Final Exam – Multiple Choice

Fill in your scantron form as follows:

- Write and bubble in your name in the upper left (last name first).
- Sign your form on the upper right. By so doing you verify that you are abiding by Creighton’s policy on academic honesty.

As always, choose the best answer for each multiple-choice question. Answer on your scantron form. Each question is worth 3 points.

1. Which of the following fluids is normally high in K\(^+\) and low in Na\(^+\)?
   a. Intracellular fluid
   b. Interstitial fluid
   c. Blood plasma
   d. Two of the above
   e. All of the above

2. Which of the following does not represent an example of a positive feedback loop?
   a. The increasing strength of contraction seen in the uterus during parturition.
   b. The erection of the penis in men.
   c. The increasing levels of estrogen seen shortly before ovulation in women.
   d. The increase in body temperature seen in response to an infection.
   e. All of the above are examples of positive feedback loops.

3. If we see water moving from one side (side A) of an epithelial cell layer to the other (side B), which of the following would not by itself be a potential explanation for this movement?
   a. The overall concentration is higher on side B than side A.
   b. The overall concentration is higher on side A than side B, but paracellular pockets of high concentration on side B are generated by epithelial cells.
   c. The two sides are initially the same overall concentration, but a solute diffuses from side A to side B
   d. The two sides are the same overall concentration, but the pH is higher on side A than side B.
   e. The hydrostatic pressure is higher on side A than side B.
4. Imagine a neuron with a relatively long axon covered in myelin but lacking any nodes of Ranvier (i.e., the myelin is completely continuous along the axon). Which of the following best describes the result?

   a. The axon would have better cable properties than if it lacked myelin, and an action potential would be able to propagate the length of the axon.
   b. The axon would have better cable properties than if it lacked myelin, but an action potential would not be able to propagate the length of the axon.
   c. The axon would have worse cable properties than if it lacked myelin, but an action potential would still be able to propagate the length of the axon.
   d. The axon would have worse cable properties than if it lacked myelin, and an action potential would not be able to propagate the length of the axon.
   e. Only invertebrates and professors have myelinated axons.

5. At a neural synapse, the release of neurotransmitter by the presynaptic neuron causes the postsynaptic neuron to hyperpolarize after a delay of about 100ms, and it stays hyperpolarized for several seconds. This means that the receptors are most likely

   a. ionotropic receptors that cause Na\(^+\) channels to open.
   b. ionotropic receptors that cause Na\(^+\) channels to close.
   c. metabotropic receptors that cause Na\(^+\) channels to open.
   d. metabotropic receptors that cause Na\(^+\) channels to close.
   e. broken.

6. The process of neuronal integration (including both spatial and temporal summation) takes information input from any number of presynaptic neurons and ends up encoding it as a single output, which is in the form of

   a. axonal contractions of different strengths.
   b. axonal contractions of different frequencies.
   c. action potentials of different amplitudes.
   d. action potentials of different individual durations.
   e. action potentials at different frequencies.

7. Taste receptors for salt increase neurotransmitter release when

   a. Na\(^+\) activates G-protein pathways that open Ca\(^{2+}\) channels in the receptor.
   b. Na\(^+\) enters through channel proteins, depolarizing the cell and opening Ca\(^{2+}\) channels.
   c. Cl\(^-\) activates G-protein pathways that open Ca\(^{2+}\) channels in the receptor.
   d. Cl\(^-\) exits through channel proteins, depolarizing the cell and opening Ca\(^{2+}\) channels.
   e. Osmotic water movement shrinks the receptors, opening Ca\(^{2+}\) channels.
8. A problem that occasionally occurs with the semicircular canals is that a stray otolith will get into the canal, and end up pushing against the cupula of one of the canals. When this happens, the person is likely to feel that as though
   a. her head is spinning.
   b. she is rapidly accelerating.
   c. she is falling straight down.
   d. her inner ear is on fire.
   e. her inner ear smells the scent of wildflowers on a spring morning.

9. A person is listening to a pure tone (single frequency) sound that is initially fairly quiet and then becomes louder. The reason the person is able to detect the increase in the volume of the sound is
   a. a different region along the length of the cochlea vibrates.
   b. the frequency of the vibration in the sensitive region of the cochlea increases.
   c. the amplitude of the vibrations of the sensitive region of the cochlea increases.
   d. the cochlea increases in overall length.
   e. the cochlea decreases in overall length.

10. Which of the following statements about rod photoreceptors is false?
    a. The molecule that detects light is located in the lamellae.
    b. Rhodopsin changes form when struck by a photon.
    c. Transducin is inactivated when a photoreceptor is exposed to light.
    d. Levels of cGMP control the state (open or closed) of Na⁺ channels.
    e. The cell membrane is depolarized in the dark and hyperpolarized in the light.

11. Which of the following is not a common effect of hormones? (Note that “hormones” includes lipophobic and lipophilic hormones.)
    b. Activating or deactivating enzymes to influence biochemical pathways.
    c. Altering gene expression rates.
    d. Only one of the above is a common effect of hormones.
    e. All of the above are common effects of hormones.

12. A person normally experiences the greatest level of growth hormone release
    a. about an hour before meals.
    b. about an hour after meals.
    c. a few hours after going to sleep.
    d. a few hours before waking up.
    e. Growth hormone release is constant throughout the day.
13. Which of the following correctly describes the pathway of excitation-contraction coupling in skeletal muscles?
   a. An action potential in the t-tubule activates DHP, causing ryanodine in the sarcoplasmic reticulum to open and release Ca\textsuperscript{2+}, which binds to troponin, causing tropomyosin to move.
   b. An action potential in the t-tubule activates DHP, causing ryanodine in the sarcoplasmic reticulum to open and release Ca\textsuperscript{2+}, which binds to tropomyosin, causing troponin to move.
   c. An action potential in the t-tubule activates ryanodine, causing DHP in the sarcoplasmic reticulum to open and release Ca\textsuperscript{2+}, which binds to troponin, causing tropomyosin to move.
   d. An action potential in the t-tubule activates ryanodine, causing DHP in the sarcoplasmic reticulum to open and release Ca\textsuperscript{2+}, which binds to tropomyosin, causing troponin to move.
   e. An action potential in the t-tubule activates tropomyosin, causing troponin in the sarcoplasmic reticulum to open and release Ca\textsuperscript{2+}, which binds to ryanodine, causing DHP to move.

14. Which of the following would be likely to fatigue most quickly?
   a. A fast-glycolytic myofiber generating occasional twitch contractions
   b. A fast-glycolytic myofiber generating a sustained tetanic contraction
   c. A slow-oxidative myofiber generating occasional twitch contractions
   d. A slow-oxidative myofiber generating a sustained tetanic contraction
   e. All of these would fatigue at about the same time.

15. Cardiovascular output can be increased by all of the following except:
   a. Increased sympathetic stimulation of the sinoatrial node
   b. Decreased parasympathetic stimulation of the sinoatrial node
   c. Increased sympathetic stimulation of the ventricular muscle
   d. Decreased parasympathetic stimulation of the ventricular muscle
   e. Increased venous return to the heart

16. Which of the following best describes how substances move in and out of capillaries?
   a. Oxygen, Na\textsuperscript{+} and glucose all diffuse across endothelial cell membranes.
   b. Oxygen and Na\textsuperscript{+} diffuse across endothelial cell membranes; glucose diffuses through pores between cells.
   c. Oxygen and glucose diffuse across endothelial cell membranes; Na\textsuperscript{+} diffuses through pores between cells.
   d. Oxygen diffuses across endothelial cell membranes; Na\textsuperscript{+} and glucose diffuse through pores between cells.
   e. Oxygen, Na\textsuperscript{+} and glucose all diffuse through pores between endothelial cells.
17. A drop in mean arterial pressure is likely to bring about all of the following response except:
   a. An increase in cardiac output
   b. An increase in vasoconstriction
   c. An increase in thirst
   d. An increase in urine production
   e. All of the above would be seen if MAP drops.

18. During a complete ventilatory cycle in a resting individual, alveolar pressure is normally highest (most positive)
   a. midway through inhalation.
   b. at the end of inhalation.
   c. midway through exhalation.
   d. at the end of an exhalation.
   e. Alveolar pressure is constant throughout the ventilatory cycle.

19. During a forceful exhalation, which of the following muscles would be activated?
   a. The diaphragm
   b. External intercostals
   c. Internal intercostals
   d. a and b
   e. a and c

20. Imagine that a person has been given a mysterious drug that causes the rate of oxygen delivery to tissues to be reduced. Assuming the P_{O2} of the alveoli and of the tissues are normal, and do not change after the drug is given, which of the following might be possible effects of the drug that would explain this pattern?
   a. It left-shifts the oxygen affinity curve, and/or causes the formation of more carbamino compounds.
   b. It right-shifts the oxygen affinity curve, and/or causes the formation of more carbamino compounds.
   c. It left-shifts the oxygen affinity curve, and/or damages hemoglobin so its total carrying capacity is reduced.
   d. It right-shifts the oxygen affinity curve, and/or damages hemoglobin so its total carrying capacity is reduced.
   e. None of these things would affect oxygen delivery.

21. One major advantage of the filtration-reabsorption method of urine production is that
   a. it is effective at getting rid of a wide variety of toxins and wastes that might be found in the blood.
   b. it is very energy efficient, using little ATP to process the urine.
   c. only a small quantity of water and solute needs to be reabsorbed from the nephron.
   d. all the urea that initially enters the nephron leaves in the final urine.
   e. it produces only about 1 ml of urine per hour.
22. If a person had his adrenal cortex damaged, so that he could no longer release aldosterone, which of the following would be expected if he experienced low blood Na\(^+\) concentrations?

a. His liver would not release angiotensinogen.
b. He would not be able to release renin.
c. He would not be able to convert angiotensinogen into angiotensin I.
d. He would not experience vasoconstriction in response to increased renin release.
e. He would not experience increased Na\(^+\) reabsorption in the distal tubule.

23. One of the effects of the release of atrial natriuretic factor (ANF) is

a. increased release of anti-diuretic hormone (ADH).
b. increased release of renin.
c. increased reabsorption of Na\(^+\).
d. increased vasodilation.
e. increased water reabsorption in the collecting ducts.

24. Which of the following might be a problem for someone who secreted little or no stomach acid?

a. Bacteria and other pathogens might not be killed as effectively.
b. Proteins might not be digested as effectively.
c. It might be harder to maintain a relatively neutral pH in the small intestine.
d. Two of the above might be a problem.
e. All of the above might be a problem.

25. The release of digestive enzymes from the pancreas is controlled mainly by the hormone

a. cholecystokinin.
b. enterokinase.
c. gastrin.
d. procarboxypeptidase.
e. secretin.

26. Bile salts are useful in the processing of fats in the small intestine because they

a. cleave fatty acids off triglyceride fats.
b. act as a detergent to help break up large fat droplets.
c. carry fatty acids across the epithelial wall.
d. convert fatty acids back into triglyceride fats in the epithelial cells.
e. coat fat droplets in the epithelial cells to form chylomicrons.

27. The bacterial fauna found in our large intestines

a. are just little parasites that eat our leftover nutrients and do us more harm than good.
b. don’t really hurt us, but don’t do us any good, either.
c. can provide some essential nutrients, and may have more profound health effects.
d. are absolutely essential to life – you couldn’t live 24 hours without them.
e. are totally disgusting – look where they live!
28. The liver stores glycogen primarily as
   a. a source of energy for its own needs.
   b. a source of energy for the kidneys.
   c. a source of energy for muscles.
   d. a source of energy for the nervous system.
   e. a way to keep the fat cells from storing too much fat.

29. The switch from glucose to fats/fatty acids as the primary source of fuel by most body cells during the post-absorptive period occurs in response to
   a. increasing blood insulin levels.
   b. decreasing blood insulin levels.
   c. increasing blood glucagon levels.
   d. decreasing blood glucagon levels.
   e. Admonitions from health organizations to cut down on sugary foods.

30. Which of the following best describes the process of spermatogenesis?
   a. Spermatids undergo meiosis to form spermatocytes, which develop into spermatozoa that become fully mature after about two days.
   b. Spermatids undergo meiosis to form spermatocytes, which develop into spermatozoa that become fully mature after about two months.
   c. Spermatocytes undergo mitosis to form spermatids, which develop into spermatozoa that become fully mature after about two months.
   d. Spermatocytes undergo meiosis to form spermatids, which develop into spermatozoa that become fully mature after about two days.
   e. Spermatocytes undergo meiosis to form spermatids, which develop into spermatozoa that become fully mature after about two months.

31. The erection of the penis is initiated by
   a. vasodilation of arterioles entering the penis, under the influence of the parasympathetic nervous system.
   b. vasodilation of arterioles entering the penis, under the influence of the sympathetic nervous system.
   c. vasoconstriction of venules leaving the penis, under the influence of the parasympathetic nervous system.
   d. vasoconstriction of venules leaving the penis, under the influence of the sympathetic nervous system.
   e. chaste thoughts.

32. During puberty in females, increasing levels of estrogen cause all of the following except:
   a. Development of the breasts
   b. Deposition of fat on the buttocks and thighs rather than the abdomen
   c. The limitation of body hair growth to primarily the axillary and pubic regions
   d. The growth of wider hips and narrower shoulders than men
   e. Increased muscle mass
33. Which of the following best describes the cellular activity in a well-developed follicle in an ovary?

a. Granulosa cells produce estrogen; theca cells support development of the oocyte.
b. Granulosa cells produce androgens; theca cells convert androgen to estrogen and support development of the oocyte.
c. Theca cells produce estrogen; granulosa cells support development of the oocyte.
d. Theca cells produce androgens; granulosa cells convert androgen to estrogen and support development of the oocyte.
e. You know what word is fun to say? Oogonia!

34. The growth of a new endometrial layer in the uterus every month is driven by increasing levels of

a. estrogen.
b. luteinizing hormone.
c. oxytocin.
d. progesterone.
e. prolactin.

35. The delay between fertilization of an oocyte by a sperm and implantation of the resulting blastocyst into the uterine wall is about

a. seven minutes.
b. 30 minutes.
c. seven hours.
d. 30 hours.
e. seven days.

36. The reason that a woman’s estrogen and progesterone levels plummet immediately after she gives birth is that

a. her corpus luteum rapidly degenerates.
b. her levels of LH and FSH drop to almost nothing.
c. she begins lactating.
d. the placenta that was supplying these hormones has detached from her uterus.
e. her uterus begins shrinking.

37. In addition to the leukocytes found in the blood, immune cells tend to be found concentrated in all of the following areas except:

a. The appendix
b. The kidneys
c. The lymph nodes
d. The skin
e. The tonsils
38. The major histocompatibility complex (MHC) serves as a way for cells to
   a. present possible antigens to immune cells in a way that identifies the presenting cell as “self.”
   b. kill pathogens living inside the cell.
   c. kill pathogens living outside the cell.
   d. initiate a cascade of events that results in the insertion of a pore into the membrane of bacteria.
   e. initiate the inflammatory response.

39. A body cell infected with a virus is a likely target for attack by a
   a. plasma cell.
   b. cytotoxic T cell.
   c. helper T cell.
   d. macrophage.
   e. mast cell.

40. Which of the following statements about the activation of B cells is correct?
   a. B cells have “I” shaped antigen receptors on their surface.
   b. B cells do not have a memory cell form, so their response to a second infection by a pathogen is no different than the first.
   c. To start proliferating, B cells usually need to be activated by both an antigen and the cytokine interleukin-2.
   d. Activated B cells kill bacteria by phagocytosis.
   e. The “B” is for “Bluejay”.

Extra-credit: Fill out a survey, get points – no salesmen will call! (1 point each)

41. How often did you access lecture materials on BlueCast?
   a. Never
   b. A few times
   c. A middling number of times
   d. For many or all lectures

42. Did you find the lecture recordings on BlueCast to be
   a. of little or no help.
   b. somewhat helpful.
   c. very helpful.
   d. I already told you I didn’t look at them! Why do I even bother answering these questions if you’re not going to look at the answers!

(One more on the back)
43. Lecture typically involves relatively small number of slides and relatively large number of diagrams, lists, etc., drawn on the whiteboard. On the whole, would you prefer
   a. More slides and less white board use.
   b. About the current balance.
   c. Even fewer slides and even more whiteboard use!
Final Exam – Short Answer

Write a concise answer to each of the questions that begin on the next page. Your answers should fit in the spaces provided. Diagrams are welcome but must be accompanied by written explanations. Each question is worth 8 points.

44. Consider the effects of anti-diuretic hormone (ADH), which we covered in the renal section of the course. To the extent you can, put the release of ADH in the context of a negative feedback loop, bringing in other structures or pathways as needed to complete your explanation. Identify the sensor, afferent pathway, integrating center, efferent pathway and effector(s) as specifically as possible. You do not need to explain the specific cellular effects of ADH.

45. Graph an action potential. You need to provide labels and approximate values for each axis, (with some latitude for error). Next, mark the approximate time range over which each combination of channel states (shown in the table) would occur, using the letters shown as labels. (Not all labels may be used.)

<table>
<thead>
<tr>
<th>Label</th>
<th>VG Na⁺ Channels</th>
<th>VG K⁺ Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>B</td>
<td>Closed</td>
<td>Open</td>
</tr>
<tr>
<td>C</td>
<td>Open</td>
<td>Closed</td>
</tr>
<tr>
<td>D</td>
<td>Open</td>
<td>Open</td>
</tr>
</tbody>
</table>
46. Complete the following table with the appropriate hormones. Note that one of the hormones is inhibitory. Be sure that you use full names, “h.” allowed for “hormone.”

<table>
<thead>
<tr>
<th>Hypothalamus</th>
<th>Anterior Pituitary</th>
<th>Target Organ or Tissue and Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Thyroid hormone ( T_3/T_4 ) release</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adrenal cortex Cortisol release</td>
</tr>
<tr>
<td></td>
<td></td>
<td>General body tissues Growth and repair</td>
</tr>
<tr>
<td>(Inhibitory)</td>
<td></td>
<td>Liver IGF-1 release</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

47. List or diagram (with labels, etc.) the molecular events involving myosin, actin and ATP during cross-bridge cycling in a muscle. You do not need to describe how this process is controlled.
48. List the mechanical events that occur in the left ventricle during ventricular systole in the heart. Be sure the cause-and-effect relationship between events is clear. You do not need to describe the electrical events in the heart or ventricular diastole. Please begin your discussion with the very first event of ventricular systole.

49. Describe or graph the relationship between ventilation rate and the $P_{CO_2}$ in the arterial blood, and between ventilation rate and the $P_{O_2}$ in the arterial blood. Briefly explain why each relationship shows the pattern it does.
50. If someone was injected with a drug that deactivated the sodium transporters in the ascending loop of Henle, how might this affect the person’s ability to make a hyperosmotic urine? How about a hyposmotic urine? Explain your answer.

51. Diagram or describe the hormonal pathway that promotes spermatogenesis in men, including any feedback loops. You do not need to describe the process of spermatogenesis itself.
52. On the graph below, draw in lines representing the approximate levels of estrogen, progesterone, and luteinizing hormone during the human menstrual cycle. Also, indicate on the graph when each of the following events occurs:
   a. Ovulation  b. First day of menstruation
c. Corpus luteum first appears  d. Corpus luteum starts to degenerate
e. Follicles begin developing  f. Dominant follicle appears

53. List and briefly explain the events that take place as part of the inflammatory response to an injury.