

University of Choice)

**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
(MMUST)**

UNIVERSITY EXAMINATIONS

**2021/2022
ACADEMIC YEAR**

**MAIN EXAMINATIONS
MAIN CAMPUS**

**FIRST YEAR END OF SECOND TRIMESTER
EXAMINATIONS**

**FOR THE DEGREE
OF
BACHELOR OF MEDICINE AND BACHELOR OF
SURGERY**

COURSE CODE: MBS 102

COURSE TITLE: MEDICAL PHYSIOLOGY I

DATE: 22ND APRIL 2022

TIME: 9AM

INSTRUCTIONS TO CANDIDATES

- 1) Section A MCQS (70marks): Answer **ALL** questions in this section and Select the **best answer**.
- 2) Section B SAQS (40marks): answer **ALL** questions in this section
- 3) Section C LAQS (40marks): answer **ALL** questions in this section

TIME: 3 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 14 Printed Pages. Please Turn Over.

SECTION A (MCQS 70marks)

1. Through what “permissive action” do glucocorticoids accelerate gluconeogenesis during fasting?
 - a) Glucocorticoids stimulate the secretion of insulin, which activates gluconeogenic enzymes in the liver
 - b) Glucocorticoids inhibit the use of glucose by skeletal muscle
 - c) Glucocorticoids inhibit glycogenolysis
 - d) Glucocorticoids maintain the intracellular concentrations of many of the enzymes needed to carry out gluconeogenesis through effects on transcription

2. Which of the following substances is derived from pro-opiomelanocortin (POMC)?
 - a) Adrenocorticotrophic hormone (ACTH)
 - b) Follicle-stimulating hormone (FSH)
 - c) Melatonin
 - d) Cortisol

3. Which step in steroid hormone biosynthesis is stimulated by adrenocorticotrophic hormone (ACTH)?
 - a) Cholesterol → pregnenolone
 - b) Progesterone → 11-deoxycorticosterone
 - c) 17-Hydroxypregnenolone → dehydroepiandrosterone
 - d) Testosterone → estradiol

4. Secretion of oxytocin is increased by
 - a) Milk ejection
 - b) Dilation of the cervix
 - c) Increased prolactin levels
 - d) Increased extracellular fluid (ECF) volume

5. Which of the following substances acts on its target cells via an inositol 1,4,5-triphosphate (IP₃)–Ca²⁺ mechanism?
 - a) Somatomedins acting on chondrocytes
 - b) Oxytocin acting on myoepithelial cells of the breast
 - c) Antidiuretic hormone (ADH) acting on the renal collecting duct
 - d) Adrenocorticotrophic hormone (ACTH) acting on the adrenal cortex

6. Secretion of which of the following hormones is stimulated by extracellular fluid volume expansion?
 - a) Antidiuretic hormone (ADH)
 - b) Aldosterone
 - c) Atrial natriuretic peptide (ANP)
 - d) 1,25-Dihydroxycholecalciferol

7. Which of the following hormones causes contraction of vascular smooth muscle?
 - a) Antidiuretic hormone (ADH)
 - b) Aldosterone
 - c) Atrial natriuretic peptide (ANP)
 - d) 1, 25-Dihydroxycholecalciferol

8. A major league baseball player takes human growth hormone to increase his performance. Which of the following is true regarding human growth hormone?
- Secretion is stimulated by somatostatin and inhibited by ghrelin
 - It has a long half-life
 - It inhibits protein synthesis
 - It stimulates production of somatomedins (insulin-like growth factors I and II) by the liver, cartilage, and other tissues
9. The endogenous secretion of ACTH is correctly described in which of the following statements?
- It shows a circadian rhythm in humans.
 - It is decreased during periods of stress.
 - It is inhibited by aldosterone.
 - It is stimulated by glucocorticoids
10. During sleep there is a fall in the circulating level of ALL of the following EXCEPT
- Cortisol.
 - Insulin.
 - Adrenaline.
 - Antidiuretic hormone
11. Thyroid hormones, when secreted in excess, may cause an increase in ALL of the following EXCEPT
- Peripheral vasodilation.
 - Frequency of defaecation.
 - Energy expenditure required for a given workload.
 - Duration of tendon reflexes
12. Aldosterone secretion is increased by an increase in plasma of
- Volume
 - Osmolality
 - Sodium
 - Potassium
13. All of the following are TRUE of Growth hormone EXCEPT
- Promotes positive nitrogen and phosphorus balance.
 - Secretion is under hypothalamic control.
 - Levels in the blood are higher in children than in adults.
 - Secretion surges during sleep.
14. Pancreatic glucagon
- Is produced by the beta cells of the islets of Langerhans.
 - Is an amine.
 - Output is inversely proportional to the blood glucose level.
 - Has a half-life in the circulation of 3–4 hours.

15. All of the following are TRUE of Cortisol EXCEPT
- Is bound in the plasma to an alpha globulin.
 - Is inactivated in the liver and excreted in the bile.
 - Injections lead to a rise in arterial pressure.
 - Inhibits release of ACTH from the anterior pituitary gland
16. Releasing hormones produced in the hypothalamus
- Are secreted by cells in the median eminence.
 - Pass down nerve axons to reach the pituitary gland.
 - Control the output of only one pituitary hormone.
 - Regulate the release of insulin.
17. Thyroid-stimulating hormone (TSH) secretion is increased in ALL of the following EXCEPT
- After partial removal of the thyroid gland.
 - In infants born without a thyroid gland.
 - When metabolic rate rises.
 - In starvation
18. All of the following are TRUE of insulin EXCEPT
- Stimulates release of free fatty acids from adipose tissue.
 - Secretion tends to lower the plasma potassium level.
 - Facilitates entry of glucose into skeletal muscle.
 - Facilitates entry of amino acids into skeletal muscle
19. The following are TRUE of pituitary gland EXCEPT
- Regulates activity in all other endocrine glands.
 - Output of prolactin is regulated by hypothalamic releasing factors.
 - Secretes antidiuretic hormone when blood osmolality rises.
 - Has an intermediate lobe which secretes melanotropin
20. The following are TRUE of Thyroxine EXCEPT
- Is stored in the follicular cells as thyroglobulin.
 - Increases the resting rate of carbon dioxide production.
 - Is essential for normal development of the brain.
 - Is essential for normal red cell production
21. Hormones secreted by the adrenal cortex
- Include cholesterol.
 - Are less bound to plasma proteins.
 - Do not include sex hormones.
 - Are essential for the maintenance of life.

22. Destruction of the anterior pituitary gland causes all of the following EXCEPT
- Amenorrhoea.
 - Diabetes insipidus.
 - Skin pallor.
 - Impaired ability to survive severe stress.
- 23 How do hormones from the thyroid and parathyroid regulate the calcium concentration of the blood?
- Calcitonin lowers blood calcium; parathyroid hormone raises blood calcium.
 - Parathyroid hormone lowers blood calcium; calcitonin raises blood calcium.
 - Thyroxine and triiodothyronine together regulate calcium levels, as needs dictate
 - Both parathyroid hormone and the three thyroid hormones function to regulate blood calcium levels
- 24 The endocrine gland responsible for the body's circadian rhythm is the:
- Thymus gland.
 - Pineal gland.
 - Parathyroid gland.
 - Pituitary gland.
25. Exposure to UV light directly facilitates which of the following?
- Conversion of cholesterol to 25-hydroxycholecalciferol
 - Conversion of 25-hydroxycholecalciferol to 1,25-dihydroxycholecalciferol
 - Transport of calcium into the extracellular fluid
 - Formation of calcium binding protein
- 26 Parathyroid hormones directly
- controls the rate of 25-hydroxycholecalciferol formation
 - controls the rate of calcium transport in the mucosa of the small intestine
 - controls the rate of formation of calcium binding proteins
 - controls the rate of formation of 1, 25-dihydroxycholecalciferol
- 27) Extracellular ionic calcium activity will be decreased within 1 min by which of the following?
- Increase in extracellular phosphate ion activity
 - Increase in extracellular pH
 - Decrease in extracellular P_{CO_2}
 - All of the above
- 28) In controlling aldosterone secretion, angiotensin II acts on which of the following structures?
- Zona glomerulosa
 - Zona fasciculata
 - Zona reticularis
 - Adrenal medulla

- 29 Which of the following statements about peptide or protein hormones is usually true?
- They have longer half-lives than steroid hormones
 - They have receptors on the cell membrane
 - They have a slower onset of action than both steroid and thyroid hormones
 - They are not stored in endocrine-producing glands
- 30 Cortisol and growth hormone are most dissimilar in their metabolic effects on which of the following?
- Protein synthesis in muscle
 - Glucose uptake in peripheral tissues
 - Plasma glucose concentration
 - Mobilization of triglycerides
- 31 Release of which of the following hormones is an example of neuroendocrine secretion?
- Growth hormone
 - Oxytocin
 - Prolactin
 - Adrenocorticotrophic hormone
- 32 Which of the following would most likely occur in the earliest stages of type II diabetes?
- Increased insulin sensitivity
 - High circulating levels of C-peptide
 - Decreased hepatic glucose output
 - Metabolic acidosis
- 33 Which of the following statements about nerve cells is correct?
- Typically, one copy of the same peptide is cut from the same precursor molecule
 - It is generally recognized that the cytosol provides the source of selective protein synthesis limited to neurotransmitters
 - Cytosolic proteins show significant modification or processing following their translation
 - Nuclear and mitochondrial proteins that are encoded by the cell's nucleus are targeted to their proper organelle by a process called posttranslational importation
- 34 Which of the following statements correctly characterizes ion channels?
- The passage of ions through ion channels typically requires an active mechanism
 - A common stimulus serves as the basis for opening ion channels
 - Exposure of a ligand-gated channel to continuous high concentrations of its ligand is the necessary and sufficient stimulus for opening that channel
 - The opening or closing of an ion channel may be affected by the use of drugs
35. Which of the following statements concerning the resting membrane potential is correct?
- Passive fluxes of Na^+ and K^+ are balanced by an active pump that derives energy from enzymatic hydrolysis of adenosine 5'-triphosphate (ATP)

- b) A membrane is depolarized when the separation of the charge across the membrane is increased
- c) As the inside of the cell is made more negative with respect to the outside, the cell becomes depolarized
- d) In a cell whose membrane possesses only K^+ channels, the membrane potential cannot be determined

36 Which of the following statements concerning ligand gating of neuronal membrane channels is true?

- a) The normal triggering mechanism for gating involves nonspecific binding by large classes of molecules
- b) Channels are opened when a given molecule selectively binds with the gating molecule
- c) Ligand gating is triggered by changes in the electrical potential across the membrane
- d) The channels are constructed of a mixture of proteins and lipids

37 After the occurrence of an action potential, there is a repolarization of the membrane. The principal explanation for this event is that

- a) Potassium channels have been opened
- b) Sodium channels have been opened
- c) Potassium channels have been inactivated
- d) The membrane becomes impermeable to all ions

38. During an in vitro experiment, the membrane potential of a nerve cell is hyperpolarized to -120 mV. At that time, a transmitter, known to be inhibitory in function, is applied to the preparation and results in a depolarization of the membrane. The most likely reason for this occurrence is that

- a) Inhibitory transmitters normally depolarize the postsynaptic membrane
- b) The normal response of the postsynaptic membrane to any transmitter is depolarization
- c) The inhibitory transmitter activates ligand-gated potassium channels
- d) Sodium channels become inactivated

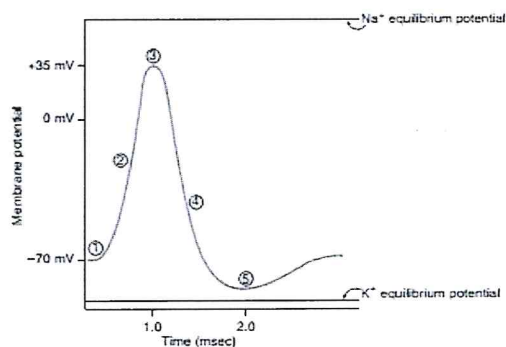
39. Which of the following statements concerning sodium channels is true?

- a) They are opened when the membrane is hyperpolarized
- b) They display a high conductance in the resting membrane
- c) They open rapidly following depolarization of the membrane
- d) They are rapidly inactivated by tetraethylammonium

40. The term all-or-none response is most closely related to

- a) The resting potential
- b) Increased-conductance presynaptic potentials
- c) Increased-conductance postsynaptic potentials
- d) The action potential

The following diagram of a nerve action potential applies to **Questions 41–43**



41. At which labeled point on the action potential is the K^+ closest to electrochemical equilibrium?
- 1
 - 2
 - 3
 - 5
42. What process is responsible for the change in membrane potential that occurs between point 1 and point 3?
- Movement of Na^+ into the cell
 - Movement of Na^+ out of the cell
 - Movement of K^+ out of the cell
 - Activation of the Na^+-K^+ pump
43. What process is responsible for the change in membrane potential that occurs between point 3 and point 4?
- Movement of Na^+ into the cell
 - Movement of Na^+ out of the cell
 - Movement of K^+ into the cell
 - Movement of K^+ out of the cell
44. Which of the following is TRUE; Nerve fibres continue to conduct impulses when
- Extracellular sodium is replaced by potassium.
 - Extracellular sodium is replaced by a non-diffusible cation.

- c) The sodium-potassium pump is inactivated
- d) Temperature is lowered to below 0°C provided freezing does not occur

45. Which of the following is TRUE; an action potential in a nerve fibre

- a) Occurs when its membrane potential is hyperpolarized to a critical level.
- b) Is associated with a transient decrease in membrane permeability to sodium.
- c) Is associated with a transient decrease in membrane permeability to potassium.
- d) Induces local electrical currents in adjacent segments of the fibre.

46. Non-myelinated axons differ from myelinated axons in that they are

- a) Not sheathed in Schwann cells.
- b) Not capable of regeneration after section.
- c) Found only in the autonomic nervous system.
- d) Less excitable

47. Which of the following is False; an inhibitory post-synaptic potential

- a) Cannot be recorded in a post-ganglionic sympathetic neurone.
- b) May be recorded in an anterior horn motor neurone.
- c) Does not exceed one millivolt in amplitude.
- d) Moves membrane potential towards the equilibrium potential for potassium

48. Which of the following is FALSE; the equilibrium potential (E) for

- a) An ion species is the membrane potential observed when its concentrations on each side of the membrane are in equilibrium.
- b) Na^+ is about +65 mV in squid axon.
- c) An ion species depends on the ratio of the concentrations of the ion outside (I_o) and inside (I_i) the cell.
- d) An ion species is the potential the membrane potential would approach if it became freely permeable to that ion.

49. Which of the following is FALSE with regard to saltatory conduction

- a) Occurs only in myelinated fibres.
- b) Does not depend on depolarization of the nerve membrane.
- c) Has a slower velocity in cold than in warm conditions.
- d) Is faster than non-saltatory conduction in nerve fibres with diameters around 10 μm .

50. Select the one correct answer concerning ion channels:

- a) Most ion channels are open 100 percent of the time.
- b) Na^+ ions pass more readily through chloride channels than Cl^- ions do.
- c) Most ion channels are composed of subunits.
- d) A change in voltage across the cell membrane can open anion channels but never cation channels.

51. Ca^{2+} ions are needed in the extracellular solution for synaptic transmission because:
- Ca^{2+} ions enter the presynaptic nerve terminal with depolarization and trigger synaptic vesicles to release their contents into the synaptic cleft.
 - Ca^{2+} ions are required to activate glycogen metabolism in the presynaptic cell.
 - Ca^{2+} ions must enter the postsynaptic cell to depolarize it.
 - Ca^{2+} ions prevent Mg^{2+} ions from releasing the transmitter in the absence of nerve impulses.
52. Select the correct answer. Electrical and chemical synapses differ in that
- Electrical synapses have a longer synaptic delay than chemical synapses.
 - Chemical synapses can amplify a signal while electrical synapses cannot.
 - Chemical synapses do not have a synaptic cleft while electrical synapses do have a synaptic cleft.
 - Electrical synapses use agonist-activated channels and chemical synapses do not.
53. Mark the false statement; Electrical synapses
- Can rectify.
 - Are gap junctions in the nervous system.
 - Have a longer synaptic delay than chemical synapses.
 - Do not require transmitters.
54. Which of the following is true about adaptation of sensory receptors:
- Light touch is a slowly adapting stimuli
 - Fast adaptation of muscle spindle fiber is necessary for postural balance
 - Nociceptors adapt rapidly
 - Plasticity of neuronal synapses may influence speed of adaptability.
55. False about signals transmitted via type C unmyelinated fibers.
- Travel at slowest velocities of 2mm/ second
 - May sub serve sensations of tickle and itch
 - Crude pressure and poorly localized touch travel via these pathway
 - They mostly follow the dorsal column medial lemniscal pathway.
56. True statement regarding pain pathways
- Fast pain is transmitted in unmyelinated type C fibres
 - Synaptic transmitter accounting for slow pain is glutamate
 - The dorsal horn accounts for plasticity of pain modulation
 - Naked nerve endings are rapidly adapting to stimuli
57. False about visceral pain
- Is poorly localized and unpleasant
 - Usually radiates or is referred to another anatomic site

- c. May lead to reflex contraction of adjacent skeletal muscles
 - d. Is not caused by ischemia or chemical stimuli
58. True statement regarding referred pain
- a. Accounts for pain in the inner left arm following angina pectoris attacks
 - b. Knowledge of different sites of referred pain has no clinical significance
 - c. Visceral pain fibres do not synapse on the same second order neurons as somatic fibres.
 - d. Dermatomal rule has no relation to referred pain physiology
59. Which of the following temporal sequences is correct for excitation–contraction coupling in skeletal muscle?
- a) Increased intracellular $[Ca^{2+}]$; action potential in the muscle membrane; cross-bridge formation
 - b) Action potential in the muscle membrane; depolarization of the T tubules; release of Ca^{2+} from the sarcoplasmic reticulum (SR)
 - c) Action potential in the muscle membrane; splitting of adenosine triphosphate (ATP); binding of Ca^{2+} to troponin C
 - d) Release of Ca^{2+} from the SR; depolarization of the T tubules; binding of Ca^{2+} to troponin C
60. In skeletal muscle, which of the following events occurs before depolarization of the T tubules in the mechanism of excitation–contraction coupling?
- a) Depolarization of the sarcolemmal membrane
 - b) Opening of Ca^{2+} release channels on the sarcoplasmic reticulum (SR)
 - c) Uptake of Ca^{2+} into the SR by Ca^{2+} -adenosine triphosphatase (ATPase)
 - d) Binding of Ca^{2+} to troponin C
61. Which of the following causes rigor in skeletal muscle?
- a) No action potentials in motoneurons
 - b) An increase in intracellular Ca^{2+} level
 - c) An increase in adenosine triphosphate (ATP) level
 - d) A decrease in ATP level
62. Which of the following muscle proteins plays an important role in contraction of both smooth and striated muscle?
- a) Calmodulin
 - b) Troponin
 - c) Tropomyosin
 - d) Actin
63. When comparing the contractile responses in smooth and skeletal muscle, which of the following is most different?
- a) The source of activator calcium
 - b) The role of calcium in initiating contraction
 - c) The mechanism of force generation
 - d) The source of energy used during contraction

64. If all the $\text{Na}^+ - \text{K}^+$ pumps in the membrane of a muscle cell were stopped, all of the following changes would be expected for the muscle cell **EXCEPT**
- Immediate loss of the ability of the cell to carry action potentials.
 - Gradual decrease in internal K^+ concentration.
 - Gradual increase in internal Na^+ concentration.
 - Gradual decrease in resting membrane potential (the potential would become less negative).
65. Which one of the following statements is correct about the activation of different types of muscle?
- Autonomic neurons can alter the frequency and strength of smooth muscle contraction
 - Neurons are not involved in the activation of smooth muscle cells.
 - Cardiac muscle contraction is triggered by motor neuron activity.
 - Postsynaptic potentials from autonomic neurons can alter skeletal muscle contraction.
66. Energy for skeletal muscle contraction is derived from stores of which of the following?
- ATP, creatine phosphate, myoglobin
 - ATP, creatine phosphate, glycogen
 - ATP, creatine phosphate, amino acids
 - ATP, creatine phosphate, collagen
67. Hyperkalemia (high extracellular potassium concentration) can stop the heart because
- Potassium ions bind to sodium channels, preventing their activity.
 - Potassium ions stimulate the sodium-potassium pump and thereby prevent cardiac action potentials.
 - The membrane potential of heart cells depolarizes and its sodium channels inactivate.
 - Potassium ions rush out through the inward rectifier.
68. Which of the following is **not** true of the structure of smooth muscles?
- The sarco tubular system and triad of the myofibrils is poorly developed
 - There is less thick filaments and more thin filaments
 - Troponin is present in actin of the muscle
 - Myosin binds only if phosphorylated
69. Which of the following is **not** a characteristic of cardiac muscles?
- Striated with intercalated discs
 - It has a peripherally placed nucleus
 - Cardiac muscle fiber is bound by sarcolemma
 - Myofibrils are embeded in the sarcoplasm

SECTION B (SAQS 40marks)

1. State five (5) differences between graded potentials and action potentials (5 marks)
2. Describe the role of Na^+ - K^+ ATPase in creating the resting membrane potential (5 marks)
3. State five (5) differences between Neuromodulators and Neurotransmitters (5marks)
4. State five (5) changes that occur in Nerve Cell Body during retrograde degeneration (5 marks)
5. How does a decrease in serum K^+ concentration alter the resting membrane potential of the skeletal muscle? (5marks)
6. State five (5) actions of Insulin hormone in the human body. (5 marks)
7. List 5 hormones of the hypothalamus and state their functions. (5 marks)
8. Explain the regulation of Parathyroid hormone (5marks)

70. Which of the following is **not** an effect of physical activity in skeletal muscle?
- a. Promotes efficiency in contraction of the muscles from increased sarcoplasmic reticulum, mitochondria and ATP production
 - b. Increase interleukin-6 synthesis which inhibits muscle fiber apoptosis and atrophy
 - c. Generates muscular strength and induces hypertrophy of the muscle fibers
 - d. Reduces oxidative stress with subsequent decrease in the production of reactive oxygen species