BMED 3100: Systems Physiology
Test 5, April 6, 2009

_____
Last Name

Honor Pledge
All students are required, when requested, to attach the following statement to any material turned in for a grade in any course at Georgia Institute of Technology:
On my honor, I pledge that I have neither given nor received inappropriate aid in the preparation of this assignment.

_____KEY_____
Signature

_____
Name (Printed)

Be brief in your answers.

Write clearly.

Backs of pages will not be graded.

Calculators must be kept on the ledge unless being used.

Closed book and notes.

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Multiple Choice: Write the *best* answer on the line to the right. (2 pts each)

1. Each of the following substances is initially present in proximal tubular fluid in the kidney. Which one is *not* normally present in urine? ___E___

A. calcium ion
B. hydrogen ion
C. potassium ion
D. phosphate ion
E. glucose

2. Which of the following statements regarding glomerular filtration is correct? ___A___

A. It will occur when the hydrostatic pressure in the glomerulus exceeds the sum of the fluid pressure in the capsule plus the osmotic force due to proteins in the plasma.
B. GFR is increased by sympathetic stimulation of afferent glomerular arterioles.
C. GFR increases in response to decreasing plasma volume.
D. Both A and B are correct.
E. Both A and C are correct.

3. Changes in *intracellular fluid volume* occur in response to changes in: ____D____

A. isosmotic changes in extracellular fluid volume
B. intracellular fluid osmolarity
C. urine output volume
D. extracellular fluid osmolarity
E. vasopression secretion

4. Formation of a highly concentrated urine is dependent upon ____D____

A. elevated levels of vasopressin in the plasma.
B. elevated levels of aldosterone in the plasma.
C. active transport of Na^+ and Cl^- by the descending limb of the loops of Henle.
D. elevated levels of vasopressin and elevated levels of aldosterone in the plasma.
E. All of the choices are correct.

5 Gastrointestinal function depends upon each of the following processes except ____B____

A. digestion.
B. filtration.
C. secretion.
D. motility.
E. absorption.

6. Which of the following statements about neural control of digestion is *not* true? ____D____

A. Parasympathetic stimulation is excitatory to digestion.
B. Sympathetic stimulation is generally inhibitory to digestion.
C. Local nerve networks (nerve plexuses) stimulate digestive functions.
D. Under normal circumstances, nerve plexuses regulate digestion without input from the autonomic nervous system.
E. None of the choices are correct.

7. What are the two types of motility in the GI tract? (2 pts)

1) Segmental (circumferential OK)
2) Peristaltic

8. What are the three phases of digestion? (3 pts)

3) Cephalic
4) Gastric
5) Instestinal

10. What is the cause of most stomach ulcers? (2 pts)

Bacterial infection (Helicobacter pylori to be specific – name of bacterium not necessary)

11. What are the mechanisms of action of the two major classes of over-the-counter anti-acid / anti-reflux medications? (4 pts)

1) Histamine receptor inhibition
2) Na^+/K^+ ATPase pump inhibition

12. What is the effect of histamine release (with respect to an inflammatory response? (4 pts)

An inflammatory response mediated by mast cells that lead to increased vascular permeability and protein infiltration.
(Also, leads to redness, swelling, pain)

13. (2 pts each):
Antibodies bind to ____antigens_____.

The first responding cell in the inflammatory response neutrophil (a type of leukocyte)_____.

An example of a pathogen is ____bacterium or virus or other living infectious agent_____.

Most absorption of digested food takes place in the ____small intestine_____.

The mixture of digested food is called ____chyme_____.

14. Consider an individual who develops a pathology that results in a more than normal leaky glomerulus. Predict the changes (increase / decrease / no change) that will be present in the following parameters as a consequence of this pathology (24 pts)

Parameter	Predicted change	Reason
Plasma protein concentration	decrease	With a leaky glomerulus, plasma proteins will be filtered into Bowman's capsule. These proteins will then be excreted and lost from the body.
Plasma colloid osmotic pressure	decrease	The decreased concentration of plasma proteins lowers the plasma oncotic pressure.
Total body sodium	increase	There will be an increase in filtrate osmolarity and an increase in Na reabsorption. Since the fluid entering the interstitial space contains Na; the accumulation of water in the tissues (edema) will result in an accumulation of Na and increased total body Na.
GFR	increase	A leaky glomerulus will lead to an increase in GFR, since more solutes, proteins, and fluid will enter Bowman's capsule.
Plasma volume	decrease	There will be increased filtration of water out of the vascular compartment into the interstitial compartment, which has two consequences: 1) the plasma volume will be decreased, and 2) the volume of fluid in the interstitial compartment will be increased.
Interstitial fluid volume	increase	Therefore, there will be increased filtration of water out of the vascular compartment into the interstitial compartment, which has two consequences: 1) the plasma volume will be decreased, and 2) the volume of fluid in the interstitial compartment will be increased.

15. If 1 liter of a 3.5% NaCl solution is infused intravenously into a 80 kg man, what will be the intracellular and extracellular fluid volumes and osmolarities after osmotic equilibrium. Assume the initial plasma osmolarity is 280 mOsM and that there is no excretion or other fluid loss (25 pts)

Initial conditions:
Initial TBW = 80 kg x .6 = 48 kg or 48 L water
Initial ICF volume = 100 kg x 0.4 = 32 kg or 32 L water
Initial ECF volume = 100 kg x 0.2 = 16 kg or 16 L water

Initial Total body osmoles = 48 kg x 280 mOsm/kg = 13440 mOsm
Initial ICF osmoles = 32 kg x 280 mOsm/kg = 8960 mOsm
Initial ECF osmoles = 16 kg x 280 mOsm/kg = 4480 mOsm

Calculate the total mOsmoles added to the ECF in 1 L of 3.5% NaCl:

3.5% solution of NaCl → 3.5 g/100mL; MW of NaCl ≈58 g/mol ⇒ 0.603 mol / L (1.206 osmoles) For 1 L ⇒ 1206 mosmoles NaCl added to the ECF

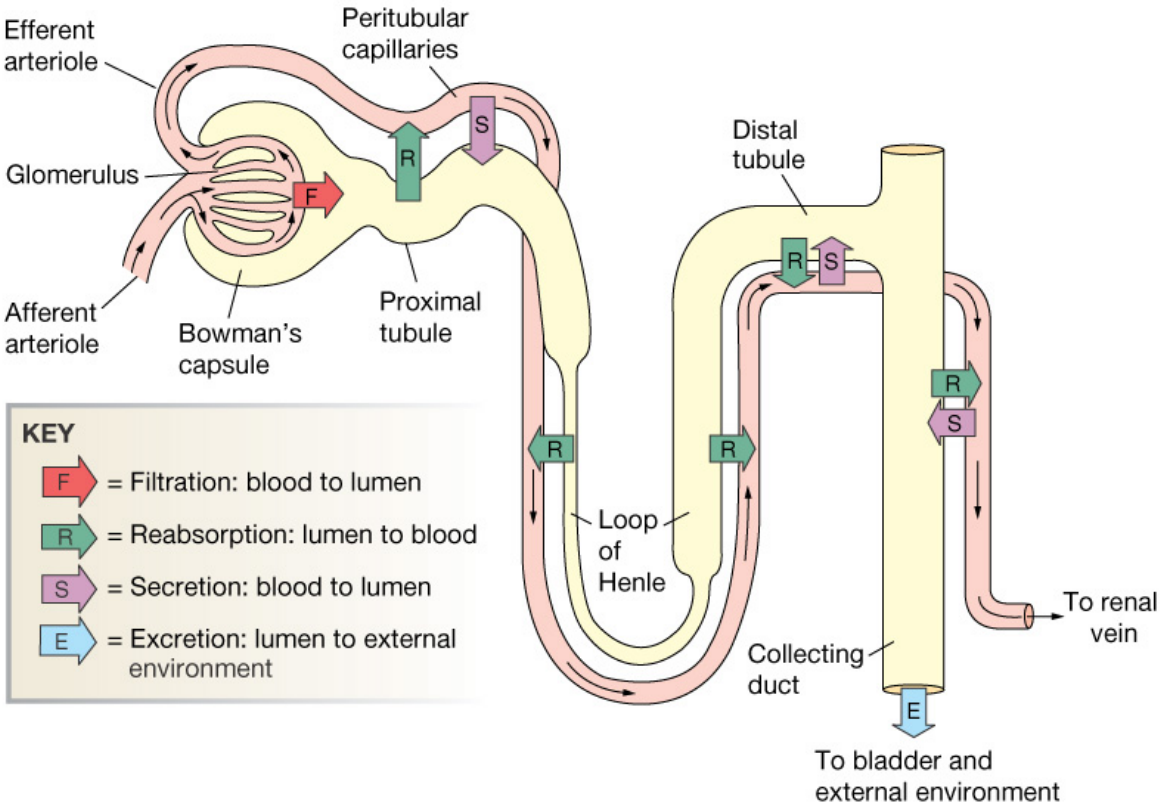
Instantaneous effect of adding 1206 mosmoles to 4480 mosmoles
Total of 5686 mosmoles in 17 L yields 334.5 mOsm/L

At osmotic equilibrium, water should shift from the intracellular space to the extracellular space. Assume solutes do not move between compartments.
Final TBW = 48 L + 1 L = 49 L
New osmolality = 5686+8960 = 14646 mOsm/49 kg water = **298.9 mOsM in ECF and ICF**
ECF Volume = (ECF osmoles)/(new ECF osmolality)
5686 mOsm/(298.9 mOsm/kg water) = **19 L**
ICF Volume = (ICF osmoles)/(new ICF osmolality)
8960 mOsm/(298.9 mOsm/kg water) = **30 L**

As a check, 19L + 30L = 49 L

16. For # 15, what is the kidney's response at the level of the nephron? (14 pts)

There is no excretion, but since osmolarity is increased overall, the nephron will conserve water in order to help bring total body osmolarity down. Blood pressure will increase slightly since blood volume in increased, which may increase glomerular filtration rate (but not much). Sodium reabsorption will decrease, therefore there will be less aldosterone released and a higher osmolarity in the filtrate. More water reabsorption via vasopression release (from hypothalamic osmoreceptors) will also increase filtrate osmolarity and ultimately urine osmolarity.



Questions	Possible points	Points correct
p. 1	12	
p. 2	25	
p. 3	24	
p. 4	25	
p. 5	14	
TOTAL	100	