

NROSCI/BIOSC 1070 and MSNBIO 2070

Exam # 2

October 23, 2015

Total POINTS: 100 20% of grade in class

- 1) Arterial and venous blood samples are taken, and other physiological measures are obtained, from a normal individual at rest and while exercising maximally **on a stationary bicycle**. In the table below, indicate whether each value is higher, lower, or relatively the same during exercise compared to the resting state. **(5 points)**.

Parameter	Value During Exercise (relative to resting)		
Arterial O ₂ Content	Higher	Same	Lower
Venous O ₂ Content (in leg vein)	Higher	Same	Lower
Arterial pCO ₂	Higher	Same	Lower
Venous pCO ₂ (in leg vein)	Higher	Same	Lower
Blood Flow to Arm Muscles	Higher	Same	Lower

- 2) During exercise, oxygen delivery to working muscle increases. List 4 distinct physiological mechanisms that operate in tandem to increase oxygen delivery to exercising muscle. **(16 points)**.

- 3) A patient with serious coronary artery disease also suffers from high blood pressure. A physician prescribes an alpha-receptor antagonist to lower the patient's afterload. However, the patient complains that taking the alpha-receptor antagonist results in chest pain. Briefly describe the physiological mechanism that explains the patient's chest pain after taking an alpha-receptor antagonist. **(6 points)**.
- 4) Investigators often use animal models to find cures for human diseases. A commonly-used animal model of hypertension is the "one-clip" hypertension model, which is produced by placing a clip on one renal artery, thereby decreasing blood flow to one kidney (called the "Goldblatt hypertension model," after the scientist who first described the method). Shortly after placing the renal artery clamp, blood pressure increases significantly. Discuss the major physiological mechanism responsible for the short-term blood pressure elevation in the Goldblatt hypertension model. **(6 points)**.

- 5) L-NAME is an inhibitor of the enzyme nitric oxide synthase.
- a) Would providing L-NAME to a patient cause their mean blood pressure to change? Briefly discuss the rationale for your response. **(5 points)**.
- b) Would providing L-NAME to a patient cause their pulse pressure to change? Briefly discuss the rationale for your response. **(5 points)**.

- 6) Alirocumab (trade name Praluent) is a biopharmaceutical drug approved by the FDA on July 24, 2015 as a treatment for high cholesterol in adults whose cholesterol is not controlled by diet and statin treatment. Briefly describe the mechanism through which Alirocumab acts to radically lower blood cholesterol levels. **(7 points)**.

- 7) Pregnant women are advised to avoid taking common pain relievers such as aspirin; such drugs act by inhibiting the synthesis of prostaglandins. Continuing use of aspirin during the third trimester can cause pulmonary hypertension in the fetus, resulting in serious medical problems. Briefly describe why taking aspirin can result in fetal pulmonary hypertension. **(6 points)**.

8) Buminate is a preparation of albumin that can be injected intravenously. What effect, if any, would intravenous Buminate administration have on lymph fluid flow? Provide a brief explanation for your answer. **(5 points)**.

9) Hemophiliacs have malformed clotting Factor VIII. Does a lack of functional Factor VIII pose a more or less serious medical problem than a lack of functional Prothrombin? Provide a brief explanation for your answer. **(6 points)**.

- 10) The chart below shows pH, pCO₂ and HCO₃⁻ levels measured from an arterial blood sample. For each example, indicate whether 1) acidosis or alkalosis is present, 2) whether the cause is metabolic or respiratory and 3) whether the condition is compensated or uncompensated. Circle the correct choices. (9 points).

pH: 7.43	pCO ₂ : 55 mmHg	HCO ₃ ⁻ : 35 mEq/L
Acidosis Alkalosis	Respiratory Metabolic	Compensated Uncompensated

pH: 7.25	pCO ₂ : 45 mmHg	HCO ₃ ⁻ : 19 mEq/L
Acidosis Alkalosis	Respiratory Metabolic	Compensated Uncompensated

pH: 7.64	pCO ₂ : 25 mmHg	HCO ₃ ⁻ : 24 mEq/L
Acidosis Alkalosis	Respiratory Metabolic	Compensated Uncompensated

- 11) The following physiological parameters are determined for a patient:
 Oxygen consumption: 250 ml O₂/min
 Arterial oxygen content (CaO₂): 0.2 ml O₂/ml blood
 Venous oxygen content (CvO₂): 0.15 ml O₂/ml blood

Based on these parameters, calculate the patient's cardiac output. You must show your calculation. (6 points).

- 12) Which of the major respiratory “pump” muscles (diaphragm, intercostals, abdominals) would be paralyzed following a T2 spinal transection, and which would not be? Circle the correct answers. **(6 points)**.

Diaphragm: Paralyzed Unparalyzed

Intercostals: Paralyzed Unparalyzed

Abdominals: Paralyzed Unparalyzed

- 13) During surgery to remove a tumor from the throat, an unfortunate patient’s larynx is denervated (the nerves to the larynx are cut). Which lung volume would be most profoundly altered following the laryngeal denervation? Provide a brief explanation. **(6 points)**.

- 14) An arterial blood sample for a patient at sea level is obtained, and the following physiological values are measured:

$p\text{CO}_2$: 55 mmHg

HCO_3^- : 33 mEq/L

What is the patient's arterial pH? You must show your calculations. **(6 points)**.