I. Read the text and answer 10 questions to it.

MRI

In 1974, Mansfield made the first MRI scan of a human body part - cross-sectional images of a student's finger. However, the scans took up to 23 minutes to create. To speed up the process, he developed the echo-planar imaging technique, which produced multiple nuclear NMR echoes from a single excitation of the protons. This meant that an entire MR image could be obtained in a fraction of a second. The advantage of echo-planar imaging is that it can image rapid physiological processes, such as respiration and cardiac rhythm. Mansfield used echo-planar imaging in his prototype scanner, which went into experimental use in 1978. In the US, Damadian unveiled the first whole-body MRI scanner in May 1977. The US Food and Drug Administration (FDA) approved it for use in 1984. The big advantage of MRI is that it provides extremely detailed images. It is used for non-invasive examination of the brain and spinal cord, bones and joints, breasts, blood vessels, the heart, and other organs. One disadvantage is the cost of an MRI scanner — as high as £1.5 million (US$2 million). The other disadvantage of MRI is that it cannot be used on patients with metallic implants. Despite this, there were more than 50,000 MRI scanners in service in 2018, with the highest concentration — 55 per 1 million people — in Japan. Scanners with powerful 3T (tesla) magnets produce very high-quality images of the minute details of the musculoskeletal and nervous systems. Engineers are building increasingly powerful scanners that will provide even more detailed images of the body faster. British electrical engineer Godfrey Hounsfield and American physicist Allan MacLeod Cormack developed CT (computed tomography) — also known as CAT (computerized axial tomography) — scanning for medical diagnosis. Hounsfield's first scanner, in 1968, took nine days to capture a full three-dimensional (3D) image of a dead pig's brain. He later used X-rays and reduced the scanning time to nine hours. It worked by firing gamma rays as it rotated around the brain, one degree at a time, creating thousands of cross-sectional images. A computer programme then assembled these "slices"(the word tomography derives from tomei, the Greek word for slice) to produce the 3D image.

1. What advantage did echo-planar imaging offer in MRI technology?

A. It could image rapid physiological processes
B. It reduced the cost of MRI scanners
C. It created 3D images of the brain
D. It was used for non-invasive examination of blood vessels
E. It produced MRI scans in 23 minutes

2. What is one of the disadvantages of MRI technology mentioned in the text?

A. High cost
B. Short imaging time
C. Compatibility with metallic implants
D. Widespread use in the US
E. Low image quality

3. Where was the highest concentration of MRI scanners per 1 million people in 2018?

A. Japan
B. The United Kingdom
C. The United States
D. Germany
E. China

4. How long did it take Hounsfield's first scanner, in 1968, to capture a full 3D image of a dead pig's brain?

A. Nine days
B. Nine hours
C. Nine minutes
D. Nine seconds
E. Ninety hours

5. What type of radiation did Hounsfield's scanner use as it rotated around the brain?

A. Gamma rays
B. X-rays
C. Ultraviolet rays
D. Infrared rays
E. Microwaves

6. What does the term "tomography" derive from in Greek?

A. Slice
B. Tomatoes
C. Tumor
D. Gamma
E. Computer

7. What are engineers working on to improve MRI technology?

A. Developing scanners with more powerful magnets
B. Reducing the number of MRI scanners in service
C. Increasing the cost of MRI scans
D. Using metallic implants in MRI scans
E. Firing gamma rays in CT scanning

8. The US Food and Drug Administration (FDA) approved the first whole-body MRI scanner in the UK in 1977.

A. Not given
B. False
C. True
D. —
E. —

9. One of the disadvantages of MRI technology is its incompatibility with metallic implants.

A. True
B. False
C. Not given
D. —
E. —

10. Echo-planar imaging is a technique that uses gamma rays for MRI scans.

A. False
B. True
C. Not given
D. —
E. —

11. When performing an ultrasound of the heart, the doctor observes the semilunar valves. What happens with them during ventricular diastole?

A. They close, closing the vascular lumina
B. They turn inside out into the vascular cavities
C. They turn inside out into the ventricular cavities
D. They press to the walls of blood vessels
E. They press to the ventricular walls

12. A patient diagnosed with epidemic encephalitis presents with unilateral or bilateral ptosis (drooping eyelid), divergent strabismus, and impaired accommodation of the eye. The pupils are dilated. In this case, the nuclei of a certain pair of cranial nerves are damaged. Which pair of cranial nerves is it?

A. III
B. IV
C. V
D. VI
E. VII

13. The plasma cell produces specific antibodies against a certain antigen. When the antigen is introduced into the body, the number of plasma cells increases. What blood cells increase in number in this case, resulting in increased total number of plasma cells?

A. B lymphocytes
B. T lymphocytes
C. Monocytes
D. Basophils
E. Eosinophils

14. A 35-year-old woman has come to her physician with the chief complaint of her blood pressure being elevated up to 180/100 mm Hg. She currently takes no medications. During the physical examination, her blood pressure is 140/80 mm Hg, her heart rate is 65/min., and her body temperature is 36,8^{o}C. Examination detects a "moon face", hirsutism, centripetal concentration of the body fat, and atrophy and striae on the skin of the abdomen and thighs. What is the most likely cause of the patient's condition?

A. Adrenocortical adenoma
B. Hyperthyroidism
C. Hypothyroidism
D. Ovarian insufficiency
E. Pancreatic islet cells hyperfunction

15. Autopsy of the body of a 44-year-old man, who died of cardiopulmonary failure, revealed pneumosclerosis, pulmonary emphysema, and hypertrophy of the right ventricle of the heart. Multiple mostly subpleural foci up to 1 cm in diameter are observed in both lungs. Histologically, in the center of the foci there is a zone of necrosis, while on their periphery a border consisting of epithelioid cells and lymphocytes with addition of macrophages and plasma cells is observed. Langhans giant cells are present. A small number of blood capillaries can be detected on the periphery of the lesion foci. What disease is it?

A. Hematogenous tuberculosis
B. Pulmonary actinomycosis
C. Sarcoidosis
D. Syphilis
E. Silicosis

16. A patient with acute appendicitis has been hospitalized into the surgical department. An appendectomy under local anesthesia was initially recommended to the patient. However, it was later discovered that the patient had a history of frequent allergic reactions to medicines. Select from the list the drug that would be the optimal chioce for infiltration anesthesia in this case.

A. Xycaine (Lidocaine)
B. Novocaine (Procaine)
C. Dicaine (Tetracaine)
D. Anesthesine (Benzocaine)
E. Cocaine

17. A patient with frequent hemorrhages from the internal organs and mucosal membranes has proline and lysine in the composition of the collagen fibers. Their hydroxylation is impaired because the following vitamin is deficient in the patient's body:

A. Vitamin C
B. Vitamin K
C. Vitamin A
D. Vitamin B_1
E. Vitamin E

18. Laboratory study of the blood of a 33-year-old patient revealed erythrocyte agglutination reaction in standard sera of groups I and II. Agglutination reaction was not observed with a group III serum and an anti-rhesus serum. What blood group (taking into account the CDE system) can be transfused to this person, if necessary?

A. III (B) Rh-
B. I (O) Rh+
C. II (A) Rh-
D. IV (AB) Rh+
E. IV (AB) Rh-

19. The father and mother are healthy. Amniocentesis detects that the karyotype of the fetus is 45 X0. Make the diagnosis.

A. Turner syndrome
B. Edwards syndrome
C. Patau syndrome
D. Cri-du-chat syndrome
E. Trisomy X

20. A 25-year-old man came to his family doctor with complaints of increased body temperature, fatigue for 5 days, pain in the muscles, and headaches. He also admits that he had regular unprotected sex with multiple partners. Examination detects the following: blood pressure — 120/80 mm Hg, heart rate — 98/min., respiratory rate — 16/min., body temperature — 38^oC. Physical examination revealed icteric skin, hepatosplenomegaly, and tenderness on palpation in the right upper quadrant of the abdominal wall. Serological markers are as follows: IgM anti-HBc — positive result, HBsAg — positive result. What disease is most likely in this patient?

A. Viral hepatitis B
B. Viral hepatitis A
C. Acquired immunodeficiency syndrome (AIDS)
D. Tuberculosis
E. Syphilis

21. It was established that overstretching of the atria in the heart leads to decreased sodium reabsorption in the distal convoluted tubule and an increase in the glomerular filtration rate. What hormone has an effect that most likely causes such physiological changes in the body?

A. Natriuretic peptide
B. Aldosterone
C. Renin
D. Angiotensin
E. Vasopressin

22. A newborn boy developed jaundice on his eighth hour of life. The boy's blood group is A(II) Rh(+), while the mother's blood group is 0(I) Rh(+). Laboratory studies revealed an elevated titer of the mother's anti-A antibodies, normal levels of glucose-6-phosphate dehydrogenase, and negative results of a sickle cell anemia test. The infant's serum hemoglobin is 106 g/L. What is the most likely cause of the infant's jaundice?

A. Hyperbilirubinemia
B. Glucose-6-phosphate dehydrogenase deficiency
C. Sickle cell anemia
D. Rh incompatibility
E. Hypobilirubinemia

23. A 38-year-old man complains of rapid fatigability. He wobbles and loses his balance, when standing with his eyes closed. His skeletal muscle tone is reduced. What brain structure is most likely to be affected in this patient?

A. Cerebellum
B. Thalamus
C. Hypothalamus
D. Precentral gyrus of the cerebral cortex
E. Basal ganglia

24. In a patient with chronic glomerulonephritis, the incretory function of the kidneys was impaired. What blood elements become deficient in this pathological condition?

A. Erythrocytes
B. Leukocytes
C. Platelets
D. Leukocytes and platelets
E. Erythrocytes and leukocytes

25. A patient has a knee injury with a crushed patella. In this case, the damage is most likely to be observed in the tendon of the following thigh muscle:

A. Quadriceps femoris muscle
B. Biceps femoris muscle
C. Sartorius muscle
D. Adductor magnus muscle
E. Adductor longus muscle

26. The mother of a 4-month-old

boy brought him to a pediatrician with complaints of her child refusing to eat and losing weight. The child had trouble latching onto his bottle and has become extremely lethargic. Examination revealed hepatosplenomegaly and decreased muscle tone in all four limbs. Ophthalmoscopy revealed macular cherry-red spots. During the next 2 weeks, the hepatosplenomegaly was progressing, the boy was gaining weight poorly and continued to refuse eating. Chest X-ray shows a reticulonodular pattern with calcified nodules. Biopsy of the liver detects Niemann-Pick cells. The child has most likely inherited the deficiency of a certain enzyme. Name this enzyme.

A. Sphingomyelinase
B. Glucose-6-phosphatase
C. Galactocerebrosidase
D. Glucocerebrosidase
E. Phenylalanine hydroxylase

27. When performing a surgery on the thyroid gland, the surgeon needs to isolate the superior thyroid artery and inferior thyroid artery that form arterial anastomoses in the gland. There arteries are the branches of the following large vessels:

A. *A. carotis externa et a. subclavia*
B. *A. carotis interna et a. subclavia*
C. *A. carotis externa et a. carotis interna*
D. *A. subclavia et truncus thyrocervicalis*
E. *A. subclavia et a. transversa colli*

28. When anaphylactic reactions develop, marked hyperemia, edema of the mucosa, and pain can be observed. What mediator of anaphylaxis determines the development of these disorders?

A. Histamine
B. Heparin
C. Chemotactic factors
D. Platelet-activating factor
E. Complement proteins

29. Autopsy of the body of a 48-year-old woman revealed signs of diffuse osteoporosis with foci of bone tissue destruction. Proliferation of atypical plasma cells is observed in the bone marrow. Bence Jones protein is detected in the urine. What pathological condition can be suspected by a pathologist in this case?

A. Multiple myeloma
B. Osteoporosis
C. Osteodystrophy
D. Lymphogranulomatosis
E. Bekhterev disease (ankylosing spondylitis)

30. A person with a head injury in the temporal region has been diagnosed with an epidural hematoma. What artery is most likely to be damaged in this case?

A. Middle meningeal
B. Middle cerebral
C. Superficial temporal
D. Anterior meningeal
E. Posterior auricular

31. During local anesthetization a man developed anaphylactic shock. What drug must be administered in this case?

A. Adrenaline hydrochloride
B. Diazepam
C. Atropine sulfate
D. Anaprilin (Propranolol)
E. Nitroglycerin

32. During the autopsy of the body of a 58-year-old woman with diabetes mellitus, histology of the kidneys revealed segmented, homogeneous, oxyphilic deposits in the glomeruli. The walls of the arterioles were diffusely thickened, homogeneous, and oxyphilic. What pathological condition has developed in the renal glomeruli and blood vessels?

A. Hyalinosis
B. Hyaline-droplet dystrophy
C. Amyloidosis
D. Mucoid swelling
E. Fibrinoid swelling

33. Autopsy of the body of a 47-year-old man detects an ulcer 3 cm in diameter on the posterior gastric wall. The ulcer penetrates into the tissue of the pancreas adjacent to the intestine. There are multiple steatonecroses in the area of the ulcer, in the pancreas and in the surrounding fatty tissue. What complication of peptic ulcer disease has occurred in this man?

A. Penetration
B. Phlegmon of the stomach wall
C. Stenosis
D. Perforation
E. Malignization

34. Macroscopically, the kidney of a person, who died of chronic renal failure, is enlarged, dense, yellowish-white on section, and resembles old lard — a "fatty kidney". What pathological process is it?

A. Amyloidosis
B. Hyalinosis
C. Hyaline-droplet dystrophy
D. Fatty dystrophy
E. Fibrinoid swelling

35. Laboratory blood tests revealed an increased activity of creatine phosphokinase in a 46-year-old man. What pathological condition has most likely developed in the patient?

A. Myocardial infarction
B. Acute pancreatitis
C. Pulmonary thromboembolism
D. Hemolytic anemia
E. Kidney failure

36. After starting the treatment for pulmonary tuberculosis, the patient came to a doctor with complaints of tears and urine becoming red-colored. What drug has caused these changes?

A. Rifampicin
B. Benzylpenicillin sodium salt
C. Benzylpenicillin potassium salt
D. Biseptol-480
E. Cefazolin

37. What is the mechanism of the pain-relieving effect of a narcotic analgesic?

A. Activation of opioid receptors
B. Inhibition of cholinergic receptors
C. Activation of D2-dopamine receptors
D. Inhibition of serotonergic receptors
E. Inhibition of histaminergic receptors

38. For the treatment of megaloblastic anemia, the doctor prescribed a 13-year-old girl a drug that stimulates the transition of the megaloblastic type of hematopoiesis to the normoblastic type, takes part in the synthesis of purine and pyrimidine bases, and activates the synthesis of protein and methionine. What drug was prescribed for the patient?

A. Cyanocobalamin
B. Iron sulfate
C. Hemostimulin
D. Erythropoietin
E. Rose hips

39. A 32-year-old man has been hospitalized with an injury to his left hand. Examination detects an incised wound in the area of the thenar eminence, the thumb is difficult to flex. What muscle is damaged in this case?

A. *M. flexor pollicis brevis*
B. *M. abductor pollicis brevis*
C. *M. opponens pollicis brevis*
D. *M. adductor pollicis brevis*
E. *M. flexor pollicis longus*

40. Microscopicy of an oval cell shows that it is 150 mcm in size and has cytoplasm with yolk inclusions, but contains no centrioles. What cell is it?

A. Oocyte
B. Leukocyte
C. Myocyte
D. Fibroblast
E. Macrophage

41. Bone tissue contains large cells with numerous lysosomes, many nuclei, and a ruffled zone. Name these cells.

A. Osteoclasts
B. Mesenchymal cells
C. Semi-stem osteogenic cells
D. Osteoblasts
E. Osteocytes

42. A 26-year-old man has been diagnosed with anemia against the background of chronic gastritis with deficiency of intrinsic Castle factor. What type of anemia is most likely in this patient?

A. B_12 and folate deficiency anemia
B. Iron deficiency anemia
C. Hypoplastic anemia
D. Thalassemia
E. Chronic posthemorrhagic anemia

43. During the examination of a 36-year-old woman, the doctor used urological instruments. After some time, serous fluid began to discharge from the patient's urethra. The fluid contained pear-shaped cells with flagella, an undulating membrane, and an axostyle. What is the most likely causative agent of the disease, based on its described morphology?

A. *Trichomonas vaginalis*
B. *Trichomonas tenax*
C. *Trichomonas hominis*
D. *Lamblia intestinalis*
E. *Leishmania tropica*

44. Gamma-aminobutyric acid is the most important mediator of the central nervous system. This biogenic amine forms in the process of decarboxylation of a certain amino acid. Name this amino acid.

A. Glutamate
B. Histidine
C. Tryptophan
D. Tyrosine
E. Lysine

45. The cellular cytoskeleton consists of microtubules, intermediate filaments, and microfilaments. What protein is contained in the microtubules?

A. Tubulin
B. Globulin
C. Albumin
D. F-actin
E. G-actin

46. Microscopy of the specimen prepared from the peripheral part of the lung shows a cross-section of a tubular structure with the wall that consists of the mucosa and adventitia. The surface of the mucosa has numerous folds, its muscularis mucosae layer is formed by a continuous layer of smooth myocytes. What element of the airways is it?

A. Small bronchus
B. Medium-sized bronchus
C. Large bronchus
D. Terminal bronchiole
E. Alveolar duct

47. A certain enzyme releases arachidonic acid (the source of eicosanoid synthesis) from the phospholipid bilayer of cell membranes. Name this enzyme.

A. Phospholipase A2
B. Phospholipase D
C. Phospholipase C
D. Cyclooxygenase
E. Lipoxygenase

48. What are the effective conditions for oxidative phosphorylation?

A. Availability of ADP, oxygen, reduced equivalents
B. Availability of ATP, oxidized equivalents, carbon dioxide
C. Availability of AMP, oxygen, oxidized equivalents
D. Availability of GDP, oxygen, reduced equivalents
E. Availability of AMP, oxygen, reduced equivalents

49. A bacteriological laboratory has received a material obtained from a patient diagnosed with peritonitis. Microscopy of the material revealed Gram-positive and Gram-negative microorganisms. What morphological structure of a bacterial cell causes Gram staining?

A. Cell wall
B. Cytoplasm
C. Flagella
D. Spores
E. Capsule

50. A 72-year-old woman with essential hypertension was prescribed a calcium channel blocker to lower her blood pressure. How will the effect of this drug manifest in the functioning of the ventricular myocardium?

A. Reduced plateau phase
B. Increased contractility
C. Increased heart rate
D. Increased duration of repolarization
E. No effect