UNIVERSITY OF TEXAS AT ARLINGTON

DEPARTMENT OF BIOLOGY

HUMAN PHYSIOLOGY
(Biol 3345)

Dr. David G. Bernard

THIRD INTRASESSIONAL EXAMINATION

April 19, 2007

4

First Name SMITA Last Name: SHARMA UTA ID # 1000389323

There are 50 items in this booklet; 45 are multiple choice questions and the remainder are either short essay questions or diagrams to be labeled. Be careful not to overlook any pages in the examination booklet. You have 80 minutes to complete these questions.

During the course of the examination students will remain in their assigned seats. If assistance is needed, the student should raise his/her hand and a proctor will attend the individual needs of that student.

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GOOD LUCK!

DIRECTIONS: Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 2 points.

1. The ciliary muscle helps to:
   A. control the amount of light reaching the retina
   B. control the shape of the lens
   C. control the production of aqueous humor
   D. move the eyeball
   E. None of the above is correct.

2. The vitreous chamber of the eye:
   A. contains the lens
   B. helps to stabilize it and gives physical support to the retina
   C. is located between the lens and the iris
   D. contains blood vessels that nourish the retina
   E. All of the above

3. Which of the following is **NOT** a function of smooth muscle tissue?
   A. altering the diameter of the respiratory passageways
   B. elevating hairs on the arm
   C. forcing blood from the heart into the major arteries
   D. moving food materials along the digestive tract
   E. forcing urine out of the urinary tract

4. The lacrimal apparatus:
   A. is a system of glands and ducts
   B. keeps the cornea moist with continuous tear flow
   C. is innervated by sympathetic neurons from cranial nerve VII
   D. A and B
   E. All of the above are correct.

5. Information about sound must through each of these areas of the brain. Put them in the correct order.
   1. thalamus 2. medulla 3. auditory cortex of cerebrum 4. midbrain
   A. 1, 2, 3, 4 B. 2, 1, 4, 3 C. 2, 4, 1, 3
   D. 3, 2, 1, 4 E. 3, 4, 1, 2

6. Tonic receptors:
   A. are slowly adapting receptors
   B. fire rapidly when first activated, then slow and stop firing even with a continuing stimulus
   C. are activated by parameters that must be continuously monitored by the body
   D. are proprioreceptors, for example
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7. During the cardiac cycle,
   A. the p wave of the ECG occurs between the first and second heart sounds
   B. the QRS complex of the EKG precedes the increase in ventricular pressure
   C. the third heart sound occurs during atrial systole
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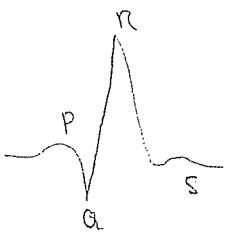


8. Vibrations received the ear are amplified by the action of the:
   A. cochlea B. bones of the middle ear C. oval window
   D. round window E. tympanic membrane

9. The purpose of transverse tubules is to:
   A. ensure a supply of Ca^{2+} ions through the muscle fiber
   B. rapidly conduct the action potentials to the interior of the muscle fiber
   C. ensure a supply of glycogen throughout the muscle sarcoplasm
   D. conduct the ATP molecules out of the mitochondria throughout the sarcoplasm
   E. All of these statements are true.

10. In cardiac muscle:
   A. calcium ions are not released from the sarcoplasmic reticulum
   B. calcium ions do not bind to troponin molecules
   C. calcium ions play no role in the process of contraction
   D. some of the calcium ion required for contraction comes from outside of the cell
   E. calcium ion plays an important role in repolarizing the membrane after the depolarization phase

11. In circulating from the brain to the arm, a drop of blood would ***NOT*** have to pass through which of the following structures?
   A. left atrium B. aorta C. inferior vena cava
   D. pulmonary vein E. superior vena cava

12. The I band contains:
   A. thick filaments B. thin filaments
   C. an area of overlapping filaments D. All of the above are correct.
   E. None of the above is correct.

13. The plateau phase of the cardiac muscle action potential is due to:
   A. the movement of fewer sodium ions across the cell membrane
   B. the calcium channels remaining open longer than the sodium channels
   C. the increased membrane permeability to potassium
   D. a decrease in the amount of calcium diffusing across the membrane
   E. an increased membrane permeability to sodium ions

14. Ca^{2+} is important in the contraction of smooth muscle. Which of the following is NOT true about smooth muscle contraction?
   A. Ca^{2+} enters the cytosol from the sarcoplasmic reticulum.
   B. Ca^{2+} binds to calmodulin.
   C. Contraction is immediately triggered by calmodulin binding.
   D. MLCK (myosin light chain kinase) forms a complex to activate myosin.
   E. When MLCK activates myosin, ATPase activity is high and crossbridge formation is active.

15. An important difference between single-unit and multiunit smooth muscle is:
   A. the ability of single-unit fibers to change into multiunit fibers when advantageous.
   B. longer actin and myosin filaments in multiunit smooth muscle, which allow coordination of contraction
   C. numerous gap junctions in single-unit muscle, which allow many cells to work together as a sheet
   D. closely controlled individual fibers in single-unit smooth muscle to allow fine control and graded contractions by selective activation
   E. All of the above are correct.

16. The ossicles connect the:
   A. cochlea to the oval window
   B. tympanic membrane to the round window
   C. oval window to the round window
   D. cochlea to the tympanic membrane
   E. tympanic membrane to the oval window

17. A viral infection involving the vestibular nuclei may result in:
A. loss of hearing B. loss of sight C. a sense of dizziness
D. local paralysis E. high blood pressure

18. The structure that separates the cochlear duct from the tympanic duct is the:
A. tectorial membrane B. basilar membrane
C. membranous labyrinth D. bony labyrinth
E. stapedius

19. During the isovolumic phase of ventricular systole,
A. the atria contract
B. the atrioventricular valves and semilunar valves are closed
C. blood is ejected into the great vessels
D. the ventricles are relaxing
E. the ventricles are filling with blood

20. The loudness or intensity of a sound wave is related to its:
A. amplitude B. frequency C. duration
D. decibels E. pitch

21. Which description is **NOT** correctly matched to the tissue?
A. skeletal muscle – controls voluntary body movements
B. cardiac muscle – classified as striated muscle
C. cardiac muscle – found ONLY in the heart
D. skeletal muscle – always attached to bones
E. smooth muscle – the primary muscle of internal organs

22. As ATP binds to the myosin head at the beginning of a muscle contraction cycle,
A. the myosin head detaches from actin
B. the myosin head initiates binding with actin
C. the myosin head tightens its bond to actin
D. ATP does not bind to the myosin head
E. None of these complete the statement correctly.

23. The first heart sound is heard when:
A. the AV valves open B. the AV valves close
C. the semilunar valves close D. the atria contract
E. blood enters the aorta

24. Which event happens at the start of a cardiac cycle?
A. Blood is ejected from the atrium.
B. The SA node fires.
C. Ventricular systole occurs.
D. The P wave develops.
E. Atrial systole occurs.

25. If the EDV is 140 mL, which other values are most likely to occur in a healthy, normal person?
A. The ESV could be 70 mL and the SV could be 70 mL.
B. The ESV could be 190 mL and the SV could be 50 mL.
C. The ESV could be 50 mL and the SV could be 90 mL.
D. A and B
E. A and C

26. Put these phases of the cardiac cycle in the correct order.

1. opening of the semilunar valves
2. isovolumetric contraction
3. atrial systole begins
4. closure of the AV valves
5. ventricular filling is complete
6. ventricular systole begins
7. ventricular relaxation
8. ventricular ejection

3, 2, 6, 4, 5, 7, 1

A. 4, 5, 1, 2, 7, 8, 3, 6
B. 3, 2, 6, 1, 4, 5, 8, 7
(C.) 3, 5, 6, 4, 2, 1, 8, 7
D. 3, 5, 6, 1, 8, 4, 2, 7
E. 3, 2, 6, 4, 5, 8, 7, 1

27. The intensity of a stimulus can be determined by:

A. population coding B. labeled line coding C. frequency coding
(D.) A and C E. All of the above.

28. Excitation-contraction coupling refers to _____.

A. the arrival of acetylcholine at the neuromuscular junction due to its exocytosis from the axon terminal
B. acetylcholine opening ion channels
(C.) the chemical and electrical events that trigger the mechanical events in a muscle fiber
D. the enzymatic removal of acetylcholine from the synapse which can then allow relaxation to occur
E. B and D

29. Which of the following are involved directly in the systemic circulation?

(A.) superior vena cava, right atrium, and left ventricle.
B. right ventricle, pulmonary artery, and left atrium.
C. left ventricle, pulmonary artery, and inferior vena cava
D. right atrium, right ventricle, and left ventricle
E. inferior vena cava, pulmonary vein, pulmonary artery

30. The thick, gel-like fluid that helps support the structure of the eyeball is the:

(A.) vitreous humor B. aqueous humor C. ora serrata
D. perilymph E. ortholymph

31. At the conclusion of the power stroke,

A. inorganic phosphate has been released from the myosin
B. actin has been moved toward the M line
C. ADP is released from the myosin head
D. the myosin head is tightly bound to actin
(E.) All of the above are correct.

32. Displacement of stereocilia toward the kinocilium of a hair cell:

(A.) produces a depolarization of the membrane
B. produces a hyperpolarization of the membrane
C. decreases the membrane permeability to sodium ions
D. increases the membrane permeability to potassium ions
E. does not affect the transmembrane potential of the cell

33. The receptors in the inner ear are the:

A. utricles B. saccules (C.) hair cells
D. supporting cells E. ampullae

34. Transduction involves
A. a stimulus altering the permeability of a receptor membrane
B. changes in the transmembrane potential of the sensory receptor
C. production of a receptor potential
D. generation of an action potential that can be processed and interpreted by the CNS
(E.) All of the above

35. The two-point discrimination test:
A. is used to determine clarity of vision
B. provides information about olfactory receptors
(C.) provides a detailed map for sensory receptors
D. is used to test for hearing disorders
E. monitors the activity of taste buds

36. Which of the following statements is true about titin?
A. Titin returns stretched muscle to their resting length.
B. Titin stabilizes the position of the contractile filaments.
C. Titin is helped by actin.
(D.) A and B are correct.
E. All of the above are correct.

37. The flattening of the action potentials of myocardial contractile cells, called the plateau phase, is due to a combination of _____ K^+ permeability and _____ Ca^{2+} permeability.
A. increasing, increasing
B. decreasing, decreasing
C. increasing, decreasing
(D.) decreasing, increasing
E. cannot be determined

38. Fast pain, usually described as sharp and localized, is carried by:
A. large, unmyelinated C fibers
(B.) small, myelinated A-delta fibers
C. small, unmyelinated C fibers
D. large myelinated A-beta fibers
E. None of the above.

39. Central fatigue _____.
A. include feeling tired
B. may precede physiological muscle fatigue
C. may be related to changes in the brain related to changes in the pH of the blood
(D.) A and B
E. A, B and C

40. Sensations of gravity and linear acceleration are registered in the:
A. semicircular canals
B. cochlea
(C.) saccule and utricle
D. ossicles
E. organ of Corti

41. The ____ of a sensory receptor may be irregular in shape and overlap with those of neighboring receptors. The size of this area determines the sensitivity to a stimulus.
A. discriminatory area
B. spatial field
C. somatic esthetic
(D.) receptive field
E. None of the above

42. The force generated by a single muscle fiber:
A. is always the same
B. can be increased by increasing the frequency of action potentials
C. can be increased due to summation
(D.) B and C
E. All of the above are correct

43. Which statement best describes arteries?
   A. All carry oxygenated blood to the heart.
   B. All contain valves to prevent the back-flow of blood.
   C. All carry blood away from the heart.
   D. Only large arteries are lined with endothelium.
   E. All are larger than veins.

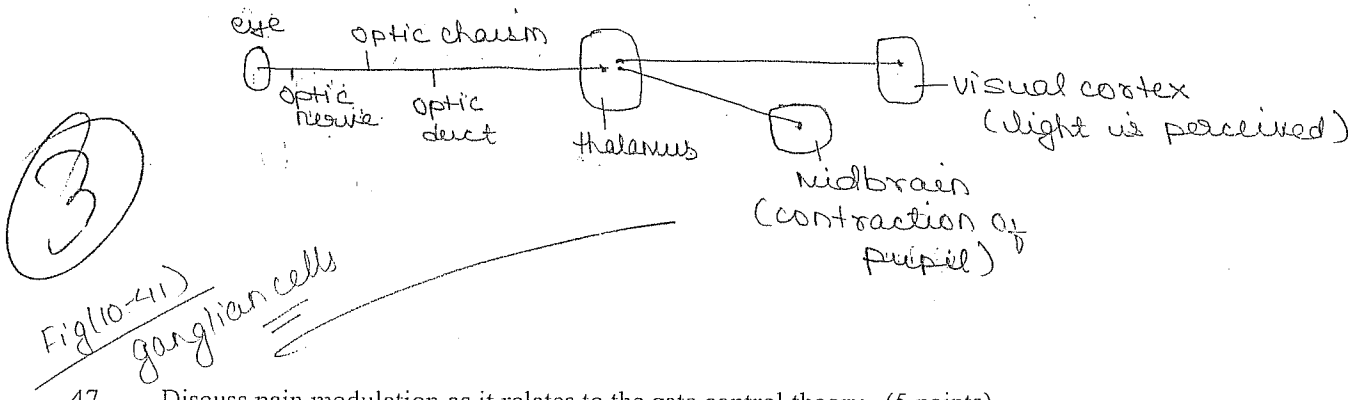
44. What structures monitor vertical movements?
   A. cristae and the semicircular canals
   B. maculae of the saccule
   C. maculae of the utricle
   D. B and C
   E. All of the above

45. Light passes through the following structures in which order?
   A. vitreous humor, cornea, lens, aqueous humor
   B. cornea, aqueous humor, lens, vitreous humor
   C. cornea, vitreous humor, lens, aqueous humor
   D. aqueous humor, cornea, lens, vitreous humor
   E. vitreous humor, lens, aqueous humor, cornea

Short Answer Questions

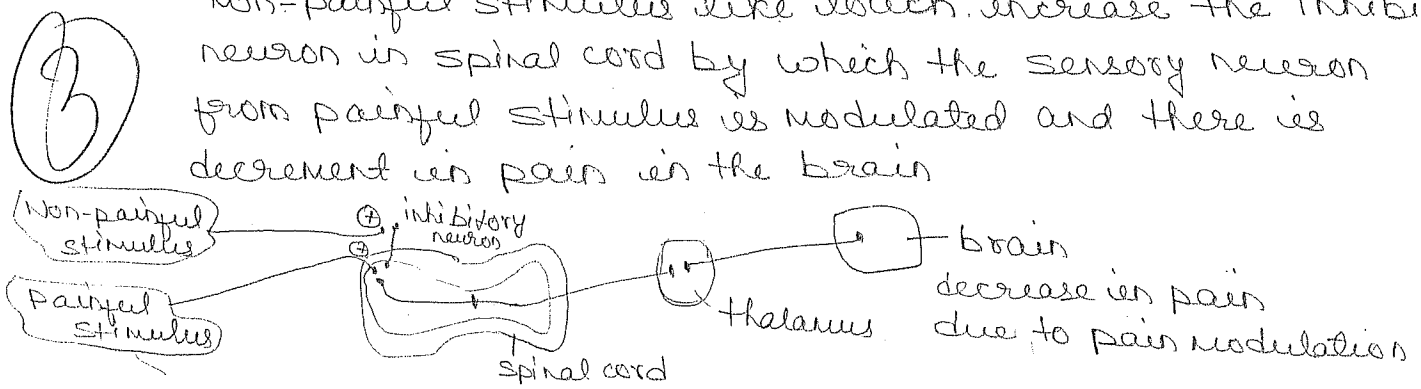
Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!!
You can use the back of the last page to continue any question. Number them, please!!

46. Trace the path of light from the time it is converted to an action potential until it is perceived. (5 points)



47. Discuss pain modulation as it relates to the gate control theory. (5 points)

Non-painful stimulus like touch. increase the inhibition neuron in spinal cord by which the sensory neuron from painful stimulus is modulated and there is decrement in pain in the brain



*[A-β fibre & C-fibre & interneuron] Fig[10-12]

48. Describe the different types of smooth muscle. (5 points)

5

① Respiratory – in air passages
② Urinary – in ureter, urinary bladder
③ Vascular
④ Reproductory – in reproductive parts
⑤ Ocular – in eyes
⑥ Gastrointestinal

49. A certain drug is known to block monovalent cation channels. This drug is used as a "muscle relaxer." Would it affect both smooth and skeletal muscle, or only skeletal muscles? Defend your answer. (5 points)

2.4

It affects only skeletal muscles because skeletal muscle uses monovalent cation i.e. Na^+ in depolarising the action potential which helps in the influx of Ca^{2+} by opening Ca^{2+} channel while contraction but its opposite in relaxation – Ca^{2+} channel is closed, Na^+ channel is blocked.
Smooth muscle doesnot use monovalent cation for Ca^{2+} entry to ECF in relaxation.
[Hormone, neurohormone – smooth muscle].

50. **Please answer only ONE of the following (A OR B).** Circle the one you are answering. (5 points)

A. Your physiology professor has 5 liters of blood distributed between his pulmonary and systemic circuits. Assume 20% of the blood is in his lungs at any moment. If his cardiac output is 5 L/min, how long will it take a drop of blood to flow from his right ventricle to his left ventricle? **Show your calculations for full points.**

OR

B. Explain how Ca^{2+} levels inside myocardial cells are altered. (Fig 14-11).

(A) Cardiac output = 5 L/min
blood in lungs = 20% of 5L
$= \frac{20}{100} \times 5 = 1\,L$

Remaining = 4L

C.O = stroke volume × Heart rate

Heart rate $= \frac{C.O}{\text{stroke volume}} = \frac{5\,L/min}{4\,L}$

$= \frac{5}{4}/min = 1.25/min$

1 min — 5 L
$\frac{1}{5}$ min — 1 L
$\left(\frac{1}{5} \times 60\right)$ sec = 12 sec

1

1.25 — 1 min
1 drop — $\frac{1}{1.25}$ min

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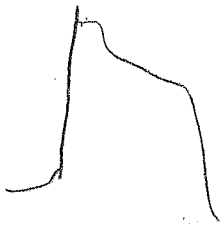

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   B. right ventricle, pulmonary artery, and left atrium.
   C. left ventricle, pulmonary artery, and inferior vena cava
   D. right atrium, right ventricle, and left ventricle
   E. inferior vena cava, pulmonary vein, pulmonary artery

LV → Aorta → Body → RA ← Vena Cava

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   B. tympanic membrane to the round window
   C. oval window to the round window
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3 bones

Tymp → Oval

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   D. are proprioreceptors, for example
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   D. A and B
   E. A and C

SV = EDV - ESV

70 = 140 - 70

90

50

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C. cardiac muscle – found ONLY in the heart
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E. ortholymph

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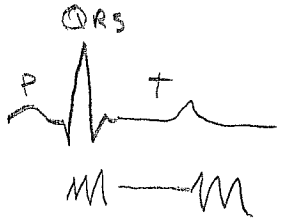

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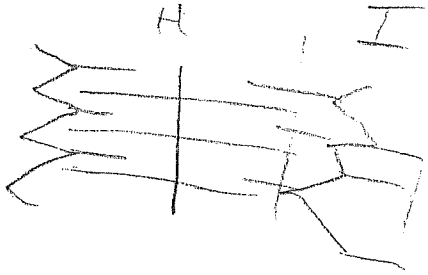

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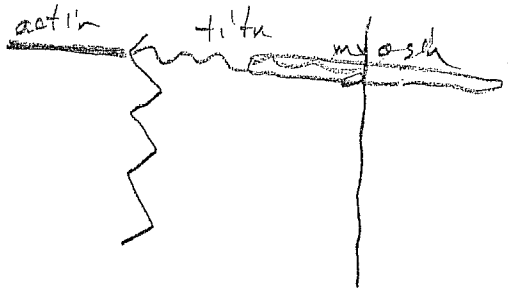
A. thick filaments
B. thin filaments
C. an area of overlapping filaments
D. All of the above are correct.
E. None of the above is correct.

31. The loudness or intensity of a sound wave is related to its:

A. amplitude
B. frequency
C. duration
D. decibels
E. pitch

32. A viral infection involving the vestibular nuclei may result in:

A. loss of hearing
B. loss of sight
C. a sense of dizziness
D. local paralysis
E. high blood pressure



33. Which of the following statements is true about titin?
- A. Titin returns stretched muscle to their resting length.
- B. Titin stabilizes the position of the contractile filaments.
- C. Titin is helped by actin.
- D. A and B are correct.
- E. All of the above are correct.

34. Which event happens at the start of a cardiac cycle?
- A. Blood is ejected from the atrium.
- B. The SA node fires.
- C. Ventricular systole occurs.
- D. The P wave develops.
- E. Atrial systole occurs.

35. In circulating from the brain to the arm, a drop of blood would ***NOT*** have to pass through which of the following structures?

A. left atrium B. aorta C. inferior vena cava
D. pulmonary vein E. superior vena cava

36. The structure that separates the cochlear duct from the tympanic duct is the:

A. tectorial membrane B. basilar membrane
C. membranous labyrinth D. bony labyrinth
E. stapedius

37. The first heart sound is heard when:

A. the AV valves open B. the AV valves close
C. the semilunar valves close D. the atria contract
E. blood enters the aorta

38. In cardiac muscle:
- A. calcium ions are not released from the sarcoplasmic reticulum
- B. calcium ions do not bind to troponin molecules
- C. calcium ions play no role in the process of contraction
- D. some of the calcium ion required for contraction comes from outside of the cell
- E. calcium ion plays an important role in repolarizing the membrane after the depolarization phase

39. Information about sound must through each of these areas of the brain. Put them in the correct order.

1. thalamus 2. medulla 3. auditory cortex of cerebrum 4. midbrain

A. 1, 2, 3, 4 B. 2, 1, 4, 3 C. 2, 4, 1, 3
D. 3, 2, 1, 4 E. 3, 4, 1, 2

40. The two-point discrimination test:
- A. is used to determine clarity of vision
- B. provides information about olfactory receptors
- C. provides a detailed map for sensory receptors
- D. is used to test for hearing disorders
- E. monitors the activity of taste buds

41. The vitreous chamber of the eye:
- A. contains the lens
- B. helps to stabilize it and gives physical support to the retina
- C. is located between the lens and the iris
- D. contains blood vessels that nourish the retina
- E. All of the above

42. An important difference between single-unit and multiunit smooth muscle is:
- A. the ability of single-unit fibers to change into multiunit fibers when advantageous.
- B. longer actin and myosin filaments in multiunit smooth muscle, which allow coordination of contraction
- C. numerous gap junctions in single-unit muscle, which allow many cells to work together as a sheet
- D. closely controlled individual fibers in single-unit smooth muscle to allow fine control and graded contractions by selective activation
- E. All of the above are correct.

43. Vibrations received the ear are amplified by the action of the:
A. cochlea B. bones of the middle ear C. oval window
D. round window E. tympanic membrane

44. At the conclusion of the power stroke,
- A. inorganic phosphate has been released from the myosin
- B. actin has been moved toward the M line
- C. ADP is released from the myosin head
- D. the myosin head is tightly bound to actin
- E. All of the above are correct.

45. Light passes through the following structures in which order?
- A. vitreous humor, cornea, lens, aqueous humor
- B. cornea, aqueous humor, lens, vitreous humor
- C. cornea, vitreous humor, lens, aqueous humor
- D. aqueous humor, cornea, lens, vitreous humor
- E. vitreous humor, lens, aqueous humor, cornea

90 pts
25

Short Answer Questions

Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!!

You can use the back of the last page to continue any question. Number them, please!!

46. Trace the path of light from the time it is converted to an action potential until it is perceived. (5 points)

Light becomes an action potential inside the photoreceptors.
From there pathway of signal is:

Photoreceptor → Optic nerve
R eye
photoreceptor → Optic nerve
L eye
→ Optic Chiasm
→ R. Lateral Geniculate Nucleus (Thalamus)
→ R visual cortex (perception)
→ Midbrain
→ Left LGN → Left visual cortex (perception)

47. Discuss pain modulation as it relates to the gate control theory. (5 points)

There are inhibitory neurons that block the transmission of nociceptive signals to the higher CNS. When a painful stimulus is experienced by a nociceptor, signals travel via a C fiber to inhibit the inhibitory neurons in the spinal cord thus allowing the nociceptive signal to travel to the higher CNS

cont on extra sheet

48. Describe the different types of smooth muscle. (5 points)

Vascular → found in Blood vessels

Gastrointestinal → found in GI tract

Urinary → found in urinary tract

Reproductive → found in female reproductive system

Respiratory → lungs, alveoli

Occular → ciliary muscles

5

49. A certain drug is known to block monovalent cation channels. This drug is used as a "muscle relaxer." Would it affect both smooth and skeletal muscle, or only skeletal muscles? Defend your answer. (5 points)

-Blocking monovalent cation channels would lead to decreased levels of Na^+ and Ca^{2+} in the sarcoplasm.

Both skeletal and smooth muscle depend on Ca^{2+} for movement of actin and myosin

skeletal → Ca^{2+} binds to troponin to slop tropomyosin from blocking myosin binding site on actin

Smooth → to bind to CaM to increase PLCK activity and in turn myosin ATPase.

Yes it affects both skeletal + smooth

0-5

50. **Please answer only ONE of the following (A OR B).** Circle the one you are answering. (5 points)

A. Your physiology professor has 5 liters of blood distributed between his pulmonary and systemic circuits. Assume 20% of the blood is in his lungs at any moment. If his cardiac output is 5 L/min, how long will it take a drop of blood to flow from his right ventricle to his left ventricle? **Show your calculations for full points.**

Answered on extra sheet

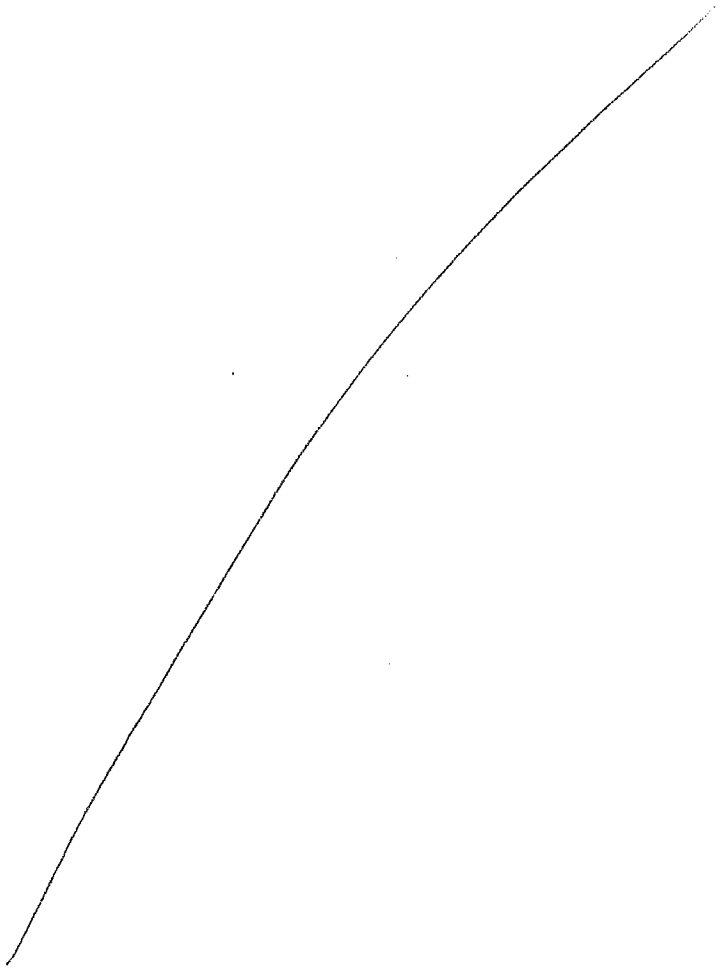
OR

B. Explain how Ca^{2+} levels inside myocardial cells are altered.

4

(47) continued.

Gate control theory states that these painful signals can be modified by activating AB fibers in the same topographical area. (For example, rubbing your knee after you bang it into a desk). The rubbing is transmitted via AB fibers which inturn stimulate the inhibitory neurons in the spinal cord which work to block the nociceptive signal from the injury. The modulation is a graded summation of the activity of the C fiber and the AB fiber on the inhibitory neuron in the spinal cord.

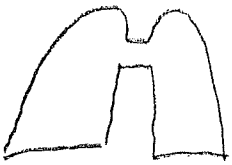


50 A → on reverse

50 A

5 L distributed between

Pulmonary
20%



systemic
80%

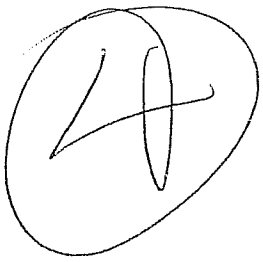
20% x 5L = (1L) 80% x 5L = (4L)

Cardiac output = 5L/min

Pathway: Right V → Pulmonary Circ → Left V

Pulmonary circulation is 1L of blood

Cardiac output is 5L/min



$$1L \times \frac{1 min}{5L} = \frac{1}{5} min \approx \boxed{20 sec}$$

it takes approx 20 sec for that drop of blood to travel from RV to LV

PART 1

SUBJECTIVE SCORE INSTRUCTOR USE ONLY

100	90	80	70	60
50	40	30	20	10
9	8	7	6	5
4	3	2	1	0

No.	(T)	(F)			KEY
	%	2	3		5
1	A	B	C	D (marked)	E
2	A	B	C	D (marked)	E
3	A	B (marked)	C	D	E
4	A	B	C (marked)	D	E
5	A	B	C	D (marked)	E
6	A	B (marked)	C	D	E
7	A	B	C (marked)	D	E
8	A (marked)	B	C	D	E
9	A	B	C (marked)	D	E
10	A	B	C	D (marked)	E
11	A	B	C (marked)	D	E
12	A	B (marked)	C	D	E
13	A	B (marked)	C	D	E
14	A	B (marked)	C	D	E
15	A	B	C (marked)	D	E
16	A (marked)	B	C	D	E
17	A	B	C	D	E (marked)
18	A	B (marked)	C	D	E
19	A (marked)	B	C	D	E
20	A	B	C	D	E (marked)
21	A	B	C (marked)	D	E
22	A	B	C	D	E (marked)
23	A	B	C	D	E (marked)
24	A	B	C	D (marked)	E
25	A	B	C (marked)	D	E
26	A	B	C	D (marked)	E
27	A (marked)	B	C	D	E
28	A	B (marked)	C	D	E
29	A	B	C (marked)	D	E
30	A	B (marked)	C	D	E
31	A (marked)	B	C	D	E
32	A	B	C (marked)	D	E
33	A	B	C	D (marked)	E
34	A	B (marked)	C	D	E
35	A	B	C (marked)	D	E
36	A	B (marked)	C	D	E
37	A	B (marked)	C	D	E
38	A	B	C	D (marked)	E
39	A	B	C (marked)	D	E
40	A	B	C (marked)	D	E
41	A	B	C	D (marked)	E
42	A	B	C (marked)	D	E
43	A	B (marked)	C	D	E
44	A	B	C	D	E (marked)
45	A	B (marked)	C	D	E
46	A	B	C	D	E
47	A	B	C	D	E
48	A	B	C	D	E
49	A	B	C	D	E
50	A	B	C	D	E

FEED THIS DIRECTION

06 07 08 M12 1606 999 12 11 10 9 8 7 6 5

IMPORTANT

USE NO. 2 PENCIL ONLY

- MAKE DARK MARKS
- ERASE COMPLETELY TO CHANGE
- EXAMPLE: A B ▬ D E

TO USE SUBJECTIVE SCORE FEATURE:

- Mark total possible subjective points
- Only one mark per line on key
- 163 points maximum

EXAMPLE OF STUDENT SCORE: 1 2 5

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UNIVERSITY OF TEXAS AT ARLINGTON

DEPARTMENT OF BIOLOGY

HUMAN PHYSIOLOGY
(Biol 3345)

Dr. David G. Bernard

THIRD INTRASESSIONAL EXAMINATION

April 17, 2008

2

First Name Nicole Last Name: Khakhi UTA ID # 1000546162

There are 60 items in this booklet; 55 are multiple choice questions and the remainder are either short essay questions or diagrams to be labeled. Be careful not to overlook any pages in the examination booklet. You have 80 minutes to complete these questions.

During the course of the examination students will remain in their assigned seats. If assistance is needed, the student should raise his/her hand and a proctor will attend the individual needs of that student.

Upon completion of the exam, each student is to remain seated, raise her/his hand, and the exam materials will be collected by a proctor. At no time is the student to leave his/her seat and carry the exam materials to the proctors or other areas of the room.

After collection of exam materials, the student is to immediately, quietly, and promptly leave the Examination Room.

NO EXTRA TIME WILL BE ALLOWED AT THE END OF THE EXAMINING PERIOD FOR ANSWERS TO BE TRANSFERRED.

GOOD LUCK!

DIRECTIONS: Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 1.6 points.

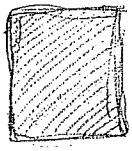
1. Which statement best describes arteries?
   A. All carry oxygenated blood to the heart.
   B. All contain valves to prevent the back-flow of blood.
   C. All carry blood away from the heart.
   D. Only large arteries are lined with endothelium.
   E. All are larger than veins.

2. Which description is correctly matched to the tissue?
   A. skeletal muscle – controls involuntary body movements
   B. cardiac muscle – classified as striated muscle
   C. cardiac muscle – found ONLY near the heart
   D. skeletal muscle – always attached to bones
   E. smooth muscle – the muscle of internal organs ONLY

3. Excitation-contraction coupling refers to _____.
   A. the arrival of acetylcholine at the neuromuscular junction due to its exocytosis from the axon terminal
   B. acetylcholine opening ion channels
   C. the chemical and electrical events that trigger the mechanical events in a muscle fiber
   D. the enzymatic removal of acetylcholine from the synapse which can then allow relaxation to occur
   E. B and D

4. Restoring lost fluid from the capillaries back to the circulatory system is one of the major functions of the _____ system.
   A. urinary B. thirst quenching C. lymphatic
   D. immune E. digestive

5. Asynchronous recruitment:
   A. helps avoid fatigue during sustained muscle contractions
   B. refers to different motor units taking turns maintaining muscle tension
   C. makes an entire muscle seem to contract smoothly
   D. A and B
   E. A, B, and C



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6. Each of the following statements concerning the movement of fluid between capillaries and interstitial space is true **EXCEPT** one. Identify the exception.
   A. Blood hydraulic pressure forces fluid from the capillary to the interstitial space.
   B. Blood osmotic pressure moves fluid from the interstitial space to the capillary
   C. The osmotic pressure of the interstitial fluid is less than the blood osmotic pressure.
   D. The blood hydraulic pressure and the blood osmotic pressure are equal in magnitude but opposite in action.
   E. The hydraulic pressure of the interstitial fluid does not oppose the movement of fluid from the capillary.

7. The depolarization phase of the conducting system muscle action potential is the result of:
   A. increased membrane permeability to sodium ions
   B. increased membrane permeability to potassium ions
   C. increased membrane permeability to calcium ions
   D. decreased membrane permeability to sodium ions
   E. increased membrane permeability to chloride ions

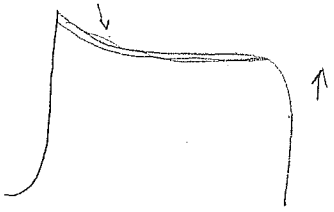
8. If the ESV is 60 mL, which other values are most likely to occur in a healthy, normal person?
   A. The EDV could be 70 mL and the SV could be 70 mL.
   B. The EDV could be 140 mL and the SV could be 90 mL.
   C. The EDV could be 150 mL and the SV could be 90 mL.
   D. The EDV could be 120 mL and the SV could be 70 mL.
   E. B and D

EDV − ESV = SV

150 − 60 =

9. Skeletal muscles at rest receive about _____ of the cardiac output. During exercise, they receive as much as _____.
   A. 20%, 85%
   B. 20%, 20%
   C. 85%, 20%
   D. 85%, 85%
   E. none of the above

10. The flattening of the action potentials of myocardial contractile cells, called the plateau phase, is due to a combination of _____ K^+ permeability and _____ Ca^{2+} permeability.
   A. increasing, increasing
   B. decreasing, decreasing
   C. increasing, decreasing
   D. decreasing, increasing
   E. cannot be determined



11. Contractions of the papillary muscles:
   A. close the atrioventricular valves
   B. close the semilunar valves
   C. eject blood from the ventricles
   D. prevent the atrioventricular valves from projecting into the atria
   E. eject blood from the atria into the ventricles

12. Substances transported by the cardiovascular system include:
   A. nutrients transported to the external environment
   B. materials that move from cell to cell within the body
   C. waste that the cells eliminate
   D. A and C
   E. B and C

13. In circulating from the brain to the arm, a drop of blood would ***NOT*** have to pass through which of the following structures?
   A. left atrium
   B. aorta
   C. inferior vena cava
   D. pulmonary vein
   E. superior vena cava

14. The amount of blood flowing to skeletal muscles is greatly increased during exercise. This redirection of blood into muscles is accomplished by:
   A. contraction of muscle in the walls of arterioles
   B. relaxation of muscle in walls of arterioles
   C. opening of valves in veins
   D. opening of valves in arteries
   E. relaxation of muscle in the walls of veins

15. Central fatigue _____.
   A. include feeling tired
   B. may precede physiological muscle fatigue
   C. may be related to changes in the brain related to changes in the pH of the blood
   D. A and B
   E. A, B and C

16. In the arm, the biceps brachii act as flexor whereas triceps brachii act as extensor. Which of the following statements is true?

A. The biceps brachii would be the primary muscle responsible for movement of the hand and forearm towards the shoulder.
B. The triceps brachii would be the primary muscle responsible for movement of the hand and forearm towards the shoulder.
C. Theses muscles are an example of antagonistic muscle groups.
D. A and C
E. B and C

17. At the conclusion of the power stroke:

A. inorganic phosphate has been released from the myosin
B. actin has been moved toward the M line
C. ADP is released from the myosin head
D. the myosin head is tightly bound to actin
E. All of the above are correct.

18. In muscles used for fine actions, such as controlling eye movement or use of the hand, a motor unit will have _____ muscle fibers when compared to a motor unit in muscles used for power and strength.

A. hundreds more
B. very few
C. approximately the same numbers of
D. Any of these answers could be correct, as this is impossible to predict
E. None of the above is correct.

19. The purpose of transverse tubules is to:

A. ensure a supply of Ca^{2+} ions through the muscle fiber
B. rapidly conduct the action potentials to the interior of the muscle fiber
C. ensure a supply of glycogen throughout the muscle sarcoplasm
D. conduct the ATP molecules out of the mitochondria throughout the sarcoplasm
E. All of these statements are true.

20. Put these events in the correct chronological sequence.

1. end plate potentials trigger action potentials
2. transverse tubules convey potentials into the interior of the cell
3. acetylcholine binds to receptors on the motor end plate
4. binding sites on actin are uncovered, allowing myosin to bind and carry out power strokes
5. Ca^{2+} is released from the sarcoplasmic reticulum
6. chemically regulated ion channels open, causing depolarization
7. Ca^{2+} ions bind to troponin-C, pulling on tropomyosin

A. 5, 3, 2, 1, 4, 7, 6
B. 3, 6, 1, 2, 5, 7, 4
C. 4, 1, 3, 7, 2, 6, 5
D. 2, 4, 7, 6, 3, 1, 5
E. 3, 6, 1, 5, 7, 2, 4

21. Ca^{2+} is important in the contraction of smooth muscle. Which of the following is true about smooth muscle contraction?

A. Ca^{2+} only enters the cytosol from the sarcoplasmic reticulum.
B. Ca^{2+} binds to troponin.
C. Contraction is immediately triggered by calmodulin binding.
D. MLCK (myosin light chain kinase) forms a complex to activate myosin.
E. When MLCK activates myosin, ATPase activity is low and crossbridge formation is inactive.

22. Blood flow to a tissue will increase if the:
   A. level of oxygen at the tissue increases
   B. level of carbon dioxide at the tissue increases
   C. pH rises
   D. vessel constricts
   E. all of the above

23. In living muscle at rest, which situation is most common?
   A. The myosin head is not attached to any molecule.
   B. The myosin head is weakly attached to G-actin.
   C. The myosin head is attached to ADP and inorganic phosphate.
   D. B and C
   E. None of the above

24. Stretching a myocardial cell:
   A. decreases the force of a contraction
   B. allows more Ca^{2-} to enter
   C. increases the force of contraction
   D. A and B
   E. B and C

25. The plateau phase of the cardiac muscle action potential is due to:
   A. the movement of fewer sodium ions across the cell membrane
   B. the calcium channels remaining open longer than the sodium channels
   C. the increased membrane permeability to potassium
   D. a decrease in the amount of calcium diffusing across the membrane
   E. an increased membrane permeability to sodium ions

26. The cardiovascular control center in the brain can directly cause:
   A. arterioles to dilate or constrict ✓
   B. the heart rate to increase or decrease ✓
   C. the elasticity of the heart to increase or decrease
   D. A and B
   E. A, B, and C

27. Which of the following statements is true about titin?
   A. Titin returns stretched muscle to their resting length.
   B. Titin stabilizes the position of the contractile filaments.
   C. Titin is helped by actin.
   D. A and B are correct.
   E. All of the above are correct.

28. Type I alveolar cells:
   A. allow rapid diffusion of gases through their thin membranes
   B. secrete a chemical known as surfactant
   C. are phagocytic
   D. All of the above
   E. None of the above

29. Stroke volume would be expected to decrease when:
   A. there is an increase in contractility
   B. there is a sudden increase in aortic pressure
   C. the end-diastolic volume increases
   D. there is a slow heart rate
   E. when blood flow returning to the heart is increased

30. A contraction that generates force and moves a load is known as _____, whereas one that generates force without movement is known as _____.
   A. ~~isotropic~~, isometric
   B. isometric, eccentric
   C. isotonic, ~~isometric~~
   D. isometric, isotonic
   E. ~~isotonic, eccentric~~

31. Which of the following is a function of smooth muscle tissue?
   A. altering the diameter of skeletal muscles
   B. elevating the arm
   C. forcing blood from the heart into the major arteries
   D. moving food materials around the mouth
   E. forcing urine out of the urinary tract

32. In muscle contraction, calcium apparently acts to:
   A. increase the action potential transmitted along the sarcolemma
   B. release the inhibition on the Z lines
   C. remove the blocking action of tropomyosin
   D. cause ATP binding to actin

33. During the cardiac cycle:
   A. the P wave of the ECG occurs before the first and second heart sounds
   B. the QRS complex of the EKG follows the increase in ventricular pressure
   C. the third heart sound occurs during atrial systole
   D. the second heart sound coincides with the QRS complex of the ECG
   E. the greatest increase in ventricular pressure occurs during the ejection phase

34. During the isovolumic phase of ventricular systole:
   A. the atria contract
   B. blood is ejected into the great vessels
   C. the ventricles are relaxing
   D. the ventricles are filling with blood
   E. All the valves of the heart are closed

35. During the cardiac cycle:
   A. the P wave of the ECG occurs before the first and second heart sounds
   B. the QRS complex of the EKG follows the increase in ventricular pressure
   C. the third heart sound occurs during atrial systole
   D. the second heart sound coincides with the QRS complex of the ECG
   E. the greatest increase in ventricular pressure occurs during the ejection phase

36. When the diaphragm and external intercostal muscles contract:
   A. the volume of the thorax increases
   B. the volume of the thorax decreases
   C. the volume of the lungs decreases
   D. the lungs collapse
   E. expiration occurs

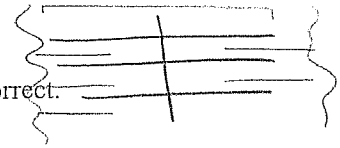
37. Within a single fiber, the tension developed during a twitch depends on:
   A. the magnitude of the stimulus
   B. the length of the sarcomeres prior to contraction
   C. the force required to move the relevant joint
   D. the amount of neurotransmitter in the synapse
   E. the duration of the stimulus

38. Which statement is true?
A. Myosin is a motor protein that converts the chemical bond energy of ATP into the mechanical energy of motion.
B. Each myosin molecule acts as an enzyme which both binds ATP and releases its energy.
C. The energy released by ATP produces the power stroke by swiveling the myosin head.
D. A and B
E. A, B, and C

39. _____ is made of multiple globular molecules polymerized to form long chains or filaments.
A. actin B. tropomyosin C. troponin
D. myosin E. titin

40. An important difference between single-unit and multiunit smooth muscle is:
A. the ability of single-unit fibers to change into multiunit fibers when advantageous.
B. longer actin and myosin filaments in multiunit smooth muscle, which allow coordination of contraction
C. numerous gap junctions in single-unit muscle, which allow many cells to work together as a sheet
D. closely controlled individual fibers in single-unit smooth muscle to allow fine control and graded contractions by selective activation
E. All of the above are correct.

41. The A band contains:
A. thick filaments B. thin filaments
C. an area of overlapping filaments D. All of the above are correct.
E. None of the above is correct.



42. Contraction of vascular smooth muscle is regulated by:
A. Ca^{2+}
B. hormones
C. paracrines
D. neurotransmitters
E. All of the above.

43. The airway between the larynx and the primary bronchi is the:
A. pharynx B. bronchiole C. trachea
D. alveolar duct E. laryngeal duct

44. As ATP binds to the myosin head at the beginning of a muscle contraction cycle:
A. the myosin head detaches from actin
B. the myosin head initiates binding with actin
C. the myosin head tightens its bond to actin
D. ATP does not bind to the myosin head
E. None of these complete the statement correctly.

45. The first heart sound is heard when:
A. blood enters the aorta B. the semilunar valves close
C. the AV valves open D. the atria contract
E. the AV valves close

46. The common passageway shared by the respiratory and digestive systems is the:
A. larynx B. glottis C. vestibule
D. pharynx E. esophagus

47. The force generated by a single muscle fiber:
A. is always the same
B. can be increased by increasing the frequency of action potentials
C. can be increased due to summation
D. B and C
E. All of the above

48. The power stroke begins when:
A. the actin is released by the myosin head
B. the ATP is hydrolyzed by the myosin head
C. the inorganic phosphate and ADP are released from the myosin
D. the actin is attached to the myosin head
E. A and B

49. Tom suffers from hypertension (high blood pressure). Which of the following might help deal with his problem? A drug that:
A. stimulates alpha receptors in cardiac muscle tissue
B. blocks alpha receptors in cardiac muscle tissue
C. stimulates cAMP formation in cardiac muscle tissue
D. blocks beta receptors in cardiac muscle tissue
E. blocks muscarinic receptors in cardiac muscle tissue

50. If the HR is 72 bpm and the SV is 72 mL, the cardiac output would be approximately equal to:
A. 5184 mL/minute
B. 5.2 liters/minute
C. 144 mL/minute
D. A and B
E. none of the above

72 x 72 = 144
5040
5184
1000 = 5.2
CO = HR x SV

51. At an intercalated disc:
A. the cell membranes of two cardiac muscle fibers are completely separated by a synapse
B. the myofibrils are loosely attached to the membrane of the disc
C. two cardiac muscle cells are connected by gap junctions
D. t-tubules unite the membranes of the adjoining cells
E. all of the above

52. As ATP binds to the myosin head at the beginning of a muscle contraction cycle:
A. the myosin head detaches from actin
B. the myosin head initiates binding with actin
C. the myosin head tightens its bond to actin
D. ATP does not bind to the myosin head
E. None of these complete the statement correctly.

53. When comparing complete tetanus with unfused tetanus, which is true?
A. In complete tetanus, no relaxation occurs between stimuli.
B. In complete tetanus, maximum tension is developed.
C. In complete tetanus, the muscle fiber is stimulated at a higher frequency.
D. A and B
E. A, B, and C

bear
min

54. Which of the following are involved directly in the systemic circulation?

A. superior vena cava, right atrium, and left ventricle ✓
B. right ventricle, pulmonary artery, and left atrium.
C. left ventricle, pulmonary artery, and inferior vena cava
D. right atrium, right ventricle, and left ventricle
E. inferior vena cava, pulmonary vein, pulmonary artery

55. In smooth muscle:

A. calcium ions do not bind to troponin molecules ✓
B. calcium ions are not released from the sarcoplasmic reticulum X
C. calcium ions play no role in the process of contraction X
D. none of the calcium ion required for contraction comes from outside of the cell X
E. calcium ion plays an important role in repolarizing the membrane after the depolarization phase

All valve close

Short Answer Questions

Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!!

You can use the back of the last page to continue any question. Number them, please!!

56. List the mechanical events of the cardiac cycle in sequence, beginning with atrial systole. (*Hint: include the positions of the valves* and serially number each event) (5 points)

when the action potential at SA node is delivered to VA node and the two atrium are contracted the initial part of p vave of EKG happens the AV valve closed and the first sound of the heart heard by the sending the ation potential down the bovdle of his the p wave completed and atriums contract at the same time.

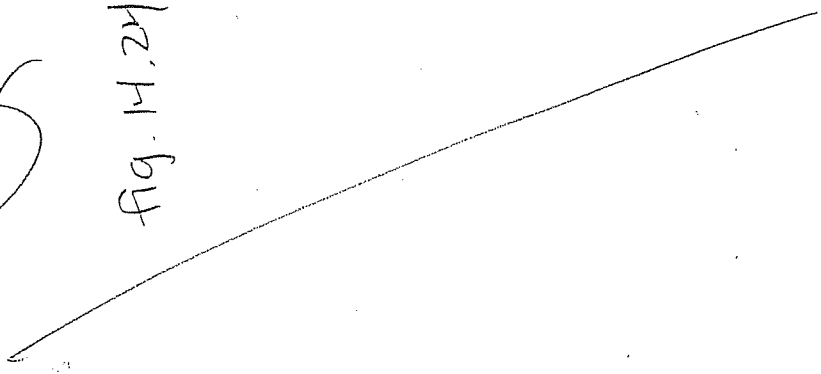
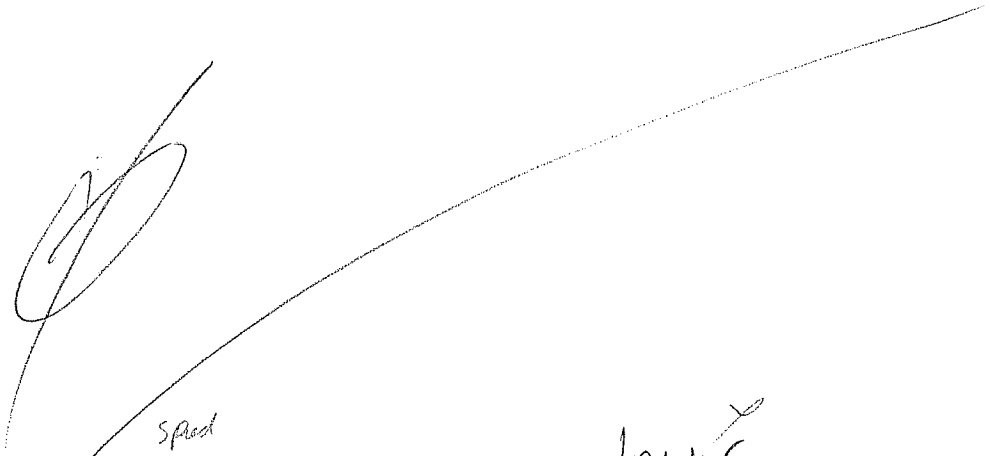


fig. 14.24

57. What effect will a calcium channel blocker have on the heart, the blood pressure, and cardiac output? Why? (5 points)

the effect of calcium channel blocker is to block the channels that release Ca^{++} in the cytoplasm of mycardium cells in order to bind to troponin and take the tropomyosin away from the binding site of actin-myosin so the excitibility doesn't occur and blood pressure decreese and cardiac output decrease and the transfer of O_2 ~~and~~ in whole body decrease and lack of oxygen for cells and tissues occur

58. Tom loves to soak in hot tubs and whirlpools. One day he decides to raise the temperature in his hot tub as high as it will go. After a few minutes in the very warm water, he feels faint, passes out, and nearly drowns. Luckily he is saved by an observant bystander. Explain what happened. (5 points)



59. The rate of blood flow through the lungs is lower (*higher/the same/lower*) than the rate in other tissues. Why? (5 points)

I think because the only sourse of exchange the O_2 and CO_2 with external environment is through the lung we need to capture enough O_2 and repel enough CO_2 and take enough O_2 for whole organs of the other tissues and. because the pressure of right ventricle is much lower than left ventricle to send blood to lungs.

60. Your physiology professor has 5 liters of blood distributed between his pulmonary and systemic circuits. Assume 20% of the blood is in his lungs at any moment. If his cardiac output is 5 L/min, how long will it take a drop of blood to flow from his left ventricle to his right ventricle? **Show your calculations for full points.** (5 points)

$5 \times 20\% = 1$ liter in lungs at any moment

$C.O = 5\,L/min = SV \times HR$ beat/min

$5 - 1 = 4$ liter in Systemic

$SV = 4$ L/beat

left ventricle → semilunar valve → aorta → arteries → arterioles → capillaries → venules → veins (superior / inferior) → right atrium → Tricops → right ventricle.

$HR = \frac{5\ L/min}{4\ liter/beat} = 1.25$ beat/min

$\frac{4}{5} \times 60 = 48$ sec

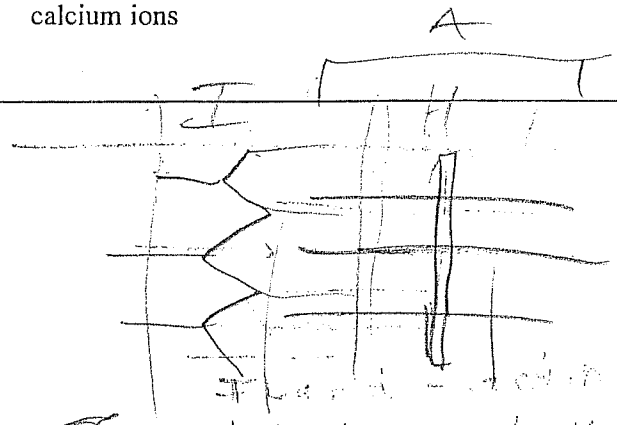
DIRECTIONS: **Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 1.5 points. YOU DO NOT HAVE TO ATTEMPT ALL THE QUESTIONS TO EARN 100 POINTS.**

1. The cytoplasm of a skeletal muscle fiber is called the:
   A. sarcolemma B. sarcomere C. sarcosome
   D. sarcoplasmic reticulum E. sarcoplasm

2. The detachment of the myosin cross-bridges is directly triggered by:
   A. the repolarization of T tubules
   B. the attachment of ATP to myosin heads
   C. the hydrolysis of ATP
   D. calcium ions

3. Muscle fibers differ from "typical cells" in that muscle fibers:
   A. lack a cell membrane B. have many nuclei C. are very small
   D. lack mitochondria E. both B and C

4. At rest, the active sites on the actin are blocked by:
   A. myosin molecules B. troponin molecules
   C. tropomyosin molecules D. calcium ions
   E. ATP molecules



Match each with its function (Questions 5 to 7):

   A. I band
   B. H zone
   C. A band
   D. both A and B
   E. none of the above are correct

5. Can increase in size or length.

6. Marks the boundary between adjacent sarcomeres.

7. The central portion of each thick filament is connected to its neighbors in this region.

8. In the Peruvian Andes where the atmospheric pressure is half the normal sea level, the PO_2 of tracheal inspired gas is:
   A. 60 B. 70
   C. 80 D. 90 E. 100

9. Which of the following is **NOT** a characteristic of smooth muscle?
   A. Smooth muscle connective tissue forms tendons.
   B. Neurons that innervate smooth muscles are under involuntary control
   C. Smooth muscles are uninucleate.
   D. Smooth muscles do not contain sarcomeres.
   E. The thin filaments of smooth muscle fibers are attached to dense bodies.

10. The statement "in a mixture of gases, the total pressure is the sum of the individual partial pressures of gases in the mixture" is called:
   A. Henry's law B. Dalton's law C. Boyle's law D. Charles' law

11. According to the length-tension relationship:
A. longer muscles can generate more tension than shorter muscles
B. the greater the zone of overlap in the sarcomere the greater the tension the muscle can develop
C. the greatest tension is achieved in sarcomeres where the actin and myosin initially do not overlap
D. there is an optimum range of actin and myosin overlap that will produce the greatest amount of tension
E. both B and D

12. The function of the atrium is to:
A. collect blood
B. pump blood to the lungs
C. pump blood into the systemic circuit
D. pump blood to the heart
E. both A and D

13. The heart is innervated by _____ nerves
A. parasympathetic
B. sympathetic
C. both sympathetic and parasympathetic
D. neither sympathetic nor parasympathetic

14. The plateau phase of the cardiac muscle action potential is due to:
A. the movement of fewer sodium ions across the cell membrane
B. the calcium channels remaining open longer than the sodium channels
C. the increased membrane permeability to potassium ion
D. a decrease in the amount of calcium diffusing across the membrane
E. an increased membrane permeability to sodium ions

15. The T wave on an ECG tracing represents:
A. atrial depolarization
B. atrial repolarization
C. ventricular depolarization
D. ventricular repolarization
E. ventricular contraction

16. The first heart sound is heard when the:
A. AV valves open
B. AV valves close
C. semilunar valves close
D. atria contract
E. blood enters the aorta

17. During the cardiac cycle, the:
A. P wave of the ECG occurs between the first and second heart sounds
B. QRS complex of the ECG precedes the increase in ventricular pressure
C. second heart sounds coincides with the QRS complex
D. both B and C

18. The volume of blood ejected from each ventricle during a contraction is called:
A. end-diastolic volume
B. end-systolic volume
C. stroke volume
D. cardiac output
E. cardiac reserve

19. Which of the following is greater?
A. the number of action potentials per minute spontaneously generated by the SA node
B. the number of action potentials per minute spontaneously generated by the AV node
C. neither is greater

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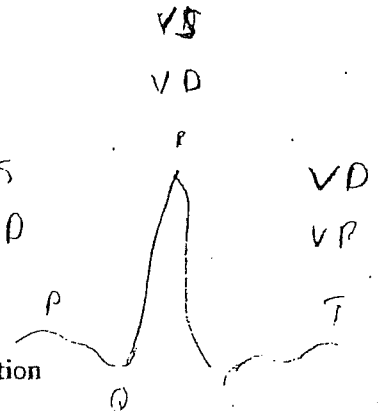

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20. The blood vessels that play the most important role in the regulation of blood flow to a tissue and blood pressure are the:

A. arteries B. arterioles C. veins
D. venules E. capillaries

21. Materials can move across capillary walls by:

A. diffusion and osmosis B. active transport and bulk flow
C. secretion and absorption D. A and B
E. all of the above

22. Blood moves forward through veins by all of the following, **EXCEPT**:

A. because the pressure in the veins is lower than in the arteries
B. because of contraction-relaxation pumping of the smooth muscle in the wall of the vein
C. with the aid of the thoracoabdominal pump Builds pressure in heart
D. because valves in the veins prevent the backflow of blood
E. with the aid of contractions of skeletal muscles

23. The alveolar ventilation in a young healthy person whose lean body weight is 120 pounds (V_D = 120 ml) when he/she breathes at a frequency of 10 breaths per minute with a tidal volume of 400 ml is:

A. 3500 B. 5220
C. 4000 D. 2800 E. 3200

400 - 120 = 280

24. Blood pressure within the cardiovascular system fluctuates because_____.

A. the volume within the heart changes
B. the volume within the blood vessels changes
C. the pressure within the heart changes
D. all of the above

25. The rapid depolarization phase of the action potentials of myocardial contractile cells is due to which ion(s)?

A. Ca^{2+} B. K^+ C. Na^+
D. A and B E. A and C

26. Which occur(s) during ventricular filling?

A. The atria are filling.
B. The AV valves are open.
C. The last 20% of ventricular filling is accomplished.
D. A and C
E. A, B and C

27. At a PO_2 of 70 mm Hg and normal temperature and pH, hemoglobin is _____ saturated with oxygen.

A. 10% B. 25% C. 50%
D. 75% E. over 90%

28. The sliding filament model of contraction involves:

A. the Z lines sliding over the myofilaments
B. the shortening of thick filaments so that thin filaments slide past
C. actin and myosin shortening but not sliding past each other
D. actin and myosin sliding past each other but not shortening

29. The walls of the alveoli are composed of two types of cells, type I and type II. The function of type II is:

A. to secrete surfactant
B. to trap dust and other debris
C. to replace mucus in the alveoli
D. to protect the lungs from bacterial invasion

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B. to trap dust and other debris
C. to replace mucus in the alveoli
D. to protect the lungs from bacterial invasion

30. Which of the following is most correct.

E
- A. Muscle length and tension remain constant during isotonic contraction.
- B. Myofilaments are sliding during isotonic contraction.
- C. The A band does not shorten during isotonic contraction
- D. The Z disc shortens during isotonic contraction.
- E. Both Band C are correct.

31. If the period of ventricular filling were increased in duration:

B
- A. less blood would flow into the ventricles for any given time interval
- B. the amount of blood in the ventricles at the end of diastole would be greater
- C. the amount of blood in the ventricles at the end of systole would be greater
- D. the stroke volume would decrease

32. When the heart is beating at a rate of 75 times per minute, the duration of one cardiac cycle is _____ second(s):

A
- A. 60/75
- B. 75/60
- C. 1
- D. 3600/75
- E. cannot be determined

33. Theodore decides to make an attempt to get into the record books by sitting under water for the longest time. He fixes a mouthpiece to a long plastic tube, weights himself down, and sits at the bottom of an eight foot deep pool with the top of the plastic pipe 3 inches above the water. After a few minutes, he finds that:

B
- A. his alveolar ventilation rate has increase
- B. he is breathing faster and deeper
- C. his vital capacity is larger
- D. his tidal volume has decreased
- E. his residual volume has increased

True/False

F 34. T/F During isometric contraction, the energy used appears as movement.

T 35. T/F The dicrotic notch refers to the brief rise in pressure caused by the closure of the AV valves during ventricular systole.

Match each with its function (Questions 36 to 38):

- A. larynx
- B. glottis
- C. pharynx
- D. trachea
- E. nasal cavity

C 36. Common passageway shared by the respiratory and digestive systems. pharynx

A 37. The 'vocal cords' are located here. larynx

B 38. The _____ is the opening to the larynx. glottis

Short Answer Questions

Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!!

You can use the back of the last page to continue any question. Number them, please!!

39. List the events of the cardiac cycle in sequence, beginning with atrial diastole and ventricular systole. Note where the valves open and close. (10 points)

~~Apex~~ AS → VS → VD

(3) (1) (2)

(1) Atrial Diastole - bicuspid and tricuspid valves are closed, and blood enters from the vena cava and pulmonary vein

(2) Ventricular Systole - Cardiac muscle contracts, forcing blood out of the aorta and pulmonary artery through the open aortic semilunar valve and the open pulmonary semilunar valve, respectively.

(3) Ventricular Diastole - aortic & pulmonary semilunar valves are closed, ~~ventricles are filled by blood from the atrium that enters through the bicuspid and tricuspid AV valves~~ AV valves are closed

4 Atrial Systole - AV valves are open, and the atria contracts, forcing blood through the AV valves.

40. Can a skeletal muscle contract without shortening? Explain. (5 points)

Isometric muscle contraction. A sarcomere remains rigid but does not contract. Tonic + Slow-twitch muscles maintain posture for a long time.

2

41. List the factors that will shift the oxygen-hemoglobin saturation curve to the left. (2 points)

Decreased CO_2

Increased pH

Decreased temperature

-5

42. List seven (7) major functions of the respiratory system. (4 points)

- intake of O_2
- output of CO_2
- regulation of blood pH
- elimination of certain ... production of other chemicals
- phonation
- filtration of microbes
- regulation of blood pressure

43. Trace the pathway of blood **from where the blood pressure is at its lowest to where the blood pressure is at its highest**. Include the following information: heart chambers involved, major blood vessels involved, valves, and general areas through which the blood flows. (10 points)

Start (low pressure) → capillary beds → venules → veins → vena cavae → right atrium → tricuspid AV valve → right ventricle → pulmonary semilunar valve → lungs → left atrium → bicuspid AV valve → left ventricle → Aortic semilunar valve → Aorta → End (high pressure)

44. Compare and contrast cardiac muscle cells to skeletal muscle. (4 points)

Cardiac	Skeletal
autonomic	voluntary
autonomic motor neurons	somatic motor neurons
cells short and branched	cells (muscle fibers) long and thin
contains intercalated discs	
striated	striated
have sarcolemma	have sarcolemma
contain actin, myosin, troponin + tropomyosin	contain actin, myosin, troponin + tropomyosin
uninucleate	multinucleate

Cardiac	Skeletal
autonomic	Voluntary
cell short + branched	

DIRECTIONS: **Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 2 points.**

1. The sliding filament of contraction involves:
   - (A) Actin and myosin sliding past each other but not shortening
   - B. The shortening of thick filaments so that the thin filaments slide past
   - C. Actin and myosin shortening but not sliding past each other
   - D. The Z discs sliding over the myofilaments.

2. Contractions of the papillary muscles:
   - A. close the atrioventricular valves
   - B. close the semilunar valves
   - C. eject blood from the ventricles
   - (D) prevent the atrioventricular valves from projecting into the atria
   - E. eject blood from the atria into the ventricles

3. If you feel like you heart is beating rapidly while you sit here taking this exam, you are probably:
   - A. right because the somatic nervous system is in control
   - B. right because the parasympathetic systemic responds to stress situations
   - (C) right because the sympathetic system is responding to the stress of the test situation
   - D. wrong because the pacemaker tends to keep your heart beating at a steady rate even under stress
   - E. wrong because the response of your body to stress is to shift energy to the skeletal muscles from the heart muscle

4. Blood within the pulmonary veins is returned directly to the:
   - A. lungs
   - B. right atrium
   - (C) left atrium
   - D. right ventricle
   - E. left ventricle

5. Each of the following statements concerning the movement of fluid between capillaries and interstitial spaces is true except one. Identify the exception.
   - A. Blood hydraulic pressure forces fluid from the capillary to the interstitial space
   - B. Blood osmotic pressure moves fluid from the interstitial space to the capillary
   - C. The osmotic pressure of the interstitial fluid is less than the blood osmotic pressure.
   - (D) The blood hydraulic pressure and the blood osmotic pressure are equal in magnitude but opposite in action.
   - E. The hydraulic pressure of the interstitial fluid does not oppose the movement of fluid from the capillary.

6. During the period of ventricular filling:
   - A. pressure in the heart is at its peak
   - B. the atria remain in diastole
   - (C) blood flows passively through the atria and the open AV valves
   - D. blood is flowing through the open pulmonary valve
   - E. the mitral valve remains closed

7. A 25 year old Human Physiology student has a total lung capacity of 6000 ml, residual volume of 1000 ml, tidal volume of 500 ml and inspiratory capacity of 3000 ml. Her functional residual capacity (FRC) is:
   - (A) 2,000 ml
   - B. 2,500 ml
   - (C) 3,000 ml
   - D. 3,500 ml
   - E. 5,000 ml

8. Site where the velocity of blood flow is least.
   A. large arteries B. arterioles C. capillaries
   D. large veins E. inferior vena cava

9. Stroke volume would be expected to decrease when:
   A. there is an increase in contractility
   B. there is a sudden increase in aortic pressure
   C. the end-diastolic volume increases
   D. there is a slow heart rate
   E. when blood flow returning to the heart is increased

10. The lung volume which represents the total volume of exchangeable air is the:
   A. tidal volume B. vital capacity C. inspiratory capacity
   D. expiratory reserve volume E. total lung capacity

11. Which of the following are involved directly in pulmonary circulation?
   A. superior vena cava, right atrium, and left ventricle
   B. right ventricle, pulmonary artery, and left atrium
   C. left ventricle, aorta, and inferior vena cava
   D. right atrium, aorta, left ventricle

12. Which statement is true?
   A. The sarcomere shortens, the two Z disks at each end move closer together, and the I band and H zone virtually disappear.
   B. The thin actin filaments slide along the thick myosin filaments as they move toward the M line in the center of the sarcomere.
   C. When a muscle contracts, myosin molecules coil up like springs to shorten the length.
   D. A and B are true
   E. A, B and C are true

13. If the vagal nerves to the heart were cut, the result would be:
   A. the heart would stop, since the vagal nerves trigger the heart to contract
   B. parasympathetic stimulation would increase, causing a decrease in heart rate
   C. the AV node would become the pacemaker of the heart
   D. the heart rate would increase by about 25 beats per minute
   E. None of the above is correct.

14. Isovolumetric contraction:
   A. refers to the short period during ventricular systole when the ventricles are completely closed chambers
   B. occurs while the AV valves are open
   C. occurs immediately after the semilunar valves close
   D. only occurs in people with heart valve defects
   E. occurs immediately after the atria relax

15. The deflection waves in an ECG tracing include:
   A. the T wave, which indicates ventricular repolarization
   B. the Q-T interval, which indicates the time of atrial contraction
   C. the PQRS complex, which follows ventricular contraction
   D. the P wave, which is only present in patients who have had a heart attack

16. Which of the following is NOT characteristic of smooth muscle?
   A. smooth muscle connective tissue forms tendons
   B. neurons that innervate smooth muscles are under involuntary control
   C. smooth muscles are uninucleate
   D. smooth muscles do not contain sarcomeres
   E. the thin filaments of smooth muscle fibers are attached to dense bodies

17. The tricuspid valve is closed: → right A.V.
   A. while the ventricle is in diastole ✗
   B. while the atrium is contracting ✗
   C. by movement of blood from atrium to ventricle ✗
   D. when the ventricle is in systole ✓

18. Which of the following is most likely to represent normal arterial blood gas values, in mm Hg?
   A. PO_2 - 120, PCO_2 - 60
   B. PO_2 - 70, PCO_2 - 32
   C. PO_2 - 60, PCO_2 - 40
   D. PO_2 - 90, PCO_2 - 38

19. Surfactant helps to prevent the alveoli from collapsing by:
   A. humidifying the air before it enters ✗
   B. warming the air before it enters ✗
   C. interfering with the cohesiveness of water molecules, thereby reducing the surface tension of alve fluid
   D. protecting the surface of alveoli from dehydration and other environmental variations

20. The depolarization phase of the conducting system muscle action potential is the result of: → Na+ in
   A. increased membrane permeability to sodium ions
   B. increased membrane permeability to potassium ions
   C. increased membrane permeability to calcium ions
   D. decreased membrane permeability to sodium ions
   E. increased membrane permeability to chloride ions

21. A subject has a tidal volume of 800 ml, an anatomical dead space of 200 ml and a respiratory rate of 15 breaths per minute. His alveolar ventilation (V_A) is (in ml/minute):
   A. 1,000
   B. 3,000
   C. 9,000
   D. 12,000

   800 − 200 = 600 ml
   600 × 15 = 9,000

22. In mouth-to-mouth artificial respiration, the rescuer blows air from his or her own respiratory system into of the victim, thus:
   A. expansion of the victim's lungs is brought about by blowing air in at higher than atmospheric pres
   B. during inflation of the lungs, the intrapleural pressure increases
   C. intrapulmonary pressure exceeds intrapleural pressure
   D. All of the above are correct.

23. Which of the following statements concerning alveolar pressure is/are correct?
   A. Alveolar pressure is less than atmospheric pressure during a normal negative pressure inspiration.
   B. Alveolar pressure is greater than atmospheric pressure during a forced expiration ✓
   C. Alveolar pressure equals atmospheric pressure at the end of a normal tidal expiration.
   D. All of the above.

24. In the Peruvian Andes where the atmospheric pressure is half the normal sea level value, the P_{O_2} of trachea inspired gas is:
   A. 60 mm Hg
   B. 70 mm Hg
   C. 80 mm Hg
   D. 90 mm Hg
   E. 100 mm Hg

25. "The quantity of a slightly soluble gas that will dissolve in a given mass of liquid at a stated temperature directly proportional to the partial pressure of that gas". This statement refers to:

A. Charles law B. Graham's law C. Dalton's law
D. Avogadro's law E. Henry's law

26. Which of the following would act as a stimulus to initiate a muscle contraction?

A. hormonal activity B. neurotransmitters
C. a change in the pH of a muscle D. All of the above

27. The plateau phase of the cardiac muscle action potential is due to:

A. the movement of fewer sodium ions across the cell membrane
B. the calcium channels remaining open longer than the sodium channels
C. the increased membrane permeability to potassium
D. a decrease in the amount of calcium diffusing across the membrane
E. an increased membrane permeability to sodium ions

28. The walls of the alveoli are composed of two types of cells, type I and type II. The function of type II is

A. to secrete surfactant
B. to trap dust and other debris
C. to replace mucus in the alveoli
D. to protect the lungs from bacterial invasion
E. to increase the diffusion distance

29. Place the following structures of the respiratory tree in order, considering how air enters the tree: 1. terminal bronchioles 2. bronchus 3. respiratory bronchioles 4. alveolar duct 5. bronchioles 6. alveolar sacs

A. 2, 4, 1, 5, 3, 6 B. 1, 5, 2, 3, 6, 4 C. 3, 1, 2, 5, 4, 6
D. 5, 1, 3, 2, 6, 4 E. 2, 5, 1, 3, 4, 6

30. In muscle contraction, calcium apparently acts to:

A. increase the action potential transmitted along the sarcolemma
B. release the inhibition on the Z lines
C. remove the blocking action of tropomyosin
D. cause ATP binding to actin

31. The amount of blood flowing to skeletal muscles is greatly increased during exercise. This redirection of blood into muscles is accomplished by:

A. contraction of muscle in the walls of arterioles
B. relaxation of muscle in walls of arterioles
C. opening of valves in veins
D. opening of valves in arteries
E. relaxation of muscle in the walls of veins

32. If the period of ventricular filling were increased in duration:

A. less blood would flow into the ventricle for any given time interval
B. the amount of blood in the ventricles at the end of diastole would be greater
C. the amount of blood in the ventricles at the end of systole would be greater
D. the stroke volume would decrease

33. The respiratory membrane is a combination of:

A. respiratory bronchioles and alveolar ducts
B. alveolar and capillary walls and their fused basal lamina
C. atria and alveolar sacs
D. None of the above

Short Answer Questions

Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!!
You can use the back of the last page to continue any question. Number them, please!!

51. Imagine grasping an object with a handle and lifting it 20 centimeters. What is different about the muscle *behavior* lifting a coffee mug, a full half gallon of milk, or a 10 kilogram suitcase? (Ignore positional differences of the arm; address the *effort* required.) Do sarcomeres behave differently? (5 points)

Coffee mug: (not much effort)
Lifting a coffee mug is done by isotonic contraction where the muscle tension stays constant and the muscle length shortens (sarcomeres shortening).

Milk:
Lifting the half gallon of milk will require more effort than the coffee mug but the movement is still isotonic meaning the tension will stay constant and the muscle will shorten (sarcomeres shorten).

Suitcase:
Lifting the suitcase requires substantially more effort than the mug or milk. If it is too heavy and cannot be lifted the muscles will experience isometric contraction in which the tension will increase but the muscle length will not shorten meaning sarcomeres will not shorten. If the suitcase can be lifted isotonic contraction will occur meaning tension will be constant and muscle length will shorten (sarcomeres will shorten)

52. Your physiology professor has suffered a myocardial infarction (after seeing the grades on the last exam). Although his heart rate is 60 beats per minute, his ejection fraction (SV divided by EDV) is only 25%, with a stroke volume of 40 mL. What is his EDV, ESV, and CO? Show your calculations. (5 points)

$HR = 60 \frac{bt}{min}$

$SV = 40\ mL$

$EF = 25\% = \frac{40}{EDV}$

$\frac{25}{100} = \frac{40}{EDV}$

$25EDV = 4000$

$EDV = 160\ mL$

$CO = HR \times SV$

$CO = 60 \frac{bt}{min} \times 40\ mL$

$CO = 2400 \frac{mL}{min}$

$ESV =$

$CO = ESV + EDV$

$2400 = ESV + 160$

$2240 = ESV$

Short Answer Questions

Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!!

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51. Neurons are treated with a drug that instantly and permanently stops the Na,K-ATPase pumps. The neuron is then repeatedly stimulated, and recordings are made of the response. What happens to the resting membrane potential immediately and over time? (4 points)

During any one action potential generated, only a few molecules of Na^+ and K^+ actually move, so the concentration gradients are not significantly altered. The resting membrane potential is not significantly changed. According to the textbook, another action potential could be generated without restoring the ions. But over a long period of stimulation (millions of times), the RMP would probably stay depolarized

(4)

52. How is the action of neurotransmitters terminated? (3 points)

Neurotransmitters can be terminated in 3 ways:

1. diffuse away from the synaptic cleft, deactivating from the receptors
2. inactivated by enzymes in the cleft (ex: acetylcholinesterase)
3. transported back into presynaptic neuron or neuroglial cell

(3)

CH. 9

53. Trace the path of cerebrospinal fluid from its point of production until it is reabsorbed into the blood. (6 points)

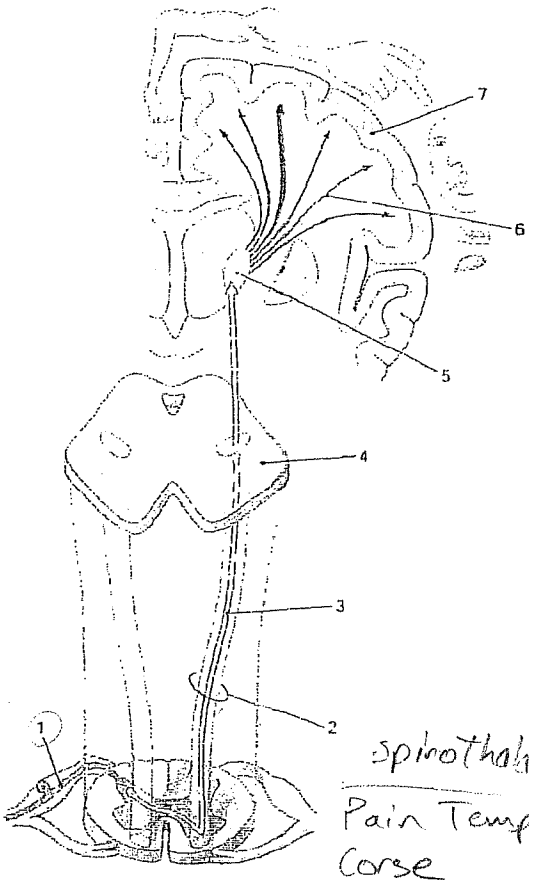
From the point of production, there are 2 paths which CSF can flow:

1. out the opening in the medulla, move up to the subarachnoid space, move around the brain dorsally, move to the arachnoid villi where it is absorbed
2. down the spinal cord by going through the center canal, exit the system, move around dorsally, move up the spinal cord + brain posteriorly until it gets to the arachnoid villi

(1)

DIRECTIONS: **Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 2 points.**

Use the diagram to the right to answer the next three (3) questions.



1. Identify the structure labeled "5."
   A. thalamus
   B. cerebral cortex
   C. primary motor cortex
   D. primary sensory cortex
   E. autonomic ganglion

2. Which structure receives impulses directly from a sensory receptor?
   A. 1 B. 2 C. 3
   D. 5 E. 7

3. Identify the type of information that travels along the structure labeled "2."
   A. motor commands to skeletal muscles
   B. proprioception to the cerebral cortex
   C. fine touch to the cerebral cortex
   D. pain and crude touch sensations
   E. visceral motor commands to smooth muscle

Spinothal
Pain Temp
Corse
DCML
Fine
Vibration
Proprioception

4. The sliding filament of contraction involves:
   A. Actin and myosin sliding past each other but not shortening.
   B. The shortening of thick filaments so that the thin filaments slide past.
   C. Actin and myosin shortening but not sliding past each other.
   D. The Z discs sliding over the myofilaments.

5. Contractions of the papillary muscles:
   A. close the atrioventricular valves
   B. close the semilunar valves
   C. eject blood from the ventricles
   D. prevent the atrioventricular valves from projecting into the atria
   E. eject blood from the atria into the ventricles

6. The _____ ear collects sounds waves and transmits them to the _____ ear, which contains sensory organs for hearing.
   A. inner; middle B. outer; middle C. outer; inner
   D. middle; inner E. none of these

7. Site where the velocity of blood flow is least.
   A. large arteries B. arterioles C. capillaries
   D. large veins E. inferior vena cava

8. If you feel like you heart is beating rapidly while you sit here taking this exam, you are probably:
   A. right because the somatic nervous system is in control
   B. right because the parasympathetic systemic responds to stress situations
   C. right because the sympathetic system is responding to the stress of the test situation
   D. wrong because the pacemaker tends to keep your heart beating at a steady rate even under stress
   E. wrong because the response of your body to stress is to shift energy to the skeletal muscles from the heart muscle

9. Damage to the fovea of the eye would interfere with the ability to:
   A. focus on an image
   B. regulate the amount of light striking the retina
   C. bleach visual pigments
   D. see black and white
   E. see color

10. The lens focuses light on the photoreceptor cells by:
   A. moving up and down
   B. moving in and out
   C. changing shape
   D. opening and closing
   E. dilating and constricting

11. Blood within the pulmonary veins is returned directly to the:
   A. lungs B. right atrium C. left atrium
   D. right ventricle E. left ventricle

12. Each of the following statements concerning the movement of fluid between capillaries and interstitial space is true **EXCEPT** one. Identify the exception.
   A. Blood hydraulic pressure forces fluid from the capillary to the interstitial space.
   B. Blood osmotic pressure moves fluid from the interstitial space to the capillary
   C. The osmotic pressure of the interstitial fluid is less than the blood osmotic pressure.
   D. The blood hydraulic pressure and the blood osmotic pressure are equal in magnitude but opposite in action.
   E. The hydraulic pressure of the interstitial fluid does not oppose the movement of fluid from the capillary.

13. During the period of ventricular filling:
   A. pressure in the heart is at its peak
   B. the atria remain in diastole
   C. blood flows passively through the atria and the open AV valves
   D. blood is flowing through the open pulmonary valve
   E. the mitral valve remains closed

14. Stroke volume would be expected to decrease when:
   A. there is an increase in contractility
   B. there is a sudden increase in aortic pressure
   C. the end-diastolic volume increases
   D. there is a slow heart rate
   E. when blood flow returning to the heart is increased

15. The cartilaginous structure that surrounds the external auditory meatus si the:
   A. saccule B. utricle C. labyrinth
   D. pinna E. ossicle

16. Which statement is true?
A. The sarcomere shortens, the two Z disks at each end move closer together, and the I band and H zone virtually disappear.
B. The thin actin filaments slide along the thick myosin filaments as they move toward the M line in the center of the sarcomere.
C. When a muscle contracts, myosin molecules coil up like springs to shorten the length.
D. A and B are true
E. A, B and C are true

17. If the vagal nerves to the heart were cut, the result would be:
A. the heart would stop, since the vagal nerves trigger the heart to contract
B. parasympathetic stimulation would increase, causing a decrease in heart rate
C. the AV node would become the pacemaker of the heart
D. the heart rate would increase by about 25 beats per minute
E. None of the above is correct.

18. Isovolumetric contraction:
A. refers to the short period during ventricular systole when the ventricles are completely closed chambers
B. occurs while the AV valves are open
C. occurs immediately after the semilunar valves close
D. only occurs in people with heart valve defects
E. occurs immediately after the atria relax

19. The shape of the lens is controlled by the:
A. papillary constrictor muscles
B. papillary dilator muscles
C. iris
D. ciliary muscles
E. aqueous body

20. The deflection waves in an ECG tracing include:
A. the T wave, which indicates ventricular repolarization
B. the Q-T interval, which indicates the time of atrial contraction
C. the PQRS complex, which follows ventricular contraction
D. the P wave, which is only present in patients who have had a heart attack

21. Which of the following is **NOT** characteristic of smooth muscle?
A. smooth muscle connective tissue forms tendons
B. neurons that innervate smooth muscles are under involuntary control
C. smooth muscles are uninucleate
D. smooth muscles do not contain sarcomeres
E. the thin filaments of smooth muscle fibers are attached to dense bodies

22. The tricuspid valve is closed:
A. while the ventricle is in diastole
B. while the atrium is contracting
C. by movement of blood from atrium to ventricle
D. when the ventricle is in systole

23. The depolarization phase of the conducting system muscle action potential is the result of:
A. increased membrane permeability to sodium ions
B. increased membrane permeability to potassium ions
C. increased membrane permeability to calcium ions
D. decreased membrane permeability to sodium ions
E. increased membrane permeability to chloride ions

24. Which of the following would act as a stimulus to initiate a muscle contraction?
A. hormonal activity
B. neurotransmitters
C. a change in the pH of a muscle
D. All of the above

25. The plateau phase of the cardiac muscle action potential is due to:
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26. In muscle contraction, calcium apparently acts to:
A. increase the action potential transmitted along the sarcolemma
B. release the inhibition on the Z lines
C. remove the blocking action of tropomyosin
D. cause ATP binding to actin

27. The ossicles connect the:
A. tympanic membrane to the oval window
B. tympanic membrane to the round window
C. oval window to the round window
D. cochlea to the tympanic membrane
E. cochlea to the oval window

Ossicles - bones

28. The amount of blood flowing to skeletal muscles is greatly increased during exercise. This redirection of blood into muscles is accomplished by:
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D. opening of valves in arteries
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A

29. If the period of ventricular filling were increased in duration:
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C. the amount of blood in the ventricles at the end of systole would be greater
D. the stroke volume would decrease

30. In circulating from the brain to the arm, a drop of blood would ***NOT*** have to pass through which of the following?
A. left atrium
B. aorta
C. superior vena cava
D. pulmonary vein
E. inferior vena cava

31. Which of the following is NOT a function of smooth muscle tissue?
A. altering the diameter of the respiratory passageways
B. elevating hairs on the arm
C. forcing blood from the heart into the major arteries
D. moving food materials along the digestive tract
E. forcing urine out of the urinary tract

C

32. Vibrations received th the ear are amplified by the action of the:
A. auditory ossicles
B. cochlea
C. oval window
D. round window
E. tympanic membrane

33. The pulmonary circulation differs from the systemic circulation because:
   A. Pulmonary blood flow is only half that of the cardiac output.
   B. There are no arterioles in the pulmonary circulation.
   C. It is a low pressure system while the systemic circulation is a high pressure system.
   D. It is less distensible than the systemic circulation.

34. Which of the following has a pulsatile flow into capillaries?
   A. the systemic circulation
   B. the pulmonary circulation
   C. both
   D. neither

35. Which statement best describes arteries?
   A. All carry oxygenated blood to the heart.
   B. All contain valves to prevent the back-flow of blood.
   C. All carry blood away from the heart.
   D. Only large arteries are lined with endothelium.

36. The bacterium that causes tetanus produces a toxin that affects the central nervous system and skeletal muscles producing powerful tetanic contractions of the skeletal muscles. The toxin probably acts by:
   A. increasing the amount of acetylcholinesterase in the synapse
   B. making the cells less permeable to sodium ions
   C. increasing the amount of potassium ions in the intercellular fluid
   D. making the cell membranes more permeable to calcium ions
   E. competing with acetylcholine for receptors at the motor end plate

37. Central fatigue _____.
   A. include feeling tired
   B. may precede physiological muscle fatigue
   C. may be related to changes in the brain related to changes in the pH of the blood
   D. A and B
   E. A, B and C

38. Which of the following are involved directly in the systemic circulation?
   A. superior vena cava, right atrium, and left ventricle.
   B. right ventricle, pulmonary artery, and left atrium.
   C. left ventricle, pulmonary artery, and inferior vena cava
   D. right atrium, right ventricle, and left ventricle

39. Which description is NOT correctly matched to the tissue?
   A. skeletal muscle – controls voluntary body movements
   B. skeletal muscle – always attached to bones
   C. cardiac muscle – found only in the heart
   D. cardiac muscle – classified as striated muscle
   E. smooth muscle – the primary muscle of internal organs

40. Excitation-contraction coupling refers to _____.
   A. acetylcholine opening ion channels
   B. the arrival of acetylcholine at the neuromuscular junction due to its exocytosis from the axon terminal
   C. the chemical and electrical events that trigger the mechanical events in a muscle fiber
   D. the enzymatic removal of acetylcholine from the synapse which can then allow relaxation to occur
   E. B and D

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E. B and D

41. Put these events in the correct order of occurrence.
1. End plate potentials trigger action potentials
2. Transverse tubules convey action potentials into the interior of the muscle fiber
3. Acetylcholine binds to receptors on the motor end plate.
4. Binding sites on actin are uncovered, allowing myosin to bind and carry out power strokes.
5. Ca^{2+} is released from the sarcoplasmic reticulum.
6. Chemically regulated ion channels open, causing depolarization.
7. Ca^{2+} ions bind to troponin-C, pulling on tropomyosin

A. 5, 3, 2, 1, 4, 7, 6
B. 3, 6, 1, 2, 5, 7, 4
C. 4, 1, 3, 7, 2, 6, 5
D. 2, 4, 7, 6, 3, 1, 5
E. 3, 6, 1, 5, 7, 2, 4

42. An important difference between single-unit and multi-unit smooth muscle is _____.
A. numerous gap junctions in single-unit smooth muscle, which allow many cells to work together as a sheet
B. longer actin and myosin filaments in multi-unit smooth muscle, which allow coordination of contraction
C. the ability of single-unit fibers to change into multi-unit fibers when advantageous
D. Closely controlled individual fibers in single-unit smooth muscle to allow fine control and graded contractions by selective activation
E. All of these

Scala Vestibuli
Scala Media
Scala Tympani

43. The structure that separates the cochlea duct from the tympanic duct is the:
A. tectorial membrane B. basilar membrane C. membrane labyrinth
D. bony labyrinth E. stapedius

44. The thick, gel-like fluid that helps support the structure of the eyeball is the:
A. vitreous humor B. aqueous humor C. ora serrata
D. perilymph E. otolymph

45. Light passes through the following structures in which order?
A. vitreous humor, lens, aqueous humor, cornea
B. cornea, aqueous humor, lens, vitreous humor
C. cornea, vitreous humor, lens, aqueous humor
D. aqueous humor, cornea, lens, vitreous humor

46. In the sympathetic nervous system, preganglionic fibers are _____ and post ganglionic fibers are _____.
A. white; gray B. long; short C. square; round
D. thick; skinny E. short; long

47. A certain drug decreases heart rate by producing hyperpolarization at the membrane of the pacemaker cells of the heart. This drug probably binds to _____ receptors.
A. nicotinic B. muscarinic C. alpha-1 adrenergic
D. alpha -2 adrenergic E. beta

48. A/B (T/F) White blood cells form a plug that seals a break in a blood vessel.

49. A/B (T/F) All muscle cells are elongated and are therefore called muscle fibers.

50. The Sensory vers. Motor homunculus is a map of the motor cortex of the cerebrum. **Write in your answer.**

3

DIRECTIONS: **Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 2 points.**

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4. Blood within the pulmonary veins is returned directly to the:
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   - (C) left atrium
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5. Each of the following statements concerning the movement of fluid between capillaries and interstitial space is true except one. Identify the exception.
   - A. Blood hydraulic pressure forces fluid from the capillary to the interstitial space.
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6. During the period of ventricular filling:
   - A. pressure in the heart is at its peak
   - B. the atria remain in diastole
   - (C) blood flows passively through the atria and the open AV valves
   - D. blood is flowing through the open pulmonary valve
   - E. the mitral valve remains closed

7. A 25 year old Human Physiology student has a total lung capacity of 6000 ml, residual volume of 1000 ml, tidal volume of 500 ml and inspiratory capacity of 3000 ml. Her functional residual capacity (FRC) is:
   - (A) 2,000 ml
   - B. 2,500 ml
   - C. 3,000 ml
   - D. 3,500 ml
   - E. 5,000 ml

8. Site where the velocity of blood flow is least.
A. large arteries B. arterioles C. capillaries
D. large veins E. inferior vena cava

9. Stroke volume would be expected to decrease when:
Stroke vol = amt out of ventricle
SV = EDV - ESV
A. there is an increase in contractility
B. there is a sudden increase in aortic pressure
C. the end-diastolic volume increases
D. there is a slow heart rate
E. when blood flow returning to the heart is increased

10. The lung volume which represents the total volume of exchangeable air is the:
A. tidal volume B. vital capacity C. inspiratory capacity
D. expiratory reserve volume E. total lung capacity

11. Which of the following are involved directly in pulmonary circulation?
A. superior vena cava, right atrium, and left ventricle
B. right ventricle, pulmonary artery, and left atrium
C. left ventricle, aorta, and inferior vena cava
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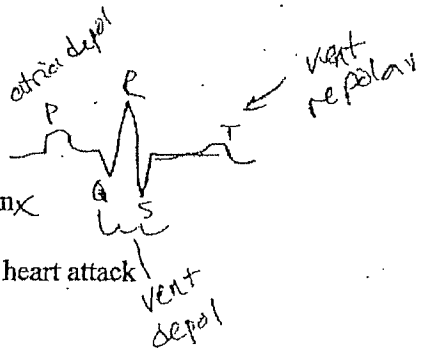

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   E. the thin filaments of smooth muscle fibers are attached to dense bodies

17. The tricuspid valve is closed: → right A.V.
   A. while the ventricle is in diastole
   B. while the atrium is contracting
   C. by movement of blood from atrium to ventricle
   D. when the ventricle is in systole

18. Which of the following is most likely to represent normal arterial blood gas values, in mm Hg?
   A. PO_2 - 120, PCO_2 - 60
   B. PO_2 - 70, PCO_2 - 32
   C. PO_2 - 60, PCO_2 - 40
   D. PO_2 - 90, PCO_2 - 38

19. Surfactant helps to prevent the alveoli from collapsing by:
   A. humidifying the air before it enters
   B. warming the air before it enters
   C. interfering with the cohesiveness of water molecules, thereby reducing the surface tension of alveolar fluid
   D. protecting the surface of alveoli from dehydration and other environmental variations

20. The depolarization phase of the conducting system muscle action potential is the result of: → Na+ in
   A. increased membrane permeability to sodium ions
   B. increased membrane permeability to potassium ions
   C. increased membrane permeability to calcium ions
   D. decreased membrane permeability to sodium ions
   E. increased membrane permeability to chloride ions

21. A subject has a tidal volume of 800 ml, an anatomical dead space of 200 ml and a respiratory rate of 15 breaths per minute. His alveolar ventilation (V_A) is (in ml/minute): 800 - 200 = 600 mL
   A. 1,000
   B. 3,000
   C. 9,000
   D. 12,000
   600 x 15 = 9,000

22. In mouth-to-mouth artificial respiration, the rescuer blows air from his or her own respiratory system into that of the victim, thus:
   A. expansion of the victim's lungs is brought about by blowing air in at higher than atmospheric pressure
   B. during inflation of the lungs, the intrapleural pressure increases
   C. intrapulmonary pressure exceeds intrapleural pressure
   D. All of the above are correct.

23. Which of the following statements concerning alveolar pressure is/are correct?
   A. Alveolar pressure is less than atmospheric pressure during a normal negative pressure inspiration.
   B. Alveolar pressure is greater than atmospheric pressure during a forced expiration.
   C. Alveolar pressure equals atmospheric pressure at the end of a normal tidal expiration.
   D. All of the above.

24. In the Peruvian Andes where the atmospheric pressure is half the normal sea level value, the PO_2 of tracheal inspired gas is:
   A. 60 mm Hg
   B. 70 mm Hg
   C. 80 mm Hg
   D. 90 mm Hg
   E. 100 mm Hg

25. "The quantity of a slightly soluble gas that will dissolve in a given mass of liquid at a stated temperature is directly proportional to the partial pressure of that gas". This statement refers to:

A. Charles law B. Graham's law C. Dalton's law
D. Avogadro's law E. Henry's law

$P_1V_1 = P_2V_2$

26. Which of the following would act as a stimulus to initiate a muscle contraction?

A. hormonal activity B. neurotransmitters
C. a change in the pH of a muscle. D. All of the above

27. The plateau phase of the cardiac muscle action potential is due to:

A. the movement of fewer sodium ions across the cell membrane
B. the calcium channels remaining open longer than the sodium channels
C. the increased membrane permeability to potassium
D. a decrease in the amount of calcium diffusing across the membrane
E. an increased membrane permeability to sodium ions

Ca^{2+}

28. The walls of the alveoli are composed of two types of cells, type I and type II. The function of type II is:

A. to secrete surfactant
B. to trap dust and other debris
C. to replace mucus in the alveoli
D. to protect the lungs from bacterial invasion
E. to increase the diffusion distance

29. Place the following structures of the respiratory tree in order, considering how air enters the tree: 1. terminal bronchioles 2. bronchus 3. respiratory bronchioles 4. alveolar duct 5. bronchioles 6. alveolar sacs

A. 2, 4, 1, 5, 3, 6 B. 1, 5, 2, 3, 6, 4 C. 3, 1, 2, 5, 4, 6
D. 5, 1, 3, 2, 6, 4 E. 2, 5, 1, 3, 4, 6

2 5 1 3 4 6

30. In muscle contraction, calcium apparently acts to:

A. increase the action potential transmitted along the sarcolemma
B. release the inhibition on the Z lines
C. remove the blocking action of tropomyosin
D. cause ATP binding to actin

31. The amount of blood flowing to skeletal muscles is greatly increased during exercise. This redirection of blood into muscles is accomplished by:

A. contraction of muscle in the walls of arterioles ✓
B. relaxation of muscle in walls of arterioles ✗
C. opening of valves in veins ✗
D. opening of valves in arteries ✗
E. relaxation of muscle in the walls of veins ✗

32. If the period of ventricular filling were increased in duration:

A. less blood would flow into the ventricle for any given time interval
B. the amount of blood in the ventricles at the end of diastole would be greater
C. the amount of blood in the ventricles at the end of systole would be greater
D. the stroke volume would decrease

33. The respiratory membrane is a combination of:

A. respiratory bronchioles and alveolar ducts
B. alveolar and capillary walls and their fused basal lamina ✓
C. atria and alveolar sacs ✗
D. None of the above

34. When you exhale, the diaphragm:
   A. relaxes and arches
   B. relaxes and flattens
   C. contracts and arches
   D. contracts and flattens
   E. contracts and arches, but only when you are exercising vigorously

35. In circulating from the brain to the arm, a drop of blood would ***NOT*** have to pass through which of the following?
   A. left atrium
   B. aorta
   C. superior vena cava
   D. pulmonary vein
   E. inferior vena cava

36. Which of the following is NOT a function of smooth muscle tissue?
   A. altering the diameter of the respiratory passageways
   B. elevating hairs on the arm
   C. forcing blood from the heart into the major arteries
   D. moving food materials along the digestive tract
   E. forcing urine out of the urinary tract

37. The pulmonary circulation differs from the systemic circulation because:
   A. Pulmonary blood flow is only half that of the cardiac output
   B. There are no arterioles in the pulmonary circulation.
   C. It is a low pressure system while the systemic circulation is a high pressure system.
   D. It is less distensible than the systemic circulation.

38. Which of the following has a pulsatile flow into capillaries?
   A. the systemic circulation
   B. the pulmonary circulation
   C. both
   D. neither

39. Which statement best describes arteries?
   A. All carry oxygenated blood to the heart
   B. All contain valves to prevent the back-flow of blood
   C. All carry blood away from the heart.
   D. Only large arteries are lined with endothelium.

Match each with its function (Questions 40 and 41):
   A. If the items vary directly
   B. If the items vary inversely
   C. If changes in the first item are not ordinarily accompanied by changes in the second
   D. Both A and B
   E. Neither A nor B

40. Area of a membrane **AND** the total amount of a gas diffusing through that membrane.

41. Thickness of a membrane **AND** diffusion of a gas through that membrane.

---

42. The bacterium that causes tetanus produces a toxin that affects the central nervous system and skeletal muscles producing powerful tetanic contractions of the skeletal muscles. The toxin probably acts by:
   A. increasing the amount of acetylcholinesterase in the synapse
   B. making the cells less permeable to sodium ions
   C. increasing the amount of potassium ions in the intercellular fluid
   D. making the cell membranes more permeable to calcium ions
   E. competing with acetylcholine for receptors at the motor end plate

43. Central fatigue _____.
A. include feeling tired
B. may precede physiological muscle fatigue
C. may be related to changes in the brain related to changes in the pH of the blood
D. A and B
E. A, B and C

44. Which of the following are involved directly in the systemic circulation?
A. superior vena cava, right atrium, and left ventricle.
B. right ventricle, pulmonary artery, and left atrium.
C. left ventricle, pulmonary artery, and inferior vena cava
D. right atrium, right ventricle, and left ventricle

left ventricle
aorta
right atrium

45. Which description is **NOT** correctly matched to the tissue?
A. skeletal muscle – controls voluntary body movements
B. skeletal muscle – always attached to bones
C. cardiac muscle – found only in the heart
D. cardiac muscle – classified as striated muscle
E. smooth muscle – the primary muscle of internal organs

46. Excitation-contraction coupling refers to _____.
A. acetylcholine opening ion channels
B. the arrival of acetylcholine at the neuromuscular junction due to its exocytosis from the axon terminal
C. the chemical and electrical events that trigger the mechanical events in a muscle fiber
D. the enzymatic removal of acetylcholine from the synapse which can then allow relaxation to occur
E. B and D

47. Put these events in the correct order of occurrence.
1. End plate potentials trigger action potentials
2. Transverse tubules convey action potentials into the interior of the muscle fiber
3. Acetylcholine binds to receptors on the motor end plate.
4. Binding sites on actin are uncovered, allowing myosin to bind and carry out power strokes.
5. Ca^{2+} is released from the sarcoplasmic reticulum.
6. Chemically regulated ion channels open, causing depolarization.
7. Ca^{2+} ions bind to troponin-C, pulling on tropomyosin

3, 6, 1, 2, 5, 7, 4

A. 5, 3, 2, 1, 4, 7, 6
B. 3, 6, 1, 2, 5, 7, 4
C. 4, 1, 3, 7, 2, 6, 5
D. 2, 4, 7, 6, 3, 1, 5
E. 3, 6, 1, 5, 7, 2, 4

3, 6, 1, 2, 5, 7, 4

48. An important difference between single-unit and multi-unit smooth muscle is _____.
A. numerous gap junctions in single-unit smooth muscle, which allow many cells to work together as a sheet
B. longer actin and myosin filaments in multi-unit smooth muscle, which allow coordination of contraction
C. the ability of single-unit fibers to change into multi-unit fibers when advantageous
D. Closely controlled individual fibers in single-unit smooth muscle to allow fine control and graded contractions by selective activation
E. All of these

49. T F All muscle cells are elongated and are therefore called muscle fibers. F

50. T F Intrapleural pressure is always negative and stable. F

Short Answer Questions

Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!!
You can use the back of the last page to continue any question. Number them, please!!

51. What are the four types of sensory receptors for the general senses? What is the nature of the stimuli that excite each type? (4 points)

Baroreceptors - Pressure
Thermoreceptors - Temperature
Chemoreceptors - pH
Nociceptors - Pain

Chemo
Mechano
Thermo
Photo

52. Imagine grasping an object with a handle and lifting it 20 centimeters. What is different about the muscle *behavior* lifting a coffee mug, a full half gallon of milk, or a 10 kilogram suitcase? (Ignore positional differences of the arm; address the *effort* required.) Do sarcomeres behave differently? Explain! (5 points)

recruitment
no sarcomeres
behave in the same
way bc all or none movement

53. Your physiology professor has suffered a myocardial infarction (after seeing the grades on the last exam). Although his heart rate is 60 beats per minute, his ejection fraction (SV divided by EDV) is only 25%, with a stroke volume of 40 mL. What is his EDV, ESV, and CO? **Show your calculations for full points.** (5 points)

CO = Cardiac Output
CO = HR x SV
= .04L
= 2.4 L

EDV = End-Diastolic Volume
25% = 1/4
SV = 1/4 (EDV)
40mL = 1/4 (EDV)
160mL = EDV
.16L

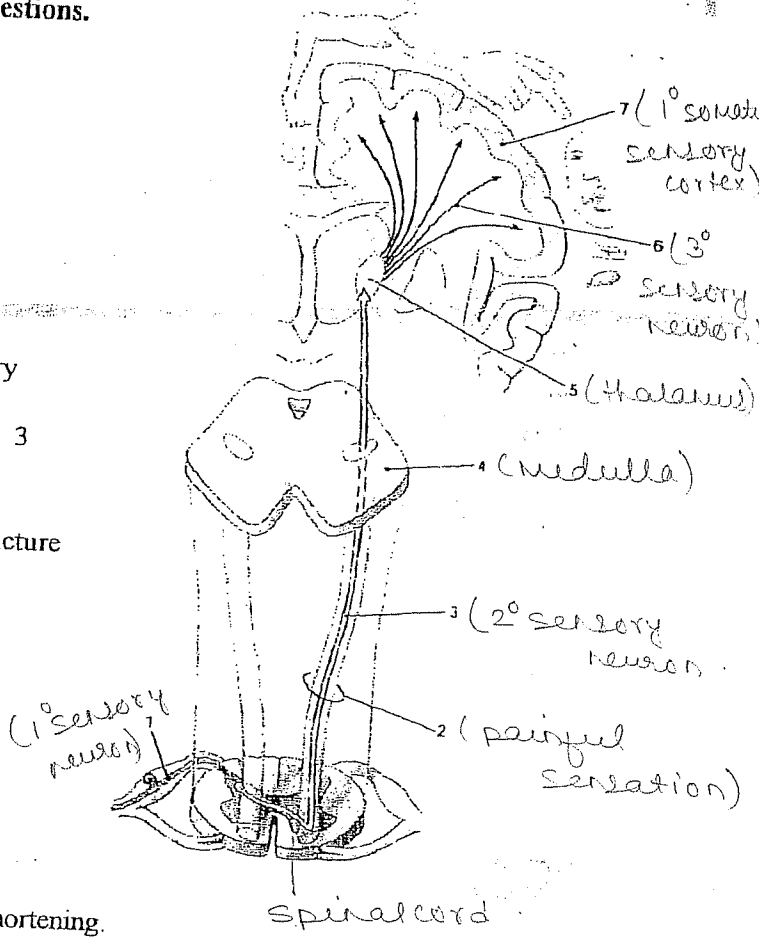
ESV = End-Systolic Volume
EDV - ESV = SV
160mL - 40mL = 120mL

HR x SV = CO
SV = EDV - ESV

Olfactory

DIRECTIONS: **Each of the numbered items or incomplete statements in this section is followed by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 2 points.**

Use the diagram to the right to answer the next three (3) questions.



1. Identify the structure labeled "5."
   - (A) thalamus
   - B. cerebral cortex
   - C. primary motor cortex
   - D. primary sensory cortex
   - E. autonomic ganglion

2. Which structure receives impulses directly from a sensory receptor?
   - (A) 1
   - B. 2
   - C. 3
   - D. 5
   - E. 7

3. Identify the type of information that travels along the structure labeled "2."
   - A. motor commands to skeletal muscles
   - B. proprioception to the cerebral cortex
   - C. fine touch to the cerebral cortex
   - (D) pain and crude touch sensations
   - E. visceral motor commands to smooth muscle

4. The sliding filament of contraction involves:
   - (A) Actin and myosin sliding past each other but not shortening.
   - B. The shortening of thick filaments so that the thin filaments slide past.
   - C. Actin and myosin shortening but not sliding past each other.
   - D. The Z discs sliding over the myofilaments.

5. Contractions of the papillary muscles:
   - A. close the atrioventricular valves
   - B. close the semilunar valves
   - C. eject blood from the ventricles
   - (D) prevent the atrioventricular valves from projecting into the atria
   - E. eject blood from the atria into the ventricles

Brain Stem
Midbrain
Pons
Medulla

Failure
Unknown
Rejection
Isolation
Loss
death

6. The _____ ear collects sounds waves and transmits them to the _____ ear, which contains sensory organs for hearing.
   - A. inner; middle
   - B. outer; middle
   - C. outer; inner
   - (D) middle; inner
   - E. none of these

7. Site where the velocity of blood flow is least.
   - A. large arteries
   - B. arterioles
   - (C) capillaries
   - D. large veins
   - E. inferior vena cava

If you feel like you heart is beating rapidly while you sit here taking this exam, you are probably:

A. right because the somatic nervous system is in control
B. right because the parasympathetic systemic responds to stress situations
C. right because the sympathetic system is responding to the stress of the test situation
D. wrong because the pacemaker tends to keep your heart beating at a steady rate even under stress
E. wrong because the response of your body to stress is to shift energy to the skeletal muscles from the heart muscle

9. Damage to the fovea of the eye would interfere with the ability to:

A. focus on an image
B. regulate the amount of light striking the retina
C. bleach visual pigments
D. see black and white
E. see color

10. The lens focuses light on the photoreceptor cells by:

A. moving up and down
B. moving in and out
C. changing shape
D. opening and closing
E. dilating and constricting

11. Blood within the pulmonary veins is returned directly to the:

A. lungs
B. right atrium
C. left atrium
D. right ventricle
E. left ventricle

12. Each of the following statements concerning the movement of fluid between capillaries and interstitial space is true **EXCEPT** one. Identify the exception.

A. Blood hydraulic pressure forces fluid from the capillary to the interstitial space.
B. Blood osmotic pressure moves fluid from the interstitial space to the capillary
C. The osmotic pressure of the interstitial fluid is less than the blood osmotic pressure.
D. The blood hydraulic pressure and the blood osmotic pressure are equal in magnitude but opposite in action.
E. The hydraulic pressure of the interstitial fluid does not oppose the movement of fluid from the capillary.

13. During the period of ventricular filling:

A. pressure in the heart is at its peak
B. the atria remain in diastole
C. blood flows passively through the atria and the open AV valves
D. blood is flowing through the open pulmonary valve
E. the mitral valve remains closed

14. Stroke volume would be expected to decrease when:

A. there is an increase in contractility
B. there is a sudden increase in aortic pressure
C. the end-diastolic volume increases
D. there is a slow heart rate
E. when blood flow returning to the heart is increased

15. The cartilaginous structure that surrounds the external auditory meatus si the:

A. saccule
B. utricle
C. labyrinth
D. pinna
E. ossicle

Which statement is true?

A. The sarcomere shortens, the two Z disks at each end move closer together, and the I band and H zo virtually disappear.

B. The thin actin filaments slide along the thick myosin filaments as they move toward the M line in the center of the sarcomere.

C. When a muscle contracts, myosin molecules coil up like springs to shorten the length.

(D) A and B are true

E. A, B and C are true

17. If the vagal nerves to the heart were cut, the result would be:

A. the heart would stop, since the vagal nerves trigger the heart to contract

B. parasympathetic stimulation would increase, causing a decrease in heart rate

C. the AV node would become the pacemaker of the heart

(D) the heart rate would increase by about 25 beats per minute

E. None of the above is correct.

18. Isovolumetric contraction:

(A) refers to the short period during ventricular systole when the ventricles are completely closed chambers

B. occurs while the AV valves are open

C. occurs immediately after the semilunar valves close

D. only occurs in people with heart valve defects

E. occurs immediately after the atria relax

19. The shape of the lens is controlled by the:

A. papillary constrictor muscles

B. papillary dilator muscles

C. iris

(D) ciliary muscles

E. aqueous body

20. The deflection waves in an ECG tracing include:

(A) the T wave, which indicates ventricular repolarization

B. the Q-T interval, which indicates the time of atrial contraction

C. the PQRS complex, which follows ventricular contraction

D. the P wave, which is only present in patients who have had a heart attack

21. Which of the following is <u>NOT</u> characteristic of smooth muscle?

(A) smooth muscle connective tissue forms tendons

B. neurons that innervate smooth muscles are under involuntary control

C. smooth muscles are uninucleate

D. smooth muscles do not contain sarcomeres

E. the thin filaments of smooth muscle fibers are attached to dense bodies

22. The tricuspid valve is closed:

A. while the ventricle is in diastole

B. while the atrium is contracting

C. by movement of blood from atrium to ventricle

(D) when the ventricle is in systole

23. The depolarization phase of the conducting system muscle action potential is the result of:

A. increased membrane permeability to sodium ions

B. increased membrane permeability to potassium ions

(C) increased membrane permeability to calcium ions

D. decreased membrane permeability to sodium ions

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Which of the following would act as a stimulus to initiate a muscle contraction?

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26. In muscle contraction, calcium apparently acts to:

A. increase the action potential transmitted along the sarcolemma
B. release the inhibition on the Z lines
C. remove the blocking action of tropomyosin
D. cause ATP binding to actin

27. The ossicles connect the:

A. tympanic membrane to the oval window
B. tympanic membrane to the round window
C. oval window to the round window
D. cochlea to the tympanic membrane
E. cochlea to the oval window

28. The amount of blood flowing to skeletal muscles is greatly increased during exercise. This redirection of blood into muscles is accomplished by:

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31. Which of the following is NOT a function of smooth muscle tissue?

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B. elevating hairs on the arm
C. forcing blood from the heart into the major arteries
D. moving food materials along the digestive tract
E. forcing urine out of the urinary tract

32. Vibrations received th the ear are amplified by the action of the:

A. auditory ossicles
B. cochlea
C. oval window
D. round window
E. tympanic membrane

The pulmonary circulation differs from the systemic circulation because:

A. Pulmonary blood flow is only half that of the cardiac output.
B. There are no arterioles in the pulmonary circulation.
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E. A, B and C

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B. right ventricle, pulmonary artery, and left atrium.
C. left ventricle, pulmonary artery, and inferior vena cava
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D. cardiac muscle – classified as striated muscle
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5. Ca^{2+} is released from the sarcoplasmic reticulum.
6. Chemically regulated ion channels open, causing depolarization.
7. Ca^{2+} ions bind to troponin-C, pulling on tropomyosin

A. 5, 3, 2, 1, 4, 7, 6
(B) 3, 6, 1, 2, 5, 7, 4 3, 6, 1, 2
C. 4, 1, 3, 7, 2, 6, 5
D. 2, 4, 7, 6, 3, 1, 5
E. 3, 6, 1, 5, 7, 2, 4

42 An important difference between single-unit and multi-unit smooth muscle is _____.

(A) numerous gap junctions in single-unit smooth muscle, which allow many cells to work together as a sheet
B. longer actin and myosin filaments in multi-unit smooth muscle, which allow coordination of contraction
C. the ability of single-unit fibers to change into multi-unit fibers when advantageous
D. Closely controlled individual fibers in single-unit smooth muscle to allow fine control and graded contractions by selective activation
E. All of these

43 The structure that separates the cochlea duct from the tympanic duct is the:

A. tectorial membrane (B) basilar membrane C. membrane labyrinth
D. bony labyrinth E. stapedius

44 The thick, gel-like fluid that helps support the structure of the eyeball is the:

(A) vitreous humor B. aqueous humor C. ora serrata
D. perilymph E. otolymph

45 Light passes through the following structures in which order?

A. vitreous humor, lens, aqueous humor, cornea
(B) cornea, aqueous humor, lens, vitreous humor
C. cornea, vitreous humor, lens, aqueous humor
D. aqueous humor, cornea, lens, vitreous humor

46 In the sympathetic nervous system, preganglionic fibers are _____ and post ganglionic fibers are _____.

A. white; gray B. long; short C. square; round
D. thick; skinny (E.) short; long

47 A certain drug decreases heart rate by producing hyperpolarization at the membrane of the pacemaker cells of the heart. This drug probably binds to _____ receptors.

A. nicotinic (B.) muscarinic C. alpha-1 adrenergic
D. alpha -2 adrenergic E. beta

48 A/B (T/F) F White blood cells form a plug that seals a break in a blood vessel.

49 A/B (T/F) F All muscle cells are elongated and are therefore called muscle fibers.

50 The _____ is a map of the motor cortex of the cerebrum. **Write in your answer.**

5

Short Answer Questions

Please answer these questions briefly. Label diagrams correctly, with lines pointing to the proper structures. Partial credit will be given where appropriate. Write legibly!!

You can use the back of the last page to continue any question. Number them, please!!

51. What are the four types of sensory receptors for the general senses? What is the nature of the stimuli that excite each type? (4 points)

Merkel = pressure
Perkinje: vibrations
Rand = light touch
= stretching of skin.

① Mechanoreceptor – vibrations
② Chemoreceptor – chemicals, pH
③ Thermoreceptor – temperature
④ Photoreceptor – photons of light

52. Imagine grasping an object with a handle and lifting it 20 centimeters. What is different about the muscle *behavior* lifting a coffee mug, a full half gallon of milk, or a 10 kilogram suitcase? (Ignore positional differences of the arm; address the *effort* required.) Do sarcomeres behave differently? Explain! (5 points)

yes

53. Your physiology professor has suffered a myocardial infarction (after seeing the grades on the last exam). Although his heart rate is 60 beats per minute, his ejection fraction (SV divided by EDV) is only 25%, with a stroke volume of 40 mL. What is his EDV, ESV, and CO? **Show your calculations for full points.** (5 points)

SV = 25% of EDV
40 = 25/100 × EDV
EDV = 160 mL
EDV − ESV = SV

Heart rate = 60 beats/min
SV/EDV = 25%
SV = 40 mL
CO = HR × SV
CO = 60 × 40
= 2400

DIRECTIONS: **Each of the numbered items or incomplete statements in this section is followe by answers or completions of the statement. Select the ONE lettered answer or completion that is BEST in each case and write your selection in the left margin beside the question. Each multiple choice question is worth 2 points.**

1. The ciliary muscle helps to:
   A. control the amount of light reaching the retina
   B. control the shape of the lens
   C. control the production of aqueous humor
   D. move the eyeball
   E. None of the above is correct.

2. The vitreous chamber of the eye:
   A. contains the lens
   B. helps to stabilize it and gives physical support to the retina
   C. is located between the lens and the iris
   D. contains blood vessels that nourish the retina
   E. All of the above

3. Which of the following is **NOT** a function of smooth muscle tissue? → not stated
   A. altering the diameter of the respiratory passageways ✓
   B. elevating hairs on the arm ✓
   C. forcing blood from the heart into the major arteries ✗
   D. moving food materials along the digestive tract ✓
   E. forcing urine out of the urinary tract ✓

4. The lacrimal apparatus:
   A. is a system of glands and ducts
   B. keeps the cornea moist with continuous tear flow
   C. is innervated by sympathetic neurons from cranial nerve VII
   D. ~~A and B~~
   E. All of the above are correct.

5. Information about sound must through each of these areas of the brain. Put them in the correct order.
   1. thalamus 2. medulla 3. auditory cortex of cerebrum 4. midbrain
   A. 1, 2, 3, 4
   B. 2, 1, 4, 3
   D. 3, 2, 1, 4
   E. 3, 4, 1, 2
   2, 4, 1, 3

6. Tonic receptors:
   A. are slowly adapting receptors
   B. fire rapidly when first activated, then slow and stop firing even with a continuing stimulus
   C. are activated by parameters that must be continuously monitored by the body
   D. are proprioreceptors, for example
   E. ~~A, C, and D~~

7. During the cardiac cycle,
   A. the p wave of the ECG occurs between the first and second heart sounds
   B. the QRS complex of the EKG precedes the increase in ventricular pressure
   C. the third heart sound occurs during atrial systole ✗
   D. the second heart sound coincides with the QRS complex of the ECG
   E. the greatest increase in ventricular pressure occurs during the ejection phase

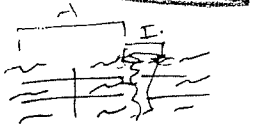
8. Vibrations received the ear are amplified by the action of the:
   A. cochlea
   B. bones of the middle ear
   C. oval window
   D. round window
   E. tympanic membrane

T-tubule

9. The purpose of transverse tubules is to:
   A. ensure a supply of Ca^{2+} ions through the muscle fiber
   B. rapidly conduct the action potentials to the interior of the muscle fiber
   C. ensure a supply of glycogen throughout the muscle sarcoplasm
   D. conduct the ATP molecules out of the mitochondria throughout the sarcoplasm
   E. All of these statements are true.

10. In cardiac muscle:
   A. calcium ions are not released from the sarcoplasmic reticulum
   B. calcium ions do not bind to troponin molecules
   C. calcium ions play no role in the process of contraction
   D. some of the calcium ion required for contraction comes from outside of the cell (ECF)
   E. calcium ion plays an important role in repolarizing the membrane after the depolarization phase

11. In circulating from the brain to the arm, a drop of blood would ***NOT*** have to pass through which of the following structures?
   A. left atrium
   B. aorta
   C. inferior vena cava
   D. pulmonary vein
   E. superior vena cava



12. The I band contains:
   A. thick filaments
   B. thin filaments
   C. an area of overlapping filaments
   D. All of the above are correct.
   E. None of the above is correct.

13. The plateau phase of the cardiac muscle action potential is due to:
   A. the movement of fewer sodium ions across the cell membrane
   B. the calcium channels remaining open longer than the sodium channels
   C. the increased membrane permeability to potassium
   D. a decrease in the amount of calcium diffusing across the membrane
   E. an increased membrane permeability to sodium ions

14. Ca^{2-} is important in the contraction of smooth muscle. Which of the following is NOT true about smooth muscle contraction?
   A. Ca^{2-} enters the cytosol from the sarcoplasmic reticulum.
   B. Ca^{2-} binds to calmodulin.
   C. Contraction is immediately triggered by calmodulin binding.
   D. MLCK (myosin light chain kinase) forms a complex to activate myosin.
   E. When MLCK activates myosin, ATPase activity is high and crossbridge formation is active.

15. An important difference between single-unit and multiunit smooth muscle is: (MANY)
   A. the ability of single-unit fibers to change into multiunit fibers when advantageous.
   B. longer actin and myosin filaments in multiunit smooth muscle, which allow coordination of contraction
   C. numerous gap junctions in single-unit muscle, which allow many cells to work together as a sheet
   D. closely controlled individual fibers in single-unit (multi) smooth muscle to allow fine control and graded contractions by selective activation
   E. All of the above are correct.

multi unit - has few

16. The ossicles connect the:
   A. cochlea to the oval window
   B. tympanic membrane to the round window
   C. oval window to the round window
   D. cochlea to the tympanic membrane
   E. tympanic membrane to the oval window

17. A viral infection involving the vestibular nuclei may result in:
A. loss of hearing
B. loss of sight
C. a sense of dizziness
D. local paralysis
E. high blood pressure

18. The structure that separates the cochlear duct from the tympanic duct is the:
A. tectorial membrane
B. basilar membrane
C. membranous labyrinth
D. bony labyrinth
E. stapedius

19. During the isovolumic phase of ventricular systole,
A. the atria contract
B. the atrioventricular valves and semilunar valves are closed
C. blood is ejected into the great vessels
D. the ventricles are relaxing
E. the ventricles are filling with blood

20. The loudness or intensity of a sound wave is related to its:
A. amplitude
B. frequency
C. duration
D. decibels
E. pitch

21. Which description is **NOT** correctly matched to the tissue?
A. skeletal muscle – controls voluntary body movements
B. cardiac muscle – classified as striated muscle
C. cardiac muscle – found ONLY in the heart
D. skeletal muscle – always attached to bones
E. smooth muscle – the primary muscle of internal organs

22. As ATP binds to the myosin head at the beginning of a muscle contraction cycle,
A. the myosin head detaches from actin
B. the myosin head initiates binding with actin
C. the myosin head tightens its bond to actin
D. ATP does not bind to the myosin head
E. None of these complete the statement correctly.

23. The first heart sound is heard when:
A. the AV valves open
B. the AV valves close
C. the semilunar valves close
D. the atria contract
E. blood enters the aorta

24. Which event happens at the start of a cardiac cycle?
A. Blood is ejected from the atrium.
B. The SA node fires.
C. Ventricular systole occurs.
D. The P wave develops.
E. Atrial systole occurs.

25. If the EDV is 140 mL, which other values are most likely to occur in a healthy, normal person?
A. The ESV could be 70 mL and the SV could be 70 mL.
B. The ESV could be 190 mL and the SV could be 50 mL.
C. The ESV could be 50 mL and the SV could be 90 mL.
D. A and B
E. A and C

26. Put these phases of the cardiac cycle in the correct order.

1. opening of the semilunar valves
2. isovolumetric contraction
3. atrial systole begins
4. closure of the AV valves
5. ventricular filling is complete
6. ventricular systole begins
7. ventricular relaxation
8. ventricular ejection

A. 4, 5, 1, 2, 7, 8, 3, 6
B. 3, 2, 6, 1, 4, 5, 8, 7
C. 3, 5, 6, 4, 2, 1, 8, 7
D. 3, 5, 6, 1, 8, 4, 2, 7
E. 3, 2, 6, 4, 5, 8, 7, 1

27. The intensity of a stimulus can be determined by:

A. population coding
B. labeled line coding
C. frequency coding
D. A and C
E. All of the above.

28. Excitation-contraction coupling refers to _____.

A. the arrival of acetylcholine at the neuromuscular junction due to its exocytosis from the axon terminal
B. acetylcholine opening ion channels
C. the chemical and electrical events that trigger the mechanical events in a muscle fiber
D. the enzymatic removal of acetylcholine from the synapse which can then allow relaxation to occur
E. B and D

29. Which of the following are involved directly in the systemic circulation?

A. superior vena cava, right atrium, and left ventricle.
B. right ventricle, pulmonary artery, and left atrium.
C. left ventricle, pulmonary artery, and inferior vena cava
D. right atrium, right ventricle, and left ventricle
E. inferior vena cava, pulmonary vein, pulmonary artery

30. The thick, gel-like fluid that helps support the structure of the eyeball is the:

A. vitreous humor
B. aqueous humor
C. ora serrata
D. perilymph
E. ortholymph

31. At the conclusion of the power stroke,

A. inorganic phosphate has been released from the myosin
B. actin has been moved toward the M line
C. ADP is released from the myosin head
D. the myosin head is tightly bound to actin
E. All of the above are correct

32. Displacement of stereocilia toward the kinocilium of a hair cell:

A. produces a depolarization of the membrane
B. produces a hyperpolarization of the membrane
C. decreases the membrane permeability to sodium ions
D. increases the membrane permeability to potassium ions
E. does not affect the transmembrane potential of the cell

33. The receptors in the inner ear are the:

A. utricles
B. saccules
C. hair cells
D. supporting cells
E. ampullae

34. Transduction involves
A. a stimulus altering the permeability of a receptor membrane
B. changes in the transmembrane potential of the sensory receptor
C. production of a receptor potential
D. generation of an action potential that can be processed and interpreted by the CNS
E. All of the above

35. The two-point discrimination test:
A. is used to determine clarity of vision
B. provides information about olfactory receptors
C. provides a detailed map for sensory receptors
D. is used to test for hearing disorders
E. monitors the activity of taste buds

36. Which of the following statements is true about titin?
A. Titin returns stretched muscle to their resting length.
B. Titin stabilizes the position of the contractile filaments.
C. Titin is helped by actin.
D. A and B are correct.
E. All of the above are correct.

37. The flattening of the action potentials of myocardial contractile cells, called the plateau phase, is due to a combination of _____ K^- permeability and _____ Ca^{2-} permeability.
A. increasing, increasing
B. decreasing, decreasing
C. increasing, decreasing
D. decreasing, increasing
E. cannot be determined

38. Fast pain, usually described as sharp and localized, is carried by:
A. large, unmyelinated C fibers
B. small, myelinated A-delta fibers
C. small, unmyelinated C fibers
D. large myelinated A-beta fibers
E. None of the above.

39. Central fatigue _____.
A. include feeling tired
B. may precede physiological muscle fatigue
C. may be related to changes in the brain related to changes in the pH of the blood
D. A and B
E. A, B and C

40. Sensations of gravity and linear acceleration are registered in the:
A. semicircular canals
B. cochlea
C. saccule and utricle
D. ossicles
E. organ of Corti

41. The ____ of a sensory receptor may be irregular in shape and overlap with those of neighboring receptors. The size of this area determines the sensitivity to a stimulus.
A. discriminatory area
B. spatial field
C. somatic esthetic
D. receptive field
E. None of the above

42. The force generated by a single muscle fiber:
A. is always the same
B. can be increased by increasing the frequency of action potentials
C. can be increased due to summation
D. B and C
E. All of the above are correct

3. Which statement best describes arteries?
   A. All carry oxygenated blood to the heart.
   B. All contain valves to prevent the back-flow of blood.
   C. All carry blood away from the heart.
   D. Only large arteries are lined with endothelium.
   E. All are larger than veins.

4. What structures monitor vertical movements?
   A. cristae and the semicircular canals
   B. maculae of the saccule
   C. maculae of the utricle
   D. B and C
   E. All of the above

5. Light passes through the following structures in which order?
   A. vitreous humor, cornea, lens, aqueous humor
   B. cornea, aqueous humor, lens, vitreous humor
   C. cornea, vitreous humor, lens, aqueous humor
   D. aqueous humor, cornea, lens, vitreous humor
   E. vitreous humor, lens, aqueous humor, cornea

CAKV
CAIVL

Short Answer Questions

ease answer these questions briefly. Label diagrams correctly, with lines pointing to e proper structures. Partial credit will be given where appropriate. Write legibly!!

u can use the back of the last page to continue any question. Number them, please!!

Trace the path of light from the time it is converted to an action potential until it is perceived. (5 points)

~~lens → photons~~

t → cornea → aqueous humor → lens → vitreous humor → photoreceptors cells

occipital lobe ← thalamus ← bounce to front

Discuss pain modulation as it relates to the gate control theory. (5 points)