TARAS SHEVCHENKO NATIONAL UNIVERSITY OF KYIV
EDUCATIONAL SCIENTIFIC CENTER
"INSTITUTE OF BIOLOGY AND MEDICINE"

HISTOLOGY, CYTOLOGY, EMBRYOLOGY

A GUIDE FOR KNOWLEDGE LEVEL CONTROL FOR FOREIGN STUDENTS OF SPECIALIZATION "MEDICINE"

Part 1. Cytology, Embryology.

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Histology, Cytology, Embryology. A guide for knowledge level control for foreign students of specialization "Medicine". Part 1. Cytology, Embryology / compliers: I. V. Byelinska, V. Ye. Lavrynenko, O. V. Lynchak, O. Ye. Maievskyi. – Kyiv, 2023. – 130 p.

This part of A guide for knowledge level control of discipline "Histology, Cytology, Embryology" contains questions devoted to Cytology and Embryology. Altogether it contains 9 chapters basing on the number of topics connected to cell components and compartments as well as the process of embryonic development. Eight chapters contain the basic theoretical material describing the features of cellular structures and their functions while the last chapter is dedicated to the main events of early embryonic development and differentiation of cells and tissues. At the end of each chapter there is a wide range of questions with medical models or descriptions that modulate the situation where such type of knowledge should be applied. The questions allow to check the level of material perception by students. For students of specialty 222 "Medicine" of the educational qualification level "Master".

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INTRODUCTION

The first part of a guide for knowledge level control for foreign students of specialization "Medicine" of discipline «HISTOLOGY, CYTOLOGY, EMBRYOLOGY» contains the basic theoretical material and questions from topics that belong to Cytology and Embryology issue.

The first part of this guide contains 8 chapters that provide relevant questions about histological methods of investigation, main components of the cell, its structures as well as cell's compartments and functions: methods and equipment of cells and tissue studies, cell envelope, cytoskeleton, cytosol, single and double membrane organelles, nucleus and cell cycle. The ninth chapter related to the early embryonic development, cells differentiation and tissues formation. Each chapter has questions about specification of cellular components, their function, and mechanisms of development.

The first chapter of this guide is devoted to the stages of tissue processing, used instruments and equipment, different approaches for tissue investigation and basic knowledge about the structure of cells of various organisms: prokaryotes, eukaryotes, plant and animal cells.

The second chapter of the guidebook includes questions about structural component of cell envelope, peculiarities of its structure, interaction in a cell and functions.

The third chapter is dedicated to the questions of organization, interaction and function of cytoskeleton, its comparative characteristics and some disturbance associated with this structure of the cell.

The fourth chapter contains control questions regarding the cytosol organization and its role in cell behavior, in different types of protein synthesis, energy molecules turnover, accumulation of specific substances.

In the fifth chapter students can find questions of the structure and functions of one-membrane organelles. It provides main information about morphology of rough and smooth endoplasmic reticulum, Golgi body, lysosomes and peroxisomes, the basis of their functioning, what processes in the cell they participate in and what disorders may be caused by them. Students can also get information which types of cells in human organism have each organelle developed the best and why.

The sixth chapter gives students possibility to deepen and check their knowledge about the two-membrane organelle – mitochondria. As a provider of ATP for the cell, its role is hard to overestimate. On the other side, its functioning is associated with production of substances potentially dangerous for the cell, so the aspects of possible problems connected with this organelle are also included in the questions.

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The seventh chapter draws students' attention to nucleus as the central part of the cell. It describes the surface apparatus, nucleoplasm, nuclear skeleton, chromatin, and nucleolus – the way they look like, what they consist of and how they participate in functioning of nucleus. Cases of certain typical disorders connected with nuclear lamina are also provided in test tasks.

The eighth chapter has questions about processes happening in the cell during its cycle – from mitotic division through growing and differentiation, doubling the DNA and preparing for the following mitosis. The information from this chapter also gives possibility to understand each stage of mitotic division – which changes happen in the cell and how genetic material is regrouped during prophase, metaphase, anaphase and telophase.

The ninth chapter provides questions devoted to the embryogenesis, the development of an embryo. It contains questions about pre-embryonic and embryonic periods of human life. This chapter includes information about gametogenesis, characteristics of the gametes, fertilization, cleavage, gastrulation, neurulation, organogenesis and extraembryonic organs.

Students get the possibility to respond the suggested questions which allows them to check the level of competence in the theoretical material and the ability to apply it, as well as to avoid the subjective assessment of knowledge by the teacher. The acquired knowledge will be the basis for mastering the next unit of this course "Basic histology" and "Special histology".

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Chapter I.

Tissue processing

1. Nephrectomy (kidney removal) was done to a 36-year-old patient due to severe inflammatory process in the organ and loss of its function. To make a diagnosis, morphological examination of tissues is carried out. What is the first step of tissue processing?

A. clearing
B. staining
C. fixation
D. embedding
E. mounting

2. A 24-year-old patient underwent a nephrectomy (removal of a kidney) due to a long term severe inflammatory process in the organ and loss of its function. For diagnosis, it is necessary to conduct a morphological examination of tissues. The first step of tissue processing is prevention of tissue degradation. What type of fixation can be used?

A. chemical fixation
B. physical fixation
C. formaldehyde solution
D. glutaraldehyde
E. all of them

3. The pathologist is asked to immediately analyse tissues acquired during surgery. This information is important to determine how the operation will proceed. What rapid type of physical tissue fixation can be used?

A. fixation using an acetone solution
B. fixation using a formaldehyde solution
C. fixation using a glutaraldehyde
D. freezing using a liquid nitrogen
E. fixation using an ethanol solution

4. A 16-year-old patient underwent splenectomy (removal of the spleen) due to excessive destruction of red blood cells. For diagnosis, it is necessary to conduct a morphological examination of the tissue. For microscopic examination, histological specimen should be prepared. What equipment is used to cut a paraffin embedded tissue?

A. blade
B. microscope

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C. thermostat
D. automatic tissue processor
E. microtome

5. A 32-year-old patient underwent splenectomy (removal of the spleen) due to mechanical trauma. It is necessary to conduct a morphological examination of the tissue. For microscopic examination, histological specimen should be prepared and stained. For the staining procedure, paraffin must be replaced by water in a tissue because most dyes are water soluble. What chemical is used for deparaffinization of tissue?

A. glutaraldehyde
B. xylene
C. formaldehyde
D. immersion oil
E. glycerol

6. Liver biopsy was done to a 46-year-old patient for diagnostic purpose. A microscopic examination of the tissue must be performed. The morphology of the nucleus is an important feature for evaluating tissue pathology. What dye must be applied for nucleus staining?

A. eosin
B. hematoxylin
C. acid fuchsine
D. orange G
E. none of the them

7. A 53-year-old patient had to undergo liver biopsy for diagnostic purpose. Routine staining with hematoxylin and eosin was used for the primary assessment of tissues. What color does eosin stain the cytoplasm of liver cells?

A. dark blue
B. pink
C. green
D. brown
E. orange

8. A skin neoplasm biopsy was performed in a 53-year-old patient for diagnostic purpose. A morphological examination of the tissue must be carried out. The nucleus shape, specificity of staining and structure are an important characteristic for tissue alteration assessment. What color will the tissue be after staining with hematoxylin only?

A. dark blue nuclei
B. pink cytoplasm

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C. red nuclei
D. brown cytoplasm
E. brown nuclei

9. After tissue biopsy histological specimen must be prepared for the following examination. It is necessary to increase the tissue density for making thin sections. For this purpose, the water in the tissue must be replaced with paraffin. What chemical must be applied for tissue dehydration?

A. alcohol
B. formalin
C. immersion oil
D. paraffin
E. xylene

10. Myopathy (muscle weakness) was diagnosed in the two-year-old patient. Tissue biopsy was done. Electron microscopy is going to be performed. What type of fixative is used to prepare specimens for electron microscopy?

A. water
B. glutaraldehyde
C. paraffin
D. mounting medium
E. immersion oil

11. The 28-year-old patient has progression of myopathy (muscle weakness). Muscle tissue biopsy was made for diagnostic purpose. The electron micrograph of tissue is going to be analyzed. What type of dye is used to stain specimen for electron microscopy?

A. haematoxylin
B. eosin
C. safranin
D. osmium tetroxide
E. methylene blue

12. After a tissue biopsy, the sample must undergo fixation and after several steps must be embedded in paraffin or plastic for slicing. What chemical is used for replacement of alcohol after dehydration of tissue and can be mixed with paraffin for embedding process?

A. mounting medium
B. xylene (benzene)
C. formaldehyde
D. immersion oil

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E. acetone

13. During histological specimen preparation tissue processing passes through several stages. What chemical is used for clearing stage?
A. xylene
B. benzene
C. ethanol
D. paraffin

14. Tissue processing goes through several stages to prepare histological specimen. What changes does the tissue undergo during the clearing stage?
A. blocking enzymatic destruction
B. termination of cell metabolism
C. cross-linking protein molecules
D. replacing water with alcohol
E. replacing alcohol with organic solvent (xylene)

15. A lymph node biopsy was done for diagnostic purpose in a 47-year-old patient. The histological slides must be prepared for microscopic examination of tissue. The preparation of histological specimens take place in a several stages. What is the last stage of a histological specimen preparation?
A. embedding
B. staining
C. fixation
D. dehydration
E. mounting on glass with mounting medium and coverslip

16. After a tissue biopsy, the sample must undergo preservation from degradation and thin slices of tissue must be prepared for microscopic evaluation. For this, the tissue must be condensed for the cutting process. What substance is used to condense tissue during the preparation of a histological sample?
A. immersion oil
B. paraffin
C. mounting medium
D. alcohol
E. xylene

Microscopes types

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17. What type of microscope is used for basic examination of histological specimen after conventional hematoxylin and eosin stain?
A. light microscope
B. electron microscope
C. fluorescent microscope
D. polarizing microscope
E. dark field microscope

18. What type of microscope is used to study ***only*** unstained live cells in suspension?
A. light microscope
B. transmission electron microscope
C. fluorescent microscope
D. scanning electron microscope
E. dark field microscope

19. What type of microscope is used to study crystals in synovial fluids or urine?
A. light microscope
B. all of the listed types
C. polarizing microscope
D. dark field microscope

20. What type of microscope is used for examination of cytological specimen after immunofluorescence stain?
A. light microscope
B. electron microscope
C. fluorescent microscope
D. polarizing microscope
E. dark field microscope

21. The medical laboratory scientist starts to assess bone marrow smear of a patient after fine-needle aspiration. First, he must focus the tissue at low magnification. What part of the light microscope should he use to bring the overall focus to the tissue?
A. condenser
B. objective
C. ocular
D. fine adjustment
E. course adjustment

22. The medical laboratory researcher starts to assess spleen specimen of a patient after tissue biopsy. After choosing area of tissue for investigation,

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he must focus the tissue at high magnification. What part of the light microscope should scientist use to provide fine focus of the tissue?

A. condenser
B. objective
C. ocular
D. fine adjustment
E. course adjustment

23. The medical laboratory researcher starts to assess liver specimen of a patient after tissue biopsy. After choosing specimen cite for analysis at low magnification further assessment is carried out at high magnification. What parts of the light microscope influence the magnification of an object?

A. A) condenser
B. B) objective
C. C) ocular
D. Both A and B
E. Both B and C

24. Ability to analyze small objects, for example procaryotic and eukaryotic cells, using microscope depends on the magnification and resolution of the microscope. What is the resolution of microscope?

A. How many times the object is magnified
B. The ability to see small close objects separately
C. The ability to see the color of objects
D. Process of objects measurement
E. Process of fine tissue focusing

25. A researcher begins a microscopic evaluation of a test animal's kidney sample after using a new anti-inflammatory drug. He starts to focus on the tissue. What part of the light microscope does NOT belong to the optical system of a microscope?

A. condenser
B. objectives
C. ocular lenses
D. eyepiece
E. course adjustment

Basic structure of cells

26. Which of these researchers is NOT an author of “The Cell Theory”?

A. Matthias Jakob Schleiden
B. Theodor Schwann

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C. Rudolf Virchow
D. Robert Hook
E. All these researchers are the authors of "The Cell Theory"

27. The medical laboratory scientist assesses vaginal smears of a patient. A lot of large epithelial cells and lactobacilli are visible during the microscopic examination. Lactobacilli are the most numerous bacteria situated in healthy vagina of child-bearing women. What organelles can be found in both bacteria (prokaryotes) and epithelial cells (eukaryotes)?

A. nucleus
B. mitochondria
C. lysosomes
D. rough endoplasmic reticulum
E. ribosomes

28. A 27-year-old woman visited a doctor for women's health screening. A cytological examination of smears from the vagina and cervix was carried out. A large number of mature squamous epithelial cells and lactobacilli were found in the smears. What organelles are NOT found in bacteria/prokaryotic cells (but can be found in epithelial/eukaryotic cells)?

A. plasma membrane
B. cytoplasm
C. ribosomes
D. nucleus
E. all of the listed can be found in bacterial cell

29. A 36-year-old woman visited a doctor for the scheduled assessment of women's health. An examination of smears from the vagina and cervix was performed. A numerous epithelial cells and lactobacilli (prokaryotes) were found in the smears. Which of the features is NOT characteristic of prokaryotic cells?

A. nucleoid
B. cell of multicellular organism
C. plasma membrane
D. cytoplasm
E. ribosomes

30. During laboratory classes, the student received two samples for research: one with animal cells, the other with plant cells. Which of the features can NOT be found in animal cells?

A. plasma membrane
B. cytoplasm

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C. ribosomes
D. nucleus
E. cell wall

31. During exam, the student received two samples for research: one with animal cells, the other with plant cells. What characteristic is NOT specific for animal cells?
A. plasma membrane
B. mitochondria
C. lysosomes
D. rough endoplasmic reticulum
E. starch deposition

32. During laboratory classes, the student received two samples for assessment: one with animal cells, the other with plant cells. Which of the cellular structure can be found in BOTH animal and plant cells?
A. plasma membrane
B. starch deposition
C. large central vacuole
D. cell wall
E. glycogen deposition

33. In an electron micrograph of liver cells non-membrane, single- and double-membrane organelles can be distinguished. Which cell organelles have a double membrane?
A. lysosomes
B. rough endoplasmic reticulum
C. mitochondria
D. smooth endoplasmic reticulum
E. peroxisomes

34. A scientist analyzes an electron micrograph of epithelial tissue after a high dose of ionizing radiation exposure of an experimental animal. The structure of non-membrane, single- and double-membrane organelles undergoes alteration. Which cell organelles are non-membrane?
A. lysosomes
B. rough endoplasmic reticulum
C. ribosomes
D. smooth endoplasmic reticulum
E. peroxisomes

35. A researcher analyzes an electron micrograph of a tumor tissue of an experimental animal after treatment with a new anticancer drug. The

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structure of single-membrane organelles undergoes alteration. Which cell organelles are NOT single-membrane?

A. lysosomes
B. rough endoplasmic reticulum
C. ribosomes
D. smooth endoplasmic reticulum
E. peroxisomes

36. The researcher analyzes electron micrographs of muscle tissue biopsies of volunteers after a complex of sports workouts and the administration of a new biologically active supplement. The structure of single-membrane organelles undergoes excessive development. Which cell organelles are single-membrane?

A. lysosomes
B. rough endoplasmic reticulum
C. All of the listed
D. smooth endoplasmic reticulum
E. peroxisomes

Answers

1 – C; 2 – E; 3 – D; 4 – E; 5 – B; 6 – B; 7 – B; 8 – A; 9 – A; 10 – B; 11 – D; 12 – B; 13 – A; 14 – E; 15 – E; 16 – B; 17 – A; 18 – E; 19 – B; 20 – C; 21 – E; 22 – D; 23 – E; 24 – D; 25 – E; 26 – D; 27 – E; 28 – D; 29 – B; 30 – E; 31 – E.

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Chapter II.

Cell envelope

1. A 21-year-old male suffers from bilateral cataracts, learning disabilities, behaviour disorders, small stature and growth delay, but doesn`t have microcephaly. He was diagnosed with autosomal recessive defect involving the demethylating membrane-bound enzyme that causes defects of cholesterol biosynthesis and development of metabolic disorders. What type of proteins is linked with the plasma membrane, but is not immersed in the phospholipid bilayer?

A. integral protein
B. semi-integral protein
C. non-integral protein
D. non-peripheral protein
E. peripheral protein

2. A 9-year-old patient has microcephaly, growth delay, congenital cataracts, and since age of six he suffers from severe psoriasis form of dermatitis. He was diagnosed with autosomal defect in membrane-bound enzyme that causes defects of sterol lipid biosynthesis. What type of lipids is sterol lipid in animal cell membranes?

A. phosphatidylcholine
B. cholesterol
C. cardiolipin
D. phosphatidylserine
E. phosphatidylinositol

3. A 21-year-old patient has extreme polyuria (Excessive Urine Production). This condition is caused by intake of Lithium medication for treatment of bipolar disorder. Lithium suppresses expression of aquaporin gene, reduces its mRNA production and transcription. Aquaporin protein is water channel, providing water transport through plasma membrane. What type of proteins totally crosses the cell envelope?

A. peripheral protein
B. semi-integral protein
C. non-integral protein
D. non-peripheral protein
E. integral protein

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4. Pregnant woman suffers from deep vein thrombosis of the lower extremities. Antiphospholipid syndrome (autoimmune disease) has been diagnosed. This disorder is associated with production of anti-cardiolipin antibodies. Cardiolipin is one of the membrane phospholipids. How many layers of phospholipids form the cell membranes?

A. one
B. tree
C. four
D. two
E. five

5. Senescent of red blood cells (RBC) in the RBC-storage is associated with degradation of membrane-bound carbohydrate and in consequence causes removing of such cells from the circulation by macrophages after transfusion. Membranous carbohydrates are attached to the plasma membrane:

A. on the one side of the membrane, facing the cytoplasm
B. on the one side of the membrane, facing the intercellular space
C. on the both sides of the membrane
D. between the layers of lipid bilayer
E. between hydrophobic tails of lipids

6. Plasma membrane provides regulation of activated/inactivated state of cells due to concentration of different ions inside and outside of cells. Concentration of which ion is bigger at the protoplasmic surface of a plasma membrane, comparing to the external surface in inactivated condition?

A. Na
B. K
C. Cl^-
D. Ca^2
E. Mg^2

7. The transition of cells from an inactive state to activated and vice versa is related with a change in the concentration of ions inside cells. Concentration of which ion is bigger in the protoplasmic surface of a plasma membrane, comparing to the extra cellular spaces?

A. Na
B. Ca
C. Mg^2
D. Cl -
E. $H_2PO_4^-$

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8. Sterol lipid of plasma membrane regulates membrane fluidity and rigidity. Composition of this lipid in membrane of nerve cells changes with development of Alzheimer's disease. Choose a sterol lipid in animal cell membranes.

A. sphingomyelin
B. cholesterol
C. cardiolipin
D. phosphatidylserine
E. phosphatidylinositol

9. Altered function of mitochondrial Ca^2-transporter is associated with development of cardiac arrhythmia. If only one chemical passes through the membrane, in this case type of transport is called:

A. uniport
B. symport
C. antiport
D. multiport
E. teleport

10. Development of Parkinson's disease is related with impairment in synaptic neurotransmitter recycling. Which type of transmembrane transport requires ATP hydrolysis?

A. facilitated diffusion
B. transport through ion channels
C. transport with ionophores
D. simple diffusion
E. pinocytosis

11. Some types of large molecule transport need energy source. Which type of transmembrane transport requires ATP hydrolysis?

A. facilitated diffusion
B. transport through ion channels
C. phagocytosis
D. transport with ionophore
E. simple diffusion

12. 24-year-old patient develops acute pancreatitis due to alteration of releasing of digestive enzymes. What type of transport across the membrane is vesicular transport?

A. facilitated diffusion
B. K channel
C. osmosis
D. $Na\text{-}I^-$ symport

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E. exocytosis

13. Some transport proteins are activated under the influence of chemical substances or light exposure. An example of active transport is
A. K-channel
B. facilitated diffusion
C. simple diffusion
D. H-transport by bacteriorhodopsin
E. osmosis

14. 3-year-old patient has epileptic seizures, severe decrease of magnesium in urine and altered intelligence. The gene for protein, which is involved in ion transport through plasma membrane, has mutated. What type of transport is active transport?
A.K-channel
B.facilitated diffusion
C.simple diffusion
D.osmosis
E.Na-K pump

15. Patient has severe lung alteration due to development of Corona virus infection. Transport of oxygen through lung epithelium is strongly diminished and patient develops severe hypoxemia. What type of transport is passive transport?
A. doesn't require energy
B. requires energy
C. requires ATP
D. substances can move against concentration gradient
E. substances can move both against and along the concentration gradient

16. 2-years old patient demonstrates easy break of bones, blue sclera of eyes and low height. Human genetic disease osteogenesis imperfecta has been diagnosed. This disease develops due to impaired function of fibroblasts. Fibroblasts of such patients have low ability to synthesise collagen type I and pack it into vesicles. A vesicle moves to the plasma membrane and releases its contents into the extracellular space. Name this process.
A. clathrin-dependent endocytosis
B. pinocytosis
C. phagocytosis
D. clathrin-independent endocytosis
E. exocytosis

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17. Development of familial hypercholesterolemia, one of the human genetic diseases, is related with alteration in the low-density lipoprotein receptors and impaired transport of cholesterol from plasma to cells. What type of transport provides movement of cholesterol inside of cells?

A. clathrin-dependent endocytosis
B. receptor-mediated endocytosis
C. pinocytosis
D. phagocytosis
E. exocytosis

18. 34-year-old patient has pain in epigastric region for a long time. Elevated acidity of gastric juice and Helicobacter pylori infection have been diagnosed. Increased production of hydrochloric acid is due to function of proton pumps which secrete H ions and chloride channels that transport Cl- ions into the lumen of stomach. Active transport:

A. doesn't require membrane transport proteins
B. doesn't require energy
C. substances can move against concentration substances only move down concentration gradient
D. carried out through receptors
E. gradient

19. 44-year-old patient has pain in epigastric region. pH-Metry shows elevated acidity of gastric juice. Increased production of hydrochloric acid is due to function of proton pump (H/K ATPase) which secretes H ions and chloride channels that transport Cl- ions into the lumen of stomach. After food intake, blood gets slightly alkaline due to active exchange of HCO_3^- for $\mathbf{Cl}^-$ ions. The simultaneous transport of two molecules in opposite directions by a single transport protein is called:

A. symport
B. uniport
C. pumping
D. diffusion
E. antiport

20. Mutations in the alpha-subunit of voltage-gated sodium channel in cardiac muscle cells cause development of Long QT syndrome, fast disorderly heartbeats and can induce sudden patient death. Transport through channel:

A. doesn't require energy
B. requires energy
C. requires ATP

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D. substances can move against concentration gradient
E. substances can move both against and along the concentration gradient

21. 65-year-old patient with diabetes mellitus develops arterial hypertension due to increased reabsorbtion of glucose and sodium ions by SGLT transporter in kidney. The simultaneous transport of two molecules in one direction by a single transport protein is called:
A. antiport
B. symport
C. uniport
D. pumping
E. diffusion

22. 24-year-old patient has elevated production of steroid hormone aldosterone. This condition causes low potassium concentration in blood and develops weakness and muscle spasms. Which second messenger is synthesised to mediate the effect of steroid hormones?
A. cyclic AMP
B. cyclic GTP
C. nitrogen (II) oxide
D. no second messenger is needed
E. diacylglycerol

23. Novel treatment methods of chronic kidney disease are related with application of connective tissue growth factor receptor blocker. A substance that binds to a receptor is called:
A. enzyme
B. ion
C. acid
D. base
E. ligand

24. Development of autoimmune diseases is associated with hyperactivity of immune system. Activation of immune cells is related with second messenger concentration elevating in the cytosol. Application of drugs that regulate second messenger production for treatment of asthma and chronic obstructive pulmonary disease have been approved. What type of molecules is generated as a second messenger?
A. ATP
B. cAMP
C. GTP
D. cholesterol
E. glycerol

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25. 69-year-old patient has Parkinson disease. Tremor or shaking in a limb, bradykinesia (slowed movement), rigid muscles, impaired posture and balance is caused by dysregulation in transport of certain ions. Which of the following molecules can NOT cross the plasma membrane with a simple diffusion?

A. Ca
B. oxygen
C. nitrogen
D. water
E. carbon (IV) oxide

26. 1 year old patient has mental and motor developmental delays, infantile seizures, microcephaly (head growth deceleration). Dysfunction of definite transporter has been diagnosed. Which of the following molecules can NOT cross the plasma membrane with a simple diffusion?

A. oxygen
B. carbon (IV) oxide
C. nitrogen
D. water
E. glucose

27. Development of gastric tumours is related with alteration of ions transport into lumen of stomach. In some cases, this happens due to defect of energy molecule production. What is the energy source for H-K pump?

A. GTP
B. ATP
C. light
D. H - gradient
E. nuclear power

28. A fourteen-year-old male patient was hospitalized to the Paediatric Neurology Department due to seizures. Physical examination, revealed rash in the neck and behind the ears (appeared two years ago), hyperkeratotic papules were detected. Biochemical tests and complete blood cell count, electrocardiogram, cerebral magnetic resonance imaging, and finally awake and sleep electroencephalogram were normal. Skin condition was characterized by wart-like blemishes on the body. Darier disease (is associated with gene mutation that encoded transport protein) was diagnosed. Which of the following molecules can NOT cross the organelles membrane with a simple diffusion?

A. oxygen
B. nitrogen

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C. Ca
D. water
E. carbon (IV) oxide

29. Timothy syndrome was diagnosed in a 1-year-old patient. It is associated with missense mutation of gene that encodes definite ion-channels. This alteration causes development of arrhythmias, “webbed fingers”, congenital heart disease, intermittent hypoglycaemia, immune deficiency, cognitive abnormalities and autism. By facilitated diffusion mechanisms through membranes can be transported

A. Ca
B. NO
C. CO_2
D. O_2
E. CO

30. Growth factors bind to the surface structure of the cells and initiate their mitotic division. A protein that binds a signal molecule is called:

A. receiver
B. hormone
C. second messenger
D. receptor
E. ligand

31. Colon cancer cells have elevated concentration of certain ions that increase cell proliferation. Which ion can act as a second messenger?

A. Na
B. K
C. Ca^2
D. Cl^-
E. HCO_3^-

32. 1,5-year-old patient has significant bradycardia. Mutation in gene that provides sinoatrial node auto rhythmic excitation has been found. Which enzyme catalyses the conversion of adenosine triphosphate (ATP) to 3',5'-cyclic AMP (cAMP)?

A. adenylyl cyclase
B. phospholipase A
C. guanylate cyclase
D. phospholipase C
E. nitric oxide synthase

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33. 3-year-old patient has ocular defects (small eyes), dental abnormalities (loss of tooth enamel), syndactyly, and craniofacial bones defects. Mutations in the GJA1 gene encoding Connexin Cx43 has been found and Oculodentodigital dysplasia has been diagnosed. What type of cell junctions are Connexons composed of?

A. tight junction
B. adherents junction
C. focal adhesion
D. chemical synapse
E. gap junction

34. Relationships between major depressive disorders/autism spectrum disorders are associated with dysfunction of communicative cell junctions. Which type of cell junction results in a direct contact between cytoplasm of neighbouring animal cells?

A. tight junction
B. chemical synapse
C. gap junction
D. desmosome
E. plasmodesma

35. Which of the following protein families does NOT mediate any type of cell junctions?

A. immunoglobulins
B. clathrins s
C. integrins
D. cadherins
E. selectin

36. A 69-year-old patient has diabetes. He has impaired vision due to development of retinopathy. Initial stage of retinopathy is associated with increased permeability of blood vessels of blood-retinal barrier. Which cell junction isolates one part of the intercellular space from another?

A. adherens junction
B. desmosome
C. hemidesmosome
D. tight junction
E. gap junction

37. A 60-year-old man visited clinic for estimation of a chronic eruption on the chest and legs that had appeared 14 years prior and had worsened over the preceding 3 years. Biopsies of involved skin on the chest, back, and legs revealed suprabasal acantholysis with dyskeratosis. Darier

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disease (that is associated with gene mutation that encoded transport protein with consequence alteration of formation of calcium-dependent transmembrane proteins of cell junctional complex) was diagnosed. Which cell junction links to the actin filaments of cytoskeleton of two cells?

A. adherent junction e
B. hemidesmosome
C. gap junction
D. Connexon
E. desmosom

38. The autoimmune diseases pemphigus vulgaris is associated with autoantibody formation against cells junctional protein and blister appearance on the skin. Which cell junction links the cytoskeletal intermediate filaments of two cells?

A. adherent junction
B. hemidesmosome
C. gap junction
D. tight junction
E. desmosome

39. Contraction of the heart as an organ depends on the active movement of ions through coupling between heart cells. These ions initiate the simultaneous contraction of many cardiomyocytes. What type of junctions is communicative junction?

A. tight junction
B. gap junction
C. hemidesmosome
D. desmosome
E. focal adhesion

40. 5-year-old patient has congenital non-syndromic sensorineural hearing impairment. Mutations in the gene encoding junctional protein have been found. Choose a communicative junction?

A. tight junction
B. focal adhesion
C. gap junction
D. hemidesmosome
E. desmosome

41. Contraction of the heart as an organ depends on the simultaneous contraction of many cardiomyocytes. Cardiomyocytes tightly adhere to

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each other and are connected by cytoskeleton. What type of junctions connects the actin filaments of neighboring cells?

A. adherent junction
B. gap junction
C. focal adhesion
D. hemidesmosome
E. desmosome

42. 13-year-old patient has congenital deafness. Mutations in the gene encoding Connexin Cx26 protein have been found. The other term for "Nexus" is

A. focal adhesion
B. gap junction
C. adherens junction
D. tight junction
E. hemidesmosome

43. Polycystic kidney disease is autosomal recessive disease associated with loss of function in one of the junctional proteins and is characterized by cystic dilation of renal collecting tubules, loss of renal function in patients if they survive the perinatal period. What type of junctions provides cell-matrix (cell-substrate) attachment?

A. adherent junction
B. plasmodesma
C. tight junction
D. desmosome
E. focal adhesion

44. A 65-year-old female visited the hospital with a blistering lesions typically filled with clear fluid. The eruption started four weeks prior and was distributed mainly on her lower extremities. The patient has no fever, normal leukocytes count, but C-reactive protein was elevated at 78.8 mg/L. Antibodies directed against the structural components of the cell-substrate junctional complex have been found. What type of junctions provides cell-matrix (cell-substrate) attachment?

A. adherens junction
B. plasmodesma
C. hemidesmosome
D. gap junction
E. desmosome

Answers

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1 – E; 2 – B; 3 – E; 4 – D; 5 – B; 6 – B; 7 – E; 8 – B; 9 – A; 10 – E; 11 – C; 12 – E; 13 – D; 14 – E; 15 – A; 16 – E; 17 – B; 18 – C; 19 – E; 20 – A; 21 – B; 22 – D; 23 – E; 24 – B; 25 – A; 26 – E; 27 – B; 28 – C; 29 – A; 30 – D; 31 – C. 32 – A; 33 – E; 34 – C; 35 – B; 36 – D; 37 – A; 38 – E; 39 – B; 40 – C; 41 – A; 42 – B; 43 – E; 44 – C.

Chapter III

Cytoskeleton structure and function

1. In the electron micrograph the division of two cells is under analysis. Contractile ring is formed. What type of cytoskeleton makes up contractile ring?

A. actin
B. tubulin
C. desmin
D. keratin
E. vimentin

2. In the cell culture of immortalized cells, the meshwork of cytoskeleton fibres is analysed after treatment with novel antiproliferative substances. What type of antibody should be applied to evaluate microfilaments?

A. against actin protein
B. against tubulin protein
C. against desmin protein
D. against keratin protein
E. against vimentin protein

3. In the electron micrograph on the cell surface numerous finger-like protrusions are visible which increase the surface area (microvilli). What type of cytoskeleton makes up core of microvillus?

A. actin
B. tubulin
C. desmin
D. keratin
E. vimentin

4. In cell culture experiment movement of fibroblasts was affected. It was discovered that protrusions for migration are NOT formed. What type of cytoskeleton provides migrative protrusion construction?
   A. Microfilament
   B. Microtubules

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C. Intermediate filaments
D. Desmin filaments
E. Keratin filaments

5. During contraction of muscle fibres one type of cytoskeleton can move along the surface of microfilaments. What type of motor protein can do such movement?

A. myosin
B. tropomyosin
C. kinesin
D. dynein
E. desmin

6. For stabilisation of microvilli on the surface of cells some protein provides anchoring of microfilaments to the terminal web of intermediate filaments at the bases of microvilli. The same type of proteins provides microfilaments fixture on the plasma membrane for cell shape stabilisation (for example erythrocytes). What type of protein provides such types of binding?

A. fimbrin
B. filamin
C. spectrin
D. Mini-myosin
E. Gelsolin

7. Certain type of X-linked inherence disorder is associated with mutation of gene which encodes protein for assembling of actin filaments into a ***three-dimensional*** meshwork. What type of actin-binding protein provides such type of connection?

A. fimbrin
B. filamin
C. sequestrin
D. spectrin
E. sphingosine

8. Treadmilling is the mechanism of microfilament movement in the cytoplasm of cells. This process is associated with:

A. Synthesis of tubulin molecules
B. Coupling of globular actin to the plus-end of microfilament ONLY
C. Dissociation of globular actin from the minus-end of microfilament ONLY
D. Coupling of globular actin to the plus-end of microfilament AND Dissociation of globular actin from the minus-end of microfilament

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E. Coupling of globular actin to the both side of microfilament (plus-end and minus-end)

9. Some type of cytoskeleton filament has assembling “plus” and disassembling “minus” ends of filament. What type of filament is it?
A. keratin filament
B. glial acid fibrillar filament
C. actin filament
D. neurofilament
E. tropomyosin filaments

10. On the surface of different cells several types of protrusions for different functions can be formed. What types of protrusions are formed by microfilaments?
A. cilia and flagella
B. microvilli and pseudopodia
C. cilia and pseudopodia
D. microvilli and flagella
E. microvilli and cilia

11. On the apical surface of epithelium in small intestine numerous microvilli are observed. Microfilaments form core of microvilli and they are connected into a bunch. Antibody against what type of protein should be applied for investigation of ***bunch*** actin-binding proteins?
A. fimbrin
B. filamin
C. gelsolin
D. spectrin
E. alpha-actinin

12. What type of process assists in changing the length of cytoskeletal fibres using coupling globular actin to the “plus”-end and dissociation of globular actin from the minus-end of a microfilament?
A. treadmilling
B. dynamic instability
C. nucleation
D. elongation
E. catastrophe

13. Specialized surface apparatus of cells includes permanent and dynamic protrusions for different functions. In formation of which type of protrusion do actin filaments NOT participate?
A. microvillus

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B. cilium
C. filopodium
D. pseudopodium
E. lamellipodium

14. Motor proteins provide movement of organelles in the cytosol of cells or cell contraction as these proteins interact with cytoskeleton fibers. What type of motor protein interconnects with actin filament for movement?

A. kinesin
B. dynein
C. gelsolin
D. myosin
E. Alpha-actinin

15. Assembling some types of cytoskeleton fibres is an energy dependent process. What type of energy molecule activates globular actin for microfilaments construction?

A. ATP
B. 5'-AMP
C. GTP
D. CTP
E. UTP

16. In the electron micrograph a meshwork of cytoskeleton protein filaments assists cell-cell interaction. What type of cytoskeletal filaments has globular monomer as a building block?

A. glial acid fibrillar protein filaments
B. keratin filaments
C. actin filaments
D. myosin filaments
E. nestin filaments

17. For diagnostic purpose the origin of cancer cells is investigated using antibody against intermediate filaments, which is specific for certain type of tissue. What type of protein constructs connective tissue intermediate filament?

A. glial fibrillary acidic protein
B. protein of neurofilaments
C. desmin filaments
D. keratin filaments
E. vimentin filaments

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18. Cytoskeleton fibres participate in the formation of different types of specialized surface cellular protrusions. What type of protrusions is made of intermediate filaments?

A. cilia and flagella
B. microvilli and pseudopodia
C. cilia and pseudopodia
D. microvilli and flagella
E. none of them

19. Main function of intermediate filaments in different types of cells is mechanical support. What type of protein constructs muscle cell intermediate filaments?

A. glial fibrillary acidic protein
B. neurofilament protein
C. desmin filament
D. keratin filament
E. vimentin filament

20. The 18-year-old male suffers from skin fragility. In the patient`s blood autoantibody against intermediate filaments of keratinocytes has been revealed. What function of cells will be affected in this case?

A. mitotic spindle assembles
B. cell contraction
C. microvilli movement
D. cell resilience (mechanical stability)
E. cell division

21. The 16-year-old patient has large swelling on the back. After diagnostic puncture cytological specimen were made. Some atypical cells were found in the slides. For epithelial cells identification of what type of antibody against intermediate filaments should be applied?

A. antibody against actin
B. antibody against tubulin
C. antibody against myosin
D. antibody against keratin
E. antibody against vimentin

22. Antibodies against what type of cytoskeleton protein can be used as a general marker for eukaryotic cells?

A. acidic keratin filaments
B. lamin filaments
C. desmin filaments
D. vimentin filaments

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E. basic keratin filaments

23. The intracranial neoplasm has been removed from the 3-year-old patient`s body. Antibodies against what type of cytoskeleton intermediate filament protein can be applied to identify cells of neuronal origin?
A. glial fibrillary acidic protein
B. neurofilaments
C. desmin
D. keratin
E. vimentin

24. In the experiment starvation of nucleotide pool in the cells was induced. As a result, microtubules assembly was affected. What type of nucleotide is critical for microtubules assembly?
A. ATP
B. TTP
C. GTP
D. CTP
E. UTP

25. Wide range of neurological disorders is associated with dysfunction of cytoskeleton fibres in the nerve cells. Some of them are related with microtubule package and interaction with actin filament. What type of protein assists microtubules to compile them in bundles?
A. Microtubule associated protein 2 (MAP-2) protein
B. myosine
C. alpha-actinin
D. spectrin
E. clathrin

26. In the electron micrograph there is a non-membrane organelle – centriole which is located near the nucleus, under analysis. What are the structural features of the structure of centrioles, from which set of microtubules are they formed?
A. nine triplets of peripherally located microtubules without central microtubules
B. nine triplets of peripherally located microtubules plus two central microtubules
C. nine doublets of peripherally located microtubules plus two central microtubules
D. nine doublets of peripherally located microtubules without central microtubules

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E. nine doublets of peripherally located microtubules plus two central microtubules

27. Cilia on the cell surface are analysed in an electron micrograph. Motor protein dynein provides movability of cilia. To which microtubules are dynein molecules anchored and to which microtubules do they extend their arms in the cilia?

A. dynein anchored to A-microtubule and extend dynein arms to B-microtubule of peripheral duplets
B. dynein anchored to A-microtubule of peripheral duplets and extend dynein arms to central microtubule
C. dynein anchored to B-microtubule of peripheral duplets and extend dynein arms to central microtubule
D. dynein anchored to C-microtubule of peripheral duplets and extend dynein arms to A-microtubule of next peripheral duplets
E. dynein anchored to B-microtubule of peripheral duplets and extend dynein arms to A-microtubule of next peripheral duplets

28. An alteration in the development of nerve cell during embryogenesis was revealed. Microtubules are involved in controlling the formation of neural processes during development. Antibody against what type of protein should be applied for microtubules to be revealed in the cell?

A. actin
B. tubulin
C. desmin
D. keratin
E. vimentin

29. A couple is planning a child and have visited a doctor for screening consultation. Spermogram has been prescribed. Low movability of sperm cells was revealed. Movement of sperm cells depends on the activity of motor protein which can move on the surface of flagella microtubules. What type of protein is it?

A. sperm lysine
B. dynein
C. acrosine
D. myosin
E. keratin

30. Secreted substances from the cells are packed in the membrane bounded vesicles and moved in the cytosol toward plasma membrane. Movement happens on the surface of microtubules with activity of motor proteins.

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Which of listed proteins can move vesicles on the surface of microtubules?

A. myosin
B. acrosine
C. kinesin
D. keratin
E. desmin

31. A 14-year-old patient has numerous blisters on the skin. Antibody against protein which connects microtubules with intermediate filaments was revealed in the serum. What type of protein is damaged?

A. MAP-2 protein
B. gamma-tubulin
C. keratin
D. plectin
E. myosin

32. During cytological exam student obtained two electron micrographs for analysis. In one electron micrograph a cross-section of the cellular surface protrusion can be seen with set of tubular cytoskeleton structures. What set of microtubules is specific for cilium?

A. nine peripheral triplets of microtubules and central doublet of microtubules
B. nine peripheral doublets of microtubules and central doublet of microtubules
C. nine peripheral doublets of microtubules without central doublet of microtubules
D. nine peripheral triplets of microtubules without central doublet of microtubules
E. nine peripheral triplets of microtubules and triplet centrally located microtubules

33. During parturition women has low contraction of uterus. For increasing contractility oxytocin was injected. What motor protein in muscle tissue manages muscle contraction?

A. Dynein
B. Myosin
C. Keratin
D. Kinesin
E. Nestin

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34. In the electron micrograph cytoskeleton of tubular structure is analysed. Each tubular component consists of numerous globular subunits. What type of cytoskeleton is made of globular protein subunits?

A. neurofilaments
B. keratin filaments
C. microtubules
D. nestin filaments
E. desmin filaments

35. An 83-year-old patients with Alzheimer's disease has died. Nerve tissue was analyzed after autopsy. Several types of cytoskeleton associated proteins form aggregates in neurons and block transport in the cells and finally damage nerve cell function. What type of protein is assembled into cylindrical structures and forms cytoskeleton tubules?

A. actin
B. tubulin
C. keratin
D. dynein
E. myosin

36. A 2-year-old patient of urgent department had pushed part of toy in the nose. Mechanical injury of epithelial surface was found after toy extraction. What type of surface cellular structure can be formed by microtubules?

A. cilia and flagella
B. microvilli and pseudopodia
C. cilia and pseudopodia
D. microvilli and flagella
E. microvilli and cilia

37. During the visit to the family physician, the patient complains of frequent and prolonged respiratory diseases. Such condition accompanies the patient his whole life. The doctor suggested a genetic disorder of a motor protein that can move along the surface of microtubules and moves the cilia of the respiratory epithelium to remove sputum. Molecular analysis of gene that encoded which type of motor protein should be performed?

A. myosin
B. keratin
C. nestin
D. dynein
E. desmin

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38. In the interphase cell microtubules start their polymerization from the microtubule organizing centre. What type of protein initiates the microtubules polymerization?

A. keratin
B. gamma-tubulin
C. dynein
D. kinesin
E. vimentin

39. A couple consults a doctor about the problem of conceiving a child. Spermogram has been prescribed. Movement of sperm cells was impaired. It is suggested that there is a defect in the structure of the flagellum. How many microtubules is a flagellum made of?

A. Nine peripheral triplets of microtubules and central doublet of microtubules
B. nine peripheral doublets of microtubules and central doublet of microtubules
C. nine peripheral doublets microtubules without central doublet of microtubules
D. nine peripheral triplets of microtubules without central doublet of microtubules
E. nine peripheral triplets of microtubules and central doublet of microtubules

40. Microtubule's structure is analysed in the electron micrograph. How many globular proteins can be seen in the cross section of a microtubule?

A. 1
B. 3
C. 5
D. 10
E. 13

41. Which motor protein is responsible for the movement of human sperm cells?

A. actin
B. myosin
C. kinesin
D. dynein
E. spermin

42. During cell division centrosomes occupy the poles of the cell and the mitotic spindle starts to assemble. In the electron micrograph cross

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section of a centriole is visible. What is the structural formula of a centriole?

A. 9×20
B. 9×22
C. 9×30
D. 9×32
E. 9×33

43. In the interphase cell two centrioles make a centrosome. On the surface of one of them distal appendages assemble. What centriole has distal appendages?

A. mother centriole
B. daughter centriole
C. central centriole
D. peripheral centriole
E. sister centriole

44. During cell division centrosomes occupy the poles of the cell and the mitotic spindle begins to assemble. What protein is the mitotic spindle made of?

A. actin
B. tubulin
C. keratin
D. myosin
E. lamin

45. An electron micrograph of a cross-section of several fibers in skin fibroblasts is analysed. What is the diameter of microtubules lumen?

A. 3 nm
B. 14 nm
C. 25 nm
D. 52 nm
E. 94 nm

46. In the experiment, mitosis must be stopped in metaphase to assess chromosome morphology. What chemicals should be applied to stop microtubules polymerization by blocking attachment of new tubulin monomers?

A. taxol
B. vinblastine
C. cytochalasin
D. colchicine
E. phalloidin

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47. Polycystic kidney disease is associated with alteration of basal body structure. In the electron micrograph structure of cilia are analysed. Basal bodies are clearly visible at the base of the cilia. The ***basal body*** has the same structure as:

A. microvilli
B. centrioles
C. flagella
D. mitotic spindle apparatus
E. cilia

48. Mitotic spindle assembles during mitosis. Between which organelles is the mitotic spindle formed?

A. chromosomes
B. centrosomes
C. Basal body
D. microvilli
E. cilia

49. In the cilia, several types of binding proteins stabilize its structure. Primary ciliary dyskinesia with axonemal disorganization is characterized by chronic respiratory infections of the upper and lower airways, hypofertility. This disease can be caused by a mutation in the gene that codes the nebulin protein. What is the Nexin function?

A. Binds centrioles in the cells
B. Binds actin filaments
C. Binds vimentin protofilaments
D. Binds peripheral microtubule doublets
E. Binds central microtubule doublets

50. Patients with a mutation of the gene that encodes the dynein protein have frequent upper and lower respiratory tract infections and reduced fertility. Which organelles have a similar structure and are damaged in this case?

A. basal body and cilium
B. centriole and microvilli
C. cilium and microvillus
D. microvillus and basal body
E. cilium and flagellum

51. Microscopic analysis of the immortalized cell population revealed the formation of a multipolar mitotic spindle after the cadmium oxide action. Injury of duplication of centrioles was induced. What structure do the centrioles have?

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A. 2 peripheral microtubule triplets
B. 5 peripheral microtubule doublets
C. 9 peripheral microtubule triplets
D. 9 peripheral microtubule doublets and central microtubule triplets
E. 9 peripheral microtubule doublets and central microtubule doublets

Answers

1 – A; 2 – A; 3 – A; 4 – A; 5 – A; 6 – C; 7 – B; 8 – D; 9 – C; 10 – B; 11 – A; 12 – A; 13 – A; 14 – D; 15 – A; 16 – C; 17 – E; 18 – E; 19 – C; 20 – D; 21 – D; 22 – B; 23 – B; 24 – C; 25 – A; 26 – B; 27 – A; 28 – B; 29 – B; 30 – C; 31 – D; 32 – B; 33 – B; 34 – C; 35 – B; 36 – A; 37 – D; 38 – B; 39 – B; 40 – E; 41 – D; 42 – C; 43 – A; 44 – B; 45 – B; 46 – D; 47 – B; 48 – B; 49 – D; 50 – E; 51 – C.

Chapter IV

Cytoplasm, cytosol structure and function

1. Glycolysis is the main energy source in red blood cells. Some genetic disorders are associated with the mutation of genes encoding glycolytic enzymes that cause the development of anaemia due to increased destruction of red blood cells. How many ATP molecules are synthesized when one glucose molecule is broken down during glycolysis?

A. 10
B. 2
C. 5
D. 32
E. 48

2. Glycolysis is the most important source of energy for skeletal muscle. Some hereditary diseases are the result of changes in the genes encoding glycolytic enzymes and cause the development of metabolic myopathy (muscle weakness). Where do glycolytic enzymes provide their function in cells?

A. mitochondria
B. lysosomes
C. peroxisomes
D. cytoplasm

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E. nucleus

3. Cytosol is the site of intermediate metabolism in the cell. What chemical component of the cytosol is the most abundant?
A. Fat
B. water
C. proteins
D. carbohydrates
E. ions

4. Cytosol is the site of numerous chemical processes in the cell. What kind of reaction does NOT take place in the cytosol of eukaryotic cells?
A. DNA replication
B. ATP synthesis
C. glycolysis
D. protein synthesis
E. protein folding

5. Cytosol is the site of numerous chemical processes in the cell. What kind of reaction does NOT take place in the cytosol of eukaryotic cells?
A. protein synthesis
B. glycolysis
C. translation
D. transcription
E. synthesis and cleavage of amino acids

6. Cell homeostasis and activation of cells depends on the intensity of chemical processes in the cells and the viscosity of cytosol. What is the term for more fluid state of the cytosol?
A. watery
B. gel
C. sol
D. fluid
E. cytoplasm

7. Cell homeostasis and activation of cells depends on intensity of chemical processes in the cells and the viscosity of cytosol. What is the term for more viscous state of the cytosol?
A. watery
B. gel
C. sol
D. fluid
E. cytoplasm

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8. Cells accumulate various substances in the cytosol for their metabolic support, protection or as waste products. Some hereditary diseases are the result of changes in the genes structure encoding enzymes breaking down molecules in the cells. As a result, the cytoplasm is overloaded with certain substances. What type of inclusion in animal cells is trophic inclusion?

A. glucose
B. glycogen
C. melanin
D. albumin
E. lipofuscin

9. A 96-year-old woman has numerous yellow-brown sports on the surface of skin. These spots are accumulations in the skin cells excretory inclusion. What type of inclusion is aging pigment?

A. melanin
B. lipids
C. glycogen
D. haemoglobin
E. lipofuscin

10. Researcher is analysing different types of cells under microscope. Different types of inclusions with different purposes can be stored in human cells. What type of inclusion could not be accumulated in human cells?

A. glycogen
B. lipofuscin
C. melanin
D. lipid drops
E. starch

11. In the histological specimen of a liver tissue biopsy from an 87-year-old man, numerous granular yellow-gold pigments are visible in the cytoplasm of hepatocytes in each cell. These spots are accumulations of excretory inclusion. What type of inclusion in human cells is excretory inclusion?

A. melanin
B. fat inclusion
C. lipofuscin
D. haemoglobin
E. yolk

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12. Trophic inclusions accumulate in the cell for metabolic support at different periods of cell cycle. What type of inclusion accumulates in the cytoplasm of oocytes for metabolic support of the early stages of embryo development after fertilisation?

A. Melanin
B. yolk
C. Hemoglobin
D. Myoglobin
E. Glycogen

13. Blocking the accumulation of trophic inclusions in the insect eggs is an experimental approach in the treatment of some tropical diseases. What types of trophic inclusions are lipid-protein complexes accumulated in the cytoplasm of oocytes for metabolic support of the early stages of embryo development after fertilisation?

A. Melanin
B. yolk
C. haemoglobin
D. triglyceride
E. Glycogen

14. In the cytoplasm of muscle cells accumulation of some inclusions is revealed in the histological specimen of a 23-year-old patient muscle tissue biopsy after Periodic Acid Schiff staining. What type of trophic inclusions is made of polysaccharides?

A. glycogen
B. haemoglobin
C. melanin
D. triglyceride
E. starch

15. Microscopic analysis of animal cells revealed accumulation of numerous inclusions in the cytoplasm. Which inclusions can be accumulated in animal cells as trophic inclusions?

A. melanin
B. haemoglobin
C. actin
D. yolk
E. starch

16. Aggregates of cells with numerous dark brown inclusions in the cytoplasm are analyzed in an unstained touch preparation of the 62-year-

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old patient skin biopsy. What type of inclusions belongs to pigment inclusions?

A. glucose
B. mucus
C. myosin
D. melanin
E. melatonin

17. Aggregates of large cells with large droplets in the cytoplasm are analyzed in an unstained touch preparation of the 28-year-old patient skin biopsy. Which molecule mostly accumulates in the form of lipid inclusion in the cells of a healthy person?

A. mucus
B. triglycerides
C. glycogen
D. phosphatidylcholines
E. phosphatidylinositols

18. Different types of inclusions are analysed on an electron micrograph of several types of human cells. Some inclusions accumulate directly in the cytosol, some of them have a membrane envelope. What type of inclusion is surrounded by membrane?

A. lipid droplets
B. secretory granules
C. cytoplasmic glycogen granules
D. hemoglobin
E. hemosiderin

19. A dermatologist analyzes hair follicles for transplantation as an approach to wound repair. What type of pigment accumulates in the skin cells with red color of hair?

A. hemoglobin
B. lipofuscin
C. myoglobin
D. pheomelanin
E. eumelanin

20. The effect of ultraviolet light on the skin increases the production of protective inclusions to protect the DNA molecule from damage. What type of inclusions is protective from ultraviolet light damage?

A. glycogen
B. lipofuscin
C. melanin

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D. hemoglobin
E. myoglobin

21. In the cytoplasm of the skin cells some dark-brown inclusions are accumulated. What type of pigment inclusion can be accumulated in the skin tissue?
A. glycogen
B. lipofuscin
C. melanin
D. lipid drops
E. starch

22. Gold-brown inclusions are accumulated in the liver, the cardiac muscle and the nerve tissue cells in necropsy biopsy of a 96-year-old patient. What type of pigment accumulates in different types of cells as a cell senescence pigment?
A. hemoglobin
B. pheomelanin
C. bilirubin
D. lipofuscin
E. eumelanin

23. Patients with Alzheimer's disease accumulate proteins in the cytosol of nerve cells due to impaired protein degradation. What non-membrane organelle provides breakdown of altered or misfolded or old proteins in the cytosol?
A. ribosome
B. nucleosome
C. proteasome
D. chaperone
E. signal recognition particle

24. Patients with Parkinson's disease have accumulation of abnormal proteins in the cytosol of nerve cells. Protein synthesis and acquiring an active conformation takes place in several stages. During what stage does protein obtain specific three-dimensional conformation?
A. folding
B. proteolysis
C. chaperone
D. translation
E. transcription

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25. Toxic substance (Cadmium exposure) reduces albumin synthesis in the rat hepatocytes. Reduction of RNA concentration that delivers amino acids to ribosome during protein synthesis was found. What type of RNA delivers the amino acids to ribosome during protein synthesis?

A. mRNA
B. tRNA
C. rRNA
D. heterogeneous nuclear RNA
E. siRNA

26. Fibroblasts actively synthesize and release pro-collagen protein during organism growth. Protein synthesis passes several stages. What is the first stage of protein synthesis?

A. indication
B. invitation
C. initiation
D. immigration
E. introduction

27. Proteins function in cells for a certain time, after which they undergo degradation. What chain of small proteins binds to the old protein as a marker for degradation by proteasome?

A. ubiquitin
B. myosin
C. tubulin
D. caveolin
E. keratin

28. Fibroblasts actively synthesize and release pro-collagen protein during tissue reparation. The synthesis of all types of proteins goes through several stages. What type of RNA molecule maintains information about the sequence of amino acids in a polypeptide chain and serves as a template for protein synthesis?

A. mRNA
B. tRNA
C. rRNA
D. siRNA
E. heterogeneous nuclear RNA

29. Tissue damage causes the release of factors that activate tissue regeneration. This process is associated with activation of protein synthesis. The transfer of information from DNA to protein molecule

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passes through several stages. What stage of information transmission occurs in the nucleus of a eukaryotic cell in a normal condition?

A. transcription
B. translation
C. post-translational modification of proteins
D. proteolysis
E. folding

30. The obtaining of a three-dimensional conformation of a protein (folding) regulates its functional activity. What type of protein regulates the proper folding of other proteins and accelerates this process in cells?

A. ubiquitin
B. chaperones
C. myosin
D. tubulin
E. caveolin

31. When external antigen gets into the body, certain types of cells (such as plasma cells) actively produce antibodies, which are protective proteins. The synthesis of antibody is provided by ribosomes on the rough endoplasmic reticulum surface. The ribosome consists of:

A. mRNA and proteins
B. tRNA and proteins
C. rRNA and proteins
D. DNA and proteins
E. DNA and RNA

32. Fibroblasts actively synthesize and release pro-collagen protein during skin growth. What is a specific marker for proteins that will be synthesized in the rough endoplasmic reticulum and then released from the cell?

A. importin
B. signal sequence
C. exportin
D. symporter
E. ubiquitin

33. When external antigen gets into the body, certain types of cells (such as plasma cells) actively produce antibodies, which are protective proteins. The synthesis of antibody proteins is provided by ribosomes on the rough endoplasmic reticulum surface. Where does the synthesis of proteins that will be released from cells begin?

A. on the rough endoplasmic reticulum surface

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B. on the smooth endoplasmic reticulum surface
C. on the polysomes in the cytosol
D. in the lysosomes
E. in the nucleus

34. Hepatocytes synthesize and release some plasma proteins (albumin, fibrinogen). Where does the synthesis of proteins that will be released from cells begin?
A. on the rough endoplasmic reticulum surface
B. on the smooth endoplasmic reticulum surface
C. on the polysomes in the cytosol
D. in the lysosomes
E. in the nucleus

35. During the growth of the body, cells actively synthesize proteins (for example, fibroblasts actively release collagen and elastic fibres) and release them in the extracellular matrix. Where does the synthesis of proteins that will be released from cells begin?
A. on the rough endoplasmic reticulum surface
B. on the smooth endoplasmic reticulum surface
C. on the polysomes in the cytosol
D. in the lysosomes
E. in the nucleus

36. After cells division they restore their volume and actively synthesize proteins and other molecules. Where are the proteins, which will be incorporated in the plasma membrane of cells, synthesized in cells?
A. on the rough endoplasmic reticulum surface
B. on the smooth endoplasmic reticulum surface
C. on the polysomes in the cytosol
D. in the lysosomes
E. in the nucleus

37. What is the structure of ribosomes in eukaryotes?
A. cylindrical degradation chamber with two regulatory subunits
B. 40S Small and 60S large subunits
C. dictyosomes
D. diplosome
E. membrane bound vesicles

38. A 15-year-old patient has a reduced granulocytic lineage in the red bone marrow, which lowers the number of neutrophils in the blood. The patient suffers from frequent infections. A mutation was detected in the gene that

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encoded the product of the signal recognition particle. What is the structure of proteasome?

A. cylindrical degradation chamber with two regulatory subunits (caps)
B. 40S Small and 60S large subunits
C. dictyosomes
D. diplosome
E. membrane bound vesicles

39. A 25-year-old patient has a decrease in the number of neutrophils in blood and a decrease in the volume of the pancreas with enzymatic insufficiency. A mutation was detected in the genes that encoded the product of the signal recognition particle. What is the structure of signal recognition particle?

A. cylindrical degradation chamber with two regulatory subunits (caps)
B. 40S Small and 60S large subunits
C. dictyosomes
D. complex polypeptides and RNA
E. membrane bound vesicles

40. Cells accumulate in the cytoplasm a variety of structural proteins and enzymes to perform their specific functions. Where are the proteins, which will function in the cytosol of cells, synthesized in cells?

A. on the rough endoplasmic reticulum surface
B. on the smooth endoplasmic reticulum surface
C. on the polysomes in the cytosol
D. in the lysosomes
E. in the nucleus

41. Some cells are specialized for destruction of engulfed substances (such as macrophages). In this type of cells, a large number of lysosomes are accumulated in the cytoplasm. Where are the enzymes for lysosomes synthesized in cells?

A. on the rough endoplasmic reticulum surface
B. on the smooth endoplasmic reticulum surface
C. on the polysomes in the cytosol
D. in the lysosomes
E. in the nucleus

42. Some cells are specialized for the active transport of various substances through cells (such as epithelial cells). In this type of cells, a large number of mitochondria is accumulated in the cytoplasm for energy support of the transport systems. Where are mitochondria proteins synthesized in cells?

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A. on the rough endoplasmic reticulum surface
B. on the smooth endoplasmic reticulum surface
C. on the polysomes in the cytosol
D. in the lysosomes
E. in the nucleus

43. Where are the proteins that will function in the nucleus synthesized in cells?
A. on the rough endoplasmic reticulum surface
B. on the smooth endoplasmic reticulum surface
C. on the polysomes in the cytosol
D. in the lysosomes
E. in the nucleus

44. What non-membrane organelle of the cells translocates the polysomes toward rough endoplasmic reticulum for elongation of proteins which will be embedded in plasma membrane of cell?
A. transport ribosome
B. signal recognition particle
C. centriole
D. proteasome
E. diplosome

45. Which mechanism provides the movement of cytosol polysomes to the membranes of rough endoplasmic reticulum for elongation of proteins which will be released from the cell?
A. importin
B. Interaction of signal recognition particle with signal sequence of polypeptide chain
C. exportin
D. symport
E. ubiquitin

46. The growth of the organism is interconnected with the increase in the number of cells in the body and extracellular molecules. This process is associated with activation of protein synthesis. The synthesis of all types of proteins goes through several stages. What is the last stage of polypeptide chain synthesis (translation)?
A. termination
B. elongation
C. initiation
D. degradation
E. splicing

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47. Maintaining of genetic information and subsequent transfer of this information from cell to cell is a complex process that goes through several stages in different compartments of the cell. What process can NOT take place in the cytosol of eukaryotic cells?

A. DNA replication
B. ATP synthesis
C. glycolysis
D. protein synthesis
E. translation

48. The reaction of cells to various stimuli is associated with activation of synthesis of certain proteins. The activation of genes and subsequent synthesis of proteins goes through several stages in different compartments of the cell. What process can NOT take place in the cytosol of human cells?

A. protein synthesis
B. glycolysis
C. translation
D. transcription
E. glycogen synthesis

Answers

1 – B; 2 – D; 3 – B; 4 – A; 5 – D; 6 – C; 7 – B; 8 – D; 9 – E; 10 – E; 11 – C; 12 – B; 13 – B; 14 – A; 15 – D; 16 – D; 17 – B; 18 – B; 19 – D; 20 – C; 21 – C; 22 – D; 23 – C; 24 – A; 25 – B; 26 – C; 27 – A; 28 – A; 29 – A; 30 – B; 31 – C; 32 – B; 33 – C; 34 – C; 35 – B; 36 – A; 37 – B; 38 – A; 39 – D; 40 – C; 41 – A; 42 – C; 43 – C; 44 – B; 45 – B; 46 – A; 47 – A; 48 – D.

Chapter V.

1. While analysing biopsy material from a 36 y.o. patient with suspected protein hormone-producing disorder a scientist needs to study material under electron microscope in order to see and evaluate the condition of the organelle responsible for these proteins production. Which organelle synthesizes secretory proteins?

A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

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2. Laboratory assistant studies ultrastructure of hepatocytes from liver of a patient after partial hepatectomy. The cells have pale nuclei with dominant euchromatin and other characteristics that prove high level of protein production in them. In the electronogram laboratory assistant can see cisternae whose membranes are connected to the outer nuclear membrane. This organelle is:
A) mitochondrion
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

3. Biochemical analysis shows high concentration of peptidyl disulfide isomerase in the cells of adrenal gland medulla that are responsible for adrenalin production. Presence of this enzyme is a proof of protein synthetic activity of the cell. Peptidyl disulfide isomerase can be detected in:
A) rough endoplasmic reticulum
B) outer mitochondrial membrane
C) matrix of mitochondrion
D) peroxisomes
E) lysosomes

4. In the electronogram one can see a labyrinth of single membranes that surround cisternae and contain black dots – ribosomes, on their surface. These membranes are connected with outer nuclear membrane and fill a big part of the cell. What is the main function of the described organelle?
A) synthesis of proteins
B) synthesis of DNA
C) synthesis of ATP
D) synthesis of GTP
E) synthesis of RNA

5. Ultrastructural analysis of biopsy sample from large intestine taken from a 60 y.o. patient during operation shows enterocytes of epithelium lining the wall of the digestive tube. The cells contain multiple membranes that fill the cytoplasm looking like a labyrinth. At the same time not all of the membranes are smooth. An organelle near nucleus has ribosomes attached to it. Which organelle is under study?
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

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6. A sample of parathyroid gland was taken during resection of thyroid gland in a 50 y.o. patient with disordered basic metabolism. The light microscopy study demonstrates chief cells that have bright purple cytoplasm due to presence of mRNA that provides active parathyroid hormone synthesis. Parathyroid hormone is a protein hormone. Which organelle is expected to be highly developed?
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) lysosome
D) mitochondrion
E) peroxisome

7. Binding immunoglobulin protein (BiP) belongs to the family of heat shock proteins. These proteins reverse or inhibit denaturation or unfolding of cellular proteins in response to stress or high temperature. It is also a protein which is induced by agents or conditions that adversely affect the organelle responsible for these cellular proteins production. BiP can be detected in _____.
A) peroxisome
B) lysosome
C) mitochondrion
D) rough endoplasmic reticulum
E) Golgi apparatus

8. Biochemical analysis of the cytoplasmic content from hepatocytes that were actively producing blood plasma proteins (albumin, fibrinogen etc) shows a high concentration of binding immunoglobulin protein (BiP) in the rough endoplasmic reticulum of these cells. This protein is known to reverse or inhibit denaturation or unfolding of cellular proteins in response to stress. The main function of the BiP is _____.
A) synthesis of DNA
B) synthesis of RNA
C) synthesis of ATP
D) proteolysis in Golgi apparatus
E) folding in rough endoplasmic reticulum

9. The histological analysis of neuroendocrine cells of pituitary gland shows morphological characteristics of active hormone production process. The cells contain pale nucleus with high concentration of euchromatin and a well-developed organelle that fills large part of cytoplasm and has ribosomes attached to its membrane. The MAIN function of this organelle is
A) synthesis of protein
B) synthesis of ATP
C) synthesis of lipids

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D) synthesis of carbohydrates
E) synthesis of glucose

10. The cells that require a lot of energy for their functioning are always under risk of reactive oxygen species (ROS) influence. ROS can cause irreversible damage to DNA as they oxidize and modify some cellular components and prevent them from performing their original functions. Such toxic substances can be neutralized by a single-membrane organelle present in the cells due to special enzymes (oxidase, peroxidase, catalase) contained in it. Which organelle can neutralize toxic substances?
A) ribosome
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

11. A transmembrane protein (TP) is a type of integral membrane protein that spans the entirety of the cell membrane. Many transmembrane proteins function as gateways to permit the transport of specific substances across the membrane. Transmembrane proteins are synthesized in:
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosomes
E) peroxisomes

12. It is known that rough endoplasmic reticulum has its name due to its special structure – it has numerous ribosomes attached to its surface. Ribosomal subunits assemble around mRNA and provide translation stage of protein synthesis. But the type and location of protein produced by ribosomes depends where these ribosomes are located. All of the following proteins can be synthesized at the rough endoplasmic reticulum ribosomes EXCEPT:
A) transmembrane proteins that pass through the membrane once
B) transmembrane proteins that pass through the membrane two and more times
C) free soluble proteins
D) endoplasmic reticulum lumen-located anchored proteins
E) cytosol-located anchored proteins

13. Histological analysis of a biopsy taken during operation of partial hepatectomy (removing part of the liver) in a 52 y.o. patient because of alcoholic damage to the organ shows presence of macrophages. These cells are resident for liver and are called Kupfer cells. Their main function is phagocytosis of foreign particles and cell debris. In order to digest the eaten

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particles macrophages contain a lot of lysosomes with hydrolytic enzymes. Lysosomal enzymes are synthesized in:
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosomes
E) peroxisomes

14. A laboratory assistant studies samples from pituitary gland surgically removed from experimental animal under electron microscope. The cells of pituitary gland demonstrate all signs of protein hormone secreting cells. On the electronogram the laboratory assistant sees cisternae with ribosomes on their membrane, connected with outer nuclear membrane. The organelle under study is _____ .
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosomes
E) peroxisomes

15. While looking at hepatocytes in liver trabecula of a biopsy taken from healthy young experimental animal from control group, a scientist sees the evidence that these cells are in active protein production process. Most probably the blood plasma proteins (albumin, fibrinogen) are being produced. The nucleus is pale due to dominance of euchromatin and its outer membrane is connected with a well-developed organelle. Outer nuclear membrane might be connected with:
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) lysosomes
D) Golgi apparatus
E) mitochondria

16. The study of pseudounipolar neurons from sensory ganglion after Nissl staining shows multiple purple cisternae spread around perikaryon (body of the cell). They are only absent in nucleus and axon hillock (area of cytoplasm where axon starts). It is known thar these cisternae belong to a special organelle of neurons - tigroid (Nissl body) and they produce neuromediators. Tigroid is the form of _____ .
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) mitochondria
D) lysosome

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E) peroxisome

17. The light microscopy of a sample taken as a biopsy from fundus of stomach shows chief cells that are responsible for production of enzymes. After eosin and haematoxylin staining these chief cells have purple cytoplasm due to abundancy of rough endoplasmic reticulum associated with mRNA. If a cell has a highly developed rough endoplasmic reticulum what function does it most probably provide?
A) detoxication
B) synthesis of mucus
C) synthesis of a protein that will be secreted
D) synthesis of steroid hormone
E) heat production

18. Some cells around the body produce substances that they don't use themselves but release to the bloodstream (hormones), to some cavities (mucous, enzymes) or on the surface of the body (sweat, sebum). This way such cells help to support some global processes happening in human organism. Synthesis of substances that are necessary for extracellular metabolism or for the needs of the whole organism is called:
A) autosynthesis
B) autopsy
C) heterosynthesis
D) medieval synthesis
E) homosynthesis

19. The study of biological sample from medulla of adrenal gland under electron microscope shows a well-developed labyrinth of membranes spread around the cytoplasm of the cell. Not all of these membranes are equal in structure. On the electronogram we see cisternae made of membranes with ribosomes attached to them. The function of this organelle is _____ .
A) detoxication
B) synthesis of mucus
C) synthesis of protein hormone
D) synthesis of steroid hormone
E) heat production

20. It is known that metabolism of the cell is organised due to compartmentalisation of the cytoplasm – it is split into multiple small areas isolated from each other by lipid membranes. This way a cell is able to simultaneously produce multiple substances of various chemical nature. Which organelle synthesizes phospholipids and steroids?
A) smooth endoplasmic reticulum

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B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

21. A 33 y.o. patient comes to his doctor because of extreme fatigue, weight loss and loss of appetite, low blood pressure and low blood sugar, also called hypoglycaemia. The doctor suspects adrenal insufficiency, which is not being able to increase the amount of cortisol made as a result of stress that can lead to an addisonian crisis. Cortisol is a steroid hormone produced by cortex of adrenal gland. The organelle might be not working in the cells if cortisol is not produced on sufficient level?
A) ribosome
B) smooth endoplasmic reticulum
C) peroxisome
D) lysosome
E) Golgi apparatus

22. A person that lost consciousness in the street was carried to hospital with typical symptoms of intoxication: irregular breathing, pale skin, low body temperature (hypothermia), seizures and slow breathing. The most possible explanation could be the influence of excessive amount of alcohol on the body. It is known that normally liver deals with alcohol to decrease its influence on the body. Due to that the cells of liver - hepatocytes have a highly developed sER and peroxisomes. The function of these cells is:
A) detoxication
B) synthesis of mucus
C) synthesis of protein hormone
D) synthesis of steroid hormone
E) heat production

23. Single membrane organelles of the cell are all interconnected into one integrated system. Even though they are all similar in structure as they are made of one membrane, their individual morphological characteristics differ because of exact functions that they are providing. It is known that rough endoplasmic reticulum provides synthesis of proteins while smooth endoplasmic reticulum is responsible for carbohydrates metabolism and steroids production. Basing on its functions smooth endoplasmic reticulum does NOT contain:
A) ribosomes
B) calreticulin
C) calsequestrin
D) dolichol
E) Ca2-pump

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24. It is known that additional to their main function majority of the cell organelles have additional roles and morphological modifications to provide them. As Calcium presence and certain concentration in the cytoplasm is vital for normal contraction of muscles, their cells have a certain organelle specialised for its accumulation and dynamic releasing. This organelle is a derivative of sER and is called _____.
A) secretory granule
B) ribosome
C) sarcoplasmic reticulum
D) peroxisome
E) lysosome

25. A patient complains his doctor about constant spasms of muscles. One of possible explanations could be imbalance in Calcium exchange in the skeletal muscle fibres. These fibres have a specific morphological modification in order to store this element. Which of these organelles cat act as an intracellular Ca2 depot?
A) rough endoplasmic reticulum
B) smooth endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

26. Phosphatidylcholine is one of major components of biological membranes. Although multiple pathways exist for the biosynthesis of phosphatidylcholine, the predominant route in eukaryotes involves condensation between diacylglycerol and cytidine 5'-diphosphocholine. Both of these molecules have steroid nature. On the electronogram we can see cisternae in which the synthesis of phosphatidylcholine is detected. This organelle is:
A) mitochondrion
B) smooth endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

27. A patient was administered to hospital with confusion, vomiting, seizures, slow irregular breathing, and blue-tinged skin – all the visual symptoms of intoxication. The doctor suspected intoxication with some poisonous substance several hours before administration. Which organelle can neutralize toxic substances?
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum

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C) Golgi apparatus
D) phagosome
E) ribosome

28. Calreticulin is a multifunctional soluble protein that binds Ca2 ions (a second messenger in signal transduction), rendering it inactive. One of characteristic features of calreticulin is that it binds Ca2 with low affinity, but high capacity, and can be released on a signal in case it's necessary for the cell. On the electronogram we can see cisternae in which calreticulin is detected. This organelle is:
A) mitochondrion
B) smooth endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

29. One of key points in the complicated process of muscle contraction is interaction between actin and myosin. Calcium diffusing in the cytoplasm between myosin and actin filaments of the muscle fibrils causes the filaments to slide into each other, triggering the contraction of the entire muscle fibre. On the electronogram from a skeletal muscle fibre we can see cisternae in which the Ca2-pump is detected. This organelle is:
A) rough endoplasmic reticulum
B) smooth endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

30. The metabolism of the cell as a structural unit of human organism is associated with production of multiple substances that may damage the cell due to their toxicity. To avoid their negative influence on the cell there are special organelles in the cytoplasm that provide neutralisation of such substances – detoxication. Some cells around human body provide detoxication not only for themselves but for the rest of the organism as well like hepatocytes in liver. Such cells are specialized in detoxification. Which organelles are expected to be highly developed in them?
A) rough endoplasmic reticulum, mitochondria, lysosomes
B) rough endoplasmic reticulum, mitochondria, peroxisomes
C) smooth endoplasmic reticulum, mitochondria, peroxisomes
D) smooth endoplasmic reticulum, lysosomes, peroxisomes
E) smooth endoplasmic reticulum, lysosomes, rough endoplasmic reticulum

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31. Calcium is a mineral most often associated with healthy bones and teeth, although it also plays an important role in blood clotting, helping muscles to contract, and regulating normal heart rhythms and nerve functions. As for muscle contraction, Calcium triggers it by reaction with regulatory proteins that in the absence of Calcium prevent interaction of actin and myosin. Which organelle can store the Calcium ions dynamically and release it to cytoplasm in case of contraction?
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

32. Calcium in human body can be accumulated in bones but in the muscles as well. Its storage in the bones is more stable while in the muscles it is dynamic and is used to regulate contraction process. For the normal process of muscle contraction Calcium must be stored in cisternae in cytoplasm where it is pumped using energy of ATP and from where it can be easily released. Which organelle contains the Ca2-pump in its membrane?
A) rough endoplasmic reticulum
B) smooth endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

33. Calcium is known to play a vital role in cell metabolism not only in bones and teeth but everywhere around the organism as well. This element can be accumulated in the cell cytoplasm and dynamically released when it is necessary. For storing and balancing Calcium around the cell certain organelles are provided with mechanisms of its transportation. Which organelle contains Ca2-channels in its membrane?
A) rough endoplasmic reticulum
B) smooth endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

34. While studying ultrastructure of a skeletal muscle fibre medical student finds all the typical morphological features that help to provide contraction: dark and light bands of sarcomeres, multiple mitochondria for energy production and cisternae of a certain organelle that accumulate Calcium. Which organelle contains a lot of Ca2 ions?
A) peroxisome

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B) lysosome
C) Golgi apparatus
D) sarcoplasmic reticulum
E) rough endoplasmic reticulum

35. The study of the cell under electron microscope demonstrates well-developed labyrinth of membranes that provide compartmentalisation of the cytoplasm. Due to these membranes different parts of the cell have different characteristics and conditions, they can provide different metabolic processes. Also, in different compartments of the cell the concentration of certain ions may differ as well. The concentration of Ca2 ions inside the smooth ER is:
A) equal to cytosolic Ca2 concentration
B) smaller than cytosolic Ca2 concentration
C) bigger than cytosolic Ca2 concentration
D) cannot be compared to cytosolic Ca2 concentration
E) Ca2 is not commonly found inside the smooth ER

36. Biochemical analysis of the cell shows the presence of dolichol which participates in the co-translational modification of proteins in the form of dolichol phosphate. Dolichols also function as a membrane anchor for the formation of the oligosaccharides. This molecule is normally not equally spread around the cell but concentrated in certain compartments where it can provide its functions. Dolichol can be detected in the membrane of:
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosomes
E) peroxisomes

37. Microscopic analysis of ultrastructure of biological sample taken during operation on liver shows a network of sac-like structures and tubes in the cytoplasm of a cell. Proteins and other molecules move through this network – endoplasmic reticulum. The outer surface of the endoplasmic reticulum can contain ribosomes if it produces proteins but may be free of them as well. Which type of endoplasmic reticulum does NOT exist?
A) intermediate
B) smooth
C) rough
D) nuclear and mitochondrial
E) smooth and rough

38. Laboratory assistant studies a biopsy sample from mucosa of small intestine and finds the cells of lining epithelium that produce mucous – Goblet cells.

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These cells may be distinguished not only due to their specific shape but also due to special organelles well developed in their cytoplasm to provide their functions. These functions include not only production of mucous compounds but also their packaging into vesicles. Which organelle sorts and packs proteins, oligosaccharides, and lipids into vesicles?
A) mitochondrion
B) ribosome
C) Golgi apparatus
D) lysosome
E) peroxisome

39. Secretory cells of human organism are characterised by certain morphological features including the presence of organelles that produce required products as well as those responsible for their modification, sorting, and packaging. One of those organelles includes specific element called "dictyosome" that receives newly synthesised molecules and packages them into single membrane vesicles for future transportation. What exactly is a "dictyosome"?
A) immature lysosome
B) a vesicle that carriers newly synthesized proteins from the ER
C) a vesicle that carriers proteins from the Golgi apparatus
D) a stack of Golgi cisternae
E) mature lysosome

40. While studying inflamed tissue removed from the wound in the skin under light microscope a doctor observes activated macrophages of dermis – Langerhans cells. These cells are mostly responsible for phagocytosis of foreign particles and bacteria from connective tissue around. In order to digest these antigens, macrophages have multiple lysosomes in their cytoplasm. Primary lysosomes are formed by _____.
A) peroxisomes
B) mitohondria
C) rough endoplasmic reticulum
D) smooth endoplasmic reticulum
E) Golgi apparatus

41. A scientist studies ultrastructure of a hormone-producing cell and finds multiple secretory vesicles accumulated in basal part of the cell. The location of these vesicles closer to basal membrane is explained by the direction of secretion – hormones are released directly to capillaries that are present in loose connective tissue below it. The secretory materials may be produced in several compartments around the cell depending on their chemical nature but they are

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all packaged into secretory vesicles in one organelle. Secretory vesicles are made at:
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) vesicle-tubular cluster
D) trans-Golgi network
E) lysosomes

42. Medical student studies a sample taken from the wall of large intestine during colonoscopy. While analysing it under light microscope he finds abundant cells of lining epithelium that are called Goblet cells due to their specific structure. Basal part of these cells is narrow and attached to basal membrane while apical part is large due to accumulation of secretory product. These cells have highly developed Golgi apparatus. The function of these cells is:
A) detoxication
B) synthesis of mucus
C) synthesis of protein hormone
D) synthesis of steroid hormone
E) heat production

43. Medical student studies respiratory epithelium under light microscope. Among lining cells, he sees one with typical characteristic of secretory activity. It is known that whichever secret is released by the cell its main morphological feature is a well-developed Golgi apparatus as it is responsible for packaging of this secret. The cell under the microscope contains many structural units of Golgi body. Golgi apparatus consists of _____.
A) microtubules
B) 2 subunits
C) granules
D) cisternae
E) desmosomes

44. One of possible reasons of chronic inflammatory processes development in respiratory pathways is inappropriate condition of mucous produced by goblet cells – it may be too dense or too liquid. The consistence of mucous depends on the organelles that participate in its production and packaging. Which organelle is expected to be highly developed in goblet cells in case of their proper functioning?
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) lysosomes
D) mitochondria

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E) Golgi apparatus

45. Production of various substances around the cytoplasm is compartmented and provided by both smooth and rough endoplasmic reticulum that are responsible for making different organic polymers. On the other side majority of modifications and linking between these polymers happens in another single-membrane organelle which receives them from these networks. Which organelle modifies proteins, oligosaccharides, lipids, and other compounds that are synthesized in the endoplasmic reticulum?
A) mitochondrion
B) ribosome
C) Golgi apparatus
D) lysosome
E) peroxisome

46. While studying the sample from testis of a 40 y.o. male patient under electron microscope doctor sees large pale cells filled with lipid droplets – Leydig cells. They are located in loose connective tissue of testis interstitium and provide production of steroid hormones. One of their characteristic features is presence of multiple lipid inclusions. Their cytoplasm is also filled with an organelle responsible for phospholipids and steroids production. Which organelle is that?
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

47. Medical student studies autopsy material from the heart of a deceased 80 y.o. patient and finds multiple damaged organelles in cytoplasm of cardiomyocytes. He also sees the morphological features that prove the natural process of removing these organelles from the cytoplasm of the cell. It is proved by presence of certain single-membrane organelles around cytoplasm. Which organelle is responsible for the lysis of the old or damaged cellular structures?
A) mitochondria
B) ribosome
C) Golgi apparatus
D) lysosome
E) peroxisome

48. The electronogram of a macrophage taken from infected tissue demonstrates multiple lysosomes located around the cytoplasm. Their presence is a result of phagocytotic activity that is typical for macrophages fighting bacteria.

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Lysosomes are single-membrane vesicles with various content depending on their current state and processes happening in them. A vesicle that contains lytic enzymes only (no molecules to destroy) is called:
A) endosome
B) phagosome
C) primary lysosome
D) secondary lysosome
E) tertiary lysosome

49. Multiple organelles of the cell provide compartmentalisation of the cytoplasm and create individual spaces with different environments required for specific reactions. For example, the work of hydrolytic enzymes requires acidic pH that activates them. The pH for their activity is 5 and can be reached in a single-membrane vesicle. This organelle is _____ .
A) mitochondrion
B) smooth endoplasmic reticulum
C) rough endoplasmic reticulum
D) lysosome
E) peroxisome

50. Certain types of white blood cells in human organism are responsible for eliminating the antigens by phagocytosis. After being eaten the antigen must be digested by hydrolytic enzymes inside of a single-membrane vesicle. Which organelle provides the lysis of the various substrates which are phagocytized by the cell?
A) mitochondria
B) ribosome
C) Golgi apparatus
D) lysosome
E) peroxisome

51. Lysosomes provide digestion of various substances consumed by the cell and play a vital role in functioning of macrophages that participate in immune reactions by digesting foreign particles. Hydrolytic enzymes that control this digestion require specific conditions for their activation, including acidic environment. The internal medium of the lysosome is acidified due to the activity of:
A) H-channel
B) H-pump
C) OH--channel
D) OH--pump
E) H- OH—antiporter

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52. A 27 y.o. woman came to the doctor for amniocentesis (analysis of amniotic fluid). The results allowed doctor to suspect I-cell disease (mucolipidosis II) – a rare inherited metabolic disorder caused by a defective phosphotransferase enzyme that is located in the Golgi apparatus and characterized by skeletal abnormalities, and mental retardation. The propagation of the I-cell disease is due to the accumulation of an undigested material in:
A) mitochondria
B) lysosomes
C) smooth endoplasmic reticulum
D) rough endoplasmic reticulum
E) nucleus

53. Histochemical analysis of a cell aimed at determining location of certain enzymes demonstrates presence of acid phosphatase in certain vesicles spread around the cell. These single-membrane vesicles originate in Golgi body and demonstrate digestive activity. What are they?
A) cisternae of smooth endoplasmic reticulum
B) cisternae of rough endoplasmic reticulum
C) mitochondrion
D) lysosomes
E) peroxisomes

54. A scientist studies histological sample from the tissue irradiated by X-rays under the light microscope. Some of the damaged cells express the features of regeneration and "self-cleaning" – damaged and dysfunctional organelles are removed. The cell has a special mechanism of renovating itself and getting rid of unnecessary elements. Cells can destroy their organelles through the process that is called:
A) autopsy
B) denaturation
C) degradation
D) lysis
E) autophagy

55. The process of digestion of consumed particles in the cell includes several stages. After phagocytosis materials eaten by the cell get under influence of certain hydrolytic enzymes and broken to monomers useful for the cell. In any case not all eaten particles are processed to the very end and completely used by the cell, they make the core of "residual bodies". "Residual body" is one of the types of:
A) rough endoplasmic reticulum
B) smooth endoplasmic reticulum
C) Golgi apparatus

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D) lysosomes
E) peroxisomes

56. Lysosomes are one-membrane organelles that provide various functions in the cell. Not only do they digest the particles consumed by the cell but also, they help to remove some structures in the cytoplasm that are not necessary for the cell. In order to provide such functions lysosomes contain certain enzymes. They destruct various substances with the help of:
A) oxidases
B) kinases
C) basic hydrolases
D) neutral synthetases
E) acidic hydrolases

57. The study of the cell morphology under light microscope shows several damaged organelles that are being eliminated from the cytoplasm. This process is called autolysis and provides the enzymatic digestion of cells by the action of their own enzymes, and it mostly occurs in dying or dead cells. Autolysis is provided by:
A) rough endoplasmic reticulum
B) mitochondrion
C) Golgi apparatus
D) lysosome
E) peroxisome

58. A 4 y.o. patient was diagnosed with a rare lysosomal storage disorder – mucopolysaccharidosis type 1. This disease is characterised by an abnormal build-up of various toxic materials, called glycosaminoglycans (GAGs) in the cells of human organism. The propagation of the mucopolysaccharidosis type I is due to the accumulation of an undigested material in:
A) rough endoplasmic reticulum
B) smooth endoplasmic reticulum
C) Golgi apparatus
D) lysosomes
E) peroxisomes

59. Normal functioning of phagocytotic processes in macrophages is provided by activity of lysosomal hydrolytic enzymes. These enzymes require certain environment for their activation created inside of lysosomal membrane. One of conditions necessary for proper functioning of these enzymes is acidity – it is provided by H pumps embedded in lysosomal membrane. The pH inside the mature lysosome is about:
A) 7-7,5

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B) 6,5-7
C) 6-6,5
D) 5,5-6
E) 5-5,5

60. It is known that the process of food digestion by the cell is complicated and includes multiple stages. This process is regulated by hydrolytic enzymes located in lysosomes. Which kind of lysosomes contains the hydrolytic digestive enzymes only?
A) phagosomes
B) primary lysosomes
C) secondary lysosomes
D) residual bodies
E) exosomes

61. One-membrane organelles are known to provide compartmentalisation of intracellular space to provide individual conditions for various processes. Some metabolic reactions necessary for digestion of substrates that are eaten by the cell or removing old and damaged cell organelles are catalysed by specific enzymes that need acidic pH provided by H pump embedded in their wall. Which organelle contains H-pump in its membrane?
A) peroxisome
B) lysosome
C) smooth endoplasmic reticulum
D) rough endoplasmic reticulum
E) Golgi apparatus

62. Various reactions around the cell can happen simultaneously due to the possibility to separate conditions necessary for them as well as activate specific enzymes that regulate these reactions. One of such enzymes is acidic hydrolase that requires specific acidic environment for its activation. Such pH is created dur to the presence of H pumps in the membrane of a certain one-membrane organelle. Acid hydrolase is located in:
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosomes
E) peroxisomes

63. Cytological analysis of a smear of cervical epithelium taken from a 40 y.o. female patient who came to consultation due to symptoms of chronical inflammation shows multiple macrophages spread between cells of flat epithelium. Macrophages are usually present in the smear in case of

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inflammation and are responsible for phagocytosis of bacteria. Which organelle is expected to be highly developed in them?
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) mitochondrion

64. A 2 y.o. child is diagnosed with an inherited metabolic disorder – Niemann-Pick disease. This disease is characterised by abnormal amounts of lipids (fatty materials such as waxes, oils, and cholesterol) build up in the brain, spleen, liver, lungs, and bone marrow. The propagation of Niemann-Pick disease is due to the accumulation of an undigested material in:
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) nucleus
E) lysosomes

65. The cells in human organism have a well-developed mechanism of self-renewal. Majority of old and damaged organelles can be digested by lysosomes. Primary lysosomes produced by Golgi apparatus fuse with such dysfunctional organelles and destroy them. In any case the lysosome isn't able to digest any substrate with no trace – some remnants are left inside it. Which kind of lysosomes contains the indigestible materials?
A) phagosome
B) primary lysosome
C) secondary lysosome
D) residual body
E) exosomes

66. The process of digestion that follows consuming of certain materials by the cell includes several stages. The lysosomes produced by Golgi body fuse with phagosomes and provide digestion. When this process finishes some indigestible materials are excreted from the cell. Every stage of digestion results in formation of certain type of lysosomes. Choose the type of lysosome:
A) tigroid
B) residual body
C) dictyosome
D) mitochondrial reticulum
E) tubular-vesicular complex

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67. The cytological diagnostics of a print from the surface of a wound shows macrophages that are aimed at phagocytosis of bacteria. The presence of these cells in the print is typical for chronic inflammation. They need multiple lysosomes to provide their function. These organelles are produced by Golgi body. Which kind of lysosomes is formed by the Golgi apparatus?
A) phagosome
B) primary lysosome
C) secondary lysosome
D) residual body
E) exosome

68. Parents brought an 8-month-old child to pediatrician as he had begun to show neurological symptoms, including: slowing of development, progressive loss of mental ability and dementia. Affected child appeared to develop without a problem until age of about 6 months. The child was diagnosed with a rare syndrome – the Tay-Sachs disease. The propagation of this disease is due to the accumulation of an undigested material in:
A) mitochondria
B) lysosomes
C) smooth endoplasmic reticulum
D) rough endoplasmic reticulum
E) Golgi apparatus

69. Certain cells around human organism provide secretion of special substances like hormones or enzymes. Such types of secretion are usually stimulated by regulation from outside of the cell from both nerve and endocrine systems. On the other side, secretion of other substances does not need additional stimulation. Constant secretion of different substances out of the cell even in the absence of specific signals is called:
A) temporary exocytosis
B) constitutive exocytosis
C) unspecific exocytosis
D) regulated exocytosis
E) fast exocytosis

70. Various glands located around human organism produce certain substances to secrete them and “share” with the rest of the body. Such secretions are usually hormones for regulation of metabolism or enzymes for catalysis of digestive reactions. In any case multiples substances secreted in the cell are used on the spot in the cytoplasm so they don’t leave it. Synthesis of substances which are necessary for intracellular metabolism is called:
A) autosyntesis
B) autopsy

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C) heterosynthesis
D) medieval synthesis
E) homosynthesis

71. During the microscopic study of a smear of exudate from the wound laboratory assistant finds multiple dead cells with segmented nuclei – neutrophils. These cells are responsible for local immunity and are able to destroy bacteria by phagocytosis. White blood cells surround the bacteria with their pseudopodia and pull it in while forming the one-membrane vesicle around it. This vesicle is called lysosome. Which kind of lysosomes contains the digestible materials only?
A) phagosomes
B) primary lysosomes
C) secondary lysosomes
D) residual bodies
E) exosomes

72. One of immune defensive mechanisms of human organism is based on phagocytosis – such white blood cells as neutrophils and macrophages are able to destroy bacteria invading the body by surrounding them with outgrowths of their plasma membrane and pulling them inside of the cytoplasm. During this process plasmalemma surrounds the bacteria making a one-membrane vesicle that is classified as a certain type of lysosome. Which kind of lysosomes is formed by phagocytosis?
A) phagosome
B) primary lysosome
C) secondary lysosomes
D) residual body
E) exosomes

73. Ultramicroscopic study of a macrophage shows multiple lysosomes spread around cytoplasm that demonstrate the phagocytotic activity of this cell. The biggest type of lysosome has oval shape and heterogeneous content made of substrate and activated enzymes digesting it. This kind of lysosomes is formed by the combination of a primary lysosome and a phagosome. How is it called?
A) phagosome
B) primary lysosome
C) secondary lysosome
D) residual body
E) exosome

74. The body of new-born babies has an adaptive mechanism to resist the stress from low temperatures. In case of drastic decrease of temperature of

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environment influencing the organism a special tissue surrounding vital organs of the baby starts producing extra heat. This tissue is called brown adipose tissue and it disappears when the baby grows up. The production of heat in the brown adipose tissue is due to the:
A) active movement of mitochondria in the cytosol
B) uncoupling of H- transport and ATP synthesis
C) rapid shrinkage of active mitochondria
D) actin-myosin-mediated mitochondrial constriction
E) release of the heat during the lysosomal degradation of sugars

75. Peroxisomes are one-membrane organelles, found in the cytoplasm of eukaryotic cells. They are oxidative organelles and owe their name to hydrogen peroxide generating and scavenging activities. These activities are provided by special peroxisomal enzymes that are proteins by nature. Peroxisomal proteins are made at:
A) free cytosolic ribosomes
B) endoplasmic reticulum-bound ribosomes
C) Golgi-bound ribosomes
D) peroxisome-bound ribosomes
E) mitochondrion-bound ribosomes

76. The ultrastructural study of a hepatocyte under electron microscope shows one-membrane round organelles located near the endoplasmic reticulum and mitochondria. These organelles contain dark crystalloid core inside of them made of specific enzymes that help them to provide their functions. The organelles were defined as peroxisomes. The main function of peroxisomes in animal cells is:
A) oxidation of various substances
B) production of ATP
C) synthesis of proteins that should be evacuated from the cell
D) acidification of cytosol
E) digestion of phagocytized cells and substances

77. The biochemical analysis of the content of a certain one-membrane organelle shows the presence of oxidative enzymes (oxidases and peroxidases). These enzymes are known to be responsible for sequestering diverse oxidative reactions and play important roles in metabolism and reactive oxygen species detoxification. Which organelle contains these enzymes?
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

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78. The electron microscope image of a cell that underwent oxidative stress shows increased number of single-membrane vesicles. The characteristic feature that helps to verify these organelles is electron-dark zone present in each vesicle. This zone is called crystalloid core. Crystalloid core is the internal component of:
A) primary lysosome
B) secondary lysosome
C) peroxisome
D) endosome
E) Golgi apparatus

79. Majority of one-membrane organelles make strongly interconnected system of compartmentalisation in the cytoplasm. Due to this fact during division of the cell they reproduce by branching and growing. On the other side, one single-membrane organelle is an exception from this rule. It can reproduce by division like mitochondria. Which organelle is this?
A) peroxisome
B) endosome
C) Golgi apparatus
D) smooth endoplasmic reticulum
E) rough endoplasmic reticulum

80. One of main functions of peroxisomes is detoxification as these organelles contain enzymes such as catalase that convert hydrogen peroxide to water and oxygen, thereby neutralizing the toxicity. In that way peroxisomes provide a safe location for the oxidative metabolism of certain molecules. The increase in number of peroxisomes is often associated with oxidative stress of the cell and happens mainly due to:
A) de novo peroxisome formation
B) transformation of lysosomes
C) degeneration of mitochondria
D) division of pre-existing peroxisomes
E) vacuolization of smooth endoplasmic reticulum

81. Ultrastructural study of a cell shows some one-membrane organelles which contain enzymes that oxidize certain molecules normally found in the cell, notably fatty acids and amino acids. Those oxidation reactions produce hydrogen peroxide, which is the basis of the name of these organelles. Which organelle can produce H_2O_2?
A) mitichondrion
B) peroxisome
C) endosome

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D) Golgi apparatus
E) lysosomes

82. Peroxisomes are one-membrane organelles that contain a large variety of different enzymes as they provide regulation of a broad spectre of chemical reactions. Which of these enzymes does NOT work inside the peroxisome?
A) oxidase
B) catalase
C) peroxidase
D) acid hydrolase
E) all of the above

83. Laboratory assistant studies a cell from the tissue that was under oxidative stress for some period of time with the electron microscope. He observes multiple one-membrane vesicles located closer to mitochondria and endoplasmic reticulum. The characteristic that helps to verify these organelles is a dark area in them – crystalloid core. Crystalloid core is located in:
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosomes
E) peroxisomes

84. The cells of liver are known to have the function of detoxication, neutralising multiple substances potentially dangerous for the organism. One of chemical processes that provides this function is regulated by the enzyme catalase that is able to convert hydrogen peroxide to water and oxygen, thereby neutralizing their toxicity. Catalase is detected in a single-membrane organelle. This organelle is called:
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) Golgi apparatus
D) lysosome
E) peroxisome

85. One of single-membrane vesicles that can be found in the cytoplasm especially in case of increased oxidative stress is a peroxisome. It is typical for those cells responsible for detoxication as it contains enzymes that can deactivate H2O2 by breaking it into oxygen and water. Choose the enzyme that can be found in peroxisomes:
A) ATP-synthetase
B) catalase
C) acidic hydrolases

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D) NADH-dehydrohenase
E) cytochrome oxidase

Answers

1 – B; 2 – B; 3 – A; 4 – A; 5 – B; 6 – B; 7 – D; 8 – E; 9 – A; 10 – E; 11 – B; 12 – E; 13 – B; 14 – B; 15 – B; 16 – B; 17 – C; 18 – C; 19 – C; 20 – A; 21 – B; 22 – A; 23 – A; 24 – C; 25 – B; 26 – B; 27 – A; 28 – B; 29 – B; 30 – C; 31 – A; 32 – B; 33 – B; 34 – D; 35 – C; 36 – A; 37 – D; 38 – C; 39 – D; 40 – E; 41 – D; 42 – B; 43 – D; 44 – E; 45 – C; 46 – A; 47 – D; 48 – C; 49 – D; 50 – D; 51 – B; 52 – B; 53 – D; 54 – E; 55 – D; 56 – E; 57 – D; 58 – D; 59 – E; 60 – B; 61 – B; 62 – D; 63 – D; 64 – E; 65 – D; 66 – B; 67 – B; 68 – B; 69 – B; 70 – A; 71 – A; 72 – A; 73 – C; 74 – B; 75 – A; 76 – A; 77 – E; 78 – C; 79 – A; 80 – D; 81 – B; 82 – D; 83 – E; 84 – E; 85 – B.

Chapter VI.

1. A scientist studies an ultrathin section of a skeletal muscle taken as a biopsy from a sportsman. Between the structured pattern of myofibrils, he observes multiple mitochondria oriented parallel to the long axis of the muscle fibre. Their presence is vital to provide the main function of skeletal muscle – contraction. The main function of mitochondria is _____.
A) synthesis of ADP
B) synthesis of ATP
C) synthesis of carbohydrates
D) phagocytosis
E) glycolysis

2. Multiple processes happening in the cell require energy in the form of ATP. This molecule is used for instance as a substrate in Sodium-Potassium pump that helps to keep the balance of these molecules between the inner and outer surface of cellular plasma membrane. ATP is the easiest to use source of energy. It is synthesized in _____.
A) peroxisomes
B) rough endoplasmic reticulum lumen
C) smooth endoplasmic reticulum lumen
D) mitochondrial matrix
E) mitochondrial intermembrane space

3. The citric acid cycle — also known as the Krebs cycle is a series of chemical reactions to release stored energy through the oxidation of acetyl-CoA derived

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from carbohydrates, fats, and proteins. The Krebs cycle is used by organisms that respire to generate energy in the form of ATP, either by anaerobic respiration or aerobic respiration. The reactions of the Krebs cycle are carried out in _____.
A) peroxisomes
B) rough endoplasmic reticulum lumen
C) smooth endoplasmic reticulum lumen
D) mitochondrial matrix
E) mitochondrial intermembrane space

4. There are ten basic steps in the citric acid cycle (Krebs cycle) that lead to ATP production and are regulated by a set of various enzymes. Which part of mitochondria contains Krebs cycle enzymes?
A) outer mitochondrial membrane
B) inner mitochondrial membrane
C) intermembrane space
D) matrix
E) stroma

5. One of the main enzymes detected in the cristae of inner membrane of mitochondria is the ATP-synthase that uses the difference in concentration of H ions between certain compartments of mitochondria to produce ATP from ADP involving energy in special energy-rich bond. Choose the correct direction of the H-flow through the mitochondrial ATP-synthase during the ATP synthesis:
A) cytosol → intermembrane space
B) intermembrane space → cytosol
C) intermembrane space → matrix
D) matrix → intermembrane space
E) cytosol → matrix

6. Multiple organelles around the cell are interconnected and depend much on the nucleus. One of the reasons for that is the fact that nuclear DNA keeps information about proteins participating in structure and regulating function of these organelles. On the other side, these is a special organelle that is relatively independent and autonomous from nucleus as it has its own genetic material and even the ability to produce proteins. Which organelle has its own DNA?
A) peroxisome
B) lysosome
C) Golgi apparatus
D) mitochondrion
E) smooth endoplasmic reticulum

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7. Despite similar structure of outer and inner mitochondrial membrane their permeability is different. Both of them are made of double layer of phospholipids but the set of integral proteins in them is a bit different. Due to this difference inner membrane remains almost impermeable for majority of substances while the outer one is much more permeable. The porin proteins can be detected in:
A) inner mitochondrial membrane
B) outer mitochondrial membrane
C) matrix of mitochondrion
D) peroxisome
E) lysosome

8. A medical student studies the ultrastructure of mitochondria under electron microscope. This organelle has a complicated structure and is surrounded by two membranes. The inner membrane makes multiple folds inside of mitochondrial inner space that is filled with matrix. Such complicated morphology helps to arrange multiple steps of energy production and enzymes responsible for them. Which part of a mitochondrion contains ATP-synthase?
A) outer mitochondrial membrane
B) inner mitochondrial membrane
C) intermembrane space
D) matrix
E) stroma

9. The respiratory chain is composed of more than ninety protein subunits that are organized into five different multi-subunit respiratory complexes. These complexes produce 90% of the ATP required for cell sustenance. The proteins of respiratory chain are embedded in:
A) Golgi apparatus
B) inner mitochondrial membrane
C) outer mitochondrial membrane
D) matrix of mitochondrion
E) peroxisomes

10. An electron transport chain is a series of protein complexes and other molecules that transfer electrons from electron donors to electron acceptors via redox reactions (both reduction and oxidation occurring simultaneously) and couples this electron transfer with the transfer of protons (H ions) across a membrane. Which part of a mitochondrion contains the electron transport chain?
A) outer mitochondrial membrane
B) inner mitochondrial membrane
C) intermembrane space

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D) matrix
E) stroma

11. Unlike other organelles in the cell mitochondria likely evolved from engulfed prokaryotes that once lived as independent organisms. At some point, a eukaryotic cell engulfed an aerobic prokaryote, which then formed an endosymbiotic relationship with the host eukaryote, gradually developing into a mitochondrion. Which of the following does NOT support the endosymbiotic origin of mitochondria?
A) they have their own DNA
B) the number of mitochondria increases through the division of pre-existing mitochondria
C) mitochondrial proteins are mostly coded in nuclear DNA
D) they have some special lipids that are uncommon in eukaryotes
E) they have their own prokaryotic-type ribosomes

12. There are two types of adipose tissue in human organism. While white fat provides thermo isolation, the brown fat that may be found in new-born babies and elderly people is responsible for thermo-production. The colour of brown adipocytes is defined by cytochromes present in a certain organelle. Which organelle is highly developed in brown adipocytes?
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) lysosomes
D) mitochondria
E) Golgi apparatus

13. While studying the energy-productive abilities of the cell scientists discover an enzyme that creates energy-rich bond by adding phosphate group to ADP molecule creating ATP – the most common energy substrate in the living cell. This enzyme due to its function is called ATP-synthetase. The ATP-synthetase requires specific conditions for its functioning so it can be detected in a certain organelle. This organelle is likely to be:
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) mitochondrion
D) Golgi apparatus
E) peroxisome

14. The ribosomes are known to have the main function – protein production wherever they are situated. Some of them are freely spread around cytoplasm, majority are attached to endoplasmic reticulum thus making it rough. Some ribosomes are even included in certain two-membrane organelles in the cell and

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produce proteins for them. Which of these proteins are NOT synthesized at the rough endoplasmic reticulum?
A) lysosomal proteins
B) mitochondrial proteins
C) extracellular proteins
D) proteins of Golgi apparatus
E) integral proteins of plasmalemma

15. Mitochondria are known to be pretty autonomous organelles that are most probably descendants of some bacteria engulfed by eukaryotic cell. There are many features that show the independence of mitochondria, they even have their own protein-synthetizing apparatus – including genetic material (DNA and RNA) and ribosomes. Which part of a mitochondrion contains the mitochondrial DNA?
A) outer mitochondrial membrane
B) inner mitochondrial membrane
C) intermembrane space
D) matrix
E) stroma

16. The energetic state of a cell is easy to evaluate by looking at morphology of mitochondria. These organelles are dynamic in their response to changes in cell condition and influence of various stress. In response to such changes the mitochondria might join together (fusion) or split into smaller forms (fission). Fusion of mitochondria may result in a big branched structure that is called _____ .
A) macromitochondrion
B) chondriosome
C) automitochondrion
D) multimitochondrion
E) mitochondrial reticulum

17. One of main features that demonstrates the autonomy of an organelle from the nucleus is the ability to produce some proteins for itself independently. In order to provide this ability such organelles need the DNA as information carrier, RNA, and ribosomes necessary for transcription and translation. Which organelle in animal cell has its own ribosomes and is able to make some proteins on its own?
A) peroxisomes
B) lysosome
C) Golgi apparatus
D) mitochondrion
E) smooth endoplasmic reticulum

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18. The cells of human body can be substituted by new ones in case of some critical damage or might undergo intracellular regeneration if they survive. After certain levels of stress or due to aging some organelles in the cytoplasm may become damaged and dysfunctional. Cleaning cytoplasm from such structures is a vital part of cell renewing and is provided by certain type of lysosomes. Cells can digest their own mitochondria in case of their damage by _____.
A) phagosomes
B) residual bodies
C) autophagosomes
D) peroxisomes
E) mitochondria

19. Mitochondria is the only two-membrane organelle in animal cell. Even though both its membranes are made of phospholipid bilayer they have some special structural features that give them different properties. The outer membrane is known to be much more permeable than the inner one. Choose the correct property of the outer mitochondrial membrane:
A) highly impermeable
B) contains ATP-syntase complex
C) forms cristae
D) contains catalase
E) its lipid composition resembles other cellular membranes

20. While studying a pancreatic acinar cell under electron microscope the research assistant sees an organelle surrounded by two membranes. The outer one is smooth while the inner one makes multiple folds increasing its surface. Which double-membrane organelle does the assistant see?
A) Golgi apparatus
B) mitochondrion
C) lysosome
D) peroxisome
E) endoplasmic reticulum

21. The endosymbiotic theory of the origin of a certain organelle postulates that it used to be bacteria engulfed by the cell that survived phagocytosis because of being useful to the cell. This theory is proved by multiple facts including ability of this organelle to produce certain proteins for it due to presence of DNA in its matrix. DNA synthesis is detected in an organelle. This organelle is called _____.
A) lysosome
B) rough endoplasmic reticulum

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C) mitochondrion
D) Golgi apparatus
E) peroxisome

22. Porins are special integral proteins that are embedded in membrane and act as a pore, through which molecules can diffuse. Unlike other membrane transport proteins, porins are large enough to allow passive diffusion, as they act like channels that are specific to different types of molecules. Porins can be located in _____ .
A) outer mitochondrial membrane
B) inner mitochondrial membrane
C) intermembrane space of a mitochondrion
D) matrix
E) stroma

23. Mitochondria are known to be surrounded by 2 membranes that are not identical in structure. Due to slightly different chemical composition outer and inner mitochondrial membranes have different properties and functions. The outer membrane is pretty permeable while the inner one is almost impermeable and hosts proteins of electron-transport chain and ATP-synthases. The specific lipid of the inner mitochondrial membrane is called:
A) dolichol
B) ganglioside
C) cholesterol
D) cardiolipin
E) mitofusin

24. Transcription is a process of RNA production on DNA matrix necessary for protein synthesis. Majority of DNA in the cell is accumulated in nucleus where transcription normally happens. In any case there is an organelle in the cytoplasm of human cells that also has its own protein-producing apparatus including DNA and ribosomes. RNA synthesis on DNA matrix is detected in an organelle. This organelle is called:
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) mitochondrion
D) lysosomes
E) peroxisome

25. Mitochondria is a unique organelle that is characterised by high level of independence in the cell. It can produce proteins for itself due to presence of its own genetic material and ribosomes. It is worth mentioning that ribosomes present in mitochondrial matrix are not similar to those spread in cytoplasm and

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attached to membranes of endoplasmic reticulum. The mitochondrial ribosomes are similar to those of:
A) plants
B) fungi
C) algae
D) bacteria
E) none of the answers

26. Certain tissues around human organism are more energy-consuming than the others. For example, muscles need more energy for contraction and nerve cells for conduction of impulses. Muscle fibres, soma of neurons and hepatocytes that have high level of activity contain in their cytoplasm increased number of organelles that produce ATP. Which organelle synthesizes ATP?
A) mitochondrion
B) ribosome
C) Golgi apparatus
D) lysosome
E) peroxisome

27. Some of cellular membranes make multiple invaginations or folds to increase their surface for performing various functions. During electron microscope study of hepatocyte scientist observes a certain organelle whose membrane rich in enzymes makes inner folds called cristae. Cristae are located in:
A) mitochondria
B) smooth endoplasmic reticulum
C) Golgi apparatus
D) lysosomes
E) peroxisomes

28. Ribosomes are non-membrane organelles located in the cell both freely spread around cytoplasm and attached to the wall of rough endoplasmic reticulum. Different location of ribosomes is connected to different destiny of proteins that they produce. There is also one organelle in the cell that contains its own ribosomes for producing proteins for itself. This organelle is called _____.
A) smooth endoplasmic reticulum
B) rough endoplasmic reticulum
C) mitochondrion
D) lysosome
E) peroxisome

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29. While studying the ultrastructure of the nerve cell a laboratory assistant finds multiple organelles whose membrane folds inside of their matrix making thin protrusions called cristae. The main function of cristae is increasing the surface for attachment of various enzymes. Cristae can be found in:
A) mitochondria
B) smooth endoplasmic reticulum
C) rough endoplasmic reticulum
D) lysosome
E) peroxisome

30. Mitochondria are complex organelles that include multiple structures helping them to organise various processes that eventually lead to producing ATP molecules to provide energy needs of the cell. Which of the following is NOT the part of the mitochondrion:
A) outer membrane
B) inner membrane
C) intermembrane space
D) matrix
E) stroma

31. Mitochondria are characterised by their own protein-production systems that make them to a certain degree independent from the nucleus. These two-membrane organelles contain genetic material and all the forms of RNA that are necessary to provide all stages of protein synthesis from transcription to translation. Which of the following can NOT be found inside the mitochondrion:
A) circular DNA
B) linear DNA
C) mRNA
D) tRNA
E) rRNA

32. Majority of organelles in the cell make a system that is very much connected due to possibility of membranes to fuse with each other and later detach making vesicles. These vesicles help to transport materials from one organelle to another. In any case there is an organelle rather isolated from this system of interaction. Vesicles from the Golgi apparatus can be targeted to every specified part of the cell EXCEPT:
A) endoplasmic reticulum
B) lysosome
C) mitochondrion
D) plasmalemma
E) secretory vesicle

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33. Ultrastructural study of a muscle fibre demonstrates increased number of mitochondria with typical folds present in them that have characteristic wrinkled shape, providing a large amount of surface area for chemical reactions to occur on. These folds are called cristae and they contain various proteins, including ATP synthase and a variety of cytochromes. Cristae are formed by __
A) outer mitochondrial membrane
B) inner mitochondrial membrane
C) intermembrane space
D) matrix
E) stroma

Answers

1 – B; 2 – D; 3 – D; 4 – D; 5 – C; 6 – D; 7 – B; 8 – B; 9 – B; 10 – B; 11 – C; 12 – D; 13 – C; 14 – B; 15 – D; 16 – E; 17 – D; 18 – C; 19 – E; 20 – B; 21 – C; 22 – A; 23 – D; 24 – C; 25 – D; 26 – A; 27 – A; 28 – C; 29 – A; 30 – E; 31 – B; 32 – C; 33 – B.

Chapter VII.

1. The electron microscopy analysis of the tissue from the tumour of a 40 y.o. male shows the changes in the nuclear envelope structure of the cells. Which statement about the nuclear envelope is NOT correct?
A) It is made of 2 membranes
B) Chromatin may be attached to inner nuclear membrane
C) Outer nuclear membrane contains ribosomes
D) Pore complexes include 6 proteins
E) The space between membranes is called perinuclear

2. The liver taken from a young experimental animal from the control group (which didn't undergo any influence) was processed and studied under the light microscope with classical eosin and haematoxylin staining. The nuclei in majority of hepatocytes were pale due to abundancy of euchromatin. Which statement about euchromatin is true?
A) It does not participate in transcription
B) It is mostly concentrated under nucleolemma
C) It is typical for inactive hepatocytes
D) It proves the protein production activity of the cell
E) It is better stained by haematoxylin than heterochromatin

3. A 29 y.o. patient addressed the hospital due to constant nosebleeds. The general blood analysis has shown decreased number of platelets in peripheral

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blood. The patient was sent for a biopsy of red bone marrow to analyse the capability of blood production. The blood stem cells located in red bone marrow are responsible for this process. What statement about these cells is true?
A) They have high nuclear index
B) They have low nuclear index
C) Their nucleus is dark due to dominating euchromatin
D) All statements are true
E) All statements are false

4. A baby was taken to the hospital by its parents as it was showing the characteristic signs of premature aging. After a series of clinical check-ups, the progeria was detected. It is a disease connected with the disordered genes coding proteins of nuclear lamina. There are several proteins of nuclear lamina that can be received after alternative splicing of the transcribed gene.
Transcription is the process of:
A) DNA repair
B) Doubling of all DNA molecules
C) RNA synthesis
D) DNA synthesis
E) Polypeptide synthesis

5. One of the keys to study of cell aging lays in the molecular analysis of the reasons of progeria (a disease that develops because of gene mutation and leads to pre-mature aging). The interesting fact is that the mutated gene codes 2 different nuclear proteins that can be received during mRNA processing. The third stage of RNA processing is:
A) Polyadenylation
B) Capping
C) Trimming
D) Splicing
E) Elongation

6. During the crime scene investigation in the place where the murder was committed forensic scientist found several droplets of blood. The fast analysis under the light microscope demonstrated the presence of Barr bodies in the neutrophils of the blood. It was the evidence that the blood belonged to female. What is the form of Barr body in the interphase cell?
A) Euchromatin
B) Facultative heterochromatin
C) Constitutive heterochromatin
D) Nucleoplasm
E) Nuclear juice

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7. Permanent stress due to chronic inflammation, ultraviolet or reactive Oxygen species might induce a mutation in DNA and its arrangement around the nucleus of influenced cell. It is known that the DNA of interphase cell is structured as euchromatin or heterochromatin. What statement about heterochromatin is true?
A) It is pale-stained
B) It is transcriptionally active
C) It is a non-replicated chromatin
D) It is a loosely packed form of DNA
E) It is a tightly packed form of chromatin

8. A 27 y.o. patient comes to the hospital for a regular check-up. A doctor finds the symptoms of liver disorder. The light microscopy analysis of liver biopsy shows a high concentration of heterochromatin in nuclei of hepatocytes. What statement about facultative heterochromatin is correct?
A) It is always highly condensed and inactive
B) It is inactive and highly condensed, but may transform into euchromatin
C) It is active and not highly condensed
D) It is inactive and not highly condensed
E) It is active and highly condensed

9. A 52 y.o. man who has been working open-air for a many years has addressed the doctor because of rash and itchy skin that couldn't be explained by allergy. After histological analysis, the doctor diagnosed skin cancer. It is known that excessive influence of the sun light on the skin may lead to cancer due to the damage to DNA structure and arrangement. Choose an INCORRECT property of DNA molecules:
A) Can form double-stranded structures
B) Their nucleotides contain deoxyribose
C) Can act as an enzyme
D) Contain cytosine
E) Contain uracil instead of thymine

10. A 5 y.o. patient was diagnosed with type I diabetes. The reason of this type of diabetes is related to disorder of insulin production by cells of pancreas. This protein is produced by ribosomes attached to some membranes in the cell. Mature functionally active ribosomes can be found at:
A) Outer nuclear membrane
B) Inner nuclear membrane
C) Nuclear lamina
D) Nuclear lumen
E) Nucleolus

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11. The nucleus plays major role in regulation of cell metabolism and other aspects of its functioning. Disorders in the nuclear structured can be diagnosed under light microscope as they usually are expressed by modified and changed nuclear surface apparatus. What is NOT a nuclear surface apparatus component?
A) Inner nuclear membrane
B) Outer nuclear membrane
C) Barr body
D) Nuclear lamina
E) Nuclear pore

12. During the operation on the small intestines of a 70 y.o. patient a biopsy was taken for the further histological analysis. The routine eosin and haematoxylin staining allowed to diagnose the cancer because of dramatic changes expressed in nuclear envelope structure. What is NOT a nuclear envelope component?
A) Inner nuclear membrane
B) Outer nuclear membrane
C) Lumen
D) Nucleolus
E) Nuclear pore

13. A 45 y.o. man was taken to hospital with chest pain and fatigue. Medical examination and various laboratory tests helped to diagnose dilated cardiomyopathy. This disease may be caused by mutations that lead to nuclear envelope disorders. The nuclear envelope is considered as an extension of:
A) Mitochondrion
B) Peroxisome
C) Golgi apparatus
D) SER
E) RER

14. Hepatocytes are known to produce blood plasma proteins like fibrinogen and albumins. It is known that the organelles responsible for protein production are ribosomes produced by nucleoli of the cells. Which part of the nucleolus contains the majority of ribosomal subunits?
A) Fibrillar center
B) Dense fibrillar component
C) Light center
D) Light component
E) Granular component

15. Multiple important processes related to protein production and regulation of cell metabolism happen inside nucleus. Majority of these processes are energy-

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consuming so the ATP produced by mitochondria in the cytoplasm must enter the nucleus trough nuclear pores. How many globular subunits does the nuclear pore contain in each of three rings?
A) 3
B) 6
C) 8
D) 12
E) 24

16. An autopsy from the body of a 40 y.o. man who died of cancer showed multiple tumours around the body. Histological analysis of the material from these tumours demonstrated cancer-modified cells – they had overstretched lumen of irregular shape. The nuclear lumen is:
A) Connected to the cytosol through the nuclear pore complexes
B) Connected to the karyoplasm through the nuclear pore complexes
C) Connected to the internal space of the RER through the nuclear pore complexes
D) Connected to the extracellular space through the nuclear pore complexes
E) Not connected to the any other space through the nuclear pore complexes

17. One of the most dramatic diseases connected with proteins that form nuclear lamina is progeria – pre-mature aging. It is caused by mutation in the gene coding several lamin proteins. The nuclear lamina in human cells is composed of all the following proteins EXCEPT:
A) Lamin A
B) Lamin B1
C) Lamin B2
D) Lamin C
E) Lamin D

18. Cancer cells are known for uncontrolled division that leads to the grows of tumours. Their endless mitotic cycles are based on the process of DNA replication. What is it?
A) DNA repair
B) Synthesis of DNA on RNA
C) Synthesis of RNA on DNA
D) Doubling of all RNA molecules
E) Doubling of all DNA molecules

19. Female patient in her mid-forties came to endocrinologist to check the level of adrenal glands hormones in blood. While the level of steroid hormones was normal, the protein-nature hormones' level was decreased. Proteins meant for

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secretion are known to be produced on the ribosomes of RER. What statement about their production is NOT true?
A) They are produced inside nucleus
B) They are produced in nucleolus
C) Small and large subunits are assembled in the nucleus
D) Small and large subunits are assembled in the cytoplasm
E) All the statements are true

20. The microscopic study of the epithelial cells from the skin biopsy of a 27 y.o. patient who had suspicion of a malignant neoplasm showed dark nuclei with dominant heterochromatin. What do euchromatin and heterochromatin have in common?
A) They are both made of DNA
B) They both contain histones
C) They both disappear during cell divisions
D) They both are typical for interphase
E) All statements are true

21. It is known that nucleus is responsible for the control over the processes in the cell. One of its functions is transcription that is the first stage of protein production. What is typical for the morphology of nucleus in the cells that actively produce proteins?
A) Dominance of euchromatin
B) Dominance of constitutive heterochromatin
C) Dominance of facultative heterochromatin
D) Extension of perinuclear space
E) All of the answers

22. The study of the cell from the autopsy material of a 75 y.o. deceased male patient demonstrates the structure surrounded by 2 membranes filled with pale zones of euchromatin and dark zones of heterochromatin. What structure is under the electron microscope study?
A) Mitochondria
B) Nucleus
C) Nucleolus
D) Raugh endoplasmic reticulum
E) Chloroplast

23. The dynamic processes of cell activity and metabolism are always reflected in the structure of the nucleus, first of all in the ration between different types of chromatin. What is the correct characteristic of constitutive heterochromatin?
A) It is always highly condensed and inactive
B) It is inactive and highly condensed, but may transform into euchromatin

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C) It is active and not highly condensed
D) It is inactive and not highly condensed
E) It is active and highly condensed

24. It is known that one of the main functions of nucleus is storing the information about structure of polypeptides in the form of DNA. The molecule of DNA is too long and must be compacted to be stored in nucleus. This function is provided by histones that build a core for DNA to twist around and make nucleosomes. How many histone molecules compose the core of nucleosomes?
A) 2
B) 4
C) 5
D) 8
E) 10

25. The standard staining of the cell with eosin and haematoxylin results in the purple colour of nucleus. The reason is that this structure is basophilic and attracts basic dye that is haematoxylin. The basophilic nature of nucleus is mostly caused by presence of DNA and its chemical nature. Which structure is NOT a DNA component?
A) Phosphoric acid
B) Deoxyribose
C) Ribose
D) Thymine
E) Cytosine

26. Hutchinson–Gilford syndrome that leads to pre-mature aging is caused by a single gene mutation. This gene can make several proteins necessary for supporting the shape of nucleus. When it gets mutated, an abnormal form of lamin A protein is produced. The other lamin protein Lamin C is not damaged by mutation even though it is coded by the same gene because it is produced from another version of mRNA. Different mature mRNAs can be formed from one hnRNA template through:
A) Termination
B) Differential capping
C) Alternative splicing
D) Polyadenylation
E) Initiation

27. The study of a cell under the light microscope after eosin and haematoxylin staining shows purple nucleus that is not homogenously stained – there are

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darker zones of heterochromatin in the periphery. What types of heterochromatin can be distinguished in the cell nucleus?
A) Facultative
B) Constitutive
C) Constitutional
D) A and B
E) A and C

28. Morphological study of cells from the biopsy taken during the operation under the electron microscope shows the dark zones located right under the inner membrane of the nuclear envelope. Which structures are these?
A) Nucleoli
B) Aggregations of euchromatin
C) Aggregations of wall surface heterochromatin
D) Nucleoplasm
E) Nuclear matrix

29. The nucleus includes the surface apparatus, nucleoplasm, nucleoskeleton, nucleoli and chromatin. Chromatin is a compacted form of the DNA, but it also includes histones and RNA. Which structure is NOT an RNA component?
A) Phosphoric acid
B) Deoxyribose
C) Ribose
D) Guanine
E) Cytosine

30. Chemical analysis of the chromatin extracted from the nucleus of the cell shows the presence of 3 main compounds: DNA, proteins (mostly histones) and RNA. Choose an INCORRECT property of RNA molecules:
A) Can form double-stranded structures
B) Their nucleotides contain ribose
C) Can act as an enzyme
D) Contain cytosine
E) Contain thymine instead of uracil

31. Nucleus plays major role in the process of protein synthesis by the cell. Not only does it provide information about the order of amino acids in the polypeptides but also it produces ribosomes that provide translation stage of this process. Large and small ribosomal subunits are made by nucleolus. Which part of the nucleolus contains the majority of newly synthesized rRNA?
A) Fibrillar center
B) Dense fibrillar component
C) Granular center

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D) Dense granular component
E) Light component

32. The histological study of a sample of tissue from the 80 y.o. male patient deceased of lung cancer shows abnormal structure of nuclear surface apparatus in alveolar malignant cells. The space between outer and inner nuclear membranes was overstretched and had irregular shape. What is the correct name of this space?
A) Perinuclear
B) Paranuclear
C) Intranuclear
D) Extranuclear
E) Endonuclear

33. It is known that the nucleus is very well integrated in multiple metabolic processes in the cell. Nucleoplasm and cytoplasm are connected by the nuclear pores. Which molecules come from cytoplasm to nucleoplasm through the pores?
A) ATP and subunits of ribosomes
B) Histones and subunits of ribosomes
C) ATP and mRNA
D) Histones and mRNA
E) ATP and histones

34. The analysis of ultramicroscopic structure of nucleus under electron microscope shows the “gaps” in the nuclear envelope limited by proteins – nuclear pores. It is known that they connect the inner space of nucleus – nucleoplasm, with cytoplasm. Which molecules come from nucleoplasm to cytoplasm through the pores?
A) ATP and subunits of ribosomes
B) mRNA and subunits of ribosomes
C) ATP and mRNA
D) Histones and mRNA
E) ATP and histones

35. Ultramicroscopic study of the nucleus in the cells of liver tissue received from biopsy demonstrate the connection of this organelle with the rough endoplasmic reticulum around it. What part of nucleus is directly connected to RER and even contains ribosomes?
A) Inner nuclear membrane
B) Outer nuclear membrane
C) Nucleoplasm
D) Nucleoli

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E) Chromatin

36. Researcher studies the ultrastructure of cancer cell line under electron microscope. Distended irregularly shaped perinuclear space is a typical morphological feature of malignantly modified cells. Where is it located?
A) Between outer and inner mitochondrial membrane
B) Between membranes of RER
C) Between membranes of SER
D) Between outer and inner nuclear membranes
E) All the answers are wrong

37. The vital role of nucleus in the life of a cell relates to its structure. It is separated from cytoplasm by 2 membranes and all transport to nucleus is strictly controlled by nuclear pore complexes. What statement about their structure is correct?
A) They are made of 3 rings with 8 proteins in each
B) They are made of 1 ring with 8 proteins
C) They are made of 8 rings with 3 proteins in each
D) They are made of 3 rings with 6 proteins in each
E) They are made of 4 rings with 4 proteins in each

38. While studying the nucleus under electron microscope it is possible to distinguish 2 membranes with perinuclear space between them. The shape and size of perinuclear space is an important diagnostic feature in cell morphological studies. What is the main difference between inner and outer nuclear membranes?
A) Presence of phospholipids
B) Presence of pore protein rings
C) Presence of ribosomes
D) All of the answers
E) None of the answers

39. A 15 y.o. female patient comes to the dietologist because of nearly total loss of fat beneath the skin. After medical check-up and several laboratory studies doctor diagnoses laminopathic lipodystrophy. This rare genetic disease is associated with proteins of nuclear skeleton – lamin proteins. Where are lamin proteins located?
A) In perinuclear space
B) Attached to outer nuclear membrane
C) Attached to inner nuclear membrane
D) In nucleolus
E) Attached to ribosomes

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40. The excessive influence of ultraviolet on the cell may lead to its malignant transformations because it causes damage to double DNA helix. What process in the nucleus is aimed to resist such negative influences, fix the damage caused by such factors and decrease number of possible mistakes in DNA structure?
A) Replication
B) Transcription
C) Translation
D) Splicing
E) Reparation

41. Nucleus plays a significant role in protein synthesis but not all stages of this process take place in the nucleoplasm. What stage of protein production takes place in cytoplasm?
A) Transcription
B) Translation
C) Splicing
D) Polyadenylation
E) All of the answers

Answers

1 – D; 2 – D; 3 – A; 4 – C; 5 – D; 6 – C; 7 – E; 8 – B; 9 – E; 10 – A; 11 – C; 12 – D; 13 – E; 14 – E; 15 – C; 16 – E; 17 – E; 18 – E; 19 – C; 20 – E; 21 – A; 22 – B; 23 – A; 24 – D; 25 – C; 26 – C; 27 – D; 28 – C; 29 – B; 30 – A; 31 – B; 32 – A; 33 – E; 34 – B; 35 – B; 36 – D; 37 – A; 38 – C; 39 – C; 40 – E; 41 – B.

Chapter VIII.

Cell cycle.

1. Histological study of biopsy material from pancreas reveals a large number of cells that don't divide at the moment and provide their secretory functions. These cells are in interphase. The interphase of eukaryotic cells includes the following stages:
A) prophase, metaphase, anaphase
B) chromatin, chromatid, chromosome
C) telophase, mitosis, binary fission
D) presynthetic, synthetic, postsynthetic
E) interphase, metaphase, anaphase

2. Majority of somatic cells in the body have the ability to divide with mitosis. Still, certain processes must be provided before the cell that has just divided, will be able to divide again. The part of cell cycle where the cell grows to its

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full size, copies the DNA and organelles, and prepares to divide is called the _____.
A) mitosis
B) interphase
C) fission
D) cytokinesis
E) meiosis

3. Typical laboratory analysis of the biopsy samples from the body under light microscope allows to analyse morphology of somatic cells. Most of the cells are usually observed in a certain period of their cell cycle as it is the longest and the probability to "catch" them in this period is the highest. The longest part of the cell cycle is the _____.
A) interphase
B) mitosis
C) cytokinesis
D) binary fission
E) karyokinesis

4. A biopsy taken from the red bone marrow of a 15 y.o. donor before transplantation to the recipient shows multiple cells that are able to divide with mitosis and reproduce the blood cells of human organism. Before dividing, a cell must make a copy of its _____.
A) cytoplasm
B) DNA
C) ATP
D) nucleus
E) membrane

5. The most common method of overview staining for tissues taken from human organism that allows to characterise general condition of cells is eosin and haematoxylin staining. Nucleus is known to be stained by haematoxylin because it expresses basophilic characteristics as it has acidic nature – it contains nucleic acids. A nucleic acid that contains the genetic instructions for the development and function of living things is called _____.
A) RNA
B) CPR
C) DNA
D) ATP
E) GTP

6. Analysis of a sample taken from human small intestine during operation shows the basal cell that divides to provide regeneration of intestinal covering

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epithelium. The cell is in metaphase so allows to see all the chromosomes present in it. Humans somatic cells have _ chromosomes.
A) 24
B) 52
C) 16
D) 46
E) 63

7. Somatic cells of our body are known to divide with mitosis to reproduce their populations. The process of division is connected with multiple changes in nuclear structures including DNA. Due to that, structuring of genetic material in human cells that are in interphase (don't divide) and during their division is totally different. Which of these structures are present during the interphase?
A) mitotic spindle
B) nuclear envelope
C) nuclear reticulum
D) X-shaped chromosomes
E) V-shaped chromosomes

8. The cells of epithelial tissue tend to desquamate with pretty high frequency. In order to provide regeneration of epithelial tissue, basal cells attached to basal membrane have ability to divide and substitute the desquamated ones. One of the most important events in cell cycle that prepares the cell for division is duplication of DNA. At what period of cell cycle does the DNA duplicate?
A) G1-period
B) S-period
C) G2-period
D) G0-period
E) S0-period

9. It is known that mitosis of human somatic cells is provided by separation of doubled chromosomes of the mother cell between daughter cells in anaphase of this division. Very important role in this separation belongs to mitotic spindle produced by centrioles. So, before starting mitosis centrioles must be doubled to go to opposite poles of the cell in the future. At what period of cell cycle do centrioles double?
A) G1-period
B) S-period
C) G2-period
D) G0-period
E) S0-period

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11. One of the main characteristics and dangers of cancer development is the unstoppable division of cancer cells that leads to growth of the tumour. Cancer can be seen as a disruption of normal restriction point function, as cells continually and inappropriately reenter the cell cycle. At what period of cell cycle do cells pass the restriction point R?

A) G1-period
B) S-period
C) G2-period
D) G0-period
E) S0-period

12. Cancer cells are known to spend less time in interphase and reproduce rapidly before they have had a chance to mature. One of important stages in cell division is cytokinesis that leads to splitting the cytoplasm of the mother cell between two daughter cells. The resulting cells are smaller than the original one so before starting to function or dividing again they have to reach the original size. The part of interphase during which a cell grows to its full size is called the _____.

A) G1-period
B) S-period
C) G2-period
D) G0-period
E) S0-period

13. Stem cells of our body have ability to divide and substitute those cells that have limited life span and periodically die (epithelial, blood cells etc). In any case stem cells can't start new division immediately after the previous one finished as certain processes must take place in the cell before division. Some of them must happen right before the start of mitosis. The part of interphase during which a cell produces tubulins for future mitotic spindle and finishes preparation to division is called _____.

A) G1-period
B) S-period
C) G2-period
D) G0-period
E) S0-period

14. A 75 y.o. patient comes to the hospital with chronic symptoms of hypoxia (difficulty breathing, rapid heart rate, and bluish skin). In order to evaluate the ability of his body to regenerate the red blood cells responsible for oxygen carrying capacity of blood, red bone marrow biopsy was taken. In the smear multiple stem cells are in interphase preparing for future division. The part of

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interphase during which a cell copies the DNA and centrioles is called the _____.
A) G1-period
B) S-period
C) G2-period
D) G0-period
E) S0-period

15. After partial hepatectomy (surgical removal of a portion of the liver) in a 30 y.o. patient some hepatocytes in remaining part of liver that did not divide for some time restored ability for mitosis. This ability increases the regenerative potential of liver. After intensive regenerative process, the cells stopped divisions again. Cells that have temporarily stopped divisions but retain the ability to return to the division process are in the _____.
A) elongated G1-period
B) elongated S-period
C) elongated G2-period
D) G1-period
E) G2-period

16. A 54 y.o. female patient was transported to hospital after ischemic stroke. Acute hypoxia has led to dramatic changes in the brain including cell death of neurons. After reperfusion (restoring blood supply to the tissues) the main aim of the therapy was restoring of brain functions. Unfortunately, neurons belong to a category of cells that are so highly specialised that they lose their ability to divide and substitute dead cells. The period used to describe the cells that have permanently stopped divisions is _____.
A) G1-period
B) S-period
C) G2-period
D) G0-period
E) S0-period

17. Multiple cells in our body have the ability to divide and provide regenerative processes. They need to pass certain stages in their cell cycle before and after their divisions. They are called interphase all together and include pre-synthetic, synthetic and post-synthetic phases. Pre-synthetic period can also be called _____.
A) G1-period
B) S-period
C) G2-period
D) G0-period
E) S0-period

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18. One of the most important events in a cell cycle is the process of DNA replication as during division the daughter cells must receive 46 chromatids. It is known that doubling of DNA happens during synthetic period. Synthetic period is a/an _____.
A) G1-period
B) S-period
C) G2-period
D) G0-period
E) S0-period

19. Majority of cells in human body are able to divide with mitosis. Preparation for division is rather complicated and includes a series of stages joined with the name interphase. These stages have different names; one of them is called post-synthetic. What is another name for post-synthetic period?
A) G1-period
B) S-period
C) G2-period
D) G0-period
E) S0-period

20. Starting from the prophase of mitosis, centrioles (microtubule-organizing centres) start producing microtubules by assembling special protein – tubulin that had been accumulated in the cell in G2 phase. There are various types of microtubules participating in mitotic spindle, some of them are called astral. Choose the correct direction of an astral microtubule.
A) begins at the microtubule-organizing center and ends at plasmalemma
B) begins at plasmalemma and ends at the microtubule-organizing center
C) begins at the microtubule-organizing center and ends at kinetochore
D) begins at kinetochore and ends at the microtubule-organizing center
E) begins at the microtubule-organizing center and ends near opposite pole

21. The main purpose of mitotic spindle is to attach to chromosomes arranged in metaphase plate and separate sister chromatids to opposite poles of the cell during anaphase. This leads to equal distribution of genetic material between the daughter cells. According to direction of their growth different types of microtubules can be distinguished. Choose the correct direction of kinetochore microtubules.
A) begins at the microtubule-organizing center and ends at plasmalemma
B) begins at plasmalemma and ends at the microtubule-organizing center
C) begins at the microtubule-organizing center and ends at kinetochore
D) begins at kinetochore and ends at the microtubule-organizing center
E) begins at the microtubule-organizing center and ends near opposite pole

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22. Mitotic spindle is made of microtubules and grows from the centrioles (microtubule-organizing centres) in all of the directions. Not all microtubules are going to reach the chromosomes and get attached to them. Choose the correct direction of polar microtubules.
A) begins at the microtubule-organizing center and ends at plasmalemma
B) begins at plasmalemma and ends at the microtubule-organizing center
C) begins at the microtubule-organizing center and ends at kinetochore
D) begins at kinetochore and ends at the microtubule-organizing center
E) begins at the microtubule-organizing center and ends near opposite pole

23. An analysis of a red bone marrow smear from the biopsy of a 25 y.o. patient who volunteered to be a donor for his younger brother shows multiple hematopoietic cells on different stages of cell cycle. The stage of the cell cycle when the nucleus divides into two nuclei is called _____.
A) prophase
B) interphase
C) cytokinesis
D) mitosis
E) anaphase

24. While studying the biopsy from the liver tumour of a 37 y.o. patient the scientist observes the cells that are able to divide uncontrollably. The cells divide with mitosis and pass all the stages of this division again and again with pretty short interphase between them. Place the stages of mitosis in a right order.
A) telophase, prophase, metaphase, anaphase
B) metaphase, anaphase, telophase, prophase
C) anaphase, telophase, prophase, metaphase
D) prophase, metaphase, anaphase, telophase
E) prophase, anaphase, metaphase, telophase

25. Genetic scientist studies the dividing cells from a stimulated cell culture. Some of the cells are characterised by the presence of metaphase plate in equatorial zone. The metaphase plate during mitosis is made of chromosomes, each of them consisting of 2 chromatids. Chromosomes are held together by _____.
A) centriole
B) centromere
C) chromatid
D) telomere
E) satellite

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26. Colchicine is a medication used to block the mitotic spindle assembling in order to study the chromosomes in the cell in metaphase. The main aim of mitotic spindle is to pull the chromatids to the opposite poles of the cell. To provide the process of chromatid separation the fibres of mitotic spindle attach to them. A proteinous structure associated with duplicated chromatids in eukaryotic cells where the spindle fibers attach during cell division is called _____.

A) glucose
B) kinetochore
C) cytoplasm
D) fission
E) ATP

27. Hepatocytes are characterised by high level of metabolic activity. One of their functions is production and secretion of blood plasma proteins like albumin and fibrinogen. In order to increase intensity of protein synthesis some hepatocytes have 2 nuclei. Such morphology is a result of the cell skipping the stage of cytokinesis in late telophase. During cytokinesis, a cell _____.

A) copies the DNA
B) forms chromosomes
C) splits the nucleus
D) divides into two cells
E) forms chromatid

28. It is known that mitosis is a part of the cell cycle in which replicated chromosomes are separated into two new nuclei. The process of mitosis is divided into stages corresponding to the completion of one set of activities and the start of the next. What is the correct order of the stages of mitosis? 1-Anaphase 2-Metaphase 3-Prophase 4-Telophase

A) 3,2,1,4
B) 3,4,1,2
C) 1,2,3,4
D) 1,3,2,4
E) 4,1,3,2

29. The process of cell division is complicated and includes a long preparation and several stages that result in rearrangement of chromatids between the daughter cells. The last phase of mitosis is telophase and it provides formation of new nuclei around these chromatids. The last process taking place in telophase is cytokinesis. The term cytokinesis describes _____.

A) the splitting of a cell during mitosis
B) the duplication of genetic material during mitosis
C) the condensing of chromatin into chromosomes during mitosis

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D) the separation of chromosomes during mitosis
E) the splitting of a cell nucleus

30. After hepatectomy (removing part of liver) in a 39 y.o. patient the remaining part of the organ actively regenerates. Hepatocytes enter mitosis and divide to substitute the missing cells. During the process of mitosis certain processes happen with DNA as it is restructured. During the prophase stage of mitosis, the _____.
A) chromosomes separate
B) chromosomes line up
C) chromosomes condense
D) chromosomes decondense
E) chromatids form

31. The result of mitosis is a production of new cells. Cell division by mitosis gives rise to genetically identical cells in which the total number of chromosomes is maintained. In order to rearrange the DNA of the mother cell between daughter cells it is condensed and decondensed. At what stage of mitosis do the chromosomes condense?
A) prophase
B) metaphase
C) anaphase
D) telophase
E) cytokinesis

32. The nucleus is a container for DNA that helps to arrange it and use the information coded by it. The level of DNA condensation in interphase and during division is different so while mitosis cell nucleus disintegrates to give the possibility to rearrange the DNA between daughter cells. At what stage of mitosis does the nucleus envelope disintegrate into small membrane vesicles?
A) prophase
B) metaphase
C) anaphase
D) telophase
E) cytokinesis

33. One of the roles of nucleus in the life of a cell is participation in the process of protein production. Not only does it transcribe the information to mRNA but also produces subunits of ribosomes for future translation. The function of ribosomal subunits production belongs to nucleoli. As during cell division this production stops and DNA from nucleoli condenses to chromosomes, they disappear. At what stage of mitosis do the nucleoli disappear?
A) prophase

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B) metaphase
C) anaphase
D) telophase
E) cytokinesis

34. The process of mitosis is connected with multiple modifications within DNA that lead to its rearrangement between daughter cells. In the first stage of mitosis some nuclear structures like nucleoli and nuclear envelope disintegrate. Which of these events occurs to chromosomes during prophase?
A) divergence of the chromosomes to the poles of the cell
B) condensation of the chromosomes
C) decondensation of the chromosomes
D) lining of the chromosomes in the equatorial plate
E) lining of the chromosomes at the poles of the cell

35. Mitotic division of the cell is accompanied by equal distribution of sister chromatids between daughter cells. It is provided by mitotic spindle and restructuring of nuclear elements and happens during consecutive series of phases. One of these phases is metaphase. During the metaphase stage of mitosis, _____.
A) chromosomes line up
B) two nuclei form
C) chromosomes separate
D) chromosomes condense
E) splits the nucleus

36. Mitosis in human organism ensures that one chromatid from each of 46 replicated chromosomes passes into each new cell. Before this separation starts, all the chromosomes are arranged in the equatorial zone of the cytoplasm in mother cell making so called “equatorial plate”. At what stage of mitosis do the chromosomes line up in the equatorial plate?
A) prophase
B) metaphase
C) anaphase
D) telophase
E) cytokinesis

37. The period of cell division is convenient for the study of number and morphology of chromosomes as they are not visible during interphase because DNA is in the form of chromatin. The main phase of mitotic division normally used for such studies is metaphase. Which of these events occur during metaphase?
A) divergence of the chromosomes to the poles of the cell

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B) condensation of the chromosomes
C) decondensation of the chromosomes
D) lining of the chromosomes in the equatorial plate
E) lining of the chromosomes at the poles of the cell

38. The scientist analyses a laboratory-produced image of a person's chromosomes isolated from an individual cell and arranged in numerical order. It is used to look for abnormalities in chromosome number or structure. The best period of a cell cycle to study chromosomes is metaphase of mitotic division. Which of these structures are present during the metaphase?
A) nucleolus
B) nuclear envelope
C) X-shaped chromosomes
D) V-shaped chromosomes
E) euchromatin

39. A karyotype is an individual's complete set of chromosomes. In medicine it is studied in order to diagnose genetic diseases connected with abnormalities in number and morphology of chromosomes. During interphase, the chromosomes are decondensed, so such studies are not possible. In mitotic period on the other hand it is possible to observe chromosomes that can have X-shape or V-shape depending on the phase. Which of these structures are present during the anaphase?
A) nucleolus
B) nuclear envelope
C) X-shaped chromosomes
D) V-shaped chromosomes
E) euchromatin

40. The “fastest” stage of mitotic division is anaphase – it takes the least time comparing to all other phases. This phase is connected with activity of mitotic spindle and relocation of chromosomes in the cytoplasm. During the anaphase stage of mitosis, the _____.
A) chromosomes form
B) two nuclei form
C) chromosomes separate
D) chromosomes line up
E) splits the nucleus

41. The DNA contained in the cell nucleus during interphase of cell cycle is condensed during mitotic division to produce chromosomes. These chromosomes are pulled to the opposite poles of the cells to give start to new nuclei. The movement of chromosomes is provided by microtubules of mitotic

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spindle that attach to them in the zone of centromeres. During which stage of mitosis do the centromeres split?
A) prophase
B) interphase
C) anaphase
D) telophase
E) synthesis stage

42. Mitotic spindle plays a great role in the process of cell division. It provides the movement of sister chromatids from chromosomes doubled in the S-phase of cell cycle to the future daughter cells. During which of the following phases do the chromosomes separate and move to the opposite sides of the cell?
A) interphase
B) prophase
C) metaphase
D) anaphase
E) telophase

43. A morphological study of the intestinal epithelium from the biopsy material taken from small intestines of a 15 y.o. patient during operation shows basal epithelial cells at different stages of mitotic division. Some of these basal cells show V-shaped chromosomes attached to mitotic spindle. At what stage of mitosis do the chromosomes diverge to the poles of the cell?
A) prophase
B) metaphase
C) anaphase
D) telophase
E) cytokinesis

44. A biopsy of skin from a 50 y.o. female patient taken due to suspicion of melanoma was sent for further analysis under the microscope. Basal layer of epidermis contains cells with mitotic figures that help with processes of regeneration. Some of these cells are in anaphase. Which of these events occur during anaphase?
A) divergence of the chromosomes to the poles of the cell
B) condensation of the chromosomes
C) decondensation of the chromosomes
D) lining of the chromosomes in the equatorial plate
E) lining of the chromosomes at the poles of the cell

45. Mitotic division of the cell includes several consecutive stages. Each of these stages is characterised by certain changes in nuclear elements and DNA

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structures. Telophase as the last stage provides the return of cellular structures to their interphase state. During the telophase stage of mitosis, _____.
A) chromosomes form
B) two nuclei form
C) chromosomes separate
D) chromosomes line up
E) splits the nucleus

46. The lifespan of enterocytes (cells of intestines) is relatively short (~5–7 days). The samples of small intestine mucosa show basal cells that are dividing to produce new enterocytes. In some of the cells the scientist observes chromosomes that are in process of decondensation. At what stage of mitosis do the chromosomes decondense?
A) prophase
B) metaphase
C) anaphase
D) telophase
E) interphase

47. It is known that the nucleus undergoes major changes during mitotic division as its regular structure would not allow to rearrange the genetic material between two cells. Such parts of nucleus as nucleolus and nuclear surface apparatus completely disappear. Nuclear envelope falls apart into individual vesicles that make a new envelope by the end of mitotic process. At what stage of mitosis is the new nuclear envelope formed?
A) prophase
B) metaphase
C) anaphase
D) telophase
E) cytokinesis

48. While analysing the puncture from red bone marrow of a 45 y.o. patient who addressed the hospital due to leukaemia diagnoses, doctor sees the cells in the process of mitosis. Some of the cells have already divided their nuclei and have irregular shape because their cytoplasm started the process of division as well. At what stage of mitosis is the cytoplasm divided?
A) prophase
B) metaphase
C) anaphase
D) telophase
E) interphase

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49. General logic of mitotic division process in the cell is based on the fact that the nucleus disappears for some time, DNA gets structured in chromosomes which are separated between daughter cells. When genetic material is equally spread between the cells new nuclear structures are formed around it. The last stage of mitosis, responsible for such processes is the telophase. Which other events occur during telophase?
A) divergence of the chromosomes to the poles of the cell
B) condensation of the chromosomes
C) decondensation of the chromosomes
D) lining of the chromosomes in the equatorial plate
E) lining of the chromosomes at the poles of the cell

50. The study of hepatocytes from the biopsy of liver shows some cells that were probably infected by the virus and were programmed to die. They got shrunk and fell apart into individual bodies covered by membrane. The process of programmed cell death is called _____.
A) apoptosis
B) amitosis
C) dissociation
D) meiosis
E) life cycle

Answers

1 – D; 2 – B; 3 – A; 4 – B; 5 – C; 6 – D; 7 – B; 8 – B; 9 – B; 10 – A; 11 – A; 12 – A; 13 – C; 14 – B; 15 – A; 16 – D; 17 – A; 18 – B; 19 – C; 20 – A; 21 – C; 22 – E; 23 – D; 24 – D; 25 – B; 26 – B; 27 – D; 28 – A; 29 – A; 30 – C; 31 – A; 32 – A; 33 – A; 34 – B; 35 – A; 36 – B; 37 – D; 38 – C; 39 – D; 40 – C; 41 – C; 42 – D; 43 – C; 44 – A; 45 – B; 46 – D; 47 – D; 48 – D; 49 – C; 50 – A.

Chapter IX

9.10. Control questions.

1. Which of the following are the stages of prenatal development?
A. Pre-embryonic, embryonic and post-embryonic
B. Progenesis, embryonic and post-embryonic
C. Germinal, embryonic and fetal
D. Prezygotic, prenatal and postnatal
E. Germinal, embryonic and postnatal

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2. During early stages of embryogenesis primordial germ cells accumulate in the the yolk sac. They migrate here from the region of the Hansen's nodule of the epiblast. When do the primordial germ cells appear in the region of the Hansen's nodule?
A. On the 4th week of embryogenesis
B. On the 2nd week of embryogenesis
C. On the 3th week of embryogenesis
D. On the 6th week of embryogenesis
E. On the 1st week of embryogenesis

3. In which week of embryogenesis does the migration of the gametes precursors from the yolk sac to the developing gonads take place?
A. on the 4th week of embryogenesis
B. on the 2nd week of embryogenesis
C. on the 3th week of embryogenesis
D. on the 6th week of embryogenesis
E. on the 1st week of embryogenesis

4. During this prosses cells replicate their DNA, homologous chromosomes align in pairs and then interchange their chromatid segments, duplicated chromosomes form the metaphase plate and separate, cell divides. What is the name of this prosses?
A. meiosis II
B. meiosis I
C. mitosis
D. amitosis
E. none of the them

5. At the histological specimen of the testis of a young man in the seminefrous tubules the cells in which the synaptonemal complex begins to form are seen. In which stage of meiosis prophase-1 are these cells?
A. pachytene
B. diakinesis
C. leptotene
D. diplotene
E. zygotene

6. In which stage of the prophase of the first division during meiosis do the homologous chromosomes align in pairs?
A. pachytene
B. diakinesis
C. leptotene
D. diplotene

`

E. zygotene

7. There is recombination of DNA, chiasmata formation and amplification of ribosomal genes duiring gametogenesis. In which stage of the meiosis prophase-1 do this prosses take place?
A. pachytene
B. diakinesis
C. leptotene
D. diplotene
E. zygotene

8. In the pachytene stage of the meiosis prophase-1 the “bivalent” is formed. What is the “bivalent”?
A. zygote that contains two nuclei
B. hermaphroditic organism
C. paired homologous chromosomes
D. doubled-tailed spermatozoon
E. embryo after the first division of a zygote

9. Samples of male and female gamets are studied. Which set of chromosomes will be found in normal gamete?
A. 22 single chromosomes
B.23 autosomes and 1 sex chromosome
C. 23 autosomes
D. 22 autosomes
E. 22 autosomes and 1 sex chromosome

10. Histological examination of the epithelial tissue of young woman shows that near the nuclear membrane lays the dense body (inactivate X hromosome). This chromosome is called a _____.
A. Single chromosome
B. Autosome
C. Interphase chromosome
D. Somatic
E. Barr body

11. When does primary spermatocytes formation start?
A. On 4^{th} week of embryogenesis
B.On 2^{nd} week of embryogenesis
C. At birth
D. During the fetal period
E. At puberty

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12. Histological investigation of testes revealed presence of Sertoli cells and cells in different stages of spermatogenesis in the convoluted seminiferous tubules. Which of them has a haploid number of chromosomes represented by one chromatid?
A. Spermatids
B. Secondary spermatocytes
C. Primary spermatocytes
D. Spermatogonia
E. Sertoli cells

13. At the histological slide of a testis of 22-years-old man the seminiferous tubules with spermatogonia, primary spermatocytes, secondary spermatocytes, spermatids, Sertoli cells, interstitial tissue, Leydig cells, small blood vessels are seen. Which of the cells groups in the slide is germ cell?
A. Spermatids
B. Secondary spermatocytes
C. Primary spermatocytes
D. Spermatogonia
E. Sertoli cells

14. During one of the spermatogenesis phases the male germ cells are represented by spermatogonia. Which phase is this?
A. reproduction
B. growth
C. maturation
D. formation
E. none of the them

15. This phase of gametogenesis is characterized by a significant increase in the volume of the nucleus and cytoplasm of developing cells, and their size increases in four or more times.
A. reproduction
B. growth
C. maturation
D. formation
E. none of the them

16. In this phase of gametogenesis the spermatozoa are formed from the spermatids.
A. reproduction
B. growth
C. maturation
D. formation

`

E. none of the them

17. There are several arrests of gametogenesis. In humans, the first arrest of spermatogenesis occurs in ____.
A. prophase of the first meiotic division
B. metaphase of the first meiotic division
C. prophase of the second meiotic division
D. metaphase of the second meiotic division
E. there is no meiotic arrest during spermatogenesis

18. Spermatogenesis occurs simultaneously at different stages in various regions of the testis for a steady production and availability of mature sperm. In humans the time needed to form mature spermatozoa is ____.
A. 1-3 day
B. 7-9 days
C. 30-35 days
D. 65-75 days
E. 120-150 days

19. The right order of spermatogenesis is _____.
A. spermatogonia→primary spermatocyte→secondary spermatocyte→spermatids→spermatozoa
B. primary spermatocyte→secondary spermatocyte→spermatogonia →spermatozoa→spermatids
C. spermatids→spermatogonia→primary spermatocyte→secondary spermatocyte→ spermatozoa
D. spermatogonia →spermatids→spermatozoa→primary spermatocyte→secondary spermatocyte
E. spermatozoa→spermatogonia→primary spermatocyte→secondary spermatocyte→spermatids

20. The spermatogenesis is studied under the microscope. In wich structure does it take place?
A. seminiferous tubules
B. Graafian follicle
C. polar body
D. Sertoli cells
E. Leydig cells

21. The histological specimen of a human testis is studied under the microscope. There are big, pyramid-shaped cells lying on the basement membrane of the seminiferous tubule. These cells are supportive cells in testicular seminiferous tubules. They are called _____.

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A. spermatogonia
B. follicular cells
C. Leydig cells
D. Sertoli cells
E. antral cells

22. In the process of spermatogenesis sperm cell production takes place. Cells that enter into the spermatogenesis are called ____.
A. spermatogonia
B. primary spermatocytes
C. secondary spermatocytes
D. spermatids
E. spermatozoa

23. In the spermatogenesis 4 spermatozoa arise from _____.
A. 2 spermatogonia
B. 2 primary spermatocytes
C. 1 secondary spermatocyte
D. 1 spermatid
E. 1 spermatogonium

24. In the process of meiosis, DNA replication of each chromosome occurs, forming a structure consisting of two sister chromatids attached to a single centromere. What is this structure?
A. A duplicated chromosome
B. Two chromosomes
C. A synapsed chromosome
D. A crossover chromosome
E. A homologous pair

25. In humans, oogenesis starts _____.
A. before birth
B. in the first ten days after birth
C. in the first year after birth
D. at the beginning of puberty
E. at the end of puberty

26. As a result of the meiotic division during oogenesis large and small cells are formed. The lage cell is mature oocyte and a small cell is _____.
A. pole body
B. polar body
C. animal pole
D. vegetal pole

`

E. micromere

27. During histological study of the human ovary the follicles with oocytes surrounded by a single layer of the squamous follicular cells are found. These follicles are called_____.
A. primordial
B. primary
C. secondary
D. Graafian
E. tertiary

28. During oogenesis as a result of the first meiotic division _____ are formed.
A. 2 primary oocytes
B. 2 secondary oocytes
C. 2 polar bodies
D. 1 primary oocyte and 1 polar body
E. 1 secondary oocyte and 1 polar body

29. Which phase of gametogenesis is absent in oogenesis?
A. reproduction
B. growth
C. maturation
D. formation
E. none of the them

30. There are centrioles in the electronogram of the spermatozoon longitudinal section. Which part of spermatozoon is represented?
A. head
B. neck
C. middle piece
D. tail
E. cortex

31. There are mitochondria in the electronogram of the spermatozoon longitudinal section. Which part of spermatozoon is represented?
A. head
B. neck
C. middle piece
D. tail
E. cortex

32. This spermatozoon organelle has Golgi apparatus origin.

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A. acrosome
B. mitochondrion
C. middle piece
D. tail
E. cortex

33. The normal human spermatozoon contains ____ chromosomes.
A. 12
B. 23
C. 46
D. 69
E. 92

34. The normal human spermatozoon is ___.
A. haploid
B. diploid
C. aneuploid
D. triploid
E. euploid

35. The spermatozoon has all of the structures, exept:
A. head
B. neck
C. tail
D. acrosome
E. leg

36. It the result of the spermatogenesis from 1 spermatogonium ___ spermatozoa are formed.
A. 2
B. 3
C. 5
D. 6
E. 4

37. All primary oocytes are formed by _____.
A. week 4 of embryonic life
B. month 5 of fetal life
C. birth
D. month 5 of infancy
E. puberty

`

38. In the oogenesis, which of the following cells can remain dormant for 12 to 40 years?
A. Primordial germ cell
B.Primary oocyte
C. Secondary oocyte
D. First polar body
E. Second polar body

39. In the spermatogenesis, which of the following cells remains dormant for 12 years?
A. Primordial germ cell
B.Primary spermatocyte
C. Secondary spermatocyte
D. Spermatid
E. Sperm

40. Approximately 40,000 primary oocytes are present in the ovary of a mature young woman. How many of them will ovulate during a woman's lifetime?
A. 40,000
B.35,000
C. 480
D. 48
E. 12

41. The presence or absence of the Barr body is used to diagnose the fetal sex. What is the Barr body?
A. Inactivation of both X chromosomes
B.Inactivation of homologous chromosomes
C. Inactivation of one Y chromosome
D. Inactivation of one X chromosome
E. Inactivation of one chromatid

42. How much DNA does a primary spermatocyte contain?
A. 1N
B.2N
C. 4N
D. 6N
E. 8N

43. Pairing of homologous chromosomes occurs during meiosis. It allows DNA large segments to be exchanged. This process is called _____.
A. Synapsis
B.Nondisjunction

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C. Alignment
D. Crossing over
E. Disjunction

44. At what specific stage of meiosis does the secondary oocyte reside during ovulation?
A. Prophase of meiosis I
B.Prophase of meiosis II
C. Metaphase of meiosis I
D. Metaphase of meiosis II
E. Meiosis is completed at the time of ovulation

45. When do the oogonia enter meiosis I to form primary oocytes?
A. During fetal life
B.At birth
C. At puberty
D. With each ovarian cycle
E. Following fertilization

46. The primordial germ cells initially develop _____.
A. In the gonads at week 4 of embryonic development
B.In the yolk sac at week 4 of embryonic development
C. In the gonads at month 5 of embryonic development
D. In the yolk sac at month 5 of embryonic development
E. In the gonads at pubert

47. Numerous specified secretory vesicles of egg cells are called _____.
A.acrosomes
B.secretory granules
C.vitelline envelope
D.female pronuclei
E.cortical granules

48. A type of egg cells that contains a large amount of yolk, which is concentrated at one pole of the cell, is called _____.
A.mesolecithal
B.centrolecithal
C.isolecithal
D.telolecithal
E.alecithal

49. How can be human egg cells classified according to the amount of yolk?
A.alecithal

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B. polylecithal
C. telolecithal
D. isolecithal
E. mesolecithal

50. What do the regulatory secretory organelles of oocytes (cortical granules) contain?
A. Na
B. actin
C. pronucleus
D. lysosomal enzymes
E. ZP III

51. Which of the egg cells have a large amount of yolk?
A. mesolecithal
B. oligolecithal
C. isolecithal
D. polylecithal
E. alecithal

52. There is a cavity inside the mature ovary follicle. How is it called?
A. acrosome
B. lecithum
C. antrum
D. zona pellucida
E. coelom

53. In which stage of the meiotic division are human oocytes arrested before the fertilization?
A. prophase of the first meiotic division
B. metaphase of the first meiotic division
C. prophase of the second meiotic division
D. metaphase of the second meiotic division
E. meiosis is complete

54. In which stage of the meiotic division are *Parascaris equorum* oocytes arrested before the fertilization?
A. prophase of the first meiotic division
B. metaphase of the first meiotic division
C. prophase of the second meiotic division
D. metaphase of the second meiotic division
E. meiosis is complete

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55. In which stage of oogenesis is human oocyte when spermatozoon enters during fertilization?
A. primary oocyte
B. secondary oocyte
C. mature ovum
D. zygote
E. ovary

56. What is the term for series of structural changes of spermatozoa inside female reproductive tract?
A. maturation
B. spermiogenesis
C. spermiation
D. capacitation
E. activation

57. Which molecule is responsible for a species-specific recognition of spermatozoa in mammals?
A. bindin
B. ZP I glycoprotein
C. ZP II glycoprotein
D. ZP III glycoprotein
E. acrosin

58. What is the slow block to polyspermy caused by?
A. acrosomal reaction
B. cortical reaction
C. hydrolytic enzymes of sperm
D. depolarization of plasma membrane of egg cell
E. actin filaments of sperm

59. What is the function of the acrosomal reaction?
A. penetrate corona radiata
B. penetrate zona pellucida
C. penetrate egg cell's plasma membrane
D. penetrate sperm cell's plasma membrane
E. penetrate a wall of a follicle

60. How many polar bodies are normally observed at the moment of entry of the spermatozoon into the egg cell in humans?
A. 0
B. 1
C. 2

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D.3
E. 4

61. How many spermatozoa normally reach the site of fertilization?
A.3-5
B.300-500
C.10 000-20 000
D.200 000 – 300 000
E. 200 000 000 – 300 000 000

62. What is the fast block to polyspermy caused by?
A.acrosomal reaction
B.cortical reaction
C.hydrolytic enzymes of sperm
D.depolarization of plasma membrane of egg cell
E. actin filaments of sperm

63. During capacitation all the prosses take place, exept:
A.membrane of spermatozoa becomes less stable
B.some glycoproteins are removed from the sperm cell's plasma membrane
C.the motility of sperm cells increases
D.dynein molecules in the axoneme become more active
E. membrane of spermatozoa becomes less fluid

64. The derivative of which structure is the fertilization envelope?
A.egg cell's plasma membrane
B.sperm cell's plasma membrane
C.corona radiata
D.zona pellucida
E. yolk

65. Which of these events is needed for the fast block to polyspermy?
A.depolarization of the sperm cell membrane
B.depolarization of the egg cell membrane
C.formation of the fertilization envelope
D.formation of zona pellucida
E. egg activation

66. Through which process is the blockage of polyspermy achieved?
A.cortical reaction
B.acrosomal reaction
C.metabolic activation
D.formation of polar bodies

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E. phagocytic degradation of sperm cells

67. Where does the process of capacitation take place?
A. testis
B. male genital tract
C. female genital tract
D. ovum
E. prostate

68. When does the fertilization occur in most cases?
A. 4-5 days of ovarian-menstrual cycle
B. 9-10 days of ovarian-menstrual cycle
C. 14-15 days of ovarian-menstrual cycle
D. 19-20 days of ovarian-menstrual cycle
E. 24-25 days of ovarian-menstrual cycle

69. Which of these events is needed for the slow block to polyspermy?
A. depolarization of the sperm cell membrane
B. depolarization of the egg cell membrane
C. formation of the fertilization envelope
D. formation of zona pellucida
E. egg activation

70. Which process is previous to the entry of the sperm cell's head into the egg cell?
A. lysis of the egg cell's plasma membrane
B. fusion of the egg and sperm plasma membranes
C. endocytosis of the sperm cell by the egg cell
D. polar body-mediated transport
E. follicular cells-mediated transport

71. What is the name of the unicellular (first) stage of the embryonal development?
A. blastomere
B. blastocyst
C. germ disk
D. zygote
E. implant

72. When does synkaryon form in humans?
A. after the fusion of female and male pronuclei
B. after the first mitotic division of the embryo
C. as the result of the second meiotic division of the egg cell

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D. as the result of the first meiotic division of the egg cell
E. no synkaryon is formed

73. Which ligand is responsible for specific binding of sperm and the initiation of acrosome reaction?
A. ZP I
B. ZP II
C. ZP III
D. ZP IV
E. ZP V

74. Which type of cleavage is expected if zygote contains large amount of centrally located yolk?
A. holoblastic
B. spiral
C. bilateral
D. radial
E. superficial

75. Which pattern of cleavage is typical for avian embryos?
A. holoblastic equal
B. holoblastic unequal
C. meroblastic discoidal
D. meroblastic superficial
E. holoblastic discoidal

76. Which pattern of cleavage is typical for human embryos?
A. holoblastic equal
B. holoblastic unequal
C. meroblastic discoidal
D. meroblastic superficial
E. holoblastic discoidal

77. Which pattern of cleavage is typical for human embryos?
A. spiral
B. rotational
C. superficial
D. radial
E. bilateral

78. Which type of egg cell is characterised by discoidal cleavage?
A. microlecithal isolecithal
B. mesolecithal isolecithal

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C. mesolecithal centrolecithal
D. polylecithal centrolecithal
E. polylecithal telolecithal

79. The series of mitotic divisions in the newly formed embryo is called _____.
A. fertilization
B. cleavage
C. blastulation
D. gastrulation
E. neurulation

80. Which of the following is NOT a holoblastic cleavage pattern?
A. radial
B. rotational
C. spiral
D. superficial
E. bilateral

81. Which pattern of cleavage is typical for embryos of frogs?
A. holoblastic equal
B. holoblastic unequal
C. meroblastic discoidal
D. meroblastic superficial
E. holoblastic discoidal

82. When does cleavage take place in humans?
A. after the implantation and under the fertilization envelope
B. after the implantation and out of the fertilization envelope
C. before the implantation and under the fertilization envelope
D. before the implantation and out of the fertilization envelope
E. during the implantation and under the fertilization envelope

83. What is the name of the upper layer of cells in discoblastula?
A. hypoblast
B. hyperblast
C. epiblast
D. embryoblast
E. trophoblast

84. The histological specimen of a human embryo is studied under the microscope. There is an early embryo that consists of tightly packed blastomeres and has no cavity inside. What is the name of this stage?

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A. coeloblastula
B. amphiblastula
C. stereoblastula
D. morula
E. discoblastula

85. Which type of blastula is typical for frogs?
A. coeloblastula
B. amphiblastula
C. stereoblastula
D. morula
E. discoblastula

86. How is human blastula classified?
A. periblastula
B. blastocyst
C. coeloblastula
D. discoblastula
E. stereoblastula

87. For which type of blastula is the absence of cavity typical?
A. periblastula
B. blastocyst
C. coeloblastula
D. discoblastula
E. amphiblastula

88. Which type of blastula is typical for chickens' embryos?
A. coeloblastula
B. amphiblastula
C. stereoblastula
D. morula
E. discoblastula

89. Which type of blastula is typical for birds?
A. coeloblastula
B. amphiblastula
C. stereoblastula
D. morula
E. discoblastula

90. What is the name of the cells formed as a result of the first mitotic division in an embryo?

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A. zygotes
B. blastulas
C. blastomeres
D. cleavages
E. gonocytes

91. Morula in humans transforms into _____.
A. coeloblastula
B. amphiblastula
C. stereoblastula
D. blastocyst
E. discoblastula

92. What is blastula?
A. a cell that is formed during the cleavage
B. an embryonal structure with defined three germ layers
C. a structure that undergoes meiotic divisions
D. a specific form of embryo in insects
E. an embryonal structure that is formed as a result of cleavage

93. What is the name of the prosses during gastrulation when a sheet of cells infolds into the embryo?
A. invagination
B. involution
C. ingression
D. delamination
E. epiboly

94. What is epiboly?
A. infolding of cell sheet into the embryo
B. inturning of cell sheet over the basal surface of an outer layer
C. migration of individual cells into the embryo
D. splitting of one sheet into two sheets
E. the expansion of one cell sheet over other cells

95. From which part of the human embryo are embryonal primary tissues formed during gastrulation?
A. trophoblast
B. epiblast
C. hypoblast
D. umbilical vesicle
E. notochord process

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96. What is invagination?
A. infolding of a cell sheet into the embryo
B. inturning of a cell sheet over the basal surface of an outer layer
C. migration of individual cells into the embryo
D. splitting of one layer of cells into two
E. expansion of one cell sheet over other cells

97. When a sheet of cells turns over the basal surface of an outer layer during gastrulation, this is called _____.
A. invagination
B. involution
C. ingression
D. delamination
E. epiboly

98. What is the name of the primary cavity of embryos?
A. blastocoel
B. coelom
C. archenteron
D. gastrocoel
E. blastopore

99. The nuclear-to-cytoplasmic ratio of embryonal cells is restored to normal levels through _____.
A. gastrulation
B. meiosis
C. cleavage
D. fertilization
E. capacitation

100. The prosses of migration of individual cells into the embryo during gastrulation is called _____.
A. invagination
B. involution
C. ingression
D. delamination
E. epiboly

101. What is delamination?
A. infolding of a cell sheet into the embryo
B. inturning of a cell sheet over the basal surface of an outer layer
C. migration of individual cells into the embryo
D. splitting of one layer of cells into two

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E. expansion of one cell sheet over other cells

102. Splitting of one layer of cells into two during gastrulation is called _____.
A. invagination
B. involution
C. ingression
D. delamination
E. epiboly

103. The expansion of one sheet of cells over the other cells during gastrulation is called _____.
A. invagination
B. involution
C. ingression
D. delamination
E. epiboly

104. Which of the following cavities can be found in the middle stage of amphibian gastrulation?
A. blastocoel and gastrocoel
B. blastocoel and coelom
C. gastrocoel and coelom
D. blastocoel and blastocyst
E. gastrocoel and blastocyst

105. During neurulation the neural tube is formed from _____.
A. neural crest
B. neural vesicle
C. neural hinge
D. neural plate
E. neural pleura

106. Which germ layer gives rise to the notochord?
A. embryonic mesoderm
B. extra-embryonic mesoderm
C. embryonic ectoderm
D. extra-embryonic ectoderm
E. embryonic endoderm

107. Which extraembryonic membranes in humans take part in the formation of the umbilical cord?
A. yolk sac only

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B. yolk sac and allantois
C. allantois and amnion
D. yolk sac, allantois and amnion
E. allantois only

108. Which layers does amnion consist of?
A. inner mesodermal, outer ectodermal
B. inner ectodermal, outer mesodermal
C. inner mesodermal, outer endodermal
D. inner endodermal, outer mesodermal
E. inner endodermal, outer ectodermal

109. What is somite?
A. lateral part of neural tube
B. ventral part of notochord
C. paraxial part of mesoderm
D. extra-embryonic ectoderm
E. extra-embryonic endoderm

110. What are the structural components of somite?
A. dermatome, sclerotome, splanchnotome
B. sclerotome, splanchnotome, paraxial mesoderm
C. myotome, sclerotome, nephrotome
D. sclerorome, myotome, splanchnotome
E. dermatome, myotome, sclerotome

111. During embryonal development the embryo passes though several stages. Choose the correct order of them.
A. cleavage → fertilization → gastrulation → neurulation → organogenesis
B. fertilization → cleavage → neurulation →gastrulation → organogenesis
C. fertilization → cleavage → gastrulation → neurulation → organogenesis
D. fertilization → cleavage → gastrulation → organogenesis → neurulation
E. fertilization → gastrulation → neurulation → cleavage →organogenesis

112. What is the correct order of these structures in the avian embryo? (from the most dorsal to the most ventral)
A. neural tube → notochord → primitive gut
B. neural tube → primitive gut → notochord
C. primitive gut → notochord → neural tube
D. notochord → neural tube → primitive gut
E. notochord → primitive gut → neural tube

113. The primitive gut is also called _____.

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A. blastocoel
B. blastopore
C. gastrula
D. archenteron
E. coelom

114. Between which structures is the neural crest formed?
A. ectoderm and neural tube
B. neural tube and notochord
C. notochord and endoderm
D. somit and notochord
E. neural tube and endoderm

115. All of the following germ layers take part in the formation of the digestive tract, except:
A. ectoderm and mesoderm
B. ectoderm only
C. mesoderm only
D. ectoderm and endoderm
E. all three germ layers participate in the formation of digestive tract

116. What is the name of the cell that is able to respond to a specific signal?
A. competent
B. differentiated
C. induced
D. active
E. passive

117. Which tissue can produce a signal that changes cellular behaviour?
A. responder
B. target tissue
C. competent tissue
D. inducer
E. signal tissue

118. Which germ layer gives rise to the musculature of a heart?
A. neural crest
B. non-neural ectoderm
C. mesoderm
D. endoderm
E. neural tube

119. Which inducer is the most important in the development of human limbs?

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A. retinol
B. retinoic acid
C. retina
D. hyaluronic acid
E. Noggin

120. Which of the following cell types are not derived from neural crest?
A. melanocytes
B. neurocytes of the spinal cord
C. Schwann cells
D. odontoblasts
E. sympatho-adrenal cells

121. The medullar part of the adrenal gland arises from the cells of the _____ during embryonic development.
A. neural crest
B. non-neural ectoderm
C. mesoderm
D. endoderm
E. neural tube

122. What is the inducing region for the formation of the human eye?
A. zone of polarising activity
B. chordomesoderm
C. optic stalk
D. apical ectodermal ridge
E. lens

123. During embryonic development the lining epithelium of the oral cavity is formed from the cells of _____.
A. neural crest
B. non-neural ectoderm
C. mesoderm
D. endoderm
E. neural tube

124. This extraembryonic structure in humans consists of two parts: maternal and embryonal. Which extraembryonic structure is this?
A. amnion
B. yolk sac
C. allantois
D. umbilical vesicle
E. placenta

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125. Which layers are present in the chorion?
A. inner mesodermal, outer ectodermal
B. inner ectodermal, outer mesodermal
C. inner mesodermal, outer endodermal
D. inner endodermal, outer mesodermal
E. inner endodermal, outer ectodermal

126. How can cells that will form neural tube be distinguished from the surrounding ones in the beginning of neurulation?
A. these cells are taller
B. these cells are lower
C. these cells are wider
D. these cells are more pigmented
E. these cells are less pigmented

127. This extraembryonic membrane in humans is filled with liquid, in which an embryo develops. Which extraembryonic structure is this?
A. amnion
B. yolk sac
C. allantois
D. umbilical vesicle
E. placenta

128. Which of the structures mentioned below is not an extraembryonic membrane?
A. chorion
B. yolk sac
C. umbilical cord
D. allantois
E. amnion

129. Which extraembryonic structure functions as a disposal site for urinary waste?
A. allantois
B. amnion
C. umbilical vesicle
D. placenta
E. yolk sac

Answers

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1 – C; 2 – B; 3 – A; 4 – B; 5 – E; 6 – E; 7 – A; 8 – C; 9 – E; 10 – E; 11 – E; 12 – A; 13 – D; 14 – A; 15 – B; 16 – D; 17 – A; 18 – D; 19 – A; 20 – A; 21 – D; 22 – A; 23 – E; 24 – A; 25 – A; 26 – B; 27 – A; 28 – E; 29 – D; 30 – B; 31 – C; 32 – A; 33 – B; 34 – A; 35 – E; 36 – E; 37 – B; 38 – B; 39 – A; 40 – C; 41 – D; 42 – C; 43 – D; 44 – D; 45 – A; 46 – B; 47 – E; 48 – D; 49 – A; 50 – A; 51 – D; 52 – C; 53 – D; 54 – A; 55 – B; 56 – D; 57 – D; 58 – B; 59 – B; 60 – B; 61 – B; 62 – D; 63 – E; 64 – D; 65 – B; 66 – A; 67 – C; 68 – C; 69 – C; 70 – B; 71 – D; 72 – E; 73 – C; 74 – E; 75 – C; 76 – A; 77 – B; 78 – E; 79 – B; 80 – D; 81 – B; 82 – C; 83 – C; 84 – D; 85 – B; 86 – B; 87 – A; 88 – E; 89 – E; 90 – C; 91 – D; 92 – E; 93 – A; 94 – E; 95 – B; 96 – A; 97 – B; 98 – A; 99 – C; 100 – C; 101 – D; 102 – D; 103 – E; 104 – A; 105 – D; 106 – A; 107 – B; 108 – B; 109 – C; 110 – E; 111 – C; 112 – A; 113 – D; 114 – A; 115 – E; 116 – A; 117 – D; 118 – C; 119 – B; 120 – B; 121 – A; 122 – C; 123 – B; 124 – E; 125 – A; 126 – A; 127 – A; 128 – C; 129 – A.

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CONTENT

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ГІСТОЛОГІЯ, ЦИТОЛОГІЯ, ЕМБРІОЛОГІЯ

Збільник тестових завдань для поточного контролю рівня знань студентів спеціалізації «Медицина»

Частина 1. Цитологія, ембріологія.

(англійською мовою)

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