1. An End Plate Potential initiates an action potential, which propagates across the membrane and down into the T-Tubules in the muscle cell which causes the _____ to release _____,
   a) sarcoplasmic reticulum, $K^+$
   b) sarcoplasmic reticulum, $Ca^{++}$
   c) sarcoplasmic reticulum, $Na^+$
   d) troponin, $Ca^{++}$
   e) tropomyosin, $K^+$

2. which then binds to ______ and causes _____ to move aside, thereby exposing the myosin binding sites on the actin molecules. On the contact of myosin and actin, the myosin head releases _____ and phosphate, and the myosin head strokes forward.
   a) troponin; tropomyosin, ADP
   b) tropomyosin; troponin; ADP
   c) troponin; tropomyosin; ATP
   d) tropomyosin; troponin; ATP
   e) dense bodies; tropomyosin; ATP

3. How many motor neurons innervate a single skeletal muscle fiber? What % of muscle fibers in a motor unit contract when the motor neuron that innervates them is activated?
   a) 1; 100%
   b) 1; 50%
   c) 1; 1%
   d) depends on the muscle; 100%
   e) depends on the muscle; 50%

4. The functional unit (that is, the smallest component that performs all the functions of the whole muscle) of skeletal muscle is the
   a) Muscle fiber
   b) Myofibril
   c) Sarcomere
   d) Thin filament
   e) Thick filament
5. Which of the following statements about skeletal muscle motor units is true?
   a) The number of muscle fibers in a motor unit that contract is proportional to the strength of the action potential in the motor neuron
   b) Anytime a muscle contracts all the motor units in the muscle are activated
   c) Each motor unit contains all 3 muscle fiber types
   d) Both a and b are true
   e) None of the above are true

6. Which of the following accurately describes changes in a myofibril during contraction?
   a) the sarcomeres shorten
   b) z-lines get closer together
   c) the sarcomeres stay the same width
   d) both a and b occur
   e) both b and c occur

7. In Fig 1 part A is called _____; part C of Figure 1 is called ____
   a) Latent period; contraction time
   b) Latent period; relaxation time
   c) Contraction time; relaxation time
   d) Relaxation time; contraction time
   e) Contraction time; latent period

8. Which can be rapidly altered (in seconds) to influence the strength of skeletal muscle contraction?
   a) motor unit recruitment
   b) muscle fiber thickness
   c) frequency of stimulation
   d) all the above
   e) a and c only

9. Creatine phosphate is the _______ source of energy tapped by an exercising muscle. _______ is produced from creatine phosphate and _______ in the presence of the enzyme creatine phosphatase.
   a) first, ATP, Ca^{++}
   b) last, ADP, ATP
   c) first, ATP, ADP
   d) last, ATP, ADP
   e) first, ADP, ATP

10. Which of the following are characteristic of slow oxidative muscle fibers?
    a) low myosin-ATPase activity
    b) few mitochondria
    c) low capacity for oxidative phosphorylation
    d) few capillaries
    e) none of the above are characteristic of slow oxidative fibers

11. Mitochondrial density is high in which muscle fiber type(s)?
    a) Slow oxidative
    b) Fast oxidative
    c) Fast glycolytic
    d) Both a and b
    e) Both b and c
12. In Figure 2 part A is called __________________; part C is called __________________.
   a) Twitch; tetanus
   b) Twitch; summation
   c) Summation; tetanus
   d) Summation; twitch
   e) Tetanus; summation

13. Smooth muscle myogenic activity occurs in two different ways; by ______ and by ______.
   a) slow wave potential, functional unit recruitment
   b) functional unit recruitment, pacemaker activity
   c) slow wave potential, pacemaker activity
   d) slow wave potential, somatic nervous system
   e) slow wave potential, autonomic nervous system

Questions 14 to 16 refer to the following:

1. Skeletal  
2. Single Unit Smooth  
3. Multi Unit smooth 
4. Cardiac

14. What type of muscle is (are) linked by gap junctions?
   a) 2
   b) 2, 4
   c) 2, 3
   d) 2, 3, 4
   e) 4

15. What type of muscle contain(s) sarcomeres?
   a) 1
   b) 4
   c) 1, 2, 3, 4
   d) 1, 4
   e) 1, 3, 4

16. What type of muscle contract(s) using cross bridge cycling?
   a) 1
   b) 4
   c) 1, 4
   d) 2, 3
   e) 1, 2, 3, 4

17. During smooth muscle contraction, Ca++ enters the cell primarily from the ______ via the process of ________. The Ca++ then activates ______, which in turn activates ______ to phosphorylate myosin.
   a) ECF; active transport; calmodulin; myosin light chain kinase
   b) SR; diffusion; calmodulin; myosin light chain kinase
   c) SR; active transport; tropomyosin; myosin light chain kinase
   d) ECF; diffusion; calmodulin; myosin light chain kinase
   e) ECF; diffusion; myosin light chain kinase; calmodulin
18. Factors that modify cytosolic Ca\(^{++}\) levels and hence contractile strength in both single unit and multi-unit smooth muscle are
   a) both branches of the autonomic nervous system
   b) hormones
   c) metabolites
   d) somatic nervous system
   e) all the above except d

19. Indicate which is the proper sequence of blood flow though the circulatory system:
   1. right atrium  6. pulmonary vein
   2. left atrium  7. lungs
   3. right ventricle  8. systemic tissues
   4. left ventricle  9. aorta
   5. pulmonary artery  10. venae cavae
   a) 10-1-2-3-4-5-6-7-8-9
   b) 10-2-4-5-7-6-1-3-9-8
   c) 10-1-3-5-7-6-2-4-9-8
   d) 10-2-1-3-4-5-7-6-9-8
   e) 10-2-1-3-4-5-7-6-9-8

20. The normal pacemaker of the heart is the _____.
    Action potentials travel from there to the ___ via the internodal pathway; once there, the action potential slows down to allow the ventricles to fill with blood. The action potential then rapidly goes through the _____ and then the _____, and from there spreads into the contractile cells of the ventricles.
    a) bundles of His, AV node, SA node, Purkinje fibers
    b) AV node, SA node, Purkinje fibers, bundles of His
    c) AV node, SA node, bundles of His, Purkinje fibers
    d) SA node, AV node, Purkinje fibers, bundles of His
    e) SA node, AV node, bundles of His, Purkinje fibers

21. The pacemaker potential in a cardiac autorhythmic cell (part A of Fig 3) is caused by a discontinuation of the passive outward leak of _____, while _________ leaks into the cell at a higher rate. Then the membrane is further depolarized (part B of Fig 3) to reach threshold by ______. Finally, the rising phase of the action potential (part C of Fig 3) is caused by ______
    a) Na\(^+\), K\(^+\), the entry of Ca\(^{++}\), the entry of Ca\(^{++}\)
    b) K\(^+\), Na\(^-\), the entry of Ca\(^{++}\), the entry of Ca\(^{++}\)
    c) K\(^+\), Ca\(^{++}\), the entry of Ca\(^{++}\), the entry of Ca\(^{++}\)
    d) K\(^+\), Na\(^-\), the entry of Na\(^-\), the entry of Na\(^-\)
    e) K\(^+\), Na\(^-\), the entry of Ca\(^{++}\), the entry of Na\(^-\)

22. Action potentials enter cardiac contractile cardiac cells from _______. The arrival of the action potential results in _______ the cell, which causes part A of Fig 4. The plateau phase of a cardiac contractile cell action potential (part B of Fig 4) is caused by _____ the cell and the inactivation of most of the _____ channels.
    a) ECF; Na\(^-\) entering; Ca\(^{++}\) entering; K\(^+\)
    b) Gap junctions; Ca\(^{++}\) entering; Ca\(^{++}\) entering; Na\(^+\)
    c) Gap junctions; Na\(^-\) entering; Na\(^-\) entering; K\(^+\)
    d) Gap junctions; Na\(^-\) entering; Ca\(^{++}\) entering; K\(^+\)
    e) T-tubules; Ca\(^{++}\) entering; Ca\(^{++}\) entering; K\(^+\)
23. In an ECG, the P wave is caused by ________, the QRS complex is caused by _______ and the T wave is caused by __________.
   a) Atrial repolarization, ventricular repolarization, atrial depolarization
   b) Atrial depolarization, ventricular depolarization, ventricular repolarization
   c) Atrial depolarization, ventricular depolarization, atrial repolarization
   d) Ventricular depolarization, atrial repolarization, ventricular repolarization
   e) Ventricular repolarization, atrial depolarization, ventricular depolarization

24. Which of the following does NOT have a valve to prevent backflow of blood?
   a) junction of atrium and ventricle
   b) junction of ventricle and aorta
   c) junction of ventricle and pulmonary artery
   d) junctions of veins and atria
   e) none of the above

25. The parasympathetic nervous system can influence heart rate by
   a) increasing rate of depolarization of SA node and decreasing AV nodal delay
   b) decreasing rate of depolarization of SA node and increasing AV nodal delay
   c) increasing rate of depolarization of SA node and increasing AV nodal delay
   d) decreasing rate of depolarization of SA node and decreasing AV nodal delay
   e) none of the above because the parasympathetic can not influence heart rate

26. End Diastolic Volume is 150 ml/beat, End Systolic Volume is 80 ml/beat, and heart rate is 70 beats/min. What is the Cardiac Output?
   a) 4200 ml/min
   b) 420 ml/min
   c) 4900 ml/min
   d) 490 ml/min
   e) 49000 ml/min

27. Bulk flow is most important for
   a) exchange of materials between plasma and interstitial fluid
   b) distributing fluid between ECF and ICF
   c) distributing fluid between plasma and interstitial fluid
   d) regulating cardiac output
   e) regulating respiration rate

28. Capillary exchange is facilitated by
   a) Reduced flow rate of blood through capillaries
   b) Reduced velocity of blood through capillaries
   c) Large surface area of capillaries
   d) b and c only
   e) a and c only

29. Which of the following would you expect to see during a flight or flight response?
   a) Increased AV nodal delay
   b) Increased depolarization of the SA node
   c) Increased permeability of cardiac contractile cells to Ca++
   d) All the above
   e) Only b and c
Questions 30 to 33 refer to the following events in the cardiac cycle on the left side of the heart:

1) Atrial pressure is greater than ventricular pressure  
9) Blood flow is from atrium to ventricle
2) Atrial pressure is less than ventricular pressure  
10) No blood flow from atrium to ventricle
3) Aortic pressure is greater than ventricular pressure  
11) Blood flow is from ventricle to aorta
4) Aortic pressure is less than ventricular pressure  
12) No blood flow from ventricle to aorta
5) AV valve is open  
13) Blood flow from vein to atrium
6) AV valve is closed  
14) No blood flow from vein to atrium
7) Aortic valve is open
8) Aortic valve is closed

30. Which of the following best describe the events during the ST interval in an ECG?
   a) 1, 3, 5, 8, 9, 12, 14
   b) 1, 3, 5, 8, 9, 12, 13
   c) 2, 4, 6, 7, 10, 11, 13
   d) 2, 4, 6, 7, 10, 11, 14
   e) 2, 3, 5, 8, 9, 12, 14

31. Which of the following best describe the events that occur when the end systolic volume can be measured (i.e., from the middle of the T wave to the end of the T wave)?
   a) 2, 3, 6, 8, 10, 12, 14
   b) 2, 3, 6, 8, 10, 12, 13
   c) 1, 4, 5, 7, 9, 12, 13
   d) 1, 3, 5, 8, 9, 12, 13
   e) 2, 4, 6, 7, 10, 11, 13

32. Which of the following best describe the events that occur during the TP interval in an ECG?
   a) 1, 3, 5, 8, 9, 12, 14
   b) 1, 3, 5, 8, 9, 12, 13
   c) 2, 3, 6, 8, 10, 12, 14
   d) 2, 3, 6, 8, 10, 12, 13
   e) 2, 3, 6, 8, 10, 11, 14

33. Which of the following best describe the events during the PQ interval in an ECG?
   a) 2, 3, 6, 8, 10, 11, 14
   b) 2, 3, 6, 8, 10, 12, 13
   c) 1, 4, 5, 7, 9, 12, 13
   d) 1, 3, 5, 8, 9, 12, 14
   e) 1, 3, 5, 8, 9, 12, 13

34. Which of the following is going to cause increased vasodilation in arterioles?
   a) Increased histamine in the tissue
   b) Increased carbon dioxide in the tissue
   c) Decreased oxygen in the tissue
   d) All the above
   e) Both b and c only
35. Which of the following is the most important method of capillary exchange?
   a) vesicular transport
   b) passive diffusion
   c) bulk flow
   d) active transport
   e) Na\(^+\)-K\(^+\)-ATPase pump

36. Which of the following statements about veins is NOT true?
   a) skeletal muscle activity increases venous return
   b) veins have one way valves to prevent backflow of blood
   c) the lower pressure in the chest cavity aids venous return
   d) veins are high resistance blood vessels
   e) sympathetic stimulation increases venous return

37. Blood pressure is equal to
   a) Cardiac Output divided by Resistance
   b) Cardiac Output times Resistance
   c) Resistance divided by Cardiac Output
   d) Cardiac Output plus Resistance
   e) Resistance minus Cardiac Output

38. Red blood cells contain
   a) Hemoglobin
   b) Organelles
   c) Nucleus
   d) All the above
   e) Both a and c

39. If the hematocrit is 45, about what percentage of the whole blood is plasma?
   a) 35%
   b) 40%
   c) 45%
   d) 50%
   e) 55%

40. Indicate the proper sequence of events during hemostasis:

   1. fibrin produced from fibrinogen
   2. inhibition of prostacyclin production
   3. release of cascade of clotting factors
   4. platelet attachment to damaged collagen
   5. vascular spasms

   a) 1-2-3-4-5
   b) 5-2-4-3-1
   c) 5-3-1-2-4
   d) 5-4-3-1-2
   e) 3-2-4-5-1
41. When blood pressure becomes elevated above normal your body responds by
   a) Increasing the rate of action potentials in afferent nerves of baroreceptors
   b) Decreasing the sympathetic cardiac nerve activity
   c) Increasing the sympathetic vasoconstrictor nerve activity
   d) Decreasing heart rate and stroke volume
   e) All the above are true except c

42. Pacemaker activity shifting to the Purkinje fibers or Branch Bundles is called
   a) Atrial flutter
   b) Ectopic focus
   c) Ventricular fibrillation
   d) Myocardial infarction
   e) Atrial fibrillation

43. Muscular dystrophy is caused by an inability to
   a) Regulate Na⁺ leaks in muscle cells
   b) Regulate K⁺ leaks in muscle cells
   c) Regulate Ca²⁺ leaks in muscle cells
   d) Regulate acetylcholine binding to muscle cells
   e) Regulate Cl⁻ leaks in muscle cells

44. Which of the following would you expect in a trained endurance athlete versus an untrained person?
   a) Higher maximum heart rate
   b) More mitochondria in the heart
   c) More capillaries in the heart
   d) Increase in blood volume
   e) All the above

45. The leading cause of death in Western nations is
   a) Heart block
   b) Cancer
   c) Atrial flutter
   d) Atrial fibrillation
   e) Ischemic heart disease
Biology 251  
4 November 2010  
Exam Three  
FORM W KEY

PRINT YOUR NAME AND ID NUMBER in the space that is provided on the answer sheet, and then blacken the letter boxes below the corresponding letters of your name and ID number. You will have 4 points deducted if you fail to do this!!!!!!

WRITE YOUR TEST FORM LETTER above your name on the answer sheet.

WRITE YOUR LAB SECTION DAY & TIME AND TA'S NAME on the upper margin of your answer sheet.

Your exam should have 45 questions. Please check to make sure it is complete.

For each of the following questions, please indicate the most correct answer by blackening the corresponding letter on the accompanying answer sheet. Each correct answer is worth 2 points. Partial credit of ½ point may be available for questions that have answers such as “all the above”, “both a and b are true”, etc.

1. Which of the following is NOT a property of glycolytic fibers as compared to oxidative fibers?
   a) high capacity for lactic acid production
   b) fewer capillaries
   c) absence of myoglobin
   d) poor ability to produce ATP in the absence of oxygen
   e) readily fatigable

2. An increase in venous return would result in a(n) ________.
   a) increased end-systolic volume
   b) decreased end-systolic volume
   c) decreased end-diastolic volume
   d) increased end-diastolic volume
   e) increase mid-systolic volume

3. Blockage of cardiac arteries is most likely to lead to
   a) Heart block
   b) Ectopic focus
   c) Atrial flutter
   d) Atrial fibrillation
   e) Ischemic heart disease

4. A skeletal muscle is composed of many _____, each of which is composed of many ______, which in turn are composed of ________.
   a) Myofibrils, thick filaments, thin filaments
   b) Muscle fibers, myofibrils, thick and thin filaments
   c) Myofibrils, muscle fibers, thick and thin filaments
   d) Muscle fibers, thick filaments, myofibrils
   e) Muscle fibers, thick filaments, thin filaments
5. The fundamental repeating unit of the myofibril called a ________ gives skeletal muscle its striated appearance, and is bordered by ________.  
   a) crossbridge : Z lines 
   b) sarcomere : M lines 
   c) sarcomere : I bands 
   **d) sarcomere : Z lines** 
   e) crossbridge : A bands

6. Place the sequence of a skeletal muscle contraction in order:  
   1. Ca\(^{++}\) binds to troponin  
   2. End Plate Potential becomes Action Potential on surface of membrane  
   3. Tropomyosin moves aside  
   4. Actin binds to myosin  
   5. Action potential moves into T tubules  
   6 Ca\(^{++}\) released from SR  
   7. Cross-bridge cycling occurs  
   8. Ca\(^{++}\) pumped into SR 
   a) 2-6-5-1-3-4-7-8 
   **b) 2-5-6-1-3-4-7-8** 
   c) 2-5-6-1-4-3-7-8 
   d) 2-8-5-6-3-4-7-1 
   e) 2-5-6-3-4-1-7-8

7. The latent period of muscle contraction is the  
   a) time between initiation of stimulation and peak tension 
   **b) time between initiation of stimulation and start of contraction** 
   c) time between start of contraction and complete relaxation  
   d) time between start of contraction and peak tension  
   e) time between peak tension and complete relaxation

8. What percent of your blood plasma is water? 
   a) 10% 
   b) 45%  
   c) 55% 
   d) 75%  
   **e) 90%**

9. The energy source that can be used most rapidly by contracting muscle is  
   a) ATP produced from glycolysis 
   b) ATP produced from Krebs cycle 
   **c) ATP produced from creatine phosphate** 
   d) ATP produced from oxidative phosphorylation  
   e) Both b and d combined

10. Which of the following is NOT an accurate description of specific muscle fiber types?  
    a) Fast glycolytic fibers are the largest diameter fibers.  
    b) Slow oxidative fibers are the smallest diameter fibers.  
    **c) Slow oxidative fibers are quick to fatigue.** 
    d) Fast glycolytic fibers produce their ATP by glycolysis. 
    e) Fast oxidative fibers have a high mitochondrial density.
Questions 11 to 15 refer to the following:

1. Skeletal  
2. Single Unit Smooth  
3. Multi Unit Smooth  
4. Cardiac Contractile  
5. Cardiac Autorhythmic

11. In which type(s) of muscle can functional units of muscle cells act independently?
   a) 1  
   b) 2  
   c) 1 and 3  
   d) 1 and 2  
   e) 1, 2, and 3

12. In what type of muscle does Ca** activate calmodulin?
   a) 2  
   b) 3  
   c) 2 and 3  
   d) 2, 3 and 5  
   e) 2, 3, 4 and 5

13. What type of muscle contain(s) thin filaments made of actin and thick filaments made of myosin?
   a) 1  
   b) 1 and 4  
   c) 1, 4 and 5  
   d) 1, 3, 4 and 5  
   e) 1, 2, 3, 4 and 5

14. What type of muscle can generate action potentials myogenically (i.e., on its own)?
   a) 2  
   b) 4  
   c) 2 and 3  
   d) 2 and 5  
   e) 2, 3 and 5

15. What type of muscle can generate slow wave potentials?
   a) 2  
   b) 2 and 3  
   c) 2, 3 and 5  
   d) 2 and 5  
   e) 2, 3, 4 and 5

16. Part A of Fig 1 is caused by a decrease in the outward leak of _____, while at the same time an increase occurs in the inward leak of ______ by ________.
   a) Ca**, Na**, passive diffusion  
   b) K*, Na*, passive diffusion  
   c) K*, Na*, active transport  
   d) Ca**, Na*, active transport  
   e) K*, Ca**, passive diffusion
17. Indicate which is the proper sequence of blood flow through the circulatory system:
   1. right atrium  6. pulmonary vein
   2. left atrium  7. lungs
   3. right ventricle  8. systemic tissues
   4. left ventricle  9. aorta
   5. pulmonary artery  10. venae cavae
   a) 10-1-2-3-4-5-6-7-8-9
   b) 10-2-4-5-7-6-1-3-9-8
   c) **10-1-3-5-7-6-2-4-9-8**
   d) 10-1-2-3-4-5-7-6-9-8
   e) 10-2-1-3-4-5-7-6-9-8

18. How does the frequency of muscle stimulation influence the strength of contraction of the whole muscle?
   a) It ensures that the optimal length of the muscle is achieved
   b) **It allows twitch summation**
   c) **It allows tetanus**
   d) It allows asynchronous recruitment
   e) **Both b and c are true**

19. Part C of Fig 1 is caused by _______ ions _______ the cell by the process of _______.
   a) K⁺, exiting, passive diffusion
   b) Na⁺, entering, passive diffusion
   c) **Ca²⁺, entering, passive diffusion**
   d) Na⁺, entering, active transport
   e) Ca²⁺, entering, active transport

20. The parasympathetic decreases heart rate by changing the following properties of the SA node:
   _______ Na⁺ leaks into the cells, _______ Ca²⁺ leaks into the cells, and _______K⁺ leaks out of
   the cells, all of which make the membrane potential more _______.
   a) decrease; decrease; decrease; negative
   b) **decrease; decrease; increase, negative**
   c) increase; increase; decrease; negative
   d) decrease; decrease; increase; positive
   e) increase; increase; decrease; positive

21. Which of the following is the correct conduction pathway through the heart?
   a) Purkinje fibers; bundle of His; bundle branches; SA node; AV node
   b) **SA node; AV node; bundle of His; bundle branches; Purkinje fibers**
   c) AV node; SA node; bundle branches; bundle of His; Purkinje fibers
   d) Bundle of His; bundle branches; Purkinje fibers; SA node; AV node
   e) SA node; Purkinje fibers; AV node; bundle of His; bundle branches

22. What is a motor unit?
   a) all the muscle fibers in a fascicle
   b) all the myofibrils in a muscle fiber
   c) a muscle fiber and all the motor neurons that innervate it
   d) **a motor neuron and all the muscle fibers it innervates**
   e) a spinal nerve and all the muscle fibers it innervates
23. Place the sequence of cross-bridge cycling in order:
   1. Ca\textsuperscript{++} released from SR
   2. “Power stroke” as myosin pulls actin forward
   3. ATP split into ADP and Phosphate on myosin
   4. Myosin binding site on actin exposed
   5. ADP released by myosin
   6. ATP binds myosin
   7. Actin releases myosin
   a) 1-7-6-3-5-4-2
   b) 1-3-4-5-2-7-6
   c) \textbf{1-4-2-5-6-7-3}
   d) 1-4-2-5-7-6-3
   e) 1-6-3-4-2-5-7

24. 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) The lymphatic system returns filtered fluid is returned to the blood.
   b) The net filtration is equally balanced by absorption.
   c) Gravity moves the fluid to the lowest point in the body, where the fluid is absorbed.
   d) While fluid moves out across the capillary, it tends to move inward across veins.
   e) The kidneys are involved in the reabsorption of the remaining fluid.

25. Which of the following is (are) NOT true of arterioles?
   a) They can regulate blood flow to specific organs
   b) They regulate arterial blood pressure
   c) They convert the systolic-diastolic pressure swing into a non-fluctuating pressure
   d) **They are the site of material exchange with the tissues**
   e) Both c and d are not true of arterioles.

26. Part 0 of Fig. 2 is caused by ______ ions _______ the cell by the process of ______.
   a) K\textsuperscript{+}, exiting, passive diffusion
   b) Na\textsuperscript{+}, entering, passive diffusion
   c) Ca\textsuperscript{++}, entering, passive diffusion
   d) Na\textsuperscript{+}, entering, active transport
   e) Ca\textsuperscript{++}, entering, active transport

27. Which of the following would you expect in a trained endurance athlete versus an untrained person?
   a) Higher maximum heart rate
   b) Lower resting heart rate
   c) Higher workload at maximum heart rate
   d) Both a and b
   e) Both b and c

28. Which of the following statements about contraction of cardiac contractile cells is false?
   a) Ca\textsuperscript{++} enters the cell from the ECF
   b) Ca\textsuperscript{++} enters the cell from the SR
   c) **Ca\textsuperscript{++} activates calmodulin**
   d) Both a and c are false statements
   e) Both b and c are false statements
Questions 29 to 32 refer to the following events in the cardiac cycle on the left side of the heart:

1) Atrium is in diastole                         9) Ventricle is in diastole
2) Atrium is in systole                        10) Ventricle is in systole
3) Atrial pressure is greater than ventricular pressure 11) Ventricular pressure is greater than aortic pressure
4) Atrial pressure is less than ventricular pressure 12) Ventricular pressure is less than aortic pressure
5) AV valve is closed                          13) Aortic valve is closed
6) AV valve is open                            14) Aortic valve is open
7) Blood flow is from atrium to ventricle      15) Blood flow is from ventricle to aorta
8) No blood flow from atrium to ventricle      16) No blood flow from ventricle to aorta

29. Which of the following best describe the events during the ST interval in an ECG?
   a) 2, 4, 6, 7, 9, 12, 14, 15
   b) 2, 3, 6, 7, 9, 12, 13, 16
   c) 1, 4, 5, 8, 9, 12, 13, 16
   d) **1, 4, 5, 8, 10, 11, 14, 15**
   e) 1, 3, 6, 7, 10, 11, 13, 15

30. Which of the following best describe the events that occur when the end systolic volume can be measured (i.e., from the peak of the T wave to the end of the T wave in an ECG)?
   a) 1, 4, 5, 8, 10, 11, 13, 15
   b) 1, 4, 5, 8, 9, 11, 14, 15
   c) **1, 4, 5, 8, 9, 12, 13, 16**
   d) 1, 3, 6, 7, 10, 11, 13, 15
   e) 1, 3, 6, 7, 9, 12, 13, 16

31. Which of the following best describe the events that occur during the TP interval in an ECG?
   a) 2, 3, 6, 7, 9, 12, 13, 16
   b) 1, 3, 6, 7, 10, 11, 13, 15
   c) 1, 3, 6, 7, 9, 12, 14, 15
   d) **1, 3, 6, 7, 9, 12, 13, 16**
   e) 1, 4, 5, 8, 10, 11, 13, 15

32. Which of the following best describe the events during the PQ interval in an ECG?
   a) **2, 3, 6, 7, 9, 12, 13, 16**
   b) 1, 3, 6, 7, 10, 11, 13, 15
   c) 1, 3, 6, 7, 9, 12, 13, 16
   d) 1, 3, 6, 7, 9, 12, 14, 15
   e) 1, 4, 5, 8, 10, 11, 13, 15

33. The binding of epi and/or norepi to ______ receptors on contractile cells in the ventricles will increase contractile strength of ventricles by ______ the Ca++ permeability of the cells, ______ Ca++ movement out of the SR, ______ the rate of myosin ATPase activity and _____ the rate of pumping Ca++ back into the SR.
   a) Beta-2; increasing; increasing; decreasing; decreasing
   b) Beta-1; increasing; increasing; decreasing; decreasing
   c) Beta-1; decreasing; increasing; decreasing; increasing
   d) Beta-2; increasing; increasing; increasing; decreasing
   e) **Beta-1; increasing; increasing; increasing; increasing**
34. Which of the following functions in forming blood clots?
   a) erythrocytes only
   b) leukocytes only
   c) platelets only
   d) both erythrocytes and leukocytes
   e) both leukocytes and platelets

35. Which of the following would NOT cause arterioles to vasodilate?
   a) Increased CO₂ in the surrounding tissue
   b) Binding of epi by beta-2 receptors on the arteriole
   c) Histamine release in the surrounding tissue
   d) Increased O₂ in the surrounding tissue
   e) Neither c nor d would cause vasodilatation

36. Capillary exchange is facilitated by
   a) Increased flow rate of blood through capillaries
   b) Increased velocity of blood through capillaries
   c) Large surface area of capillaries
   d) b and c only
   e) a and c only

37. Bulk flow is most important for
   a) exchange of materials between plasma and interstitial fluid
   b) distributing fluid between ECF and ICF
   c) distributing fluid between plasma and interstitial fluid
   d) distributing fluid between interstitial fluid and the ICF
   e) regulating cardiac output

38. Your hematocrit level is
   a) The percent of whole blood that is red blood cells
   b) The percent of whole blood that is plasma
   c) The percent of your ECF that is plasma
   d) The percent of your ECF that is interstitial fluid
   e) The percent of your total body fluids that are ECF

39. Choose the correct order of the steps of synaptic transmission at the motor end plate are listed.
   1. Acetylcholine binds to postsynaptic receptors.
   2. Acetylcholine is released.
   3. A graded depolarization is produced.
   4. An action potential is produced on the muscle cell membrane.
   5. Channels for both sodium and potassium are opened.
   7. An action potential arrives at the axon terminal.

   a) 7-5-2-1-3-4-6
   b) 7-6-2-1-5-3-4
   c) 5-2-3-1-7-4-6
   d) 2-1-5-3-6-7-4
   e) 4-3-5-7-2-6-1
40. Indicate the proper sequence of events during hemostasis:
1. fibrin produced from fibrinogen
2. inhibition of prostacyclin production
3. release of cascade of clotting factors
4. platelet attachment to damaged collagen
5. vascular spasms
   a) 1-2-3-4-5
   b) 5-2-4-3-1
   c) 5-3-1-2-4
d) 5-4-3-1-2
e) 3-2-4-5-1

41. End Diastolic Volume is 150 ml/beat, End Systolic Volume is 80 ml/beat, and heart rate is 60 beats/min. What is the stroke volume? What is the cardiac output?
   a) 230 ml/beat; 290 ml/min
   b) 70 ml/beat; 1300 ml/min
   c) 20 ml/beat; 120 ml/min
d) 70 ml/beat; 4200 ml/min
e) 70 ml/beat; 4900 ml/min

42. Which of the following statement about pressure are true?
   a) \( P = R/F \) (where \( P \) = pressure, \( F \) = flow rate and \( R \) = resistance)
   b) Increasing the resistance in a vessel will decrease the pressure.
   c) Increasing the flow rate will decrease the pressure
d) If a vessel radius is increased by a factor of 2, pressure in that vessel will decrease by 16
e) Both a and d are true

43. During smooth muscle contraction, \( Ca^{++} \) enters the cell primarily from the ______ via the process of _______. The \( Ca^{++} \) then activates _______, which in turn activates ______ to phosphorylate myosin so that cross bridge cycling between thick and thin filaments occurs. At the end of the contraction, \( Ca^{++} \) is removed from the cell by the process of _______.
   a) ECF; diffusion; calmodulin; myosin light chain kinase; diffusion
   b) SR; diffusion; calmodulin; myosin light chain kinase; active transport
c) SR; active transport; tropomyosin; myosin light chain kinase; active transport
d) ECF; diffusion; calmodulin; myosin light chain kinase; active transport
e) ECF; diffusion; myosin light chain kinase; calmodulin; active transport

44. Which of the following does NOT occur during the “oxygen debt” recovery from exercise?
   a) Production of ATP from creatine phosphate
   b) Replenishment of glycogen stores
   c) Metabolisms of lactic acid
d) Recovery from high levels of epi
e) Recovery from elevated chemical reactions

45. Ventricular fibrillation is
   a) Rapid but regular depolarizations and contractions of ventricles
   b) Rapid irregular uncoordinated depolarizations contractions of ventricles
c) Action potentials not conducted between atria and ventricles
d) Overexcitation of non-SA node autorhythmic regions of heart
e) Reduced blood supply to heart
Biology 251  
3 November 2011  
Exam Three  
FORM W KEY

PRINT YOUR NAME AND ID NUMBER in the space that is provided on the answer sheet, and then blacken the letter boxes below the corresponding letters of your name and ID number. You will have 10 points deducted if you fail to do this!!!!!!

WRITE YOUR TEST FORM LETTER above your name on the answer sheet.

WRITE YOUR LAB SECTION # AND TA’S NAME on the upper margin of your answer sheet.

Your exam should have 45 questions. Please check to make sure it is complete.

For each of the following questions, please indicate the most correct answer by blackening the corresponding letter on the accompanying answer sheet. Each correct answer is worth 2 points. Partial credit of ½ point may be available for questions that have answers such as “all the above”, “both a and b are true”, etc.

Questions 1 to 3 refer to the following events in the cardiac cycle on the left side of the heart:
1) Atrium is in diastole  
2) Atrium is in systole  
3) Atrial pressure is greater than ventricular pressure  
4) Atrial pressure is less than ventricular pressure  
5) AV valve is closed  
6) AV valve is open  
7) Blood flow is from atrium to ventricle  
8) No blood flow from atrium to ventricle  
9) Ventricle is in diastole  
10) Ventricle is in systole  
11) Ventricle pressure is greater than aortic pressure  
12) Ventricle pressure is less than aortic pressure  
13) Aortic valve is closed  
14) Aortic valve is open  
15) Blood flow is from ventricle to aorta  
16) No blood flow from ventricle to aorta

1. Which of the following best describe the events during the ST interval in an ECG?
   a)  2, 4, 6, 7, 9, 12, 14, 15  
   b)  2, 3, 6, 7, 9, 12, 13, 16  
   c)  1, 4, 5, 8, 9, 12, 13, 16  
   d)  1, 4, 5, 8, 10, 11, 14, 15  
   e)  1, 3, 6, 7, 10, 11, 13, 15

2. Which of the following best describe the events that occur when the end systolic volume can be measured (i.e., from the peak of the T wave to the end of the T wave in an ECG)?
   a)  1, 4, 5, 8, 10, 11, 13, 15  
   b)  1, 4, 5, 8, 9, 11, 14, 15  
   c)  1, 4, 5, 8, 9, 12, 13, 16  
   d)  1, 3, 6, 7, 10, 11, 13, 15  
   e)  1, 3, 6, 7, 9, 12, 13, 16

3. Which of the following best describe the events that occur during the TP interval in an ECG?
   a)  2, 3, 6, 7, 9, 12, 13, 16  
   b)  1, 3, 6, 7, 10, 11, 13, 15  
   c)  1, 3, 6, 7, 9, 12, 14, 15  
   d)  1, 3, 6, 7, 9, 12, 13, 16  
   e)  1, 4, 5, 8, 10, 11, 13, 15
Questions 4 to 7 refer to the following:

1. Skeletal  
2. Single Unit Smooth  
3. Multi Unit Smooth  
4. Cardiac Contractile  
5. Cardiac Autorhythmic

4. In which type(s) of muscle can functional units be independently activated?
   a) 1  
   b) 2  
   c) 1 and 3  
   d) 1 and 2  
   e) 1, 2, and 3

5. What type(s) of muscle contain(s) sarcomeres?
   a) 1  
   b) 4  
   c) 1, 2, 3, 4  
   d) 1, 4, 5  
   e) 1, 3, 4

6. What type(s) of muscle is (are) controlled by the somatic nervous system?
   a) 1  
   b) 2 and 3  
   c) 4 and 5  
   d) 2, 3, 4 and 5  
   e) 1, 2, 3, 4 and 5

7. What type(s) of muscle contain(s) thin filaments made of actin and thick filaments made of myosin?
   a) 1  
   b) 1 and 4  
   c) 1, 4 and 5  
   d) 1, 3, 4 and 5  
   e) 1, 2, 3, 4 and 5

8. The shortening of a skeletal muscle fiber during contraction involves which of the following?
   a) the thick filaments shortening  
   b) the thin filaments shortening  
   c) the sarcomeres shortening  
   d) the A bands shortening  
   e) the Z lines not changing their position

9. End Diastolic Volume is 150 ml/beat, End Systolic Volume is 80 ml/beat, and heart rate is 60 beats/min. What is the stroke volume? What is the cardiac output?
   a) 230 ml/beat; 290 ml/min  
   b) 70 ml/beat; 1300 ml/min  
   c) 20 ml/beat; 120 ml/min  
   d) 70 ml/beat; 4200 ml/min  
   e) 70 ml/beat; 4900 ml/min
10. Pacemaker activity shifting to the Purkinje fibers is called
   a) Atrial flutter
   b) Ectopic focus
   c) Ventricular fibrillation
   d) Myocardial infarction
   e) Atrial fibrillation

11. How many motor neurons innervate a single skeletal muscle fiber? What % of muscle fibers in a motor unit contract when the motor neuron that innervates them is activated?
   a) 1; 100%
   b) 1; 50%
   c) 1; 1%
   d) depends on the muscle; 100%
   e) depends on the muscle; 50%

12. The parasympathetic decreases heart rate by changing the following properties of the SA node:
    _______ Na⁺ leaks into the cells, _______ Ca⁺⁺ leaks into the cells, and _______ K⁺ leaks out of the cells, all of which make the membrane potential more _______.
    a) decrease; decrease; decrease; negative
    b) decrease; decrease; increase; negative
    c) increase; increase; decrease; negative
    d) decrease; decrease; increase; positive
    e) increase; increase; decrease; positive

13. Capillary exchange is facilitated by
    a) Reduced flow rate of blood through capillaries
    b) Reduced velocity of blood through capillaries
    c) Large surface area of capillaries
    d) b and c only
    e) All the above

14. Which of the following statement about pressure are true?
    a) \( P = \frac{R}{F} \) (where \( P \) = pressure, \( F \) = flow rate and \( R \) = resistance)
    b) Increasing the resistance in a vessel will decrease the pressure.
    c) Increasing the flow rate will decrease the pressure.
    d) If a vessel radius is increased by a factor of 2, pressure in that vessel will decrease by 16
    e) Both b and d are true

15. Which of the following does NOT occur during the “oxygen debt” recovery from exercise?
    a) Production of ATP from creatine phosphate
    b) Replenishment of glycogen stores
    c) Metabolisms of lactic acide
    d) Recovery from high levels of epi
    e) Recovery from elevated chemical reactions

16. Which of the following is NOT a property of glycolytic fibers as compared to oxidative fibers?
    a) high capacity for lactic acid production
    b) fewer capillaries
    c) reduced mitochondria
    d) poor ability to produce ATP in the absence of oxygen
    e) readily fatiguable
17. Which can be rapidly altered (in seconds) to influence the strength of skeletal muscle contraction?
   a) motor unit recruitment
   b) muscle fiber thickness
   c) frequency of stimulation
   d) all the above
   e) a and c only

18. Indicate the proper sequence of events during hemostasis:
   1. fibrin produced from fibrinogen
   2. inhibition of prostacyclin production
   3. release of cascade of clotting factors
   4. platelet attachment to damaged collagen
   5. vascular spasms

   a) 1-2-3-4-5
   b) 5-2-4-3-1
   c) 5-3-1-2-4
   d) 5-4-3-1-2
   e) 3-2-4-5-1

19. Red blood cells contain
   a) Hemoglobin
   b) Organelles
   c) Nucleus
   d) All the above
   e) Both a and c

20. During smooth muscle contraction, Ca++ enters the cell primarily from the _____ via the process of _________. The Ca++ then activates _______, which in turn activates ______ to phosphorylate myosin so that cross bridge cycling between thick and thin filaments occurs. At the end of the contraction, Ca++ is removed from the cell by the process of _________.

   a) ECF; diffusion; calmodulin; myosin light chain kinase; diffusion
   b) SR; diffusion; calmodulin; myosin light chain kinase; active transport
   c) SR; active transport; tropomyosin; myosin light chain kinase; active transport
   d) ECF; diffusion; calmodulin; myosin light chain kinase; active transport
   e) ECF; diffusion; myosin light chain kinase; calmodulin; active transport

21. Where are gap junctions commonly found?
   a) single-unit smooth muscle only
   b) multi-unit smooth muscle only
   c) cardiac muscle only
   d) both single-unit smooth muscle and cardiac muscle
   e) both single-unit and multi-unit smooth muscle
22. Indicate which is the proper sequence of blood flow through the circulatory system:

   1. right atrium
   2. left atrium
   3. right ventricle
   4. left ventricle
   5. pulmonary artery
   6. pulmonary vein
   7. lungs
   8. systemic tissues
   9. aorta
   10. venae cavae

   f) 10-1-2-3-4-5-6-7-8-9
   g) 10-2-4-5-7-6-1-3-9-8
   h) **10-1-3-5-7-6-2-4-9-8**
   i) 10-1-2-3-4-5-7-6-9-8
   j) 10-2-1-3-4-5-7-6-9-8

23. In an ECG, the P wave is caused by ________, the QRS complex is caused by _______ and the T wave is caused by ________.

   a) Atrial repolarization, ventricular repolarization, atrial depolarization
   b) Atrial depolarization, ventricular depolarization, ventricular repolarization
   c) Atrial depolarization, ventricular depolarization, atrial repolarization
   d) Ventricular depolarization, atrial repolarization, ventricular repolarization
   e) Ventricular repolarization, atrial depolarization, ventricular depolarization

24. Which of the following does NOT have a valve to prevent backflow of blood?

   a) junction of atrium and ventricle
   b) junction of ventricle and aorta
   c) junction of ventricle and pulmonary artery
   d) **junctons of veins and atria**
   e) none of the above

25. The normal pacemaker of the heart is the ______. Action potentials travel from there to the ___ via the internodal pathway; once there, the action potential slows down to allow the ventricles to fill with blood. The action potential then rapidly goes through the _____ and then the _____, and from there spreads into the contractile cells of the ventricles.

   a) bundles of His, AV node, SA node, Purkinje fibers
   b) AV node, SA node, Purkinje fibers, bundles of His
   c) AV node, SA node, bundles of His, Purkinje fibers
   d) SA node, AV node, Purkinje Fibers, bundles of His
   e) **SA node, AV node, bundles of His, Purkinje fibers**

26. Which of the following is going to cause increased vasodilation in arterioles?

   a) Increased oxygen in the tissue
   b) **Increased carbon dioxide in the tissue**
   c) Decreased oxygen in the tissue
   d) Increased histamine in the tissue
   e) All the above occur except a

27. If the hematocrit is 45, about what percentage of the whole blood is plasma?

   a) 35%
   b) 40%
   c) 45%
   d) 50%
   e) **55%**
28. A skeletal muscle is composed of many _____, each of which is composed of many ______, which in turn are composed of ________.
   a) Myofibrils, thick filaments, thin filaments
   b) **Muscle fibers, myofibrils, thick and thin filaments**
   c) Myofibrils, muscle fibers, thick and thin filaments
   d) Muscle fibers, thick filaments, myofibrils
   e) Muscle fibers, thick filaments, thin filaments

29. An initial phase of depolarization caused by a decrease in K⁺ leaking from the cell as Na⁺ continues to leak into the cell occurs in
   a) neurons
   b) **autorehythmic cardiac cells**
   c) contractile cardiac cells
   d) all the above
   e) only b and c

30. In order for crossbridge cycling to occur, the actin-myosin complex must be broken by which of the following?
   a) binding of tropomyosin to myosin
   b) binding of ATP to actin
   c) binding of the troponin complex to actin
   d) conformational change that occurs as the myosin head changes from the high to low energy state
   e) binding of ATP to myosin

31. The binding of epi and/or norepi to ______ receptors on contractile cells in the ventricles will increase contractile strength of ventricles by ______ the Ca⁺⁺ permeability of the cells, ______ Ca⁺⁺ movement out of the SR, _______ the rate of myosin ATPase activity and _____ the rate of pumping Ca⁺⁺ back into the SR.
   a) Beta-2; increasing; increasing; decreasing; decreasing
   b) Beta-1; increasing; increasing; decreasing; decreasing
   c) Beta-1; decreasing; increasing; decreasing; increasing
   d) Beta-2; increasing; increasing; increasing; decreasing
   e) Beta-1; increasing; increasing; increasing; increasing

32. The opening and closure of the atrioventricular and semilunar valves is driven by ________.
   a) contraction of the valve
   b) contraction of muscles attached to the valves
   c) contraction of the ventricle and atria that pull the valves into place
   d) **differences in pressure across the valve**
   e) contraction and relaxation of the valve

33. Which of the following is the most important method of capillary exchange?
   a) vesicular transport
   b) **passive diffusion**
   c) bulk flow
   d) active transport
   e) Na⁺⁻K⁺⁻ATPase pump
34. The most important function of the lymph system is  
   a) to return to cardiovascular system excess fluid filtered out of capillaries  
   b) to facilitate exchange of material between plasma and interstitial fluid  
   c) to enhance venous return  
   d) to regulate the ICF osmolarity  
   e) to regulate Na⁺ retention

35. Creatine phosphate is the ________ source of energy tapped by an exercising muscle. _______ is produced from creatine phosphate and _______ in the presence of the enzyme creatine phosphatase.  
   a) first, ATP, Ca⁺⁺  
   b) last, ADP, ATP  
   c) first, ATP, ADP  
   d) first, Ca⁺⁺, ADP  
   e) first, ADP, ATP

36. Your blood plasma volume is about 2.75 liters. How much fluid passes through your lymph system each day?  
   a) About 0.5 liters  
   b) About 1 liter  
   c) About 1.5 liters  
   d) About 3 liters  
   e) About 6 liters

37. Blood pressure is equal to  
   a) Cardiac Output divided by Resistance  
   b) Cardiac Output times Resistance  
   c) Resistance divided by Cardiac Output  
   d) Cardiac Output plus Resistance  
   e) Resistance minus Cardiac Output

38. Action potentials enter cardiac contractile cardiac cells from _______. The arrival of the action potential results in _______ the cell, which causes the rising phase of the action potential. The plateau phase of a cardiac contractile cell action potential is caused by _______ the cell and the inactivation of most of the ___ channels.  
   a) ECF; Na⁺ entering; Ca⁺⁺ entering; K⁺  
   b) Gap junctions; Ca⁺⁺ entering; Ca⁺⁺ entering; Na⁺  
   c) Gap junctions; Na⁺ entering; Na⁺ entering; K⁺  
   d) Gap junctions; Na⁺ entering; Ca⁺⁺ entering; K⁺  
   e) T-tubules; Ca⁺⁺ entering; Ca⁺⁺ entering; K⁺

39. The contraction time during skeletal muscle contraction is the  
   a) time between initiation of stimulation and peak tension  
   b) time between initiation of stimulation and start of contraction  
   c) time between start of contraction and complete relaxation  
   d) time between start of contraction and peak tension  
   e) time between peak tension and complete relaxation
40. Which of the following does NOT influence the force generated by an individual muscle fiber?
   a) frequency of stimulation
   b) fiber diameter
   c) length at onset of contraction
   d) **recruitment**
   e) summation

41. ____ is rapid and uncoordinated depolarization of the atria.
   a) Heart block
   b) Ectopic focus
   c) Atrial flutter
   d) **Atrial fibrillation**
   e) Ventricular fibrillation

42. An End Plate Potential initiates an action potential, which propagates across the membrane and down into the T-Tubules in the muscle cell which causes the ____ to release ____ ,
   a) sarcoplasmic reticulum, K⁺
   b) **sarcoplasmic reticulum, Ca²⁺**
   c) sarcoplasmic reticulum, Na⁺
   d) troponin, Ca²⁺
   e) tropomyosin, K⁺

43. which then binds to ______ and causes _____ to move aside, thereby exposing the myosin binding sites on the actin molecules. On the contact of myosin and actin, the myosin head releases _____ and phosphate, and the myosin head strokes forward.
   a) troponin; tropomyosin, ADP
   b) tropomyosin; troponin; ADP
   c) troponin; tropomyosin; ATP
   d) tropomyosin; troponin; ATP
   e) dense bodies; tropomyosin; ATP

44. An increase in venous return would result in a(n) ________ .
   a) increased end-systolic volume
   b) decreased end-systolic volume
   c) decreased end-diastolic volume
   d) **increased end-diastolic volume**
   e) increase mid-systolic volume

45. What cardiovascular changes occur in a well trained endurance athlete versus an untrained person?
   a) Increased mitochondrial density in heart cells
   b) *Increased blood volume*
   c) *Increased stroke volume*
   d) All the above
   e) **Both b and c**
PRINT YOUR NAME AND ID NUMBER in the space that is provided on the answer sheet, and then blacken the letter boxes below the corresponding letters of your name and ID number. You will have 4 points DEDUCTED if you fail to do this!!!!!!

WRITE YOUR TEST FORM LETTER above your name on the answer sheet.

WRITE YOUR LAB SECTION # AND TA’S NAME on the upper margin of your answer sheet.

Your exam should have 45 questions and a figure page. Please check to make sure it is complete.

For each of the following questions, please indicate the most correct answer by blackening the corresponding letter on the accompanying answer sheet. Each correct answer is worth 2 points. Partial credit of ½ point may be available for questions that have answers such as “all the above”, “both a and b are true”, etc.

1. Asynchronous recruitment of skeletal muscle
   a) slows the onset of fatigue
   b) occurs during tetanus
   c) can only occur during anaerobic exercise
   d) both a and b
   e) both a and c

2. Which of the following statements about the heart are true?
   a) atria and ventricles go through separate cycles of systole and diastole
   b) the left ventricle and the right ventricle go through separate cycles of systole and diastole
   c) the left atrium and the right atrium go through separate cycles of systole and diastole
   d) all the above are true
   e) only b and c are true

3. Which of the following would you expect to see during a flight or flight response?
   a) Increased AV nodal delay
   b) Increased depolarization of the SA node
   c) Increased permeability of cardiac contractile cells to Ca++
   d) All the above
   e) Only b and c

4. Capillary exchange is facilitated by
   a) Increased flow rate of blood through capillaries
   b) Increased velocity of blood through capillaries
   c) Large surface area of capillaries
   d) b and c only
   e) a and c only
5. Place the correct sequence of synaptic transmission at the motor end plate in the correct order.
   1. Acetylcholine binds to postsynaptic receptors.
   2. Acetylcholine is released from axon terminal.
   3. A graded potential is produced on the post-synaptic membane.
   4. An action potential is produced on the muscle cell membrane.
   5. Channels for both sodium and potassium are opened.
   7. An action potential arrives at the axon terminal.

   a) 7-5-2-1-3-4-6
   b) 7-6-2-1-5-3-4
   c) 5-2-3-1-7-4-6
   d) 2-1-5-3-6-7-4
   e) 4-3-5-7-2-6-1

6. Which of the following could cause a pacemaker potential?
   a) spontaneous opening of sodium channels
   b) spontaneous opening of potassium channels
   c) spontaneous closing of calcium channels
   d) spontaneous opening of chloride channels
   e) All of the above

7. Ischemic heart disease is
   a) Rapid but regular depolarizations and contractions
   b) Rapid irregular uncoordinated depolarizations contractions
   c) Action potentials not conducted between atria and ventricles
   d) Overexcitation of non-SA node autorhythmic regions of heart
   e) Reduced blood supply to heart

8. Conduction of action potentials through which of the following is slow to allow atria to contract before ventricles?
   a) Atria
   b) SA node
   c) AV node
   d) bundle of His
   e) Purkinje fibers

9. In Fig 1 part A is called _____; part C of Fig 1 is called _____
   a) Latent period; contraction time
   b) Latent period; relaxation time
   c) Contraction time; relaxation time
   d) Relaxation time; contraction time
   e) Contraction time; latent period

10. The flat thin structure of red blood cells facilitates
    a) their function as part of the immune system
    b) decreased cell thickness to facilitate diffusion of oxygen
    c) increased surface area to facilitate diffusion of oxygen
    d) all the above
    e) both b and c
11. Which of the following is (are) NOT true of arterioles?
   a) They can regulate blood flow to specific organs
   b) They regulate arterial blood pressure
   c) They convert the systolic-diastolic pressure swing into a non-fluctuating pressure
   d) **They are the site of material exchange with the tissues**
   e) Both c and d are not true of arterioles.

12. In Fig 2 part A is called ______; part D of Fig 2 is called ______.
   a) Twitch; tetanus
   b) Twitch; summation
   c) Summation; tetanus
   d) Summation; twitch
   e) Tetanus; summation

Questions 13 to 16 refer to the following:
2. Single Unit Smooth 4. Cardiac Contractile

13. What type of muscle contract(s) using cross bridge cycling?
   a) 1
   b) 4
   c) 1, 4
   d) 2, 4, 5
   e) 1, 2, 3, 4, 5

14. What type of muscle cells can generate action potentials myogenically?
   a) 2
   b) 4
   c) 2 and 3
   d) **2 and 5**
   e) 2, 3 and 5

15. In what type of muscle are cells linked by gap junctions?
   a) 2
   b) 2, 4
   c) 2, 3
   d) 2, 3, 4
   e) **2, 4, 5**

16. Which type(s) of muscle show(s) a clear cut relationship between muscle length and muscle tension?
   a) 1
   b) 4, 5
   c) **1, 4, 5**
   d) 1, 3, 4, 5
   e) 1, 2, 3, 4, 5
17. The contractile portion of the thin filament is composed of what protein?
   a) myosin
   b) tropomyosin
   c) troponin
   d) actin
   e) titin

Questions 18 to 21 refer to the following events in the cardiac cycle on the left side of the heart:

1) Atrium is in diastole
2) Atrium is in systole
3) Atrial pressure is greater than ventricular pressure
4) Atrial pressure is less than ventricular pressure
5) AV valve is closed
6) AV valve is open
7) Blood flow is from atrium to ventricle
8) No blood flow from atrium to ventricle
9) Ventricle is in diastole
10) Ventricle is in systole
11) Ventricular pressure is greater than aortic pressure
12) Ventricular pressure is less than aortic pressure
13) Aortic valve is closed
14) Aortic valve is open
15) Blood flow is from ventricle to aorta
16) No blood flow from ventricle to aorta

18. Which of the following best describe the events during part C of Fig. 5?
   a) 2, 4, 6, 7, 9, 12, 14, 15
   b) 2, 3, 6, 7, 9, 12, 13, 16
   c) 1, 4, 5, 8, 9, 12, 13, 16
   d) **1, 4, 5, 8, 9, 10, 11, 14, 15**
   e) 1, 3, 6, 7, 10, 11, 13, 15

19. Which of the following best describe the events during part D of Fig. 5?
   a) 1, 4, 5, 8, 10, 11, 13, 15
   b) 1, 4, 5, 8, 9, 11, 14, 15
   c) **1, 4, 5, 8, 9, 12, 13, 16**
   d) 1, 3, 6, 7, 10, 11, 13, 15
   e) 1, 3, 6, 7, 9, 12, 13, 16

20. Which of the following best describe the events that occur during part E of Fig. 5?
   a) 2, 3, 6, 7, 9, 12, 13, 16
   b) 1, 3, 6, 7, 10, 11, 13, 15
   c) 1, 3, 6, 7, 9, 12, 14, 15
   d) **1, 3, 6, 7, 9, 12, 13, 16**
   e) 1, 4, 5, 8, 10, 11, 13, 15

21. Which of the following best describe the events during part A of Fig. 5?
   a) **2, 3, 6, 7, 9, 12, 13, 16**
   b) 1, 3, 6, 7, 10, 11, 13, 15
   c) 1, 3, 6, 7, 9, 12, 13, 16
   d) 1, 3, 6, 7, 9, 12, 14, 15
   e) 1, 4, 5, 8, 10, 11, 13, 15
22. Mitochondrial density is high in which muscle fiber type(s)?
   a) Slow oxidative
   b) Fast oxidative
   c) Fast glycolytic
   d) All the above
   e) Both a and b

23. Part B of Fig. 3 is caused by
   a) the exit of K⁺ by passive diffusion
   b) the entry of Ca²⁺ by passive diffusion
   c) the entry of Ca²⁺ by active transport
   d) the entry of Na⁺ by passive diffusion
   e) the entry of Na⁺ by active transport

24. Which of the following statement about pressure are true?
   a) P = R/F (where P = pressure, F = flow rate and R = resistance)
   b) Increasing the resistance in a vessel will decrease the pressure.
   c) Increasing the flow rate will decrease the pressure
   d) If a vessel radius is increased by a factor of 2, pressure in that vessel will decrease by 16
   e) Both b and d are true

25. Ventricular fibrillation is
   a) Rapid but regular depolarizations and contractions of ventricles
   b) Rapid irregular uncoordinated depolarizations contractions of ventricles
   c) Action potentials not conducted between atria and ventricles
   d) Overexcitation of non-SA node autorhythmic regions of heart
   e) Reduced blood supply to heart

26. Which of the following statements about contraction of cardiac contractile cells is false?
   a) Ca²⁺ enters the cell from the ECF
   b) Ca²⁺ enters the cell from the SR
   c) Ca²⁺ activates calmodulin to initiate contraction
   d) Both a and c are false statements
   e) Both b and c are false statements

27. End Diastolic Volume is 150 ml/beat, End Systolic Volume is 80 ml/beat, and heart rate is 70 beats/min. What is the Cardiac Output?
   a) 4200 ml/min
   b) 420 ml/min
   c) 4900 ml/min
   d) 490 ml/min
   e) 49000 ml/min

28. A skeletal muscle is composed of many _____, each of which is composed of many _____, which in turn are composed of _______.
   a) Myofibrils, thick filaments, thin filaments
   b) Muscle fibers, myofibrils, thick and thin filaments
   c) Myofibrils, muscle fibers, thick and thin filaments
   d) Muscle fibers, thick filaments, myofibrils
   e) Muscle fibers, thick filaments, thin filaments
29. 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) **The lymphatic system returns filtered fluid is returned to the blood.**
   b) The net filtration is equally balanced by absorption.
   c) Gravity moves the fluid to the lowest point in the body, where the fluid is absorbed.
   d) While fluid moves out across the capillary, it tends to move inward across veins.
   e) The kidneys are involved in the reabsorption of the remaining fluid.

30. 90% of plasma is
   
   a) red blood cells
   b) **water**
   c) proteins and inorganic ions
   d) platelets
   e) leukocytes

31. Which of the following would NOT cause arterioles to vasodilate?
   
   a) Increased CO₂ in the surrounding tissue
   b) Binding of epi by beta-2 receptors on the arteriole
   c) Histamine release in the surrounding tissue
   d) **Increased O₂ in the surrounding tissue**
   e) Neither c nor d would cause vasodilation

32. The fundamental repeating unit of the myofibril called a ______ gives skeletal muscle its striated appearance, and is bordered by ________.
   
   a) crossbridge : Z lines
   b) sarcomere : M lines
   c) sarcomere : I bands
   d) **sarcomere : Z lines**
   e) crossbridge : A bands

33. Bulk flow is most important for
   
   a) exchange of materials between plasma and interstitial fluid
   b) distributing fluid between ECF and ICF
   c) **distributing fluid between plasma and interstitial fluid**
   d) distributing fluid between interstitial fluid and the ICF
   e) regulating cardiac output

34. In smooth muscle, calcium triggers contraction by binding to what protein?
   
   a) troponin
   b) myosin light chain kinase
   c) myosin
   d) **calmodulin**
   e) actin

35. Part 2 of Fig. 4 is caused primarily by
   
   a) **the entry of Ca**⁺⁺ by passive diffusion
   b) the entry of Na⁺ by passive diffusion
   c) the entry of Ca⁺⁺ by active transport
   d) the entry of Na⁺ by active transport
   e) the entry of K⁺ by active transport
36. Which of the following statements about veins is NOT true?
   a) skeletal muscle activity increases venous return
   b) veins have one way valves to prevent backflow of blood
   c) the lower pressure in the chest cavity aids venous return
   d) veins are high resistance blood vessels
   e) sympathetic stimulation increases venous return

37. The energy source that can be used most rapidly by contracting muscle is
   a) ATP produced from glycolysis
   b) ATP produced from krebs cycle
   c) ATP produced from creatine phosphate
   d) ATP produced from oxidative phosphorylation
   e) Both b and d combined

38. For which of the following is hemostasis the primary function?
   a) erythrocytes
   b) leukocytes
   c) platelets
   d) both erythrocytes and leukocytes
   e) both leukocytes and platelets

39. When an action potential is generated within a motor neuron, ________.
   a) the muscle cells of the motor unit will occasionally contract
   b) only select muscle cells within the motor unit are stimulated to contract
   c) every muscle cell of the motor unit is stimulated to contract
   d) the muscle cells from a neighboring motor unit will contract
   e) all of the muscle cells within the motor unit are stimulated to relax

40. How does the frequency of muscle stimulation influence the strength of contraction of the whole muscle?
   a) It ensures that the optimal length of the muscle is achieved
   b) It allows twitch summation
   c) It allows tetanus
   d) Both a and b are true
   e) Both b and c are true

41. If the hematocrit is 45, about what percentage of the whole blood is red blood cells?
   a) 35%
   b) 40%
   c) 45%
   d) 50%
   e) 55%

42. Mobile units of the immune system are
   a) red blood cells
   b) hemoglobin
   c) leukocytes
   d) platelets
   e) both a and c
43. Indicate which is the proper sequence of blood flow though the circulatory system:

1. right atrium 6. pulmonary vein
2. left atrium 7. lungs
3. right ventricle 8. systemic tissues
4. left ventricle 9. aorta
5. pulmonary artery 10. venae cavae

a) 10-1-2-3-4-5-6-7-8-9
b) 10-2-4-5-7-6-1-3-9-8
c) **10-1-3-5-7-6-2-4-9-8**
d) 10-1-2-3-4-5-7-6-9-8
e) 10-2-1-3-4-5-7-6-9-8

44. Place the sequence of a skeletal muscle contraction in the correct order:

1. Ca++ binds to troponin
2. End Plate Potential becomes Action Potential on surface of membrane
3. Tropomyosin moves aside
4. Actin binds to myosin
5. Action potential moves into T tubules
6. Ca++ released from SR
7. Cross-bridge cycling occurs
8. Ca++ pumped into SR

a) 2-6-5-1-3-4-7-8
b) **2-5-6-1-3-4-7-8**
c) 2-5-6-1-4-3-7-8
d) 2-8-5-6-3-4-7-1
e) 2-5-6-3-4-1-7-8

45. Which of the following would you expect in a trained endurance athlete versus an untrained person?

a) Higher maximum heart rate
b) *Lower resting heart rate*
c) *Higher workload at maximum heart rate*
d) Both a and b
e) **Both b and c**