THE UNIVERSITY OF WESTERN ONTARIO
Physiology 2130 650-Introduction to Human Physiology
Distance Studies
Midterm Exam
Date: June 23rd, 2012
Format: 2 hours Markex Exam

DIRECTIONS FOR COMPLETING THE ANSWER SHEET

Using a **PEN** for your signature, and a **PENCIL** for all other information

Print your name, the course name (Human Physiology) and the course number (2130).

Under the heading **STUDENT NUMBER**, record all 9 digits of your student number. FILL IN THE OVAL UNDER THE NUMBERS COMPLETELY!

The **SECTION** number is **130.** The digits and ovals must be filled in underneath the section number.

The **CODE,** enter **650**.

To answer the multiple choice questions, use an HB pencil to completely fill the ovals on the answer sheet.

Calculators are permitted.

QUESTION BOOKLET

Please make sure that this booklet contains **60 questions** (17 page sides, including front page).

Hand in this booklet (with your name signed below), along with the scantron sheet, when you have completed the exam.

NAME:_____

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

Questions

1. Which of the following is **TRUE** regarding the plasma membrane?

A) It is highly permeable to water.
B) It has transmembrane proteins that are involved in energy production.
C) Proteins can pass through it via simple diffusion.
D) The most abundant component are phospholipids.
E) It has a hydrophilic core.

2. Which of the following statements regarding ion concentrations in and around the cell is **FALSE**?

A) Na^+ has a higher concentration inside the cell.
B) K^+ has a lower concentration outside the cell.
C) Ca^{2+} has a higher concentration outside the cell.
D) Cl^- has a lower concentration inside the cell.
E) Proteins have a higher concentration inside the cell.

3. Which of the following is **NOT** a component of a negative feedback loop?

A) set-point
B) control centre
C) output regulator
D) effector
E) sensor

4. Side A of a chamber consists of a solution of 200 mM $CaCl_2$ and Side B of a chamber consists of a solution of 150 mM glucose. A membrane permeable only to chloride (Cl^-) separates the two chambers. What will happen once the solution has reached equilibrium?

A) Side A will decrease in osmolarity.
B) Side B will increase in water volume.
C) Cl^- will move into side B by osmosis.
D) Side B will become more negatively charged.
E) A and D are correct.

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

5. Which of the following does **NOT** influence the rate of diffusion of a fat-soluble molecule?

A) Surface area of the cell
B) Temperature
C) Concentration gradient
D) Competitive inhibition
E) Size of molecule

6. Which of the following statements about plasma is **FALSE**?

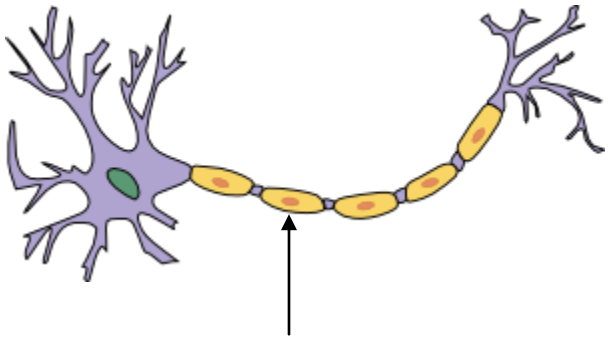
A) Plasma makes up approximately 7% of total body water (TBW).
B) Plasma contains plasma proteins like albumin.
C) Plasma volume can fluctuate greatly.
D) Plasma is a colloidal solution.
E) Plasma has a greater concentration of Cl^- than inside the cell.

7. What is **TRUE** regarding the resting membrane potential?

A) It is present only in excitable cells.
B) It is due to the selective permeability of the plasma membrane.
C) In most cases it is -60mV.
D) It is unaffected by equilibrium potentials.
E) It is able to increase during an action potential.

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

8.



What is the arrow in the above diagram pointing to?

A) Axon terminal
B) Node of Ranvier
C) Cell Body
D) Myelin
E) Dendrite

9. Put the following steps of an action potential in the correct order:

1. Voltage-gated K^+ channel opens
2. Na^+ activation gate closes
3. Neuron reaches threshold
4. Neuron is hyperpolarized
5. Na^+ enters the cell through voltage-gated channels

A) 3, 5, 2, 1, 4
B) 3, 5, 1, 4, 2
C) 5, 3, 1, 4, 2
D) 5, 3, 2, 1, 4
E) 2, 3, 5, 1 , 4

10. Which of the following statements is **TRUE** about voltage-gated K^+ channels?

A) They close slowly.
B) They open immediately in response to a change in voltage.
C) They contribute to the depolarization of the membrane in an action potential.
D) They have an inactivation gate.
E) They allow K^+ and Na^+ ions to pass through.

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

11. What is **TRUE** regarding the absolute refractory period?

A) A greater depolarization is necessary to cause an action potential during this time.
B) Is due to an increased leakage of K^+ following repolarization.
C) Is due to the inactivation gate of K^+ blocking the K^+ channel.
D) Immediately precedes the relative refractory period.
E) Is caused by an excess influx of Cl^- ions.

12. Which of the following statements about Na^+ movement/permeability is **TRUE** during an action potential?

A) Na^+ enters the cell after K^+ enters the cell.
B) At one point during an action potential, a small amount of Na^+ enters the cell while K^+ is leaving the cell.
C) Na^+ channels open slowly so sodium enters the cell slowly.
D) Na^+ moving back out of the cell causes the rounded peak of the action potential.
E) The permeability of Na^+ does not change during an action potential.

13. Which of the following is a **CORRECTLY DEFINED** component of the neuromuscular junction?

A) End plate potential- action potential in the alpha motor neuron
B) Synaptic vesicle- contains Ca^{2+} ions
C) Sarcolemma- the membrane of the axon
D) Acetylcholinesterase- neurotransmitter released at the neuromuscular junction
E) Synaptic cleft- the gap between the motor fiber and muscle cell

14. How does the propagation of action potentials **DIFFER** between unmyelinated and myelinated axons?

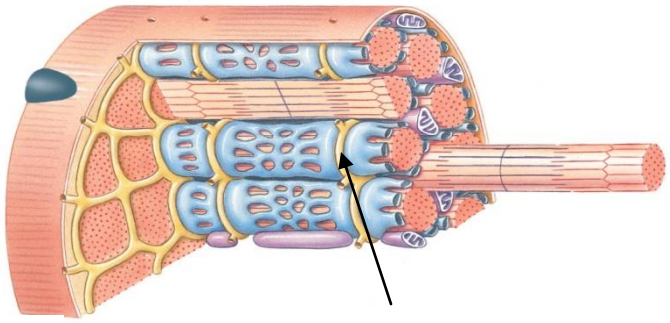
A) Unmyelinated axons have Nodes of Ranvier and myelinated axons do not.
B) Only myelinated axons depend on the inactivation of the Na^+ voltage-gated channel.
C) Only unmyelinated axons have Na^+ and K^+ voltage-gated channels down the length of the axon.
D) Unmyelinated axons require a higher threshold to fire an action potential.
E) Only myelinated axons generate action potentials at the axon hillock.

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

15. You are a scientist working in a lab and have developed a drug that blocks the action of acetylcholinesterase. You predict that this drug will do which of the following?

A) Increase the number of inhibitory post-synaptic potentials at the neuromuscular junction.
B) Increase the conduction of action potentials down the motor neuron.
C) Decrease the force of contraction in the muscle fiber.
D) Increase the rate of muscle relaxation in the muscle fiber.
E) Increase the end-plate potential and muscle contraction in the muscle fiber.

16.



Identify the structure indicated by the arrow.

A) T-tubule
B) Sarcolemma
C) Sarcoplasmic reticulum
D) Myofibril
E) Nucleus

17. In the sarcomere, which of the following **DOES** occur during a muscle contraction?

A) The thick filaments shorten.
B) The thin filaments lengthen.
C) The M-line shortens.
D) The Z-lines get closer together.
E) The sarcomeres remain the same length.

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

18. Which of the following statements is **CORRECT** concerning troponin?

A) Troponin is a component of the thick myofilament (myosin).
B) Troponin generates the powerstroke when attaching its energized globular head group to the thin filament (actin).
C) Troponin binds tropomyosin, Ca^{+2} and ATP.
D) Troponin holds tropomyosin over the myosin binding sites in a muscle at rest.
E) Troponin rolls off of the thin myofilament (actin) upon Ca^{+2} binding.

19. A person picks up a 60 Kg barbell and holds it off the floor for 20 seconds. Which of the following events is likely occurring in his muscles in order for the person to hold the weight?

A) Tetanic contraction
B) Summation of twitch contractions
C) Motor unit recruitment
D) Increased frequency of action potentials in the motor nerve
E) All the above

20. Which of the following is **NOT** part of the actin-myosin and ATP cycle?

A) Formation of cross-bridges occurs when Ca^{2+} binds to troponin C.
B) Actin binds ATP which energizes it for powerstroke formation.
C) The powerstroke occurs when the myosin head bends and slides over the thin myofilaments.
D) A new ATP molecule must bind to myosin to break the cross-bridge.
E) Troponin C moves tropomyosin off myosin binding sites found on actin.

21.Where in the brain does visual information get processed?

A) Parietal lobe
B) Frontal lobe
C) Occipital lobe
D) Temporal lobe
E) Thalamus

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

22. Which of the following is **CORRECT** regarding cells in the brain?

A) Neurons make up roughly 90% of the total number of cells in the brain.
B) Myelin is made by oligodendrocytes in the central nervous system.
C) Astrocytes, microglia, and ependymal cells are types of neurons.
D) Microglia have the longest axons of any neuron in the brain.
E) Glial cells make up about 50% of the total number of cells in the brain.

23. Which of the following occurs right after an action potential reaches the axon terminal in the presynaptic neuron?

A) Synaptic vesicles fuse with the pre-synaptic membrane.
B) An excitatory pre-synaptic potential is triggered.
C) Ca^{2+} voltage-gated channels open.
D) Acetylcholinesterase is released.
E) The post-synaptic membrane depolarizes.

24. Which of the following statements is **FALSE** regarding receptor potentials?

A) They propagate down the neuron.
B) They are proportional to the strength of the stimulus.
C) They can be depolarizing or hyperpolarizing.
D) The further from the stimulus, the weaker the signal.
E) They may or may not lead to an action potential.

25. As a scientist, you have discovered that a chemical synapse you are studying always releases the neurotransmitter glutamate. What do you predict about this chemical synapse?

A) The post-synaptic cell will always fire an action potential.
B) The pre-synaptic cell will have a greater frequency of action potentials.
C) The post-synaptic cell will become hyperpolarized.
D) The pre-synaptic cell will be an inhibitory interneuron.
E) The post-synaptic cell will have an excitatory post-synaptic potential.

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

26. What do Pacinian corpuscles detect?

A) Pain.
B) Fine touch and vibration.
C) Changes in temperature.
D) Low frequency vibrations.
E) High frequency vibrations.

27. Which of the following statements is **FALSE** regarding alpha-gamma co-activation?

A) Alpha motor neurons cause extrafusal muscle to contract.
B) Intrafusal muscles are stimulated to contract via gamma motor neurons.
C) Extrafusal muscle contracts faster than intrafusal muscle.
D) Stretch receptors in the intrafusal muscle are stimulated.
E) Ensures continuous information about muscle length is sent to the brain.

28. Which of the following is **NOT** a function of the limbic system?

A) Drinking
B) Control of heart rate
C) Motivation
D) Learning
E) Feeding

29. Which of the following statements if **FALSE** regarding the autonomic nervous system?

A) The neurotransmitter released by the parasympathetic postganglionic neuron is always acetylcholine.
B) Nerves of the parasympathetic nervous system have longer preganglionic fibers.
C) The neurotransmitter released by the sympathetic postganglionic neuron is usually norepinephrine.
D) The nerves of the sympathetic nervous system exit the spinal cord in the sacral and cervical regions of the spinal cord.
E) The effects of the sympathetic and parasympathetic nervous system on their target organs are usually the opposite.

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

30. Which of the following best defines an adequate stimulus?

A) It is a stimulus of sufficient magnitude to cause action potentials.
B) It is a stimulus that is able to activate more than one sensory receptor.
C) It is the type of stimulus that most quickly generates an action potential.
D) It is a type of energy that a sensory receptor can respond to sub-optimally.
E) It is the particular form of environmental stimulus to which the sensory receptor is most sensitive.

31. How are rod and cone cells **SIMILAR**?

A) They both release inhibitory neurotransmitters.
B) They both have the same type(s) of photopigment.
C) Stimulation causes action potentials in both.
D) They both detect colour.
E) They are both located mostly in the fovea.

32. How are neuromuscular junctions and neuron to neuron synapses the **SAME**?

A) Both always release excitatory neurotransmitters
B) Both contain voltage-gated channels on the post-synaptic membrane
C) Both always result in a depolarization of the muscle/neuron
D) Both require the presynaptic membrane to depolarize
E) B and D are correct.

33. Which of the following statements is **TRUE** regarding the transmission of light to action potentials?

A) Light directly stimulates the bipolar cells to depolarize.
B) Light stimulates the opening of Na^+ channels.
C) Light stimulates the release of neurotransmitters.
D) Action potentials occur in the absence of neurotransmitter release.
E) Darkness causes rod cells to hyperpolarize.

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

34. Which of the following statements best describes the function of the middle ear?

A) It converts fluid waves into action potentials.
B) It amplifies the sound waves of the tympanic membrane.
C) It detects head rotation.
D) It detects linear accelerations in the horizontal plane.
E) It helps propagate action potentials in the central nervous system (CNS).

35. Which of the following is TRUE regarding somatosensory information?

A) It will only travel to the brain by the spinothalamic tract.
B) Once the sensory information reaches the brain, it will travel to the precentral gyrus.
C) Areas that receive more sensory information (such as the lips) have a greater representation on the cortex.
D) All somatosensory information passes through the pituitary gland.
E) All somatosensory information crosses the midline at the thalamus.

36. Which of the following receptors are found within the otolith organs?

A) Rods
B) Cones
C) Hair cells
D) Temperature sensors
E) Golgi tendon organs

37. Which of the following is true regarding semicircular canals?

A) They contain a sensory region called the crista ampullaris.
B) They are found within the cochlea.
C) They are filled with a fluid called perilymph.
D) They detect linear accelerations.
E) They consist of the utricle and saccule.

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

38. You are beginning to accelerate as you merge on Highway 401. Which of the following is occurring in your vestibular apparatus?

A) The hair cells in your semicircular canal will be bending.
B) Otolith crystals will be releasing post-synaptic potentials.
C) The utricle will be increasing the frequency of action potentials to the brain.
D) The saccule will be decreasing the frequency of action potentials to the brain.
E) There will be no change in the otolith organs since they detect velocity, not acceleration.

39. Which of the following is **NOT** a type of eye movement?

A) Vestibular ocular reflex
B) Tectorial
C) Saccades
D) Smooth pursuit
E) Vergences

40. Which of the following is **TRUE** regarding the auditory system?

A) Auditory information is processed in the temporal lobe.
B) Pitch is encoded by the frequency of action potentials.
C) Hair cells in the ear constantly release an inhibitory neurotransmitter.
D) The eardrum is also known as the Eustachian tube
E) Loudness is encoded by the number of endolymph fluid waves.

41. What is the cardiac output for someone with the following measurements?

Weight= 175 lbs
Heart rate= 68 beats per minute
EDV = 90mL
ESV = 25mL

A) 6120 mL/min
B) 4420 mL/min
C) 1700 mL/min
D) 11900 mL/min
E) 7820 mL/min

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

42. In which structure is the conduction of the action potential the **SLOWEST** in the heart?

A) The AV node
B) The Purkinje Fibres
C) The Bundle of His
D) The SA node
E) The ventricular muscle

43. Which of the following structures of the heart is **INCORRECTLY** matched with its function?

A) left ventricle- pumps blood through the aorta to the rest of the body
B) chordae tendineae- prevent AV valves from being pushed into atria
C) tricuspid valve- ensures blood travels only from right atrium to right ventricle
D) right atrium- receives oxygenated blood from the lungs
E) superior vena cava- delivers blood to the heart from the head and upper limbs

44. Put the following steps of blood circulation through the heart in the correct order:

1. blood passes through pulmonary artery
2. blood enters right atrium
3. blood enters left ventricle through AV valve
4. blood passes through aorta
5. blood passes through pulmonary vein

A) 3, 1, 5, 2, 4
B) 2, 1, 5, 3, 4
C) 2, 5, 1, 3, 4
D) 2, 3, 1, 5, 4
E) 4, 1, 3, 2, 5

45. How are skeletal muscle cells and cardiac contractile cells **DIFFERENT**?

A) Skeletal muscle cells have more actin and myosin then cardiac contractile cells.
B) Cardiac contractile cells have more nuclei than skeletal muscle cells.
C) Skeletal muscle cells are more efficient at extracting oxygen from the blood than cardiac contractile cells.
D) Cardiac contractile cells have more mitochondria than skeletal muscle cells.
E) There are no major differences between skeletal muscle cells and cardiac contractile cells.

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

46. At which stage of the cardiac cycle is the AV valve (mitral valve) open?

A) Early ventricular diastole
B) Late ventricular diastole
C) Atrial systole
D) Ventricular systole
E) B and C are correct

47. Which of the following statements is **FALSE** regarding the cardiac cycle during the QRS complex of an ECG?

A) The ventricles begin contracting.
B) There is a change in volume of the ventricle.
C) Pressure builds in the ventricle.
D) The atrial valve closes.
E) The aortic pressure is higher than ventricular pressure.

48. Which of the following will **INCREASE** heart rate?

A) Decreasing the slope of the pacemaker potential.
B) Opening more K^{+} channels during the pacemaker potential.
C) Opening more Ca^{+2} channels during the pacemaker potential.
D) An increase in the release of acetylcholine onto the SA node.
E) Both A and B are correct.

49. Which of the following will **INCREASE** stroke volume?

A) Activating the parasympathetic nervous system.
B) Using skeletal muscle to constrict the arteries.
C) Increasing the end systolic volume.
D) Increasing the release of acetylcholine onto the SA node.
E) Constricting smooth muscle in the veins.

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

50. How is the SA node action potential **DIFFERENT** than an action potential in a neuron?

A) The SA node has no resting membrane potential.
B) The SA node is more permeable to Na^+.
C) The SA node has a threshold of -60mV.
D) The SA node is more permeable to K^+.
E) A and B are correct.

51. In which blood vessel is resistance the **LARGEST**?

A) The arteries
B) The arterioles
C) The capillaries
D) The venules
E) The veins

52. Which of the following is **TRUE** regarding capillaries?

A) They have the slowest blood velocity.
B) They carry the largest portion of blood.
C) They have three layers of cells.
D) They have the lowest blood pressure.
E) They have valves.

53. Given the following data, calculate the net fluid movement at the capillary. Will the fluid be filtered or absorbed?

P_c= 25mmHg
P_{IF} = -8mmHg
π_P= 20mmHg
π_{IF} = 5mmHg

A) 18 mmHg- the fluid will be reabsorbed
B) 18 mmHg- the fluid will be filtered
C) 13 mmHg- the fluid will be reabsorbed
D) -13 mmHg- the fluid will be filtered
E) -2 mmHg- the fluid will be reabsorbed

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

54. Which of the following will cause vasodilation of blood vessels?

A) An increase in pH
B) Angiotensin II
C) A decrease in CO_2
D) An increase in temperature
E) Vasopressin

55. Which of the following is **FALSE** regarding edema?

A) It can be caused by an increase in the capillary hydrostatic pressure.
B) It can be caused by severe malnutrition.
C) It refers to an accumulation of fluid within the lymphatic capillaries.
D) It does not occur under normal physiological circumstances.
E) It can be caused by a blockage in the lymphatic system.

56. Which of the following is/are factors that **INCREASE** blood flow?

A) Decreased viscosity of the fluid
B) Decreased length of the vessel
C) Increased length of the vessel
D) Decreased blood vessel diameter
E) A and B are correct

57. You are a physician working in a busy emergency room and examine a patient who has ingested an unknown substance. You examine the patient and find that their blood vessels are dilated and they have a decreased mean arterial pressure. The substance they may have ingested is:

A) An antihistamine
B) Angiotensin II
C) Epinephrine
D) Vasopressin
E) An antacid

DIRECTIONS: Each of the questions or incomplete statements below is followed by 5 suggested answers or completions. Select the <u>ONE</u> that is the <u>BEST</u> in each case and blacken the appropriate space on the Scantron sheet.

58. Which of the following is **TRUE** regarding the baroreceptor reflex?

A) The baroreceptor reflex works to decrease blood pressure to normal levels.
B) Baroreceptors are located in the medulla oblongata and the left ventricle.
C) The baroreceptor reflex will cause an increase in cardiac output.
D) The baroreceptor reflex will cause an increase in total peripheral resistance.
E) The baroreceptor reflex will increase sympathetic activity in the heart.

59. What causes action potentials to travel in one direction?

A) The myelin sheath and nodes of Ranvier
B) The inactivated voltage-gated K^+ channels
C) The relative refractory period
D) The inactivated voltage-gated Na^+ channels
E) The axon hillock

60. Which of the following is **TRUE** regarding hair cells?

A) They are the sensory receptor in the eye.
B) They produce action potentials.
C) When the stereocilia bends towards the kinocilia they release more neurotransmitter.
D) They are only able to depolarize, they cannot hyperpolarize.
E) They are involved in detecting heavy touch (pressure).