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*.

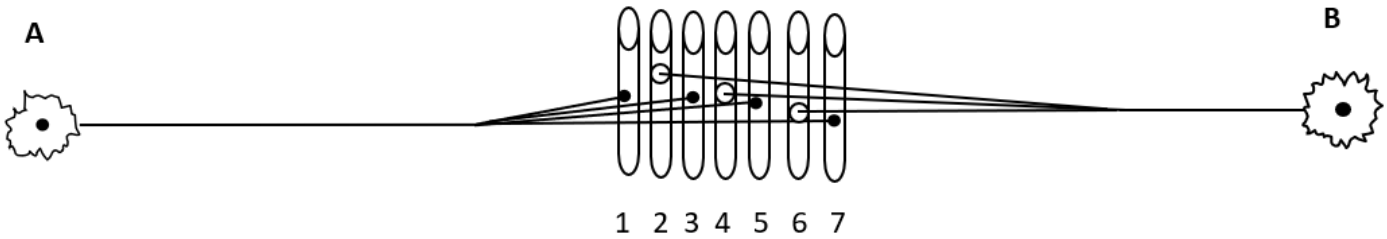
16. Briefly explain the process of temporal summation in a skeletal muscle fiber.

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. Sketch a neuromuscular junction for skeletal muscle and describe how muscle contraction functions.

31. Now, state how the following substances would affect the neuromuscular junction for skeletal muscle.
a) Botulism toxin -
b) Curare -
c) Organophosphates -