MCB3210F NAME _____
EXAM 1A SECTION _____

CELLS, TISSUES, ORGANS, FLUIDS AND HOMEOSTASIS

1. Organs like the brain are defined as _____.
A) a collection of cells that perform similar functions
B) a collection of cells that function independently of one another
C) a combination of two or more tissues that operate together to perform a specific function
D) a collection of tissues that function independently of one another
C

2. T-F? Interstitial fluid and plasma are both extracellular fluids.
T

3. Which of the following is an example of positive feedback?
A) Blood glucose concentration increases following a meal, and this triggers insulin release from the pancreas to stimulate glucose uptake into muscle and liver cells.
B) In an a nerve, depolarization increases Na^+ permeability, which depolarizes the cell
C) In an a nerve, depolarization increases K^+ permeability, which hyperpolarizes the cell
D) Exercise increases CO_2 production and breathing rate.
E) All of the above are examples of positive feedback
B

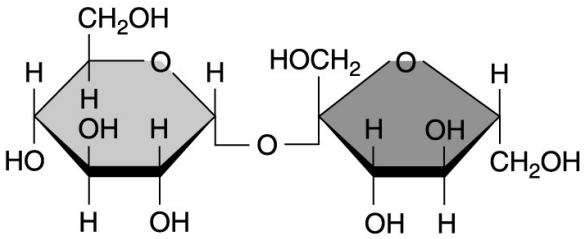
MOLECULES

4. Solution A has pH 3 while solution B has pH 8. Which of the following statements is true?
A) Solution A is basic.
B) Solution B is acidic.
C) $[H^+]$ of solution A is higher than $[H^+]$ of solution B.
D) A-C are all true
E) A-C are all false.
C

5. T-F? Digestion of proteins occurs by dehydration synthesis and yields amino acids and water.
F

6. T-F? The C-C bonds in lipids are polar, covalent bonds.
F

7. What type of molecule is shown in the figure?
A) monosaccharide
B) disaccharide
C) fatty acid
D) phospholipid
E) peptide



B

8. _____ are molecules composed of glycerol and three fatty acids.
A) Phospholipids B) Saturated fatty acids C) Membrane bilayers D) Steroids E) Triglycerides
E

9. T-F? Hydrogen bonds are important determinants of surface tension of water and also of secondary and tertiary structures of proteins.
T

CELL ORGANELLES

10. Which of the following is found in plasma membranes?
A) proteins B) cholesterol C) carbohydrates D) phospholipids E) all of the above
E
11. The organelle responsible for packaging vesicles for secretion is
A) mitochondrion B) Golgi
C) the agranular endoplasmic reticulum D) granular endoplasmic reticulum
B
12. What organelle contains digestive enzymes?
A) rough endoplasmic reticulum B) Golgi apparatus C) lysosomes D) nucleus E) mitochondria
C

ENZYMES

13. T-F? For the reaction between CO_2 and H_2O, the law of mass action states that increases in CO_2 concentration will cause a reduction of pH of the solution: $CO_2+H_2O \rightarrow H_2CO_3 \rightarrow H^+ + HCO_3^-$
T
14. T-F? Energy and heat are released in the reaction ATP $\rightarrow$ ADP + P_i.
T
15. T-F? Enzymes of glycolysis are continuously consumed and resynthesized in the cytosol.
F
16. Enzymes increase the rates of biological reactions by
A) elevating the temperature of the reactants. B) decreasing substrate concentration.
C) reducing the activation energy. D) enhancing the law of mass action.
C

CELLULAR METABOLISM

17. Oxidation of glucose to pyruvic acid is.
A) catabolic and exergonic. B) anabolic and exergonic.
C) catabolic and endergonic. D) anabolic and endergonic.
A
18. The main products of the Krebs cycle are
A) CO_2, H_2O and ATP. B) CO_2, NADH, FADH and ATP.
C) Pyruvic acid, NADH and ATP. D) O_2, glucose, CO_2, and H_2O.
E) NAD, FAD, H_2O and ATP
B
19. In oxidative phosphorylation, the energy to transport protons against their gradient across the inner mitochondrial membrane most directly comes from
A) transport of electrons B) transport of H_2O C) transport of O_2 D) osmosis
A
20. During cell metabolism, ____ transports electrons from the cytosol to the mitochondria.
A) H_2O B) O_2 C) CO_2 D) NADH E) all of the above
D

MEMBRANE PERMEABILITY AND TRANSPORT

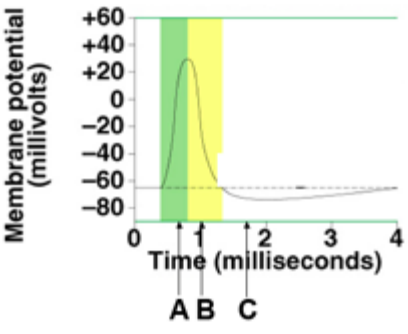
21. Which of the following molecules will diffuse freely though the lipids of the cell membrane?
A) CO_2 B) Glucose C) Amino acids D) K^+
A

22. T-F? Water will flow across a semipermeable membrane (permeant to water but not to solutes) from a solution containing 60 mM $CaCl_2$ to a solution containing 100 mM glucose + 75 mM KCl.
F
23. Which of the following membrane proteins is an example of an antiporter?
A) one that catalyzes production of H^+ and HCO_3^- from CO_2 and H_2O
B) one that transports Cl^- into the cell and HCO_3^- out of the cell
C) enzyme that hydrolyzes lactose to glucose and galactose
D) enzyme that hydrolyzes maltose to two glucose molecules
B
24. Which of the following will be inhibited when ATP levels fall to low levels or zero?
A) ion channel B) lactase C) oxidative phosphorylation D) Na-K pump
D

ELECTROPHYSIOLOGY AND ACTION POTENTIAL

25. The potassium equilibrium potential of a cell is -94 mV. What does this mean?
A) at the resting membrane potential of neurons, potassium is at equilibrium
B) at -94 mV, the chemical force for potassium movement is zero
C) at -94 mV, the electrical force for potassium movement is zero
D) at -94 mV, the chemical force for potassium movement is opposed exactly by the electrical force
E) at -94 mV, potassium movement is opposed exactly by sodium movement
D
26. If an axon were treated with a drug that blocks voltage-gated K^+ channels, which of the following would occur?
A) The axon will not be able to depolarize or repolarize.
B) The axon will be able to depolarize and repolarize normally.
C) The axon will be able to depolarize normally, but cannot repolarize normally.
D) The axon will not be able to depolarize normally, but could repolarize normally.
C
27. T-F? In nerve synapses, activation of Na^+ channels in postsynaptic nerves causes depolarization while activation of K^+ channels causes hyperpolarization.
T
28. During an action potential in nerve axons inactivation of Na^+ channels occurs in response to
A) depolarization B) hyperpolarization C) second messengers D) all of the above
A
29. The absolute refractory period of a nerve axon
A) results from rapid influx of Na^+
B) assures one way conduction of action potentials in nerves
C) assures rapid conduction of action potentials in nerves
D) all of the above are true
B
30. T-F? At the peak of the action potential, $[Na^+]_{cell} > [Na^+]_{outside}$.
F

#31 and 32 refer to the action potential shown.



31. Na^+ channels are inactivated at ___.
B
32. K^+ channels are active and cell voltage is hyperpolarized at ___. **C**

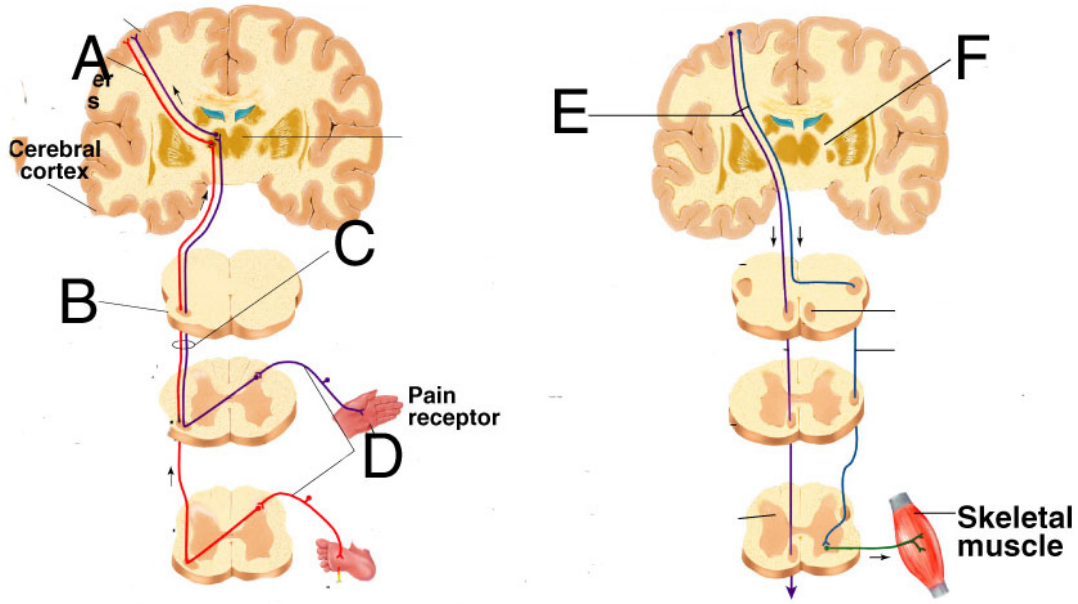
SYNAPSES

33. Neurotransmitter release from synapses
A) follows depolarization of the nerve terminal by the action potential
B) requires Ca^{2+} entry into the nerve terminal
C) occur by exocytosis
D) all of the above are true
D
34. The excitatory neurotransmitter acetylcholine
A) binds to adrenergic receptors
B) depolarizes postsynaptic nerves
C) increases Ca^{2+} permeability of the presynaptic nerve
D) all of the above
B
35. T-F? Temporal summation occurs when a nerve stimulates another nerve with two sequential EPSP's.
T
36. An inhibitory neurotransmitter reduces excitation of postsynaptic nerves by
A) preventing binding of excitatory neurotransmitters to their receptors
B) depolarizing presynaptic nerves
C) hyperpolarizing postsynaptic nerves
D) triggering EPSP's
E) generating second messengers that open Na^{+} channels in the axon hillock of nerve axons.
C

CENTRAL NERVOUS SYSTEM

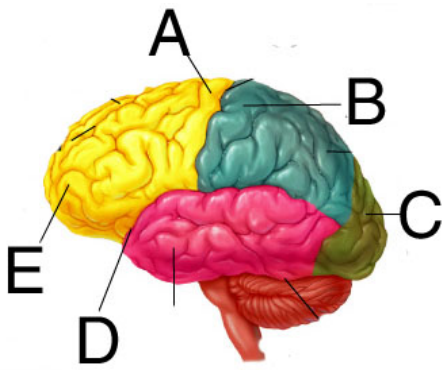
#37 refers to the schematic diagrams of sensory and motor pathways shown below.

37. Nerves here originate in the pre-central gyrus ___
E



38. The cortex of the cerebral hemispheres is _____ (gray, white) because it is composed primarily of _____ (cell bodies, myelinated axons).
A) white, cell bodies B) white, axons C) gray, cell bodies D) gray, axons
C
39. Which of the following is NOT directly involved in controlling coordinated movements of skeletal muscles:
A) cerebellum B) basal ganglia C) primary motor cortex D) pons
D
40. T-F? Movement of skeletal muscles in the right hand begins with activation of nerves in the right cerebral cortex in the precentral gyrus.
F

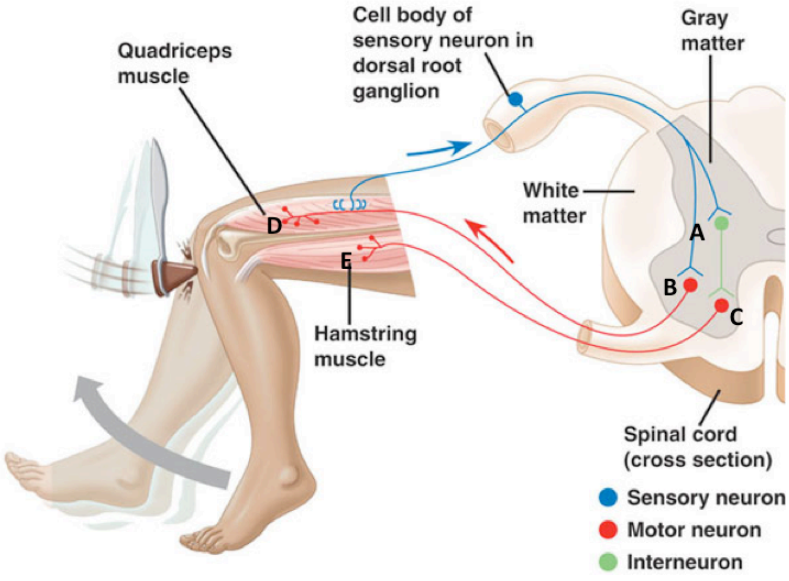
#41-42. Match one of the letters pointing to the brain structure to the functional descriptions:



41. Involved in vision sensation ___
C
42. Most important for social behavior and judgement ___
E

#43 The knee jerk reflex.

43. Which of the following occurs following tapping of the knee tendon?
A) EPSP occurs at synapses A and B
B) IPSP occurs at synapse C
C) EPP is triggered at D and quadriceps contracts
D) EPP is triggered at E and hamstring contracts.
E) A - C are true but not D
E



AUTONOMIC AND SOMATIC MOTOR NERVOUS SYSTEMS

44. Skeletal muscle fibers (cells) are innervated by _____.
A) a single motor neuron B) multiple motor neurons
C) a single motor neuron and autonomic neuron D) multiple motor neurons and autonomic neurons
A

45. Where do preganglionic neurons of the sympathetic nervous system emerge from the spinal cord?
A) thoracic region only B) sacral region only
C) lumbar region only D) thoracic and lumbar regions E) lumbar and sacral regions
D

46. Parasympathetic ganglia are located
A) in a chain parallel to the spinal cord B) in the dorsal roots of spinal nerves
C) next to or in the organs innervated D) in the brain
C

47. Which of the following neurons of the efferent branch of the peripheral nervous system does NOT release acetylcholine?
A) sympathetic preganglionic neuron B) parasympathetic preganglionic neuron
C) sympathetic postganglionic neuron D) parasympathetic postganglionic neuron
E) motor neuron
C

48. The two subtypes of cholinergic receptors are
A) adrenergic and nicotinic B) dopaminergic and muscarinic
C) nicotinic and muscarinic D) dopaminergic and nicotinic
C

49. T-F? Sympathetic and parasympathetic nerves are similar to motor nerves in that they carry action potentials and release neurotransmitter when Ca^{2+} enters the nerve terminal.
T

50. T-F? During fight or flight circumstances, there will be increased frequency of action potentials in nerves leading to the adrenal medulla.
T

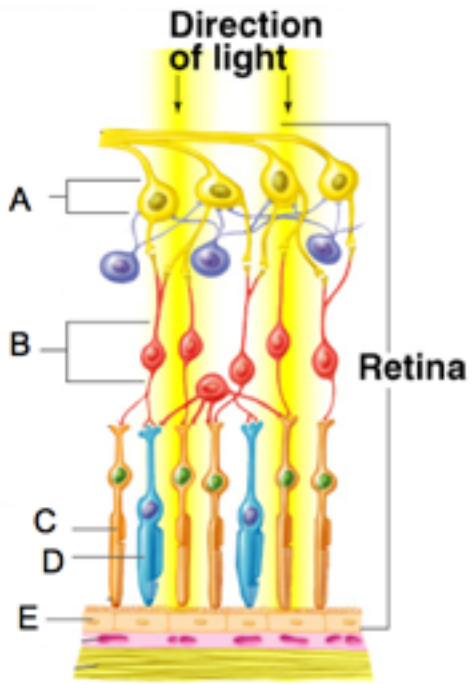
SENSORY NEUROPHYSIOLOGY

51. Which of the following is characteristic of synaptic potentials AND generator potentials (hint: remember rods and cones)?
A) They are graded in amplitude. B) They can be either depolarizing or hyperpolarizing.
C) They are propagated from cell bodies to dendrites.
D) Both A and B are true. E) A, B and C are all true.
D

52. T-F? Rapidly adapting touch receptors exhibit decreasing frequency of action potentials during constant pressure stimulation of the skin.
T

53. Which cell is the longest?
A) Sensory nerve from muscle spindle of quadriceps to synapse with interneuron in the spinal cord
B) Motor nerve from motor cortex to the synapse with motor nerve in spinal cord leading to quadriceps.
C) Optic nerve from eye to the visual cortex
D) Presynaptic autonomic nerve from spinal cord to the sympathetic chain
B

#54-56 refer to the schematic drawing of the retina.



54. Action potentials are generated in these cells. ____
A
55. During light exposure these cells depolarize. ____
A or B
56. These cells contain pigment but do not respond directly to light. _____
E

SHORT ANSWER

Write your answers to the following questions on these two pages.

1. With regard to aerobic and anaerobic metabolism,

A) Explain the role of transmitochondrial membrane gradient of [H^+] in the production of ATP. 3 pts.
H conc inside is lower than outside mitochondrion. H moves through the ATPsynthase, down this conc gradient. The energy of this gradient is thereby stored in the bond energy of ATP.

B) Explain how ATP is produced in the cytosol in the absence of oxygen. 3 pts
NADH from glycolysis is reconverted to NAD using the conversion of pyruvic acid to lactic acid, allowing glycolysis to proceed, generating two ATPs for each glucose broken down.

2. Using a diagram, describe the roles of Na-glucose symport, glucose uniport and Na-K-ATPase in the absorption of Na^+ and glucose and water across the intestine. 5 pts.

Na+glucose entry at apical membrane
Na/K pump at basal membrane to establish the Na conc gradient across the cell and glucose+Na entry
Na/K pump also transports Na out of the cell
Glucose moves up a conc gradient to get into the cell and down a conc gradient on the glucose uniporter to get out of the cell
Osmosis moves water ap→ basal because transport of solutes increases osmotic conc on basal side compared to apical side

3. Explain how nerve conduction is speeded in myelinated vs. non-myelinated nerves. 4 pts
Schwann cells make myelin to wrap the nerve
Ion channels are localized to the nodes of Ranvier
Action potentials generated at the nodes only, so it "jumps" from node to node. This wrapping increases the distance that the nerve excitation travels as one AP excites adjacent regions of the nerve. The increased distance per time translates into faster conduction.

4. Discuss how a poison that blocked acetylcholine esterase can yield long-lasting nerve excitation. 3 pts.

Ach degraded by Ach esterase to inactivate it and keep action of the neurotransmitter brief. Blocking the esterase will cause accumulation of the Ach in the nerve terminal and persistent activation of Ach receptor, causing persistent triggering of action potentials. This is uncontrollable, in contrast to the precise release and degradation that occurs under normal conditions.