Answer:** Before replication, DNA is in the form of single chromosomes. After replication, each chromosome consists of two identical strands called chromatids, joined at a point called the centromere. During mitosis, these chromatids are separated into new cells.

**Q172. What happens to the two sets of chromosomes during mitosis?**

**Answer:** During mitosis, the two sets of chromosomes are pulled to opposite ends of the cell. This ensures that each new cell will get one complete set of chromosomes, making them genetically identical to the original cell.

**Q173. What are stem cells?**

**Answer:** Stem cells are cells that have not yet specialised. They can divide many times and have the potential to turn into different types of cells, depending on the signals they receive. They are found in embryos, adult tissues like bone marrow, and plant meristems.

**Q174. Why are stem cells called "undifferentiated"?**

**Answer:** Stem cells are called undifferentiated because they haven't developed into a specific type of cell yet. They still have the ability to change into other types of cells, like muscle, nerve, or blood cells, depending on what the body needs.

**Q175. What can stem cells become after differentiation?**

**Answer:** After differentiation, stem cells can become specialised cells such as nerve cells, muscle cells, red blood cells, or any other type depending on their role. In plants, they can become leaf cells, root cells, or xylem and phloem cells.

**Q176. Where can stem cells be found in the human body?**

**Answer:** Stem cells in the human body are mainly found in embryos and in certain adult tissues such as bone marrow. Embryonic stem cells can develop into most types of human cells, while adult stem cells are more limited but can still form several different types of cells, like blood cells.

**Q177. What is the role of stem cells in embryos?**

**Answer:** In embryos, stem cells are responsible for forming all the different types of cells that make up the human body. These cells divide and then specialise to create tissues and organs, supporting the growth and development of the whole organism from a single fertilised egg.

**Q178. How do stem cells in adult bone marrow help the body?**

**Answer:** Stem cells in adult bone marrow can differentiate into various types of blood cells, including red blood cells, white blood cells, and platelets. This is essential for maintaining the blood system and replacing cells that are lost due to damage, disease, or natural cell death.

**Q179. Where are meristem stem cells found in plants?**

**Answer:** Meristem stem cells in plants are found in specific regions called meristems. These are located at the tips of roots and shoots, where the plant is actively growing. These areas constantly produce new cells that allow the plant to increase in size and repair damage.

**Q180. What is the function of meristem stem cells?**

**Answer:** The function of meristem stem cells is to produce new, undifferentiated cells that can then become specialised to form all parts of a plant, such as leaves, roots, and flowers. They allow plants to grow continuously and regenerate damaged parts throughout their life.

**Q181. How can stem cells from embryos be used in medicine?**

**Answer:** Embryonic stem cells can be grown and directed to develop into specific cell types needed by patients, such as nerve cells or insulin-producing cells. These cells can then be used to treat conditions like paralysis or diabetes by replacing damaged or non-functioning tissues.

**Q182. Why are embryonic stem cells useful in research?**

**Answer:** Embryonic stem cells are useful in research because they have the ability to become nearly any

type of cell in the human body. Scientists can study how cells grow, develop, and react to diseases, which helps in understanding human development and finding new treatments.

**Q183. What is therapeutic cloning?**

**Answer:** Therapeutic cloning is a technique in which an embryo is created using the patient's own DNA. The embryo's stem cells have the same genetic makeup as the patient, which means they can be used in treatment without being rejected by the immune system.

**Q184. Why is therapeutic cloning less likely to cause rejection?**

**Answer:** Because the stem cells in therapeutic cloning are created using the patient's own genetic material, the body recognises the cells as its own. This reduces the risk that the immune system will reject the transplanted cells or tissues.

**Q185. Give one condition that stem cells could potentially treat.**

**Answer:** One condition that stem cells could potentially treat is type 1 diabetes. Stem cells can be directed to develop into insulin-producing cells, which could replace the damaged cells in a diabetic patient's pancreas, helping to control blood sugar levels.

**Q186. What makes stem cells useful for treating paralysis?**

**Answer:** Stem cells can develop into nerve cells, which could replace damaged nerves in people with paralysis. If these new cells can make connections with the existing nervous system, they may restore movement or feeling in areas of the body that have lost function.

**Q187. What is one risk of using stem cells in treatment?**

**Answer:** One risk of using stem cells in treatment is that they may divide uncontrollably, leading to the formation of tumours or cancer. Because stem cells are capable of rapid growth and division, they must be carefully monitored and controlled in medical use.

**Q188. How might stem cell use lead to viral infection?**

**Answer:** If stem cells are not handled or tested properly, they might carry viruses that could be transferred to the patient. This is especially risky when using stem cells from donors, where contamination might not be immediately detected before treatment begins.

**Q189. Why do some people object to using embryonic stem cells?**

**Answer:** Some people object to using embryonic stem cells because the process involves the destruction of an embryo. They believe that human life begins at conception, so destroying an embryo for research or treatment raises ethical and moral concerns.

**Q190. What ethical concerns are linked with stem cell research?**

**Answer:** Ethical concerns include the destruction of embryos, the possibility of cloning humans, and fears of playing with human life unnaturally. Some people also worry about consent from embryo donors or the potential misuse of stem cell technology in future applications.

**Q191. How can meristem stem cells help preserve rare plant species?**

**Answer:** Meristem stem cells can be used to clone rare or endangered plant species. These clones are genetically identical and can be produced quickly in large numbers, helping to protect species from extinction by growing them in controlled environments or reintroducing them to the wild.

**Q192. Why is it beneficial to clone crop plants with disease resistance?**

**Answer:** Cloning crop plants with disease resistance ensures that all new plants have the same beneficial trait. This can help farmers grow healthier crops with less need for pesticides, increasing food production and reducing costs and environmental damage.

**Q193. How can stem cells reduce the need for organ donors?**

**Answer:** Stem cells can be used to grow new tissues or even entire organs in the lab, using the patient's own cells. This can reduce the demand for donated organs and lower the risk of rejection, making organ transplants more accessible and successful.

**Q194. Why might farmers prefer cloned plants over naturally grown ones?**

**Answer:** Farmers might prefer cloned plants because they are uniform, grow at the same rate, and have known traits such as high yield or disease resistance. This makes planning and harvesting more efficient and predictable, reducing the risk of crop failure.

**Q195. What are the social benefits of using stem cells in medicine?**

**Answer:** Social benefits include improved health and quality of life for people with previously untreatable conditions. Stem cell treatments can reduce the burden on healthcare systems, allow patients to return to work, and improve the wellbeing of families and communities.

**Q196. What are the potential disadvantages of stem cell treatments?**

**Answer:** Disadvantages include the risk of uncontrolled cell growth, high costs of treatment, ethical concerns, and the possibility of immune rejection. Long-term effects are not yet fully known, and there is a risk that treatments might not work as expected in every patient.

**Q197. Why is it important to evaluate both the risks and benefits of using stem cells?**

**Answer:** It's important to weigh risks and benefits so that stem cell treatments can be used safely and effectively. This helps scientists, doctors, and patients make informed decisions. Proper evaluation also helps avoid harm and ensures that resources are used responsibly.

**Q198. What does cloning mean in the context of stem cells?**

**Answer:** In the context of stem cells, cloning means creating genetically identical cells or organisms. This can be done to grow identical tissues for medical use or to produce plants or animals with specific traits by replicating cells without changing their DNA.

**Q199. How is stem cell use in plants different from that in animals?**

**Answer:** In plants, stem cells from meristems can continue to differentiate into any type of cell throughout the

plant's life. In animals, embryonic stem cells can do this, but adult stem cells are more limited. Also, plant stem cells are often used to clone entire plants for farming.

**Q200. Describe a medical situation where stem cells could be used.**

**Answer:** A medical situation where stem cells could be used is in treating a patient with leukaemia. The patient's bone marrow may be destroyed during treatment, so stem cells can be transplanted to produce new, healthy blood cells and rebuild the immune system.

**Q201. What does it mean to clone a plant quickly and economically?**

**Answer:** Cloning a plant quickly and economically means producing many identical plants in a short time using methods like tissue culture. This allows farmers or scientists to reproduce plants with desirable traits, such as disease resistance, without growing them from seeds, saving time and resources.

**Q202. Why are stem cells more flexible when taken from embryos compared to adults?**

**Answer:** Embryonic stem cells are more flexible because they are pluripotent, meaning they can develop into almost any type of cell in the body. Adult stem cells are limited to forming certain types of cells, making embryonic ones more useful for treating a wider range of conditions.

**Q203. In what way can stem cell therapy help people with diabetes?**

**Answer:** Stem cell therapy can help people with diabetes by producing insulin-producing cells in the pancreas. These new cells could replace damaged or non-functioning ones, helping the body control blood sugar levels naturally, which could reduce the need for insulin injections.

**Q204. How could stem cell research affect future generations?**

**Answer:** Stem cell research could lead to treatments or even cures for many serious diseases, benefiting future generations. It might allow for organ regeneration, personalised medicine, and better understanding of genetic conditions, improving healthcare and quality of life in the long term.

**Q205. Why is public opinion important when deciding laws about stem cell use?**

**Answer:** Public opinion is important because stem cell research, especially involving embryos, raises ethical and moral concerns. Governments consider the views of society to make fair laws that balance scientific progress with respect for different beliefs and values.

**Q206. What makes plant cloning a useful technique for agriculture?**

**Answer:** Plant cloning is useful in agriculture because it ensures consistency in crop quality, helps reproduce plants with desired traits, speeds up production, and reduces costs. It also allows farmers to grow plants that are more resistant to diseases or harsh environments.

**Q207. How could stem cells help in treating injuries to the spinal cord?**

**Answer:** Stem cells could help repair damaged spinal cord tissue by replacing nerve cells that no longer function. This might restore some movement or feeling to people with spinal injuries, offering hope for recovery where other treatments have failed.

**Q208. Why is the use of standardised procedures important in stem cell research?**

**Answer:** Standardised procedures ensure that stem cell experiments are reliable, repeatable, and safe. They help scientists compare results and reduce the risk of errors or contamination, which is important when developing treatments for humans.

**Q209. What challenges must scientists overcome to make stem cell therapy safe?**

**Answer:** Scientists must prevent uncontrolled cell growth, avoid immune rejection, and ensure cells don't carry infections. They also need to prove treatments are effective and safe through testing before they are used widely in patients.

**Q210. Explain how cloned plants from meristem cells are genetically identical.**

**Answer:** Cloned plants from meristem cells are genetically identical because they come from the same parent plant. Meristem cells have the same DNA, and when cloned, they divide to produce exact genetic copies, meaning all resulting plants share the same traits.

**Q211. What is meant by the term diffusion?**

**Answer:** Diffusion is the movement of particles from an area of higher concentration to an area of lower concentration. It happens naturally and doesn't require energy. It's important in biology for moving substances like oxygen and carbon dioxide in and out of cells.

**Q212. In which direction do particles move during diffusion?**

**Answer:** Particles move from an area of high concentration to an area of low concentration during diffusion. This continues until the particles are evenly spread out in the space available.

**Q213. Name one gas that enters cells by diffusion and one that leaves.**

**Answer:** Oxygen enters cells by diffusion for use in respiration. Carbon dioxide leaves cells by diffusion as a waste product of respiration.

**Q214. What happens to the rate of diffusion when the concentration gradient increases?**

**Answer:** The rate of diffusion increases when the concentration gradient becomes steeper. This means there's a bigger difference between the high and low concentration areas, causing particles to move faster.

**Q215. How does temperature affect the rate of diffusion?**

**Answer:** Higher temperatures increase the rate of diffusion because particles gain energy and move faster. Lower temperatures slow diffusion down as particles have less energy to move.

**Q216. What effect does a larger surface area have on diffusion?**

**Answer:** A larger surface area allows more particles to pass through at once, increasing the rate of diffusion. This is why cells that need to exchange substances quickly often have thin and wide membranes.

**Q217. Why is diffusion important for gas exchange in the lungs?**

**Answer:** Diffusion allows oxygen to enter the blood from the air in the lungs and lets carbon dioxide move

from the blood to the lungs to be breathed out. This is vital for respiration and removing waste gases from the body.

**Q218. How does urea move from cells into the blood?**

**Answer:** Urea moves from cells where it's made into the blood by diffusion. It travels from a high concentration in the cells to a lower concentration in the blood, where it is carried to the kidneys for removal.

**Q219. Explain why a thin membrane increases the rate of diffusion.**

**Answer:** A thin membrane means a shorter distance for particles to travel, so they can diffuse more quickly. This is why many exchange surfaces in the body, like the lungs, are only one cell thick.

**Q220. Why do single-celled organisms not need a transport system?**

**Answer:** Single-celled organisms have a large surface area compared to their volume, so substances like gases and nutrients can diffuse directly in and out of the cell quickly enough to meet their needs.

**Q221. What is surface area to volume ratio?**

**Answer:** It is a comparison of how much surface area an object has compared to its volume. In biology, this ratio helps determine how effectively a cell can exchange materials with its surroundings.

**Q222. Calculate the surface area to volume ratio of a cube with sides of 1 cm.**

**Answer:** The surface area of a cube is calculated using the formula:  $6 \times \text{side}^2$ . For a cube with sides of 1 cm:

Surface Area =  $6 \times (1 \times 1) = 6 \text{ cm}^2$

Volume is calculated using the formula:  $\text{side}^3$ . So, Volume =  $1 \times 1 \times 1 = 1 \text{ cm}^3$

Surface area to volume ratio = Surface Area  $\div$  Volume =  $6 \div 1 = 6:1$

**Solution:** The surface area to volume ratio of a 1 cm cube is **6:1**.

**Q223. Why is a high surface area to volume ratio helpful for single-celled organisms?**

**Answer:** A high surface area to volume ratio means substances can diffuse in and out of the cell quickly and efficiently. This is important for meeting the cell's needs for oxygen, nutrients, and waste removal.

**Q224. Why do large multicellular organisms need exchange surfaces?**

**Answer:** As organisms get bigger, their surface area to volume ratio gets smaller. This means substances can't reach all cells fast enough by diffusion alone, so they need specialised exchange surfaces and transport systems.

**Q225. Explain how the lungs are adapted for efficient gas exchange.**

**Answer:** The lungs have millions of tiny air sacs called alveoli with large surface areas. Their walls are very thin, close to blood capillaries, and they are ventilated with air. These features allow fast and efficient gas exchange of oxygen and carbon dioxide.

**Q226. Describe one feature of the small intestine that increases its surface area.**

**Answer:** The small intestine has many finger-like projections called villi, and each villus is covered with even smaller microvilli. These structures significantly increase the surface area of the small intestine, allowing for

more efficient absorption of nutrients into the blood. This large surface area ensures that digested food molecules have more space to be absorbed quickly and effectively.

## **Q227. How are gills in fish adapted for exchanging gases?**

**Answer:** Gills in fish are adapted for gas exchange by having a large surface area, thin membranes, and a good blood supply. The gill filaments are covered in tiny lamellae which increase the surface area further. Blood flows in the opposite direction to the water, maintaining a steep concentration gradient. This ensures that oxygen can diffuse into the blood efficiently and carbon dioxide can diffuse out.

## **Q228. What features of root hair cells help in absorbing water and minerals?**

**Answer:** Root hair cells have long, thin extensions that increase the surface area for absorbing water and minerals from the soil. They also have a thin cell wall which allows water to pass through easily by osmosis. In addition, they contain many mitochondria to provide energy for the active transport of minerals against their concentration gradient into the cell.

## **Q229. How does a leaf's structure help it with gas exchange?**

**Answer:** A leaf is adapted for gas exchange by having a large surface area and many tiny pores called stomata. These stomata allow carbon dioxide to enter the leaf for photosynthesis and oxygen to exit as a waste product. The internal air spaces in the leaf allow gases to diffuse quickly to and from cells. The thinness of the leaf also helps reduce the distance gases must travel.

## **Q230. Why is it important for exchange surfaces to be thin?**

**Answer:** It is important for exchange surfaces to be thin so that substances like oxygen, carbon dioxide, or nutrients can diffuse quickly across them. A shorter distance means that diffusion happens faster, which is essential for cells to get the materials they need quickly and to remove waste products before they build up and cause harm.

## **Q231. What role does blood supply play in increasing the rate of diffusion?**

**Answer:** A good blood supply helps maintain a steep concentration gradient, which speeds up the rate of diffusion. For example, in the lungs or intestines, blood continuously carries absorbed substances away and brings in substances to be exchanged. This constant flow prevents the concentrations from becoming equal on both sides, allowing diffusion to continue efficiently.

## **Q232. Why is ventilation important in the lungs?**

**Answer:** Ventilation in the lungs ensures that air rich in oxygen is constantly brought into the alveoli and carbon dioxide is removed. This keeps the concentration of oxygen high in the alveoli and the concentration of carbon dioxide low, maintaining a steep concentration gradient. This helps gases to diffuse quickly and efficiently between the alveoli and the blood.

## **Q233. What is the concentration gradient and how does it drive diffusion?**

**Answer:** A concentration gradient is the difference in concentration of a substance between two areas. Diffusion happens when particles move from a region of high concentration to a region of low concentration.

The greater the difference in concentration, the steeper the gradient, and the faster the rate of diffusion. It is the natural movement of particles down the gradient that drives diffusion.

**Q234. What substances are transported by diffusion in the small intestine?**

**Answer:** In the small intestine, digested nutrients such as glucose, amino acids, fatty acids, and glycerol are transported by diffusion into the bloodstream. These small molecules move from a high concentration in the intestinal lumen to a lower concentration in the blood. This process is essential for getting nutrients into the body for energy, growth, and repair.

**Q235. How can you calculate the surface area of a cube?**

**Answer:** To calculate the surface area of a cube, use the formula:  $\text{Surface Area} = 6 \times (\text{side length})^2$ . For example, if each side of the cube is 2 cm, then the surface area is  $6 \times (2 \text{ cm})^2 = 6 \times 4 \text{ cm}^2 = 24 \text{ cm}^2$ . The surface area is important in biological systems because it affects how quickly substances can enter or leave a cell or organism.

**Q236. What is the effect of a low surface area to volume ratio in large organisms?**

**Answer:** A low surface area to volume ratio in large organisms means that they have relatively less surface area for substances to diffuse through compared to their volume. This slows down the rate of diffusion, making it harder to meet the needs of all cells. As a result, large organisms often need specialized structures like lungs or blood vessels to transport substances efficiently.

**Q237. Why is diffusion slower in colder temperatures?**

**Answer:** Diffusion is slower in colder temperatures because the particles have less kinetic energy. This means they move more slowly and collide less often, so the rate at which they spread out and mix is reduced. In biological systems, this can slow down processes like gas exchange or nutrient absorption, affecting cell activity and overall function.

**Q238. What is one example of diffusion in plants?**

**Answer:** One example of diffusion in plants is the movement of carbon dioxide into the leaf through the stomata. During photosynthesis, carbon dioxide diffuses from the air, where its concentration is higher, into the leaf cells, where its concentration is lower. This diffusion helps the plant take in the gas needed to make glucose and oxygen.

**Q239. Why do animals rely on diffusion for oxygen?**

**Answer:** Animals rely on diffusion for oxygen because it is a simple and efficient way for oxygen to move from the lungs or gills into the blood, and then from the blood into cells. Oxygen moves from an area of high concentration (like the alveoli or water) to an area of low concentration (like the blood or cells), without needing energy, making it ideal for constant supply.

**Q240. How does an efficient blood supply maintain a steep concentration gradient?**

**Answer:** An efficient blood supply constantly brings in blood low in oxygen and removes blood high in oxygen from the exchange surface, such as the alveoli. This keeps the concentration of oxygen higher in the

alveoli and lower in the blood, maintaining a steep gradient. It also removes carbon dioxide quickly, keeping the diffusion process going effectively.

**Q241. Describe how diffusion helps remove waste from cells.**

**Answer:** Diffusion helps remove waste products like carbon dioxide and urea from cells by allowing them to move from a high concentration inside the cell to a lower concentration in the surrounding blood or extracellular fluid. This movement is passive and ensures that harmful substances do not build up inside cells, which could damage or interfere with normal cell function.

**Q242. What would happen to a cell if diffusion could not take place?**

**Answer:** If diffusion could not take place, cells would not be able to get essential substances like oxygen and glucose, or remove waste products like carbon dioxide. This would cause harmful substances to accumulate and prevent cells from producing energy. Eventually, the cell would not be able to survive, and the organism could become seriously ill or die.

**Q243. How does particle size affect diffusion rate?**

**Answer:** Smaller particles diffuse faster than larger ones because they move more easily and can pass through cell membranes or other barriers more quickly. Large molecules like proteins move slowly or may need help through active transport, while smaller molecules like oxygen and carbon dioxide diffuse rapidly, allowing efficient exchange in cells and tissues.

**Q244. What is the importance of the cell membrane in diffusion?**

**Answer:** The cell membrane controls what enters and exits the cell. It is semi-permeable, meaning only certain substances can pass through by diffusion. It allows essential molecules like oxygen and water to enter, and waste products like carbon dioxide to leave, while keeping out harmful substances. This helps maintain a stable internal environment for the cell.

**Q245. Why is the large surface area of alveoli important?**

**Answer:** The large surface area of alveoli in the lungs allows more oxygen to diffuse into the blood and more carbon dioxide to diffuse out at the same time. This is crucial because it makes gas exchange more efficient. The greater the surface area, the more space there is for gases to move across, meeting the body's demands for oxygen quickly and effectively.

**Q246. Give an example of a diagram that models diffusion.**

**Answer:** An example of a diagram that models diffusion is one showing particles spreading out in a container from a high concentration area to a low concentration area. Another example is a cell with arrows showing oxygen entering and carbon dioxide leaving across the cell membrane. These diagrams help visualize how particles move down their concentration gradient during diffusion.

**Q247. How do isotonic drinks help during physical activity?**

**Answer:** Isotonic drinks help during physical activity by replacing fluids, sugars, and electrolytes lost through sweat. Because they have a similar concentration of dissolved substances as the body, the water and

nutrients in the drink can be absorbed quickly by diffusion into the bloodstream, helping to keep the body hydrated and maintain energy levels during exercise.

**Q248. How does a steeper concentration gradient affect particle movement?**

**Answer:** A steeper concentration gradient means there is a bigger difference between the concentrations on either side of a membrane. This causes particles to move faster from the area of high concentration to the area of low concentration, increasing the rate of diffusion. It ensures that cells get nutrients or oxygen faster and can remove waste more efficiently.

**Q249. How does diffusion differ in gases and liquids?**

**Answer:** Diffusion occurs faster in gases than in liquids because gas particles move more freely and quickly than particles in liquids. In gases, the particles have more energy and fewer collisions, allowing them to spread out rapidly. In liquids, particles are closer together and move slower, so diffusion takes more time. This affects how quickly substances spread in each state.

**Q250. Why does diffusion occur faster across shorter distances?**

**Answer:** Diffusion occurs faster across shorter distances because the particles have less space to travel before reaching the area of lower concentration. This means substances like oxygen or nutrients can reach cells quickly and waste products can be removed faster. In biological systems, short diffusion distances are vital for keeping cells alive and functioning properly.

**Q251. What is osmosis?**

**Answer:** Osmosis is the movement of water molecules from a region of high water concentration (dilute solution) to a region of low water concentration (concentrated solution) through a partially permeable membrane. It is a type of diffusion that only involves water. Osmosis is important in maintaining the water balance in cells and helps in the movement of water in plants and animals.

**Q252. In which direction does water move during osmosis?**

**Answer:** During osmosis, water moves from an area where it is in high concentration (dilute solution) to an area where it is in lower concentration (more concentrated solution). This movement continues until the concentration of water on both sides of the partially permeable membrane becomes equal. This is essential for maintaining cell stability.

**Q253. What is meant by a partially permeable membrane?**

**Answer:** A partially permeable membrane is a barrier that allows only certain small molecules, like water, to pass through while preventing larger molecules or solutes from moving across. This selective movement is important in osmosis, as it ensures only water moves between different solutions, allowing cells to control their internal environment.

**Q254. What is a dilute solution?**

**Answer:** A dilute solution contains a high amount of water and a low concentration of solute, like sugar or

salt. In osmosis, water usually moves from a dilute solution to a more concentrated one. Dilute solutions have more free water molecules, which is why water tends to move out of them during osmosis.

**Q255. What is a concentrated solution?**

**Answer:** A concentrated solution has a high amount of solute and less water compared to a dilute solution. Because there are fewer free water molecules, water tends to move into the concentrated solution during osmosis. This concept is key to understanding how water balances are maintained in cells.

**Q256. How does osmosis differ from diffusion?**

**Answer:** Osmosis is a type of diffusion but it specifically involves water molecules moving across a partially permeable membrane. Diffusion can involve any particles like gases or solutes and does not always need a membrane. Osmosis always moves water from high to low water concentration, while diffusion moves any particles from high to low concentration.

**Q257. Describe a situation in a plant cell where osmosis would occur.**

**Answer:** Osmosis occurs in plant cells when the plant roots absorb water from the soil. If the soil has more water (a dilute solution) than the root cells, water moves into the root cells by osmosis through the partially permeable cell membrane. This helps the plant stay hydrated and supports turgor pressure, keeping the plant firm.

**Q258. What happens to a plant cell in a concentrated solution?**

**Answer:** When a plant cell is placed in a concentrated solution, water moves out of the cell by osmosis. The cell becomes plasmolysed, meaning the cell membrane pulls away from the cell wall due to water loss. This causes the cell to shrink and lose firmness, making the plant wilt and possibly affecting its growth and survival.

**Q259. What happens to a plant cell in a dilute solution?**

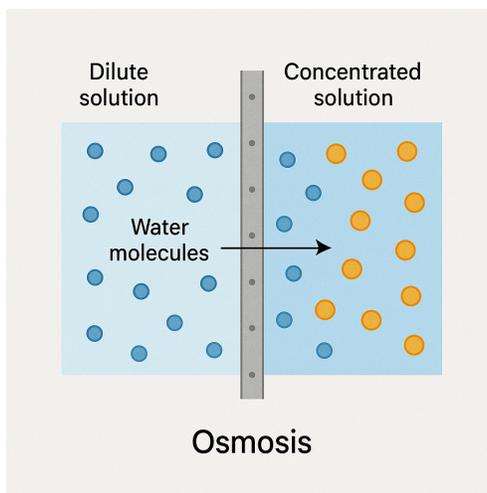
**Answer:** In a dilute solution, water enters the plant cell by osmosis. The cell swells and becomes turgid because the water fills the central vacuole and presses the cytoplasm against the cell wall. This turgidity is useful for supporting the plant structure and keeping it upright. The cell wall prevents the cell from bursting.

**Q260. How does osmosis affect animal cells differently from plant cells?**

**Answer:** Osmosis affects animal cells differently because they do not have a cell wall. If too much water enters an animal cell in a dilute solution, the cell can swell and burst. In a concentrated solution, the cell shrinks as water leaves. Plant cells have a strong cell wall that prevents bursting and helps maintain shape even during osmosis.

**Q261. How can osmosis be shown in a diagram?**

**Answer:** Osmosis can be shown in a diagram with a cell or setup that includes a partially permeable membrane separating two solutions of different concentrations. Arrows are drawn to show water moving from the dilute solution to the concentrated one. Diagrams may also show the effect of osmosis on cells, like turgid or plasmolysed plant cells.



**Q262. What is the purpose of the osmosis required practical?**

**Answer:** The purpose of the osmosis required practical is to observe and measure the effect of different concentrations of a solution on plant tissues, like potato chips. It helps students understand how osmosis works in real life, and shows how water moves into or out of cells depending on the concentration of the surrounding solution.

**Q263. Describe how to set up an experiment to test osmosis in potato chips.**

**Answer:** To test osmosis, cut equal-sized potato chips and weigh them. Place each chip into separate beakers containing different concentrations of sugar or salt solutions. Leave them for a set time, then remove, blot dry, and weigh again. Comparing the change in mass shows whether water has entered or left the chip, indicating osmosis.

**Q264. What variable is measured in the osmosis practical?**

**Answer:** The variable measured in the osmosis practical is the mass of the potato chips before and after placing them in the solution. This helps determine how much water has entered or left the tissue due to osmosis. A gain in mass shows water entered; a loss shows water left the cells.

**Q265. How is percentage gain or loss of mass calculated?**

**Answer:** Percentage gain or loss of mass is calculated using the formula:

$$\text{Percentage change} = \frac{(\text{final mass} - \text{initial mass})}{\text{initial mass}} \times 100$$

This formula helps compare the change in mass of each potato chip regardless of their original size. It allows for fair comparisons between results from different concentrations.

**Q266. What would a graph look like if osmosis is occurring in plant tissue?**

**Answer:** A graph showing osmosis in plant tissue would plot percentage change in mass on the y-axis and solution concentration on the x-axis. The curve would show gain in mass at low concentrations (dilute solutions), loss in mass at high concentrations, and no change at the point where the concentration is equal to the cell's contents.

**Q267. Why do we use salt or sugar solutions in osmosis experiments?**

**Answer:** Salt or sugar solutions are used in osmosis experiments because they create different concentrations to observe how water moves across cell membranes. These solutes affect the water concentration in the solution, helping us test how cells gain or lose water through osmosis depending on the external concentration.

**Q268. How can you calculate the rate of water uptake?**

**Answer:** The rate of water uptake can be calculated using the formula:

$$\text{Rate} = \text{change in mass} \div \text{time}$$

This shows how quickly water is entering or leaving the plant tissue. You must measure the initial and final mass of the tissue and know the time it was in the solution. The result is usually given in grams per minute or another suitable unit.

**Q269. What does it mean if a potato chip gains mass after being placed in a solution?**

**Answer:** If a potato chip gains mass after being placed in a solution, it means water has entered the cells by osmosis. This happens when the solution is more dilute than the contents of the cells, causing water to move into the cells. It shows that the potato cells absorbed water and became more turgid.

**Q270. What does it mean if a potato chip loses mass after being placed in a solution?**

**Answer:** If a potato chip loses mass after being placed in a solution, it means water has left the cells by osmosis. This happens when the surrounding solution is more concentrated than the cell contents. Water moves out of the cells into the solution, making the cells shrink and the chip lighter.

**Q271. Why do we blot potato chips dry before weighing them?**

**Answer:** We blot potato chips dry before weighing them to remove excess surface water that is not part of osmosis. If we don't remove this water, it would give a false reading of mass and affect the accuracy of our results. Blotting ensures we only measure the water that entered or left the cells.

**Q272. What is the independent variable in the osmosis practical?**

**Answer:** The independent variable in the osmosis practical is the concentration of the sugar or salt solution. This is the variable we change to see how it affects the movement of water into or out of the potato cells. It allows us to observe the effect of different concentrations on osmosis.

**Q273. What is the dependent variable in the osmosis practical?**

**Answer:** The dependent variable is the change in mass of the potato chips. This is what we measure to see how the different concentrations of solution affected water movement through osmosis. The results help show whether water entered or left the plant tissue.

**Q274. Why do we use multiple concentrations in the osmosis experiment?**

**Answer:** We use multiple concentrations to get a full picture of how osmosis affects the plant tissue across a range of conditions. It helps us identify at which concentration there is no net movement of water and allows us to draw a more accurate conclusion about the relationship between concentration and osmosis.

**Q275. Why is it important to repeat the experiment?**

**Answer:** Repeating the experiment is important to make the results more reliable and accurate. It helps identify any anomalies and ensures the results are consistent. If the same results are seen in multiple trials, we can be more confident that the conclusions are correct and not due to chance or error.

**Q276. What is active transport?**

**Answer:** Active transport is the movement of substances across a cell membrane from a region of low concentration to a region of high concentration. This process goes against the concentration gradient and requires energy from the cell. It allows cells to take in essential substances even when they are in lower concentration outside the cell.

**Q277. How is active transport different from diffusion?**

**Answer:** Active transport moves substances from low to high concentration and requires energy, while diffusion moves substances from high to low concentration and does not need energy. Active transport works against the concentration gradient, whereas diffusion follows it. This makes active transport important when substances need to be absorbed despite being less concentrated.

**Q278. What does active transport require to work?**

**Answer:** Active transport requires energy, usually in the form of ATP, which comes from respiration. It also needs special proteins in the cell membrane that act as pumps to move substances against their concentration gradient. Without energy or these transport proteins, active transport cannot happen.

**Q279. Give an example of active transport in plants.**

**Answer:** In plants, active transport happens in root hair cells, where minerals from the soil are absorbed into the plant. Even if the concentration of minerals is lower in the soil than inside the root, active transport allows the plant to take in the nutrients it needs for healthy growth and development.

**Q280. Why do root hair cells carry out active transport?**

**Answer:** Root hair cells carry out active transport to absorb mineral ions like nitrates and phosphates from the soil, even when they are in lower concentration than inside the cell. This process helps the plant get essential nutrients needed for making proteins and growing properly, which diffusion alone cannot provide.

**Q281. What is one example of active transport in the human body?**

**Answer:** One example of active transport in the human body is the absorption of glucose in the small intestine. When the concentration of glucose in the gut is lower than in the blood, cells lining the intestine use active transport to move glucose into the bloodstream so the body can use it for energy.

**Q282. How are sugar molecules absorbed in the gut by active transport?**

**Answer:** In the small intestine, sugar molecules are absorbed into the blood by active transport when their concentration is lower in the gut than in the blood. Transport proteins in the cell membranes use energy from respiration to pump sugars into the cells, ensuring the body gets enough glucose for energy.

**Q283. Why is active transport important for respiration?**

**Answer:** Active transport is important for respiration because it helps cells take in glucose and oxygen, which are needed to release energy. For example, glucose absorbed in the gut by active transport is used in cellular respiration to produce ATP, the energy that powers all cell activities, including more active transport.

**Q284. What kind of energy does active transport use?**

**Answer:** Active transport uses chemical energy in the form of ATP (adenosine triphosphate). ATP is made during respiration in the mitochondria and is used to power the transport proteins in the cell membrane that move substances against their concentration gradient.

**Q285. What would happen if active transport didn't occur in root hair cells?**

**Answer:** If active transport didn't occur in root hair cells, plants wouldn't be able to absorb enough mineral ions from the soil when those minerals are in low concentration. This would lead to poor growth, weak roots, yellowing leaves, and other signs of nutrient deficiency, since the plant couldn't get what it needs for photosynthesis and protein production.

**Q286. What role does active transport play in nutrient absorption?**

**Answer:** Active transport helps cells absorb nutrients even when those nutrients are more concentrated inside the cell than outside. This is especially important in the gut, where nutrients like glucose and amino acids are absorbed into the bloodstream so the body can use them. It ensures nothing is wasted and the body gets enough energy and materials.

**Q287. Compare the concentration gradient in diffusion and active transport.**

**Answer:** In diffusion, substances move down the concentration gradient, from high to low concentration, without using energy. In active transport, substances move up the concentration gradient, from low to high concentration, and this requires energy. This difference makes active transport useful when cells need to gather more of a substance than is available outside.

**Q288. Why can't diffusion alone meet all the needs of cells?**

**Answer:** Diffusion alone can't meet all the needs of cells because it only works when the substance is in higher concentration outside the cell. Sometimes, the cell needs substances that are in lower concentration outside, like certain nutrients. In these cases, active transport is needed to bring those substances in, even against the gradient.

**Q289. What type of cells often carry out active transport?**

**Answer:** Cells that carry out active transport often have many mitochondria to provide energy. Examples include root hair cells in plants, cells lining the small intestine in animals, and kidney cells. These cells need to move substances like minerals, glucose, and ions into the body or out of waste fluids, even when it requires energy.

**Q290. What adaptations do root hair cells have for active transport?**

**Answer:** Root hair cells have several adaptations for active transport. They have a large surface area to

absorb more minerals, thin walls to make it easier for substances to move in, and many mitochondria to produce the energy needed for active transport. These features help the plant take in essential nutrients from the soil.

**Q291. How are villi in the small intestine adapted for active transport?**

**Answer:** Villi in the small intestine are adapted for active transport by having a large surface area, thin walls, and many transport proteins in their membranes. They also contain many mitochondria to provide energy. These adaptations help absorb nutrients like glucose and amino acids into the blood, even when their concentration is higher inside the body.

**Q292. What does it mean to move substances "against the concentration gradient"?**

**Answer:** Moving substances "against the concentration gradient" means moving them from an area of low concentration to an area of high concentration. This is the opposite of what happens in diffusion, so it requires energy. Active transport is the process that moves substances in this way using transport proteins and ATP.

**Q293. What is the difference between passive and active transport?**

**Answer:** Passive transport, like diffusion and osmosis, does not need energy and moves substances from high to low concentration. Active transport needs energy and moves substances from low to high concentration. Passive transport relies on natural particle movement, while active transport uses special proteins and energy from respiration.

**Q294. What happens to energy use in a cell performing active transport?**

**Answer:** A cell performing active transport uses more energy than one that relies only on diffusion. This is because active transport requires ATP to move substances against the concentration gradient. As a result, these cells have more mitochondria to produce the energy they need for this process.

**Q295. Describe one experiment that could show active transport.**

**Answer:** One experiment to show active transport is using pieces of plant tissue like celery or root tips placed in a solution with a low concentration of a mineral ion and measuring ion uptake. If the temperature is increased or if a chemical that stops respiration is added, uptake stops. This shows that energy is needed, proving it's active transport.

**Q296. Why do active transport cells have many mitochondria?**

**Answer:** Active transport cells have many mitochondria because they need a lot of energy to move substances against the concentration gradient. Mitochondria produce ATP through respiration, and this ATP powers the transport proteins in the membrane. More mitochondria mean more energy is available for active transport.

**Q297. What are the three main ways substances move into and out of cells?**

**Answer:** The three main ways substances move into and out of cells are diffusion, osmosis, and active transport. Diffusion and osmosis are passive processes that don't need energy, while active transport is an energy-requiring process that moves substances against their concentration gradient using ATP.

**Q298. Which transport process does not require energy?**

**Answer:** Diffusion and osmosis are transport processes that do not require energy. They are passive and rely on the natural movement of particles from an area of high concentration to low concentration. These processes allow cells to exchange substances like gases and water without using ATP.

**Q299. Which process moves water only?**

**Answer:** Osmosis is the process that moves water only. It involves the movement of water molecules from a dilute solution to a concentrated solution across a partially permeable membrane. Osmosis helps balance water levels in and around cells without needing energy.

**Q300. How can you tell if a cell is using active transport?**

**Answer:** You can tell if a cell is using active transport if it moves substances from low to high concentration, uses a lot of energy, or contains many mitochondria. If stopping respiration stops the transport, it's likely active transport. This shows the process depends on ATP and is not just passive movement.