NROSCI/BIOSC 1070 and MSNBIO 2070
Exam # 3
November 14, 2014

Total POINTS: 100 20% of grade in class

1) The following table reports arterial blood gas levels measured in patients. For each set of readings indicate whether the:

a. Patient suffers from acidosis or alkalosis.
b. Whether the change in pH is respiratory or metabolic in origin.
c. Whether compensation has occurred for the condition.

Blood Chemistry			Acidosis or Alkalosis	Metabolic or Respiratory	Compensated or Uncompensated
pH	pCO_2	HCO_3^-			
7.51	40	31			
7.33	29	16			
7.48	30	23			
7.30	59	28			

(1 point each; 12 points total).

2) A patient is admitted to the hospital with an arterial PaO_2 of 55 mmHg. While talking to the patient's relatives, the physician learns that the patient has smoked for over 30 years, and has suffered from considerable shortness of breath for several years.

a) The patient's arterial oxygen saturation would likely be *(circle the best answer, **2 points**)*:

i) Approximately 55%

ii) Approximately 65%

ii) Approximately 75%

ii) Approximately 85%

ii) Approximately 95%

b) Would you expect for the patient's blood oxygen content to differ appreciably from normal levels? Provide a brief explanation for your answer. ***(3 points)***.

c) It is estimated that the patient's pulmonary artery pressure is 35/20 mmHg, but the physician is not surprised. Why is the patient's pulmonary artery pressure at this level? ***(5 points)***.

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d) The physician prescribes a treatment for the patient that includes oxygen therapy and the administration of Warfarin *(Coumadin)*, Iloprost *(Ventavis, a analog of prostaglandin PGI_2)*, and Furosemide *(Lasix, a "loop diuretic").* Briefly describe how each of these treatments is of benefit to the patient. ***(2 points each; 8 points total)***.

Treatment	Benefit to Patient
O_2 Therapy	
Warfarin	
Iloprost	
Furosemide	

3) Breathing is altered by changes in arterial pO_2, pCO_2, and pH. Which of these factors are most effective in altering alveolar ventilation? Provide a brief explanation for your answer. ***(5 points).***

4) How does activity of neurons in the Pre-Botzinger complex (rostral portion of the ventral respiratory group) change during vomiting? Provide a brief explanation for your answer. ***(5 points).***

5) Briefly describe how transection of the spinal cord at L1 alters the following ventilatory parameters, or if there is no change in the parameters. Provide a brief explanation for your answers. ***(2 points each; 6 points total)***.

Vital Capacity	
Tidal Volume	
Transpulmonary Pressure	

6) Patent ductus arteriosus can be treated medically by the administration of Indomethacin, a potent nonsteroidal anti-inflammatory drug (NSAID). Based on your knowledge of the physiology of ductus arteriosus, describe the mechanism of action of Indomethacin. ***(4 points).***

7) There are numerous critical differences between the innate and adaptive immune systems. Please provide a short statement (1-2 sentences) explaining the key differences between the innate and adaptive immune system for the 5 categories listed below. ***(10 points).***

a) The receptors used to differentiate self from non-self

b) What the receptors recognize (i.e. to distinguish what is self and non-self)

c) The diversity of receptors on adaptive and innate immune cells at birth and over time

d) 1st response to non-self

e) Repeated responses to the same non-self

8) Briefly describe the difference between an antigen and an epitope. ***(5 points).***

9) An antigen-presenting cell (APC) engulfs a dead bacteria and breaks it down in lysosomes. How would it present the resultant peptides to the immune system?

A second APC is infected with the Epstein–Barr virus (EBV), an intracellular pathogen. How would viral peptides arising inside this APC be presented to the immune system? ***(5 points).***

10) Given the profound epitope diversity generated during the process of lymphocyte antigen receptor generation, it is certain that self-reactive receptors will arise. Thus, an "education" process is needed to make sure T cells detect MHC appropriately, but have little potential for self reactivity. Describe the steps of central tolerance, including the location and cells of the body involved in this process that results in mature, functional α/β T cell. ***(10 points).***

11) Immunoglobulin from one individual B cell comes with a single specificity due to its particular combination of Variable Light (V_L) and Variable Heavy (V_H) regions. ***(8 points).***

a) Upon activation and appropriate interactions with other immune cells, however, that B cell can generate 5 distinct immunoglobulin isotypes by doing what?

b) Each isotype has a distinct function that is shaped by the kinetics of its expression and structure. Which isotype can cross the placenta and mediates maternal passive immunity of infants?

c) Which isotype is both expressed on the surface of B cells and later secreted as a pentamer?

d) What isotype is often fixed to the surface of mast cells and supports degranulation of mast cells?

12) The adaptive immune response relies on two major histocompatibility complex molecules (MHC). Where do you find MHC class I and class II expressed? ***(2 points).***

13) Which lymphocytes can undergo somatic hypermutation during reactivation and proliferation? ***(2 points).***

14) A common immune evasion strategy by tumor cells is to down regulate MHC class I molecules on their surface. This would make them invisible to which adaptive immune cells, but subject to removal by what innate immune cell? ***(4 points).***

15) Two subsets of T cells are defined by cluster of differentiation molecules (CD) and their MHC specificity. Besides being phenotypic markers, CD can also be functional molecules. ***(4 points).***

a) List a CD molecule that is found on both MHC class I and class II restricted T cells and helps support antigen receptor signaling.

b) Name the distinguishing CD markers for MHC class I and MHC class II restricted T cells. What is the function of these molecules?