

NROSCI/BIOSC 1070 and MSNBIO 2070

Exam # 3

December 2, 2016

Total POINTS: 100	20% of grade in class
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- 1) a) Assuming the typical 'normal' values of plasma glucose of 100 mg/100 ml and a renal transport maximum for glucose of 375 mg/min (along with a normal glomerular flow rate and renal plasma flow rate), draw a schematic of a nephron, labeling the parts for the nephron, and indicate the glucose concentration in each part of the nephron. **(5 pts for the schematic, 5 points for the glucose concentrations).**

- b)** Describe the nature and location of the key transporters involved in the reabsorption of glucose. **(5 points)**.
- c)** Describe what would happen if plasma glucose levels increased 5-fold (i.e., to 500 mg/100ml). **(5 points)**.

2) Antagonists of vasopressin V2 receptors and of aldosterone receptors would each produced diuresis.

a) Why would each produce diuresis? **(5 points)**.

b) What would the major problem be with using either clinically as a diuretic drug? **(5 points)**.

- 3) The arterial pressure perfusing the kidneys and intestine are very similar. However, an ultrafiltrate of plasma is pushed into the lumen of the nephron but not the lumen of the intestine. Why? **(10 points)**.

4) Consider an elderly female patient weighing approximately 100 lbs who has a creatinine clearance of 200 ml/min and a PAH clearance of 600 ml/min.

a) Describe the most likely renal abnormality in this patient. **(7 points)**.

b) What might be measured in the urine to readily confirm your diagnosis **(3 points)**.

5) Define or describe the terms below in 1-3 sentences. **(3 points each).**

a) Opsonization:

b) Anergy:

c) Perforin:

d) Killer inhibitory receptor:

e) NETosis:

- 6)** Indicate the cytokine with the following properties: **(2 points each)**.
- a)** Produced by Th2 cells and Treg; inhibits T cell responses; limits the stimulatory capacity of antigen producing cells; a deficit results in autoimmunity.

 - b)** Produced by Th1 cells and CTLs; inhibits Th2 responses; Drives CTL and Th1 responses; induces IgG2a synthesis by B cells; a deficit results in infections with intracellular microbes and poor tumor clearance.

- 7) While innate receptors have limited specificity, adaptive immune cells possess incredible diversity in the number of antigens they can recognize. This diversity results from the generation of adaptive immune cell receptors via somatic gene rearrangement.
- a) What two enzymes are instrumental for generating the variable regions of adaptive immune cell receptor found on T cells? **(2 points each; 4 points total).**
- b) Explain in two or three sentences what these two enzymes do during the generation of the variable regions of the T cell receptor? **(3 points each; 6 points total).**

- 8) Neutrophils are the first immune cells on the scene after tissue damage. Your friend wants you to invest in their biotech start up that will focus on finding natural supplements that are able to support the development of neutrophil memory responses to antibiotic resistant bacteria. What is wrong with their business model? **(5 points)**.

- 9) The generation of autologous induced pluripotent stem cells from adult cells remains a costly, time consuming and highly variable process. Those currently attempting to implement stem cell correction of nerve, heart, or muscle damage most typically use allogeneic sources for stem cells. Given your understanding of transplant immunology, explain why you would need to provide immunosuppression to a person receiving allogeneic, but not autologous, stem cells injected into their damaged heart after a myocardial infarction. **(5 points)**.

10) There are several factors that can direct isotype switching in B cell. Name or describe two of these factors. **(4 points)**.

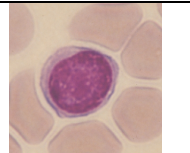
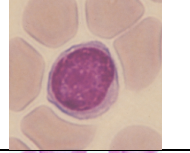
11) Rate from least to worst with regards to impact the listed immune deficiencies on immune responses to viral pathogens. **(4 points)**.

- a) Loss of CD3
- b) Eosinophil deficiency for major basic protein
- c) Loss of CD8
- d) Loss of IL-4 receptor on B cells

Least	
Worst	

- 12) You are in charge of characterizing PBMCs using a new flow cytometer that also takes a picture of a representative cell from each identified population. You obtain a grant from the World Health Organization (WHO) to take this new medical equipment in Africa to characterize individuals that are resistant to Schistosomiasis, or “snail fever”. Snail fever is a parasitic disease spread by water contamination by people and snails infected with *Schistosoma* worms. The WHO has provided you a standard panels of antibodies that recognize CD markers (CD3, CD4, CD8, CD20, CD56) and IgD. The cytometer and antibodies have arrived safely and you are ready to start characterizing subject blood samples.

Identify the population of immune cells represented in each panel by their CD markers, size, granularity and digital image. **(1 point each; 3 points total).**

Small agranular cells, CD3+, CD4+, CD8-, CD20-, CD56-, IgD-	
Small agranular cells, CD3-, CD4-, CD8-, CD20+, CD56-, IgD+	
Large, very granular cells with CD3-, CD20-, CD56-, CD8-, CD20-, CD56-, IgD-	