**\*\* ONLY TEXT AND IMAGES APPEARING INSIDE THE RED BOXES WILL BE GRADED\*\***

1. Draw the net reaction for the hydrolysis of ATP to ADP. Indicate the chemical structures and correct protonation states of all reactants and products at pH 7.0.

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1. What is the standard (biochemical) free energy change of this reaction (Δ*G*’°)?

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| Δ*G*’° = \_\_\_\_\_\_\_\_\_\_\_kJ/mol |

1. Name the major protein components of the thick filament and thin filament in muscle cells?

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1. Briefly describe/sketch the four steps in the molecular mechanism of muscle contraction. Begin with the myosin head group bound tightly to one actin monomer. Include the phrase ‘power stroke’ in your answer (i.e., the power stroke is associated with release of what molecule)?

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1. Proteins, including troponin and tropomyosin participate in allosteric regulation of muscle contraction by binding to the thin filament and blocking myosin binding (when muscle is relaxed). Release of which ion from the sarcoplasmic reticulum induces an allosteric effect that exposes the actin monomer to myosin, stimulating muscle contraction?

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1. Mysosins traverse the thin filament but kinesins and dyneins traverse\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

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1. The Ron Vale dynein video on the course website discusses the stepping behavior of kinesin and dynein. Briefly, how do they compare in step size, type, and direction?

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1. Motor proteins, including myosin, kinesin, and dynein, convert chemical energy stored in \_\_\_\_\_\_\_\_ to mechanical work.

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1. What enzyme uses the energy from ATP hydrolysis to pump H+ , against a pH gradient, across a membrane?. What enzyme captures the energy of spontaneous H+ transport across a membrane to synthesize ATP?

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| Enzyme that pumps H+ across a gradient:  Enzyme that captures H+ energy of spontaneous H+ transport: |

1. Sketch the blobology diagram of an F-type ATP synthase embedded in the inner mitochondrial membrane. Label the i) F1 domain, ii) F0 domain, iii) inner mitochondrial membrane, iv) mitochondrial matrix, v) central stalk, vi) beta subunits. Show the movement of H+. Show the reaction catalyzed. Label the mitochondrial matrix and the intermembrane mitochondrial space with physiologically realistic pH (use google for this). Use ATP Synthase Video 1 and Video 2 on the course website to inform this sketch. Take a picture of your sketch and paste it here.

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