Fill in your scantron form as follows:

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

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

1. In the field of physiology, when we say that the kidneys help regulate sodium levels, we are referring to sodium levels in the
   a. blood.
   b. cytosol.
   c. interstitial fluid.
   d. Two of the above. (a and c)
   e. All of the above.

2. If an animal is trying to regulate $K^+$ levels in its body, and $K^+$ levels are too high, which of the following patterns would likely bring the most rapid return to desired levels?
   a. Increased $K^+$ influx, increased $K^+$ efflux
   b. Increased $K^+$ influx, decreased $K^+$ efflux
   c. Decreased $K^+$ influx, increased $K^+$ efflux
   d. Decreased $K^+$ influx, decreased $K^+$ efflux
   e. Hunker down and hope for the best.

3. In human thermoregulation, the activity of sweat glands in controlled by the sympathetic nervous system. In the context of the negative feedback loop controlling body temperature, which component do neurons in the sympathetic system represent?
   a. Sensors
   b. Afferent pathways
   c. Integrating centers
   d. Efferent pathways
   e. Effectors

4. Which of the following must normally be present for the generation of a membrane potential to occur?
   a. At least one charged particle.
   b. Permeability of the membrane to at least one charged particle.
   c. Permeability of the membrane to two or more charged particles.
   d. $a$ and $b$. (Because “$a$” is implied by “$b$”, I will also accept “$b$” alone)
   e. $a$ and $c$. 
5. Consider a mammal having a mutation that caused the myelin covering of its neurons to develop without nodes of Ranvier (i.e., there is a contiguous myelin covering along the entire neuron). What would be the likely effect on the propagation of action potentials in a relatively long neuron?
   a. Propagation would be faster due to better insulation along the entire axon.
   b. Propagation would be faster due to less time taken up generating new action potentials at the nodes.
   c. Propagation would be slower due to less ion exchange between the cell and interstitial fluid.
   d. Propagation would be slower due to reduced regeneration of membrane potential by new action potentials.
   e. *Action potentials could not propagate all the way along the axon.*

6. In a presynaptic neuron, the release of synaptic vesicles from the cytoskeleton so they can bind with docking proteins is directly triggered by (i.e., the thing that actually causes the release is)
   a. *an influx of Ca\(^{2+}\) ions into the neuron.*
   b. an efflux of Ca\(^{2+}\) ions from the neuron.
   c. an influx of Cl\(^{-}\) into the neuron.
   d. an influx of Na\(^{+}\) ions into the neuron.
   e. an efflux of K\(^{+}\) ions from the neuron.

7. The term “excitatory post synaptic potential” refers to
   a. *A single, relatively short lived depolarization of a postsynaptic neuron in response to a single action potential arriving at a presynaptic neuron.*
   b. A single, relatively short lived hyperpolarization of a postsynaptic neuron in response to a single action potential arriving at a presynaptic neuron.
   c. The sum of all depolarizing effects acting on a postsynaptic neuron from all presynaptic neurons combined.
   d. The sum of all hyperpolarizing effects acting on a postsynaptic neuron from all presynaptic neurons combined.
   e. The condition in which the postsynaptic neuron is depolarized to threshold, initiating an action potential.

8. In the sensory system, a receptor that senses mild pressure applied to the skin’s surface is an example of a
   a. chemoreceptor.
   b. *mechanoreceptor.*
   c. nociceptor.
   d. photoreceptor.
   e. thermoreceptor.
9. In most tonic-type sensory neurons, an increase in stimulus intensity is encoded as
   a. an increase in the amplitude of each action potential.
   b. an increase in the duration of each action potential.
   c. an increase in action potential frequency.
   d. Two of the above.
   e. All of the above.

10. Which of the following is not known to activate any class of taste receptors?
   a. Amino acids
   b. Fats
   c. Hydrogen ions
   d. Salt
   e. Sugars

11. A person who lacked functioning hair cells would have trouble
   a. with her equilibrium.
   b. hearing.
   c. feeling pain.
   d. Two of the above. (a and b)
   e. All of the above.

12. If one sound strongly vibrated the region of the basilar membrane near the cochlea’s base,
   and another sound strongly vibrated the region near the cochlea’s tip, the sounds must have differed in their
   a. duration.
   b. frequency.
   c. volume.
   d. What’s that, sonny? Wrestler’s neck pain?
   e. I said “BASILAR MEMBRANE”!

13. The drug l-cis-diltiazem blocks cGMP-gated Na⁺ channels such as those found in vertebrate
    photoreceptors, so that Na⁺ cannot enter the cell. What would be the expected effect of this
    drug on photoreceptor function?
    a. It would keep the cells depolarized, as if they were always in the dark.
    b. It would keep the cells depolarized, as if they were always in the light.
    c. It would keep the cells hyperpolarized, as if they were always in the dark.
    d. It would keep the cells hyperpolarized, as if they were always in the light.
    e. It would make for a groovy light show, man.
14. Given their source (i.e., gonads), testosterone and estrogen must be an example of
   a. amines.
   b. neurohormones.
   c. peptide hormones.
   d. prostaglandins.
   e. **steroid hormones**.

15. Which of the following is **not** believed to be a tropic hormone?
   a. Adrenocorticotropic hormone
   b. Gonadotropin releasing hormone
   c. Luteinizing hormone
   d. Prolactin releasing hormone
   e. All of the above are tropic hormones.

16. In adults, long bones no longer increase in length because
   a. growth hormones levels are too low to promote growth at the epiphyseal plates.
   b. sex hormone levels are too low to promote growth at the epiphyseal plates.
   c. **increased sex hormone levels have caused the epiphyseal plates to “close,” or become inactive.**
   d. no activity of osteoblasts occurs after puberty.
   e. Long bones **do** increase in length throughout life.

17. If a sarcomere is lengthened beyond its normal resting length, its ability to produce force will be decreased because
   a. there is less overlap between the myosin heads and thin filaments.
   b. tropomyosin can no longer easily move away from myosin binding sites on actin.
   c. thin filaments begin overlapping, causing interference.
   d. elastic forces tend to pull the Z-lines back together.
   e. the effective concentration of ATP is reduced.

18. As a whole muscle is called on to produce more and more force, the last motor units recruited will consist of
   a. relatively small numbers of slow oxidative fibers.
   b. relatively large numbers of slow oxidative fibers.
   c. relatively small numbers of fast glycolytic fibers.
   d. **relatively large numbers of fast glycolytic fibers.**
   e. Motor units within a muscle do not differ in their composition.
19. Which of the following graphs shows the normal pattern of force production during an isometric twitch contraction of a typical muscle?

20. If 10.0 liters/min is flowing through the left heart, which of the following will not have 10 liters/min flowing through it/them?
   a. The systemic arteries
   b. The systemic capillaries
   c. The systemic veins
   d. The right heart
   e. All of the above will have 10 liters/min flowing through them.

21. If heart rate increases, but cardiac output remains the same, then
   a. stroke volume must have decreased.
   b. stroke volume must have increased.
   c. total peripheral resistance must have decreased.
   d. total peripheral resistance must have increased.
   e. Heart rate does not affect cardiac output.
22. If there is increased vasoconstriction within a particular organ, the effect will be (assuming no other changes occur)
   a. decreased blood flow to that organ and decreased total peripheral resistance.
   b. \textit{decreased blood flow to that organ and increased total peripheral resistance.}
   c. increased blood flow to that organ and decreased total peripheral resistance.
   d. increased blood flow to that organ and increased total peripheral resistance.
   e. Instant organ death

23. The rate at which lymph is formed (about 4 liters/day) is a result of
   a. osmotic pressure forcing blood out of the capillaries, countered by hydrostatic pressure inward that is about 5\% as strong.
   b. osmotic pressure forcing blood out of the capillaries, countered by hydrostatic pressure inward that is about 95\% as strong.
   c. hydrostatic pressure forcing blood out of the capillaries, countered by osmotic pressure inward that is about 5\% as strong.
   d. \textit{hydrostatic pressure forcing blood out of the capillaries, countered by osmotic pressure inward that is about 95\% as strong.}
   e. combined hydrostatic and osmotic pressure forcing blood out of the capillaries.

24. During the inhalation phase of the resting ventilatory cycle, the intrapleural pressure
   a. starts positive and increases further during inhalation.
   b. starts positive but decreases during inhalation.
   c. starts at zero but decreases during inhalation.
   d. \textit{starts negative and decreases further during inhalation.}
   e. starts negative but increases during inhalation.

25. For a person with an anatomical dead space of 140ml, a tidal volume of 440ml, and a ventilation frequency of 10 breaths/min, the alveolar ventilation rate would be
   a. 1400 ml/min
   b. 3000 ml/min
   c. 4400 ml/min
   d. 5800 ml/min
   e. incalculable from the information given.

26. Most carbon dioxide that enters the blood is transported in the form of
   a. dissolved CO$_2$.
   b. carboxamino compounds.
   c. \textit{bicarbonate ion.}
   d. Carbon dioxide is present in about equal amounts in two of these forms.
   e. Carbon dioxide is present in about equal amounts in all three of these forms.
27. The oxygen affinity curve shown below is for myoglobin. Based on this curve, about how much oxygen will be offloaded from myoglobin if the $P_{O2}$ of surrounding muscle drops from 40 torr to 10 torr?

![Oxygen Saturation Curve](image)

a. 20%

b. 40%

c. 50%

d. 60%

e. 80%

28. When discussing gastrointestinal physiology, the term “absorption” refers to

a. the breakdown of food into simpler components.

b. the transport of food across the epithelial layer of the gut.

c. the uptake of nutrients by the liver.

d. the transport of nutrients by the blood and lymph.

e. the storage of nutrients for future use.

29. Bile salts are important in the digestion of fats because

a. they promote the release of digestive enzymes by the pancreas.

b. they break fats down into fatty acids and glycerol.

c. they act as detergents to help emulsify fat droplets.

d. they transport fatty acids across the apical membrane of the epithelial cells.

e. they transport fats across the basolateral membrane of the epithelial cells.

30. During the post-absorptive phase, fat cells normally

a. take up fatty acids and store them as fat.

b. take up glucose and convert them to fat for storage.

c. release fatty acids for use by the nervous system.

d. release fatty acids for use by most cell types.

e. a and b
31. Normally, an increase in levels of the hormone leptin
   a. decreases metabolic rate.
   b. *results from an increase in fat stores.*
   c. results from a sudden decrease in food intake.
   d. results from sudden weight loss.
   e. results in an increase in appetite.

32. If a substance $S$ enters the nephrons at a rate of 1.0mg/min, and exits the nephrons at a rate of 1.0mg/min, which of the following is likely true? (Be sure to read carefully!)
   a. $S$ is being reabsorbed by the kidneys.
   b. $S$ is being secreted by the kidneys.
   c. *$S$ is neither being reabsorbed nor secreted by the kidneys.*
   d. It is impossible to guess how the kidneys are handling $S$.
   e. There really aren’t any other choices, are there?

33. Most of the reabsorption of water (by volume) in the nephrons takes place in the
   a. *proximal tubule.*
   b. descending loop of Henle.
   c. ascending loop of Henle.
   d. distal tubule.
   e. collecting duct.

34. Antidiuretic hormone has its main effects by
   a. altering sodium reabsorption in the distal tubule and collecting duct.
   b. *increasing permeability of the collecting ducts to water.*
   c. upregulating activity by the loop of Henle.
   d. decreasing the rate of formation of the primary urine.
   e. promoting vasodilation.

35. Which of the following would trigger antidiuretic hormone release most strongly?
   a. Decreased blood osmolarity and decreased blood pressure
   b. Decreased blood osmolarity and increased blood pressure
   c. *Increased blood osmolarity and decreased blood pressure*
   d. Increased blood osmolarity and increased blood pressure
   e. ADH is not affected by blood osmolarity or pressure.

36. The region of the juxtaglomerular apparatus that senses sodium levels in the urine is the
   a. afferent arteriole.
   b. efferent arteriole.
   c. granular cells.
   d. *macula densa.*
   e. sympathetic osmoreceptors.
37. In males, the release of testosterone
   a. is from the Leydig cells and is promoted by follicle stimulating hormone.
   b. is from the Leydig cells and is promoted by luteinizing hormone.
   c. is from the Sertoli cells and is promoted by follicle stimulating hormone.
   d. is from the Sertoli cells and is promoted by luteinizing hormone.
   e. Who needs testosterone when you have anabolic steroids?

38. In men, the erection of the penis results from
   a. vasodilation of arterioles and vasocompression of venules.
   b. vasoconstriction of arterioles and vasocompression of venules.
   c. vasodilation of arterioles and vasoexpansion of venules.
   d. vasoconstriction of arterioles and vasoexpansion of venules.
   e. So many possibilities here that could get me in trouble…

39. In women,
   a. estrogen is made de novo ("from scratch") by the theca cells.
   b. estrogen is made de novo by the granulosa cells.
   c. androgen is made by the theca cells and converted into estrogen by the granulosa cells.
   d. androgen is made by the granulosa cells and converted into estrogen by the theca cells.
   e. estrogen is made outside the ovaries.

40. The effects of progesterone include all of the following except
   a. the promotion of endometrial growth.
   b. the promotion of increased blood flow to the endometrium.
   c. the promotion of nutritive secretions by the endometrium.
   d. the inhibition of contractions by the uterus.
   e. Reduced release of gonadotropin releasing hormone and luteinizing hormone.