Name:_____ Student Number:_____

BIOLOGY 2A03 TEST #2

March 10, 2017 **Dr. Graham Scott**
50 minutes **Ms. Sinah Lee**

Special Instructions:

- This test contains 9 pages and 40 questions
- Mark the letter of the one fully correct answer on the scan sheet.
- One mark per questions. 40 marks total (there is no penalty for incorrect answers)
- Only the McMaster Standard Calculator (Casio FX-991) is permitted

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THE FOLLOWING EQUATIONS MAY BE NEEDED TO ANSWER SOME OF THE QUESTIONS ON THE QUIZ:

$$V = \frac{[S] \cdot V_{max}}{K_m + [S]}$$

$$F = K \cdot A \cdot ([X]_{out} - [X]_{in})$$

$$E_{ion} = \frac{61}{z} \log\left(\frac{[ion]_{out}}{[ion]_{in}}\right)$$

$$Q = \frac{\Delta P}{R}$$

$$R = \frac{8\,\eta\,L}{\pi\,r^4}$$

$$NFP = (P_{CAP} + \pi_{IF}) - (\pi_{CAP} + P_{IF})$$

$$V_A = f_R \times (V_T - V_D)$$

$$F = \frac{K \cdot A \cdot \Delta P_{gas}}{T}$$

1. When an uncharged solute diffuses across a membrane, the net flux
   a) can be described by Fick's law
   b) always occurs from low concentration to high concentration
   c) can be altered by the membrane potential
   d) All of the above
   e) None of the above

2. If the membrane potential is -70 mV and the equilibrium potential for a negatively charged ion is -90 mV, what are the directions of the electrical driving force and the electrochemical driving force for that ion?
   a) outward; inward
   b) outward; outward
   c) inward; inward
   d) inward; outward

3. Which statement best describes the depolarization phase of an action potential?
   a) It is caused by the closing of potassium channels.
   b) It is caused by the opening of sodium channels.
   c) It is caused by the inward movement of potassium ions.
   d) It is caused by the closing of chloride channels.
   e) None of the above.

4. The binding of a neurotransmitter to its receptor at an excitatory synapse can lead to the _____ of _____ channels.
   a) opening : potassium
   b) opening : sodium
   c) closure : sodium
   d) opening : chloride
   e) closing : calcium

5. Which of the following is an accurate description of the sliding filament model of muscle contraction:
   a) Contraction occurs as adjacent thick filaments slide past each other.
   b) Muscle shortening occurs as actin and myosin slide past each other.
   c) Muscle shortening occurs when thin filaments overlap each other.
   d) Muscle shortening causes the I-band to lengthen.
   e) None of the above.

6. Which of the following physiological responses is associated with elevated sympathetic nervous system activity?
   a) Enhanced digestion
   b) Enhanced absorption of nutrients
   c) Decreased heart rate
   d) Increased contractile force of the heart
   e) Inhibition of cardiovascular function

7. Sympathetic preganglionic neurons release the neurotransmitter _____; sympathetic postganglionic neurons release the neurotransmitter _____.
   a) acetylcholine ; acetylcholine
   b) acetylcholine ; norepinephrine
   c) epinephrine ; norepinephrine
   d) norepinephrine ; acetylcholine
   e) norepinephrine ; norepinephrine

8. Where in the central nervous system do the preganglionic neurons of the sympathetic nervous system originate?
   a) Brainstem
   b) Brainstem and sacral region of the spinal cord
   c) Thoracic and lumbar regions of the spinal cord
   d) Effector organ
   e) Adrenal medulla

9. Which of the following regarding the endocrine system is false?
   a) It can be under nervous control
   b) It releases hormones into synapses
   c) It is an important long-distance communication system in the body
   d) It can regulate metabolic rate
   e) It can employ both lipophilic and lipophobic messengers

10. What unique feature of Robert Wadlow made him the tallest man in recorded history?
    a) He had abnormally high growth hormone levels
    b) He had an insensitivity to glucagon
    c) He had a large posterior pituitary
    d) He ate his veggies
    e) A and C

11. Which hormone below can be responsible for short-loop negative feedback?
    a) adrenocorticotropic hormone (ACTH)
    b) cortisol
    c) corticotropin releasing hormone (CRH)
    d) estrogen
    e) None of the above

12. What hormone, released by the posterior pituitary, functions in uterine contraction and milk letdown in the breast?
    a) luteinizing hormone
    b) vasopressin
    c) oxytocin
    d) antidiuretic hormone
    e) prolactin

13. Which of the following statements is <u>false</u> in regards to catecholamines?
    a) they are secreted from chromaffin cells
    b) some of their effects can be blocked with the use of beta blockers
    c) thyroid hormones induce the synthesis of catecholamine receptors in some cells
    d) the adrenal cortex is the secondary endocrine organ involved in their release into the bloodstream
    e) All of the above statements are true

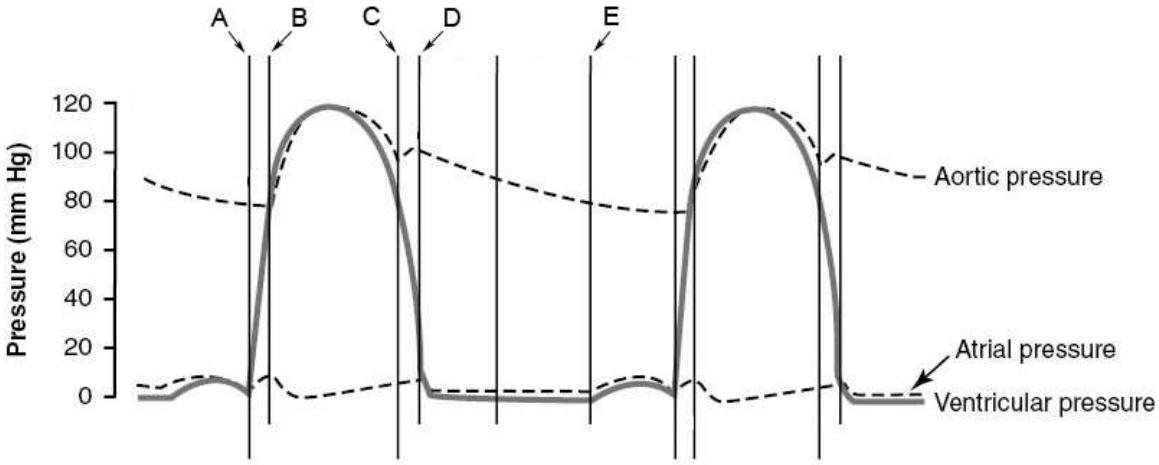
14. Antagonistic hormone interactions
    a) are the interactions between hormones with opposing effects
    b) occur between insulin and glucagon
    c) occur when two hormones have additive effects
    d) A and B
    e) All of the above

15. Type 1 diabetes is caused by _____ and type 2 diabetes is caused by _____.
    a) excess glucagon secretion; insulin resistance
    b) insulin resistance; destruction of beta cells
    c) destruction of beta cells; insulin resistance
    d) destruction of alpha cells; excess cortisol secretion
    e) pituitary adenomas; hyperthyroidism

16. The circulatory system consists of two divisions and is supplied with blood by different sides of the heart. The right heart supplies blood to the _____ circuit, whereas the left heart supplies blood to the _____ circuit.
    a) pulmonary ; systemic
    b) systemic ; pulmonary
    c) oxygenated ; deoxygenated
    d) superior (upper body) ; inferior (lower body)
    e) arterial ; venous

17. Closure of the atrioventricular valve occurs when
    a) the valve contracts.
    b) pressure inside the ventricle is less than pressure inside the atrium.
    c) pressure inside the ventricle is greater than pressure inside the atrium.
    d) the papillary muscle contracts.
    e) the atrium contracts.

The changes in pressure during the cardiac cycle for the left ventricle, left atrium, and aorta are shown in the diagram below. Use the diagram to answer questions 18 to 20.



18. Which letter on the above diagram corresponds to the point at which the aortic valve closes?
    a) A
    b) B
    c) C
    d) D
    e) E

19. Which letters correspond to the points at which heart sounds are generated?
    a) A and B
    b) A and C
    c) B and C
    d) A and D
    e) Not applicable – the heart does not generate sound

20. Which letter on the above diagram corresponds to the point at which the atria begin contracting?
    a) A
    b) B
    c) C
    d) D
    e) E

21. Which of the following statements is true about action potentials in cardiac *contractile* cells?
    a) Cardiac action potentials last much longer than neural action potentials due to the opening of Ca^{2+} channels and the closing of K^{+} channels.
    b) The depolarization phase is slower in cardiac action potentials than in neural action potentials.
    c) Neurotransmitter release at the neuromuscular junction will always induce an action potential in a cardiac muscle fibre.
    d) Action potentials in cardiac contractile cells occur spontaneously because of the slow depolarization caused by Na^{+} leak channels.
    e) None of the above.

22. Which of the following statements is true about cardiac *pacemaker* cells?
    a) They are located in the sinoatrial node and in the atrial conduction fibres.
    b) The intrinsic rate of action potential firing is faster in the atrioventricular node than in the sinoatrial node.
    c) Action potentials only occur in pacemaker cells when they are stimulated by the sympathetic nervous system.
    d) Action potentials in pacemaker cells occur spontaneously because of the slow depolarization caused by Na^{+} leak channels.
    e) None of the above.

23. Which of the following is an accurate representation of the order in which action potentials spread across the heart during a heartbeat?
    a) Sinoatrial node, intraventricular pathway, Purkinje fibres, atrioventricular node, bundle of His.
    b) Sinoatrial node, internodal pathway, atrioventricular node, bundle of His, Purkinje fibres.
    c) Sinoatrial node, internodal pathway, ventricular contractile cells, atrioventricular node, Purkinje fibres.
    d) Atrioventricular node, internodal pathway, sinoatrial node, bundle of His, intraventricular pathway.
    e) None of the above.

24. Which of the following components of an ECG represents ventricular depolarization?
    a) P wave
    b) QRS complex
    c) T wave
    d) PQ interval
    e) TQ segment

25. Which of the following mechanisms increase heart rate?
    a) Acetylcholine released by the vagus nerve.
    b) An increase in the firing rate of afferent baroreceptor neurons.
    c) Norepinephrine released by the sympathetic nervous system.
    d) Increased venous return.
    e) None of the above.

26. Which of the following statements is an accurate description of how the autonomic nervous system can control of heart rate?
    a) Norepinephrine binds to alpha-receptors on pacemaker cells to increase the force of contraction
    b) The parasympathetic nervous system slows heart rate by closing background leak channels in pacemaker cells
    c) Acetylcholine released onto the pacemaker cells by the sympathetic nervous system accelerates heart rate
    d) The autonomic nervous system changes the shape and duration of the cardiac action potential in contractile cells
    e) None of the above

27. Which of the following would increase the rate of blood flow through a blood vessel?
    a) constriction of the blood vessel
    b) increased viscosity of the blood
    c) increased pressure of the blood entering the vessel
    d) decreased radius of the vessel
    e) increased length of the vessel

28. Which of the following statements is true with regards to capillaries?
    a) They are composed of an endothelium, connective tissue, and smooth muscle
    b) Large proteins can diffuse through the space between endothelial cells
    c) They are leakier in the brain than in other tissues in order to facilitate exchange
    d) Blood velocity is slower through capillaries than through arteries
    e) The heart is the only organ that does not contain capillaries

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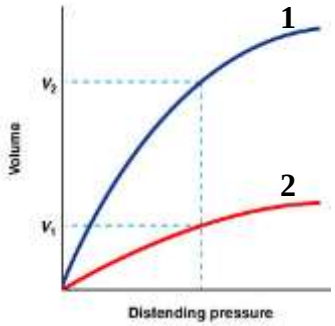
29. Which of the following statements is true about the following graph illustrating the compliance of arteries and veins?



a) Curve #1 depicts compliance in veins
b) Curve #2 depicts compliance in veins
c) Curve #1 depicts a volume reservoir
d) Curve #1 depicts a pressure reservoir
e) Both A and C are correct

30. Which of the following statements is true regarding the bulk flow of fluid across systemic capillaries?
a) Oncotic pressure in the blood causes filtration
b) Reabsorption is caused by the diffusion of proteins across the capillary wall
c) Net filtration pressure is a balance between hydrostatic and oncotic pressures
d) Filtration must equal reabsorption in order to avoid edema
e) None of the above

31. Given that the net filtration of fluid out of the capillaries averages about 3 liters per day, how is blood volume maintained in light of this apparent fluid loss?
a) Fluid is returned to the blood as lymphatic fluid by the lymphatic system.
b) Gravity moves the fluid to the lowest point in the body, where the fluid is absorbed.
c) The net filtration is equally balanced by absorption.
d) The kidneys are involved in the reabsorption of the remaining fluid.
e) Although fluid moves out across the capillary, it tends to move inward across veins.

32. The skeletal muscle pump:
a) Facilitates venous return
b) Helps increase venous blood pressure
c) Prevents blood from pooling in the extremities
d) All of the above
e) None of the above

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33. Blood pressure is:
    a) Regulated by baroreceptors in the aorta and carotid arteries
    b) Increased by activation of the parasympathetic nervous system
    c) Restored after acute blood loss because the firing of action potentials from the baroreceptors increases
    d) Regulated by a positive feedback loop
    e) All of the above

34. Which of the following could be the result of a baroreceptor reflex in response to a drop in mean arterial pressure:
    a) Decreased total peripheral resistance (TPR)
    b) Increase in heart rate
    c) Increase in parasympathetic nervous system output to the heart
    d) Decrease in venous pressure
    e) Decrease in ventricle contractility

35. Which of the following is not an important function of the conducting zone of the respiratory tract?
    a) Providing the "mucus escalator" mechanism that helps cleanse inhaled air.
    b) Warming the incoming air to 37^{o}C and humidifying it to 100% relative humidity.
    c) Providing a passageway through which air can flow.
    d) Providing supplementary respiratory gas exchange capacity.
    e) Regulating the resistance to air flow through the relaxation or constriction of smooth muscle.

36. At rest exhalation is a(n)_____ process that involves_____
    a) Passive ; relaxation of the diaphragm
    b) Active ; contraction of the diaphragm
    c) Active ; relaxation of the intercostals
    d) Passive ; contraction of the external intercostals
    e) Both A and D

37. Surfactant helps to prevent the alveoli from collapsing by _____.
    a) humidifying the air before it enters
    b) warming the air before it enters
    c) reducing the surface tension of alveolar fluid
    d) protecting the surface of alveoli from dehydration and other environmental variations
    e) strengthening lung bones

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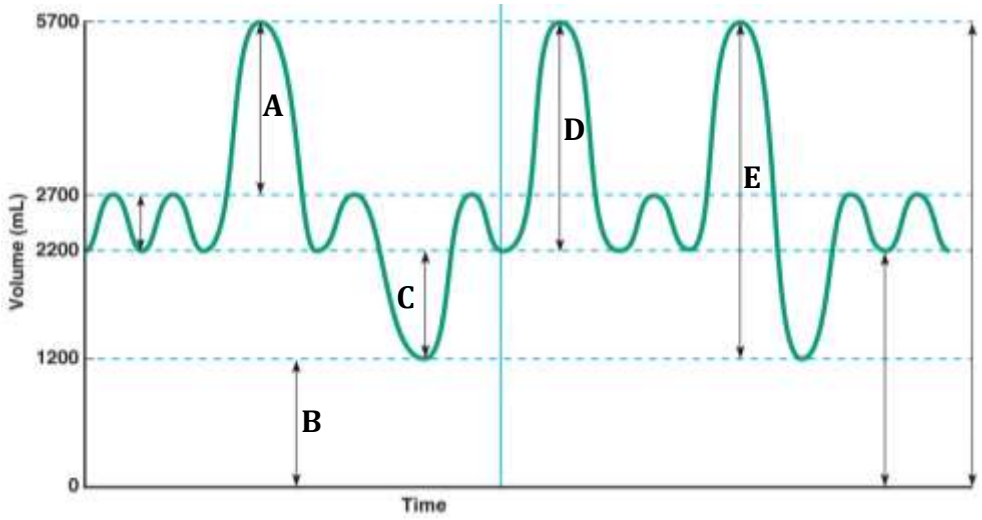
Use the diagram below to answer questions 38-39



38. Identify the letter in the above figure that corresponds to vital capacity.
    a) A.
    b) B.
    c) C.
    d) D.
    e) E.

39. Identify the letter in the above figure that represents the volume of air remaining in the lungs after a maximal exhalation.
    a) A.
    b) B.
    c) C.
    d) D.
    e) E.

40. A person is taking 12 breaths per minute and has a total ventilation of 6000 ml/min. What is his/her tidal volume? What is his/her alveolar ventilation if he/she has a dead space volume of 100 ml?
    a) 500 ml; 4800 ml/min.
    b) 500 ml; 1200 ml/min.
    c) 112.5 L; 1500 ml/min.
    d) 400 ml; 4800 ml/min.
    e) None of the above.

THE END