

Monday, December 12th, 2022

Following directions on the mark-sense form, write your **name, and student number** in the blanks and fill in the bubbles. In addition, write your **name** on this exam.

When finished with the test, turn in both the mark-sense form and the exam at the front of the room.

PLACE ALL ANSWERS ON THE MARK-SENSE FORM

MULTIPLE CHOICE: Always choose the BEST, most complete answer. (2 points each)

1. Because the kidneys regulate extracellular fluid (ECF) volume, they play an important role in the control of
 - a) heart rate.
 - b) respiration.
 - c) peristalsis in the small intestine.
 - d) blood pressure.
 - e) blood vessel growth.

2. What do the kidneys change to maintain the extracellular fluid (ECF) osmolarity within an ideal range?
 - a) reabsorption or excretion of Na⁺
 - b) reabsorption or excretion of water
 - c) volume of the ECF
 - d) pH of the ECF
 - e) protein concentration of the ECF

3. Which of the following contains uroepithelium (transitional epithelium)?
 - a) renal cortex
 - b) renal calyx
 - c) collecting duct
 - d) proximal tubule
 - e) loop of Henle

4. Which of the following is true about the glomerulus?
 - a) blood is delivered to the glomerulus by the efferent arteriole
 - b) hydrostatic pressure in the glomerular capillaries is lower than hydrostatic pressure in other capillaries in the body
 - c) the glomerulus is in the renal medulla
 - d) capillaries in the glomerulus are fenestrated
 - e) the glomerulus is the site of tubular secretion

5. How can the filtered load be greater than the amount excreted?
 - a) if the filtration membrane is damaged
 - b) if a substance is secreted
 - c) if a substance is reabsorbed
 - d) if a substance is neither reabsorbed nor secreted

6. Which of the following is a sign of diabetic kidney disease?
 - a) proteinuria
 - b) glomerulonephritis
 - c) polyuria
 - d) hyperglycemia
 - e) edema

7. When mean arterial pressure drops very low (below 80 mmHg), what happens to the glomerular filtration rate (GFR)?
 - a) The myogenic response increases GFR.
 - b) Tubuloglomerular feedback increases GFR.
 - c) Atrial natriuretic peptide decreases GFR.
 - d) Renal autoregulation increases GFR.
 - e) Sympathetic nervous system input to the kidney decreases GFR.

8. Which of the following is a drug that was originally approved to treat diabetes mellitus and is now approved to treat heart failure?
 - a) metformin
 - b) hydrochlorothiazide (a thiazide diuretic)
 - c) insulin
 - d) dapagliflozin (an SGLT2 inhibitor)
 - e) furosemide (a loop diuretic)

9. What is the main effect of a thiazide diuretic?
 - a) reduces urine volume
 - b) increases vasopressin secretion
 - c) reduces Na⁺ reabsorption
 - d) increases blood pressure
 - e) inhibits glomerular filtration

10. What is the response in the body if you drink your whole water bottle in class?
- increased vasopressin secretion
 - decreased Na^+ reabsorption in the cortical collecting duct
 - increased aquaporins in the collecting duct
 - decreased frequency of action potential firing by hypothalamic osmoreceptors
 - NONE of the above occur
11. In what way is the thick ascending limb of the loop of Henle different from other parts of the renal tubule?
- is formed from a simple epithelium
 - is impermeable to water
 - reabsorbs Na^+
 - expresses Na^+/K^+ on basolateral membrane
12. Which of the following is the action of renin?
- converts angiotensin II to aldosterone
 - converts vasopressin to aquaporin 2
 - converts ACE1 to ACE2
 - converts angiotensin II to angiotensin I
 - converts angiotensinogen to angiotensin I
13. Which of the following is the hormone that stimulates expression of the epithelial Na^+ channel (ENaC) to increase Na^+ reabsorption in the cortical collecting duct?
- aldosterone
 - atrial natriuretic peptide
 - erythropoietin
 - creatinine
 - vitamin D
14. Low blood pressure causes a decrease in GFR and ultimately results in decreased Na^+ in the distal tubule. What is the sensor in the distal tubule that detects decreased Na^+ ?
- efferent arteriole
 - osmoreceptor
 - macula densa
 - vasa recta
 - carotid baroreceptor
15. In heart failure, low blood flow to the kidney activates sensors to stimulate renin secretion and increase angiotensin II. What increases as a consequence of increased angiotensin II signaling?
- extracellular fluid volume
 - Na^+ reabsorption
 - blood pressure
 - fluid build-up in tissues (edema)
 - ALL of the above increase.

16. The activity of the enzyme _____ is important for bicarbonate (HCO_3^-) reabsorption in the proximal tubule.
- a) carbonic anhydrase
 - b) protein kinase A
 - c) trypsin
 - d) HMG-CoA reductase
 - e) ACE (angiotensin converting enzyme)
17. Which of the following structures is made up of skeletal muscle?
- a) detrusor muscle
 - b) renal pelvis
 - c) external urethral sphincter
 - d) internal urethral sphincter
 - e) ALL of the above
18. Vaccines can prevent serious disease because they
- a) suppress innate immunity.
 - b) stimulate a primary immune response and the development of memory cells.
 - c) activate complement.
 - d) upregulate barrier mechanisms of defense.
 - e) contain a special microchip that kills viruses.
19. ALL of the following cells are phagocytes EXCEPT
- a) antigen presenting cells.
 - b) plasma cells.
 - c) neutrophils.
 - d) macrophages.
 - e) dendritic cells.
20. What is the term for a protein that binds to a pathogen and stimulates phagocytosis?
- a) cytokine
 - b) T cell receptor
 - c) opsonin
 - d) inflammatory paracrine
 - e) MHC molecule
21. Which of the following is a part of innate immunity that plays an important role in the stimulation of the adaptive/specific immune responses?
- a) helper T cell
 - b) phagocytosis
 - c) complement
 - d) acute phase protein
 - e) barrier mechanism

22. Which of the following is a place where antigen-presenting cells interact with lymphocytes to stimulate an adaptive/specific immune response?
- a) spleen
 - b) liver
 - c) blood vessel
 - d) bone marrow
 - e) kidney
23. What feature is part of a B cell receptor but not part of a secreted antibody?
- a) variable region
 - b) transmembrane domain
 - c) heavy chain
 - d) F_c region
 - e) light chain
24. What type of immune cell is killed by the human immunodeficiency virus (HIV)?
- a) B cell
 - b) dendritic cell
 - c) macrophage
 - d) helper T cell
 - e) ALL of the above are killed by HIV
25. Activation of clonal expansion for a particular B cell almost always requires
- a) somatic recombination.
 - b) a secondary immune response.
 - c) complement activation.
 - d) acute phase proteins.
 - e) help from a helper T cell.
26. What binds to peptide antigen displayed on an MHC II molecule?
- a) B cell receptor
 - b) neutrophil F_c receptor
 - c) T cell receptor on a helper T cell
 - d) C-reactive protein
 - e) coronavirus spike protein
27. How does a cytotoxic T cell identify a virally infected cell?
- a) T cell receptor recognizes viral antigen displayed on an MHC I molecule.
 - b) T cell receptor recognizes foreign RNA on the surface of the virally infected cell.
 - c) Dendritic cells secrete MHC II that binds to virally infected cells.
 - d) Virally infected cells get coated with opsonins that are identified by T cell receptors.
 - e) Helper T cells secrete antibodies that binds to virally infected cells.

28. Which of the following is true about monoclonal antibody drugs?
- Monoclonal antibody drugs are usually administered orally.
 - Each drug is derived from a single B cell and recognizes a unique epitope.
 - Because they are monoclonal, they are small molecules.
 - Monoclonal antibody drugs work by suppressing clonal expansion of regulatory T cells (T_{reg}).
 - They are effective because they lack specificity and can bind to multiple targets.
29. Dexamethasone is a glucocorticoid drug that has been shown to improve survival in severely ill patients with COVID-19. Why does treatment with a glucocorticoid drug help in this situation?
- Glucocorticoids suppress the immune system and limit the damaging effects of cytokine storm.
 - Glucocorticoids enhance the immune response by stimulating lymphocyte proliferation.
 - Glucocorticoids inhibit viral replication.
 - Glucocorticoids stimulate regeneration of lung tissue.
 - Glucocorticoids stimulate cytokine release to augment the immune response.
30. Which of the following drugs works by directly disrupting cytokine signaling?
- aspirin
 - ACE inhibitor
 - JAK inhibitor
 - diuretic
 - convalescent plasma
31. The phospholipids that form the cell membrane are
- hydrophilic.
 - amphipathic.
 - charged.
 - polar.
 - covalently bound to proteins.
32. Fill in the blank. Active transport ensures that the concentration of _____ is always much higher in the extracellular fluid (ECF) than it is in the intracellular fluid.
- glucose
 - water
 - protein
 - Na^+
 - K^+
33. A neurotransmitter opens ligand-gated K^+ channels on a postsynaptic cell that is at its resting membrane potential of -70mV. What happens next?
- The postsynaptic cell fires an action potential.
 - K^+ ions enter the postsynaptic cell.
 - The postsynaptic cell is hyperpolarized.
 - The postsynaptic cell is depolarized.
 - There is no change in membrane potential in the postsynaptic cell.

34. Which of the following best describes the receptor for estrogen, a steroid hormone?
- opens a ligand gated ion channel
 - inactivates a G protein
 - is an intracellular receptor
 - acts as a second messenger to increase intracellular Ca^{++}
 - phosphorylates a GPCR
35. G protein coupled receptor signaling causes an increase in cyclic AMP (cAMP) through the activation of the enzyme adenylyl cyclase. Which of the following directly activates adenylyl cyclase?
- protein kinase A
 - guanosine triphosphate (GTP)
 - the catalytic receptor
 - G-alpha subunit bound to GTP
 - phospholipase C
36. The opening of temperature-gated channels in the sensory dendrites of an afferent neuron directly causes
- an action potential.
 - membrane cooling.
 - a postsynaptic potential.
 - a receptor potential.
 - activation of a GPCR.
37. The falling (repolarizing) phase of the action potential depends upon
- the opening of voltage-gated Na^+ channels.
 - the opening of voltage-gated K^+ channels.
 - the closing of voltage-gated K^+ channels.
 - a positive feedback loop.
 - the activity of the Na^+/K^+ -ATPase.
38. Which of the following is a protein that is found at high density in the node of Ranvier?
- nicotinic acetylcholine receptor
 - voltage-gated Ca^{++} channel
 - acetylcholinesterase
 - myelin
 - voltage-gated Na^+ channel
39. Synaptic transmission at the neuromuscular junction
- can result in either a depolarizing or a hyperpolarizing end plate potential.
 - is mediated by muscarinic acetylcholine receptors.
 - is terminated by the action of acetylcholine reuptake proteins.
 - involves multiple neuronal inputs to a single muscle fiber.
 - has a high safety factor and always results in the generation of a muscle action potential.

40. What two factors are necessary to open an NMDA channel in vivo?
- a) glutamate binding and depolarization
 - b) ATP binding and receptor phosphorylation
 - c) GABA binding and glutamate binding
 - d) NMDA binding and an increase in intracellular cAMP
 - e) NMDA binding and AMPA binding
41. The general finding that the intensity of a stimulus is encoded by the magnitude of the change in membrane potential it produces in the sensory receptor neuron is referred to as
- a) the all-or-none rule.
 - b) a labelled line.
 - c) the neural code.
 - d) reciprocal innervation.
 - e) the size principle.
42. Slow, diffuse pain is transmitted to the CNS by
- a) large, myelinated A-delta fibers.
 - b) small, unmyelinated A-delta fibers.
 - c) large, myelinated C fibers.
 - d) small unmyelinated C fibers.
 - e) large, myelinated A-beta fibers.
43. Which of the following is NOT a primary taste modality?
- a) sweet
 - b) salty
 - c) bitter
 - d) sour
 - e) spicy
44. Which of the following is true about the detection of odors in humans?
- a) Humans can detect and discriminate 5 different odors: sweet, fetid, bitter, sour, and umami.
 - b) Humans can detect and discriminate thousands of different odors because humans express thousands of unique odorant receptors.
 - c) Humans can detect and discriminate thousands of different odors through the activation of unique combinations of odorant receptors.
 - d) Humans can detect less than a hundred different odors using unique, odorant-gated ion channels.
45. In response to a rapid turning of the head, the eyes move in the opposite direction due to the
- a) flexion withdrawal reflex.
 - b) pupillary light reflex.
 - c) stretch reflex.
 - d) activation of the visual cortex.
 - e) vestibulo-ocular reflex.

46. The area of highest visual acuity in the retina is called the
- optic nerve.
 - optic chiasm.
 - fovea.
 - optic disc.
 - iris.
47. Muscle contraction and shortening are mediated by
- cAMP release.
 - inhibition of acetylcholine release from the sarcoplasmic reticulum.
 - the formation of crossbridges between the heads of myosin molecules and actin filaments.
 - the binding of troponin to tropomyosin.
 - inactivating actin molecules during the power stroke.
48. The first motor units recruited into action are normally those that
- produce the largest force.
 - are the most resistant to fatigue.
 - have the largest motor axons.
 - contract with the greatest speed.
 - have the highest number of muscle fibers in the motor unit.
49. The functional role of the crossed-extension reflex is to
- stabilize the body when a flexion reflex occurs on the opposite side.
 - increase the conduction of neural impulses.
 - counteract the vestibulo-ocular reflex.
 - stabilize the head during repetitive movements.
 - override the knee jerk reflex.
50. Lesions to the primary motor cortex in primates have a profound effect on
- somatic sensation.
 - auditory perception.
 - resting heart rate.
 - manual dexterity.
 - salivation and taste.

END OF TEST

Please turn in your mark-sense form and your question sheets at the front of the room.

Have a nice break!