**Human Physiology 2015 Test 1**

*Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* Questions 1-16 are worth 3 points each

1. Both the I band and H band shorten during muscle contraction. **True** or False?
2. EPSPs enhance depolarization of the post synaptic nerve cell whereas IPSPs enhance repolarization of the post synaptic nerve cell. **True** or False?
3. An increase in stimulus intensity will usually result in a linear increase in the frequency of action potentials in the sensory nervous system. True or **False**?
4. Most sensory receptors are specific and only respond to a single type of sensation (modality). **True** or False?
5. Increasing the radius of the curvature of a lens will increase the focusing power (diopter). True or **False**?
6. The golgi tendon is in **SERIES/**PARALLEL with muscle fibers and function as LENGTH/**TENSION** sensory receptors. Conversely, muscle spindles are in SERIES/**PARALELL** with muscle fibers and function as **LENGTH**/TENSION sensory receptors.
7. Afferent information from **SENSORY**/MOTOR neurons **ENTERS**/EXITS the spinal cord via the **DORSAL** **ROOT**/VENTRAL ROOT. (circle correct answers)
8. Which of the following actions would decrease (more negative) a cell’s membrane potential.
9. Increase the number of open potassium channels
10. Decrease the number of open potassium channels
11. Increase the number of open sodium channels
12. Decrease the number of open sodium channels
13. A and C
14. B and C
15. **A and D**
16. B and D

9) Ventricular systole

1. Is also known as the period of Isovolumetric relaxation.
2. **Is represented by QRS on an EKG.**
3. Occurs when the AV valves are open.
4. Is represented by the P wave on the EKG.
5. B and C

10) The cross-bridge cycle requires binding of to the thin and thick filaments respectively.

1. ATP and Ca++
2. Na+ and ATP
3. **Ca++ and ATP**
4. ATP and Mg++

\_\_\_\_ of 30 points

11) If a person has myopia, the image is focused

1. **In front of the retina**
2. Behind the retina
3. Directly on the retina
4. The image does not focus

12) Secretory vesicles are transported along a microtubule to the axon terminal via

1. **Kinesin protein**
2. Synapsin protein
3. Dynein protein
4. Dynamin protein

13) Carbon Dioxide levels in the body are monitored by:

1. Thermoreceptors
2. Electromagnetic receptors
3. **Chemoreceptors**
4. Nociceptors
5. Mechanoreceptors

14) Which type of blood vessel has the thickest smooth muscle layer?

1. Artery
2. Arteriole
3. **Precapillary Sphincter**
4. Venule
5. Veins

15) The absolutely refractory period is caused by

1. **sodium channels being in a closed/deactivated state**
2. potassium channels being in a closed/deactivated state
3. sodium channels being in an open/activated state
4. potassium channels being in an open/activated state

16) Which factors contribute to determining the perceived intensity of a stimulus?

1. The number of sensory receptors activated
2. The frequency of action potentials emitted by the sensory receptors
3. The amplitude of the action potential
4. **A and B**
5. A and C
6. All of the above

\_\_\_\_\_\_ of 18 pts

17) (5 pts) Ventricular contraction causes the\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **AV valves** to close, which is the beginning of ventricular (diastole/**systole**). The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **semilunar** valves were closed in the previous diastole and are now (open/**closed**) during this period. This entire sequence of events occurs during the period of (**isovolumic contraction**/ejection).

1. Sarin gas acts as an inhibitor of the enzyme which breaks down acetylcholine in the synaptic cleft of the neuromuscular junction. A) (3 pts) What is the name of this enzyme? B) 3 pts) Explain what effect exposure to a large amount of sarin gas will have at the neuromuscular junction. Another nerve toxin, botulinum toxin, also known as Botox, inhibits the release of Acetylcholine. C) (4 pts) What effect would you expect to see at the neuromuscular junction when exposed to botulinum toxin? \*In both your explanations be sure to specify the effect on stimulation of the postsynaptic muscle fiber.

**A) Acetylcholinesterase**

**B)The EPSP enducing neurotransmitter acetylcholine will not be broken down in the synaptic cleft. Acetylcholine will continue to build up and thus cause continuous stimulation of the postsynaptic neuron muscle with inability to relax**

**C)If Acetylcholine cannot be released into the synaptic cleft, the postsynaptic neuron cannot be stimulated and thus muscle cannot be stimulated to contract**

19) (4 pts) Explain the role of calcium in activating the muscle in excitation-contraction coupling.

**Calcium binds to troponin, which causes the tropomyosin to change shape/moves and expose binding sites on the actin which are then able to bind to the myosin heads.**

\_\_\_ of 19 Pts

20) (4 pts) List the steps of the cross-bridge cycle in order (you may start at any point as it is a cycle). Do not include excitation-contraction steps. B.)(2 pts) Each cross-bridge independently generates force. Explain how this influences the amount of force (tension) a muscle can generate at very long lengths versus optimal length. When a person dies, there is no longer ATP available for use in the crossbridge cycle. C.) (1pt) What is the name of this condition? D.) (2 pts) Explain what effect the absence of ATP will have in regards to the crossbridge cycle.

**ATP binds to myosin releasing myosin from actin**

**ATP is hydrolyzed**

**Myosin binds actin**

**Pi and ADP are released and power stroke moves actin**

**B) Since each cross-bridge generates force, the amount of force is proportional to the number of cross-bridges that can bind to the actin filament. As muscle length increases beyond optimal, fewer cross-bridges can bind and force decreases.**

**C) Without ATP, the myosin heads will be unable to detach, therefore the muscle cannot relax and will remain contracted. This is called rigor mortis.**

21) The concentration of Na on the outside of a nerve cell is decreased from 142 mM/L to 30 mM/L. A)(8 pts.) Calculate the new membrane potential at the peak (top spike) of the next action potential given that the permeability of Na = 200 and K = 1 at the peak and the concentrations below. B) (2 pts.) Is the new peak membrane potential higher or lower than the typical peak potential at the normal Na concentration?

[Na] inside nerve = 14 mM/L [K] inside the nerve = 140 mM/L

[K] outside the nerve = 4 mM/L





**Vm = 61 log 6004/2940 = 61 log 2.042 = 18.9 mV which is lower**

\_\_\_ of 19 pts

22) Multiple Sclerosis (MS) is a disease that effects millions of people of all ages. MS is characterized by a faulty immune response which attacks and degrades the myelin of nerve cells in the central nervous system. A) (3 pts ) What is the role of myelin in a nerve cell? B) (3 pts) What effect would you expect this disease to have on the nerve’s ability to propagate action potentials? C) (2 pts) Based on your previous explanation, suggest two signs/symptoms would you expect to see in an MS patient. **(Myelin insulates the neuron to significantly speed up AP propagation. Someone with MS would have much slower AP propagation and decreased AP generation in the CNS. Muscle weakness/fatigue/paralysis/numbness/pain/cognitive changes/etc.)**

23) You are on a day hike in the foothills of the Adirondacks. A) (2 pts) What muscle fiber type would your leg muscles use most of the time? B) (2 pts) What is the main energy pathway for these fibers after you have been hiking for 20 minutes? C**)** (2 pts) Name 2 other characteristics of this muscle fiber type.

**slow aerobic muscle fiber type. B) oxidative phosphorylation C) slow contraction, slow ATPase, slow to fatigue, high mitochondria, high myoglobin, etc…**

**Bonus Questions --------------------------**

In a healthy heart, the stroke volume of both ventricles are identical. A) (3 pts) However, if the stroke volume of the left ventricle is 200 ml/min, while the stroke volume of the right ventricle is 205 ml/min, where would you expect to see a backup of blood?

**The lungs/ the pulmonary circulatory system**

B) (3 pts) Suggest a possible reason for the decrease in stroke volume of the left ventricle.

**Hypertrophy of muscle/ damage to muscle (heart attack)/ damage to conductive tissue**

\_\_\_\_\_\_\_ of 20 pts