Anatomy and Physiology - Division C Exam

University of Georgia Science Olympiad Regional Competition

February 22th, 2020

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Team Name: _____

Team Number: _____

Total Points: _____/222 **Rank:** _____

Instructions and Clarifications:

- You have **50** minutes to finish this exam.
- You **may** split the exam but you are responsible for placing the pages back in order at the end of the testing session.
- **Tiebreakers** are considered in the following order: **#6, #18, #33, #57, #76**
- Write your **team number** on every page of the answer sheet.
- Anything written on the exam will **not** be graded. Only the **answer sheet** will be graded.
- If you have any questions or comments about the exam, feel free to email me at ***velasco.scienceolympiad@gmail.com.*** **Happy testing!**

I. Integumentary System - 60 points

Multiple Choice: Choose the most appropriate answer for the questions below. Each question is worth **one** point. **(20)**

1. Which of the following statements about the skin is correct?
    a. The connective tissue portion of this skin is termed as the epidermis.
    b. The epidermis is avascular, whereas the dermis is vascular.
    c. The subQ layer is part of the skin.
    d. The dermis contains pacinian corpuscles that are sensitive to pressure.
    e. More than one of the above

2. Which cell in the epidermis is the least numerous of the epidermal cells?
    a. Keratinocytes
    b. Langerhan cells
    c. Merkel discs
    d. Merkel cells
    e. More than one of the above

3. Which stratum in the skin is composed of a single row of cuboidal or columnar keratinocytes?
    a. Granulosum
    b. Spinosum
    c. Basale
    d. Lucidum
    e. More than one of the above

4. Which of the following statements about the stratum granulosum is correct?
    a. It consists of one layer of flattened keratinocytes that undergo apoptosis.
    b. There are no keratin intermediate filaments in the cells of this stratum.
    c. The keratin intermediate filaments of this stratum become more prominent because the organelles in the cells are regressing.
    d. This stratum contains keratohyalin.
    e. More than one of the above

5. Which stratum of the skin is present only in the skin of fingertips, palms and soles?
    a. Basale
    b. Spinosum
    c. Lucidum
    d. Corneum
    e. More than one of the above

6. Which of the following statements about the dermis is correct?
    a. The papillary region makes up 80% of the thickness of the total layer.
    b. The papillary region contains thick collagen and fine elastic fibers.
    c. The surface area of the papillary region is decreased by dermal papillae.
    d. There are dermal papillae that contain free nerve endings, which are dendrites that lack any apparent structural specialization.
    e. More than one of the above

7. What pigment in the skin has a color of yellow to red?
    a. Pheomelanin
    b. Eumelanin
    c. Carotene
    d. Hemoglobin
    e. More than one of the above

8. Which of the following statements about skin color is correct?
    a. The differences in skin color is determined by the amount of pigment that melanocytes produce and transfer to keratinocytes.
    b. The number of melanocytes in the skin is about the same in all people.
    c. Age spots are accumulations of melanin.
    d. Carotene, which is another pigment in the skin, is a precursor to vitamin A and stored in the stratum corneum and fatty areas of the dermis and subQ layer.
    e. More than one of the above

9. Melanocytes synthesize melanin from which amino acid?
    a. Alanine
    b. Threonine
    c. Asparagine
    d. Tyrosine
    e. More than one of the above

10. What part of hair surrounds the root of the hair?
    a. Hair follicle
    b. Bulb
    c. Papilla
    d. Hair matrix
    e. More than one of the above

11. What type of hair is produced by the follicles in the fifth month of development and is very fine, nonpigmented, and downy?
    a. Vellus
    b. Lanugo
    c. Terminal
    d. More than one of the above
    e. None of the above

12. What skin gland has a secreting portion that lies in the dermis and usually opens into the neck of a hair follicle?
    a. Sebaceous glands
    b. Eccrine sweat glands
    c. Apocrine sweat glands
    d. Ceruminous glands
    e. None of the above

13. What is the term when sweat first forms on the forehead and scalp and then extends to the rest of the body, forming last on the palms and soles?
    a. Thermoregulatory sweating
    b. Insensible perspiration
    c. Sensible perspiration
    d. B and C
    e. None of the above

14. Which gland is located in the external auditory canal?
    a. Sebaceous oil gland
    b. Eccrine sweat gland
    c. Apocrine sweat land
    d. Ceruminous gland
    e. None of the above

15. Which part of the nail is the part of the nail body that may extend past the distal end of the digit?
    a. Hyponychium
    b. Lunula
    c. Nail root
    d. Free edge
    e. More than one of the above

16. The dermis carries what percent of the total blood flow in a resting adult?
    a. 4-6%
    b. 8-10%
    c. 12-14%
    d. 20%
    e. None of the above

17. Which of the following is considered to be a cutaneous sensation?
    a. Pressure
    b. Touch
    c. Vibration
    d. Tickling
    e. More than one of the above

18. Calcitriol is the most active form of which vitamin?
    a. A
    b. D
    c. E
    d. K
    e. None of the above

19. Which type of cancer accounts for about 78% of all skin cancers?
    a. BCC
    b. SCC
    c. Malignant melanoma
    d. A and B
    e. None of the above

20. Which of the following is the acronym used to successfully treat malignant melanoma?
    a. ABC
    b. ABCD
    c. ABCDE
    d. ABCDEF
    e. None of the above

Labeling: Label **Figure 1** and **Figure 2** in the image packet. Each letter is worth **one** point. **(14)**

21. Figure 1 **(7)**
22. Figure 2 **(7)**

Pathology: Answer the following questions below about pathology in the most concise and specific way possible. Each question is worth **two** points. **(26)**

23. What type of burn extends into the superficial dermis?
24. How many simultaneous conditions must occur to trigger Ni-ACD?
25. Which type of burn is associated with a leathery texture?
26. Which type of burn is associated with eschar?
27. What is the medical term for athlete's foot?
28. What is the common term for the organism that causes athlete's foot?
29. ACD is considered to be a _____ predominant process.
30. What is another term for a furuncle?
31. What bacteria is the most common cause of furuncles?
32. What is the term for a cluster of several furuncles?
33. What is the general term that describes a skin irritation?
34. What is another term for eczema?
35. Which type of skin cancer has the following appearance: pearly/waxy bump, flat, flesh-colored/brown scar-like lesion, bleeding/scabbing sore that heals and returns?

II. Skeletal System - 64 points

Multiple Choice: Choose the most appropriate answer for the questions below. Each question is worth **one** point. **(20)**

36. Which part of a long bone is located at the proximal and distal ends of the bone?
    a. Diaphysis
    b. Epiphyses
    c. Metaphyses
    d. Articular cartilage
    e. None of the above

37. Which part of long bone is a thin membrane that lines the medullary cavity?
    a. Periosteum
    b. Medullary cavity
    c. Articular cartilage
    d. Endosteum
    e. None of the above

38. Which bone cell is the main cell in bone tissue and maintain its daily metabolism?
    a. Osteoprogenitor cells
    b. Osteoblasts
    c. Osteocytes
    d. Osteoclasts
    e. None of the above

39. Which bone cell is the only bone cell that undergoes cell division?
    a. Osteoprogenitor cells
    b. Osteoblasts
    c. Osteocytes
    d. Osteoclasts
    e. None of the above

40. Which of the following statements about compact bone tissue is correct?
    a. The structural units of compact bone tissue are called haversian systems.
    b. Each osteon consists of a concentric lamellae arranged inside a central canal.
    c. The concentric lamellae are located outside of the central canal.
    d. The tubelike units of the bone tend to run perpendicular to the long axis of the bone.
    e. None of the above

41. How are osteons oriented in compact bone?
    a. Same direction and parallel to the length of the diaphysis
    b. Same direction and perpendicular to the length of the diaphysis
    c. Opposite direction and parallel to the length of the diaphysis
    d. Opposite direction and perpendicular to the length of the diaphysis
    e. None of the above

42. Which of the following statements about spongy bone tissue is correct?
    a. It makes up most of the interior bone tissue of short shaped bones.
    b. It forms the core of the epiphysis in short bones.
    c. Trabeculae of spongy bone tissue is considered to be more disorganized than the osteons of compact bone tissue.
    d. Spongy bone tissue is located where bones are heavily stressed.
    e. None of the above

43. What is the term for small arteries that are accompanied by nerves that enter the diaphysis through many Volkmann's canals?
    a. Nutrient foramen
    b. Nutrient artery
    c. Metaphyseal arteries
    d. Periosteal arteries
    e. None of the above

44. In which step of intramembranous ossification do osteoblasts secrete organic extracellular matrix of the bone until they are surrounded by it?
    a. Development of the ossification center
    b. Calcification
    c. Formation of trabeculae
    d. Development of the periosteum
    e. None of the above

45. In which step of intramembranous ossification does the mesenchyme condense at the periphery of the bone?
    a. Development of the ossification center
    b. Calcification
    c. Formation of trabeculae
    d. Development of the periosteum
    e. None of the above

46. What is the term for a growth in endochondral ossification that results in an increase in length?
    a. Interstitial growth
    b. Endogenous growth
    c. Appositional growth
    d. A and B
    e. None of the above

47. Which of the following statements about the development of the primary ossification center is correct?
    a. It proceeds outwards from the external surface of the bone.
    b. A nutrient vein penetrates the perichondrium and the calcifying cartilage model through a nutrient foramen in the mid-region of the cartilage model.
    c. The osteoblasts are stimulated to differentiate into osteoprogenitor cells in the perichondrium.
    d. Osteoclasts deposit bone extracellular matrix over the remnants of calcified cartilage.
    e. None of the above

48. In which phase of a bone fracture repair are fracture hematomas formed?
    a. Reactive phase
    b. Fibrocartilagenous callus formation
    c. Bony callus formation
    d. Bone remodeling phase
    e. None of the above

49. In which phase of a bone fracture repair involves the conversion of fibrocartilage into spongy bone?
    a. Reactive phase
    b. Fibrocartilaginous callus formation
    c. Bony callus formation
    d. Bone remodeling phase
    e. None of the above

50. What type of fracture involves a bone that is splintered, crushed, or broken into pieces at the site of impact, with smaller bone fragments found between the two main fragments?
    a. Compound
    b. Comminuted
    c. Greenstick
    d. Impacted
    e. None of the above

51. What type of fracture involves the distal end of the lateral forearm bone in which the distal fragment is displaced posteriorly?
    a. Impacted
    b. Pott
    c. Open
    d. Colles
    e. None of the above

52. Which vitamin is needed for the synthesis of collagen, the main protein of the bone?
    a. A
    b. C
    c. D
    d. K
    e. None of the above

53. Which mineral helps form bone extracellular matrix?
    a. Calcium
    b. Phosphorus
    c. Fluoride
    d. Manganese
    e. None of the above

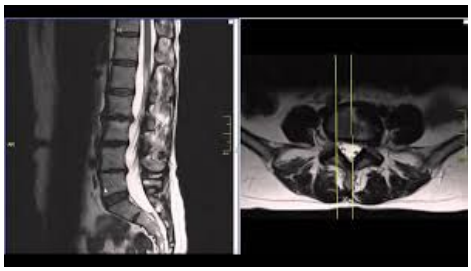
54. Which hormone is secreted by the pancreas and promotes normal bone growth by increasing the synthesis of bone proteins?
    a. hGH
    b. Insulin
    c. Estrogen
    d. Calcitonin
    e. None of the above

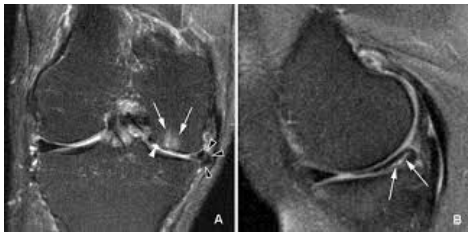
55. How many people are affected by osteoporosis in the United States per year?
    a. 5 million
    b. 8 million
    c. 10 million
    d. 12 million
    e. None of the above

Labeling: Label **Figure 3** and **Figure 4** in the image packet. Each letter is worth **one** point. **(26)**

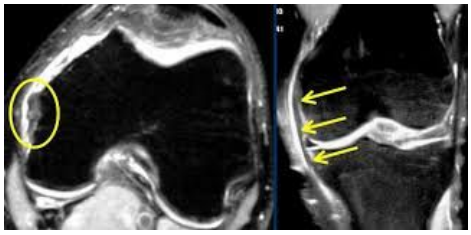
56. Figure 3 **(15)**
57. Figure 4 **(11)**

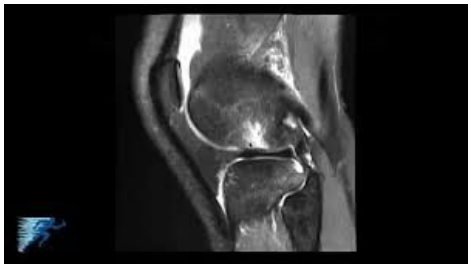
Pathology: Determine what disease or injury is shown in the given images. Each image is worth **three** points. **(18)**

58. 

59. 

60. 

61. 

62. 

63. 

III. Muscular System - 98 points

Multiple Choice: Choose the most appropriate answer for the questions below. Each question is worth **one** point. **(20)**

64. Which type of muscular tissue is stratified but has involuntary action?
    a. Skeletal
    b. Cardiac
    c. Smooth
    d. A and B
    e. All of the above

65. Which of the following is a function of muscular tissue?
    a. Producing body movements
    b. Stabilizing body positions
    c. Generating heat
    d. Storing and moving substances within the body
    e. All of the above

66. Which connective tissue layer is a layer of dense irregular connective tissue that surrounds groups of 10-100 muscle fibers and separating them into fascicles?
    a. Epimysium
    b. Perimysium
    c. Endomysium
    d. A and B
    e. None of the above

67. What is the term for the contractile organelles of skeletal muscle?
    a. SR
    b. Traid
    c. Cisterns
    d. Myofibrils
    e. None of the above

68. Which of the following is a narrow, plate-shaped region of dense protein material that separate one sarcomere from the next?
    a. Z disc
    b. A band
    c. I band
    d. H zone
    e. None of the above

69. Which of the following is located in the center of each A band and contains thick but not thin filaments?
    a. Z disc
    b. I band
    c. H zone
    d. M line
    e. None of the above

70. Which muscle protein is the main component of thick filaments and functions as a motor protein in all three types of muscle tissue?
    a. Myosin
    b. Actin
    c. Troponin
    d. Tropomyosin
    e. None of the above

71. Which of the following is a long, nonelastic protein wrapped around the entire length of each thin filament?
    a. Alpha-actinin
    b. Myomesin
    c. Dystrophin
    d. Nebulin
    e. None of the above

72. Which of the following links thin filaments of the sarcomere to integral membrane proteins of the sarcolemma, which are attached in turn to proteins in the connective tissue extracellular matrix that surrounds muscle fibers?
    a. Alpha-actinin
    b. Myomesin
    c. Dystrophin
    d. Nebulin
    e. None of the above

73. What is the term for a deep groove in the motor end plate that provides a large surface area for ACh?
    a. Synaptic vesicles
    b. Axon terminal
    c. Synaptic end bulbs
    d. Junctional folds
    e. None of the above

74. Which of the following shows the correct order of the steps of the contraction cycle?
    a. ATP hydrolysis → power stroke → attachment of myosin to actin to form cross-bridges → detachment of myosin from actin
    b. ATP hydrolysis → attachment of myosin to actin to form cross-bridges → power stroke → detachment of myosin from actin
    c. ATP hydrolysis → detachment of myosin from actin → power stroke → attachment of myosin to actin to form cross bridges
    d. ATP hydrolysis → attachment of myosin to actin to form cross-bridges → detachment of myosin from actin → power stroke
    e. None of the above

75. The SR membrane contains active transport pumps for which ion?
    a. Mg^{2+}
    b. Ca^{2+}
    c. Na^{+}
    d. K^{+}
    e. None of the above

76. Which of the following is in the correct order from smallest to largest?
    a. Muscle fiber → myofibril → thick filament
    b. Thick filament → muscle fiber → myofibril
    c. Myofibril → thick filament → muscle fiber
    d. Thick filament → myofibril → muscle fiber
    e. None of the above

77. Which of the following disappears during muscle contraction?
    a. A and I band
    b. I band and H zone
    c. I band and Z disc
    d. M line and A band
    e. None of the above

78. Which of the following occur in the cytosol?
    a. Glycolysis
    b. Glycogen breakdown
    c. Oxidation of pyruvic acid
    d. A and B
    e. All of the above

79. The myotome of a somite differentiates into what type of muscle?
    a. Skeletal
    b. Cardiac
    c. Smooth
    d. A and B
    e. All of the above

80. Which of the following statements about cardiac muscle tissue is correct?
    a. It has the same arrangement of actin and myosin as skeletal muscle fibers.
    b. It has the same arrangement of bands, zones and Z discs as skeletal muscle fibers.
    c. They are connected to each other through intercalated discs.
    d. It remains contracted 10-15 times longer than skeletal muscle tissue.
    e. More than one of the above

81. Which of the following statements about smooth muscle tissue is correct?
    a. It is nonstriated.
    b. It is voluntary.
    c. It contains intermediate filaments.
    d. It does not contain dense bodies.
    e. More than one of the above

82. How many nuclei does each muscle fiber have?
    a. 1
    b. 3
    c. 33
    d. 100
    e. None of the above

83. Which of the following are structural proteins?
    a. Tropomyosin and troponin
    b. Myosin and actin
    c. Tropomyosin and myosin
    d. Titin and myomesin
    e. None of the above

Labeling: Label **Figure 5** and **Figure 6** in the image packet. Each letter is worth **one** point. **(28)**

84. Figure 5 **(20)**
85. Figure 6 **(8)**

Pathology: Determine if the following statements about the muscular diseases are true or false. If the statement is true, write "**T**" on your answer sheet. If the answer is false, write "**F**" on your answer sheet. Each question is worth **two** points. **(30)**

86. MG is an autoimmune disease.
87. MG can be diagnosed using the edrophonium test and can be treated using neostigmine.
88. A decrease in the level of creatine kinase in blood is indicative of myositis.
89. Spasms as a result of tetanus can be severe enough to cause bone fractures.
90. Neonatal tetanus is the most common type of tetanus.
91. Less than 1% of polio cases result in muscle weakness that leads to an inability to move.
92. Most cases of polio do not result in symptoms.
93. Gowers' sign is a symptom of polio.
94. DMD usually affects males beginning around the age of four.
95. Muscular dystrophy can be inherited by individuals as an X-linked disorder, a recessive or dominant disorder.
96. The protein affected by muscular dystrophy links myosin in the cytoskeleton and dystroglycan of the sarcolemma.
97. BMD is a less severe variant of Duchenne muscular dystrophy.
98. BMD is the most common childhood form of muscular dystrophy.
99. Myotonic muscular dystrophy is an autosomal recessive condition.
100. Polymyositis is first treated with low doses of corticosteroids.

Matching: Match the following muscles to their corresponding origin. Each question is worth **two** points. **(20)**

101. Trapezius
102. Flexor digitorum superficialis
103. Masseter
104. Gluteus medius
105. Palmaris longus
106. Vastus intermedius
107. External intercostals
108. Internal intercostals
109. Serratus anterior
110. Vastus lateralis

A. Maxilla and zygomatic arch
B. Medial epicondyle of humerus
C. Medial epicondyle of humerus, coronoid process of ulna, ridge along lateral margin or anterior surface (anterior oblique line) of radius
D. Ilium
E. Greater trochanter and linea aspera of femur
F. Anterior and lateral surfaces of body of femur
G. Ribs 1-8 or 1-9
H. Superior nuchal line of the occipital bone, ligamentum nuchae, and spines of C7-T12
I. Inferior border of rib above
J. Superior border of rib belo