Name: _____

# Physiology: Skeletal Muscle Worksheet

**Directions: Write in and circle best answer on this sheet.**

**1.** Define the following terms as they apply to **skeletal muscle.**

Sarcolemma -

Sarcoplasm -

Myofibril -

Sarcoplasmic reticulum -

Transverse tubules -

**2.** Describe a **myofibril**, then describe the structures of ***myosin*** and ***actin*** in a myofibril.

Myofibril:

Myosin:

Actin:

**3.** What is a sarcomere? Show the relationship between actin and myosin in a myofibril by **drawing a diagrammatic sarcomere**. Include and label all important structures as shown in class.

**4.** Explain what creates the following structures of a sarcomere. How many of each is in one sarcomere?

A band -

I band -

H band -

M line -

Z disks -

**5. Describe the roles of Contraction Regulation by Troponin and Tropomyosin**

Troponin

Tropomyosin

**6. Acetylcholine from Somatic Motor Neurons Initiates Excitation-Contraction Coupling**

To initiate contraction, (nicotinic/muscarinic?) (adrenergic/cholinergic?) receptors on the motor end plate combine with (norepinephrine/ACh?) and open ($Na^+/K^+$/ or $Ca^{2+}$?) channels. Net ($Na^+$ entry/$Na^+$ efflux/$K^+$ entry/$K^+$ efflux?) depolarizes the cell, creating an end-plate potential (EPP). The EPP the same as a/an (graded potential/action potential?) that spreads across the (cytoplasm/sarcolemma?). The electrical signal then spreads into the _____, where voltage sensitive _____ receptors open ($Na^+/K^+/Ca^{2+}$?) channels on the _____ inside the cell.

**7.** Briefly compare the ATP yield for **aerobic** and **anaerobic** metabolism of one glucose molecule.

**8.** What is muscle fatigue? List 4 factors that are believed to contribute to muscle fatigue.

**9.** Why do $H^+$ and inorganic phosphate ($P_i$) accumulate during exercise? [Hint: Catabolism of ATP]

**10.** What is **atrophy** of a skeletal muscle?

**11.** What is **Hypertrophy** of a skeletal muscle?

**12.** What is the role of **creatine phosphate** (phosphocreatine) in muscle?

**13.** What is the role of **myoglobin** in skeletal muscle? Which fiber type has the most myoglobin? Why?

**14.** Fill in **Table 1** below for the properties of slow (red) and fast (white) twitch skeletal muscle fibers. *These details can be found in the OER text online, Ch 13, page 381.*

| Properties | Slow (Red) | Fast (White) |
|---|---|---|
| Contraction time (onset) | | |
| Fatigue | | |
| Muscle fiber diameter | | |
| Mitochondrial content | | |
| Myoglobin content | | |
| Blood supply | | |
| Color of muscle tissue | | |
| Glycogen storage | | |
| $1^o$ ATP source (Metabolism) | | |
| Contraction duration | | |
| Functional use | | |

**15.** For a single muscle fiber, explain why long and short sarcomeres develop ***less*** tension than sarcomeres at optimal length. See OER Ch 13, p368 of graph showing the relationship between sarcomere *length* and *tension*.

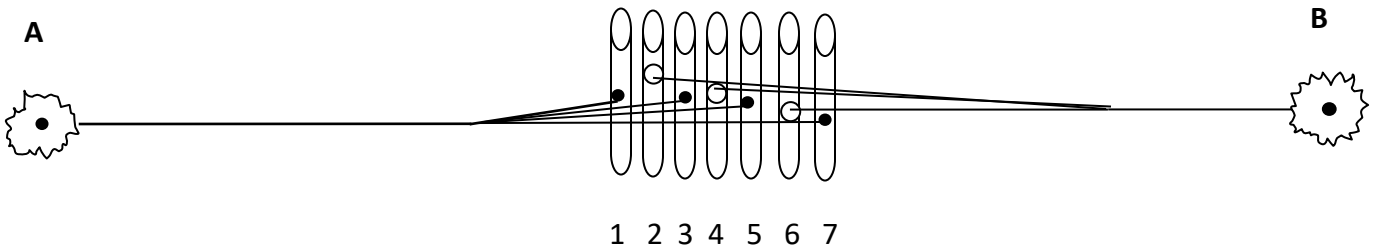
**16.** Briefly explain the process of temporal summation in a skeletal muscle fiber.

**17.** Sketch a graph showing the differences between a skeletal muscle *twitch*, *unfused tetanus* and *fused tetanus*. Describe the phases of a twitch and difference between unfused and fused (complete) tetanus.

**18.** What is a motor unit? What is motor unit recruitment and why is it used?

**19.** What type of summation is motor unit recruitment? _____.

**20.** Muscles responsible for fine movements will have (more/fewer?) muscle fibers in its motor units.




**21.** In the above illustration, 1-7 are individual muscle fibers. Which motor unit is smaller, A or B? _____.

**22.** Are the types of muscle fibers in a single motor unit the (same/different) fiber type? _____.

**23.** If muscle fiber #4 were slow twitch, what would muscle fiber # 2 be? _____.

**24. <u>Fill-in the following</u>:** *These details can be found in the OER text Ch 13, page 368 on the website.*
Laryngeal muscle: about _____ muscle fibers per motor neuron.
Rectus muscle (eye): about _____ muscle fibers per motor neuron.
Tensor tympani (ear): about _____muscle fibers per motor neuron.
Gastrocnemius: about _____ muscle fibers per motor neuron.
Quadriceps (thigh) muscle: about _____ muscle fibers per motor neuron.

**25.** The area of the sarcomere that creates the H band consists of
**a)** all of the actin **b)** actin only **c)** the z disks **d)** myosin only **e)** all of the myosin

**26.** The membrane of the T-tubules contains receptors that are sensitive to _____.
**a)** mechanical distention **b)** voltage **c)** the release of $Ca^{2+}$ **d)** influx of $Na^{+}$ **e)** dihydropyridine

**27.** Put these events in the correct order of occurrence:
**1.** ACh binds to nicotinic receptors and opens $Na^{+}/K^{+}$ channels, initiating an action potential
**2.** $Ca^{2+}$ is released from the sarcoplasmic reticulum
**3.** binding sites on actin exposed, allowing myosin and actin crossbridge formation
**4.** T-tubules spread the action potential to the lateral sacs of the SR
**5.** $Ca^{2+}$ binds to troponin, moving tropomyosin
**6.** ACh is released from synaptic end bulbs of a somatic motor neuron

**a)** 6, 4, 3, 2, 1, 5 **b)** 6, 1, 3, 4, 2, 5 **c)** 1, 6, 5, 3, 2, 4 **d)** 6, 1, 4, 2, 5, 3 **e)** 3, 4, 5, 6, 1, 2

**28.** Muscle fatigue may be associated with _____
**a)** increases in glycogen **b)** accumulation of $H^{+}$ **c)** increased levels of creatine phosphate
**d)** b and c **e)** all of these are true

**29.** When $Ca^{2+}$ is released from the SR, what is its role in muscle contraction?
**a)** it diffuses into T-tubules **b)** it detaches the actin from myosin
**c)** it binds to tropomyosin **d)** it is re-sequestered into the sarcoplasmic reticulum
**e)** it removes the inhibition for the reaction (bond) between actin and myosin

**30. A)** Draw a neuromuscular junction for skeletal muscle and describe how muscle contraction functions.

**30. B)** Now, apply how the following would affect the neuromuscular junction for skeletal muscle.
**a)** Botulism toxin -
**b)** Curare -
**c)** Organophosphates -