

Exam Copy 189

NROSCI/BIOSC 1070 and MSNBIO 2070

Exam # 1

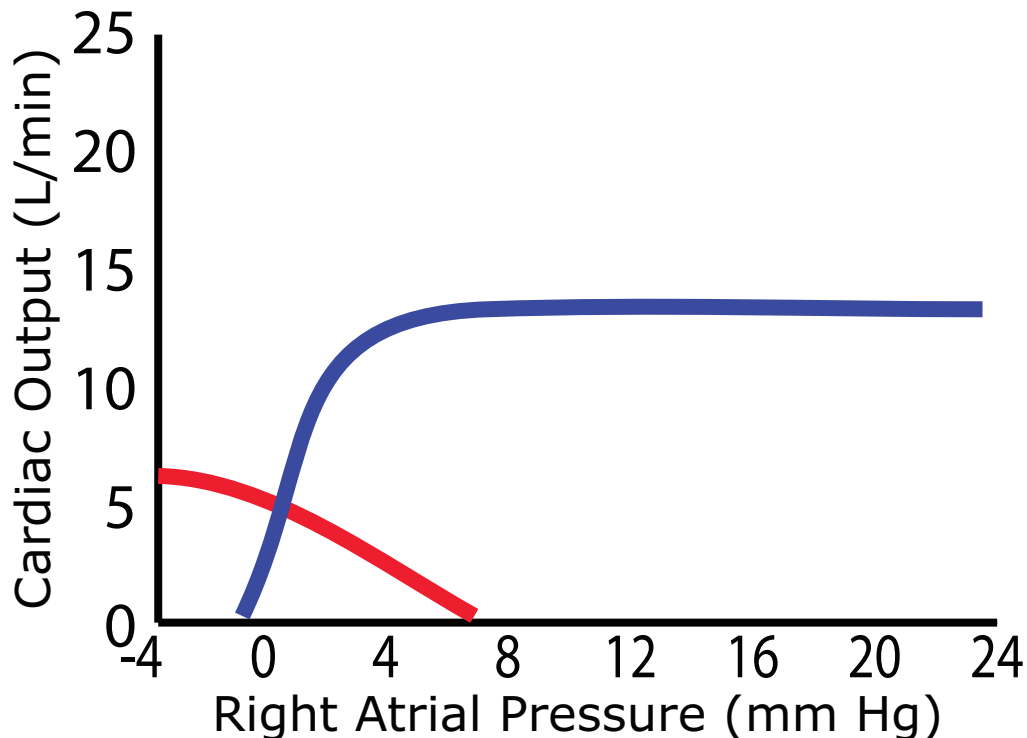
October 2, 2015

Total POINTS: 100 20% of grade in class

1. A normal vascular function curve and cardiac function curve are plotted below. Indicate how these curves change during:

- a) Maximal sympathetic nervous system activation (*dashed lines*)
- b) Maximal exercise (*solid lines*)

In drawing the curves, you should be more concerned with the relative changes between conditions than absolute values of the changes. **(8 points)**.



- c) What are the main factors responsible for differences in the vascular function curve during maximal sympathetic nerve stimulation and exercise? **(4 points)**.

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2. a) What is the difference between stressed and unstressed vascular volumes? **(4 points)**.

b) In an individual with normal vascular volumes, what fraction constitutes the stressed volume? **(2 points)**.

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3. Men who take anabolic steroids are often sterile. Discuss the physiological mechanism responsible for sterility in individuals who take anabolic steroids. **(7 points)**.

4. When heart rate increases to 120 beats/min in a normal individual, stroke volume does not decrease despite a reduced ventricular filling time. Indicate 3 reasons why ventricular filling is not compromised during modest increases in heart rate under sympathetic stimulation. **(6 points)**.

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5. A patient comes to the hospital for an exercise stress test. The baseline hemodynamic profile shows the following data:

| | |
|------------------------------|------------|
| Systemic systolic pressure | 135 mmHg |
| Systemic diastolic pressure | 75 mmHg |
| Pulmonary systolic pressure | 30 mmHg |
| Pulmonary diastolic pressure | 10 mmHg |
| Left atrial pressure | 10 mmHg |
| Right atrial pressure | 5 mmHg |
| Cardiac output | 5 L/min |
| Coronary blood flow | 250 ml/min |

During exercise, the following hemodynamic data are obtained:

| | |
|-----------------------------|----------|
| Systemic systolic pressure | 180 mmHg |
| Systemic diastolic pressure | 75 mmHg |
| Cardiac output | 15 L/min |
| Coronary blood flow | 1 L/min |

- a) What is systemic vascular resistance at rest, and what percentage change in systemic peripheral resistance occurs in the individual during exercise? Indicate whether systemic vascular resistance increases or decreases during exercise (**5 points**).
- b) What is coronary vascular resistance at rest, and what percentage change in coronary vascular resistance occurs in the individual during exercise? Indicate whether coronary vascular resistance increases or decreases during exercise (**5 points**).

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6. In the space below, draw a cardiac and skeletal muscle action potential, and indicate the approximate time scale for both action potentials. For each phase of the action potentials, indicate the ions that are entering or leaving the muscle cells, and whether the ion is moving into or out of the cells. **(9 points)**.

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7. a) Selective β_1 -receptor antagonists such as metoprolol are prescribed much more often than α -receptor antagonists in treating hypertension, as patients taking α -receptor antagonists often experience orthostatic hypotension. Describe why orthostatic hypotension is such a common side effect in patients taking α -receptor antagonists. **(5 points)**.
- b) α -receptor antagonists are only prescribed to hypertensive patients with another particular medical problem that can be treated with the same drug. What medical problem combined with hypertension makes a patient a good candidate for α -receptor antagonists? **(4 points)**.

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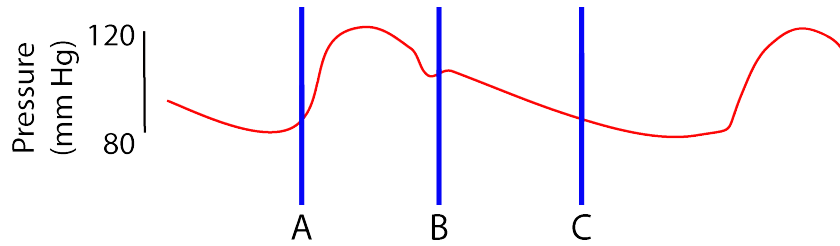
8. Dopamine receptor agonists such as Parlodel are used to treat Parkinson's disease, as well as a medical problem linked to dysfunction in the anterior pituitary (over-secretion of a particular hormone). Identify the anterior pituitary hormone whose secretion is diminished by Parlodel, and briefly describe why the drug lowers secretion of the hormone. **(4 points)**.
9. Dantrium is a drug used to alleviate severe muscle spasms. Dantrium is lipophilic, and can cross muscle cell membranes, where it inhibits the Ryanodine receptor in skeletal muscle. Briefly describe how a Ryanodine receptor inhibitor can alleviate muscle spasms. **(4 points)**.

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10. Both sympathetic and parasympathetic innervation of the heart is absent in a patient with a heart transplant.
- a) How does resting heart rate differ in a patient with a heart transplant from a normal individual? Provide a brief justification for your answer. **(4 points)**.
- b) During exercise, how do changes in cardiac output differ between a patient with a heart transplant and a normal individual? Provide a brief explanation for your answer. **(4 points)**.

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11. A standard pressure wave recorded from the aorta during the cardiac cycle is plotted below.



- a) Which component of the ECG (P, QRS, T waves) occurs closest in time to the points labeled A, B, and C in the diagram? **(6 points)**.

| Point | ECG Component Occurring Closest in Time |
|-------|---|
| A | |
| B | |
| C | |

- b) At each time indicated, are the mitral and aortic valves open or shut? **(6 points)**.

| Point | Mitral Valve (open or shut) | Aortic Valve (open or shut) |
|-------|-----------------------------|-----------------------------|
| A | | |
| B | | |
| C | | |

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12. In utero, a fetus has a low blood pressure, but blood pressure increases precipitously at birth. Briefly describe the physiological mechanism responsible for the large increase in blood pressure at birth. **(4 points)**.

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13. The dynamic properties of blood flow through the aorta are quite different from blood flow through the arterioles. The questions below compare blood flow through the aorta and arterioles. Briefly indicate how the properties of blood flow differ in arterioles and the aorta.
- a) Is surface tension higher in the aorta or arterioles? What is the main reason? **(3 points)**.
- b) Is blood flow more pulsatile in the aorta or arterioles? What is the main reason? **(3 points)**.
- c) Is the velocity of blood flow higher in the aorta or arterioles? What is the main reason? **(3 points)**.

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