

Cardiac and Smooth Muscle Practice Problems:

1. You are trying to design a drug that will cause relaxation in smooth muscle. Which of the following options would prevent contraction in smooth muscle?

- i. A drug that would prevent the inactivation of myosin light chain kinase
- ii. A drug that would inhibit the binding of calmodulin- Ca^{2+} to caldesmon
- iii. A drug that increased the affinity of calmodulin for Ca^{2+}

Clearly explain why you have chosen this option, and why you did **not** choose each of the other two options. (7 marks)

2. Compare and contrast action potentials in neurons, skeletal muscle, and cardiac muscle (contractile cardiomyocytes). (5 marks)

3. Vitamin D deficiency can lead to hypocalcemia – abnormally low levels of calcium in the blood and extracellular fluid.

- a. One symptom of hypocalcemia is irregular heart beat, and, in extreme cases, heart failure. Explain why extreme hypocalcemia could cause heart failure. (4 marks)
- b. Could hypocalcemia affect contraction of skeletal muscle? Clearly explain why or why not. (4 marks)

4. After a heart transplant, there is no direct connection between the nervous system and the heart. However, the cardiac output of patients with heart transplants can vary in response to changes in metabolic demand (for example, cardiac output will increase during exercise).

- a. How could this be possible? Explain. (4 marks)
- b. Would you expect this regulation of cardiac output to be as efficient as in an individual who has not had a heart transplant (someone who still has a direct connection between the nervous system and the heart)? Explain why or why not. (2 marks)

5. The drug propofol acts as a skeletal muscle relaxant. This drug blocks all monovalent cation channels in skeletal muscle (monovalent cations are positively charged ions with a valence of one). Propofol is specific to skeletal muscle monovalent ion channels, meaning that it will not block any other types of ion channels.

- a. Explain why treating a skeletal muscle with propofol will cause relaxation in this muscle. (4 marks)
- b. Would propofol have a similar effect on a contractile cardiomyocyte? Explain why or why not. (2 marks)
- c. Would propofol have any effect on cardiac pacemaker cells? Explain why or why not. (5 marks)

(Note that part c is quite challenging, and is more difficult than what I would put on the final exam. The reason I include it here is that it is good practice to think about how a pacemaker cell works. Don't worry about exactly what the overall effect might be, but just consider what aspects of the pacemaker potential and action potential would or would not be affected by propofol.)

6. Atropine is a drug that inhibits parasympathetic activity. How would treatment with atropine affect the heart? Explain why. No need to explain signal transduction pathways for this question. (3 marks)