



(University of Choice)  
**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

**MAIN CAMPUS**

**UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR  
SECOND YEAR END OF THIRD TRIMESTER EXAMINATION  
FOR THE DEGREE OF  
BACHELOR OF MEDICINE AND BACHELOR OF SURGERY**

**COURSE CODE: MBS 202**  
**COURSE TITLE: SYSTEMIC PHYSIOLOGY (THEORY)**

**DATE: 14<sup>TH</sup> OCTOBER, 2022**

**TIME: 3 HOURS**

**INSTRUCTIONS:**

- i. This Continuous examination consists of THREE (3) sections. Namely, Section A, Band C.
- ii. Section A, is of Multiple Choice Questions (MCQs). There are Eighty (80) questions and/or statements. In the booklet provided, write the best answer:
  - One mark is awarded for every correct response
  - Wrong response or omitted responses will NOT be penalized
- iii. Section B is of Short Answer Questions (SAQs). There are Ten(10) questions. Answer all questions in this section.
- iv. Section C is of Long Answer Questions (LAQS). There are two (2) questions. Answer all questions in this section.
- v. Write your registration number and NOT your name on all the pages of the answer booklet provided.

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MMUST observes ZERO tolerance to examination cheating

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

**SECTION A: MCQS (80 marks):**

1. Which of the following substances is released from neurons in the GI tract and produces smooth muscle relaxation?
  - a) Secretin
  - b) Gastrin
  - c) Cholecystokinin (CCK)
  - d) Vasoactive intestinal peptide (VIP)
  
2. secretion of intrinsic factor occurs in the .....
  - a) Gastric antrum
  - b) Gastric fundus
  - c) Duodenum
  - d) Ileum
  
3. *Vibrio cholerae* causes diarrhea because it
  - a) increases  $\text{HCO}_3^-$  secretory channels in intestinal epithelial cells
  - b) increases  $\text{Cl}^-$  secretory channels in crypt cells
  - c) prevents the absorption of glucose and causes water to be retained in the intestinal lumen isosmotically
  - d) inhibits cyclic adenosine monophosphate (cAMP) production in intestinal epithelial cells
  
4. Cholecystokinin (CCK) has some gastrin-like properties because both CCK and gastrin
  - a) are released from G cells in the stomach
  - b) are released from I cells in the duodenum
  - c) are members of the secretin-homologous family
  - d) have five identical C-terminal amino acids
  
5. Which of the following abolishes “receptive relaxation” of the stomach?
  - a) Parasympathetic stimulation
  - b) Sympathetic stimulation
  - c) Vagotomy
  - d) Administration of gastrin
  
6. Secretion of which of the following substances is inhibited by low pH?
  - a) Secretin
  - b) Gastrin
  - c) Cholecystokinin (CCK)
  - d) Gastric inhibitory peptide (GIP)
  
7. Micelle formation is necessary for the intestinal absorption of
  - a) Glycerol
  - b) Galactose
  - c) vitamin B<sub>12</sub>
  - d) vitamin D

8. Which of the following is characteristic of saliva?
  - a) Hypotonicity relative to plasma
  - b) A lower  $\text{HCO}_3^-$  concentration than plasma
  - c) The presence of proteases
  - d) Secretion rate that is increased by vagotomy
  
9. Which of the following substances is secreted in response to an oral glucose load?
  - a) Secretin
  - b) Cholecystokinin (CCK)
  - c) Vasoactive intestinal peptide (VIP)
  - d) Glucose-dependent insulinotropic peptide (GIP)
  
10. Which of the following is true about the secretion from the exocrine pancreas?
  - a) It has a higher  $\text{Cl}^-$  concentration than does plasma
  - b) It is stimulated by the presence of  $\text{HCO}_3^-$  in the duodenum
  - c) Pancreatic  $\text{HCO}_3^-$  secretion is increased by gastrin
  - d) Pancreatic enzyme secretion is increased by cholecystokinin (CCK)
  
11. Which of the following substances must be further digested before it can be absorbed by specific carriers in intestinal cells?
  - a) Fructose
  - b) Sucrose
  - c) Alanine
  - d) Dipeptides
  
12. Slow waves in small intestinal smooth muscle cells are
  - a) action potentials
  - b) phasic contractions
  - c) oscillating resting membrane potentials
  - d) oscillating release of cholecystokinin (CCK)
  
13. Peristalsis of the small intestine
  - a) Is coordinated by the central nervous system (CNS)
  - b) Involves contraction of circular smooth muscle behind and in front of the food bolus
  - c) Involves contraction of circular smooth muscle behind the food bolus and relaxation of circular smooth muscle in front of the bolus
  - d) Involves relaxation of circular and longitudinal smooth muscle simultaneously throughout the small intestine

14. Which of the following substances inhibits gastric emptying?
- Motilin
  - Gastrin
  - Cholecystokinin (CCK)
  - Vasoactive intestinal peptide (VIP)
15. A patient with diabetes mellitus presents with gastroesophageal reflux disease accompanying gastroparesis. Which of the following statements about gastric emptying is correct?
- Solids empty more rapidly than liquids
  - Meals containing fat empty faster than carbohydrate-rich food
  - Hyperosmolality of duodenal contents initiates a decrease in gastric emptying
  - Acidification of the antrum increases gastric emptying
16. Which of the following vitamins is both synthesized by intestinal bacteria and absorbed in significant quantities?
- Vitamin B<sub>6</sub>
  - Vitamin K
  - Riboflavin
  - Folic acid
17. A 70-year old woman presents with abdominal pain, microcytic anemia, and weight loss. Colonoscopy with biopsy confirms colon cancer. Which of the following statements about the colon is correct?
- Absorption of Na<sup>+</sup> in the colon is under hormonal (aldosterone) control
  - Bile acids enhance absorption of water from the colon
  - Net absorption of HCO<sub>3</sub><sup>-</sup> occurs in the colon
  - Net absorption of K<sup>+</sup> occurs in the colon
18. Which of the following is true regarding contraction of the gallbladder following a meal?
- It is inhibited by a fat-rich meal
  - It is inhibited by the presence of amino acids in the duodenum
  - It is stimulated by atropine
  - It occurs in response to cholecystokinin
19. Chronic administration of which of the following types of drugs would lead to a sustained increase in serum gastrin levels?
- H<sub>2</sub> receptor antagonist
  - Proton pump inhibitor
  - Anticholinergic
  - Antacid

20. Which one of the following statements about small intestinal motility is correct?
- Peristalsis is the major contractile pattern during feeding
  - Migrating motor complexes occur during the digestive period
  - Vagotomy abolishes contractile activity during the digestive period
  - Contractile activity is initiated in response to bowel wall distention
21. Which one of the following statements about gastric emptying is correct?
- Solids empty more rapidly than liquids
  - Vagotomy accelerates the emptying of solids
  - Indigestible food empties during the digestive period
  - Acidification of the antrum decreases gastric emptying
  - Vagotomy decreases accommodation of the proximal stomach
22. The principal paracrine secretion involved in the inhibitory feedback regulation of gastric acid secretion is
- Gastrin
  - Somatostatin
  - Histamine
  - Enterogastrone
23. Which gastrointestinal motor activity is most affected by vagotomy?
- Secondary esophageal peristalsis
  - Distention-induced intestinal segmentation
  - Orad stomach accommodation
  - Caudal stomach peristalsis
24. The hormone involved in the initiation of the migrating motor complex is
- Gastrin
  - Motilin
  - Secretin
  - Cholecystokinin
25. The rate of gastric emptying increases with an increase in
- Intragastric volume
  - Intraduodenal volume
  - Fat content of duodenum
  - Osmolality of duodenum
26. Basal acid output is increased by
- Acidification of the antrum
  - Administration of an H<sub>2</sub> receptor antagonist
  - Alkalinization of the antrum
  - Acidification of the duodenum

27. Which one of the following processes applies to the proximal stomach?
- Accommodation
  - Peristalsis
  - Retropulsion
  - Segmentation
28. After secretion of trypsinogen into the duodenum, the enzyme is converted into its active form, trypsin, by
- Enteropeptidase
  - Procarboxypeptidase
  - Previously secreted trypsin
  - An alkaline Ph
29. Pharmacological blockade of histamine H<sub>2</sub> receptors in the gastric mucosa
- Inhibits both gastrin- and acetylcholine-mediated secretion of acid
  - Inhibits gastrin-induced but not meal-stimulated secretion of acid
  - Has no effect on either gastrin-induced or meal-stimulated secretion of acid
  - 
  - Prevents activation of adenyl cyclase by gastrin
30. Removal of proximal segments of the small intestine results in a decrease in
- Basal acid output
  - Maximal acid output
  - Gastric emptying of solids
  - Pancreatic enzyme secretion
31. Removal of the pyloric sphincter is associated with
- An increase in maximal output of acid
  - An increase in basal output of acid
  - An increase in the rate of gastric emptying of solids
  - An increase in the serum gastrin level
32. Contraction of the gallbladder is correctly described by which of the following statements?
- It is inhibited by a fat-rich meal
  - It is inhibited by the presence of amino acids in the duodenum
  - It occurs in response to cholecystokinin
  - It occurs simultaneously with the contraction of the sphincter of Oddi
33. Acidification of the duodenum will
- Decrease pancreatic secretion of bicarbonate
  - Increase secretion of gastric acid
  - Decrease gastric emptying
  - Increase contraction of the gallbladder



34. Which one of the following statements about small intestine crypt cells is correct?
- They evidence well-developed microvilli
  - They contain significant quantities of brush border hydrolases
  - They are responsible for net NaCl and water secretion
  - They demonstrate little or no proliferative activity
35. In contrast to secondary esophageal peristalsis, primary esophageal peristalsis is characterized by which of the following statements?
- It does not involve relaxation of the lower esophageal sphincter
  - It is not influenced by the intrinsic nervous system
  - It has an oropharyngeal phase
  - It involves only contraction of esophageal skeletal muscle
36. The origin of electrical slow wave activity in gastrointestinal tract smooth muscle is
- The interstitial cells of Cajal
  - The smooth muscle of the circular muscle layer
  - The smooth muscle of the longitudinal muscle layer
  - The smooth muscle of the muscularis mucosa
37. Which one of the following statements is correct?
- Pepsin is inactivated at a pH of 3 and below
  - Gastric acid secretion is greatest during the cephalic phase of digestion
  - Somatostatin increases antral G cell gastrin release
  - Maximal acid output may be increased in a patient with duodenal ulcer disease
38. The major factor that protects the duodenal mucosa from damage by gastric acid is
- Pancreatic bicarbonate secretion
  - The endogenous mucosal barrier of the duodenum
  - Duodenal bicarbonate secretion
  - Hepatic bicarbonate secretion
39. Which one of the following statements about bile acids is correct?
- Conjugation with glycine enhances passive absorption of bile acids
  - Bile acids constitute approximately 80% of the total solutes in bile
  - Deoxycholic acid and lithocholic acid are examples of primary bile acids
  - Bile acid synthesis is catalyzed by the microsomal enzyme 7 $\alpha$ -hydroxylase
40. Removal of proximal segments of the small intestine results in a decrease in
- Maximal acid output
  - Gastric emptying of liquids
  - Gastric emptying of solids
  - Pancreatic enzyme secretion

41. Autonomic nerve supply to the sweat glands of the face is mediated by which neurotransmitter?
- Adrenaline
  - Noradrenaline
  - Acetylcholine
  - Histamine
42. Which of the following is correctly matched?
- Penile erection: parasympathetic nervous system
  - Thick viscid saliva: cholinergic transmission
  - Insulin release: alpha adrenergic
  - Positive chronotropy in the heart: histaminergic response
43. A 46 year old smoker has an apical lung tumor. When you examine him, you note that he has ptosis, anhidrosis and mydriasis. Which structure do you think is affected by the tumor?
- Celiac ganglion
  - Sympathetic chain
  - Edinger Westphal nucleus
  - External carotid artery.
44. The rate limiting step in synthesis of noradrenaline is
- Dopa decarboxylase
  - Dopamine hydroxylase
  - Inhibited by metyrosine
  - PNMT
45. Which is not correctly matched:
- Cornea: contributes to 2/3 refraction of light
  - Lens : accommodation reflex
  - Vitreous humor: nourishment of photoreceptors
  - Pupil: Depth of focus

Use the following options to answer questions 46,47 and 48

- Ganglion cells.
  - Optic chiasma
  - Lateral geniculate body
  - Cones
  - Retinal
  - Opsin
46. Lesion at this point may cause bitemporal hemianopia
47. Deficiency in Vitamin A may reduce its synthesis
48. The source of action potentials in the retina



For questions 49 to 52, fill in the following paragraph on CSF, cerebral circulation and blood brain barrier (half a mark for each correct answer).

Tight junctions present between \_\_49a\_\_ cells restrict movement of substances from plasma into CSF. The CSF formed has \_\_49b\_\_ concentration of glucose and proteins as compared to plasma. At arachnoid granulations, reabsorption of CSF occurs due to 2 significant forces: \_\_50a\_\_ and \_\_50b\_\_.

The brain receives about 15% of cardiac output. White matter receives \_\_51a\_\_ arterial blood as compared to grey matter. The mechanisms that regulate cerebral blood flow include myogenic, neurogenic, endothelial and \_\_51b\_\_. Although there are tight junctions between capillary cells, substances like glucose enter through cells using \_\_52a\_\_ transporters. Irritating substances in plasma that induce vomiting may do so through receptors in \_\_52b\_\_, an organ that is part of circumventricular organs

53. Chronic pain may be associated with all the following except
- Reduced immune function
  - Abnormal mental functioning
  - Malnutrition
  - Improved survival
54. Superficial somatic pain may have a double phenomenon: fast and slow pain. Which statement is true?
- Neurotransmitter mediating fast pain at spinal cord is glutamate
  - Type A delta fibres carry sensation of slow pain.
  - Both pains cannot be ameliorated by descending analgesia system.
  - Neospinothalamic pathway carries slow pain sensation.
55. A soldier wounded in war will continue fighting oblivious of pain because of activation of the following in descending analgesia system in CNS except
- Periaqueductal gray area
  - Nucleus accumbens
  - Nucleus raphe magnus
  - Pain inhibitory complex in dorsal horn
56. Extreme sensitivity to innocuous or non-painful stimuli is called:
- Hyperesthesia
  - Analgesia
  - Allodynia
  - Anaesthesia

Use the following options to fill in questions 57 up to 63

- Sustentacular cells
- Basal cells
- Olfactory receptor cells

- d. Taste receptor cells
  - e. Serotonin
  - f. Bitter tastants
  - g. Insular operculum cortex
  - h. Odorant binding receptors
  - i. Sweet tastants
  - j. Prepiriform cortex and amygdaloid complex
  - k. Acetylcholine
57. Is the main neurotransmitter for mediating salt and sour taste stimuli. E
58. Bipolar cells that regenerate after 4 weeks. C
59. This is the primary cortical target of gustatory pathway. J
60. Activate receptors that use the PLPC- IP3 pathway to bring about a receptor potential. F
61. Binding on the receptors stimulates release of ATP as the main neurotransmitter. I
62. Coded by more than 400 genes in human beings
63. Produce a thin layer of mucus for dissolving odorants
64. Choose a statement that correctly compares between two entities of memory
- a. Implicit memory but not explicit memory is associated with consciousness/awareness.
  - b. Long term but not short term memory is easily disrupted by brain trauma or drugs.
  - c. Forgetting facts, key events and faces may point to abnormal declarative memory, while procedural and priming are types of nondeclarative memory.
  - d. Non declarative memory is easy to form and forget as compared to declarative memory.
65. Identify a pair that is incorrectly matched
- a. Prefrontal cortex: Processing of working memory
  - b. Long term potentiation: Formation and growth of new synaptic connections.
  - c. Habituation: Increased presynaptic release of neurotransmitters following repeated stimuli.
  - d. Antegrade amnesia: Inability to form new memories after brain trauma
66. The following neurotransmitters are involved in mechanisms controlling sleep except
- a. Glutamate
  - b. GABA
  - c. Norepinephrine
  - d. Histamine

67. All the following statements are true except
- REM sleep occupies 80% of total sleep time in premature infants.
  - Sleep insufficiency enhances cognitive performance
  - Stage 2 of NREM sleep is marked by appearance of sleep spindles on EEG
  - Vivid dreams tend to occur during REM phase of sleep.

For questions 68 to 70, use the following options to answer

- Promotes feeding behavior as a response to hunger
  - Inhibits feeding behavior
  - Does both a and b
  - Neither a nor b
68. Leptin
69. Ghrelin
70. Lateral hypothalamus
71. Statement that is true concerning cochlea and auditory pathway
- The auditory pathway passes through the lateral geniculate body before going to temporal cortex
  - Outer hair cells are more resistant to ototoxic drugs compared to inner hair cells.
  - Endolymph has less concentration of potassium ions as compared to perilymph
  - Entry of potassium ions into hair cells causes depolarization
72. Movements causes the otoliths/otoconia to bend hair cells in otolith organs. This generates an impulse that travels to the brain via which nerve?
- Vestibular
  - Cochlea
  - Olfactory
  - Facial
73. Regarding sound physics and transduction
- Frequency is coded by point of maximal deflection on basilar membrane.
  - Loudness is coded by frequency of action potentials generated
  - Decibels measure sound loudness while Hertz measure sound frequency
  - Human beings can perceive sound frequencies of more than 30,000Hz
74. Which property of Paccinian corpuscle would be affected if the outer connective capsule is removed?
- Generation of receptor potential
  - Rapid adaptation to stimuli
  - Conduction of nerve impulses
  - Change in the type of adequate stimulus.

75. Choose the option that is correctly matched
- Fine touch: Type C fibre
  - Slow pain: Type II fibre
  - Cold temperature: Type A delta fibre
  - Itchiness: Type B sensory fibre
76. Two- point discrimination is well developed in the fingers as compared to the trunk because of the following reasons except:
- Higher density of mechanoreceptors.
  - Larger receptive fields
  - Larger brain tissue dedicated to sensations per surface area
  - Well-developed lateral inhibition for higher resolution
77. Basal ganglia and cerebellum play a crucial role in control of movements. Which of the following statements is true.
- Abnormal nigrostriatal pathway results in Huntington's disease
  - Flocculonodular lobe corresponds to cerebrocerebellum communication path.
  - Injury to vermis and medial portions of cerebellum may lead to loss of balance and gait impairment.
  - Putamen and caudate nucleus form the lenticular nuclei
78. Correct description of descending motor pathways is:
- Lateral corticospinal tract synapses on efferent neurons supplying proximal musculature.
  - Rubrospinal tract decussates at spinal cord to excite flexor muscles.
  - Somatosensory cortex contributes about 40% of output in pyramidal tract.
  - Upper motor neuron defect will manifest with hypertonia, flaccidity and hyporeflexia

For questions 79 and 80 fill in the paragraph. Each answer is half a mark.

\_\_\_79a\_\_\_ are composed of intrafusal fibres lying in parallel and sandwiched between extrafusal skeletal muscle fibres. Stretching of the muscle stimulates the non-contractile central portion of nuclear chain intrafusal fibres to generate impulses that are carried by Type \_\_\_79b\_\_\_ nerve fibres to spinal cord via dorsal root ganglion. Efferent output carried by Type A alpha fibres causes contraction of skeletal muscle fibre.

Isometric contraction of a muscle stretches fibres of Golgi tendon receptor, generating impulses carried by type Ib fibres to spinal cord. These fibres synapse on \_\_\_80a\_\_\_ interneurons in the ventral horn of synergistic muscle. Efferent output therefore \_\_\_80b\_\_\_ contraction of the muscle.