# Homework Assignment - Module 3

1. [20 points] Choose the statement about the mammalian skeletal muscle neuromuscular junction that is the most correct **AND** briefly explain why the remaining choices are not correct.
   A. Binding of acetylcholine (ACh) to receptors on the muscle cell membrane causes a decrease in membrane sodium conductance ($g_{Na}$).
   B. When an action potential reaches the motor nerve terminal bouton (swelling; this is the end of the motor nerve axon branch) the change in nerve membrane potential allows the entry of chloride ion ($Cl^-$) into the terminal bouton, which in turn allows the release of acetylcholine (ACh) from the nerve terminal bouton.
   C. A drug that binds to acetylcholine (ACh) receptors on the muscle membrane but whose binding does not affect muscle membrane ion permeability can uncouple excitation-contraction coupling.
   D. Increased entry of $Ca^{2+}$ into the muscle cell following binding of acetylcholine (ACh) to ACh receptors on the muscle membrane initiates a muscle membrane action potential.

2. [20 points] Choose the statement about mammalian skeletal muscle that is the most correct **AND** briefly explain why the remaining choices are not correct.
   A. Binding of $Ca^{2+}$ to tropomyosin allows the S-1 heads of crossbridges to attach to their binding sites on the actin thin filament.
   B. In response to an action potential in the T-tubular system $Ca^{2+}$ is actively pumped out of the lateral cisternae (sacs) of the sarcoplasmic reticulum into the myofilament space.
   C. The action potential in the T-tubular system is coupled to the membrane of the sarcoplasmic reticulum by gap junctions between the two membrane systems.
   D. Relaxation requires that $Ca^{2+}$ be removed from the myofilament space by an active, ATP-powered pump in the membrane of the sarcoplasmic reticulum.

3. [20 points] Assume the existence of a drug whose only effect is to prolong the time course of the binding of $Ca^{2+}$ to troponin-C (TnC) in skeletal muscle by a factor of about 3. In comparison to an untreated muscle, a muscle treated with this drug will … (chose the most correct response) **AND** briefly explain why the remaining choices are not correct.
   A. Have an increased rate of rise of force in an isometric twitch.
   B. Require a lower stimulus repetition rate to achieve a fused tetanus.
   C. Have a larger velocity of unloaded shortening ($V_o$).
   D. Relax more quickly.

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4. [20 points] With reference to mammalian skeletal muscle, choose the equation that best describes the detachment of the "used" crossbridge from the thin filament following the power stroke **AND** briefly explain/describe the steps in the crossbridge cycle represented by the remaining choices.
   A. $A + M{\bullet}ATP \rightarrow A + M^{*}{\bullet}ADP{\bullet}P_i$
   B. $A + M^{*}{\bullet}ADP{\bullet}P_i \rightarrow A{\bullet}M^{*}{\bullet}ADP{\bullet}P_i$
   C. $A{\bullet}M^{*}{\bullet}ADP{\bullet}P_i \rightarrow A{\bullet}M + ADP + P_i$
   D. $A{\bullet}M + ATP \rightarrow A + M{\bullet}ATP$

5. [20 points] Choose the statement which best describes a role of ATP in skeletal muscle *relaxation* **AND** briefly explain why the remaining choices are not correct.
   A. ATP binds to myosin S-2, which allows bound crossbridges to release from the thin filament.
   B. Chemical energy from the hydrolysis of ATP is transformed into mechanical energy when bound crossbridges rotate from the 90° to the 45° configuration.
   C. Chemical energy from the hydrolysis of ATP is needed to power the pumps in the SR that take up $Ca^{2+}$.
   D. ATP binds to TnI, allowing tropomyosin to rotate into the groove of the actin helix, thus blocking attachment of crossbridges to the thin filament.

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