Biyani Girls College
M.Sc. (Prev.) Biotechnology
I Internal Examination, 2019-20
Cell Biology

Set- A

Time: 1.30 Hours **Maximum Mark: 30**

1. **Give answer in very short.** 8x1

(i)What is basic difference between prokaryotic and eukaryotic cells.

(i)Eukaryotic cells contain three main kinds of cytoskeletal filaments: microfilaments, microtubules, and intermediate filaments. Each type is formed by the polymerization of a distinct type of protein subunit and has its own characteristic shape and intracellular distribution.

(ii)What is cytoskeleton.

(ii) The cytoskeleton is a network of filaments and tubules that extends throughout a cell, through the cytoplasm, which is all of the material within a cell except for the nucleus. It is found in all cells, though the proteins that it is made of vary between organisms.

(iii)Write the function of plasmodesmata.

(iii)Plasmodesmata are microscopic channels which traverse the cell walls of plant cells and some algal cells, enabling transport and communication between them.

(iv)Give types of endoplasmic reticulum.

(iv)There are two types of enoplasmic reticulum- smooth endoplamic reticulum, rough Endoplasmic reticulum.

(v) Define Karyotheca.

(v) Karyotheca is double-layered membrane surrounding the nucleus of a eukaryotic cell, separating the nucleoplasm from the cytoplasm.

(vi)Define apoptosis.

(vi) Apoptosis is a form of programmed cell death, or "cellular suicide." It is different from necrosis, in which cells die due to injury. Apoptosis is an orderly process in which the cell's contents are packaged into small packets of membrane for "garbage collection" by immune cells.

(vii)What are intermediate filaments.

(vii)Intermediate filaments are one of three types of cytoskeletal elements. The other two are thin filaments (actin) and microtubules. Frequently the three components work together to enhance both structural integrity, cell shape, and cell and organelle motility. Intermediate filaments are stable, durable.

(viii)Define Golgi bodies.

(viii)Golgi body is a complex of vesicles and folded membranes within the cytoplasm of most eukaryotic cells, involved in secretion and intracellular transport.

2. **Explain structure of following cell organelles.**4x2

(i)inclusion bodies

(i)Inclusion Bodies: Inclusion bodies , sometimes called elementary bodies, are nuclear or cytoplasmic aggregates of stable substances, usually proteins. They typically represent sites of viral multiplication in a bacterium or a eukaryotic cell and usually consist of viral capsid proteins. Cell organelles are membrane bound structures performing a specific function which integrate to form the functional cell. Inclusion bodies are tiny aggregates of substances. Plasma membrane is neither an organelle nor an inclusion body. It shelters the organelles & inclusion bodies. These bodies are never enclosed by a membrane and serve as storage vessels. Glycogen, which is a polymer of glucose, is stored as a reserve of carbohydrate and energy. Examples of inclusions are glycogen granules in the liver and muscle cells, lipid droplets in fat cells, pigment granules in certain cells of skin and hair, and crystals of various types.

(ii)Nucleus

(ii)The nucleus is an organelle found in eukaryotic cells. Inside its fully enclosed nuclear membrane, it contains the majority of the cell's genetic material. This material is organized as DNA molecules, along with a variety of proteins, to form chromosomes. This organelle has two major functions: it stores the cell's hereditary material, or DNA, and it coordinates the cell's activities, which include growth, intermediary metabolism, protein synthesis, and reproduction (cell division). Only the cells of advanced organisms, known as eukaryotes, have a nucleus.

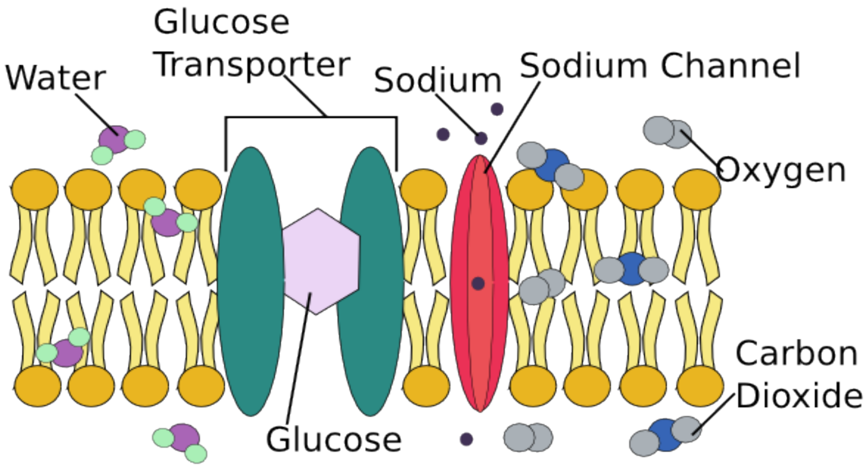
The cell nucleus is a membrane bound structure that contains the cell's hereditary information and controls the cell's growth and reproduction. It is the command center of a eukaryotic cell and is commonly the most prominent organelle in a cell. Because the cell is very small, and because organisms have many DNA molecules per cell, each DNA molecule must be tightly packaged. But during cell division, DNA is in its compact chromosome form to enable transfer to new cells. Researchers refer to DNA found in the cell's nucleus as nuclear DNA. The cell nucleus is a membrane bound structure that contains the cell's hereditary information and controls the cell's growth and reproduction. The nucleus is the site for genetic transcription, while keeping it separated from the cytoplasm.

3. Explain structure of cell membrane in eukaryotic cell, with the help of labeled diagram. 7

4. Phospholipids make up the basic structure of a cell membrane. This arrangement of cell mobility, secretions, and absorptions of substances phospholipid molecules makes up the lipid bilayer. The phospholipids of a cell membrane are arranged in a double layer called the lipid bilayer. The hydrophilic phosphate heads are always arranged so that they are near water. The primary function of the plasma membrane is to protect the cell from its surroundings. Composed of a phospholipid bilayer with embedded proteins, the plasma membrane is selectively permeable to ions and organic molecules and regulates the movement of substances in and out of cells. protects the cell by acting as a barrier.

Functions Of Cell Membrane:

(a) regulates the transport of substances in and out of the cell.
(b) receives chemical messengers from other cell.
(c) acts as a receptor.
(d) cell mobility, secretions, and absorptions of substances.



5. What are motor proteins. Explain in detail, their role in cytoskeleton. 7

5. Motor proteins are a class of molecular motors that can move along the cytoplasm of animal cells. They convert chemical energy into mechanical work by the hydrolysis of ATP. Flagellar rotation, however, is powered by a proton pump. Motor proteins are molecular motors that use ATP hydrolysis to move along cytoskeletal filaments within the cell. They fulfil many functions within biological systems, including controlling the sliding of filaments in muscle contraction and mediating intracellular transport along biopolymer filament tracks.

There are two major classes of microtubule motor proteins, kinesins and dyneins. Myosin is an actin motor proteins.

Myosin is the motor, actin filaments are the tracks along which myosin moves, and ATP is the fuel that powers movement. Studies of muscle contraction provided the first evidence that myosin heads slide or walk along actin filaments. Dynein is a family of cytoskeletal motor proteins that move along microtubules in cells. They convert the chemical energy stored in ATP to mechanical work. Dynein transports various cellular cargos, provides forces and displacements important in mitosis, and drives the beat of eukaryotic cilia and flagella. A kinesin is a protein belonging to a class of motor proteins found in eukaryotic cells. Kinesins move along microtubule (MT) filaments, and are powered by the hydrolysis of adenosine triphosphate (ATP) (thus kinesins are ATPases). Kinesins and dyneins have similarities, but an important difference is that most kinesins travel toward the plus end of the microtubule that they are on (i.e., away from the center of the cell), while dyneins travel toward the minus end of the microtubule (towards the center of the cell).

There are three major domains of motor domains proteins are organized into head, neck, and tail domains, which carry out different functions. The head domain binds actin and has ATPase activity. The light chains, bound to the neck domain.

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Set- B

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1.Give answers in short. 1x8

(i)What are main 3 types of cytoskeleton fibers.

(i)Cytoskeleton is made up of three kinds of protein filaments: Actin filaments (also called microfilaments), Intermediate The filaments and Microtubules.

(ii)What are the basic building blocks of microtubules.

(ii)Microtubules are the largest cytoskeletal filaments in cells, with a diameter of 25 nanometers. They are made out of subunits called tubulin. Each tubulin subunit is made up of one alpha and one beta tubulin that are attached to each other, so technically tubulin is a heterodimer, not a monomer.

(iii)What is MTOC (microtubules organizing center).

(iii)The microtubule-organizing center (MTOC) is a structure found in eukaryotic cells from which microtubules emerge. MTOCs have two main functions: the organization of eukaryotic flagella and cilia and the organization of the mitotic and meiotic spindle apparatus, which separate the chromosomes during cell division.

(iv)What is treadmilling.

(iv)Treadmilling is a phenomenon observed in many cellular cytoskeletal filaments, especially in actin filaments and microtubules. It occurs when one end of a filament grows in length while the other end shrinks resulting in a section of filament seemingly "moving" across a stratum or the cytosol.

(v)What is myosin

(v) Myosins are a superfamily of motor proteins best known for their roles in muscle contraction and in a wide range of other motility processes in eukaryotes. They are ATP-dependent and responsible for actin-based motility

(vi)What is the function of axonemal dyneins.

(vi) Axonemal dynein causes sliding of microtubules in the axonemes of cilia and flagella and is found only in cells that have those structures. Dynein carries organelles, vesicles and possibly microtubule fragments along the axons of neurons toward the cell body in a process called retrograde axoplasmic transport.

(vii)What is tropomyosin.

(vii)Tropomyosins are a large family of integral components of actin filaments that play a critical role in regulating the function of actin filaments in both muscle and nonmuscle cells. These proteins consist of rod-shaped coiled-coil hetero- or homo-dimers that lie along the α-helical groove of most actin filaments.

(viii)What is troponin complex.

(viii)Troponin, or the troponin complex, is a complex of three regulatory proteins that is integral to muscle contraction in skeletal muscle and cardiac muscle, but not smooth muscle.

2. Write short notes on following: 4x2

(i)Biogenesis of plasma membrane

(i) Plasma membrane biogenesis in eukaryotic cells: translocation of newly synthesized lipid. The results of these studies suggest that, although sterols and phospholipids are transported to the cell surface with similar kinetics, some sorting of the lipids must occur at an early stage in membrane biogenesis.

The growth of the plasma membrane is localized to the bud site during normal cell growth and to the projection in response to mating pheromone. Plasma membrane proteins fall into numerous classes, including transporters, sensors and receptors, signalling molecules, and landmark proteins. Hypothetically, plasma membrane biogenesis occurs as an assembly line process involving functionally specialized compartments of the cell within which the Golgi is central to assembly. The process, the synthesis and assembly of phospholipid shall be studied by biochemical techniques that determine the lipid content and phospholipid synthetic enzyme activity of fractions and whole gland.

(ii)Lysosomes

(ii)A lysosome is a membrane-bound cell organelle that contains digestive enzymes. Lysosomes are involved with various cell processes. They break down excess or worn-out cell parts. They may be used to destroy invading viruses and bacteria. Inside a cell, numerous organelles function to remove wastes. One of the key organelles involved in digestion and waste removal is the lysosome. Lysosomes are organelles that contain digestive enzymes. They digest excess or worn out organelles, food particles, and engulfed viruses or bacteria. Lysosomes are enzyme packages of cells. Lysosomes hold enzymes that were created by the cell. The purpose of the lysosome is to digest things. They might be used to digest food or break down the cell when it dies.

A lysosome is basically a specialized vesicle that holds a variety of enzymes. The enzyme proteins are first created in the rough endoplasmic reticulum. Those proteins are packaged in a vesicle and sent to the Golgi apparatus. The Golgi then does its final work to create the digestive enzymes and pinches off a small, very specific vesicle. That vesicle is a lysosome. From there the lysosomes float in the cytoplasm until they are needed. Lysosomes are single-membrane organelles.

3. Explain in detail structure and function microfilaments. 7

3. Microfilaments, also called actin filaments, are filaments in the cytoplasm of eukaryotic cells that form part of the cytoskeleton and are primarily composed of polymers of actin, but in cells are modified by and interact with numerous other proteins. A thin, helical, single-stranded filament of the cytoskeleton found in the cytoplasm of eukaryotic cells, composed of actin subunits, and functions primarily in maintaining the structural integrity of a cell and cell movements.

They are polymers of actin, which is the most abundant protein in most animal cells. In vertebrates there are several different gene products of which α actin is found in muscle and β/γ actins in the cytoskeleton of non-muscle cells. For all actin types the monomeric soluble form is called G-actin.

Actin filaments have an inert minus end, and a growing plus end to which new monomers are added. G-actin contains ATP and this becomes hydrolyzed to adenosine diphosphate (ADP) shortly after addition to the filament. As with tubules, a rapidly growing filament will bear an ATP cap which stabilizes the plus end. Microfilaments are often found to undergo 'treadmilling' such that monomers are continuously added to the plus end and removed from the minus end while leaving the filament at the same overall length.

The Function Of Microfilaments: Microfilaments are usually about 7 nm in diameter and composed of two strands of actin. Microfilament functions include cytokinesis, amoeboid movement and cell motility in general, changes in cell shape, endocytosis and exocytosis, cell contractility and mechanical stability.

Microfilaments, or actin filaments, are the thinnest filaments of the cytoskeleton and are found in the cytoplasm of eukaryotic cells. The polymers of these linear filaments are flexible but still strong, resisting crushing and buckling while providing support to the cell. Microfilaments, along with microtubules and other cellular elements, form structures called a phragmoplasts that support the assembly of a cell plate. The microfilaments break down into individual actin fragments that can be recycled to create new microfilaments when needed.

4. Explain in detail microtubule polymerization and dynamics. 7

4. The polymerization dynamics of microtubules are central to their biological functions. Polymerization dynamics allow microtubules to adopt spatial arrangements that can change rapidly in response to cellular needs and, in some cases, to perform mechanical work.

The polymerization dynamics of microtubules are central to their biological functions. Polymerization dynamics allow microtubules to adopt spatial arrangements that can change rapidly in response to cellular needs and, in some cases, to perform mechanical work. Microtubules utilize the energy of GTP hydrolysis to fuel a unique polymerization mechanism termed dynamic instability. In this review, we first describe progress toward understanding the mechanism of dynamic instability of pure tubulin and then discuss the function and regulation of microtubule dynamic instability in living cells. Polymerization dynamics allow microtubules to adopt spatial arrangements that can change rapidly in response to cellular needs and, in some cases, to perform mechanical work. Microtubules utilize the energy of GTP hydrolysis to fuel a unique polymerization mechanism termed dynamic instability. In this review, we first describe progress toward understanding the mechanism of dynamic instability of pure tubulin and then discuss the function and regulation of microtubule dynamic instability in living cells.

Nucleation is the event that initiates the formation of microtubules from the tubulin dimer. Microtubules are typically nucleated and organized by organelles called microtubule-organizing centres (MTOCs). Contained within the MTOC is another type of tubulin, γ-tubulin, which is distinct from the α- and β-subunits of the microtubules themselves. The γ-tubulin combines with several other associated proteins to form a lock washer-like structure known as the "γ-tubulin ring complex" (γ-TuRC). This complex acts as a template for α/β-tubulin dimers to begin polymerization; it acts as a cap of the (−) end while microtubule growth continues away from the MTOC in the (+) direction. Following the initial nucleation event, tubulin monomers must be added to the growing polymer. The process of adding or removing monomers depends on the concentration of αβ-tubulin dimers in solution in relation to the critical concentration, which is the steady state concentration of dimers at which there is no longer any net assembly or disassembly at the end of the microtubule. If the dimer concentration is greater than the critical concentration, the microtubule will polymerize and grow. If the concentration is less than the critical concentration, the length of the microtubule will decrease