"I pledge my honor that I have abided by the Stevens Honor System."

Name: ____________________________  Date: ___________________

Ch 382-Biological Systems Exam #2 - Dr. N. M. Kumbaraci  March 10, 2008

Short answers:
1. Name the general chemical classes of hormones. Give an example of each.
   - Amino - based on tyrosine; Epinephrine
   - Peptide - insulin
   - Steroid - testosterone; based on cholesterol

2. If all the neural connections between the hypothalamus and pituitary were severed, the secretion of which pituitary hormones would be affected? List and give your reasoning.
   - Many hormones would be affected.
   - GnRH → FSH/LH
   - CRH → ACTH
   - The reason for these being affected is because they rely on the release of hypothalamic proteins to be secreted.
   - Without these, the hormones would not be produced.
   - The hypothalamus would still be in place; however, the pituitary gland would still work.

3. Calculate the mean arterial blood pressure of a person whose systolic blood pressure is 140 mm Hg and pulse pressure is 60 mmHg.
   \[ \text{MAP} = 80 + \frac{1}{3}(140 - 80) = 100 \text{ mmHg} \]
   - \[ \text{MAP} = \text{Diastolic} + \frac{1}{3}(\text{Systolic} - \text{Diastolic}) \]
   - \[ 60 + \frac{1}{3}(140 - 60) = 86.7 \text{ mmHg} \]

4. A person is accumulating edema throughout the body. If the average capillary hydrostatic pressure is found to be 30 mmHg, what is the possible cause? Explain by describing the forces that are involved in the regulation of fluid movement across capillaries.
   \[ \text{NFP} = P_c + \pi_{IF} - P_{IF} - \pi_c \]
   - If one is accumulating edema throughout the body, that means they are accumulating fluid in their interstitial fluid. There are a few possibilities. First, they could have a high concentration of solutes in their tissues which are not being finished from the tissue. This difference in their tissues could be very high, if this was the case, fluid could be pushed through the capillaries; if they were very high, if this was the case, fluid could be pushed through the capillaries. Additionally, if the capillary fluid is higher than the tissue fluid, fluid could be pushed through the capillaries; if the capillary fluid is higher than the tissue fluid, fluid could be pushed through the capillaries. The high osmotic pressure of the capillary fluid is due to atherosclerosis or hardening from alcohol, which usually cause leaks. Maybe the osmotic pressure of the capillary fluid is too high due to a large solute concentration, which will not leak.
\[ R = \frac{8LP}{4r^4} \]

Which of the following is true of the body's capillaries?

a. Very thin walls and very fast blood flow velocity
b. Highly branched and high pressure system
c. Large total cross-sectional area, very slow blood flow velocity
d. None of the above

Which one of the following EKG-phase correctly represents an event during the cardiac cycle?

a. P-wave: depolarization of the AV-node
b. P-wave: depolarization of the ventricles
c. T-wave: repolarization of the atria
d. QRS-complex: depolarization of ventricles
e. QRS-complex: repolarization of ventricles

Red blood cells are produced in the

a. Liver
b. Spleen
c. Kidneys
d. Bone marrow

Which of the following does not lead to blood coagulation? Explain why?

a. Contact of blood with collagen
b. Conversion of inactive serum proteins such as prothrombin to thrombin
c. Formation of polymers of fibrin from fibrinogen
d. Secretion of tissue plasminogen activator (t-PA) by endothelial cells

**Plasminogen is the inactive form of plasmin. Plasmin breaks down fibrin. t-PA would activate plasmin, inducing it to break down blood clots.**

214. The hormone oxytocin, which is released from the posterior pituitary, causes uterine contractions during labor. Which of the following statements about oxytocin is most likely true?

a. Stretching the cervix decreases the secretion of oxytocin.
b. Labor is prolonged in animals who have had their pituitaries removed.
c. The uterus decreases its responsiveness to a given level of oxytocin during the last three months of pregnancy.
d. The rate of oxytocin release decreases at the onset of labor.
Experiments were conducted on rats to study the effects of hormones on tissues and organs. The testes of the rats were removed and hormone (K) was administered. The data below gives the autopsy results of "control" and "test" animals. Analyze the data and determine which hormone was injected. Draw a feedback loop showing your reasoning. Explain what caused the changes in different weights.

Hormone K is **ACTH**

**Control** (intact)

- Pituitary: 12.9 mg
- Thyroid: 250 mg
- Thymus: 475 mg
- Adrenals: 40 mg
- Seminal vesicles: 500 mg
- Prostate: 425 mg
- Testes: 3200 mg
- Body weight: 300 g

Hormone K

- Pituitary: 10.1 mg
- Thyroid: 245 mg
- Thymus: 250 mg
- Adrenals: 100 mg
- Seminal vesicles: 490 mg
- Prostate: 430 mg
- Testes: 3000 mg
- Body weight: 200 g

**Control** (castrate)

- Pituitary: 12.9 mg
- Thyroid: 250 mg
- Thymus: 480 mg
- Adrenals: 40 mg
- Seminal vesicles: 450 mg
- Prostate: 387 mg
- Body weight: 270 g

**Hormone K**

- Pituitary: 10.1 mg
- Thyroid: 250 mg
- Thymus: 250 mg
- Adrenals: 95 mg
- Seminal vesicles: 410 mg
- Prostate: 380 mg
- Body weight: 195 g

**FIG. 7.**

Autopsy results from control rats.

**Autopsy results from rats treated with hormone K**

- Prostate drops due to negative feedback from ACTH.
- Thymus drops because cortisol is an immune system suppressant.
- Adrenals go up in mass because ACTH stimulates the adrenal cortex's production of cortisol.
- Body weight drops due to increased protein catabolism in treated by cortisol.

It is likely that K is ACTH.
The right side of the heart pumps blood through the __________ circulation and the left side pumps blood through the __________ circulation.

A) diastolic; systolic
B) systolic; diastolic
C) pulmonary; systemic
D) coronary; pulmonary
E) systemic; pulmonary

2. Consider the equation \( F = \frac{\Delta P}{R} \).
   It describes the flow (F) of fluid in a tube in which there is a pressure difference (\( \Delta P \)) between the two ends and a resistance (R) to flow. The equation indicates that
   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) A and C.
   E) B and C.

3. Which of the following changes would most increase the resistance to blood flow in a blood vessel?
   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%.

4. The plateau of the action potential in cardiac ventricular cells results from the opening of voltage-gated slow __________ channels in the plasma membrane of the cell.
   A) sodium
   B) potassium
   C) calcium
   D) chloride
   E) glucose

5. Which of the following statements concerning the differences between action potentials in skeletal muscle cells and in ventricular cardiac muscle cells is true?
   A) Like skeletal muscle cells, ventricular cardiac muscle cells have a resting membrane potential closer to the sodium equilibrium potential than to the potassium equilibrium potential.
   B) Unlike skeletal muscle cells, the initial depolarization of ventricular cells is mainly due to calcium influx, not sodium influx.
   C) After sodium influx through fast channels occurs in ventricular cells, an influx of calcium occurs. No such calcium influx occurs after sodium influx in the skeletal muscle cells.
   D) Action potentials in skeletal muscle cells are longer in duration than action potentials in cardiac cells.

6. In an electrocardiogram, the QRS complex represents the
   A) depolarization of the atria.
   B) repolarization of the atria.
   C) depolarization of the ventricles.
   D) repolarization of the ventricles.
   E) the delay at the AV node.

7. An ECG would be useful for determining a patient's
   A) heart murmur.
   B) stroke volume.
   C) cardiac output.
   D) blockage of conduction of electrical signals between the atria and the ventricles.
   E) none of the above.

8. Comparing excitation-contraction coupling in cardiac muscle with that in skeletal muscle:
   A) Extracellular calcium plays a major role in cardiac but not skeletal muscle.
   B) The stimulus for calcium release from the sarcoplasmic reticulum is the same in both muscles.
   C) Troponin sites are always saturated immediately after calcium release in both muscles.
   D) There is no net change in total intracellular calcium concentration in either muscle.
14. Jane donates a pint of blood to a blood bank. A few minutes later, which of the following would be increased compared to its/her pre-donation values?
A) her stroke volume and total peripheral resistance
B) her heart rate and total peripheral resistance
C) her heart rate and mean arterial pressure
D) the percentage of her cardiac output flowing to her kidneys.
E) blood flow to her brain.

15. Which of the following would a soldier standing very still, at attention, likely experience?
A) Decreased pressure in the capillaries of the feet.
B) Increased absorption of interstitial fluid by the capillaries of the feet.
C) Increased storage of blood in the veins of the feet and legs.
D) Increased venous return.
E) All of the above.

16. During exercise, there is an increased flow of blood to
A) the brain.
B) the kidneys.
C) the skin.
D) B and C.
E) A, B and C.

17. Which of the following does not contribute to increased stroke volume during exercise?
A) Increased contractility of cardiac muscle
B) Increased venous return
C) Increased length of filling time during diastole
D) Increased sympathetic stimulation of ventricular muscle
E) Increased end-diastolic volume

18. Physical endurance training enhances a person’s
A) maximal cardiac output.
B) maximal stroke volume.
C) maximal heart rate.
D) A and B.
E) A, B and C.

19. A trained athlete differs from a "couch potato" in that the athlete has
A) a lower heart rate at rest.
B) a higher heart rate at rest.
C) greater stroke volume at maximal effort.
D) A and C.
E) B and C.
10-6 Regarding the structure and synthesis of hormones:
A) Steroid hormones are synthesized from cholesterol.
B) Thyroid hormones are catecholamines.
C) The hormones of the adrenal cortex have the same structure as the neurotransmitters of adrenergic neurons.
D) Most peptide hormones require binding proteins for transport in the blood.

10-10 Peptide hormones
A) are often derived from larger molecules called prohormones.
B) are packaged into secretory vesicles in the endoplasmic reticulum of the cells that synthesize them.
C) are secreted in response to a stimulus that causes depletion of cytosolic calcium in the secreting cell.

10-13 Some hormones are transported in plasma bound to proteins. These proteins function to
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) all of the above.

10-18 In the absence of thyroid hormone, epinephrine stimulates release of a small amount of fatty acids from adipose cells. In the presence of thyroid hormone (which has no effect by itself), epinephrine causes a much more substantial release of fatty acids from the cells. The effect of thyroid hormone on epinephrine's actions is called
A) antagonistic.
B) agonistic.
C) permissive.

10-24 The "master gland" of the endocrine system
A) is the anterior pituitary gland.
B) is the posterior pituitary gland.
C) is the hypothalamus.
D) is the pancreas.
E) is the testis.

10-34 What would be the effect of a blood clot that blocked the veins of the hypothalamo-pituitary portal system in the infundibulum between the hypothalamus and the anterior pituitary gland?
A) Secretion of ACTH will decrease and the adrenal cortex will atrophy.
B) The secretion of gonadotropins will decrease and the gonads will hypertrophy.
C) Plasma cortisol concentration will decrease, which will cause a decrease in long-loop negative feedback, and so the secretion of ACTH by the pituitary gland will increase.

10-37 If the pituitary gland is removed from a human subject, which of the following is likely to occur?
A) The adrenal gland will hypertrophy to increase cortisol production.
B) The adrenal gland will atrophy and plasma cortisol levels will be reduced.
C) The hypothalamus will secrete less CRH.

10-41 Carlos and Sally each have a routine physical examination that includes measurement of thyroid hormone levels in their plasma.

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Bound</th>
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<tbody>
<tr>
<td>Carlos</td>
<td>Plasma TH 8 μg/dL</td>
<td>7.998 μg/dL</td>
</tr>
<tr>
<td>Sally</td>
<td>Plasma TH 12 μg/dL</td>
<td>11.998 μg/dL</td>
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</tbody>
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Sally has no symptoms of thyroid problems. Therefore:
A) Carlos probably has symptoms of hypothyroidism.
B) Carlos probably has symptoms of hyperthyroidism.
C) Carlos probably has no symptoms of thyroid problems.
19-5 Which of the following statements is false?
A) Sperm formed in the testes enter the epididymis before entering the vas deferens.
B) The seminal fluid is alkaline and rich in nutrients.
C) The Sertoli cells produce androgen-binding protein.
D) Sperm entering the epididymis are fully motile.

19-17 If you start at the plasma membrane of an oocyte in a mature follicle and move outward, which is the correct order in which you would encounter the three structures listed below?
A) zona pellucida; granulosa cells; theca cells
B) zona pellucida; theca cells; granulosa cells
C) granulosa cells; zona pellucida; theca cells
D) granulosa cells; theca cells; zona pellucida
E) theca cells; zona pellucida; granulosa cells

19-21 Which of the following organs can produce androgens?
A) Testes.
B) Ovaries.
C) Adrenal cortices.
D) A and B.
E) A, B and C.

19-23 Beginning on the first day of the menstrual cycle, the order of events in the uterus is
A) proliferative, secretory, menstrual phases.
B) secretory, proliferative, menstrual phases.
C) menstrual, secretory, proliferative phases.
D) menstrual, proliferative, secretory phases.
E) secretory, menstrual, proliferative phases.

19-27 Which of the following statements about estrogen is not true?
A) In low plasma concentration estrogen inhibits pituitary secretion of LH and FSH.
B) In high plasma concentration estrogen stimulates pituitary sensitivity to GnRH.
C) In the presence of high plasma concentration of progesterone, estrogen stimulates increased secretion of GnRH.
D) Estrogen secretion is required for the LH surge.
E) Estrogen stimulates follicular growth.

19-39 Normally, only one sperm can fertilize an egg because
A) the first sperm to fuse with the oocyte plasma membrane triggers a process whereby enzymes begin to inactivate other nearby sperm.
B) the first sperm to fuse with the oocyte plasma membrane triggers a process whereby the zona pellucida becomes impenetrable to other sperm.
C) only one sperm normally makes it to the vicinity of the egg.
D) only one sperm undergoes the acrosome reaction.
E) only one sperm undergoes capacitation.

19-60 SRY
A) protein is normally coded for by a gene that is present on the Y chromosome.
B) protein is normally coded for by a gene that is present on the X chromosome.
C) gene codes for testosterone.
D) gene is indirectly involved in differentiation of the indifferent gonad and directly involved in the regression of the Müllerian ducts.

19-62 In the differentiation of a normal male,
A) undifferentiated gonads develop into testes during the fifth week of embryonic life.
B) the Wolffian ducts regress.
C) pituitary LH causes fetal Leydig cells to secrete testosterone.
D) testosterone directly stimulates development of the epididymis, vas deferens, and seminal vesicles.

19-64 In the normal development of a fetus with the XY genotype, MIS ________ be secreted by the _________. The ________ will develop into the _________.
A) will not; Sertoli cells; Wolffian ducts; epididymis
B) will; Sertoli cells; Wolffian ducts; vas deferens
C) will; Leydig cells; Wolffian ducts; epididymis
D) will not; ovary; Müllerian ducts; uterine tubes
E) will not; testes; Müllerian ducts; epididymis

19-66 The onset of puberty
A) is triggered by an increase in sensitivity of the gonads to pituitary gonadotropins.
B) is triggered by an increase in sensitivity of the pituitary to GnRH.
C) is triggered by an increase in GnRH secretion.