Anatomy and Physiology - Division C Master Key

University of Georgia Science Olympiad Invitational 2019

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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. The page numbers are located in the lower right corner of each page for your convenience.
- Tiebreakers are labeled as **TB#**. There are **5** tiebreakers in this exam.
- 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

Multiple Choice Directions: Choose the most appropriate answer for each question below. **No** partial credit will be awarded for multiple select questions. Each question is worth **one** point. **(20)**

1. Which of the following is a function of the integumentary system? (Multiple select)
   - **a. Waterproof and protect deeper layers of the skin**
   - **b. Excretion of waste**
   - **c. Regulation of body temperature**
   - **d. Attachment site for sensory receptors**

2. The integumentary system synthesizes which of the following vitamins?
   - a. A
   - b. B
   - c. K
   - **d. D**

3. Which of the following are the two main layers of the tissue? (Multiple select)
   - **a. Epidermis**
   - **b. Dermis**
   - c. Hypodermis
   - d. Subcutaneous layer

4. What cells form tight junctions with the nerves of the skin and hold the Langerhans cells and intradermal lymphocytes in position within the epidermis?
   - a. Melanocytes
   - **b. Keratinocytes**
   - c. Merkel cells
   - d. None of the above

5. What cells constitute 90% of the cells of the epidermis?
   - **a. Keratinocytes**
   - b. Melanocytes
   - c. Merkel cells
   - d. Langerhans cells

6. Which of the following stratums contain macrophages that arise in the bone marrow and then migrate to the stratified squamous epithelia of the epidermis, oral cavity, esophagus, and vagina? (Multiple select)
    a. Stratum basale
    b. Stratum spinosum
    c. Stratum granulosum
    d. Stratum lucidum

7. Which of the following stratums have cells that have no nuclei or other organelles?
    a. Stratum basale
    b. Stratum spinosum
    c. Stratum granulosum
    d. Stratum lucidum

8. Which of the following stratums have two to five layers of cells with dark-staining keratohyalin granules and is scanty in thin skin?
    a. Stratum basale
    b. Stratum spinosum
    c. Stratum granulosum
    d. Stratum lucidum

9. Which of the following layers of the skin is composed of mainly collagen but also contains elastic and reticular fibers, cells of fibrous connective tissue, blood vessels, sweat glands, sebaceous glands, hair follicles, and nail roots?
    a. Epidermis
    b. Dermis
    c. Hypodermis
    d. None of the above

10. Which of the following pigments below are concentrated in freckles and moles, on the dorsal surface of the hands and feet and in the nipple and areola?
    a. Carotene
    b. Hemoglobin
    c. Melanin
    d. None of the above

11. Which of the following statements below regarding abnormal colors of the skin is correct?
    a. Jaundice is caused by high levels of urobilinogen in the blood, causing a yellowing of the skin and whites of the eyes.
    b. Pallor could occur if there is little blood flow through the skin that the white color of the epidermal collagen shows.
    c. A hematoma is a mass of clotted blood showing through the skin.
    d. Erythema is caused by decreased blood flow in vasoconstricted blood vessels.

12. Which of the following functions of the skin is correct?
    a. The skin allows the body from absorbing excess water during swimming or bathing.
    b. The dermal surface of the skin is populated by bacteria.
    c. The skin can resist and recover from trauma better than other organs of the body.
    d. The skin is always impermeable to all chemicals, making it a strong support for the immune system.

13. Which of the following is a type of hair that is long, coarse and pigment and usually occurs on the scalp, eyebrows, and eyelashes?
    a. Vellus
    b. Terminal hair
    c. Lanugo
    d. None of the above

14. What layer of hair cross section is composed of a single layer of scaly cells that overlap each other with their free edges directed upwards?
    a. Root
    b. Medulla
    c. Cortex
    d. Cuticle

15. What is the layer of a follicle that is an extension of the epidermis?
    a. Epithelial root sheath
    b. Connective tissue root sheath
    c. Piloerector muscle
    d. None of the above

16. In what stage of hair growth do epithelial root sheath cells below the bulge undergo apoptosis?
    a. Anagen
    b. Catagen
    c. Telogen
    d. None of the above

17. What part of a nail is composed of dead epidermis that covers the proximal end of the nail?
    a. Hyponychium
    b. Nail groove
    c. Eponychium
    d. Lunule

18. What part of a nail is the region at the base of the nail that appears as a small white crescent due to a thick stratum basale that obscures dermal blood vessels from view?
    a. Free edge
    b. Nail fold
    c. Lunule
    d. Nail groove

19. What gland in the skin is also considered a scent gland that respond to events of stress and sexual stimulation?
    a. Apocrine sweat glands
    b. Merocrine sweat glands
    c. Sebaceous glands
    d. Mammary glands

20. What gland in the body matches the following description: *simple, coiled, tubular glands with ducts leading to the skin surface*.
    a. Sweat glands
    b. Sebaceous glands
    c. Ceruminous glands
    d. Mammary glands

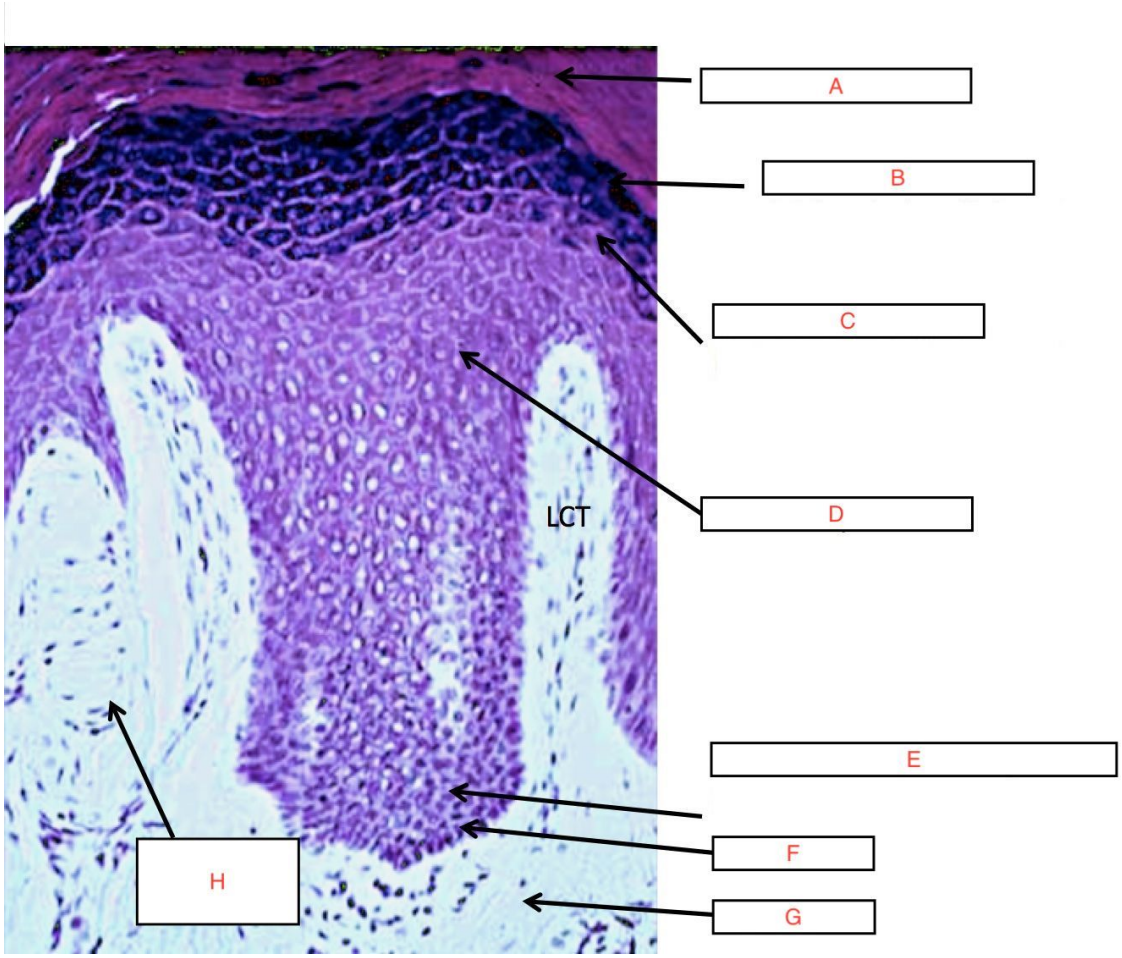
Classification Directions: Determine if the descriptions below pertain to thin or thick skin. Each question is worth **one** point. **(10)**

1. Does not have sebaceous glands **thick**
2. Does not have epidermal ridges **thin**
3. Has denser sensory receptors **thick**
4. Has numerous sudoriferous glands **thick**
5. Located everywhere on the body except for the palms, palmar surface of digits and soles **thin**
6. The epidermal thickness is 0.10-0.15 mm **thin**
7. Has the stratum lucidum **thick**
8. Does not have hair follicles **thick**
9. Does not have arrector pili muscles **thick**
10. Has dermal papillae that are parallel to each other **thick**

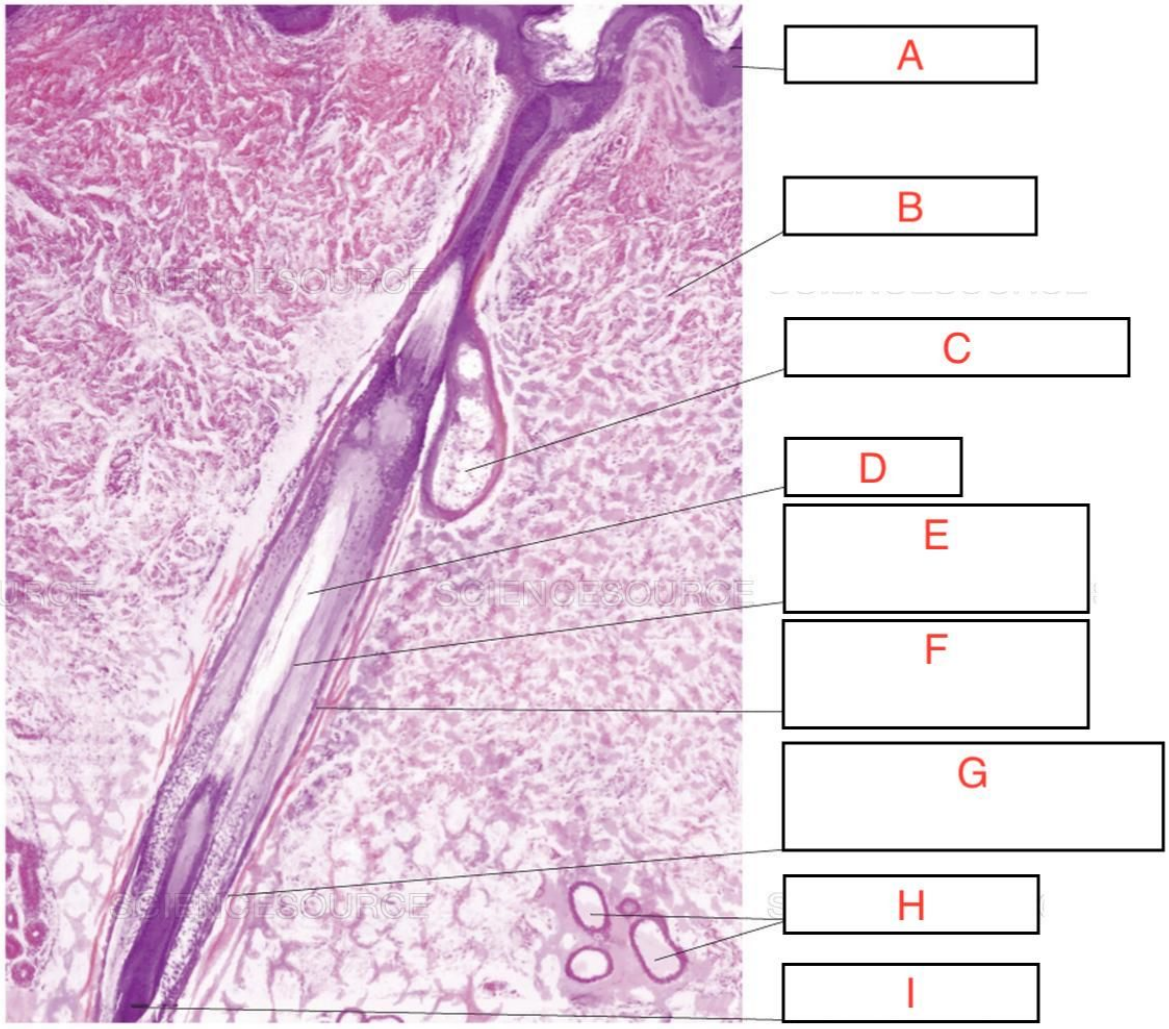
Short Answer: Answer the following questions below in the most concise and specific way possible. Each question is worth **one** point. **(10)**

1. What is the general term for a sensory receptor in the skin that responds to pressure or distortion? **Mechanoreceptor**
2. What skin receptor responds to light touch? **Tactile corpuscles/Meissner corpuscles**
3. What skin receptor responds to pressure? **Lamellar corpuscles/Pacinian corpuscles**
4. What skin receptor detects tension in the deeper regions of the skin and fascia? **Bulbous corpuscles/Ruffini endings**
5. What skin receptor detects sustained pressure? **Merkel nerve endings/Merkel discs**
6. What is the general term for a sense receptor that detects changes in temperature? **Thermoreceptor**
7. What receptor responds to stimuli that are damaging? **nociceptor/pain receptor**
8. From what type of stem cells do pain receptors develop from? **TB#1 Neural-crest**
9. What type of pain receptor does not respond unless there is injury present? **silent/sleeping**
10. What skin receptor can convert a chemical substance to a biological signal? **chemoreceptor/chemosensor**

Labeling Directions: Label **Figure 1.1 and 1.2** in the image packet. Be as concise and specific as possible. Figure 1.2 is **TB#2**. Each letter is worth **one** point. **(17)**

1. 

A. Stratum corneum
B. Stratum lucidum
C. Stratum granulosum
D. Stratum spinosum
E. Stratum germinativum/basale
F. Mitosis
G. Dermis
H. Meissner's corpuscle

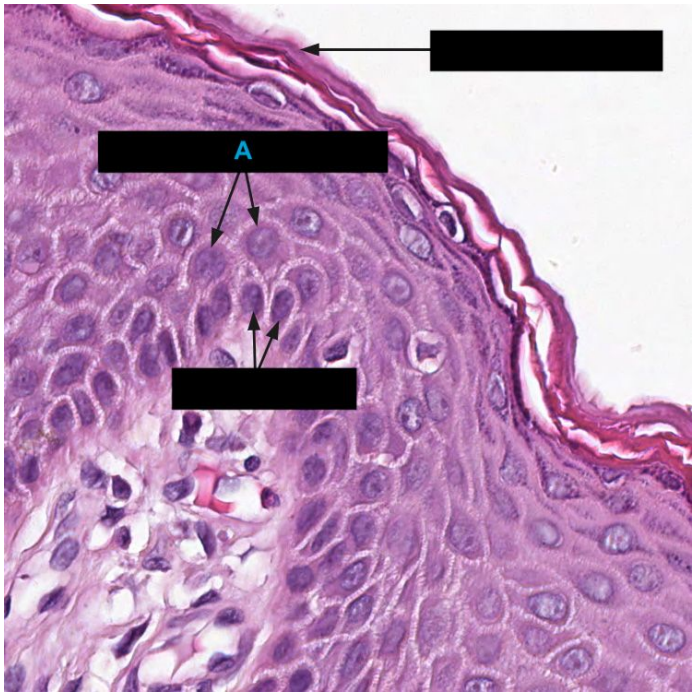


2.

TB#2

A. Epidermis
B. Dermis
C. Sebaceous gland
D. Hair
E. Internal radicular sheath
F. External radicular sheath
G. Dermic sheath of connective tissue
H. Sweat glands
I. Pilous bulb

Image-based Questions: Answer the following questions based on **Figure 1.3** in the image packet. Each question is worth **one** point unless otherwise stated. **(15)**



1. What is the structure labelled A? **Keratinocyte/Epidermal cells**
2. What percent of the epidermis is composed of Structure A? **90%**
3. What is the primary function of Structure A? **Barrier formation**
4. List one protein in the skin that contributes to the skin's function as a barrier. **Accept any of the following: filaggrin, keratin**
5. True or False: Structure A can produce CXCL10. **True**
6. True or False: Structure A can produce CCL2. **True**
7. True or False: Structure A can produce IL-10. **True**
8. What effect would hydrocortisone have on the differentiation of Structure A? (2) **it would promote it**
9. Cholecalciferol is another factor that can regulate the proliferation and differentiation of the Structure A. What is another name for cholecalciferol? (2) **vitamin D_3 (1 point for vitamin D)**
10. Describe the nucleus and cytoplasm of the Structure A when exposed to UVA in presence of psoralens. (4) **pyknotic nucleus (2) and eosinophilic cytoplasm (2)**

Pathology Directions: Answer the corresponding questions based on Figures 1.4-1.7 in the image packet. Complete sentences are **not** required for this section. Each question is worth **one** point. **(8)**

1.

e. What level of burn is shown above? **Second**

f. What layers of the skin are affected by this burn? **Epidermis and dermis (0.5 credit for epidermis or dermis only)**

2.

g. What disease is shown above? **Impetigo (give 0.5 for infection)**

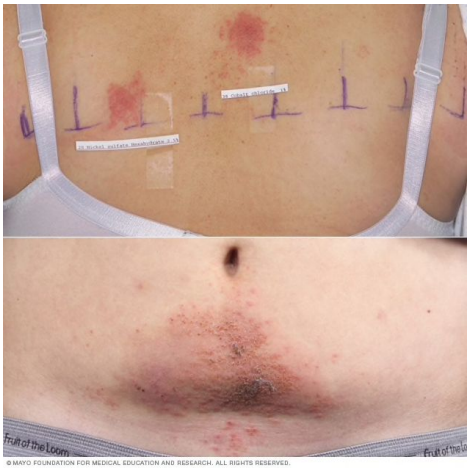
h. At what **two** ages/stages of life is this disease most common? **Infants and children (0.5 for one group only)**

3.

i. What disease is shown above? **Carbuncle (give 0.5 for infection)**

j. List a region where this disease is common. **Back of the neck, shoulders, thighs (give one point for any of the above)**

4.



k. What disease is shown above? **Allergy**

l. What would have caused the disease? **Nickel (metal)**

II. Skeletal System

Multiple Choice Directions: Choose the most appropriate answer for each question below. **No** partial credit will be awarded for multiple select questions. Each question is worth **one** point. **(20)**

1. What type of bone cell reside in lacunae which are connected by canaliculi?
    a. Osteoblasts
    b. Osteogenic cells
    c. Osteoclasts
    d. Osteocytes

2. Which of the following about the dry weight of the osseous tissue matrix is correct?
    a. ⅓ organic and ⅔ inorganic matter
    b. ⅔ organic and ⅓ inorganic matter
    c. ½ organic and ½ inorganic matter
    d. ¼ organic and ¾ inorganic matter

3. What type of bone tissue consists of trabeculae and is permeated by spaces filled with bone marrow?
    a. Compact bone
    b. Spongy bone
    c. A and B
    d. None of the above

4. What type of bone marrow consists of a delicate mesh of reticular tissue saturated with immature red blood cells and scattered adipocytes?
    a. Myeloid tissue
    b. Yellow bone marrow
    c. Gelatinous bone marrow
    d. None of the above

5. Which of the histological zones of transformation of cartilage bone involves walls between lacunae breaking down and chondrocytes dying?
    a. Zone of reverse cartilage
    b. Zone of cell proliferation
    c. Zone of cell hypertrophy
    d. Zone of bone deposition

6. What hormone promotes mineralization and lowers blood Ca^{2+} concentration in children?
    a. Cortisol
    b. Vitamin D
    c. Calcitonin
    d. Parathyroid hormone

7. What type of fracture involves bone being bent on one side and has an incomplete fracture on the opposite side?
    a. Spiral
    b. Epiphyseal
    c. Greenstick
    d. Nondisplaced

8. Which of the following statements below referring to cranial bones is correct?
    a. There are 2 frontal bones.
    b. There is 1 ethmoid bone.
    c. There are 2 sphenoid bones.
    d. There are 3 temporal bones.

9. Which of the following is considered a primary curvature? (Multiple select)
    a. Cervical curvature
    b. Thoracic curvature
    c. Lumbar curvature
    d. Pelvic curvature

10. What is the term for the triangular canal dorsal to the body of each vertebrae?
    a. Vertebral canal
    b. Vertebral arch
    c. Pedicle
    d. **Vertebral foramen**

11. An intervertebral disc consists of which of the following? (Multiple select)
    a. Inferior vertebral notch
    b. Superior vertebral notch
    c. Nucleus pulposus
    d. Annulus fibrosus

12. What type of vertebrae fits the following description: *thick, stout body, blunt, squarish spinous process.*
    a. Cervical
    b. Thoracic
    c. Lumbar
    d. Sacrum

13. Which of the following is a region of the sternum? (Multiple select)
    a. Manubrium
    b. Inferior articular facet
    c. Body
    d. Xiphoid process

14. How many bones are there per upper limb?
    a. 28
    b. 30
    c. 31
    d. 32

15. Which of the following shows the correct order of the carpal bones of the proximal row starting at the lateral side?
    a. Pisiform, triquetrum, lunate, navicular
    b. Pisiform, lunate, triquetrum, navicular
    c. Navicular, triquetrum, lunate, pisiform
    d. Navicular, lunate, triquetrum, pisiform

16. What is the term for the bones of the fingers?
    a. Metacarpals
    b. Phalanges
    c. Carpal bones
    d. Coronoid processes

17. What is the ligament that extends from the acetabulum to a pit in the femur?
    a. Intertrochanteric crest
    b. Linea aspera
    c. Fovea capitis
    d. Patellar surface

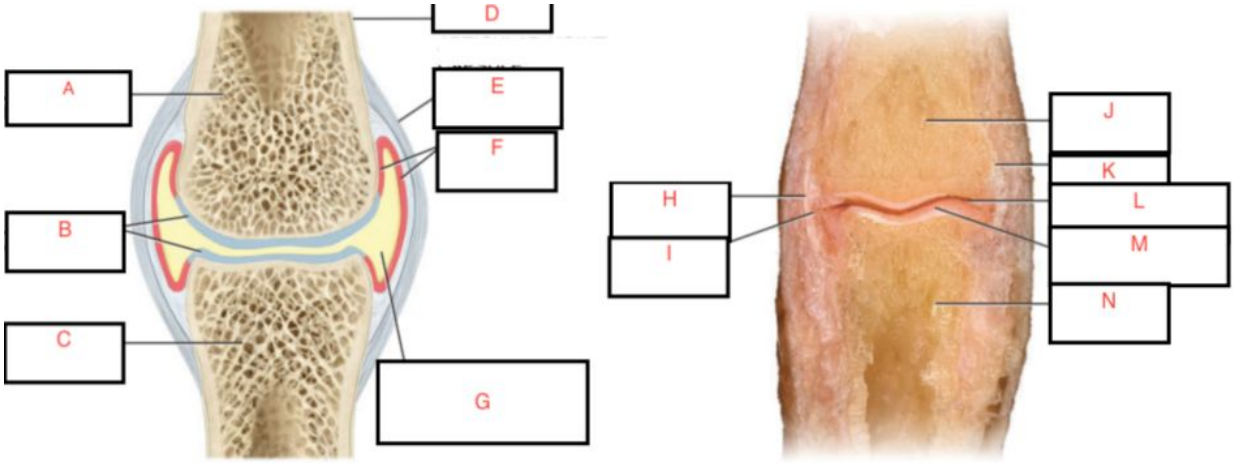
18. What is the largest tarsal bone?
    a. **Talus**
    b. Calcaneus
    c. Calcaneal tendon
    d. Lateral cuneiform

19. What arch extends from the heel to hallux and is formed from the calcaneus, talus, navicular, cuneiforms and metatarsals I to III?
    a. **Medial longitudinal arch**
    b. Lateral longitudinal arch
    c. Traverse arch
    d. None of the above

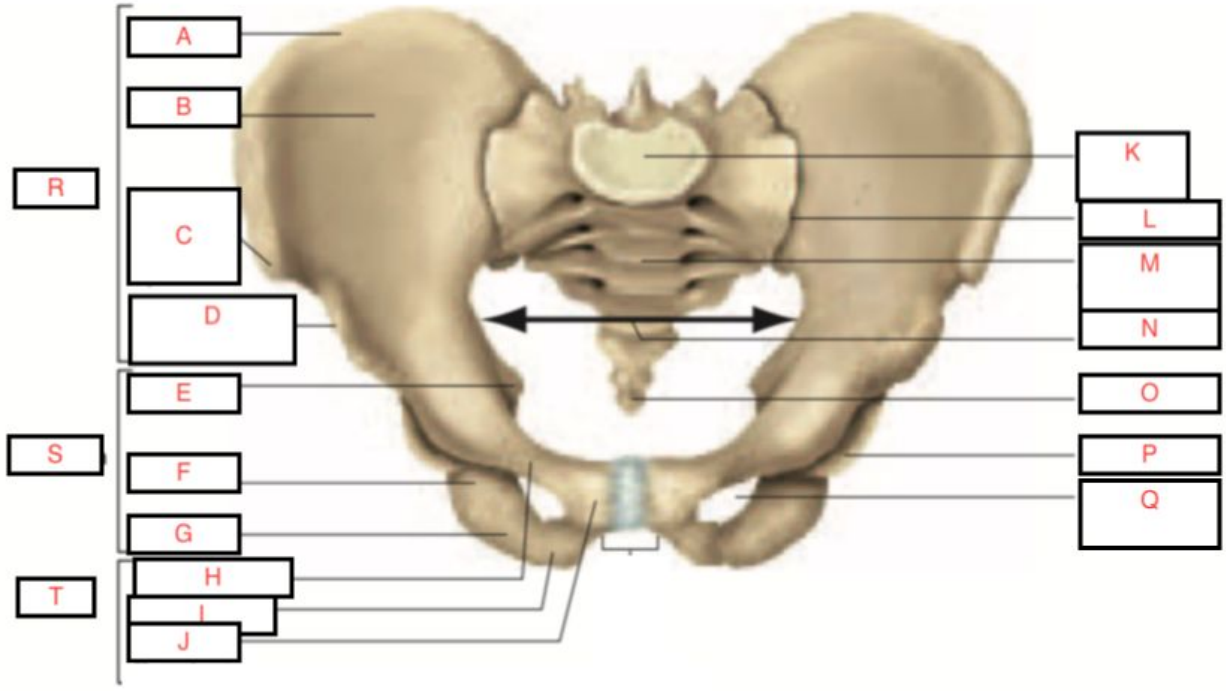
20. Which of the following is a ligament of the ankle? (Multiple select)
    a. **Anterior tibiofibular ligaments**
    b. **Posterior tibiofibular ligaments**
    c. **Deltoid ligament**
    d. **Lateral collateral ligament**

Labeling Directions: Label **Figures 2.1-2.3** in the image packet. Figure 2.2 is **TB#3**. Be as concise and specific as possible. Each letter is worth **one** point. **(56)**

1. (14)

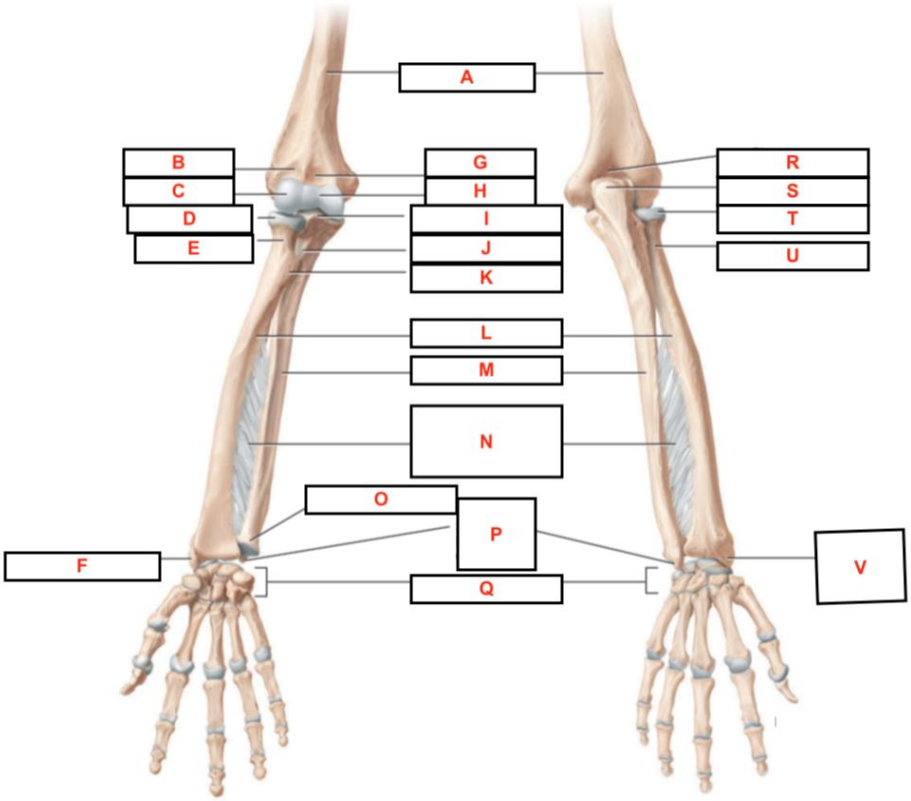


A. Articulating bone
B. Articular cartilage
C. Articulating bone
D. Periosteum
E. Fibrous membrane
F. Synovial membrane
G. Synovial (joint) cavity
H. Fibrous membrane
I. Synovial membrane
J. Articulating bone
K. Periosteum
L. Synovial (joint) cavity
M. Articular cartilage
N. Articulating bone

2. 

TB#3 (20)

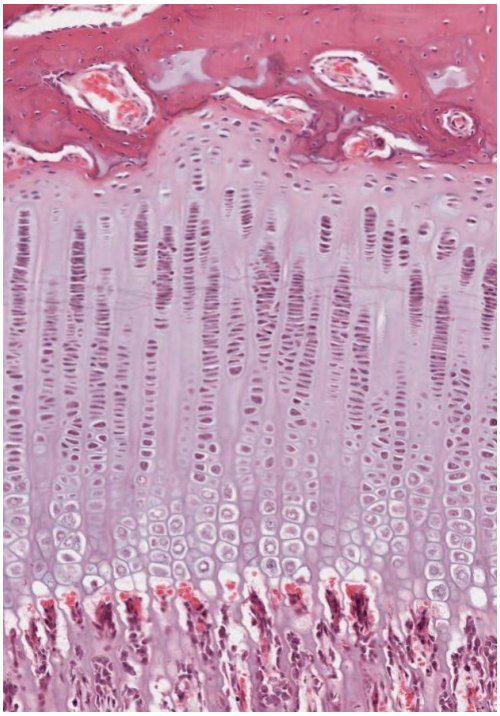
A. Crest
B. Fossa
C. Anterior superior spine
D. Anterior inferior spine
E. Spine
F. Body
G. Ramus
H. Superior ramus
I. Inferior ramus
J. Body
K. Base of sacrum
L. Sacroiliac joint
M. Pelvic surface of sacrum
N. Pelvic inlet
O. Coccyx
P. Acetabulum
Q. Obturator foramen
R. Ilium
S. Ischium
T. Pubis



3.

A. Humerus
B. Radial fossa
C. Capitulum
D. Head of radius
E. Neck of radius
F. Styloid process of radius (0.5 if radius not specified)
G. Coronoid fossa
H. Trochlea
I. Coronoid process
J. Ulnar tuberosity
K. Radial tuberosity
L. Radius
M. Ulna
N. Interosseous membrane
O. Head of ulna
P. Styloid process of ulna (0.5 if ulna not specified)
Q. Carpals
R. Olecranon fossa
S. Olecranon
T. Head of radius
U. Neck of radius
V. Styloid process of radius (0.5 if radius not specified)

Image-based Questions: Answer the following questions based on **Figure 2.4** in the image packet. Each question is worth **one** point unless otherwise stated. **(16)**

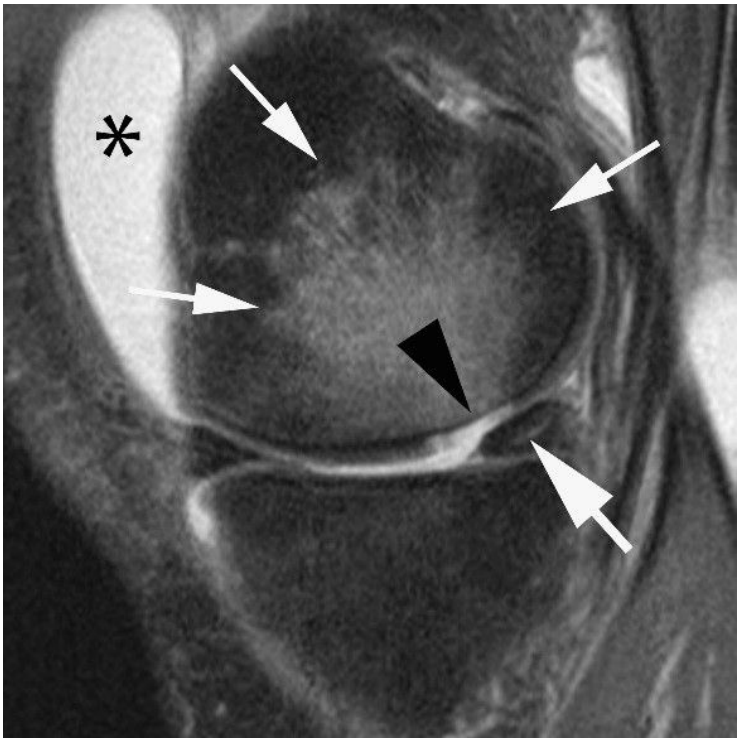


1. What is occuring in the given image? (2) **endochondral ossification (1 point for ossification)**
2. What is the term for the layer that surrounds the cartilage, which eventually forms the periosteum? (2) **perichondrium**
3. Where do secondary centers typically appear in this process? **Epiphysis**
4. Where does the first site of this process occur? (2) **in the primary center of ossification (1) located in the middle of diaphysis/shaft (1)**
5. Where can chondrocytes undergoing rapid mitosis to form stacks be located? (2) **zone of proliferation/cell columns**
6. What is formed during fracture healing? **Callus**
7. What continues to resorb bone until the ultimate thickness is achieved? (2) **osteoclasts**
8. What is the term for the point of union between the primary and secondary center? **Epiphyseal line**
9. What breaks down spongy bone to form the bone marrow cavity? (2) **osteoclasts**
10. True or False: This process does not occur during the rudimentary formation of long bones. **False**

Pathology Directions: Answer the corresponding questions based on **Figures 2.5 and 2.6** in the image packet. Complete sentences are **not** required for this section. Each letter is worth **one** point unless otherwise stated. **(11)**

1.  (5)

A. What disease/injury is shown above? **Medial collateral ligament (MCL) damage**
B. What grade of this disease/injury is shown above? **Grade 2**
C. Where would this disease/injury be located in the body? **medial/inner side of the knee joint (accept knee or knee joint)**
D. What stress to a slightly bent knee can be the cause of this disease/injury? **Valgus stress**
E. List a possible treatment for this disease. **Therapy, controlling inflammation, bracing, arthroscopic surgery if severe, replacement or suturing of MCL, prolotherapy. (give one point for any one of the listed)**

2.  (6)

A. What disease is shown in the MRI above? **Osteoarthritis**
B. List two symptoms of this disease. (2) **Pain, stiffness, tenderness, loss of flexibility, grating sensation, bone spurs, swelling. (give two points for any of the two listed)**
C. True or **False**: Men are more likely to develop this disease.
D. **True** or False: Hemochromatosis can contribute to this disease.
E. True or **False**: Obesity does not contribute to this disease.

III. Muscular System

Multiple Choice Directions: Choose the most appropriate answer for each question below. **No** partial credit will be awarded for multiple select questions. Each question is worth **one** point. **(10)**

1. What is the connective tissue sheath that separates each fascicle from each other?
    a. Endomysium
    b. Perimysium
    c. Epimysium
    d. Superficial fascia

2. The intercostal muscles between the ribs show what type of muscle attachment?
    a. Direct attachment
    b. Indirect attachment
    c. A and B
    d. None of the above

3. What type of muscle is fan-shaped, broad at the origin, and moves toward a narrower insertion?
    a. Fusiform
    b. Parallel
    c. Pennate
    d. Convergent

4. What type of muscles have fascicles that insert obliquely on a tendon that runs the length of the muscle?
    a. Convergent
    b. Parallel
    c. Pennate
    d. Fusiform

5. What is the term for a muscle that aids the muscle that produces the most of the force during a particular joint action?
    a. Synergist
    b. Prime mover
    c. Antagonist
    d. Fixator

6. What type of skeletal muscle that fits the following description: *voluntary striated muscle that is usually attached to one or more bones.*
    a. Cardiac
    b. Smooth
    c. Skeletal
    d. None of the above

7. Skeletal muscles are innervated by what type of motor neurons?
    a. Automatic
    b. Somatic
    c. Enteric
    d. None of the above

8. Each branch of a motor nerve fiber ends in a bulbous swelling called what?
    a. Synaptic cleft
    b. Synaptic knob
    c. Motor end plate
    d. Synaptic vesicles

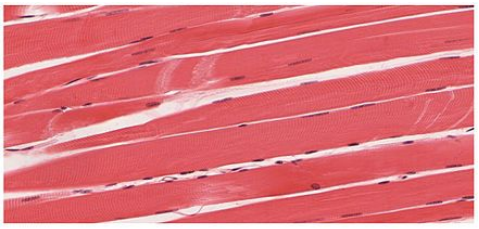
9. What is the term for the functional connection between the distal end of a nerve fiber and the middle of a muscle fiber?
    a. Motor end plate
    b. Synaptic cleft
    c. Synaptic knob
    d. Neuromuscular junction

10. Which of the following statements about muscle excitation is correct? (Multiple select)
    a. Sodium ions stimulate exocytosis of synaptic vesicles, which releases ACh into the synaptic cleft.
    b. The receptors of ACh are voltage-gated ion channels.
    c. The areas of sarcolemma next to the end plate have voltage-gated ion channels that open in response to EPP.
    d. The voltage of the sarcolemma reverses polarity as a result of ion movements.

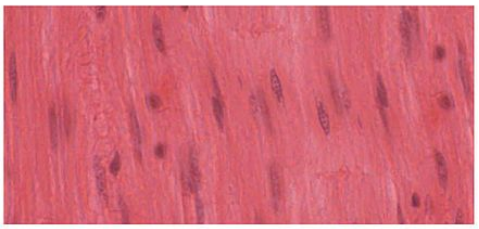
True or False: Determine if the statements below are true or false. Each question is worth **one** point. **(10)**

1. Cardiac muscles do not contain sarcomeres. **False**
2. There are three major subtypes of Type II, fast twitch muscles. **True**
3. The epimysium anchors muscle tissue to tendons. **True**
4. Pennate muscles have fibers that are oriented at an angle relative to the line of action. **True**
5. The volume of a muscle determines how forcefully it contracts. **False**
6. The afferent leg of the peripheral nervous system sends signals to the muscles. **False**
7. Not all muscles in the body produce adenosine triphosphate. **False**
8. Pyruvate is formed in aerobic conditions in the process of glycolysis. **True**
9. Muscle hypertrophy can occur due to exercising. **True**
10. Acetyl and choline cannot activate the ACh receptor. **True**

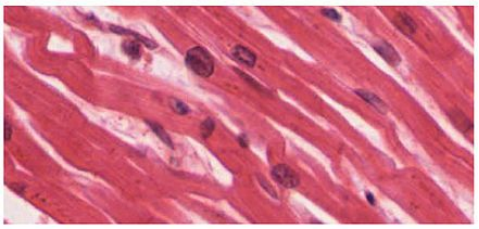
Diagram-based Part 1 questions: Based on **Figure 3.1** in the image packet, determine if the statement describes muscle type A, B or C. Write **A, B or C** for your answers. Each question is worth **one** point. **(10)**



(a)



(b)



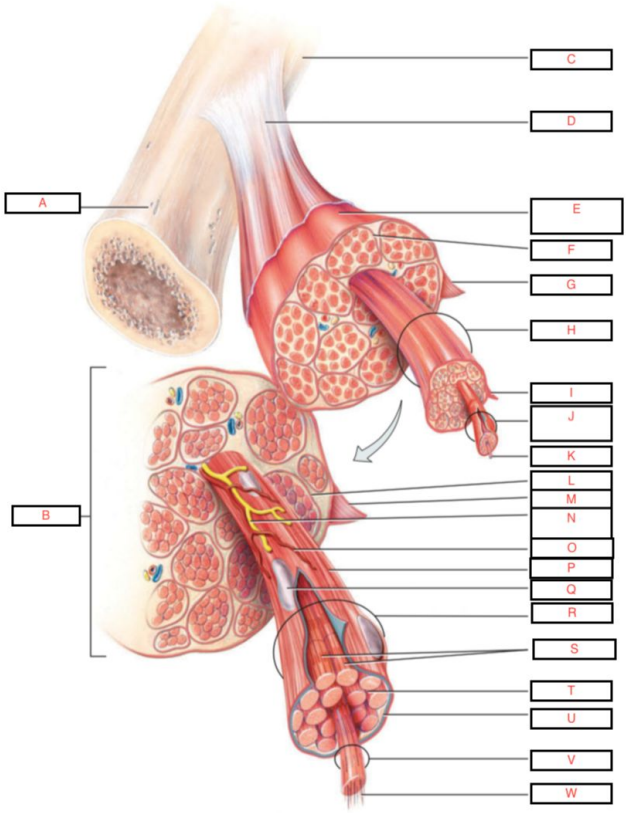
(c)

1. Located in the heart **C**
2. Also called the myocardium **C**
3. Located in the intestines **B**
4. Not under conscious control **B**
5. Connected to bones **A**
6. Contains myofibrils that are not arranged in sarcomeres **B**
7. Divided into slow twitch and fast twitch types **A**
8. Also known as myocytes **B**
9. Has a fusiform shape **B**
10. Connected to each other through intercalated discs **C**

Origin, Insertion, and Function Directions: Complete the table below regarding the origin, insertion and function of the muscles listed. Each letter is worth **two** points. **TB#4 (20)**

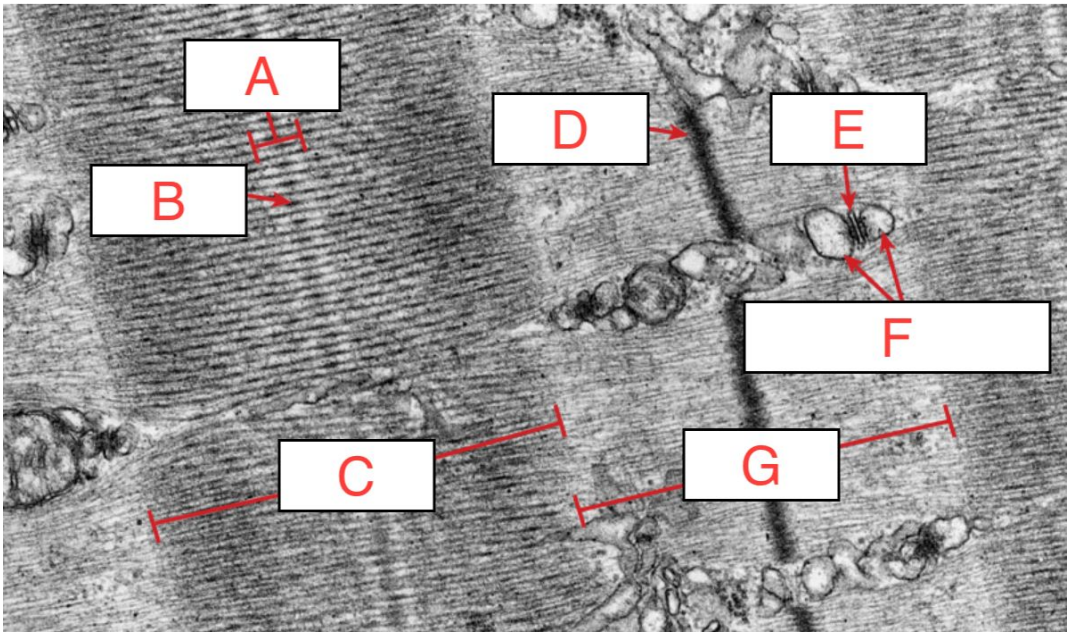
Muscle Name	Origin	Insertion	Function
Deltoid (2)	Acromial extremity of clavicle (anterior fibers), acromion of scapula (lateral fibers), and spine of scapula (posterior fibers)	**Deltoid tuberosity of humerus (2)**	Abduct arm at the shoulder joint, flex and medially rotate the arm at the shoulder joint, extend and laterally rotate arm at shoulder joint
Serratus anterior (2)	**Ribs 1-8 or 1-9 (2)**	Vertebral border and inferior angle of scapula	Abducts scapula and rotates it upward, elevates ribs when scapula is stabilized, punching and pushing (horizontal arm movements)
Brachialis	Distal, anterior surface of the humerus	**Ulnar tuberosity and coronoid process of ulna (2)**	**Flexes the forearm at the elbow joint (2)**
Gluteus medius (2)	Ilium	Tibia by iliotibial tract	**Flexes and abducts thigh at hip joint (2)**
Biceps femoris (2)	Long head arises from the ischial tuberosity; short head arises from the linea aspera of femur	**Head of fibula and lateral condyle of tibia (2)**	Flexes the leg at the knee joint and extends thigh at hip joint

Labeling Directions: Label **Figures 3.2 and 3.3** in the image packet. Be as concise and specific as possible. Each letter is worth **one** point. **(30)**



1. (23)

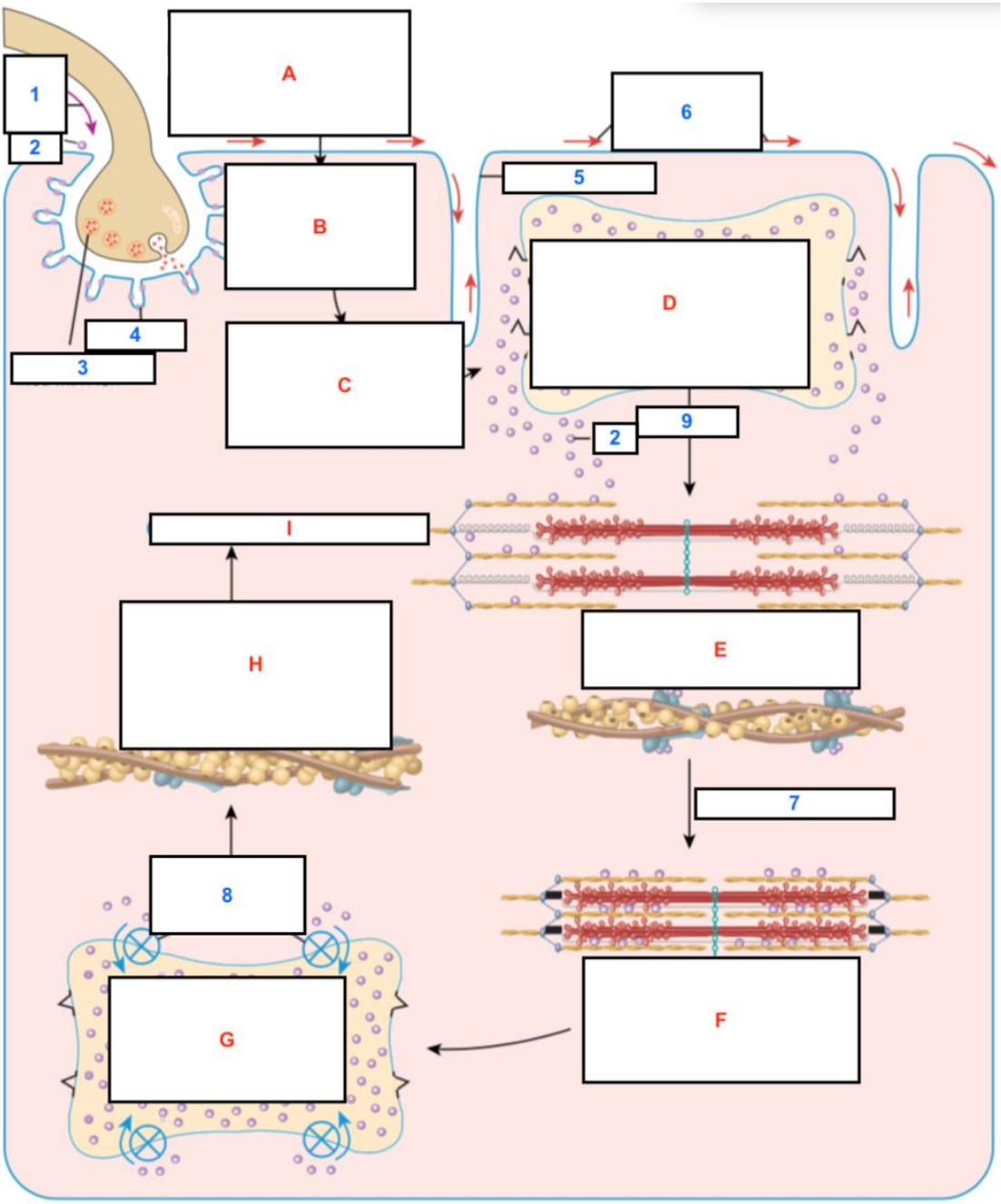
A. Bone (1)
B. Fascicle (1)
C. Periosteum (1)
D. Tendon (1)
E. Belly of skeletal muscle (accept skeletal muscle) (1)
F. Perimysium (1)
G. Epimysium (1)
H. Fascicle (1)
I. Perimysium (1)
J. Muscle fiber (cell) (1)
K. Myofibril (1)
L. Endomysium (1)
M. Perimysium (1)
N. Somatic motor neuron (1)
O. Blood capillary (1)
P. Endomysium (1)
Q. Nucleus (1)
R. Muscle fiber (1)
S. Striations (1)
T. Sarcoplasm (1)
U. Sarcolemma (1)
V. Myofibril (1)
W. Filament (1)

2. 

(7)

A. H-band (1)
B. M-line (1)
C. A-band (1)
D. Z-line (1)
E. T-Tubule (1)
F. Sarcoplasmic reticulum (1)
I-band (1)

Diagram-based Part 2 Questions: For each **LETTER**, write a sentence about what is occurring in **Figure 3.4** in the image packet. For each **NUMBER in Figure 3.4** in the image packet, label the structure denoted. Each **number and each letter** are worth **two** points. Partial credit will be given. **(36)**



Note: If the competitors **did not** include write the bolded words but included other details, give them **one** point instead of two. If the competitors did not include the bolded words and the other details, **DO NOT** give them credit.

A. Nerve impulse arrives at the axon terminal of motor neuron and releases **acetylcholine** (ACh).
B. ACh diffuses and binds to the receptors in the **motor end plate**, and causes a start of an action potential (AP).
C. **Acetylcholinesterase** destroys ACh, so there is no muscle action potential that arises unless there is more ACh released.
D. The muscle action potential leads to Ca^{2+} release channels opening in the **sarcoplasmic reticulum (SR) membrane**, which allows Ca^{2+} to flow into the sarcoplasm.
E. Ca^{2+} binds to **troponin** located on the thin filament, **exposing** the **binding sites** for myosin.
F. Contraction: ATP is used for **power strokes**; **myosin heads bind to actin**, swivel, and release; **thin filaments are pulled toward the center** of the sarcomere.
G. Ca^{2+} release channels in SR close and **Ca^{2+} active transport pumps** use ATP to restore the low Ca^{2+} levels in the sarcoplasm.
H. **Troponin-tropomyosin complex** slides back into position, blocking the myosin-binding sites on actin.
I. Muscle **relaxes.**

1. Nerve impulse
2. Ca^{2+} (calcium ion)
3. Synaptic vesicle filled with ACh
4. ACh receptor
5. Transverse tubule
6. Muscle action potential
7. Elevated (higher levels) of Ca^{2+} / calcium ions
8. Ca^{2+} active transport pumps
9. Sarcoplasmic reticulum/SR

Pathology Directions: Answer the corresponding questions based on **Figures 3.5 and 3.6**. **Figure 3.5** is **TB#5.** Complete sentences are **not** required for this section. Each letter is worth **one** point unless otherwise stated. **(11)**

1. 

TB#5

A. What disease is shown above? **Poliomyelitis or polio**
B. What is an alternative name of this disease? **Poliomyelitis, polio or Heine-Medin disease (grant one point for any of the one listed)**
C. What is the genus of the pathogen that causes this disease? ***Enterovirus***
D. What percent of patients will develop life-altering disability due to this disease? **<1% or about 0.5%**
E. How many types of this disease can occur after infection of the disease-causing pathogen? **2**

2. 

A. What is the disease that causes the symptom shown above? **Myasthenia gravis (MG)**
B. List two symptoms associated with this disease. (2) **Muscle weakness, double vision, drooping eyelids, trouble talking, trouble walking, large thymus, thymoma (give two points for any of the two listed)**
C. How many people are affected by this disease per million people? **50-200**
D. In what percentage of individuals have the symptom shown in the image above? **66.67% (⅔)**
E. True or **False**: The prognosis of this disease is generally bad.