KISII UNIVERSITY

UNIVERSITY EXAMINATIONS

FIRST YEAR EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF MEDICINE AND SURGERY/BACHELOR OF PHARMACY
FIRST SEMESTER, 2023/2024

MEDS 111: MEDICAL PHYSIOLOGY (PAPER 1)

STREAM: Y1S1 **TIME: 3 HOURS**

DAY WEDNESDAY, 9.00AM-12.00PM **DATE: 07/08/2024**

INSTRUCTIONS

1.Do not write anything on this question paper.

ANSWER ALL QUESTIONS (1 MARK EACH)

1. In comparing two types of cells from the same person, the variation in the proteins expressed by each cell type reflects which of the following?
- **A)** Differences in the DNA contained in the nucleus of each cell
- **B)** Differences in the numbers of specific genes in their genomes
- **C)** Cell-specific expression and repression of specific genes
- **D)** Differences in the number of chromosomes in each cell
- **E)** The age of the cells

2. Which statement about telomeres is incorrect?
- **A)** Telomeres are repetitive nucleotide sequences at the end of a chromatid
- **B)** Telomeres serve as protective caps that prevent the chromosome from deterioration during cell division
- **C)** Telomeres are gradually consumed during repeated cell divisions
- **D)** In cancer cells, telomerase activity is usually reduced compared with normal cells

3. Which of the following events does not occur during the process of mitosis?
- **A)** Condensation of the chromosomes
- **B)** Replication of the genome
- **C)** Fragmentation of the nuclear envelope
- **D)** Alignment of the chromatids along the equatorial plate
- **E)** Separation of the chromatids into two sets of 46 daughter chromosomes

4. The term glycocalyx refers to what?

A) The negatively charged carbohydrate chains that protrude into the cytosol from glycolipids and integral glycoproteins
B) The negatively charged carbohydrate layer on the outer cell surface
C) The layer of anions aligned on the cytosolic surface of the plasma membrane
D) The large glycogen stores found in fast muscles
E) A mechanism of cell–cell attachment

Questions 5-7

A.	Nucleolus	**F.**	Endosomes
B.	Nucleus	**G.**	Peroxisomes
C.	Agranular endoplasmic reticulum	**H.**	Lysosomes
		I.	Cytosol
D.	Granular endoplasmic reticulum	**J.**	Cytoskeleton
		K.	Glycocalyx
E.	Golgi apparatus	**L.**	Microtubules

Match the cellular location for each of the steps involved in the synthesis and packaging of a secreted protein listed below with the correct term from the list above.

5. Protein condensation and packaging-

6. Initiation of translation-

7. Gene transcription-

8. Worn-out organelles are transferred to lysosomes by which of the following?
A) Autophagosomes
B) Granular endoplasmic reticulum
C) Agranular endoplasmic reticulum
D) Golgi apparatus
E) Mitochondria

9. Which of the following does not play a direct role in the process of transcription?
A) Helicase
B) RNA polymerase
C) Chain-terminating sequence
D) Activated RNA molecules
E) Promoter sequence

10. Which statement is true for both pinocytosis and phagocytosis?
A) Involves the recruitment of actin filaments
B) Occurs spontaneously and non-selectively
C) Endocytotic vesicles fuse with ribosomes that release hydrolases into the vesicles
D) Is only observed in macrophages and neutrophils
E) Does not require ATP

11. Which of the following proteins is most likely to be the product of a proto-oncogene?

A) Growth factor receptor
B) Cytoskeletal protein
C) Na+ channel
D) Ca++-ATPase
E) Myosin light chain

12. Which statement about feedback control systems is incorrect?
A) Most control systems of the body act by negative feedback
B) Positive feedback usually promotes stability in a system
C) Generation of nerve actions potentials involves positive feedback
D) Feed-forward control is important in regulating muscle activity

13. Redundancy or degeneration of the genetic code occurs during which step of protein synthesis?
A) DNA replication
B) Transcription
C) Post-transcriptional modification
D) Translation
E) Protein glycosylation

14. What is the osmolarity of a solution containing 10 millimolar NaCl, 5 millimolar KCl, and 10 millimolar CaCl2 (in mOsm/L)?
A) 20
B) 40
C) 60
D) 80
E) 100

Use the concentrations provided below for ions in a hypothetical cell to answer 15 – 18

Intracellular (mM)	Extracellular (mM)
140 K^+	5K^+
12 Na^+	145 Na^+
5 CL^-	125 CL^-
0.0001 Ca^{2+}	5 Ca^{2+}

$$V_m = \frac{61}{Z} \text{ X } \text{Log}_{10} \frac{[C]_o}{[C]_i}$$

15. Which of the following best describes the equilibrium potential for Cl− (in millivolts)?
A) 0
B) 170
C) −170
D) 85
E) −85

16. Which of the following best describes the equilibrium potential for K+ (in millivolts)?
A) 0
B) 176

C) −176
D) 88
E) −88

17. The net driving force is greatest for which ion when the membrane potential of this cell is −85 millivolts?
A) Ca++
B) Cl−
C) K+
D) Na+

18. If this cell were permeable only to K+, what would be the effect of reducing the extracellular K+ concentration from 5 to 2.5 millimolar?
A) 19 millivolts depolarization
B) 19 millivolts hyperpolarization
C) 38 millivolts depolarization
D) 38 millivolts hyperpolarization
E) 29 millivolts depolarization
F) 29 millivolts hyperpolarization

19. Which of the following best describes the changes in cell volume that will occur when red blood cells (previously equilibrated in a 280-milliosmolar solution of NaCl) are placed in a solution of 140-millimolar NaCl containing 20-millimolar urea, a relatively large but permeant molecule?
A) Shrink, then swell and lyse
B) Shrink, then return to original volume
C) Swell and lyse
D) Swell, then return to original volume
E) No change in cell volume

20. A single contraction of skeletal muscle is most likely to be terminated by which of the following actions?
A) Closure of the postsynaptic nicotinic acetylcholine receptor
B) Removal of acetylcholine from the neuromuscular junction
C) Removal of Ca++ from the terminal of the motor neuron
D) Removal of sarcoplasmic Ca++
E) Return of the dihydropyridine receptor to its resting conformation

21. Which of the following best describes an attribute of visceral smooth muscle not shared by skeletal muscle?
A) Contraction is ATP dependent
B) Contracts in response to stretch
C) Does not contain actin filaments
D) High rate of cross-bridge cycling
E) Low maximal force of contraction

22. The resting potential of a myelinated nerve fiber is primarily dependent on the concentration gradient of which of the following ions?

A) Ca++
B) Cl−
C) HCO3−
D) K+
E) Na+

23. Calmodulin is most closely related, both structurally and functionally, to which of the following proteins?

A) G-actin
B) Myosin light chain
C) Tropomyosin
D) Troponin C

24. Which of the following decreases in length during the contraction of a skeletal muscle fiber?

A) A band of the sarcomere
B) I band of the sarcomere
C) Thick filaments
D) Thin filaments
E) Z disks of the sarcomere

E_{Q-} = *–75 millivolts*
E_{R+} = *+75 millivolts*
E_{S+} = *–85 millivolts*

25. Equilibrium potentials for three unknown ions are shown in the above figure. Note that ions S and R are positively charged and that ion Q is negatively charged. Assume that the cell membrane is permeable to all three ions and that the cell has a resting membrane potential of −90 millivolts. Which of the following best describes the net movement of the various ions across the cell membrane by passive diffusion?

	Q	R	S
A	Inward	Inward	Inward
B	Inward	Inward	Outward
C	Inward	Outward	Inward
D	Inward	Outward	Outward
E	Outward	Inward	Inward
F	Outward	Inward	Outward
G	Outward	Inward	Outward

26. Tetanic contraction of a skeletal muscle fiber results from a cumulative increase in the intracellular concentration of which of the following?

A) ATP
B) Ca++
C) K+
D) Na+
E) Troponin

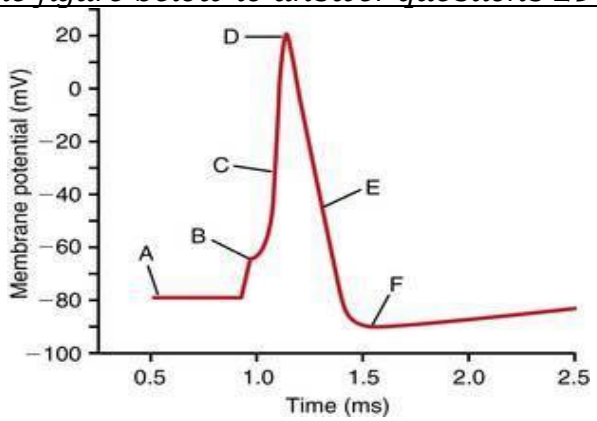
27. Weight lifting can result in a dramatic increase in skeletal muscle mass. This increase in muscle mass is primarily attributable to which of the following?

A) Fusion of sarcomeres between adjacent myofibrils
B) Hypertrophy of individual muscle fibers
C) Increase in skeletal muscle blood supply
D) Increase in the number of motor neurons
E) Increase in the number of neuromuscular junctions

28. The delayed onset and prolonged duration of smooth muscle contraction, as well as the greater force generated by smooth muscle compared with skeletal muscle, are all consequences of which of the following?

A) Greater amount of myosin filaments presents in smooth muscle
B) Higher energy requirement of smooth muscle
C) Physical arrangement of actin and myosin filaments
D) Slower cycling rate of the smooth muscle myosin cross-bridges
E) Slower uptake of Ca++ ions after contraction

Use the figure below to answer questions 29- 30



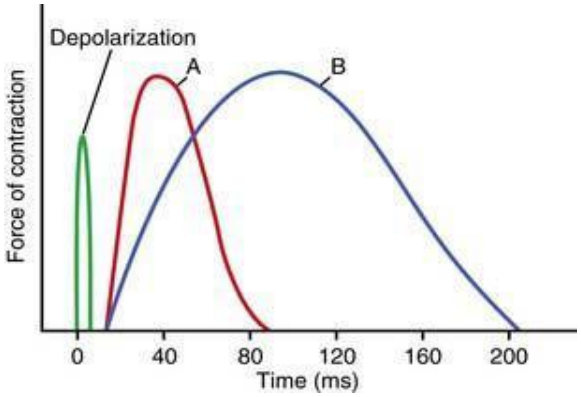
29. Which of the following is primarily responsible for the change in membrane potential between points B and D?

A) Inhibition of the Na+, K+-ATPase
B) Movement of K+ into the cell
C) Movement of K+ out of the cell
D) Movement of Na+ into the cell
E) Movement of Na+ out of the cell

30. Which of the following is primarily responsible for the change in membrane potential between points D and E?

A) Inhibition of the Na+, K+-ATPase
B) Movement of K+ into the cell
C) Movement of K+ out of the cell
D) Movement of Na+ into the cell
E) Movement of Na+ out of the cell

Use the figure below to answer 31 and 32



31. Which of the following best describes muscle B compared with muscle A?

A) Adapted for rapid contraction
B) Composed of larger muscle fibers
C) Fewer mitochondria
D) Innervated by smaller nerve fibers
E) Less extensive blood supply

32. The delay between the termination of the transient depolarization of the muscle membrane and the onset of muscle contraction observed in both muscles A and B reflects the time necessary for which of the following events to occur?

A) ADP to be released from the myosin head
B) ATP to be synthesized
C) Ca++ to accumulate in the sarcoplasm
D) G-actin to polymerize into F-actin
E) Myosin head to complete one cross-bridge cycle

33. Smooth muscle that exhibits rhythmical contraction in the absence of external stimuli also necessarily exhibits which of the following?

A) Slow voltage-sensitive Ca++ channels
B) Intrinsic pacemaker wave activity
C) Higher resting cytosolic Ca++ concentration
D) Hyperpolarized membrane potential
E) Action potentials with “plateaus”

34. Which of the following increases secretion of GH?

A) Senescence
B) Insulin-like growth factor-1 (IGF-1)
C) Somatostatin
D) Hypoglycemia
E) Exogenous GH administration

35. Exposure to ultraviolet light directly facilitates which of the following?

A) Conversion of cholesterol to 25-hydroxycholicalciferol
B) Conversion of 25-hydroxycholicalciferol to 1,25- dihydroxycholicalciferol
C) Transport of calcium into the extracellular fluid
D) Formation of calcium-binding protein
E) Storage of vitamin D3 in the liver

36. Which of the following is both synthesized and stored in the hypothalamus?

A) ADH
B) Thyroid-stimulating hormone (TSH)
C) LH
D) Somatostatin
E) Somatomedin

37. PTH does what directly?

A) Controls the rate of 25-hydroxycholicalciferol formation
B) Controls the rate of calcium transport in the mucosa of the small intestine
C) Controls the rate of formation of calcium-binding protein
D) Controls the rate of formation of 1,25-dihydroxycholicalciferol
E) Stimulates renal tubular phosphate reabsorption

38. A 30-year-old woman reports to the clinic for a routine physical examination. The examination reveals she is pregnant. Her plasma levels of TSH are high, but her total thyroid hormone concentration is normal. Which of the following best reflects the patient's clinical state?

A) Graves' disease
B) Hashimoto's disease
C) A pituitary tumor secreting TSH
D) A hypothalamic tumor secreting thyrotropin releasing hormone (TRH)
E) The patient is taking thyroid extract

39. Which anterior pituitary hormone plays a major role in the regulation of a non-endocrine target gland?

A) ACTH
B) TSH
C) Prolactin
D) FSH
E) LH

40. Which change would be expected to occur with increased binding of a hormone to plasma proteins?

A) Increase in plasma clearance of the hormone
B) Decrease in half-life of the hormone
C) Increase in hormone activity
D) Increase in degree of negative feedback exerted by the hormone
E) Increase in plasma reservoir for rapid replenishment of free hormone

41. Which of the following would be associated with parallel changes in aldosterone and cortisol secretion?

A) Addison's disease
B) Cushing's disease
C) Cushing's syndrome (adrenal tumor)
D) A low-sodium diet
E) Administration of a converting enzyme inhibitor

42. Which hormone activates enzyme-linked receptors?

A) ADH
B) Insulin
C) ACTH
D) PTH
E) Aldosterone

43. Which hormone is not stored in its endocrine-producing gland?

A) PTH
B) Aldosterone
C) ACTH
D) Insulin

44. Cortisone is administered to a patient for the treatment of an autoimmune disease. Which of the following would least likely occur in response to the cortisone treatment?

A) Hypertrophy of the adrenal glands
B) Increased plasma levels of C-peptide
C) Decreased CRH secretion
D) Increased blood pressure
E) Hyperglycemia

45. Which pituitary hormone has a chemical structure most similar to that of ADH?

A) Oxytocin
B) ACTH
C) TSH
D) FSH
E) Prolactin

46. Which of the following would be expected in a patient with vitamin D deficiency?

	Plasma [1,25-(OH)2D3]	Bone Resorption	Intestinal Calbindin
A	↑	↑	↑
B	↑	↓	↑
C	↑	↓	↓
D	↓	↓	↑
E	↓	↑	↓
F	↓	↑	↑

47. A 76-year-old man has a stroke that severely impairs his speech. Which area of his brain is most likely damaged?

A) Primary motor cortex
B) Premotor area
C) Broca's area
D) Cerebellum

48. Which statement best describes a functional role for the lateral hemispheres of the cerebellum?

A) Control and coordinate movements of the axial muscles, as well as the shoulder and hip
B) Control movements that involve distal limb musculature
C) Function with the cerebral cortex to plan movements
D) Stimulate motor neurons through their connections to the spinal cord

49. Which of the following would produce an increase in cerebral blood flow?
A) Increase in carbon dioxide concentration
B) Increase in oxygen concentration
C) Decrease in the activity of cerebral cortex neurons
D) Decrease in carbon dioxide concentration
E) Decrease in arterial blood pressure from 120 mm Hg to 90 mm Hg

50. Astrocytes participating in the metabolic control of cerebral blood flow have the following three events associated with the process: (1) prostaglandin release, (2) a calcium wave, and (3) glutamate spillover. Which sequence best describes the correct temporal order of these three events?
A) 2, 1, 3
B) 1, 2, 3
C) 3, 1, 2
D) 1, 3, 2
E) 3, 2, 1
F) 2, 3, 1

51. Which statement best describes a functional role for the cerebellar vermis?
A) Controls and coordinates movements of the axial muscles, as well as the shoulder and hip
B) Controls movements that involve distal limb musculature
C) Functions with the cerebral cortex to plan movements
D) Stimulates motor neurons through its connections to the spinal cord

A 29-year-old man steps on a broken bottle with his bare right foot. His right leg immediately lifts while his left leg extends before he can consciously react to the pain. Use this information to answer Questions 52 and 53.

52. This action is attributable to which reflex?
A) Walking reflex
B) Stretch reflex
C) Patellar tendon reflex
D) Golgi tendon reflex
E) Flexor withdrawal reflex

53. Which of the following best describes the type of reflex arc and sensory receptor for this reflex?

	REFLEX ARC	SENSORY RECEPTOR
A	Disynaptic	Pacinian corpuscle
B	Disynaptic	Nociceptor
C	Monosynaptic	Pacinian corpuscle

D	Monosynaptic	Golgi tendon organ
E	Polysynaptic	Nociceptor
F	Polysynaptic	Muscle spindle

54. A large portion of the cerebral cortex does not fit into the conventional definition of motor or sensory cortex. Which term refers to the type of cortex that receives input primarily from several other regions of the cerebral cortex?

A) Cortex that is agranular
B) Secondary somatosensory cortex
C) Association cortex
D) Supplementary motor cortex
E) Secondary visual cortex

55. The creation of memory can be interrupted by which activity?

A) Phosphorylation of a potassium channel to block activity
B) Activation of adenylate cyclase
C) Unnatural loss of consciousness
D) Increase in protein synthesis
E) Activation of cyclic guanosine monophosphate (cGMP) phosphodiesterase

56. Signals from motor areas of the cortex reach the contralateral cerebellum after first passing through which structure?

A) Thalamus
B) Caudate nucleus
C) Red nucleus
D) Basilar pontine nuclei
E) Dorsal column nuclei

57. Cerebrospinal fluid (CSF) provides a cushioning effect both inside and outside the brain. Which space that lies outside the brain or spinal cord contains CSF?

A) Lateral ventricle
B) Third ventricle
C) Cisterna magna
D) Epidural space
E) Aqueduct of Sylvius

58. The peripheral sensory input that activates the ascending excitatory elements of the reticular formation comes mainly from which of the following?

A) Pain signals
B) Proprioceptive sensory information
C) Corticospinal system
D) Medial lemniscus
E) Input from Pacinian corpuscles

59. Cells of the adrenal medulla receive synaptic input from which type of neuron?

A) Preganglionic sympathetic
B) Postganglionic sympathetic
C) Preganglionic parasympathetic

D) Postsynaptic parasympathetic
E) Presynaptic parasympathetic

60. Which activity will increase the sensitivity of the stretch reflex?
A) Cutting the dorsal root fibers associated with the muscle in which the stretch reflex is being examined
B) Increasing the activity of the medullary reticular nuclei
C) Bending the head forward
D) Enhanced activity in the fusimotor (gamma motor neuron) system
E) Stimulating the lateral hemispheres of the cerebellum

61. In a muscle spindle receptor, which type of muscle fiber is responsible for the dynamic response?
A) Extrafusal muscle fiber
B) Static nuclear bag fiber
C) Nuclear chain fiber
D) Dynamic nuclear bag fiber
E) Smooth muscle fiber

62. Which structure serves as an "alternative pathway" for signals from the motor cortex to the spinal cord?
A) Red nucleus
B) Basilar pontine nuclei
C) Caudate nucleus
D) Thalamus
E) Dorsal column nuclei

63. The phenomenon of decerebrate rigidity can be explained, at least in part, by which of the following?
A) Stimulation of type 1b sensory neurons
B) Loss of cerebellar inputs to the red nucleus
C) Overactivity of the medullary reticular nuclei involved in motor control
D) Unopposed activity of the pontine reticular nuclei
E) Degeneration of the nigrostriatal pathway

64. An area in the dominant hemisphere, when damaged, may leave the sense of hearing intact but not allow words to be arranged into a comprehensive thought. Which term is used to identify this portion of the cortex?
A) Primary auditory cortex
B) Wernicke's area
C) Broca's area
D) Angular gyrus
E) Limbic association cortex

65. Which cells receive direct synaptic input from Golgi tendon organs?
A) Type Ia inhibitory interneurons
B) Dynamic gamma motor neurons
C) Alpha motor neurons

D) Type Ib inhibitory interneurons
E) Type II excitatory interneurons

66. Light entering the eye passes through which retinal layer first?
A) Inner nuclear layer
B) Outer nuclear layer
C) Outer plexiform layer
D) Photoreceptor layer
E) Retinal ganglion layer

67. Which of the following best describes the permeability to sodium and potassium in rod cells in response to the light?
A) Decreased sodium permeability, decreased potassium permeability
B) Decreased sodium permeability, increased potassium permeability
C) Decreased sodium permeability, no change in potassium permeability
D) Increased sodium permeability, decreased potassium permeability
E) Increased sodium permeability, increased potassium permeability
F) Increased sodium permeability, no change in potassium permeability

68. Which cell type(s) have action potentials in the retina of the human eye?
A) Bipolar cells and ganglion cells
B) Bipolar cells only
C) Bipolar cells, horizontal cells, and ganglion cells
D) Ganglion cells and horizontal cells
E) Ganglion cells only
F) Horizontal cells only

69. Under low or reduced light conditions, which chemical compound is responsible for the inward-directed sodium current in the outer segments of the photoreceptors?
A) Metarhodopsin II
B) cGMP
C) 11-cis retinal
D) cAMP
E) 11-trans retinal

70. Which sensory system has the smallest range of intensity discrimination?
A) Auditory
B) Gustatory
C) Olfactory
D) Somatosensory
E) Visual

71. For the eye to adapt to intense light, which of the following may occur?
A) Bipolar cells will continuously transmit signals at the maximum rate possible
B) Photochemicals in both rods and cones will be reduced to retinal and opsins
C) The levels of rhodopsin will be very high
D) The size of the pupil will increase

E) Vitamin A will convert into retinal

72. In the central auditory pathway, which option represents the correct sequence of structures in the pathway?

A) Cochlear nuclei–superior olive–inferior colliculus via the lateral lemniscus–medial geniculate–auditory cortex
B) Cochlear nuclei–inferior olive–inferior colliculus via the medial lemniscus–medial geniculate–auditory cortex
C) Cochlear nuclei–superior olive–superior colliculus via the lateral lemniscus–lateral geniculate–auditory cortex
D) Cochlear nuclei–inferior olive–inferior colliculus via the lateral lemniscus–lateral geniculate–auditory cortex
E) Cochlear nuclei–trapezoid body–dorsal acoustic stria–inferior colliculus via the lateral lemniscus–medial geniculate–auditory cortex

73. Which statement regarding the transmission of auditory information from the ear to the cerebral cortex is correct?

A) Inferior colliculus neurons synapse in the cochlear nuclei of the brain stem
B) Neurons with cell bodies in the spiral ganglion of Corti synapse in the inferior colliculus
C) The majority of neurons from the cochlear nuclei synapse in the contralateral superior olivary nucleus
D) There is no crossing over of information between the right and left auditory pathways in the brain stem
E) Trapezoid neurons synapse in the cochlear nuclei of the brain stem

74. Which statement regarding color vision is correct?

A) Green is perceived when only green cones are stimulated
B) The stimulation ratio of the three types of cones allows specific color perception
C) The wavelength of light corresponding to white is shorter than that corresponding to blue
D) When no stimulation of red, green, or blue cones occurs, there will be the sensation of seeing white
E) Yellow is perceived when green and blue cones are stimulated equally

75. Which event prompts the auditory system to interpret a sound as loud?

A) A decreased number of inner hair cells become stimulated
B) A decreased number of outer hair cells become stimulated
C) Hair cells excite nerve endings at a diminished rate
D) The amplitude of vibration of the basilar membrane decreases
E) The amplitude of vibration of the basilar membrane increases

76. Olfactory information transmitted to the orbitofrontal cortex passes through which thalamic nucleus?

A) Dorsomedial
B) Lateral geniculate
C) Medial geniculate

D) Ventral posterolateral
E) Ventral posteromedia

77. Which neurotransmitter is released by both rods and cones at their synapses with bipolar cells?
A) Acetylcholine
B) Dopamine
C) Glutamate
D) Glycine
E) Serotonin

78. Which of the following allows the visual apparatus to accurately determine the distance of an object from the eye (depth perception)?
A) Monocular vision
B) The location of the retinal image on the retina
C) The phenomenon of stationary parallax
D) The phenomenon of stereopsis
E) The size of the retinal image if the object is of unknown size

79. Which of the following provides about two thirds of the 59 diopters of refractive power of the eye?
A) Anterior surface of the cornea
B) Anterior surface of the lens
C) Iris
D) Posterior surface of the cornea
E) Posterior surface of the lens

80. Which statement best describes the underlying basis of the dark current in the outer segment of the photoreceptors?
A) Dark current results from the influx of sodium ions via c-AMP–dependent sodium channels
B) Dark current results from the influx of sodium ions via c-GMP–dependent sodium channels
C) Dark current results from the efflux of potassium ions via c-GMP–dependent potassium channels
D) Dark current results from the efflux of sodium ions via c-GMP–dependent sodium channels
E) Dark current results from the efflux of sodium ions via c-AMP–dependent sodium channels

81. Where does the transmigration of WBCs occur in response to infectious agents?
A) Arterioles
B) Lymphatic ducts
C) Venules
D) Inflamed arteries

82. Which of the following transfusions will result in an immediate transfusion reaction?
A) O Rh-negative whole blood to an O Rh-positive patient

B) A Rh-negative whole blood to a B Rh-negative patient
C) AB Rh-negative whole blood to an AB Rh-positive patient
D) B Rh-negative whole blood to a B Rh-negative patient

83. What is the primary mechanism by which heparin prevents blood coagulation?
A) Antithrombin III activation
B) Binding and inhibition of tissue factor
C) Binding available calcium
D) Inhibition of platelet-activating factor

84. A transmitter substance released from a presynaptic neuron activates a second messenger G-protein system in the postsynaptic neuron. Which one of the following postsynaptic responses to the transmitter substance is NOT a possible outcome?
A) Activation of cyclic adenosine monophosphate (cAMP)
B) Activation of cyclic guanosine monophosphate (cGMP)
C) Activation of gene transcription
D) Closing an ion channel
E) Opening an ion channel

85. Which of the following best describes the concept of specificity in sensory nerve fibers that transmit only one modality of sensation?
A) Frequency coding principle
B) Concept of specific nerve energy
C) Singularity principle
D) Labeled line principle

86. Which of the following is an encapsulated receptor found deep in the skin throughout the body, as well as in fascial layers, where it detects indentation of the skin (pressure) and movement across the surface (vibration)?
A) Pacinian corpuscle
B) Meissner's corpuscle
C) Free nerve endings
D) Ruffini endings

87. Which substance enhances the sensitivity of pain receptors but does not directly excite them?
A) Bradykinin
B) Serotonin
C) Potassium ions
D) Prostaglandins

88. Which of the following is an important functional parameter of pain receptors?
A) Exhibit little or no adaptation
B) Not affected by muscle tension
C) Signal only flexion at joint capsules
D) Can voluntarily be inhibited

89. The excitatory or inhibitory action of a neurotransmitter is determined by which of the following?

A) The function of its postsynaptic receptor
B) Its molecular composition
C) The shape of the synaptic vesicle in which it is contained
D) The distance between the pre- and postsynaptic membranes

90. Interneurons that utilize the neurotransmitter enkephalin to inhibit afferent pain signals are most likely to be found in which region of the central nervous system?

A) Dorsal horn of spinal cord
B) Postcentral gyrus
C) Precentral gyrus
D) δ-type A
E) Type C fiber
F) Ventral horn of spinal cord

91. The sequence of the template DNA strand is 5′-GATATCCATTAGTGAC-3′. What is the sequence of the RNA produced form it?

A) 5′-CAGUGAUUACCUAUAG-3′
B) 5′-CTATAGGTAATCACTG-3′
C) 5′-CUAUAGGUAAUCACUG-3′
D) 5′-GTCACTAATGGATATC-3′
E) 5′-GUCACUAAUGGAUAUC-3′

92. Which system transmits somatosensory information with the highest degree of temporal and spatial fidelity?

A) Anterolateral system
B) Dorsal column–medial lemniscal system
C) Corticospinal system
D) Spinocerebellar system

93. A 10-year-old boy cuts his finger with a pocketknife and immediately applies pressure to the damaged area with his other hand to partially alleviate the pain. Inhibition of pain signals by tactile stimulation of the skin is mediated by which type of afferent neurons from mechanoreceptors?

A) α-type A
B) β-type A
C) δ-type A
D) Type C

94. A pool of presynaptic neurons innervates the dendrites of a postsynaptic neuron. Electrical signals are transferred from the dendrites to the soma of the postsynaptic neuron by which process?

A) Action potential
B) Active transport
C) Capacitive discharge
D) Diffusion
E) Electrotonic conduction

95. Which of the following is the basis for referred pain?

A) Visceral pain signals and pain signals from the skin synapse with separate populations of neurons in the dorsal horn
B) Visceral pain transmission and pain transmission from the skin are received by a common set of neurons in the thalamus
C) Visceral pain signals are rarely of sufficient magnitude to exceed the threshold of activation of dorsal horn neurons
D) Some visceral pain signals and pain signals from the skin provide convergent input to a common set of neurons in the dorsal horn

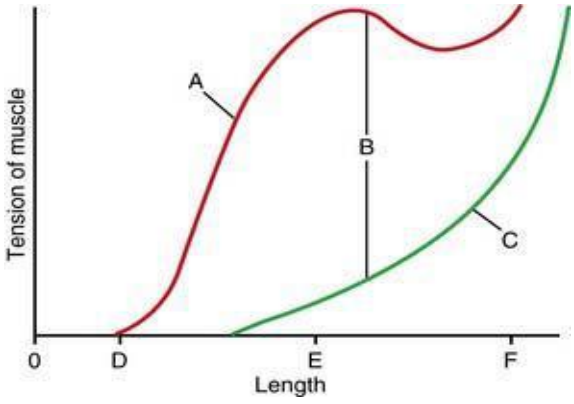
A 19-year-old man has an automobile accident that completely eliminates all nerve traffic in the right half of the spinal cord at C2. Use this information to answer Questions 96 and 97.

96. Loss of which function is most likely in the right hand of this man?

A) Crude touch and pain sensation
B) Crude touch and temperature sensation
C) Motor function and temperature sensation
D) Motor function and vibration sense
E) Vibration sense and crude touch
F) Vibration sense and pain sensation

97. Loss of which function is most likely in the left hand of this man?

A) Crude touch and pain sensation
B) Crude touch and vibration sense
C) Motor function and temperature sensation
D) Motor function and vibration sense
E) Vibration sense and pain sensation
F) Vibration sense and crude touch



The above figure illustrates the isometric length-tension relationship in a representative intact skeletal muscle.
Match the descriptions in Questions 98-100 to one of the points on the figure.

98. So-called "active" or contraction-dependent tension-

99. The muscle length at which active tension is maximal-

100. The contribution of noncontractile muscle elements to total tension-