UNIVERSITY OF BUEA **FACULTY OF HEALTH SCIENCES**

HSC 205 (INTRODUCTION TO PHYSIOLOGY): FIRST SEMESTER EXAMS (2010-2011)

Section 1: For each of the following, choose the single best response. (40Marks)

(1) In convergence, (a) thousands of synapses from many different presynaptic cells end upon a single postsynaptic cell (b) the axon of a nerve cell branches so that the activity in one neuron influences many other cells (c) the dendrites all converge upon the cell body (d) All of these answers (e) None of these answers.

(2) Select the incorrect description of the graded potential. (a) it can be depolarized (b) it can be hyperpolarized (c) it can be summated (d) it has a refractory period (e) it occurs in specialized membrane regions

(3) The nodes of Ranvier are (a) action potential recordings (b) breaks in the myelin covering (c) lipid paths (d) spaces between neurons (e) cells

(4) Neuromodulators (a) bind to receptors at nonsynaptic sites (b) do not contribute directly to EPSP formation (c) do not contribute directly to IPSP formation (d) may influence neurotransmitter production. (e) All of these answers.

(5) Presynaptic facilitation results from (a) alteration of calcium permeability (b) continued EPSP generations (c) neuromodulator effects (d) increased neurotransmitter production (e) None of these answers.

(6) Drugs may influence synaptic transmission by (a) altering the formation of neurotransmitters (b) blocking neurotransmitter reuptake (c) blocking receptors (d) blocking channels (e) All these answers.

(7) Select the last step for synaptic signaling when the action potential arrives at the axon terminal of a presynaptic neuron. (a) a neurotransmitter is released by exocytosis. (b) calcium flows in the synaptic knob (c) the neurotrasnmitter combines with protein receptor sites on the subsynaptic membrane (d) the permeability is altered in a postsynaptic neuron (e) None of these answers.

(8) Select the first step for synaptic signaling when the action potential arrives at the axon terminal of a presynaptic neuron. (a) a neurotransmitter is released by exocytosis (b) calcium flows in the synaptic knob (c) the neurotransmitter combines with protein receptor sites on the subsynaptic membrane (d) the permeability is altered in a postsynaptic neuron (e) the neurotransmitter is synthesized.

(9) If presynaptic neuron Z is repeatedly stimulated very rapidly, what change would you expect to occur in the postsynaptic neuron? (a) a single EPSP (b) a single IPSP (c) temporal summation of EPSPs (d) spatial summation of EPSPs (e) An IPSP and EPSP would cancel each other out, so there would be essentially no change in potential in the postsynaptic neuron.

(10) Which of the following is not a type of a muscle fibre? (a) smooth muscle (b) rough muscle (c) striated muscle (d) cardiac muscle (e) none

(11) A cell, initially in equilibrium, contains: concentration of impermeants S_i = 150 mM, and permeants s_i = 150 mM. It is placed in a large bath whose concentration of impermeants S_o = 300 mM, and permeants s_o = 0 mM. Cell volume will: (a) remain constant. (b) double. (c) halve. (d) triple. (e) increase until the cell ruptures.

(12) Which of the following is **NOT** true of osmosis? (a) It is diffusion of water. (b) It moves water from a higher to lower concentration of water. (c) It moves water to even out the concentration of solutes. (d) It moves water from a higher to lower concentration of solutes. (e) It is driven by thermal energy.

(13) Which of the following is **NOT** true of a biomembrane? (a) The lipid phase is impermeable to ions. (b) The lipid phase is impermeable to glucose. (c) The lipid phase is impermeable to small hydrophobic solutes. (d) The proteins mediate transport of ions. (e) The proteins mediate active transport.

(14). Which of the following is an example of secondary active transport? (a) Na^+/Ca^{2+} exchange (b) Na^+/K^+ ATPase (c) H^+ ATPase (d) Electrodiffusion of K^+ (e) Facilitative transport of a solute.

(15). Membrane capacitance: (a) increases with voltage. (b) increases with charge. (c) depends primarily on membrane proteins. (d) depends primarily on membrane lipids. (e) mediates ion movement across the membrane.

(16). A K^+ channel is determined to have an open channel conductance of 20 x 10^{-12} S, and is open on average 5% of the time. If a cell membrane contains $10^9$of these channels, what is the value of the cells K^+ conductance due to these channels? (a) 20 x 10^{-3} S (b) 50 S (c) 10^3 S (d) 10^{-3} S (e) 1 mF/cm^2

(17). Which of the following is **NOT** true of a Nernst potential? (a) It depends on which membrane channel is open. (b) It is the voltage at which an ion is in equilibrium. (c) It depends on the diffusion gradient for an ion. (d) It can drive ionic current flow when the transmembrane voltage is zero. (e) It does not require charge on the membrane capacitance.

(18). If Cl^- is membrane permeant but not actively transported, $[Cl^-]_i$ = 10 mM, and $[Cl^-]_o$ =145 mM, what is this cell's resting voltage? (a) 60 mV (b) 0 mV (c) -30 mV (d) -70 mV (e) -90 mV.

Questions 19 - 21 refer to the figure below

Intracellular		Extracellular
$[K]_i$ = 100 mM		$[Na]_o$ = 110 mM
$[K]_i$ = 100 mM		$[K]_o$ = 1 mM
$[Cl]_i$ = 110 mM		$[Cl]_o$ = 120 mM
$[Ca]_i$ = 450 nM		$[Ca]_o$ = 4.5 mM
	$[A]_i$ = 120.7 mM	
	g_K = 1.0 mS/cm^2	
	g_{Na} = 0.2 mS/cm^2	
	g_{Cl} = 0.5 mS/cm^2	

(19). What is the value of $[Cl]_i$? (a) 30.8 mM (b) 10.8 mM (c) 3.8 mM (d) 12.0 mM (e) 1.2 mM.

(20). What is the resting voltage? (a) 0 mV (b) -30 mV (c) -60 mV (d) -90 mV (e) -120 mV.
(21). What is the average valence of the impermeant anions, $[A]_i$? (a) -1.25 (b) -1.00 (c) -0.96 (d) -0.89 (e) -0.75
(22). Which of the following is **NOT** a characteristic of **ALL** types of action potentials? (a) A voltage and time dependent Na^+ conductance change (b) An inward current is responsible for depolarization (c) Constant shape within a certain cell type (d) Constant velocity within a certain cell type (e) All or none voltage change.
(23). Which of the following is a role of action potentials? (a) Regulation of contraction (b) Signal for contraction (c) Transmission of information (d) Signal for exocytosis (e) All of the above.
(24). During a nerve action potential, the voltage and time dependent increase in K^+ current: (a) Results from a depolarization in membrane potential. (b) causes the hyperpolarizing afterpotential. (c) is due to an increase in channel open probability. (d) occurs primarily after the large increase in Na^+-current. (e) All of the above.
(25). A neuron is voltage clamped to a membrane potential exactly between resting and threshold voltage. After the clamp is released, the net membrane current will be: (a) inward. (b) negative. (c) outward. (d) zero. (e) maximum.
(26). During the second half of the relative refractory period, (a) a fraction of activation n-gates of voltage-dependent K^+-channels are open. (b) a fraction of activation m-gates of voltage-dependent Na^+-channels are open. (c) there are no Na^+-channels that have inactivated. (d) a stimulus cannot elicit an action potential. (e) inward currents are larger than during the absolute refractory period.
(27). Which of the voltage dependent channels that generate action potential currents has the most rapid activation kinetics? (a) K^+ channels (b) Ca^{2+} channels (c) Cl^- channels (d) Na^+ channels (e) none of the above.
(28). At the peak of a nerve action potential, the ratio of sodium to potassium conductance, g_{Na}:g_K, is 5. If the sodium Nernst potential, E_{Na}, is +50 mV and the potassium Nernst potential, E_K, is -100 mV, what is the voltage at the peak of the action potential? (a) +100 mV (b) +50 mV (c) +35 mV (d) +25 mV (e) +15 mV.
(29). Which of the following will decrease the velocity of action potential propagation? (a) A decrease in membrane capacitance (b) An increase in the axon diameter (c) A decrease in axoplasm resistivity (d) An increase in the length constant (e) Loss of the myelin sheath.
(30). Given below are data for length constant λ and capacitance per length C_m of 5 different axons. All else being equal, which has the most rapid action potential propagation velocity? (a) λ= 2.0 mm /C_m =10 nF/mm (b) λ = 1.5 mm / C_m =10 nF/mm (c) λ = 2.0 mm /C_m =15 nF/mm (d) λ = 1.5 mm /C_m =15 nF/mm (e) λ = 2.5 mm /C_m = 5 nF/mm.
(31). Which of the following is **NOT** true of a chemical synapse? (a) Neurotransmitter is synthesized in the presynaptic cell body. (b) There is a gap between the pre- and postsynaptic cells. (c) Presynaptic transmitter release involves presynaptic Ca^{2+} entry. (d) The postsynaptic response involves binding of transmitter to a postsynaptic receptor. (e) Termination of the postsynaptic response involves reduction of transmitter concentration in the synaptic gap.
(32). Eserine inhibits the ACh esterase. At the neuromuscular junction, eserine would be expected to: (a) decrease MEPP amplitude. (b) decrease MEPP frequency. (c) increase MEPP frequency. (d) increase MEPP duration. (e) decrease MEPP duration.
(33). Which of the following is a property of the ACh receptor? (a) It is an anion channel. (b) It gates open after binding of one Ach molecule. (c) It catalyzes the breakdown of ACh. (d) It resides in the presynaptic terminal. (e) It allows monovalent cations to cross the postsynaptic membrane.
(34). In the CNS, spatial summation refers to: (a) an excitatory postsynaptic response. (b) an inhibitory postsynaptic response. (c) the postsynaptic response to a rapid series of presynaptic action potentials at one presynaptic terminal. (d) the postsynaptic response to several presynaptic action potentials arriving nearly simultaneously at different presynaptic terminals. (e) the simultaneous response in several different postsynaptic cell bodies.
(35). A postsynaptic receptor activates a G protein that decreases the open probability of Ca^{2+} channels and increases the open probability of K^+ channels. (a) This is a fast, excitatory synapse. (b) This is a slow, excitatory synapse. (c) This is a slow, inhibitory synapse. (d) This is a fast, inhibitory synapse. (e) This synapse is both inhibitory and excitatory.
(36). The transmitter at a synapse activates a postsynaptic channel that is equally selective for mono valent cations. If the postsynaptic cell body had an initial voltage of -70 mV, E_{Na} = + 70 mV, E_K = -100mV, and E_{Cl} = -70 mV, the new postsynaptic voltage will be: (a) 0 mV. (b) Between -70 mV and -100 mV. (c) Between -70 mV and 0 mV. (d) -70 mV. (e) Negative to -100 mV.
(37). In cardiac and skeletal muscle, cross bridge binding to actin sites is inhibited by: (a) $[Ca^{2+}]_i$. (b) troponin/tropomyosin. (c) the myosin kinase. (d) ATP. (e) creatine phosphate.
(38). In which type of muscle does a single action potential **NOT** directly <u>regulate</u> force of contraction? (a) Smooth muscle (b) Cardiac muscle (c) Skeletal muscle (d) Mixed Muscles (e) Brown Muscles.
(39). A muscle of unknown origin appears striated. When it is placed in a solution containing no Ca^{2+}, it will not contract when stimulated. This cell is from: (a) smooth muscle. (b) cardiac muscle. (c) skeletal muscle. (d) Brown Muscles. (e) Mixed Muscles.
(40) During the peak of the action potential which ion has the greatest permeability? (a) sodium (b) potassium (c) calcium (d) chloride (e) protein.
(41) If a neuron were experimentally stimulated at both ends simultaneously, (a) the action potentials would pass in the middle and travel to the opposite ends (b) the action potentials would meet in the middle and then be propagated back to their starting positions (c) the action potentials would stop as they met in the middle (d) the strongest action potential would override the weaker action potential (e) summation would occur when the action potentials met in the middle, resulting in a larger action potential.
(42) Which of the following statements concerning the absolute refractory period is inaccurate? (a) the absolute refractory period refers to the period of time during which another action potential cannot be initiated in a patch of membrane that has just undergone an action potential, no matter how strong the stimulus. (b) the absolute refractory period corresponds to the time period during which the Na^+ gates are first opened and then closed and

inactivated (c) immediately following the absolute refractory period, the patch of nerve fiber membrane that has just under- gone an action potential can be restimulated only by a stronger stimulus than is usually necessary (d) the absolute refractory period occurs during the after hyperpolarization phase of the action potential (e) the absolute and relative refractory periods assure the unidirectional spread of the action potential down the nerve fiber away from the initial site of activation.
(43) The refractory period (a) prevents action potentials from spreading forward and backward (b) refers to the time period during which a portion of the membrane that has just undergone an action potential cannot undergo another action potential in response to normal triggering events because the channels opened during the action potential have not been restored to their "closed but capable of opening" conformation (c) places an upper limit on the frequency with which a neuron can conduct action potentials (d) Two of these answers (e) All of these answers.
(44) The period of time following an action potential during which a membrane cannot be restimulated no matter how strong the stimulus (a) is known as the absolute refractory period (b) occurs during the time after the Na^+ gates have opened until they are restored to their "closed but capable of opening" conformation (c) prevents the action potential from spreading back over the part of the membrane where the impulse has just passed (d) Two of these (e) All of these answers.
(45) The relative refractory period occurs after the action potential is complete because of the (a) lingering inactivation of the voltage-gated Na+ channels (b) slowness of the voltage-gated channels (c) the sodium-potassium pump (d) Both (a) and (b). (e) Both (b) and (c).
(46) The trigger zone of a neuron (a) precedes the axon (b) is located in the hillock (c) contains voltage gated channels (d) Both (a) and (b) above (e) All of these answers.
(47) Temporal summation takes place when (a) two EPSPs from the same presynaptic input occur so closely together in time that they add together or sum (b) an EPSP and an IPSP occur simultaneously in time and cancel each other out (c) two EPSPs that occur simultaneously from different presynaptic inputs add together or sum (d) action potentials occurring in two presynaptic inputs simultaneously converge upon the postsynaptic cell, initiating two different action potentials in the postsynaptic cell (e) None of these answers.
(48) Spatial summation occurs in a postsynaptic neuron (a) when several EPSPs from a single presynaptic input sum to reach threshold (b) when EPSPs from several presynaptic inputs sum to reach threshold (c) upon simultaneous interaction of an EPSP and an IPSP (d) when several IPSPs from a single presynaptic input sum to hyperpolarize the membrane (e) None of these answers.
(49) At an excitatory synapse, an action potential in the (a) postsynaptic neuron depolarizes the presynaptic cell membrane (b) presynaptic neuron increases the permeability of the subsynaptic membrane of the postsynaptic cell to both Na^+ and K^+. (c) presynaptic neuron increases the permeability of the subsynaptic membrane of the postsynaptic cell to K^+ only (d) Both (a) and (b) above (e) Both (a) and (c) above.
(50) At an excitatory synapse (a) there is increased permeability of the subsynaptic membrane to both Na^+ and K^+. (b) a small hyperpolarization occurs (c) an action potential in the presynaptic neuron always causes an action potential in the postsynaptic neuron (d) Two of these answers are correct (e) All of these answers.
(51) An IPSP is (a) produced by increased Na^+ permeability and K^+ permeability. (b) produced by increased K^+ permeability or increased Cl- permeability (c) a hyperpolarization of the postsynaptic cell. (d) Both (a) and (c). (e) Both (b) and (c).
(52) Which statement regarding neural integration is incorrect? (a) inhibitory synapses cause postsynaptic hyperpolarization (b) an inhibitory synapse may may result in postsynaptic sodium channel opening (c) inhibitory synpase may result in increased postsynaptic potassium efflux (d) an excitatory synapse causes depolarization of postsynaptic membranes (e) an excitatory synapse increases sodium permeability.
(53) Sequence the following events correctly *(1)- neurotransmitter diffuses across cleft. (2)- calcium induces exocytosis of neurotransmitter. (3)- permeability of postsynaptic membrane altered (4)- ion channels open. (5)- neurotransmitter binds to receptor on chemically-gated channel.* (a) *1, 2, 3, 5, 4* (b) *1, 4, 3, 2, 5* (c) *2, 1, 5, 4, 3* (d) *3, 1, 4, 5, 2* (e) *5, 4, 3, 1, 2*
(54) Which channel type is sensitive to serotonin? (a) voltage-gated (b) chemically-gated (c) mechanically-gated (d) acustically-gated (e) None of these answers.
(55) Which of the following statements concerning neuronal inhibition is incorrect? (a) with presynaptic inhibition, another neuron selectively excites an inhibitory presynaptic input. (b) an IPSP depresses information fed into the cell from any excitatory presynaptic input. (c) all of the axon terminals of an inhibitory neuron will release inhibitory transmitter. (d) when presynaptic inhibition takes place, there is no change in postsynaptic membrane potential. (e) an IPSP moves the potential of the postsynaptic neuron farther from threshold.
(56) Two adjacent presynaptic knobs, one from neuron A, the other from neuron B, synapse on a third neuron C. The two presynaptic knobs simultaneously release transmitter, as a result of which an action potential is initiated in neuron C. This is an example of (a) temporal summation. (b) spatial summation (c) convergence (d) Both (a) and (c) above (e) Both (b) and (c) above.
(57) The nucleus of a neuron is housed in the (a) axon (b) axon hillock. (c) cell body. (d) collaterals. (e) dendrites.
(58) Select the normal direction for the movement of an action potential along part of a neuron. (a) axon hillock to cell body (b) axon terminals to collateral axon (c) axon to dendrites (d) cell body to receptor (e) dendrites to cell body.
(59) With presynaptic inhibition, (a) an IPSP occurs on the postsynaptic cell. (b) all excitatory information being fed into the cell is depressed. (c) the release of excitatory transmitter from a specific presynaptic excitatory input is depressed. (d) More than one of these answers (e) None of these answers
(60) Which of the following would result from a demyelinating disease? (a) Increased propagation velocity (b) Decreased conductance per length of axon (c) Decreased capacitance per length of axon (d) Decreased safety factor (e) Increased frequency of action potentials.

SECTION 2: (30 Marks): Questions 61 to 65

Match each type of description with the correct term.

(A) Na^+ , (B) K^+ , (C) Ca^{2+} , (D) Glucose , (E) Adrenaline.

61 its regulation is Hormonal
62 is mainly found in cells
63 is mainly found in the interstitial and blood compartments.
64 is important in regulating arterial blood pressure.
65 is found in different forms.

Questions 66 to 70

Match each type of description with the correct term or suggestion.

(A) intracellular fluid compartment, (B) Total Body Water , (C) Extracellular fluid compartment, (D) Interstitial fluid , (E) Plasma Volume.

66 Is Blood Volume minus red blood cells volume.
67. is about 2/3 of total body water.
68. is the sum of D and and E.
69. Can be measured by indicator dilution method using…….
70. Can not be measured by indicator dilution method.

Question 71 to 90

Answer true (A) or false (B)

71. Atmospheric air pressure is about 760mmhg on the nearest mountain and less than 760mmhg in Limbe.
72. Pneumothorax- abnormal air in the intrapleural space can lead to collapsed lung.
73. Boyle's law states that volume is inversely proportional to pressure. This Can be applied in the mechanics of breathing.
74. During inspiration the diaphragm muscle contracts increasing the thoracic cavity size in the superior- inferior dimension.
75. Stimulation of the parasympathetic inhibits bronchi constriction
76. Sympathetic stimulation causes an increase in airways resistance
77. Infant respiratory distress syndrome in premature babies is related to excess surfactant
78. Functional residual capacity is IRV + RV.
79. Air pressure on MT Cameroon can be about 3000mmhg as opposed to 560 mmHg at the sea bottom.
80. Oedema increases thickness of alveolar membrane hence facilitating diffusion of gasses.
81. The O_2 affinity of fetal haemoglobin is higher than 0_2 affinity of adult hemoglobin.
82. 0_2 is carried in blood in two forms, dissolved in solution(most important) or bound to haemoglobin.
83. Co_2 is transported in dissolved form (large amount), as carbamino hemoglobin and as HCO_3-.
84. H+ is buffered inside RBCs by deoxyhemoglobin.
85. Cardiac output of the left ventricle is pulmonary blood flow.
86. Pressures are higher in pulmonary circulation than in systemic circulation.
87. Hypoxia in the lungs causes vasoconstriction as opposed to other organs.
88. Right – left shunts always result in a decrease in PaO_2 because of the admixture of venous blood with arterial blood.
89. Left to right shunts does not result in a decrease in arterial P02.
90. Central chemo receptors in the medulla are sensitive to pH of the fluid (CSF) and decreases in the pH of the CSF produce increases breathing rate.

Questions 91 to 100: Select the ONE lettered answer or completion that is BEST in each case.

91 which of the following is true during inspiration? (A) intrapleural pressure is negative. (B) lung volume is less than FRC (C) Alveolar pressure equals atmospheric pressure. (D) Alveolar pressure is higher than atmospheric pressure. (E) intrapleural pressure is more negative than it is during expiration

92 Which of the following will occur as a result of residing at high altitude? (A) hypoventilation (B) arterial po2 >100mmHg. (C) Decreased 2-3DPG (D) shift to the right of the hemoglobin –O_2 dissociation curve. (E) pulmonary vasodilation.

93 When a person is standing, blood flow to the lungs is (A) Equal at the apex and base. (B) highest at the apex owing to the effects of gravity on arterial pressure. (C) highest at the base because that is where the difference between arterial and venous pressure is greatest. (D) lowest at the base because that is where alveolar pressure is greater than arterial pressure. (E) None of the above.

94 which of the following is the site of highest airway resistance? (A) Trachea , (B) largest bronchi , (C) medium-sized bronchi, (D) smallest bronchi, E Alveoli.

95 A shift of hemoglobin-O_2 dissociation curve to the right could be caused by, (A) increased pH , (B) decreased 2,3DPG, (C) strenuous exercise , (D) foetal haemoglobin , (E) CO.

96 The shift of the O_2- haemoglobin dissocation curve to the right will be associated with (A) increased P_{50}, (B) increased affinity of haemoglobin for O_2, (C) impaired ability to unload O_2 in the tissues , (D) increased O_2 carrying capacity of haemoglobin, (E) decreased O_2 carrying capacity of haemoglobin.

97) Compared with the systemic circulation, the pulmonary circulation has a (A) Higher blood flow, (B) Lower resistance, (C) Higher Arterial pressure (D) Higher capillary pressure, (E) Higher cardiac output

98) Compare with the apex of the lungs, the base of the lungs has (A) A higher pulmonary capillary PO_2, (B) A higher pulmonary capillary PCo2 (C) A higher V/Q ratio, (D) the same V/Q ratio, (E) none of the above.

99 The CO affinity for haemoglobin is, (A) 20 times that of adult haemoglobin, (B) 200 times that of CO2, (C) 10 times that of nitrogen, (D) 200times that of adult haemoglobin.

100 Vital capacity is the sum of, (A) VT and IR, (B) Tidal volume and ERV, (C) FVC-RV D IRV,VT and ERV, (E) four lung volumes.