Human Physiology Test 2 2015

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| 1. | (3 Pts) In the equation CO2 + H2O = H2CO3 = HCO3- + H+, by the law of mass action, decreasing the amount of CO2 (carbon dioxide) will increase/decrease (**circle correct answer**) the amount of H+ by driving the reaction to the left/right (**circle correct answer**) causing pH to increase/decrease (**circle correct answer**). |

2. (3 Pts) A trained aerobic athlete differs from a “couch potato”(untrained person) in that the “couch potato” has a higher/lower heart rate at rest, and a higher/lower cardiac output during exercise, due to a higher/lower stroke volume.

3. (3 points) If the radius of a blood vessel is increased 2-fold, the rate of blood flow (liters/min) in the vessel would increase/decrease (circle correct choice) \_16\_\_\_\_ - fold.

4. (3 Points) vasoconstriction of arteriols leading to metabolically active tissue occurs when

A)Oxygen levels in the tissue increase

B)Oxygen levels in the tissue decrease

C) CO2 levels in the tissue increase

5. (3 Points) Jane donates a pint of blood to a blood bank. A few minutes later, which of the following would be *increased* compared to the pre-donation values?

A) her red blood cell count and total peripheral resistance

B) her heart rate and total peripheral resistance

C) her heart rate and red blood cell count

D) the percentage of her cardiac output flowing to her kidneys

E) blood flow to her brain

6. (3 Points) Aldosterone increases the

1. Opening of water channels in the proximal tubule
2. Opening of water channels in the collecting duct
3. Transcription of mRNA encoding antiporters and ATPases involved in reabsorbing Na+
4. Transcription of mRNA encoding antiporters and ATPases involved in secreting Na+

7A. (2 points) Regulation of potassium reabsorbance occurs primarily in the

1. Proximal tubule
2. Distal tubule
3. Collection duct

7B. (1 point) Is this also where the most potassium is reabsorbed? (Yes/No) \_\_\_\_ of 21 pts

8. (6 points) The **2** factors most critical to the production of a highly concentrated urine are (**circle 2 answers**)

A) increase plasma levels of vasopressin (ADH)

B) rate of transport of sodium in the ascending limb by the Na/K ATPase

C) formation of a high medullar osmotic concentration

D) elevated levels of rennin

9. (3 points) Critical components to the loop of Henle’s function include

A) the ascending loop being permeable to water and containing Na/K ATPase pumps

B) the ascending loop being not permeable to water and containing Na/K ATPase pumps

C) the descending loop being not permeable to water and not containing Na/K ATPase pumps

D) the ascending loop being not permeable to water and not containing Na/K ATPase pumps

10. (3 points) A decrease in ECF osmolarity would cause osmoreceptor cells

A) to increase in size, increasing ADH production and opening renal water channels

B) to shrink in size, decreasing ADH production and opening renal water channels

C) to increase in size, decreasing ADH production and closing renal water channels

D) to shrink in size, increasing ADH production and opening renal water channels

1. (3 points) ADH (vasopressin) regulates Na concentration/Na amount (**circle correct answer**).
2. (3 points) If a substance is filtered from the blood in the glomerulus, it might be excreted from the body. True or False?
3. (3 points) Nitric oxide released by the macula densa causes the
4. Afferent renal arteriole to dilate, increasing hydrostatic pressure in the glomerulus which increases glomerular filtration rate (GFR).
5. Efferent renal arteriole to dilate, decreasing hydrostatic pressure in the glomerulus which increases GFR
6. Efferent arteriole to dilate, increasing hydrostatic pressure in the glomerulus which decreases GFR.
7. Afferent arteriole to dilate, decreasing hydrostatic pressure in the glomerulus which increases GFR.
8. (3 points) In the kidney the amount of a substance excreted from the body
9. = amount secreted – amount filtered + amount reabsorbed
10. = amount filtered + amount secreted – amount reabsorbed
11. = amount filtered + amount secreted + amount reabsorbed
12. = amount filtered - amount secreted + amount reabsorbed
13. (3 points) When the filtered load of glucose is greater than glucose’s tubular maximum transport rate

A) glucose will be excreted from the body

B) glucose will be secreted into the tubule

C) glucose will not be excreted from the body

D) glucose will not be converted to ATP \_\_\_\_\_ of 27 points

16. (3 points) Sodium is reabsorbed from the proximal tubule by following the osmotic gradient established by the reabsorption of sodium. True or False?

17. (3 points) When cardiac output is equal to zero, mean circulatory filling pressure (MCFP) is equal to right atrial pressure. True or False?

18. (3 points) Long term regulation of blood pressure is maintained by adjusting total peripheral resistance. True or False?

19. (3 points) If the renal artery is clamped, reducing arterial pressure to 40 mmHg, glomerulus filtration rate will increase/decrease/remain the same (**circle correct answer**)?

20 A. (3 points) A patient comes to the emergency room with a respiratory problem that increases the alveolar ventilation rate to higher than normal (increased gas exchange between body and atmosphere). What is the consequence to the pH of the blood?

pH increases.

20 B. (3 points) What is this acid/base condition called?

Respiratory alkalosis.

20 C. (4 points) How would the kidney compensate for this condition?

Any of the following are acceptable: Reabsorb H+, excrete bicarbonate, excrete a more basic urine, as these are all compensatory mechanisms.

20 D. (3 points) Does this solve the initial medical problem? No

21 A. 3 pts. The circulatory system is made up two types of blood vessels. The \_\_\_veins\_\_\_\_\_ are about \_\_\_21\_\_ times more compliant than the \_\_arteries\_\_\_\_\_\_\_\_.

21 B. 2 pts. What is the mathematical relationship between pressure, volume and compliance?

compliance = volume/pressure

21 C. 3 pts. Which one of the blood vessels types would increase in volume the most for a given increase in pressure? Veins

\_\_\_\_ of 33 pts

22. (6 points) Calculate the concentration of H2CO3 (or CO2) required to temporarily restore pH to near normal levels, i.e. 7.35, during metabolic acidosis. The concentration of bicarbonate has dropped to 20 mM/L due to binding with excess hydrogen ions.

**=**

**+**

**log**

**HCO3**

**-**

**H2CO3**

**pH**

**H2O**

**CO2**

**6.1**

7.35 = 6.1 + log (20/X)

1.25 = log (20/x)

17.782 = 20/x

X= 1.1 mM/L

23 A. (3 points) The body eliminates excess salt faster/slower (**circle correct answer**) than excess water.

23 B. (4 points) Explain.

The elimination of water is mediated by the ADH system which is faster than the system that regulates salt amounts, aldosterone system. The aldosterone system has many more steps including up-regulation of mRNA synthesis while ADH directly opens water channels in the kidney.

24 (6 pts) A new drug is tested in patients. To help determine how much should be given, we wish to determine how long it remains in the body, i.e. the drug’s clearance rate. Given a measured rate of urine production of 15 ml/min, the concentration of the drug in the urine is 500 mM/L and the amount in the plasma is 50 mM/L, what is the drug’s clearance? Given a GFR of 125 ml/min, is this drug being reabsorbed back into the blood from the tubule, secreted from the peritubular capillaries into the tubules or neither?

Clearance = (UD X Urine production)/PlasmaD

= (500 mM/L X 15 ml/min)/50 mM/L

= 150 ml/min (4 points)

This is greater than GFR, so the drug must be being secreted.

\_\_\_\_ of 19 pts

Bonus:

1. (3 points) Explain how a combination of a high salt diet and poor kidney function causes chronic high blood pressure.

If more salt is consumed than the kidney can eliminate or the kidney is not functioning well so it can not eliminate salt, then salt will build up in the plasma and ECF. This will draw water out of the kidney tubule making it harder to eliminate water. Plus, the high salt in the plasma increases ECF concentration which increases water retention as osmoreceptors sense the increased osmolarity of the extracellular fluid. This increases ADH and opens more water channels in the kidney leading to higher blood volume. Higher blood volume increases venous return, increasing cardiac output causing increased blood pressure. Normally, salt concentrations are well regulated by the kidney through the aldosterone system, but if the kidney is not functioning properly, it will not be able to get rid of the excess salt and water.

1. (3 pts)**.** How is the Australian Hopping Mouse able to produce a concentrated urine of 10,000 mOsm/L? What structure in the kidney is changed to enable the mouse to accomplish this?

By increasing the osmotic concentration of the medulla and/or increasing ADH secretion. Th structure that is changed is the loop of Henle. Its size (depth) is increased and this enables a greater counter-current multiplier effect leading to the increased osmolarity in the Medulla.

\_\_\_\_\_\_ of 6 bonus points