

Vertebrate Physiology 437 EXAM II NAME KEY, Lab Section (circle): am pm
19 October 2006. Exam is worth 100 points. You have 75 minutes.

True or False (write 'true' or 'false'; 6 points total; 1 point each)

1. True Chorionic gonadotropin is released by an implanted, fertilized egg. (or chorion more specifically)
2. True The number of muscle fibers per motor unit is greater in the biceps muscle as compared to the tongue muscle.
3. False Muscle develops the most power at the quickest muscle shortening velocity.
4. False The long action potential and prolonged muscular contraction in cardiac muscle is commonly known as the "latch state". (~40% smooth muscle)
5. True Steroid hormones are derived from cholesterol.
6. False Vasopressin works to rid terrestrial vertebrates of excess water.
↳ tends to help conserve water

Really Short Answer (maybe a few words or a sentence; 30 points total; 3 points each)

1. Distinguish between a pheromone and an autocrine hormone.

acts outside body,
often on conspecific

acts on cell that released

2. Assuming you know where you are starting from on a map, what three pieces of information do you need to keep track of in order to navigate by dead reckoning?

time
speed
direction

3. Describe where and how lipid-soluble hormones typically act as compared to a typical peptide hormone.

go into the cytoplasm and bind with intracellular receptor, often leading to alteration of gene activity

4. How does RU486 terminate human pregnancy?

binds to progesterone receptor acting as antagonist to stop the pregnancy-maintenance role of progesterone.

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KEY

5. Give an example of a bioassay discussed in class or in your text. Be sure to also include the general physiology behind the utility of the bioassay.

open; rabbit or frog utility as human pregnancy test likely answers

6. Give an example of a useful local cue that animals can use for navigation even in a novel setting. Be sure to briefly explain what is reliable about the cue.

open; could be salamander heading downhill (~toward water)
sea turtle hatchlings heading toward ~purple lights (=ocean)

7. Contrast the roles of myostatin and VEGF.

stops muscle growth/hypertrophy
vascular endothelial growth factor stimulates capillary proliferation in muscle to ↑ functional (~oxidative) capacity

8. Briefly contrast how insulin's role is altered in Type I and Type II Diabetes.

insulin no longer produced
insulin signal not responded to appropriately by cells

9. Explain how antagonistic muscles respond to the patellar tendon reflex.

(+) → quad contracts
hamstring relaxes
↓
1-a afferent from muscle spindle innervates α motor neurons to antagonistic muscles

10. List two hormones stimulated by the most common behavior (other than sleeping?) of a newborn joey. What is the behavior?

suckling/feeding
oxytocin
prolactin

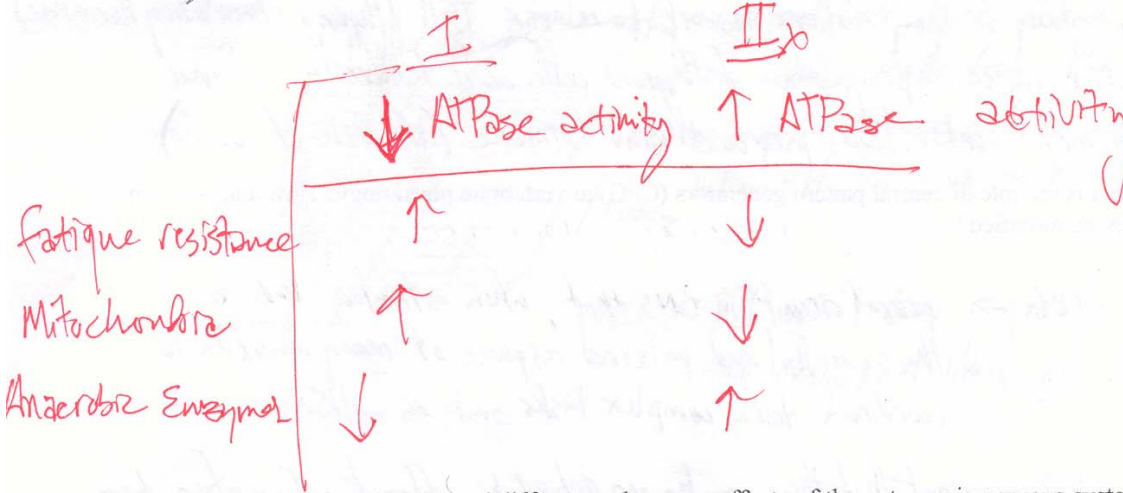
KEY

Short Answer (~ 2 or 3 sentence answers; 40 points total; 5 points each)

1. Describe differences in morphology, force production, and underlying physiology that distinguish between Type I (slow oxidative) and Type IIx (fast glycolytic) muscle fibers.

see text table 17.2 on p 480

5 total traits = 5 pts



2. Describe the similarities and differences between effects of the autonomic nervous system and the HPA axis in the stress response.

5 total = 5 pts

see fig 14.10 p. 404 in 11th ed. text

<u>diff</u>	<u>similarities</u>
sympathetic → fast (seconds)	norepinephrine & CRH
HPA → slower (~ 1 hr)	increase energy availability
	- metab. fast
	- release glucose from liver & muscles

3. Why account for phylogeny when doing research in comparative physiology? How does knowledge of phylogeny contribute to scientists' ability to predict physiological responses in unstudied vertebrate species?

② related spp that are well understood will allow informed predictions of related, but unstudied species

② not independent data points; need to account for relatedness

① for overall answer

also allows for recognition of substantial differences between related species that are likely attributable to the past action of natural selection

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4. Explain the mechanism by which a lack of iodine in the diet can lead to a goiter.

without iodine, thyroid hormone can't be made. If no thyroid hormone then no negative feedback on hypothalamus and anterior pituitary so they continue to work to release TSH (thyroid stimulating hormone) which causes upregulation of thyroid cells as it fruitlessly continues to make nonfunctional pseudo thyroid hormone (bc lack of iodine)

5. What is the role of central pattern generators (CPG) in vertebrate physiology? How and why can they be modified? 3 2

CPG → neural circuit in CNS that, when activated, leads to the sequential and patterned response of many muscles to coordinate fairly complex tasks such as walking.

it is important that they can be modified by afferent information from proprioceptors, muscle spindles, etc. to allow for slight changes in the pattern (for example walking over uneven terrain).

6. Contrast the following concepts: twitch summation, tetanus, and motor unit recruitment. How do some or all of these work together to allow sustained, submaximal muscular work? 2

twitch summation: 2 or more APs come to muscle close enough in time to lead to stronger contraction of that motor unit bc $[Ca^{2+}] \uparrow$

tetanus: maximal firing of motor unit such that $[Ca^{2+}]$ not the limiting factor, but rather speed of cross bridge cycling and ultimately fatigue.

motor unit recruitment: fire action potential to different or additional set of fibers. allows for \uparrow force production or alteration of working and resting fibers that allows for sustained, submaximal work.

7. In the context of cross-bridge cycling, explain 1) rigor mortis, and 2) how different myosin isoforms result in different muscle fiber-type properties. 2 2

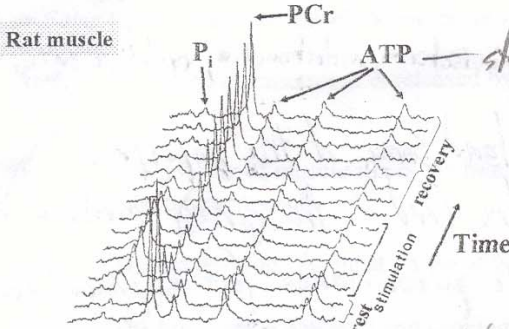
(overall)

1) rigor-mortis occurs when myosin head cannot detach from actin b/c no ATP available

2) different myosin isoforms result in diff speeds of contraction via the rate of ATPase activity (and \therefore rate of cocking of myosin head for use in shortening sarcomere). Diff myosin isoforms also associated w/ different oxidative capacities.

8. Explain what the following figure depicts about the roles of ATP, PCr and Pi in muscle contraction. Also, based on the data depicted, is this muscle fatigued? Why or why not?

³¹P-Magnetic Resonance Spectroscopy



Kushmerick & Meyer, 1985

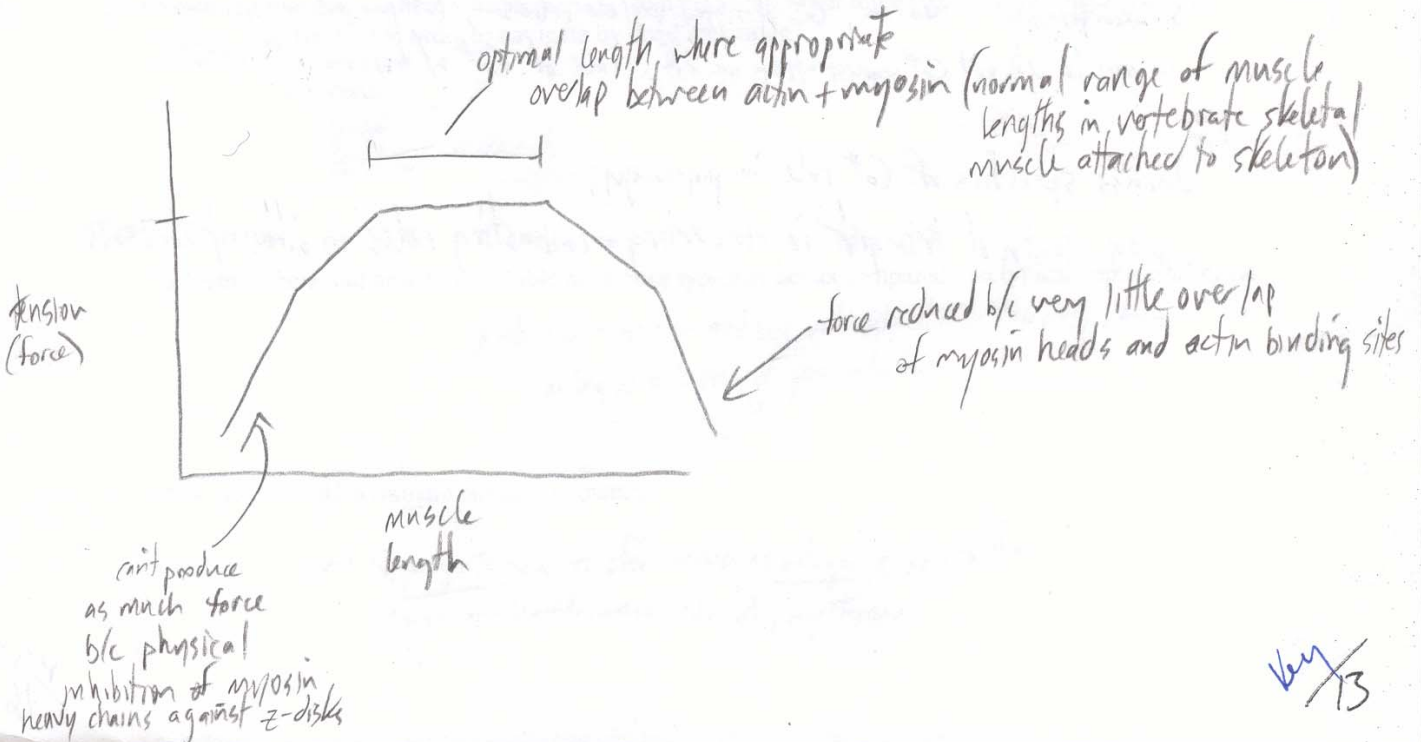
stays constant over short interval of stimulation b/c readily made from PCr. Pi is by-product of myosin ATPase activity and would lead to fatigue if built up to high enough []

b/c [ATP] didn't drop very much during stimulation this muscle was likely not fatigued

Long Answer (8 points each, 24 points total; ~a paragraph or two or an explained diagram).

- 1. Draw a graph that explains the length-tension relationship observed in vertebrate skeletal muscle. Be sure to label your axes and describe the underlying mechanisms that contribute to the shape of your graph.
- 2. Where on the graph is typical vertebrate muscle functioning? Why? Are there exceptions in vertebrates that you can think of?

→ chameleon tongues have muscles that can change length dramatically



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2. Based on the material you were asked to study for this exam, describe three possible gene therapies that you might expect to see athletes trying to use in the next decade or two. Why would they choose those different gene therapies? [What might be the side effects, if any? How would anti-doping agencies try to test for athletes abusing gene therapy?]

- very open (e.g. myosin isoform, mitochondria, oxidative enzymes, myoglobin)
- show that you understand some of the important proteins/molecules (and \therefore the genes) involved in variation in athletic performance (not exogenous additions)
- side effects and tests would further show your knowledge + understanding of physiology + mechanisms

3. You have just devised a new physiologically-active compound. Preliminary data suggest that the compound interferes with either a specific calcium binding site or with certain ATP-ases involved in maintaining calcium gradients across membranes. Using one vertebrate cell type, how could you study the hypothesized sites of activity of this new compound you have created and how would you test your various hypotheses based on your knowledge of vertebrate physiology? (the rationale and line of thinking is more important in your response than actual techniques or procedures)

Z binding site

Z ATPase

Z demonstrated understanding + rationale

- ~ axon terminal in neuron, Ca^{2+} mediated vesicle release, Ca^{2+} pumped out of terminal
- ~ muscle cell and Ca^{2+} sequestration in SR, role of Ca^{2+} w/ troponin + contraction

discuss specifics of Ca^{2+} role in physiology.

display clarity of thought in elucidating + contrasting roles in different contexts