BMED 3100: Systems Physiology
Test 4, March 13, 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.

No calculators.

Closed book and notes.

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

1. Which of the following hormones originates in the anterior pituitary +2 (none are correct)
   A. dopamine
   B. growth hormone-releasing hormone (GHRH)
   C. somatostatin
   D. gonadotropin-releasing hormone (GnRH)
   E. oxytocin

2. All of the following are considered classic endocrine glands *except.* **D**
   A. pancreas
   B. thyroid gland
   C. adrenal gland
   D. hypothalamus
   E. pituitary gland

3. Neurohormones **D**
   A. can travel either from neuron to neuron or through the blood.
   B. includes epinephrine
   C. include anterior pituitary hormones
   D. include posterior pituitary hormones
   E. primarily act direct on neurons

4. The hypothalamic-hypophyseal portal system **A**
   A. goes between the hypothalamus and the anterior pituitary gland.
   B. goes between the hypothalamus and the posterior pituitary gland.
   C. goes between the hypothalamus and the thalamus.
   D. serves to distribute dilute hormones to the systemic circulation.
   E. brings hormones directly to their target.

5. Some hormones are transported in plasma bound to proteins.
   These proteins function to **D**
   A. maintain a stable high concentration of the hormone in the plasma and reduce its clearance rate from plasma.
   B. reduce the binding of the hormone to its receptors in some cases.
   C. make the hormone more soluble in aqueous plasma.
   D. do all of these things.
   E. do none of these things.

6. Blood pressure is sensed by the following structure(s) **C**
   A. arterioles
   B. left ventricle
   C. baroreceptor
   D. nociceptor
   E. aorta

7. Consider the equation $Q = \Delta P/R$. The equation indicates that **B**
   A. the flow of fluid in a tube depends upon the absolute pressure at the beginning of the tube.
   B. the flow of fluid from point A to point B in a tube depends upon the difference in pressure between A and B.
   C. the greater the resistance to flow in a tube, the greater the flow for any given pressure difference.
   D. Both A and C are correct.
   E. Both B and C are correct.

8. Which of the following changes would most *increase* the resistance to blood flow in a blood vessel? **A**
   A. halving the diameter of the vessel
   B. doubling the diameter of the vessel
   C. halving the length of the vessel
   D. doubling the length of the vessel
   E. decreasing the hematocrit from 50% to 40%

9. Explain your answer in #8 using the governing equation and example values. (6 pts)

Poiseuille's Law:
$R=8L\eta/\pi r^4$

Values are relative for changes in r – use of a constant is OK

10. **List**, in order, and without neural stimulation, the electrical events in the heart that cause contraction. Include the cellular events throughout, the regions of the heart that are involved, and the contractile mechanisms. (10 pts)

SA node
- Autorythmic cells: spontaneously fire action potential, unstable resting membrane potential due to I_f Na channels, action potential shape is narrow (Na and K are ions involved)

Internodal pathways – throughout right atrium
AV node (delay)
AV bundle / Bundle of His / bundle fibers
Purkinje fibers – reach ventricles
Ventricular contractile cardiac muscle cells
- Connected mechanically and electrically. Na influx, followed by Ca influx, followed by K efflux. Contraction takes place when calcium enters the cells, causes calcium release from the sarcoplasmic reticulum (calcium spark), Ca binds to troponin, which moves tropomyosin from myosin head binding sites on actin, the power stroke then occurs by an ATP-dependent mechanism in which myosin heads move actin polymers closer together, causing contraction…….

11. Name the two classes of amine hormones, give one example of each, and describe the 1-synthesis, 2-storage, 3-transport, and 4-cellular mechanism of action for each (12 pts)

Amine hormone class	Hormone example	Synthesis	Storage	Transport	Cellular mechanism of action
Catechol-amine	Dopamine	Nucleus→ Rough ER / Golgi	Vesicles (release is through Ca-dependent exocytosis)	Free in blood	Second messengers / activation of enzymes
Thyroid hormone	Tyroxine (T_4)	Nucleus → Smooth ER	No storage (release is through diffusion)	Protein carriers in blood	Intracellular (cytosolic / nuclear) receptors, transcription

12. The following pertain to the left side of the heart. Fill in the blank with the most relevant answer. (2 pts each)

a) At the beginning of isovolumetric contraction of the left ventricle the ___mitral / bicuspid___ valve is closed.
b) At the end of isovolumetric contraction of the left ventricle the _aortic _____valve is open.
c) At the beginning of left atrial contraction, the _____mitral / bicuspid _____ valve is open.

13. The following pertain to the right side of the heart. Fill in the blank with the most relevant answer. (2 pts each)

a) During right ventricular contraction first the ___tricuspid_____valve closes, and then the ___pulmonary _____valve opens.

b) The right atrium receives blood from the ___vena cavae (inferior and superior)_____

c) The right ventricle receives blood from the _____right atrium_____.

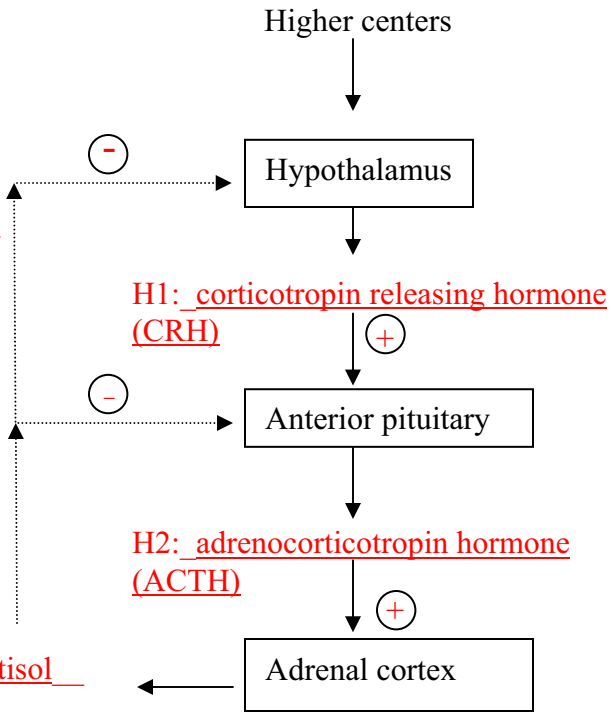
14. The below control diagram represents the HPA axis (hypothalamus-pituitary-adrenal axis).
    a) fill in the correct hormone for H1, H2, H3 on the line provided (6 pts)
    b) fill in either + or – in each of the circle to indicate the direction of the action (4 pts)
    c) what does the release of H3 do to the system? (4 pts)
    d) The dexamethasone suppression test is based on the ability of dexamethason (a synthetic glucocorticoid) to inhibit the secretion of H2. You are able to measure the levels of H3 in the blood.
        i. What happens to H3 levels in a normal person who undergoes the dexamethasone suppression test? (3pts)
        ii. If H3 levels are not affected when a person has a dexamethasone suppression test, what is likely wrong? (3 pts)

c) H3 reduces the amount of H1 and H2 produced in a negative feedback mechanism

d) i) H3 levels will be reduced, since H2 is reduced

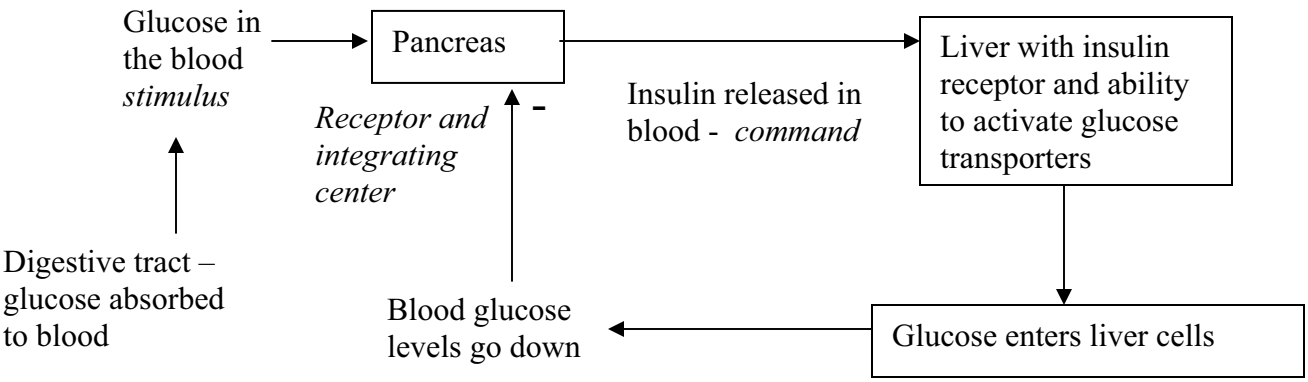
ii) There is likely a tumor in the anterior pituitary

(possible interpretation from information given That there is an adrenal tumor)



15. Consider a molecule of glucose that travels from the digestive tract to a cell in the liver. Draw a control diagram that accounts for the endocrine response that allows the glucose to enter the liver cell. (8 pts)

italics comments not necessary for full credit



16. Calculate the resistance through the following four body regions: 1-brain (1.5 L/min); 2-thorasic (1.0 L/min); 3-abdominal/pelvic (2.0 L/min); 4-lower extremities (0.5 L/min). Assume systolic BP is 130 mm Hg; diastolic BP is 70 mm Hg; venous pressure at heart is 10 mm Hg. (10 pts).

MAP = 70 mmHg + 1/3 (130 - 70 mmHg) = 90 mmHg
P_{venous} = 10 mmHg

} ΔP across CVS = 80 mmHg

1 – Brain → R = 80 mmHg / 1.5L/min = 53 mmHg*min/L

2 – Thorasic → R = 80 mmHg / 1 L/min = 80 mmHg*min/L

3 – Abdominal / pelvic → R = 80 mmHg / 2 L/min = 40 mmHg*min/L

4 – Lower extremities → R = 80 mmHg / 0.5 L/min = 160 mmHg*min/L

17. Using the values in 16 as appropriate, answer the following. If there is a stroke in the brain that reduces the overall cerebral blood vasculature diameter by 5% and the flow by 1/3, what is the relative change in blood velocity throughout the brain? (4 pts)

$V = Q / A$

$Q_{infarct} = 1/3 * 1.5L/min = 1.0$ L/min

$A = \pi (D/2)^{1/2}$

$A_{infarct} = \pi (0.95D/2)^{1/2}$

$A_{infarct} = 0.97 A$

$V_{normal} - V_{infarct} =$ 1.5-1.03 /1.5 → There is a 31% drop in velocity

Questions	Possible points	Points correct
p. 1	12	
p. 2	20	
p. 3	26	
p. 4	28	
p. 5	14	
TOTAL	100	