



**THE UNIVERSITY OF
BRITISH COLUMBIA
MICROBIOLOGY 202 PRACTICE
EXAM-STYLE QUESTIONS — IMMUNOLOGY**
Recommended time for completion: 80 minutes

NAME: _____ STUDENT # _____

READ THIS!

FAILURE TO FOLLOW INSTRUCTIONS WILL DELAY THE GRADING OF YOUR EXAM

1. All students must adhere to the Faculty of Science rules governing formal examinations (see next page).
2. This exam has 37 questions. Some of the multiple-choice questions have **one** answer. Other multiple-choice questions will require you to select **two or more** answers – this is indicated in the question stem (all must be correct in order to receive the point). This exam has **6 double-sided pages including the cover page**.
3. Record all **multiple choice responses IN DARK PENCIL** on the **computer answer sheet** — **NOT** on the question paper. Rough work may be done on the question paper, but nothing written on it will be graded.
4. Make sure to fill in the bubbles for your name (**Family name FIRST, Given name LAST**) and your **8** digit student number **IN PENCIL**. Other student information is **NOT** required. **IN INK**, sign the question paper and the answer sheet in the spaces provided. Your exam paper will **NOT** be marked if this is not done correctly.
5. Students **MUST** record their answers onto their answer sheet during the time allowed for the exam. **NO** writing will be permitted after the time allowed for the exam has expired. **NO** appeals will be considered.
6. The question paper **MUST** be returned with the answer sheet. An answer sheet without question paper will **NOT** be graded. In this regard, students are **STRONGLY CAUTIONED** to guard against theft of their question paper by other students. **NO** appeal relating to loss of a question paper by theft will be considered.
7. The invigilators will **NOT** answer any clarifying questions during the exam. **Students must interpret and answer each question on their own.**
8. **NOTE:** There will be questions that require one answer or two answers on the actual exam. You will be told how many bubbles to fill in for each question. Actual exam questions will have a maximum of 5 answers to choose from and you will not see the phrase “For this question, pick as many answers as necessary to correctly answer the question”.

Faculty of Science Rules Governing Formal Examinations

- #1. Each candidate must be prepared to produce, upon request, a Library/AMS card for identification.
- #2. Candidates are not permitted to ask questions of the invigilators, except in cases of supposed errors or ambiguities in examination questions.
- #3. No candidate shall be permitted to enter the examination room after the expiration of one-half hour from the scheduled starting time, or to leave during the first half hour of the examination.
- #4. Candidates suspected of any of the following, or similar, dishonest practices shall be immediately dismissed from the examination and shall be liable to disciplinary action:
 - Having at the place of writing any books, papers or memoranda, calculators, computers, audio or video cassette players or other memory aid devices, other than those authorized by the examiners.
 - Speaking or communicating with other candidates.
 - Purposely exposing written papers to the view of other candidates. The plea of accident or forgetfulness shall not be received.
- #5. Candidates must not destroy or mutilate any examination material; must hand in all examination papers; and must not take any examination material from the examination room without permission of the invigilator.

READ EACH QUESTION STEM CAREFULLY. THERE ARE NO PARTIAL MARKS FOR QUESTIONS REQUIRING MORE THAN ONE ANSWER. You will not see the phrase “For this question, pick as many answers as necessary to correctly answer the question” in the actual exam, but they are a very good way to test your knowledge of the material which is why they are used here.

1. Which **one** of the following statements **BEST** describes a neutrophil?
 - (a) A special type of macrophage that will activate T helper cells.
 - (b) A polymorphonuclear leukocyte that can phagocytose bacteria.
 - (c) A polymorphonuclear leukocyte that makes antibodies.
 - (d) A type of macrophage - when its in the blood its called a neutrophil, and when it moves into the tissue it differentiates into a macrophage.
 - (e) A polymorphonuclear leukocyte that present antigen to helper T cells.
2. Which of the following **two** statements describe what do neutrophils and macrophages have in common?
 - (a) They both secrete cytokines to activate T cells.
 - (b) They can be display pathogen peptides on MHC (class) II to T cells.
 - (c) They are both derived from myeloid stem cells.
 - (d) They arrive at the site of infection simultaneously and start to work immediately.
 - (e) They engulf and digest bacteria.
3. For this question, pick as many answers as necessary to correctly answer the question.

Adaptive immune responses are concentrated in the secondary immune organs such as:

- (a) thymus.
 - (b) lymph nodes.
 - (c) bone marrow.
 - (d) kidney.
 - (e) spleen.
4. Mammals have *Toll*-like receptors (TLRs) that act in a manner similar to those of insects. While not specific to a particular pathogen, a TLR can recognize a kind of macromolecule that is absent from vertebrates but present in/on certain groups of pathogens. Which **two** of the following molecules are most likely to be recognized by a particular TLR that defends some type of microorganisms?
 - (a) lipopolysaccharides
 - (b) double-stranded DNA
 - (c) double-stranded RNA
 - (d) glycoproteins
 - (e) phospholipids

5. If a newborn were accidentally given a drug that destroyed the thymus, what would **MOST LIKELY** happen?

- (a) The cells would lack MHC (class) I molecules on their surface.
- (b) The humoral immunity would be missing.
- (c) Genetic rearrangement of antigen receptors would not occur.
- (d) The T cells would not mature and differentiate appropriately.
- (e) The B cells would be reduced in number and antibodies would not form.

6. B6 and B6-nu/nu (B6 nude) are two strains of inbred mice that are frequently used in immunological research. They are genetically identical except for a mutation in the nu gene which controls the development of the thymus gland as well as hair development. B6-nu/nu mice do not have a thymus gland and are hairless (hence the name, B6 nude).

What cell types should you find in a blood sample taken from a B6 nude mouse?

- (a) rbc only
- (b) rbc and neutrophils only
- (c) rbc, neutrophils and macrophages
- (d) rbc, and all of the white blood cells except for T cells
- (e) rbc, and all of the white blood cells including T cells

7. While changing the cage of a B6 nude mouse, you notice it has a sliver in its front paw. The sliver came from the wood-chips which were used as bedding. Since the bedding is soiled, you expect a smaller number of bacteria to be present in the wound. What should you do?

- (a) Panic, get the first aid kit, wash the mouse's paw with antiseptic and carefully bandage it.
- (b) There is nothing you can do. The bacteria will multiply in the mouse and it will unfortunately die of a bacterial infection.
- (c) Do nothing. The neutrophils of the innate immune system of the mouse should be able to eliminate the bacteria.
- (d) Transfuse the mouse with some T helper cells from a normal B6 mouse. The transplanted T helper cells can help the B6 nude mouse's B cells make Ab.
- (e) Do a bone marrow transplant using bone marrow from a normal B6 mouse and hope that the B6 nude mouse will be able to develop a normal adaptive immune response.

8. Inflammatory responses may include which **two** of the following?

- (a) Clotting proteins migrating away from the site of infection.
- (b) Increased activity of phagocytes in an inflamed area.
- (c) Reduced permeability of blood vessels to conserve plasma
- (d) Release of substances to decrease the blood supply to an inflamed area.
- (e) Release of substances to promote the release of white blood cells from bone marrow.

9. Which **two** statements about the complement system are **TRUE**?

- (a) These proteins are involved in innate immunity and not adaptive immunity.
- (b) These proteins are involved in adaptive immunity but not innate immunity.
- (c) These proteins can be activated by interacting with an IgG that has bound to the surface of a pathogen.
- (d) These proteins are one group of antimicrobial proteins acting together in cascade fashion.
- (e) These proteins act individually to attack and lyse microbes.

10. The number of MHC protein combinations possible in a given population is enormous. However, an individual in that population has only a couple of MHC possibilities. Why?

- (a) The MHC proteins are made from several different gene regions that are capable of rearranging in a number of ways.
- (b) MHC proteins from one individual can only be of MHC (class) I or MHC (class) II.
- (c) Each of the MHC genes has a large number of alleles, but each individual only inherits 2 for each gene.
- (d) Once a B cell has matured in the bone marrow, it is limited to two MHC response categories.
- (e) Once a T cell has matured in the thymus, it can only respond to two MHC categories.

11. A bone marrow transplant may not be appropriate from a given donor (Jane) to a given recipient (Jane's cousin Bob), even though Jane has previously given blood for one of Bob's needed transfusions. Which **one** of the following might account for this?

- (a) Jane's blood type is a match to Bob's but her MHC proteins are not.
- (b) A blood type match is less stringent than a match required for transplant because blood is more tolerant of change.
- (c) For each gene, there is only one blood allele but many tissue alleles.
- (d) Jane's MHC (class) II genes are not expressed in bone marrow.
- (e) Bob's immune response has been made inadequate before he receives the transplant.

12. For this question, pick as many answers as necessary to correctly answer the question.

During an immune response, foreign peptides are presented by _____ molecules to _____ cells.

- (a) MHC (class) I, cytotoxic T
- (b) MHC (class) II, helper T
- (c) MHC (class) I, helper T
- (d) MHC(class) II, cytotoxic T
- (e) MHC (class) II, helper T and B

13. Which of the following statements about MHC proteins is **NOT TRUE**?

- (a) MHC (class) I proteins present antigenic peptides and are recognized by the T cell receptor and the CD8 protein.
- (b) MHC (class) II proteins presenting antigenic peptides identify normal cells as foreign and result in their cytotoxic destruction.
- (c) MHC (class) I proteins generally occur on all cells of the immune system.
- (d) MHC (class) II proteins are distributed on only a few cell types, for example; macrophage, dendritic and B cells.
- (e) MHC (class) II proteins present antigenic peptides and are recognized by the T cell receptor and the CD4 protein.

14. For this question, pick as many answers as necessary to correctly answer the question.

Which of the following types of MHC molecules would you expect to find on a human dendritic cell that had engulfed a bacterium?

- (a) HLA-A
- (b) HLA-B
- (c) HLA-C
- (d) HLA-DP
- (e) HLA-DR
- (f) HLA-DQ

15. For this question, pick as many answers as necessary to correctly answer the question.

Which of the following types of MHC molecules would you expect to find on a fibroblast from a human patient?

- (a) HLA-A
- (b) HLA-B
- (c) HLA-C
- (d) HLA-DP
- (e) HLA-DR
- (f) HLA-DQ

16. For this question, pick as many answers as necessary to correctly answer the question.

Which of the following feature(s) is/are shared by MHC (class) I and MHC (class) II molecules?

- (a) expressed by mature dendritic cells.
- (b) expressed by most cells in the body.
- (c) expressed only by the cells of the body when the host is infected with a pathogen.
- (d) associated with self-peptides in the absence of infection by pathogen.
- (e) associated intracellularly at specific stages and at the cell surface with β 2-microglobulin.

17. Which of the following uniquely distinguishes the T cell receptor (TCR) from an antibody?

- (a) The TCR can function as a cell surface antigen receptor.
- (b) The TCR polypeptides is composed of domains (regions) - an amino terminal variable portion at determines the binding specificity and a constant portion that determines the class of the polypeptide chain.
- (c) The TCR can bind an antigen fragment only in a trimolecular complex with either the MHC (class) I or MHC (class) II surface proteins of the major histocompatibility complex.
- (d) The TCR is capable of participating in a cytotoxic reaction.
- (e) The TCR is composed of two different types of polypeptide chains.

18. Which **two** of the following statements are **NOT TRUE** of CD4 and CD8 cell markers?

- (a) Both are expressed on the cell surface of ALL mature, but naïve T cells.
- (b) They bind to a conserved region of the MHC molecule of the antigen-presenting cell.
- (c) They serve to distinguish different types of T cells, e.g., helper and cytotoxic, from each other.
- (d) They are co-receptor molecules for the TCR and only one is expressed on mature T cells.
- (e) Their binding to MHC provide the second signal needed for the activation of the T cell.

19. Cytotoxic T cells kill virally infected cells and **NOT** healthy cells because:

- (a) healthy cells do not display MHC proteins on the cell surface.
- (b) the CTL's TCR recognizes a viral peptide displayed on MHC (class) II proteins of infected cells.
- (c) the CTL's TCR can recognize a self-peptide displayed on MHC proteins and terminate the production of perforin.
- (d) healthy cells do not have a receptor for the perforin molecule.
- (e) the CTL's TCR recognizes a viral peptide displayed on MHC (class) I proteins of infected cells.

20. For this question, pick as many answers as necessary to correctly answer the question.

T cells undergo a process of positive and negative selection in the thymus. If the process of negative selection were to fail, the result would be the production of T cells which:

- (a) are unable to recognize foreign peptides bound to the MHC.
- (b) do not express the TCR.
- (c) do not express any co-receptor molecules.
- (d) do not receive a survival signal and die in the thymus gland.
- (e) are more likely to cause an autoimmune reaction.
- (f) express both CD4 and CD8 co-receptors.

21. An immunoglobulin (Ig) molecule, of whatever class, has regions symbolized as C or V, H or L. A light chain has which of these regions?

- (a) one C and one V region
- (b) three C and one V region
- (c) one H and one L region
- (d) three H and one L region
- (e) two C and two V regions

22. For this question, pick as many answers as necessary to correctly answer the question.

How do antibodies of the different classes IgM, IgG, IgA, IgD, and IgE differ from each other?

- (a) in the way they are produced
- (b) in their heavy chain structure
- (c) in the type of cell that produces them
- (d) by the antigenic determinants that they recognize
- (e) by the number of carbohydrate subunits they have

23. Which of the following differentiates T cells and B cells?

- (a) T cells but not B cells are stimulated to increase the rate of their cell cycles.
- (b) Only B cells are produced from stem cells of the bone marrow.
- (c) T cells but not B cells can directly attack and destroy invading pathogens.
- (d) T cells but not B cells have surface markers.
- (e) Only B cells take part in cell-mediated immunity.

24. A nonfunctional CD4 protein on a helper T cell would result in the helper T cell being unable to:

- (a) respond to T-independent antigens.
- (b) lyse tumor cells.
- (c) stimulate a cytotoxic T cell.
- (d) interact with a MHC (class) I-peptide complex.
- (e) interact with a MHC (class) II-peptide complex.

25. There are several important differences between the primary and secondary antibody responses to the same antigen. Which **two** of the following statements are **NOT TRUE**?

- (a) The rate at which the level of antibody increases is slower in the primary response.
- (b) The amount of antibody produced is much higher in the secondary response.
- (c) B cells produce the antibodies during the primary response and T cells produce the antibodies during the secondary response.
- (d) Detectable amounts of antibody appear much earlier in the secondary response.
- (e) The plasma cells from the primary response are reactivated during the secondary response.

26. The lag phase of a primary antibody response to a bacterial pathogen occurs because:
- (a) the dendritic cells that have engulfed the pathogen have to proliferate and differentiate into antigen presenting cells before they can activate the T helper cells.
 - (b) the plasma cells have to differentiate into B cells, which then have to present antigen to T helper cells.
 - (c) the immune system doesn't make the B cells that recognize the pathogen until after it has been infected with pathogen.
 - (d) the adaptive responses wait for a week to evaluate whether the innate responses had eliminated the infection.
 - (e) the T helper cells have to be activated by dendritic cells, the B cells have to present antigen to T helper cells, then proliferate and differentiate into antibody.
27. Antigens "A" and "B" are injected into an animal at the same time. If it is the animal's first exposure to "B" but the second exposure to "A", which of the following would you expect?
- (a) Very slow decline of antigen "B"-specific antibody concentration after its been synthesized.
 - (b) Production of "B"-specific antibody predominantly of the IgG isotype.
 - (c) Production of "A"-specific antibody predominantly of the IgM isotype.
 - (d) A very short lag phase before production of antigen "A"-specific antibody starts.
 - (e) A very short lag phase before production of antigen "B"-specific antibody starts.
28. Which of the following would be **MOST** beneficial in treating an individual who has been bitten by a poisonous snake that has fast-acting venom?
- (a) there is nothing that can be done for this person.
 - (b) injection of memory B cells and memory T cells from someone that had been bit by the snake and survived.
 - (c) injection of cytokines so that B cells don't need to wait for T cell help.
 - (d) immediate vaccination with a weakened form of the venom.
 - (e) injection antibodies that bind to the venom.
29. For this question, pick as many answers as necessary to correctly answer the question.

A child receiving antibodies in the breast milk during nursing has acquired immunity that is best described as:

- (a) active
- (b) passive
- (c) artificial
- (d) natural
- (e) permanent

30. In some instances, a macrophage that contains a large number of infectious bacterial cells is unable to eliminate them completely. However, if the macrophage is assisted by another cell, it is often able to effectively destroy all of the intracellular bacteria before they (the bacteria) can do any significant damage to the macrophage. Which **one** of the following types of cells is able to provide assistance to the macrophage?

- (a) a T helper cell that has been signaled by an MHC (class) I/peptide on the surface of that macrophage.
- (b) a CTL that has been signaled by an MHC (class) I/peptide on the surface of that macrophage.
- (c) a plasma cell that is producing antibodies specific for a molecule on the surface of the infecting bacterial cells.
- (d) a T helper cell that has been signaled by an MHC (class) II/peptide on the surface of that macrophage.
- (e) a plasma cell that is producing antibodies specific for a molecule on the macrophage itself.

31. You transplant a thymus graft into the B6-nu/nu mouse which lacks its own thymus. The transplanted thymus comes from a mouse that has the same tissue type as the B6 nu/nu mouse. After recovering from surgery, you immunize the mouse against a pathogen that is common found in mouse rooms. Two weeks later, you take a small sample of blood and analyze. Which **two** of the following statements would describe your findings?

- (a) Only the same types of white blood cells that were present before the procedure.
- (b) There would be no antibodies that are specific to the pathogen.
- (c) There would be antibody present, but it would be specific to the antigens on the thymus graft.
- (d) There would be T cells in the blood sample.
- (e) There would be antibody in the blood sample.

32. A transfusion of type A blood given to a person who has type O blood would result in which of the following?

- (a) the recipient's B antigens reacting with the donated anti-B antibodies
- (b) the recipient's anti-A antibodies clumping the donated red blood cells
- (c) the recipient's anti-A and anti-O antibodies reacting with the donated red blood cells
- (d) no reaction because type O is a universal donor
- (e) no reaction because the O-type individual does not have antibodies

33. The results of an enzyme linked immunosorbent assay (ELISA) for HIV are determined by noting:

- (a) the fixing of complement.
- (b) agglutination of antigens and antibodies.
- (c) whether an animal lives after an injection.
- (d) a neutralization of toxins by antitoxins.
- (e) a colour change in the reagents.

34. An immune response to a tissue graft will differ from an immune response to a bacterium because:

- (a) MHC molecules of the donor may stimulate rejection of the graft tissue.
- (b) the tissue graft, unlike the bacterium, is isolated from the circulation and will not enter into an immune response.
- (c) a response to the graft will involve T cells and a response to the bacterium will not.
- (d) a bacterium cannot escape the immune system by replicating inside normal body cells.
- (e) the graft will stimulate an autoimmune response in the recipient.

35. A patient undergoes a high level of mast cell degranulation, dilation of blood vessels, and acute drop in blood pressure. These symptoms could be caused by one which of the following?

- (a) an autoimmune disease
- (b) a typical allergy that can be treated by antihistamines
- (c) an organ transplant, such as a skin graft
- (d) the effect of exhaustion on the immune system
- (e) anaphylactic shock immediately following exposure to an allergen

36. Scientists have developed a mouse strain that does not make MHC (class) II proteins. They developed this strain by inserting large pieces of DNA into the gene(s) that code for MHC II proteins. This type of mutation is called a "gene knock-out". With an MHC II gene knock-out mouse, which **two** of the following statements best describe what you might expect to find?

- (a) No B cells, macrophages or dendritic cells at all.
- (b) The B cells, macrophages and dendritic cells express MHC I, but they do not express MHC II.
- (c) The mouse can make a CTL response during viral infections.
- (d) The mouse can make normal Ab response during bacterial infections.
- (e) The mouse's Ab response during bacterial infections is impaired.

37. Which of the following statements about ELISAs and FACS is **TRUE**?

- (a) FACS is a useful tool for determining whether a person is making an antibody response after receiving a vaccine.
- (b) An ELISA can be used to determine what MHC proteins a person has on their neutrophils.
- (c) FACS can be useful in determining whether or not a person has AIDS.
- (d) FACS and ELISAs can be used in tissue typing to match donor organs to potential recipients.
- (e) ELISAs can be used to determine what ABO antigens are on a person's red blood cells.

ANSWER KEYS – IMMUNOLOGY (Practice Midterm)

Question	Answer
1	B
2	C, E
3	B, E
4	A, C
5	D
6	D
7	C
8	B, E
9	C, D
10	C
11	A
12	A, B
13	B
14	A - F
15	A, B, C
16	A, D
17	C
18	A, E
19	E
20	E
21	A
22	B
23	C
24	E
25	C, E
26	E
27	D
28	E
29	B, D
30	D
31	D, E
32	B
33	E
34	A
35	E
36	B, E
37	C