

BIPN 100, Mammalian Physiology I
Winter, 2006
Dr. P.A. George Fortes

2nd MIDTERM EXAMINATION

March 3, 2006.

Question 1. (12 points) 9

Question 2. (18 points) 16.5

Question 3. (18 points) 5/18

Question 4. (14 points) 13

Question 5. (12 points) 6

Question 6. (12 points) 12

Question 7. (12 points) 6

Question 8. (14 points) 10

Question 9. (12 points) 9

Total Points (124) 86.5

9 1. (12 points). Circle the correct answer or Fill in the blanks:

A. Muscle spindles are tonic / phasic receptors that are activated by stretch.

B. The patellar (knee-jerk) reflex is a flexor / extensor reflex on the ipsilateral / contralateral side.

C. In a relaxed muscle the spindle sensory neurons are firing / at rest.

For the following, indicate whether the rate of firing of muscle spindle sensory neurons increases, decreases, or remains the same:

D. During an isotonic contraction in a normal muscle: increases

E. During an isotonic contraction in a normal muscle when a load is added: increases

F. During an isotonic contraction in a muscle if the axons of the gamma motoneurons are cut: decrease or stretch

2. (18 points). You are enjoying a nice day at the world famous San Diego Zoo and suddenly an angry gorilla gets loose and heads straight to you. List the appropriate change in your organs, the corresponding types of receptor involved, and whether it is excitatory or inhibitory by this strong sympathetic stimulation.

Effector Organ	Sympathetic Response	Receptor	Excitatory or Inhibitory
A. Pupil of eye	Dilate	α_1	excitatory
B. Heart	inc. heart rate	β_1	excitatory
C. Lung	bronchodilation	β_2	Inhibitory
D. Intestine	G-I motility ↓	α_2	Inhibitory
E. Adipose tissue	↑ Fat metabolism	β_3	Excitatory
F. Sweat glands	↑ production	α	Excitatory

5/18 3. (18 points). A pharmaceutical company developed several drugs that interact with the transduction system of a hormone whose receptor is coupled to Gs. For the following, indicate whether the drug will increase (↑) or decrease (↓) the effects of the hormone, and which step is affected: Ab1

+1 A. Drug binds to the hormone binding site of the receptor, but doesn't activate it: Decrease

B. Drug inhibits the GTPase activity of Gs. Decrease

+1 C. Drug inhibits adenylyl cyclase. Decrease

+1 D. Drug inhibits Protein Kinase A. Decrease

+1 E. Drug inhibits cAMP phosphodiesterase. Increase

+1 F. Drug inhibits Protein phosphatases. Increase

4. (14 points) A young mother of a 2 month-old baby was brought to the ER in a coma after a car accident that caused a cerebral concussion. MRI showed the main problem was edema (swelling) and a small hemorrhage at the base of the brain. Fortunately, she recovered and was released apparently healthy. But a few days later she returned complaining of unquenchable thirst, frequent urination with large volumes, and noted that, although she had plenty of milk, her baby seemed to labor excessively while suckling her breast and nursing him took much longer than before the accident. Urinalysis showed no glucose in the urine. Blood tests showed she was dehydrated with elevated plasma osmolarity. ACTH, TSH, and Growth hormone levels were normal.

A. Name two hormones and their actions, so that their absence could account for all of the above symptoms:
 oxytocin - aids in milk let down, aids in uterus contraction in labor
 ADH/vasopressin - absorption of H₂O in kidney

B. What was damaged by the accident to cause the abnormalities? Posterior Pituitary

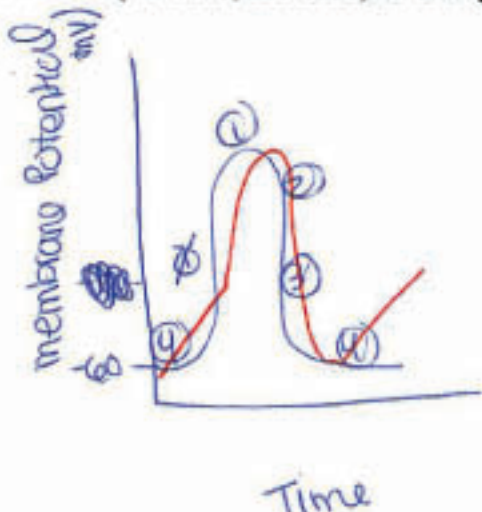
C. Was the hypothalamic-pituitary portal system damaged? (Yes or No, justify your answer):

NO, hypothalamus still releasing excitatory hormones to Post. Pituitary but Post. Pituitary not releasing to organs
 justifying that it wasn't damaged.

5. (12 points). For the following conditions in striated muscle, indicate if the myosin heads are bound to actin or free, what ligand(s), or none, are bound to or dissociating from myosin, and the value of the angle between the filaments and the crossbridges or, if it is changing, from what to what.

	Myosin-Actin	Myosin ligand(s)	Crossbridge angle
Relaxed State	bound	none	45°
Low ATP, High Ca ²⁺	bound ①	ADP + Pi ②	45° ②
During the "power stroke"	Free	ADP + Pi dissociating	90° - 45° ③

6. (12 points). A. Draw a plot of the membrane potential vs. time of a cell of the Sino-Atrial node during resting conditions. Indicate which ion channels are involved in the pacemaker potential, and in the rising portion, and the falling portion of the action potential.



- 1) Ca²⁺ enters cell
- 2) K⁺ channel open
- 3) K⁺ efflux
- 4) If channels (Na⁺/K⁺) to return to membrane potential -60mV

12

vagus nerve -> more K⁺ efflux -> hyperpolarization -> decrease heart rate

7. (12 points) Draw the electrocardiogram you expect (lead II) in a patient that suffered a lesion that killed all the cells of the S-A node. Indicate the correct letters corresponding to each wave and note any abnormal or missing waves, as well as whether the waves will be rhythmic or not, and any changes in their frequency in the ECG of this patient.

3rd degree block → no conduction

slow frequency



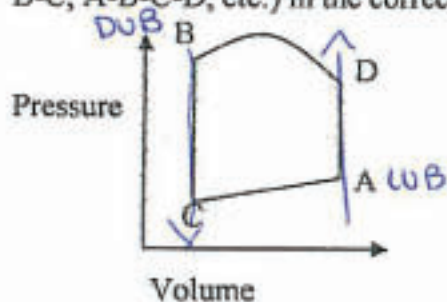
AV node needs SA node for rhythm

+6



QRS waves are more separated and don't necessarily follow the P waves, no rhythm, ↓ frequency of AP, AV node responding everytime receive stimulation not necessarily @ same time as ventricles

8. (14 points). Below is PV diagram of the left ventricle during one cardiac cycle. Fill in the blanks for the following events with either the single location (A, B, C, D) or the appropriate segment (B-A-D, B-C, A-B-C-D, etc.) in the correct sequence.



10

The correct sequence of a full cycle, starting with ventricular filling. C → A → D → B → C

A The first heart sound

B The second heart sound

~~B → C~~ The after-load

~~A → D~~ The pre-load

B → A The period when a murmur due to either stenosis of the mitral valve or incompetence of the aortic valve can be heard. ^(AV) Diastolic - 2nd and 1st heart sounds!

A → B The period when a murmur due to either stenosis of the aortic valve or incompetence of the mitral valve can be heard. Systolic - 1st + second heart sound

contractile

9. (12 points). List or diagram the transport systems that cause relaxation of myocardial cells; include the directions of transport, where are they located in the myocardial cells, and what are their energy requirements (i.e., primary or secondary active transport, energy source)? Be sure to specify stoichiometry when appropriate.

For relaxation, Need: to return Ca^{2+} to ECF, SR

- 1) Ca^{2+} leaks out through Ca^{2+} ATPases back to ECF (Primary Activation)
 - 2) Na^{+}/K^{+} ATPase (Primary) is moving Na^{+} out of SR creating a gradient, energy from Na^{+}/K^{+} ATPase powers the $3Na^{+}/Ca^{2+}$ antiporter that allows Ca^{2+} to be kicked out of cell. therefore \downarrow Tension = causing relaxation
- along membrane of cell
along SC membrane

GOOD THINKING AND GOOD LUCK!!!!