Kevin Oh grade p. 1, 2
KEB " p 3, 4

N=28 (2 took day before)

mean ~77%

Vertebrate Physiology 437 EXAM III NAME KEY, Lab Section (circle): 1pm 3pm
11 April 2008. Exam is worth 100 points. You have 50 minutes.

True or False **(1.5 points each, 9 points total)**

1. True Calcium ions are most responsible for the long plateau period of cardiac muscle cell action potentials.
2. False Stroke volume leaving the heart is halved if the time the heart is in systole is halved. diastole

bad

3. True The functional unit of the kidney is called the nephron.
4. False Activation of the sympathetic nervous system (fight or flight response) will recruit more cardiac muscle fibers to contract during each beat of the heart.
5. False Angiotensin converting enzyme (ACE) is released in the lungs to convert circulating aldosterone to anti-diuretic hormone (ADH).
6. True All else being equal, if the diameter of the afferent arteriole entering each nephron is vasoconstricted then urine production will go down.

Shorter Answer **(maybe a few words or a sentence; 28 points total; 4 points each)**

1. What is the local effect of NO (nitrous oxide) on the vertebrate circulatory system?
   vasodilation (of afferent arterioles entering capillary beds) (via cGMP intermediate)
2. Mechanistically, how do sharks have plasma that is slightly hyperosmotic to sea water, but with much lower salt (NaCl) concentrations?
   sharks regulate Na^+ and Cl^- ions rather closely and increase their plasma osmolality with urea (and TMAO)
3. Explain how two different ion permeabilities could be changed to make the heart rate speed up. Where would this change in permeability need to take place?
   SA node → ↑Na^+, ↑Ca^{++}, ↓K^+, ↓Cl^-
4. With respect to the ability to form urine of high osmotic potential, what is important about the countercurrent vasa recta system in the kidney?
   keeps the blood from abolishing the osmotic gradient in the medulla
   eg. 300 mOsm → 1200 mOsm; 300 mOsm ← 1200 mOsm
5. As described in lecture, what are the three ways animals can get water from the environment?
   free, preformed, metabolic
6. What is the atrial kick? Do you need it? Why or why not?
   last filling of ventricle when atria contract
   don't need it because ventricles are ≥90% filled before atria contract
7. How can a cardiac shunt be useful for thermoregulation?
   e.g. TC→L sends more blood to periphery, bypassing the lungs, to facilitate heat exchange between animal and its environment

oh key

37

Short Answer **(~2 or 3 sentence answers; 63 points total; 9 points each)**

1. What is different about diving-mammal physiology that allows them to feed hundreds of meters below the sea surface for up to an hour or more?

fairly open, but give us @ least three explained solutions

↑ blood volume, ↑↑ myoglobin content, ↑ RBC percentage, bradycardia
exhalation before diving
RBC reservoir in spleen
regional vasoconstriction, maintaining blood for heart + head
tolerance of anaerobic metabolism and lactic acid ↑ in muscle beds

2. Explain how bulk flow relates to the lymph system and to the lower pressure in the pulmonary circuit as compared to the systemic circuit.

Bulk flow out of the capillaries means that the plasma is losing fluid during circulation and the interstitial fluid proportion is increasing. One important role of the lymph system is to gather the excess fluid in a system of vessels w/ valves and return the fluid to the right atrium. In the capillaries, fluid is lost from the plasma b/c filtration > uptake as go from afferent to efferent end of capillary
Minimizing bulk flow, via decreased pulmonary circuit pressures is important so that the plasma is not forced into the alveoli thereby decreasing oxygen diffusion rates into the body

3. If you traced a glucose molecule dissolved in the plasma as it went from the right atrium into the Bowman's capsule and back to the right atrium, what valves, capillary beds, and epithelial layers would it have to go through to make the entire journey? (You can assume that you don't have to drink the glucose to get it back into your system once it gets into the Bowman's capsule).

RA → R-AV (tricuspid) valve → RV → pulmonary semilunar valve → pulmonary artery → pulmonary capillaries → pulmonary vein → LA → L-AV valve (bicuspid) → LV → aortic semilunar valve → aorta → arteries, arterioles → afferent arteriole to nephron → capillaries of the glomerulus → across capillary endothelium, across endothelium of Bowman's capsule → into proximal tubule → out across tubule endothelium + capillary endothelium via glucose/Na^+ symporter → venule of vasa recta → veins → vena cava → RA

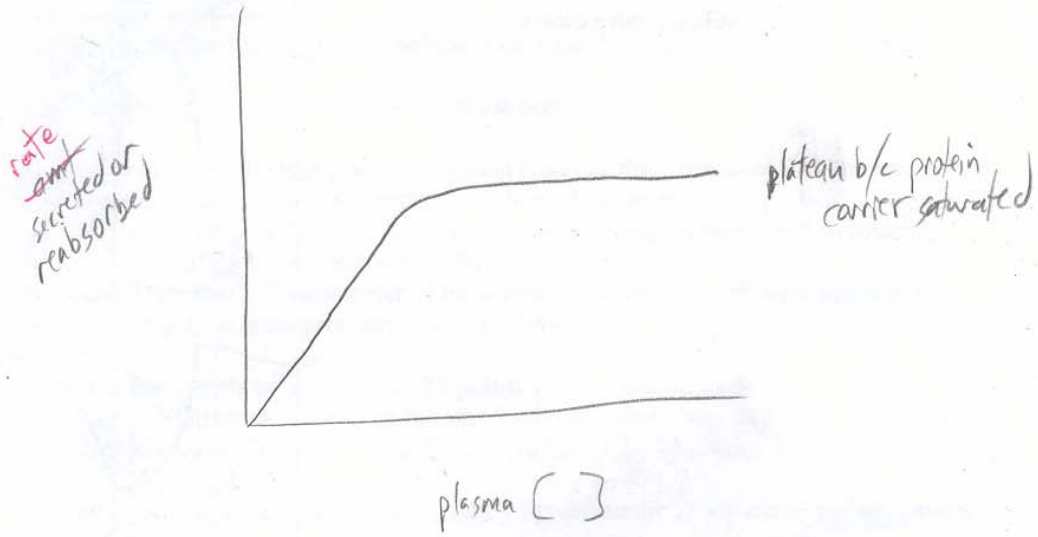
or

Key

/27

Key

4. Draw a graph, with labeled axes, that either illustrates the secretion of phenol red from the blood as the concentration of phenol red in the plasma increases, or illustrates the reabsorption of glucose from filtrate in the proximal tubule as the concentration of glucose in the plasma increases.



5. Contrast the vessels of the venous system with those of the arterial system. (Please describe three differences.)

musculature
elasticity
compliance
role in pressure/volume reservoir
valves
sympathetic/parasympathetic control
pressure
O_2 content
etc.

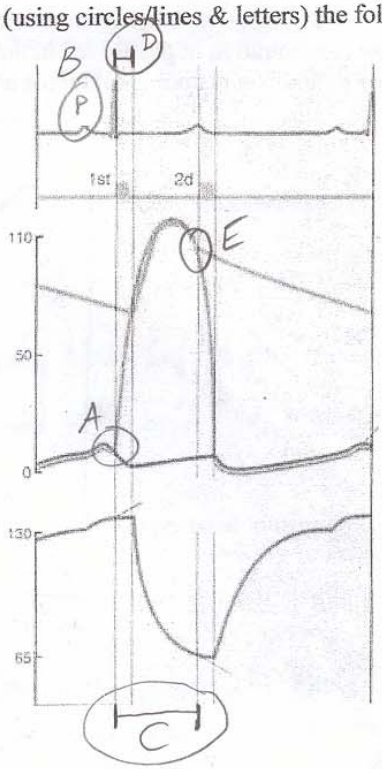
KEB key

18

Key

6. On the Wigger's Diagram to the right, clearly indicate (using circles/lines & letters) the following:

   a. AV valve closes (pressure curves cross)
   b. P wave of the electrocardiogram
   c. systole
   d. isometric contraction of ventricular muscle
   e. aortic semilunar valve closes



7. Explain three ways that the juxtaglomerular apparatus can have an effect on filtration rates.

1.† Macula densa cells of distal tubule can secrete paracrine hormones to "tell" afferent arteriole to glomerulus to vaso dilate/vasoconstrict based on flow rate + concentration sensed in distal tubule.

2.† Granular cells lining outside of afferent arteriole can secrete renin in response to too much incoming blood flow (and ∴ filtration ↑), renin leads to ↑ aldosterone and ↑ ADH by triggering Angiotensinogen → Angiotensin I (then ACE from lung takes Angiotensin I → II which ↑ aldosterone and ADH)

Ken 18

Bonus (2 points): Why are estimates of water loss rates in small, burrowing, desert rodents more prone to error than the same measurements on a camel or an oryx? Assume you have no trouble finding any of your study animals or getting repeat measurements of bodily fluids.

desert rodents in burrows will exhale + inhale some water, complicates measurement of loss