SITUATIONAL TASKS

1. Concentrations of some ions outside the cell are greater than concentrations of these ions inside the cell. Is it possible to transport such ions into the cell from outside? If “yes”, what is the mechanism?

2. In an embryo, the migration of cells via primitive streak and Hensen’s node has been blocked experimentally. Describe developmental consequences of this intervention.

3. In an embryo, the Rathke’s pouch has been removed. What parts of the pituitary gland (hypophysis) will not develop?

4. Neuroblast migration from the neural crest has been blocked experimentally. Formation of what structures will be affected?

5. Mesonephric duct of an embryo has been removed in an experiment. What defects in subsequent development of the excretory system will be observed?

6. Mesenchyme cells inside the yolk sac wall have been experimentally killed during week 3 to 4 of gestation. What developmental inconsistencies will follow from this intervention?

7. Gonocytes within the yolk sac wall of an embryo have been killed experimentally. What inconsistency of the reproductive system will follow from this intervention?

8. Removal of the thymus in a newborn animal causes distinct morphological changes in the peripheral lymphoid organs. Which zones of the spleen and lymph nodes are primarily affected? What is the location of these zones inside these organs?

9. The red bone marrow (RBM) hemopoietic microenvironment contains certain cells, which are never found in other hemopoietic organs. Name these cells and describe their functions. What other cell types compose the RBM hemopoietic microenvironment?

10. Transplantation of a genetically alien organ (tissue) results in its rejection. Which blood cells of the host are responsible for this effect? What type of immunity do they represent?

11. Removal of the thymus in a newborn animal leads to lifelong inhibition of the foreign transplant rejection reaction in this animal. Explain the observed effect.

12. An acute purulent inflammatory process has started in a patient. What changes in the blood count are expected?

13. Some pathological conditions involve considerable functional enhancement of a certain blood cell population, leading to substantial increase in the blood vessel wall permeability, consequent tissue edema and impaired blood clotting. What are these cells? What substances released from their granules modulate the endothelial cell adhesion properties and participate in the blood clotting regulation?

14. Administration of anti-histamine drugs has considerably diminished tissue edemata in a patient. Explain this effect. Which cells provide a source of histamine? Which blood vessels are implicated? Which cells are capable of competitive anti-histamine response?

15. In an animal, hemopoietic stem cells were completely destroyed by X-ray irradiation. Renewal of which cells within the loose connective tissue will be stopped?

16. In the thymus, formation of T helper cells has been blocked experimentally. What immunogenic processes, which normally occur within the loose connective tissue, will be affected at the first place?

17. A foreign body has passed under the skin. What will be the reaction of loose connective tissue and which cells participate in this reaction?

18. A shift in composition of the dermal fibers during aging leads to appearance of persistent wrinkles. Which of the fibers begin to dominate at this stage?

19. Histologic analysis of an eyeball has revealed that the apical processes of retinal pigment cells, which are tightly wrapped around the outer segments of photosensory receptor cells, contain numerous melanosomes. What can be said about the intensity of illumination at the moment of death of the individual?

20 In a blood sample taken from non-pregnant woman with normal menstrual cycle of 28 days, concentrations of estrogens and progesterone approach the lower limits of the norm. What is the phase of menstrual cycle? How long is this phase (in days)?

21. Pineal gland (epiphysis) has been removed in a sexually immature animal. What deviations from the normal course of sexual maturation will follow? What will cause these deviations?

22. Histologic examination of a testicle has revealed large cells containing prominent lipid inclusions and numerous mitochondria with tubular-vesicular cristae. Name these cells. In what portions of testicle are they found? What is their function? Which pituitary hormone regulates this function?

23. In a woman, all layers of the endometrium have been removed by surgical intervention. What pathology will possibly develop?

24. Ultrasound gynecological examination has revealed involution of the corpus luteum in combination with very thin functional layer of the endometrium. Is this normal? Analyze the results of examination.

25. Histological examination of a bioptate taken from healthy endometrium has revealed large polygonal cells located in small clusters within the stroma, with cytoplasm rich in lipids and glycogen. What are these cells? What is their function? Which phase of the menstrual cycle do they represent?

26. Certain gastrointestinal disorders cause the malabsorption of iron. What type of hemopoiesis is predominantly affected by the iron deficiency? Which organ is responsible for this type of hemopoiesis?

27. It is well known, that in a healthy body the bile never penetrates into the circulation. What ultrastructural features of hepatocytes prevent leakage of the bile from blood capillaries into the blood?

28. In an experiment, pancreatic duct has been permanently ligated. Which structures of the pancreas will undergo degeneration? Which portions of the organ will remain intact? Explain the phenomenon.

29. Clinical signs of liver dysfunction include frequent capillary bleedings from oral and nasal mucosae. Which function of the liver is highlighted by these bleedings?

30. Gallstone formation (cholelithiasis) occasionally results in obstruction of the biliary tract. What morphological changes in liver parenchyma will result from this obstruction? What functional disorders of the liver will follow?

31. Surgical operations on the pancreas frequently cause destruction of surrounding tissues resulting in delayed recovery and increased mortality. Explain why.

32. An autopsy of lung tissue from a preterm neonate, who died from pneumonia and breath failure, has revealed significantly reduced aeration of the tissue associated with critically low numbers of alveoli. What specific features of lung development compromise respiration in preterm neonates?

33. Examination of a male patient has revealed hearing impairment, increased susceptibility to respiratory infections, and infertility. Recollecting the basic university course of histology, a doctor in charge of this case hypothesizes that these symptoms may have a general cause. What possible mechanism is implied? What histological analyses must be carried out to check the hypothesis?

34. Post-traumatic skin wound healing produced an area of hairless scar tissue. What structures of the skin had been damaged? How deep had been the damage?

35. Within a certain area of the skin, all epidermal layers have been destroyed by a trauma. How will the regeneration proceed? Which cells will be involved?

36. A physician suspects renal hypertension (elevated arterial pressure caused by kidney disease) in his young patient. What blood tests are needed to check the hypothesis? What is the connection between renal physiology and arterial blood pressure?

37. A patient with chronic disease of the kidneys suffers from a heavy loss of protein in the urine and tissue edemata. What structures of the kidney are affected?

38. Urine of a patient contains protein and formed elements of the blood. What process is impaired? In which portion of the nephron?

39. A patient has been preliminary diagnosed with “autoimmune infertility”. What structural changes in his testicles would correspond to this assumption? What cells of immune system are involved in this type of pathology?

40. Histological examination of a testicular biopsy has shown complete absence of spermatogenic cells (germ cell aplasia, Sertoli-cell only syndrome). Make assumptions about possible exogenous and endogenous causes of this condition.

41. Ehlers-Danlos syndrome affects connective tissues. The symptoms include hypermobility of joints, fragility of blood vessel walls, impaired wound healing, etc. Suggest morphological and functional changes of connective tissue possibly implicated in this disease.

42. Physiological growth results from increase in the mass of muscle and bone tissues, accompanied by formation of microcirculatory blood vessels. Describe the histological background of these processes and mechanisms of their regulation.

43. Migration of glioblasts from the neural crest (ganglionic plate) has been impaired. What changes will follow? Which organs will be affected?

44. Organs of central and peripheral nervous systems are susceptible to tumorigenesis. What cells are implicated in this process? What types of tissue can be found in these tumors? Explain your opinion.

45. An experimental study of neuron structure and function included treatment of axons with colchicine (a chemical that destroys microtubules by blocking the tubulin polymerization). What changes were induced by the treatment? What type of histological examination would be appropriate to analyze these changes?

46. Pharmacological substances that act by blocking mitotic divisions are commonly used in the anti-cancer chemotherapy. Severe inflammations of the intestine represent a major complication of such therapies. Histological examination of an intestinal biopsy taken after 3-4 weeks of chemotherapy shows profound degradation of the intestinal epithelium. What have caused this degradation? Is it reasonable to continue the therapy? Will the intestine return to its normal condition after termination of the therapy?

47. Four slides prepared from different lymphoid organs, each comprising lymphoid follicles with surrounding tissue and a fragment of an organ’s capsule, have been handed to a forensic medicine expert. What characteristic features will help to distinguish the tonsil, the appendix, the lymph node and the spleen from one another?

48. A patient has undergone surgical resection of several lymph nodes. Is it necessary to follow the surgery by regular examinations? Will the lymph nodes regenerate?

49. Splenic rupture requires the immediate complete resection of the organ. Explain why.

50. A patient excretes about 20 l of urine daily. Blood tests for which hormone should be strongly recommended in this case? What plausibly causes the dysfunction?

51. Examination of a 4-year-old infant has revealed the signs of premature puberty. Levels of which hormone should be tested? Which organs produce this hormone?

52. Under strong cooling the skin turns pale. What histological and functional properties of microcirculatory blood vessels mediate this effect? Which of the vessels participate in redistribution of the blood? What are characteristic structural features of these vessels?

53. Myocardial hypoxia primarily affects the working (contractile) cardiomyocytes, whereas the conducting cardiomyocytes are less susceptible to irreversible hypoxic damage. Explain this fact in terms of difference in their structure.

54. Comparative forensic study of brain sections taken from two killed individuals has revealed striking structural differences. Precentral gyrus cortical area of the first individual comprised numerous well-developed neurons in all cortical layers including the layer V. The same cortical area of the second individual comprised increased numbers of glial cells and few neurons. Which of these two persons suffered from paralysis of the extremities? Explain your opinion. What is the function of layer V cortical neurons?

55. Meningitis, an acute inflammation of the meninges, predominantly affects the arachnoid mater and the pia mater. What types of tissue are represented in these membranes? Large numbers of what cells appear in cerebrospinal fluid of the subarachnoid space in meningitis?

56. Audiogram of a patient reveals the high frequency hearing impairment. What cells are dysfunctional? Which portion of the cochlea is affected?

57. Pathological condition of “retinal disinsertion” is caused by separation of the retinal pigment epithelium from the rods and cones layer. Explain the increased probability of such separation (consider the development). What are the functional consequences of retinal disinsertion?

58. Doxorubicin, an anti-cancer chemotherapy drug of poor selectivity, acts by introducing double-strand breaks into DNA of tumor cells, which differ from normal cells by their extremely high rates of DNA and RNA synthesis. Explain the toxic effect of doxorubicin on certain cell populations of the intestine, hair follicles, red bone marrow. What type of cell populations is attacked? Which cells in a differon are most susceptible to this drug?