

4. Diabetic nephropathy is the term for the chronic kidney disease that can occur in people with diabetes mellitus. Which of the following is a **specific sign** indicating the presence of diabetic nephropathy?
- polyuria
 - proteinuria**
 - hypertension
 - glucose in the urine
 - hyperglycemia
5. All of the following play a key role in renal autoregulation EXCEPT
- tubuloglomerular feedback
 - myogenic response
 - macula densa
 - collecting duct**
 - afferent arteriole
6. Which of the following increases the glomerular filtration rate (GFR)?
- response to mean arterial pressure (MAP) falling from 80 to 70
 - constriction of the afferent arteriole
 - atrial natriuretic peptide (ANP)**
 - activation sympathetic nervous system input to the afferent arteriole
 - dilation of the efferent arteriole
7. When SGLT2 inhibitors decrease glucose reabsorption, they also
- decrease urine volume.
 - cause weight gain.
 - decrease glycosuria (glucose in the urine).
 - increase the risk of hospitalization for heart failure.
 - decrease Na⁺ reabsorption in the proximal tubule.**
8. The activity of the Na⁺/K⁺/2Cl⁻ cotransporter (NKCC2) accounts for about 25% of the total Na⁺ reabsorption in the nephron. Where is this transporter located?
- descending limb of loop of Henle
 - ascending limb of loop of Henle**
 - medullary collecting duct
 - cortical collecting duct
 - afferent arteriole

9. Loop diuretics work to decrease extracellular fluid volume by
- increasing Na^+ reabsorption
 - decreasing glomerular filtration
 - decreasing Na^+ reabsorption**
 - inhibiting aquaporin expression
 - inhibiting vasopressin secretion
10. A defect in the ability to concentrate urine can be caused by
- a mutation in the gene for the angiotensin II receptor
 - vasopressin deficiency**
 - too much vasopressin secretion
 - inadequate blood flow to the kidney
 - aldosterone deficiency
11. The largest difference in osmolarity in the kidney is between the
- inside of the thick ascending limb of the loop of Henle and the interstitial fluid that surrounds it.
 - inside of the descending limb of the loop of Henle and the interstitial fluid that surrounds it
 - cortex and the papilla.**
 - inside of the collecting duct and the interstitial fluid that surrounds it.
 - inside of a glomerular capillary and Bowman's space.
12. The hormone aldosterone stimulates regulated Na^+ reabsorption in the cortical collecting duct by stimulating the expression of which of the following proteins?
- epithelial Na^+ channel (ENaC)**
 - Na^+ /glucose cotransporter (SGLT2)
 - Na^+ / K^+ /2 Cl^- cotransporter (NKCC2)
 - glucose transporter (GLUT)
 - aquaporin 2 (AQP2)
13. In the elderly, sometimes there can be too much vasopressin secretion. Which of the following would occur as a consequence of too much vasopressin secretion?
- ECF osmolarity would increase.
 - ECF osmolarity would decrease.**
 - ECF pH would increase.
 - ECF pH would decrease.
 - ECF volume would decrease.

14. Which of the following is a factor that can increase renin secretion?
- a. activation of the parasympathetic nervous system
 - b. hypertension
 - c. atrial natriuretic peptide (ANP)
 - d. heart failure causing decreased blood flow to the kidney**
 - e. aldosterone
15. Which of the following is the substrate for renin?
- a. angiotensinogen**
 - b. angiotensin I
 - c. angiotensin II
 - d. vasopressin
 - e. aldosterone
16. Which of the following enzymes is most important for HCO_3^- reabsorption in the proximal tubule?
- a. renin
 - b. angiotensin converting enzyme
 - c. Ca^{++} -ATPase
 - d. carbonic anhydrase**
 - e. creatine kinase
17. What type of neuron innervates the detrusor muscle?
- a. sympathetic preganglionic neuron
 - b. sympathetic postganglionic neuron
 - c. somatic motor neuron
 - d. parasympathetic preganglionic neuron
 - e. parasympathetic postganglionic neuron**
18. Which of the following is TRUE about vaccines?
- a. Vaccines contain a microchip that can be monitored by Bill Gates.
 - b. Vaccines bypass innate immunity.
 - c. Vaccines stimulate a primary immune response.**
 - d. Vaccines contain antibodies.
 - e. Vaccines deplete helper T cells.

19. An opsonin is a substance that
- a. stimulates antibody secretion.
 - b. coordinates the immune response.
 - c. is secreted by T cells.
 - d. stimulates phagocytosis.**
 - e. induces the immune response.
20. All of the following are part of the innate immune response EXCEPT
- a. plasma cells.**
 - b. neutrophils.
 - c. complement.
 - d. C-reactive protein.
 - e. phagocytosis.
21. Which of the following is a place where antigen-presenting cells interact with lymphocytes to stimulate an adaptive/specific immune response?
- a. kidney
 - b. blood vessel
 - c. liver
 - d. spleen**
 - e. ALL of the above
22. Which of the following is a key difference between a B-cell receptor and a T-cell receptor?
- a. presence of a transmembrane domain
 - b. specific binding to unique antigen
 - c. expression on the surface of a lymphocyte
 - d. involvement in adaptive immunity
 - e. two binding sites for antigen vs. one binding site for antigen**
23. Which of the following is a cell that expresses MHC II molecules on its surface?
- a. NK cell
 - b. dendritic cell**
 - c. neuron
 - d. bacterium
 - e. ALL of the above express MHC II molecules on their surface

24. In the response to a bacterial infection, which of the following initially helps to bring white blood cells such as neutrophils to the site of injury by causing inflammation?
- growth factors
 - helper T cells
 - cortisol
 - norepinephrine
 - histamine**
25. Which of the following is NOT one of the important interactions in the stimulation of the adaptive immune response to bacterial infection?
- cytotoxic T cell binds peptide antigen presented on MHC I molecule by antigen-presenting cell**
 - cytokines released by T cells stimulate proliferation and shape the immune response
 - antigen binds to B-cell receptor
 - helper T cell binds peptide antigen presented on MHC II molecule by antigen-presenting cell
26. Which of the following specifically binds to intracellular antigen displayed on an MHC molecule in the development of an immune response?
- B-cell receptor
 - T-cell receptor on a helper T cell
 - T-cell receptor on a cytotoxic T cell**
 - C-reactive protein
 - Complement
27. Which of the following is a mechanism that can directly **prevent** viral infection of a cell?
- release of perforin and granzymes by a cytotoxic T cell
 - binding of virus to its receptor on the cell surface
 - stimulation of inflammation
 - neutralizing antibodies binding to the virus**
 - activation of JAK-STAT signaling pathway
28. Which of the following is TRUE about monoclonal antibody drugs?
- each drug is derived from a single B cell and specifically recognizes a unique epitope**
 - they lack specificity and can bind to multiple targets
 - mainly work by stimulating clonal expansion of B cells
 - are used to boost the immune response to vaccination
 - are small molecules that can be administered orally

29. Which of the following is an example of active immunity?
- a. monoclonal antibody drug treatment given to President Trump in 2020 to prevent serious illness from COVID-19
 - b. antitoxin antibodies injected into an individual to prevent damage from a snake bite
 - c. antibodies passed from a mother to her infant during breastfeeding
 - d. development of neutralizing antibodies in response to infection with a virus**
 - e. use of convalescent plasma to reduce hospitalizations in outpatients infected with COVID-19
30. Which of the following is a drug that is commonly used to suppress the immune system?
- a. angiotensin II receptor blocker
 - b. SGLT2 inhibitor
 - c. ACE inhibitor
 - d. cytokine receptor agonist
 - e. glucocorticoid**
31. Which of the following molecules can move across the phospholipid bilayer of the cell membrane by simple diffusion?
- a. an ion
 - b. a sugar
 - c. a small peptide
 - d. a nonpolar molecule**
 - e. a polar molecule
32. Osmosis
- a. is an active process requiring ATP.
 - b. depends upon ion channels.
 - c. depends upon carrier proteins.
 - d. is the diffusion of water down an osmotic gradient.
 - e. is the movement of water up an osmotic gradient.**
33. For the Na^+ ion, the force due to the concentration gradient is exactly balanced by the force due to the electrical potential difference at the
- a. Na^+ equilibrium potential.**
 - b. threshold.
 - c. receptor potential.
 - d. resting membrane potential.
 - e. synaptic membrane.

34. The neurotransmitter receptors responsible for slow synaptic transmission are
- gap junctions.
 - nicotinic acetylcholine receptors.
 - G protein coupled receptors (GPCRs).**
 - ligand-gated ion channels.
 - carrier proteins.
35. Oxytocin is a hormone that stimulates smooth muscle contraction in the uterus. The oxytocin receptor is a GPCR whose activation leads to an increase in
- protein kinase A activation.
 - cAMP.
 - calmodulin.
 - Ca⁺⁺.**
 - adenylyl cyclase activity.
36. Which of the following is true about a receptor potential?
- occurs at an electrical synapse
 - varies in size according to the strength of the stimulus**
 - is usually hyperpolarizing
 - can conduct long distances without getting smaller
 - depends upon the activity of nicotinic acetylcholine receptors
37. Which of the following best describes the voltage sensor of the voltage-gated Na⁺ channel?
- flap that closes channel after activation
 - part of the channel pore that makes it selective for Na⁺
 - intracellular domain that binds to Ca⁺⁺
 - transmembrane segment with an array of positive charges**
 - requires phosphorylation to be activated
38. What factor increases the speed of action potential conduction?
- demyelination
 - larger receptor potential
 - larger axon diameter**
 - greater number of dendrites
 - increased expression of voltage-gated Ca⁺⁺ channels

39. Myasthenia gravis is a disorder of the neuromuscular junction that affects the
- a. the response to acetylcholine.**
 - b. the release of acetylcholine.
 - c. the response to norepinephrine.
 - d. interaction between actin and myosin.
 - e. the conduction of action potentials.
40. Which of the following is required for induction of LTP (long term potentiation) at a synapse?
- a. hyperpolarization of the postsynaptic cell
 - b. depolarization of the postsynaptic cell**
 - c. adrenergic receptors
 - d. release of acetylcholine
 - e. gap junctions
41. The 'neural code' is a term used to describe the relationship between the intensity of a stimulus and
- a. the sequence of amino acids within the receptor protein.
 - b. its duration.
 - c. its effect on thalamic relay cells
 - d. the frequency of action potentials generated by a sensory neuron.**
 - e. the type of receptor that responds to it.
42. Dull, poorly localized and persistent pain is transmitted to the central nervous system along
- a. large, unmyelinated C-fibers.
 - b. small, unmyelinated A-delta fibers.
 - c. small, unmyelinated C-fibers.**
 - d. large, myelinated A-beta fibers.
 - e. large, myelinated C-fibers.
43. Which of the following is a correct list of the primary gustatory (taste) sensations?
- a. spicy, salty, bitter, sour, umami
 - b. sweet, salty, bitter, sour, umami**
 - c. hot, salty, bitter, dry, umami
 - d. sweet, salty, floral, sour, umami
 - e. sweet, salty, bitter, sour, skunky

44. The depolarization of olfactory sensory neurons depends on
- activation of G protein coupled receptors.**
 - activation of acetylcholine receptors.
 - increases in ATP release.
 - Na⁺ ions flowing out of the cell.
 - K⁺ ions flowing into the cell.
45. The optimal sound frequency to excite a response in a hair cell in the cochlea is strongly influenced by
- the size of its stereocilia.
 - its position along the tympanic membrane.
 - the type of neurotransmitter it releases.
 - its position along the tectorial membrane.
 - its position along the basilar membrane.**
46. Which of the following will trigger the vestibulo-ocular reflex?
- loud sounds
 - bright light shined into the eyes
 - rapid turning of the head**
 - rapid limb flexion
 - strong odors
47. Which of the following factors contributes to the high visual acuity of the fovea?
- rod photoreceptors
 - cone photoreceptors**
 - axons of retinal ganglion cells
 - the pigmented retinal epithelium
 - the optic disc
48. In skeletal muscle contraction, calcium
- channels open to cause depolarization at the neuromuscular junction.
 - regulates the interaction between myosin and actin.**
 - binds to tropomyosin on the thick filament.
 - regulates the interaction between the thin filament and the Z-disc.
 - inactivates myosin molecules during the power stroke.

49. For slowly executed delicate movements, motor units are recruited in order of increasing size. For rapidly executed powerful movements, motor units are recruited
- a. in order of decreasing size.
 - b. from largest to smallest.
 - c. in order of decreasing axonal conduction velocity.
 - d. in the same order.**
 - e. in order of increasing resistance to fatigue.
50. Which of the following is TRUE about the primary motor cortex?
- a. contains neurons that make direct synapses onto somatic motor neurons in the spinal cord**
 - b. the left motor cortex mainly controls movements on the left side of the body
 - c. does not form connections with the cerebellum
 - d. does not form connections with the thalamus
 - e. contains the neurons involved in mediating the tendon jerk (stretch) reflex

END OF TEST

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