



SCIENCE OLYMPIAD
— AT THE —
UNIVERSITY OF FLORIDA

Northern Regional: January 18th, 2020

**Anatomy and
Physiology C - Exam**

I. Integumentary System

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

1. Which of the following statements about the integument is correct?
 - a. It is the largest organ in the body.
 - b. It has three layers: epidermis, dermis and subQ.
 - c. The epidermis is made up of non stratified squamous epithelium.
 - d. The hypodermis is located above the epidermis.
 - e. None of the above

2. What stratum of the skin determines if skin is classified as thin or thick skin?
 - a. Stratum granulosum
 - b. Stratum corneum
 - c. Stratum basale
 - d. Stratum spinosum
 - e. None of the above

3. What type of cell in the stratum basale undergo mitosis to produce new epidermal cells that replace the dead ones that flake off from the skin?
 - a. Merkel cells
 - b. Langerhans cells
 - c. Melanocytes
 - d. Keratinocytes
 - e. None of the above

4. What type of cell in the stratum basale is considered to be the receptor for the sense of touch?
 - a. Merkel cells
 - b. Langerhans cells
 - c. Melanocytes
 - d. Keratinocytes
 - e. None of the above

5. What stratum is only found in thick skin?
 - a. Stratum granulosum
 - b. Stratum lucidum
 - c. Stratum spinosum
 - d. Stratum basale
 - e. None of the above

6. Which of the following statements about the dermis is correct?
 - a. The dermis is 7mm thick in the palms and soles.
 - b. The boundary between the epidermis and dermis is not histologically distinct.
 - c. The upward waves seen in the boundary of the epidermis and dermis is known as dermal papillae.
 - d. There are no nerve endings in the dermis.
 - e. None of the above

7. Which of the following statements about the hypodermis is correct?
 - a. It is also called the superficial fascia.
 - b. It does not provide thermal insulation.
 - c. It is 12% thicker in men than in women.
 - d. Infants has more fat in this layer than adults so they do not get cold quickly.
 - e. None of the above

8. What pigment in the skin is most responsible for the brown, black, tan, yellowish and reddish hues in the skin?
 - a. Hemoglobin
 - b. Melanin
 - c. Carotene
 - d. Myoglobin
 - e. None of the above

9. What structure in the skin is a slender filament of keratinized cells that grows from a follicle?
 - a. Pilus
 - b. Apocrine gland
 - c. Nail
 - d. Ceruminous gland
 - e. None of the above

10. Along its length, what zone of a hair is the portion above the surface of the skin?
- Bulb
 - Root
 - Shaft
 - Medulla
 - None of the above
11. What part of a hair is a bundle of smooth muscle cells that extend from dermal collagen to a bulge slightly above the middle of a follicle?
- Epidermal root sheath
 - Connective tissue root sheath
 - Hair receptors
 - Arrector pili
 - None of the above
12. What stage of the hair cycle consists of epithelial root sheath cells below the bulge undergoing apoptosis?
- Anagen
 - Catagen
 - Telogen
 - All of the above
 - None of the above
13. In a hair cross section, what layer is composed of loosely arranged cells and air spaces?
- Medulla
 - Cortex
 - Cuticle
 - Root
 - None of the above
14. Which of the following statements about nails is correct?
- They are hard derivatives of the stratum basale.
 - Fingernails grow at a rate of about 2 mm per week.
 - The nail matrix is located above the skin and at the distal edge of a nail.
 - The nail plate is not visible.
 - None of the above

15. What part of a nail is the dead epidermis that covers the proximal end of the nail? **TB#1**
- Nail plate
 - Hyponychium
 - Eponychium
 - Nail matrix
 - None of the above
16. What part of a nail is the region that appears as a small white crescent?
- Free edge
 - Nail fold
 - Nail groove
 - Lunule
 - None of the above
17. What skin gland is the most numerous gland of the skin?
- Eccrine sweat gland
 - Apocrine sweat gland
 - Sebaceous gland
 - Ceruminous gland
 - None of the above
18. What gland is only located in the external ear canal?
- Eccrine sweat gland
 - Apocrine sweat gland
 - Sebaceous gland
 - Ceruminous gland
 - None of the above
19. What type of gland produces a secretion that is composed of broken-down cells that are replaced by mitosis at the base of the gland?
- Eccrine sweat gland
 - Apocrine sweat gland
 - Sebaceous gland
 - Ceruminous gland
 - None of the above

20. Which of the following statements about apocrine sweat glands is correct?
- The axilla does not have this type of gland.
 - The ducts open directly onto the surface of the skin.
 - They produce their secretion through exocytosis.
 - The secretory part of apocrine glands is smaller than a merocrine gland.
 - None of the above

Diagram-based Question: Answer the following questions based on **Figure 1.1** in the **image packet**. Each question is worth **one** point unless otherwise stated. **(15)**

- What mechanoreceptor is shown in the image?
- What sensation(s) is this mechanoreceptor sensitive to? (2)
- Does this mechanoreceptor type have a small or large receptive field?
- What is the optimal sensitivity of this mechanoreceptor in Hz? (2)
- What has to be deformed in order for this mechanoreceptor to sense stimuli? (2)
- What is depolarized after the receptive area of this mechanoreceptor is depolarized? (2)
- In percent, how much water is found in the gelatinous material separating the lamellae? (2)
- True or False:** This is the most abundant mechanoreceptor.
- True or False:** This mechanoreceptor can detect differences between rough and smooth surfaces.
- True or False:** This structure does not have a capsule.

Labeling: Label **Figure 1.2** in the **image packet**. Each letter is worth **one** point. **(25)**

Pathology: Use **Figure 1.3-1.12** in the **image packet** for the Pathology section. Determine what disease is shown in each picture. Be as specific and concise as possible. Each picture is worth **one** point. Partial credit will be awarded for semi-complete answers. **(10)**

II. Skeletal System

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

1. Which of the following statements about the function of the skeletal system is correct?
 - a. It does not provide support for soft tissues.
 - b. The rib cage only protects the heart.
 - c. Bone tissue stores about 99% of the body's calcium.
 - d. Red bone marrow only produces red blood cells.
 - e. None of the above

2. What part of a long bone reduces friction and absorbs shock at freely movable joints?
 - a. Diaphysis
 - b. Epiphyses
 - c. Metaphyses
 - d. Articular cartilage
 - e. None of the above

3. What part of a long bone is the region between the diaphysis and epiphysis?
 - a. Endosteum
 - b. Medullary cavity
 - c. Metaphyses
 - d. Periosteum
 - e. None of the above

4. What bone cell initiates calcification?
 - a. Osteoprogenitor cells
 - b. Osteoblasts
 - c. Osteocytes
 - d. Osteoclasts
 - e. None of the above

5. What bone cell is the main cell in bone tissue and maintains the metabolism of bone tissue?
 - a. Osteoprogenitor cells
 - b. Osteoblasts
 - c. Osteocytes
 - d. Osteoclasts
 - e. None of the above

6. What part of compact bone tissue is a circular plate of mineralized extracellular matrix of increasing diameter, surrounding blood vessels and nerves?
 - a. Osteons
 - b. Central canal
 - c. Concentric lamellae
 - d. Lacunae
 - e. None of the above

7. Which of the following statements about spongy bone tissue is correct?
 - a. It is also known as trabecular bone tissue.
 - b. It contains osteons.
 - c. The lamellae are arranged in a regular pattern.
 - d. There is little to no spongy bone tissue in sesamoid bones.
 - e. None of the above

8. What zone in an epiphyseal plate is nearest to the epiphysis and consists of small, scattered chondrocytes?
 - a. Zone of resting cartilage
 - b. Zone of proliferating cartilage
 - c. Zone of hypertrophic cartilage
 - d. Zone of calcified cartilage
 - e. None of the above

9. What type of bone fracture involves a bone being splintered, crushed or broken into pieces at the site of impact, and smaller bone fragments lie between the two main fragments?
- Open
 - Comminuted
 - Greenstick
 - Pott
 - None of the above
10. How many bones are in the axial skeleton?
- 78
 - 79
 - 80
 - 81
 - None of the above
11. What type of bone is somewhat cube-shaped and nearly equal in length and width?
- Short
 - Flat
 - Irregular
 - Sesamoid
 - None of the above
12. The bodies of which vertebrae are smaller than all other vertebrae except those that form the coccyx?
- C1-C3
 - C1-C7
 - T1-T4
 - L2-L5
 - None of the above
13. Which of the following statements about vertebrae is correct?
- The cervical vertebrae is the largest type of vertebrae.
 - There is one vertebral and two transverse foramina in thoracic vertebrates.
 - The thoracic vertebrae does not have articular facets for ribs.
 - The lumbar vertebrae has the thinnest intervertebral discs.
 - None of the above

14. What part of a pectoral girdle is rounded and articulates with the manubrium of the sternum?
- Sternal end
 - Sternoclavicular joint
 - Conoid tubercle
 - Acromioclavicular joint
 - None of the above
15. What part of the humerus is roughly cylindrical at its proximal end but gradually becomes triangular until it is flattened and broad at its distal end?
- Shaft
 - Deltoid tuberosity
 - Radial groove
 - Capitulum
 - None of the above
16. What part of the ulna is a depression that articulates with the head of the radius? **TB#2**
- Olecranon
 - Coronoid process
 - Radial notch
 - Ulnar tuberosity
 - None of the above
17. What type of joint is a fibrous joint that has a greater distance between the articulating surfaces and more dense irregular connective tissue than in a suture?
- Synostosis
 - Interosseous membrane
 - Gomphosis
 - Syndesmosis
 - None of the above
18. Which of the following statements about synchondrosis is correct?
- It is a type of synovial joint.
 - An example is the epiphyseal growth plate that joins the epiphysis and diaphysis of a growing bone.
 - It is a movable joint.
 - A synchondrosis could never become a synostosis.
 - None of the above

19. What type of action is a movement of a bone toward the midline?
- Abduction
 - Adduction
 - Circumduction
 - Rotation
 - None of the above
20. What type of action is a movement of a bone away from the midline?
- Abduction
 - Adduction
 - Circumduction
 - Rotation
 - None of the above

Diagram-based Question: Answer the following questions based on **Figure 2.1** in the **image packet**. Each question is worth **one** point unless otherwise stated. **(12)**

- What type of vertebrae is shown in the image?
- The vertebral column is used as a marker for some parts of the body. At what specific vertebrae are the mandible and hyoid bone located? (2) **TB#3**
- What is the thin ring of bone surrounding the vertebral and transverse foramina in this vertebrae type?
- What is located on the left and right lateral sides of each vertebrae of this type?
- How many foramina are found in this vertebral type? (2)
- True or False:** This vertebral type is the largest type of vertebrae.
- True or False:** The last vertebrae of this type has a large, non bifid spinous process.
- True or False:** The first vertebrae of this type does not have posterior arches.
- True or False:** The second vertebrae of this type does not have a vertebral body.
- True or False:** Some of the spinous processes of this vertebral type branch are bifid.

Labeling: Label **Figure 2.2** in the **image packet**. Each letter is worth **one** point. **(24)**

Pathology: Determine what disease of the skeletal system is shown based on **Figures 2.3 and 2.4** in the **image packet**. Then, answer the corresponding questions regarding that disease. Each letter is worth **one** point. **(10)**

1. Use **Figure 2.3** for this section.

- A. What disease is shown in the given image?
- B. List one symptom of this disease.
- C. Which sex has a higher risk of getting this disease: men or women?
- D. Which age group has a higher risk of getting this disease: younger people or older people?
- E. The reduction of what hormone in women at menopause is linked to a higher chance of getting this disease?

2. Use **Figure 2.4** for this section.

- A. What disease is shown in the x-ray above?
- B. List one symptom of this disease.
- C. List one possible cause of this disease.
- D. Which sex is has a higher risk of having the cruve worsen: men or women?
- E. Are more cases of this disease mild or severe?

III. Muscular System

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

1. What type of muscle tissue is striated but has an involuntary action?
 - a. Skeletal
 - b. Cardiac
 - c. Smooth
 - d. All of the above
 - e. None of the above

2. What type of muscle tissue is striated but mostly works voluntarily?
 - a. Skeletal
 - b. Cardiac
 - c. Smooth
 - d. All of the above
 - e. None of the above

3. Which of the following statements about the properties of muscular tissue is correct?
 - a. Local changes in pH cannot affect muscle action potentials.
 - b. Skeletal muscle does not pull on its attachment points when it generates tension.
 - c. Muscular tissue can stretch but it has limits before it becomes damaged.
 - d. Everytime a muscle contracts, it does not return to its original length.
 - e. None of the above

4. What layer in muscular tissue penetrates the interior of each fascicle and separates individual muscle fibers from one another?
 - a. Fascia
 - b. Epimysium
 - c. Perimysium
 - d. Endomysium
 - e. None of the above

5. What layer in muscular tissue surrounds groups of 10-100 muscle fibers and separates them into fascicles?
 - a. Fascia
 - b. Epimysium
 - c. Perimysium
 - d. Endomysium
 - e. None of the above

6. What is the protein that binds oxygen molecules that diffuse into muscle fibers from interstitial fluid?
 - a. Sarcolemma
 - b. T tubules
 - c. Sarcoplasm
 - d. Myoglobin
 - e. None of the above

7. What structure encircles each myofibril?
 - a. T tubules
 - b. Terminal cisterns
 - c. SR
 - d. Sarcolemma
 - e. None of the above

8. What component of a sarcomere is a dark, middle part of a sarcomere that extends the entire length of thick filaments and includes parts of thin filaments that overlap thick filaments?
 - a. A band
 - b. I band
 - c. H zone
 - d. M line
 - e. None of the above

9. What component of a sarcomere is a lighter, less dense area that contains the remainder of thin filaments but no filaments?
- A band
 - I band
 - H zone
 - M line
 - None of the above
10. What protein is the main component of thin filaments?
- Myosin
 - Actin
 - Troponin
 - Tropomyosin
 - None of the above
11. Which of the following statements about the contraction cycle is correct?
- The actin head includes an ATP-binding site and an ATPase.
 - Myosin heads attach to actin during relaxation.
 - Power strokes occur after cross-bridge formation.
 - The actin head detaches from myosin as ATP binds to the ATP-binding site on the actin head.
 - None of the above
12. What structure in the neuromuscular junction is the region of the sarcolemma opposite the synaptic end bulbs?
- Synapse
 - Synaptic cleft
 - Axon terminal
 - Motor end plate
 - None of the above
13. Which of the following statements about the microscopic anatomy of smooth muscle tissue is correct? **TB#4**
- A single relaxed smooth muscle fiber is 30-200 micrometers long.
 - A smooth muscle fiber is the thinnest in the middle.
 - Smooth muscle fibers do not contain intermediate filaments.
 - The thick filaments attach to dense bodies in smooth muscle fibers.
 - None of the above

14. What is a rigid structure that can move around a fixed point?
- Level
 - Fulcrum
 - Mechanical advantage
 - Mechanical disadvantage
 - None of the above
15. What type of lever has the effort between the fulcrum and the load?
- First
 - Second
 - Third
 - All of the above
 - None of the above
16. What fascicle arrangement involves fascicles spread over a broad area that converge at a thick central tendon?
- Circular
 - Triangular
 - Pennate
 - Fusiform
 - None of the above
17. What is the origin of the masseter?
- Greater wing and lateral surface of the lateral portion of pterygoid process of the sphenoid bone
 - Medial surface of the lateral portion of pterygoid process of the sphenoid bone; maxilla
 - Temporal bone
 - Maxilla and zygomatic arch
 - None of the above

18. What is the insertion of the external intercostals?
- Central tendon
 - Superior border of rib below
 - Inferior border of rib above
 - Xiphoid process of the sternum, costal cartilages, and adjacent portions of ribs 7-12, lumbar vertebrae and their intervertebral discs
 - None of the above
19. What is the action of the serratus anterior?
- Depresses and moves clavicle anteriorly and helps stabilize pectoral girdle.
 - Abducts scapula and rotates it downward.
 - Elevates ribs 3-5 during forced inhalation when the scapula is fixed.
 - Abducts scapula and rotates it upward.
 - None of the above
20. What is the origin of the flexor carpi radialis?
- Medial epicondyle of humerus
 - Metacarpals II and III
 - Medial epicondyle of humerus
 - Middle phalanx of each finger
 - None of the above

Labeling: Label **Figure 3.1** in the **image packet**. Each letter is worth **one** point. **(20)**

Diagram-based Questions: Answer the following questions based on **Figure 3.2** in the **image packet**. Each question is worth **one** point unless otherwise stated. **(13)**

- What type of muscle tissue is shown in the image?
- What ion(s) enter the muscle during an action potential in this muscle type? (2)
- What is the structure that connects the cells of this muscle tissue type to each other? (2)
- Most of these cells have how many nuclei?
- Actin is the main component of what band in this muscle tissue? (2) **TB#5**
- True or False:** This muscle tissue does not contain a lot of mitochondria.
- True or False:** The fibroblasts in this muscle type cannot contract like the main cells in this muscle tissue.
- True or False:** There are more fibroblasts than the main cells of this muscle tissue.
- True or False:** There are no glycosaminoglycans present in the matrix of this muscle tissue.
- True or False:** This type of muscle tissue does not contain T-tubules.

Pathology: Determine the diseases based on the descriptions below. Each question is worth **one** point. **(10)**

1. An unusual rash is sometimes the first sign of this condition that also involves patients tripping or falling more frequently.
2. This is a chronic autoimmune disease that causes weakness of skeletal muscles.
3. 72% of the cases of this disease does not have symptoms.
4. This disease is commonly known as “lockjaw.”
5. Symptoms of this disease includes stiffness of the neck, jaw, and other muscles, sneering, grinning expression, difficulty swallowing and uncontrollable muscle spasms.
6. 0.5% of the cases of this disease involves muscle weakness that leads to an inability to move.
7. In this disease, mutations interfere with the production of proteins needed to form muscle.
8. Symptoms of this disease include frequent falls, difficulty rising from a lying or sitting up position, trouble running and jumping, waddling gait, walking on the toes, large calf muscles, muscle pain and stiffness, and learning disabilities.
9. The name of this disease translates to “grave muscle weakness.”
10. This condition involves the inflammation of muscles.