

Monday, December 12<sup>th</sup>, 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<sup>+</sup>
  - 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<sup>+</sup> 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?
- a) increased vasopressin secretion
  - b) decreased  $\text{Na}^+$  reabsorption in the cortical collecting duct
  - c) increased aquaporins in the collecting duct
  - d) decreased frequency of action potential firing by hypothalamic osmoreceptors**
  - e) 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?
- a) is formed from a simple epithelium
  - b) is impermeable to water**
  - c) reabsorbs  $\text{Na}^+$
  - d) expresses  $\text{Na}^+/\text{K}^+$  on basolateral membrane
12. Which of the following is the action of renin?
- a) converts angiotensin II to aldosterone
  - b) converts vasopressin to aquaporin 2
  - c) converts ACE1 to ACE2
  - d) converts angiotensin II to angiotensin I
  - e) converts angiotensinogen to angiotensin I**
13. Which of the following is the hormone that stimulates expression of the epithelial  $\text{Na}^+$  channel (ENaC) to increase  $\text{Na}^+$  reabsorption in the cortical collecting duct?
- a) aldosterone**
  - b) atrial natriuretic peptide
  - c) erythropoietin
  - d) creatinine
  - e) vitamin D
14. Low blood pressure causes a decrease in GFR and ultimately results in decreased  $\text{Na}^+$  in the distal tubule. What is the sensor in the distal tubule that detects decreased  $\text{Na}^+$ ?
- a) efferent arteriole
  - b) osmoreceptor
  - c) macula densa**
  - d) vasa recta
  - e) 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?
- a) extracellular fluid volume
  - b)  $\text{Na}^+$  reabsorption
  - c) blood pressure
  - d) fluid build-up in tissues (edema)
  - e) ALL of the above increase.**

16. The activity of the enzyme \_\_\_\_\_ is important for bicarbonate ( $\text{HCO}_3^-$ ) 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<sub>c</sub> 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<sub>c</sub> 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?
- a) Monoclonal antibody drugs are usually administered orally.
  - b) Each drug is derived from a single B cell and recognizes a unique epitope.**
  - c) Because they are monoclonal, they are small molecules.
  - d) Monoclonal antibody drugs work by suppressing clonal expansion of regulatory T cells ( $T_{reg}$ ).
  - e) 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?
- a) Glucocorticoids suppress the immune system and limit the damaging effects of cytokine storm.**
  - b) Glucocorticoids enhance the immune response by stimulating lymphocyte proliferation.
  - c) Glucocorticoids inhibit viral replication.
  - d) Glucocorticoids stimulate regeneration of lung tissue.
  - e) Glucocorticoids stimulate cytokine release to augment the immune response.
30. Which of the following drugs works by directly disrupting cytokine signaling?
- a) aspirin
  - b) ACE inhibitor
  - c) JAK inhibitor**
  - d) diuretic
  - e) convalescent plasma
31. The phospholipids that form the cell membrane are
- a) hydrophilic.
  - b) amphipathic.**
  - c) charged.
  - d) polar.
  - e) 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.
- a) glucose
  - b) water
  - c) protein
  - d)  $Na^+$**
  - e)  $K^+$
33. A neurotransmitter opens ligand-gated  $K^+$  channels on a postsynaptic cell that is at its resting membrane potential of  $-70mV$ . What happens next?
- a) The postsynaptic cell fires an action potential.
  - b)  $K^+$  ions enter the postsynaptic cell.
  - c) The postsynaptic cell is hyperpolarized.**
  - d) The postsynaptic cell is depolarized.
  - e) 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?
- a) opens a ligand gated ion channel
  - b) inactivates a G protein
  - c) is an intracellular receptor**
  - d) acts as a second messenger to increase intracellular  $\text{Ca}^{++}$
  - e) 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?
- a) protein kinase A
  - b) guanosine triphosphate (GTP)
  - c) the catalytic receptor
  - d) G-alpha subunit bound to GTP**
  - e) phospholipase C
36. The opening of temperature-gated channels in the sensory dendrites of an afferent neuron directly causes
- a) an action potential.
  - b) membrane cooling.
  - c) a postsynaptic potential.
  - d) a receptor potential.**
  - e) activation of a GPCR.
37. The falling (repolarizing) phase of the action potential depends upon
- a) the opening of voltage-gated  $\text{Na}^+$  channels.
  - b) the opening of voltage-gated  $\text{K}^+$  channels.**
  - c) the closing of voltage-gated  $\text{K}^+$  channels.
  - d) a positive feedback loop.
  - e) the activity of the  $\text{Na}^+/\text{K}^+$ -ATPase.
38. Which of the following is a protein that is found at high density in the node of Ranvier?
- a) nicotinic acetylcholine receptor
  - b) voltage-gated  $\text{Ca}^{++}$  channel
  - c) acetylcholinesterase
  - d) myelin
  - e) voltage-gated  $\text{Na}^+$  channel**
39. Synaptic transmission at the neuromuscular junction
- a) can result in either a depolarizing or a hyperpolarizing end plate potential.
  - b) is mediated by muscarinic acetylcholine receptors.
  - c) is terminated by the action of acetylcholine reuptake proteins.
  - d) involves multiple neuronal inputs to a single muscle fiber.
  - e) 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
- a) optic nerve.
  - b) optic chiasm.
  - c) fovea.**
  - d) optic disc.
  - e) iris.
47. Muscle contraction and shortening are mediated by
- a) cAMP release.
  - b) inhibition of acetylcholine release from the sarcoplasmic reticulum.
  - c) the formation of crossbridges between the heads of myosin molecules and actin filaments.**
  - d) the binding of troponin to tropomyosin.
  - e) inactivating actin molecules during the power stroke.
48. The first motor units recruited into action are normally those that
- a) produce the largest force.
  - b) are the most resistant to fatigue.**
  - c) have the largest motor axons.
  - d) contract with the greatest speed.
  - e) have the highest number of muscle fibers in the motor unit.
49. The functional role of the crossed-extension reflex is to
- a) stabilize the body when a flexion reflex occurs on the opposite side.**
  - b) increase the conduction of neural impulses.
  - c) counteract the vestibulo-ocular reflex.
  - d) stabilize the head during repetitive movements.
  - e) override the knee jerk reflex.
50. Lesions to the primary motor cortex in primates have a profound effect on
- a) somatic sensation.
  - b) auditory perception.
  - c) resting heart rate.
  - d) manual dexterity.**
  - e) 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!