UNIVERSITY OF YORK
BA, BSc, and MSc Degree Examinations 2017-8

Department:
BIOLOGY

Title of Exam:
Immunology

Time Allowed:
1 hour 30 minutes

Marking Scheme:

Total marks available for this paper: 80

Section A: Short answer questions (40 marks)
Section B: Problem questions (40 marks)
The marks available for each question are indicated on the paper

Instructions:

Answer all questions in the spaces provided on the examination paper
Students must bring a ruler

Materials Supplied:
CALCULATOR
GRAPH PAPER

For marker use only:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>Total as %</th>
</tr>
</thead>
</table>

DO NOT WRITE ON THIS BOOKLET BEFORE THE EXAM BEGINS
DO NOT TURN OVER THIS PAGE UNTIL INSTRUCTED TO DO SO BY AN INVIGILATOR

page 1 of 12
SECTION A: Short answer questions

Answer all questions in the spaces provided

Mark total for this section: 40

1. Describe the main functions of the complement. (6 marks)

2. a) Describe the main hallmarks of thymic involution. (4 marks)

   b) In adult life, what is meant by the term extramedullary haematopoiesis? (3 marks)

   c) Which two cell types of the innate immune system can kill pathogens through release of toxic granules? (2 marks)
3. a) Explain what initiator and effector caspases are. Provide one example of each. (4 marks)

Initiator caspase:

Effector caspase:

b) In an apoptotic cell, where would you expect to find phosphatidylinerine? Explain your reasoning. (3 marks)
4. The diagram below represents an important mechanism in movement of immune cells around the body. Explain in detail the mechanism and why it is important for immunity to infection.

(10 marks)
5. Describe how immunovasins impair immunity to viruses. (3 marks)

6. The picture below shows a thymic medullary epithelial cell (mTEC; yellow/green) expressing a tissue specific antigen (TSA, red/white arrows). Describe the importance of this cell in preventing T cells responding to our own tissues. (5 marks)
SECTION B: Problem questions

Answer all questions in the spaces provided

Mark total for this section: 40

7. a) Rank the thymus, spleen, and lymph node in order of size. (1 mark)

b) Based on the characteristic staining, what type of cells are the two blue/purple cells in the picture; explain why you reached this conclusion? Clearly indicate which cell you are referring to. (6 marks)
8. You are investigating the function of “DLEAG17”, a protein expressed in dendritic cells.

The graph below shows levels of DLEAG17 in control dendritic cells and cells lacking the type I interferon receptor IFNAR following exposure of the cells to bacterial LPS.

![DLEAG17 levels graph](image)

a) What is your interpretation of these results? Suggest a molecular pathway that could regulate DLEAG17 expression. (7 marks)
b) In a second experiment, control dendritic cells and dendritic cells lacking DLEAG17 are treated with LPS. Expression of IL1beta, IL6 and IFNbeta is shown below.
What is your interpretation of these results with regards to DLEAG17 activity and the function of DLEAG17-deficient dendritic cells? Based on these data, which molecular pathway(s) are likely to be controlled by DLEAG17, and in which manner (activated or inhibited)?

(6 marks)
A patient is suspected of having an infection. To identify the type of infection an ELISA was performed assessing for two chemokines - one representative of viral infection and one representative of parasitic infection. The table shows the O.D. readings at 405nm depending on the dilution for serum samples taken from the patient.

<table>
<thead>
<tr>
<th>dilution</th>
<th>CCL11 positive control</th>
<th>CCL11 positive control</th>
<th>CCL11 test sample</th>
<th>CCL11 negative control</th>
<th>CCL11 test sample</th>
<th>CCL11 negative control</th>
<th>CXCL10 positive control</th>
<th>CXCL10 positive control</th>
<th>CXCL10 test sample</th>
<th>CXCL10 test sample</th>
<th>CXCL10 negative control</th>
<th>CXCL10 negative control</th>
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<tbody>
<tr>
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<tr>
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<td>1.00</td>
<td>1.00</td>
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<td>0.09</td>
<td>0.08</td>
<td>0.08</td>
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<tr>
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<td>0.09</td>
<td>0.08</td>
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<td>0.07</td>
<td>0.08</td>
<td>0.08</td>
<td>0.06</td>
</tr>
</tbody>
</table>

a) Based on the data above, draw a graph and determine which of the two chemokines is the most abundant in the patient. Explain your reasoning.  
(4 marks)

b) The concentration of the CCL11 and CXCL10 positive controls before dilution is 5 mg/ml. Determine the concentration of CCL11 and CXCL10 in the test samples. Show your calculations.  
(3 marks)
c) What type of infection does the patient have? Draw a schematic, annotated diagram of an additional ELISA that will confirm the type of infection the patient has by assessing the CD4+ T helper response. **(4 marks)**
There is an outbreak of disease in sub-Saharan Africa and the microbe involved is a gram-negative mycobacterium. Two vaccine candidates are developed and some of their properties are listed below.

<table>
<thead>
<tr>
<th></th>
<th>Vaccine A</th>
<th>Vaccine B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potent antibody response to pathogen</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Induces T cell response to pathogen</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Safe (minimum side effects)</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Biologically stable (no need for specialist storage)</td>
<td>NO</td>
<td>YES</td>
</tr>
</tbody>
</table>

a) Based on the information above, which vaccine is the better candidate? Explain your reasoning. (3 marks)

b) Vaccines A and B were assessed further and vaccine B was found to target a T cell-independent polysaccharide on the mycobacterium surface. Explain the limitations of vaccine B in this regard, and design a strategy to circumvent this limitation. (6 marks)