TUSPM Physiology Exam 1 (Cardiovascular Physiology)

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General Instructions:

There are 40 questions. Choose the one best answer. You have 2 hours to complete this exam. You may use a calculator.

- 1. Which one of the following statements about wall stress is true?
 - A. Wall stress increases as the thickness of the left ventricle increases
 - B. Wall stress increases as radius of the ventricle decreases
 - C. Wall stress is less than normal in large dilated ventricles
 - D. **As wall stress increases, myocardial energy consumption increases
- 2. Stimulation of the sympathetic nerves which innervate the ventricles will:
 - A. increase the duration of ventricular relaxation
 - B. increase inhibition of calcium release by phospholamban
 - C. decrease contractility
 - D. **increase the slope of the end-systolic pressure-volume relationship
- 3. Which one of the following statements describes cardiac muscle?
 - A. It is very compliant until sarcomere lengths exceed 3.2 microns
 - B. The duration of the action potential is similar to the duration of neuronal action potentials
 - C. The calcium released during systole is sufficient to activate all the contractile proteins
 - D. **Calcium-induced calcium release is the major mechanism for the release of SR calcium
- 4. Which one of the following would maintain systemic blood pressure constant despite an increase in preload (EDV)?
 - A. Increased heart rate
 - B. Increased total peripheral resistance
 - C. **Decreased contractility
 - D. Increased stroke volume
- 5. Congestive heart failure is characterized by
 - A. decreased preload
 - B. decreased afterload
 - C. decreased wall stress
 - D. **decreased cardiac output
- 6. If the blood flow is held constant but the crossectional area of a vessel is reduced to one-half its original value, the blood velocity will:
 - A. **double
 - B. decrease to one-half its original value
 - C. quadruple
 - D decrease to one-fourth its original value

- 7. Which one of the following will <u>decrease</u> vascular resistance the most?
 - A. Reducing the blood viscosity to one-half its original value
 - B. Reducing the average length of arterioles to one-half their original length
 - C. **Doubling the average radius of the arterioles to twice their original radius
 - D. Doubling the number of arterioles in series with each other
- 8. The QRS complex of an ECG recording is primarily the result of
 - A. **phase 0 of ventricular muscle action potential
 - B. phase 1 of ventricular muscle action potential
 - C. phase 2 of ventricular muscle action potential
 - D. phase 3 of ventricular muscle action potential
- 9. Which one of the following statements about myocardial blood flow is correct?
 - A. Right and left coronary blood flows are equal to each other.
 - B. **The coronary flow is determined primarily by the metabolic needs of the tissue.
 - C The greatest left coronary arterial blood flow occurs during left ventricular isovolumic contraction
 - D. A decrease in heart rate will result in an increase in coronary blood flow
- 10. Which one of the following is an <u>abnormal</u> value for a person at rest?
 - A. blood volume = 5 Liter
 - B. blood pressure = 120 mm Hg / 80 mm Hg
 - C. heart rate = 60 beats per minute
 - D. **ejection fraction = 0.3
- 11. An increased intracranial pressure is associated with
 - A. increased heart rate
 - B. decreased mean blood pressure
 - C. **increased cerebral vascular resistance
 - D. decreased total peripheral resistance
- 12. Which one of the following decreases during aerobic exercise?
 - A. Mean blood pressure
 - B. Cerebral blood flow
 - C. **Blood volume
 - D. Body temperature
- 13. Maximal left coronary artery blood flow occurs
 - A. during isovolumic contraction
 - B. early in systole
 - C. during rapid ejection
 - D. **early in diastole

- 14. As an individual moves from a supine to a standing position
 - A. cardiac contractility decreases
 - B. heart rate decreases
 - C. **central venous pressure decreases
 - D. capillary hydrostatic pressure in the legs decreases
- 15. Which one of the following will <u>increase</u> the pulse pressure?
 - A. Increased stroke volume
 - B. Decreased aortic compliance
 - C Aging
 - D. **All of the above
- 16. Which one of the following will differ the least between a trained and an untrained individual?
 - A. Their resting stroke volumes
 - B. Their resting blood volumes
 - C. **Their maximum heart rates
 - D. Their maximum oxygen consumptions
- 17. During which phase of the cardiac cycle is the mitral valve closed while the aortic valve is open?
 - A. Isovolumic contraction
 - B. **Ejection
 - C. Isovolumic relaxation
 - D. Filling
- 18. If both the sympathetic and parasympathetic nerves which innervate the heart are cut which one of the following is the most likely heart rate?
 - A. 40 beats per minute
 - B. 70 beats per minute
 - C.` **120 beats per minute
 - D. 180 beats per minute
- 19. During which one of the following does depolarization of the AV node occur?
 - A. **The PR interval
 - B. The QRS complex
 - C. The ST segment
 - D. The T wave
- 20. For which one of the following reasons does the ACE bandage compression of a sprained ankle decrease swelling (edema)?
 - A. It increases the interstitial osmotic (oncotic) pressure
 - B It decreases the capillary hydrostatic pressure
 - C. It decreases the plasma oncotic pressure
 - D **It increase the interstitial hydrostatic pressure

- 21. Which one of the following is a direct effect of a loss of blood, not a reflex effect?
 - A. An increase in heart rate
 - B. Constriction of the systemic arterioles in the skin
 - C. **A decrease in the stroke volume
 - D. An increase in ventricular contractility
- 22. Which one of the following will occur once a new steady state is reached following an increase in total peripheral resistance? (hint: consider the closed loop model of the CV system)
 - A. **An increased arterial blood volume
 - B. An increased venous blood volume
 - C. A decreased arterial blood pressure
 - D. A greater blood flow into the arteries than out of the arteries
- 23. Which one of the following changes in the SA node will <u>decrease</u> the heart rate?
 - A. Making the SA node threshold more negative
 - B. Increasing the slope of phase 4
 - C. Making the maximum diastolic potential (the most negative voltage reached during the heart cycle) less negative
 - D. **Increasing the duration of phase 4
- 24. Which one of the following is a normal physiological mechanism by which the force of myocardial contraction is <u>decreased</u>?
 - A. **Reducing the time that the L type Ca⁺⁺ channels are open
 - B. Increasing the extracellular concentration of Ca⁺⁺
 - C. Stretching the sarcomeres to a length greater than 2.4 microns
 - D. Increasing the phosphorylation of phospholamban
- 25. Which one of the following indicates that cerebral autoregulation is occurring while systemic blood pressure is increasing from 60 mm Hg to 160 mm Hg?
 - A. Pressure in the cerebral arteries remains constant
 - B. **Cerebral blood flow remains constant
 - C. Cerebral vascular resistance remains constant
 - D. The concentration of vasoactive metabolites (CO₂, etc.) remains constant in the brain tissue
- 26. Which one of the following suggests that the Cushing response to elevated intracranial pressure is occurring?
 - A. **Blood pressure = 220, Heart rate = 50 beats / minute
 - B. Blood pressure = 220, Heart rate = 220 beats / minute
 - C. Blood pressure = 50 mm Hg, Heart rate = 50 beats / minute
 - D. Blood pressure = 50 mm Hg, Heart rate = 220 beats / minute

- 27. Which one of the following is the correct comparison of the left and right coronary vasculatures?
 - A. The proximal pressure of the left coronary vasculature is greater than the proximal pressure of the right coronary arteries
 - B. **Left coronary blood flow may drop to less than right coronary blood flow during isovolumic contraction
 - C. The average left and right coronary blood flows are equal to each other
 - D. The total left coronary resistance is greater than the total right coronary vascular resistance
- 28. During which phase of the cardiac cycle will the murmur of aortic stenosis be present?
 - A. Isovolumic contraction
 - B. **Ejection
 - C. Isovolumic relaxation
 - D. Filling
- 29. Which one of the following is the mechanism by which TPR falls during aerobic exercise?
 - A. **Accumulation of metabolites in the working muscles
 - B. Dilation of the systemic arterioles within the working muscles via the action of acetylcholine (Ach)
 - C. Dilation of the systemic arterioles within the working muscles via the action of norepinephrine
 - D. Constriction of the systemic arterioles within the non-working muscles via the action of norepinephrine
- 30. The activity (number of action potentials) within which one of the following structures will <u>decrease</u> during the baroreceptor reflex response to an <u>increase</u> in blood pressure?
 - A. **The pressor center
 - B. The depressor center
 - C. The inhibitory interneurons between the pressor and the depressor centers
 - D. The carotid sinus nerve
- 31. When a person is standing upright on earth:
 - A. The mean arterial pressure in the pedal artery (an artery in the foot) will be greater than the mean arterial pressure in the proximal aorta.
 - B. The volume of blood in the leg veins will be greater than it was when the person was supine
 - C. The pressure in the cerebral veins could be negative
 - D. **All of the above
- 32. If three blood vessels are in parallel with each other:
 - A. They <u>must</u> have equal blood flows
 - B. They <u>must</u> have equal resistances
 - C. **The pressure difference (ΔP) along the length of each must be equal to each other
 - D. All of the above

- 33. As left ventricular diastolic compliance decreases:
 - A. Preload (EDV) increases
 - B. Stroke volume increases
 - C. End-diastolic left ventricular pressure decreases
 - D. **The chance for pulmonary edema to occur increases
- 34. During which phase of the cardiac cycle does the first heart sound occur?
 - A. **Isovolumic contraction
 - B. Ejection
 - C. Isovolumic relaxation
 - D. Filling
- 35. The motion of which one of the proteins listed below exposes the actin binding site for the myosin crossbridge?
 - A. Troponin
 - B. **Tropomyosin
 - C. SERCA
 - D. Titin
- 36. During atrial fibrillation:
 - A. The atrial rate (beats / minute) is equal to the ventricular rate
 - B. The atria are more effective than normal in helping to fill the ventricle
 - C. All of the action potentials which originate in the atria reach the ventricles
 - D. **The cardiac output will be less than normal
- 37. Which one of the following is the cause of essential hypertension (the most common form of hypertension)?
 - A. **Higher than normal total peripheral resistance
 - B Higher than normal cardiac output
 - C. Higher than normal blood viscosity
 - D. Higher than normal venous compliance
- 38. During inspiration systemic blood pressure falls because
 - A. Left ventricular compliance decreases
 - B. The interventricular septum moves to the left
 - C. The right ventricular end-diastolic volume increases
 - D. **All of the above

- 39. Which one of the following ions <u>enters</u> the cardiac myocyte during phase 2 of the ventricular action potential?
 - A. Cl⁻
 - B. Na⁺
 - C. **Ca++
 - D. K⁺
- 40. Which one of the following sets of data would be most likely obtained from an elite cross country skier at <u>rest</u>?
 - A. **Oxygen Consumption = 3.5 ml/kg/min, Heart Rate = 40 beats / minute, Stroke Volume = 125 ml / beat
 - B. Oxygen Consumption = 3.5 ml/kg/min, Heart Rate = 80 beats / minute, Stroke Volume = 62 ml / beat
 - C. Oxygen Consumption = 35.0 ml/kg/min, Heart Rate = 40 beats / minute, Stroke Volume = 125 ml / beat
 - D. Oxygen Consumption = 35.0 ml/kg/min, Heart Rate = 80 beats / minute, Stroke Volume = 62 ml / beat