Assignment 4: Muscle Structure and Function
Unit 2: Chapter 5

Part A Multiple Choice Questions

1. Which of the following statements about skeletal muscle is true:
A) Skeletal muscles are usually linked to each other by tendons.
B) Short muscle fibres run at an angle to the longitudinal axis of the muscle.
C) Skeletal muscles are not capable of rapid contraction and relaxation.
D) During muscle contraction, skeletal muscle lengthens.
E) None of the above.

2. Which of the following statements about tendons is false:
A) Tendons are bundles of collagen fibres.
B) One end of the tendon is usually linked to bone and the other to a skeletal muscle.
C) Tendons function to move various parts of the skeleton in response to skeletal muscle contraction.
D) Like muscle, tendons also have the ability to shorten or contract.
E) None of the above.

3. A muscle or group of muscles opposing an action is called the:
A) agonist
B) synergist
C) prime mover
D) antagonist
E) fixator

4. Skeletal muscle is made up of numerous cylinder-shaped cells called:
A) muscle fibres
B) myofilaments
C) myofibrils
D) motor units
E) myosins

5. Which of the following statements about sarcomeres is false:
A) Sarcomeres are organized in series within the muscle fibre.
B) Each sarcomere is made up of two types of protein myofilaments: actin, the thick filament, and myosin, the thin filament.
C) Projecting from each myosin filament are myosin bridges, the tiny contractile elements.
D) Examining the sarcomere longitudinally we see the striations characteristic of skeletal muscle.
E) None of the above.

6. The space between the ends of the two sets of thin filaments in each sarcomere is called the:
A) A band
7. The light region within each sarcomere is known as the:
   A) A band
   B) M line
   C) H zone
   D) Z line
   E) I band

8. The thin filaments contain the contractile protein ________ as well as ________:
   A) myosin; actin
   B) actin; myosin
   C) myosin; troponin and tropomyosin
   D) actin; troponin and tropomyosin
   E) myosin; tropomyosin

9. The ________ heads are responsible for generating cross bridge formations.
   A) troponin
   B) myosin
   C) tropomyosin
   D) actin
   E) myofibril

10. Which of the following statements about the sliding filament theory is false:
    A) The myosin filaments temporarily attach themselves to the actin filaments.
    B) Since the sarcomeres are attached to one another in series, the shortening of each sarcomere is additive.
    C) The I band and the A band shrink but the H zone remains unchanged.
    D) It is the sliding of the thin actin filaments over the thick myosin filaments that causes muscle shortening.
    E) None of the above.

11. Which of the following choices most accurately describes the muscle contraction sequence:
    i. “Rowing” type of movement of myosin cross bridges.
    ii. Movement of filaments shortens the sarcomere.
    iii. Cross bridge formation.
    iv. Motor nerve signal activates the muscle fibre.
    A) iv → iii → ii → i
    B) iii → iv → i → ii
    C) i → iii → iv → ii
    D) iv → i → iii → ii
    E) none of the above
12. Which of the following statements regarding maximal force production is **false**:
A) The distance between sarcomeres depends on the state of muscle stretch.
B) Maximal force is developed when an optimal number of cross bridges is formed.
C) Muscle stretch is a product of the position of the joint.
D) For optimal cross bridge formation, sarcomeres need to be an optimal distance apart.
E) Optimal cross bridge formation occurs when muscle is maximally shortened (i.e., at the smallest joint angle).

13. Muscle fibres can be divided into two main types or categories (i.e., Type I and Type II) based on what distinction:
A) abundance of striation
B) angle of cross bridges
C) time to reach maximum tension
D) thickness of myofilaments
E) none of the above

14. Which muscle fiber type is more aerobic?
A) type I
B) fast twitch
C) type II
D) white
E) type IIb

15. Compared with slow twitch fibres, fast twitch fibres:
A) fatigue faster, have a faster contraction speed, and are red in appearance
B) are smaller, slower contracting, and fatigue resistant
C) are larger, have a slower contraction speed, and are white in appearance
D) are larger, fatigue faster, and are white in appearance
E) fatigue faster, are more aerobic, and have a faster contraction speed

16. Which of the following statements regarding muscle fibre types is **false**:
A) Type IIa fibres show greater resistance to fatigue.
B) FT fibres are ideal for actions requiring quick bursts of power and energy.
C) ST fibres are smaller and slower contracting.
D) Type II fibres are further divided into Type IIa (glycolytic) and Type IIb (oxidative) fibres.
E) None of the above.

17. Which of the following statements regarding muscle biopsy is **false**:
A) It is a simple procedure requiring no anaesthetic.
B) It involves tissue analysis under a microscope.
C) It can determine metabolic characteristics.
D) It can determine muscle fibre type.
E) None of the above.
18. Skeletal muscle activation is initiated through:
A) sensory activation and therefore is under unconscious control
B) neural activation and therefore is under conscious control
C) sensory activation and therefore is under conscious control
D) neural activation and therefore is under subconscious control
E) sensory activation and therefore is under unconscious control

19. Which of the following statements regarding the motor unit is **false**:
A) Each muscle fibre is activated through impulses delivered via the motor end plate.
B) A group of fibres activated via the same nerve is termed a motor unit.
C) A large muscle fibre can have more than one motor end plate.
D) All muscle fibres of one particular motor unit are always of the same fibre type.
E) Muscles that need to perform precise movements generally consist of a large number of motor units.

20. What is the motor end plate?
A) the contractile unit of a skeletal muscle
B) a group of fibres activated via the same nerve
C) the basic functional entity of muscular activity
D) the ending of a motor nerve at a muscle fibre
E) both A and D

21. Sensory neurons transfer messages to the:
A) muscles
B) central nervous system
C) eyes and ears
D) neuromuscular junction
E) motor end plate

22. Which of the following statements regarding activation threshold is **false**:
A) A weak nerve impulse activates only those motor units that have a low threshold of activation, thereby generating a low contractile strength.
B) Every motor unit has the same threshold that must be reached for activation to occur.
C) Every motor unit has a specific threshold that must be reached for activation to occur.
D) A weak nerve impulse activates all motor units to a lesser degree, thereby generating a low contractile strength.
E) Both B and D.

23. Which of the following statements regarding the differences between trained and untrained individuals is **false**:
A) Trained individuals have a larger muscle mass and therefore can produce greater force.
B) Highly trained individuals further develop strength only by improving intramuscle coordination.
C) Trained individuals can activate a larger number of muscle fibres to produce greater force.
D) Trained individuals have a much smaller muscle force deficit.
E) None of the above.
24. Which of the following statements regarding strength training is true:
A) It is not necessary to develop all the relevant muscles in a balanced manner in order to optimize high-level intermuscle coordination.
B) Biological adaptation is a process specific to strength training and skeletal muscle adaptation.
C) Following strength training, muscle mass increases before enzymatic adaptation.
D) In strength training, the adaptation process proceeds at the same rates for different functional systems and physiological processes.
E) None of the above.

25. The performance capacity of muscle is determined by which of the following non-trainable factors:
A) fibre diameter
B) nerve impulse frequency
C) number of fibres
D) capillary density of muscle
E) both C and D

Part B Fill in the Blank Questions

Word Bank
Answer: tendons Answer: sarcomeres Answer: muscle force deficit Answer: motor unit
Answer: threshold Answer: intramuscle coordination Answer: number of fibres; fibre structure
Answer: fixators Answer: fatigue Answer: structure Answer: sarcolemma Answer: myofibrils
Answer: slow; fast Answer: Z Answer: striated Answer: troponin; tropomyosin Answer: actin or thin; myosin or thick Answer: prime mover Answer: actin or thin; myosin or thick Answer: cross bridge Answer: force; length Answer: Type IIa; Type IIb; Type IIa Answer: biopsy
Answer: intermuscle coordination

1. The _________ of muscle tissue determines its specific function.

2. Skeletal muscle is usually linked to bone by bundles of collagen fibres, known as ________.

3. Intensive activity causes muscles to show early signs of ________.

4. The agonist is also known as the ________.

5. Muscle groups called ________ steady joints closer to the body axis so that the desired action can occur.

6. A connective tissue sheath called the ________ surrounds each muscle fibre.

7. A large number of individual fibres known as ________ run lengthwise and parallel to one another within a muscle fibre.

8. The contractile units within muscle fibres are called ________.

9. The I band is bisected by the ________ line.
10. Skeletal muscle is considered ________ because of the alternating light and dark bands that appear when viewed under a light microscope.

11. The actin filaments contain the contractile protein actin as well as two other proteins, ________ and ________.

12. Sliding of the ________ filaments over the ________ filaments causes shortening of the muscle to create movement.

13. For optimal ________ formation, the sarcomeres should be an optimal distance apart.

14. Maximal muscle ________ occurs at optimal muscle ________.

15. Muscle fibres are divided into ________ twitch (Type I) and ________ twitch (Type II) muscle fibres.

16. Type II muscle fibres are further divided into ________ and _________. ________ have greater capacity for aerobic metabolism and produce greater force during contraction.

17. A muscle ________ is needed to determine muscle fibre type.

18. The ________ nervous system is composed of the brain and spinal cord, and the ________ nervous system is made up of nerves of various sizes. **Answer: central; peripheral**

19. The nervous system can be divided in terms of function. The ________ section collects information and transmits it to the brain. The ________ section conducts the signals from the CNS to activate the muscle contraction. **Answer: sensory; motor**

20. A group of fibres activated via the same nerve is termed a ________.

21. A specific activation ________ must be reached for muscle activation to occur.

22. The capacity to activate muscle fibres simultaneously is known as ________.

23. The difference between assisted and voluntarily generated maximal force is regarded as the ________ of the muscle contraction.

24. The capacity to contract different muscles or muscle groups simultaneously in order to produce a given movement is called ________.

25. The non-trainable factors of performance capacity are ________ and ________.
Part C Other Types of Questions

1. How are shorter muscle fibres oriented in relation to bone? Using a rope as an example, explain how this configuration works.

2. Match the following terms with their corresponding function or characteristic. Terms can be matched with more than one answer.

<table>
<thead>
<tr>
<th>Name</th>
<th>Answer</th>
<th>Function/Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agonist/prime mover</td>
<td>A) A muscle or group of muscles opposing a desired action</td>
<td></td>
</tr>
<tr>
<td>Antagonist</td>
<td>B) Muscle that acts as an antagonist during bending of the elbow (i.e., flexion)</td>
<td></td>
</tr>
<tr>
<td>Biceps</td>
<td>C) The muscles surrounding the joint being moved and supporting it in the action</td>
<td></td>
</tr>
<tr>
<td>Triceps</td>
<td>D) Muscle that acts as an agonist during bending of the elbow (i.e., flexion)</td>
<td></td>
</tr>
<tr>
<td>Synergists</td>
<td>E) Muscle groups that steady joints closer to the body axis</td>
<td></td>
</tr>
<tr>
<td>Fixators</td>
<td>F) A muscle or group of muscles producing a desired action/movement</td>
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</tr>
<tr>
<td></td>
<td>G) The muscles holding your shoulder girdle to your rib cage during hand-over-hand rope climbing</td>
<td></td>
</tr>
</tbody>
</table>

3. Label the following diagram.

Word Bank: Sarcomeres, sarcolemma, muscle fiber, myofibril, muscle belly, muscle fire bundle, tendon
4. Match the following parts of the sarcomere with their corresponding definitions.

<table>
<thead>
<tr>
<th>Term</th>
<th>Answer</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A band</td>
<td>A)</td>
<td>Links the central region of the thick filaments</td>
</tr>
<tr>
<td>I band</td>
<td>B)</td>
<td>Anchors the thin filaments</td>
</tr>
<tr>
<td>H zone</td>
<td>C)</td>
<td>The dark area made up of myosin filaments</td>
</tr>
<tr>
<td>M line</td>
<td>D)</td>
<td>The light area made up of actin filaments</td>
</tr>
<tr>
<td>Z line</td>
<td>E)</td>
<td>The space between the ends of the two sets of thin filaments</td>
</tr>
</tbody>
</table>

5. Now label these structures on the following diagram using the terms above.

![Diagram of sarcomere]

6. Explain how the muscle force changes throughout the full range of motion of elbow flexion according to the joint angle (identify specific joint angles in your answer).

7. Fill out the characteristics corresponding to each muscle fibre type in the following table.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Type I</th>
<th>Type II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contraction speed</td>
<td></td>
<td></td>
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<tr>
<td>Microscopic appearance</td>
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<td></td>
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<tr>
<td>(colour)</td>
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<td></td>
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<tr>
<td>Capacity for aerobic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>energy supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter</td>
<td></td>
<td></td>
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<tr>
<td>Number of surrounding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>capillaries</td>
<td></td>
<td></td>
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<tr>
<td>Fatigue resistance</td>
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</tr>
</tbody>
</table>
8. Identify whether the following sports/events use predominantly slow twitch (ST) or fast twitch (FT) muscle fibres.

**Answer**

<table>
<thead>
<tr>
<th>Sports/Events</th>
<th>ST</th>
<th>FT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shot put</td>
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<tr>
<td>100-m sprint</td>
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<tr>
<td>Half marathon</td>
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<tr>
<td>Weightlifting</td>
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<tr>
<td>Triathlon</td>
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<tr>
<td>High jump</td>
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<tr>
<td>Endurance swim</td>
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<tr>
<td>Basketball</td>
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<tr>
<td>Boxing</td>
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<td></td>
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<tr>
<td>Gymnastics</td>
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</tbody>
</table>

9. Describe the basic organization of the nervous system.

10. Identify whether the following factors that determine a muscle’s performance capacity are trainable (T) or non-trainable (NT).

**Answer**

<table>
<thead>
<tr>
<th>Factors</th>
<th>T</th>
<th>NT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy stores of muscle and liver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibre diameter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of fibres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intermuscle coordination</td>
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<td></td>
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<tr>
<td>Capillary density of muscle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nerve impulse frequency</td>
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<td></td>
</tr>
<tr>
<td>Fibre structure (ST or FT fibres)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intramuscle coordination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticity of muscle and its tendons</td>
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</tr>
</tbody>
</table>