

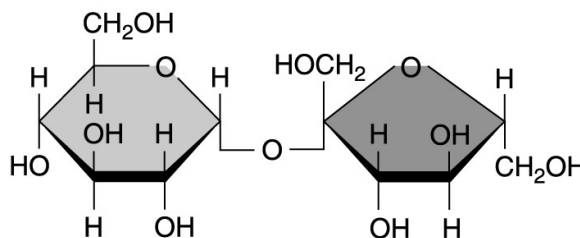
**CELLS, TISSUES, ORGANS, FLUIDS AND HOMEOSTASIS**

- 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
- T-F? Interstitial fluid and plasma are both extracellular fluids.
- 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  $\text{Na}^+$  permeability, which depolarizes the cell  
C) In an a nerve, depolarization increases  $\text{K}^+$  permeability, which hyperpolarizes the cell  
D) Exercise increases  $\text{CO}_2$  production and breathing rate.  
E) All of the above are examples of positive feedback

**MOLECULES**

- 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)  $[\text{H}^+]$  of solution A is higher than  $[\text{H}^+]$  of solution B.  
D) A-C are all true  
E) A-C are all false.
- T-F? Digestion of proteins occurs by dehydration synthesis and yields amino acids and water.
- T-F? The C-C bonds in lipids are polar, covalent bonds.

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



- \_\_\_\_\_ are molecules composed of glycerol and three fatty acids.  
A) Phospholipids B) Saturated fatty acids C) Membrane bilayers D) Steroids E) Triglycerides
- T-F? Hydrogen bonds are important determinants of surface tension of water and also of secondary and tertiary structures of proteins.

## 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
11. The organelle responsible for packaging vesicles for secretion is  
A) mitochondrion B) Golgi  
C) the agranular endoplasmic reticulum D) granular endoplasmic reticulum
12. What organelle contains digestive enzymes?  
A) rough endoplasmic reticulum B) Golgi apparatus C) lysosomes D) nucleus E) mitochondria

## ENZYMES

13. T-F? For the reaction between  $\text{CO}_2$  and  $\text{H}_2\text{O}$ , the law of mass action states that increases in  $\text{CO}_2$  concentration will cause a reduction of pH of the solution:  $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^-$
14. T-F? Energy and heat are released in the reaction  $\text{ATP} \rightarrow \text{ADP} + \text{P}_i$ .
15. T-F? Enzymes of glycolysis are continuously consumed and resynthesized in the cytosol.
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.

## 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.
18. The main products of the Krebs cycle are  
A)  $\text{CO}_2$ ,  $\text{H}_2\text{O}$  and ATP. B)  $\text{CO}_2$ , NADH, FADH and ATP.  
C) Pyruvic acid, NADH and ATP. D)  $\text{O}_2$ , glucose,  $\text{CO}_2$ , and  $\text{H}_2\text{O}$ .  
E) NAD, FAD,  $\text{H}_2\text{O}$  and ATP
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  $\text{H}_2\text{O}$  C) transport of  $\text{O}_2$  D) osmosis
20. During cell metabolism, \_\_\_\_\_ transports electrons from the cytosol to the mitochondria.  
A)  $\text{H}_2\text{O}$  B)  $\text{O}_2$  C)  $\text{CO}_2$  D) NADH E) all of the above

## MEMBRANE PERMEABILITY AND TRANSPORT

21. Which of the following molecules will diffuse freely through the lipids of the cell membrane?  
A)  $\text{CO}_2$  B) Glucose C) Amino acids D)  $\text{K}^+$

22. T-F? Water will flow across a semipermeable membrane (permeant to water but not to solutes) from a solution containing 60 mM  $\text{CaCl}_2$  to a solution containing 100 mM glucose + 75 mM KCl.

23. Which of the following membrane proteins is an example of an antiporter?

- A) one that catalyzes production of  $\text{H}^+$  and  $\text{HCO}_3^-$  from  $\text{CO}_2$  and  $\text{H}_2\text{O}$
- B) one that transports  $\text{Cl}^-$  into the cell and  $\text{HCO}_3^-$  out of the cell
- C) enzyme that hydrolyzes lactose to glucose and galactose
- D) enzyme that hydrolyzes maltose to two glucose molecules

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

### 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

26. If an axon were treated with a drug that blocks voltage-gated  $\text{K}^+$  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.

27. T-F? In nerve synapses, activation of  $\text{Na}^+$  channels in postsynaptic nerves causes depolarization while activation of  $\text{K}^+$  channels causes hyperpolarization.

28. During an action potential in nerve axons inactivation of  $\text{Na}^+$  channels occurs in response to

- A) depolarization
- B) hyperpolarization
- C) second messengers
- D) all of the above

29. The absolute refractory period of a nerve axon

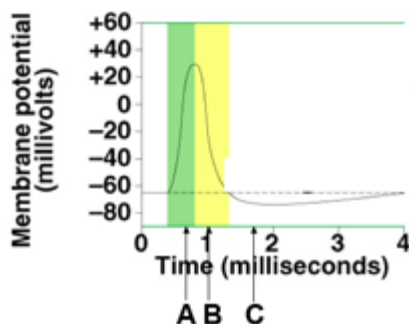
- A) results from rapid influx of  $\text{Na}^+$
- B) assures one way conduction of action potentials in nerves
- C) assures rapid conduction of action potentials in nerves
- D) all of the above are true

30. T-F? At the peak of the action potential,  $[\text{Na}^+]_{\text{cell}} > [\text{Na}^+]_{\text{outside}}$ .

**#31 and 32 refer to the action potential shown.**

31.  $\text{Na}^+$  channels are inactivated at \_\_\_\_.

32.  $\text{K}^+$  channels are active and cell voltage is hyperpolarized at \_\_\_\_.



## SYNAPSES

33. Neurotransmitter release from synapses

- A) follows depolarization of the nerve terminal by the action potential
- B) requires  $\text{Ca}^{2+}$  entry into the nerve terminal
- C) occur by exocytosis
- D) all of the above are true

34. The excitatory neurotransmitter acetylcholine

- A) binds to adrenergic receptors
- B) depolarizes postsynaptic nerves
- C) increases  $\text{Ca}^{2+}$  permeability of the presynaptic nerve
- D) all of the above

35. T-F? Temporal summation occurs when a nerve stimulates another nerve with two sequential EPSP's.

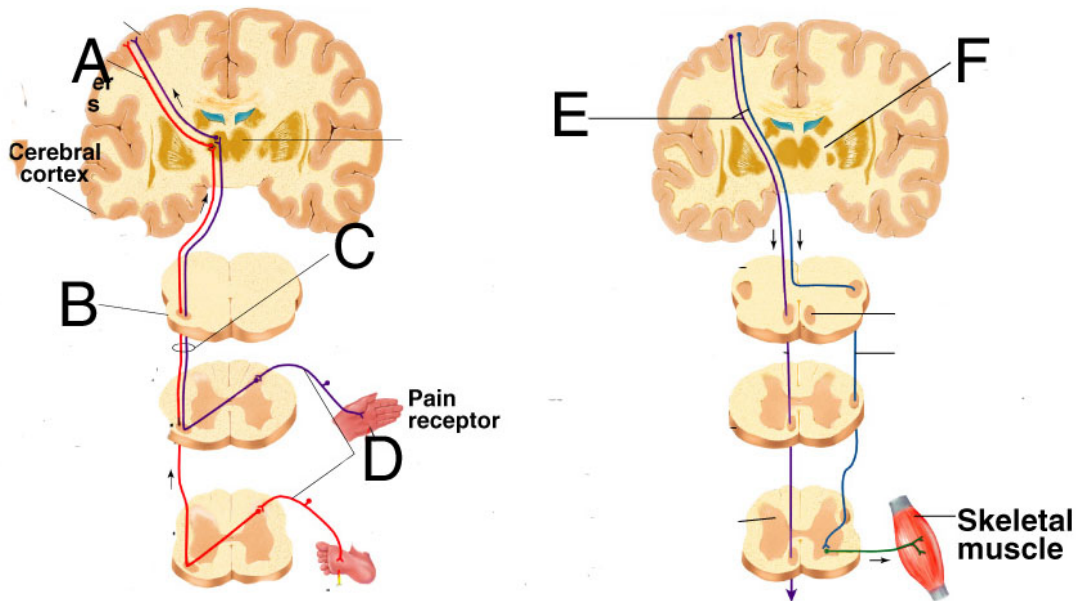
36. An inhibitory neurotransmitter reduces excitation of postsynaptic nerves by

- 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  $\text{Na}^+$  channels in the axon hillock of nerve axons.

## 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 \_\_\_\_



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

39. Which of the following is NOT directly involved in controlling coordinated movements of skeletal muscles:

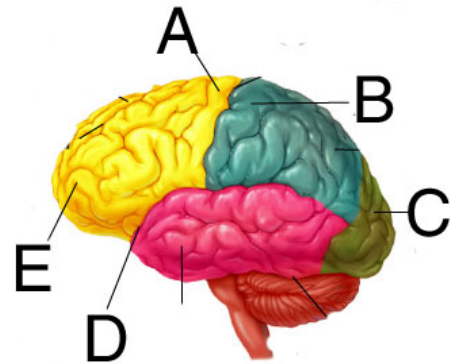
- A) cerebellum    B) basal ganglia    C) primary motor cortex    D) pons

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.

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

41. Involved in vision sensation \_\_\_\_

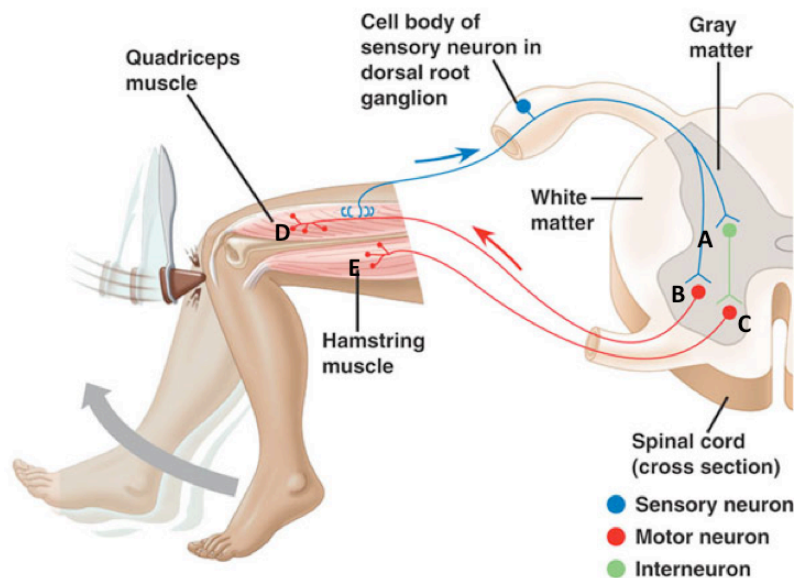
42. Most important for social behavior and judgement \_\_\_\_



**#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



## **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
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
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
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
48. The two subtypes of cholinergic receptors are  
A) adrenergic and nicotinic      B) dopaminergic and muscarinic  
C) nicotinic and muscarinic      D) dopaminergic and nicotinic
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.
50. T-F? During fight or flight circumstances, there will be increased frequency of action potentials in nerves leading to the adrenal medulla.

## **SENSORY NEUROPHYSIOLOGY**

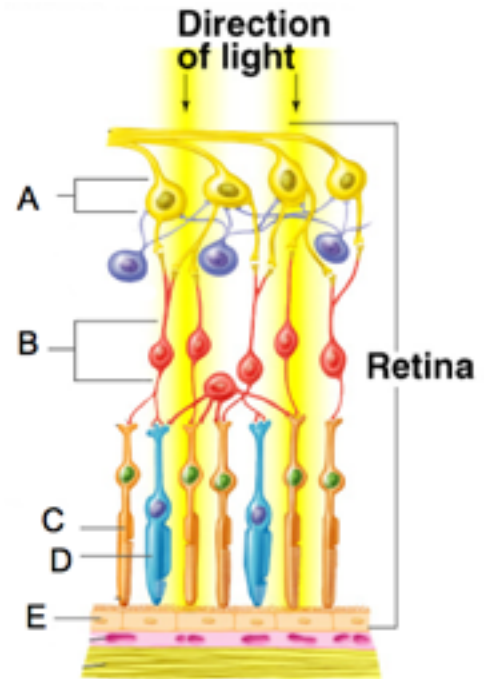
51. Which of the following is characteristic of synaptic potentials AND generator potentials (hint: remember rods and cones)?  
A) They are graded in amplitude.      B) They can be either depolarizing or hyperpolarizing.  
C) They are propagated from cell bodies to dendrites.  
D) Both A and B are true.      E) A, B and C are all true.
52. T-F? Rapidly adapting touch receptors exhibit decreasing frequency of action potentials during constant pressure stimulation of the skin.
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

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

54. Action potentials are generated in these cells. \_\_\_\_\_

55. During light exposure these cells depolarize. \_\_\_\_\_

56. These cells contain pigment but do not respond directly to light. \_\_\_\_\_



## 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 transmembrane gradient of  $[H^+]$  in the production of ATP. 3 pts.

B) Explain how ATP is produced in the cytosol in the absence of oxygen. 3 pts

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.



3. Explain how nerve conduction is speeded in myelinated vs. non-myelinated nerves. 4 pts

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