INSTRUCTIONS

1. Use only a No. 2 pencil.

2. Write your name legibly at the top of the FIRST PAGE of the exam.

3. Write and code entire student ID number on the Scantron form.

4. Write in NAME, E2, and your row and seat number on the front of the form.

5. Fill answer boxes on the Scantron completely; printed numeral should not be visible. Do not make extraneous marks on the form.

6. Mark box A through E, one only. Use A for TRUE and B for FALSE. Each question is intended to have a single best answer.

7. Erase carefully and completely; if in doubt, get a new Scantron.

8. Check your Scantron form before handing it in to see that all questions have been answered.

9. When you are done turn in your exam together with your Scantron.
QUESTIONS 1-16: [4 POINTS] MULTIPLE CHOICE Choose the single best answer

1. Most vaccinations required in the US represent which form of immunity?
   a) adoptive
   b) innate
   c) active
   d) passive

2. If the “natural” antibodies to the ABO blood group antigens were IgG, then hemolytic disease of the newborn would develop in the children of:
   a) AB mothers and O fathers
   b) A mothers and A fathers
   c) O mothers and O fathers
   d) AB mothers and B fathers
   e) None of the above

3. During the procedure for producing a hybridoma cell line, the presence of the drug aminopterin (the “A” in “HAT” medium) is necessary to prevent the proliferation of unfused:
   a) B-cells
   b) plasmacytoma cells
   c) both
   d) neither

4. Mitchell and Miller’s classic experiments involved the production of “ATxBM” mice, animals thymectomized as adults, then lethally irradiated and rescued by injection of bone marrow. Histological examination of the lymph nodes of these mice a few weeks after treatment would most closely resemble that of human lymph nodes from:
   a) a normal, healthy donor
   b) Di George Syndrome
   c) Bruton’s Agammaglobulinemia
   d) Severe Combined Immunodeficiency
   e) iatrogenic immunodeficiency

5. The “Coomb’s reagent” used to develop agglutination reactions is an antibody directed against:
   a) Rh antigen
   b) A and B blood group antigens
   c) IgG
   d) C3b
   e) FcR
6. The presence of germinal centers in the thymus is most likely an indication of:
   a) a cell-mediated immune response
   b) an autoimmune condition
   c) generation of central tolerance
   d) a humoral response to a TI antigen

7. The use of “conjugate” vaccines is a technique to convert an antigen from:
   a) TI to TD
   b) soluble to particulate
   c) monovalent to polyvalent
   d) monoclonal to polyclonal

8. Céline Dion has been tissue-typed as HLA-A(2,3);B(13,17), her husband René Angélil is A(10,11);B(8), and their brand-new son Nelson is A(3,10);B(13). Which of the following is the least likely phenotype for little Nelson’s non-identical twin brother Eddy?
   a) A(3,10);B(13)
   b) A(3,11);B(8,13)
   c) A(2,10);B(17)
   d) A(3,11);B(17)
   e) A(2,11);B(8,17)

9. (See question #8) If you wanted to use a FACS (fluorescence-activated cell sorter) to recover fetal cells from Céline’s blood during a subsequent pregnancy in order to do prenatal genetic testing on the fetus, your best choice of fluorescent-labeled antibodies would be:
   a) anti-A2 and A3
   b) anti B8
   c) anti-B8 and B17
   d) anti-A3 and A10
   e) anti-A10 and A11

10. A genetic defect in the expression of HLA Class II molecules (Bare Lymphocyte Syndrome Type 2) results in a severe deficiency in:
    a) numbers of CD4+ cells
    b) levels of serum Ig
    c) both
    d) neither
11. During the development of a secondary humoral response to a protein antigen, the TcRs of Th cells recognize antigen peptides displayed by:

a) MHC Class I on a B cell  
b) MHC Class II on a B cell  
c) MHC Class I on a macrophage  
d) MHC Class II on a macrophage

12. The carbohydrate dextran can stimulate an effective antibody response in “nude” (nu/nu) mice. This is because dextran is:

a) efficiently presented by the B-cell’s MHC Class II  
b) highly multimeric  
c) a TD antigen  
d) capable of stimulating Toll-Like Receptors (TLR) on B-cells

13. “Double positive” T-cells represent a significant proportion of lymphocytes in:

a) blood  
b) thymus  
c) parafollicular cortex  
d) all of the above  
e) none of the above

14. The likelihood of a kidney transplant between two non-identical twins being accepted with no rejection reaction is close to:

a) 0%  
b) 25%  
c) 50%  
d) 75%  
e) 100%

15. Which of the following scenarios would result in a person being diagnosed with acquired immune deficiency syndrome (AIDS)?

a) HIV antibodies detected by enzyme-linked immunosorbent assay (ELISA)  
b) HIV antibodies detected by ELISA and confirmed by western immunoblot  
c) HIV antibodies detected by ELISA, confirmed by western immunoblot, and oral thrush  
d) HIV antibodies detected by ELISA, confirmed by western immunoblot, and a CD4+ lymphocyte count of 700 cells per microliter  
e) HIV antibodies detected by ELISA, confirmed by western immunoblot, and cervical cancer
16. The 1-2 day “latent period” required for the generation of a Prausnitz-Küstner reaction represents the time necessary for:

   a) the generation of the “late phase” response  
   b) differentiation of IgE secreting cells  
   c) IgE binding to mast cells  
   d) the tissue response to mediators released by mast cells

QUESTIONS 17-20: [2 POINTS] MULTIPLE CHOICE. Choose from the following targets which may be recognized by various autoimmune reactions. Each choice may be used once, more than once or not at all

   a) acetylcholine receptor  
   b) thyroglobulin  
   c) small nuclear ribonucleoproteins (snRPs)  
   d) myelin basic protein (MBP)  
   e) TSH (thyroxin-stimulating hormone) receptor

17. ______ Systemic Lupus Erythematosus (SLE)  
18. ______ Grave’s Disease  
19. ______ Multiple Sclerosis  
20. ______ Hashimoto’s Disease

QUESTIONS 21-24: [4 POINTS] MULTIPLE CHOICE Choose the single best answer

21. The symptoms of Toxic Shock Syndrome result from excessive activation of:

   a) B-cells  
   b) CD4+ T cells  
   c) CD8+ T cells  
   d) dendritic cells  
   e) plasma cells

22. Heating an antiserum at 56°C for 30 minutes will destroy its ability to transfer:

   a) an Arthus reaction  
   b) a Prausnitz-Küstner reaction  
   c) contact dermatitis  
   d) all of the above  
   e) none of the above
23. The mechanism of receptor blockade will contribute most importantly to maintaining self-tolerance to:

   a) CD3  
   b) HLA-DR  
   c) albumin  
   d) Fc receptors  
   e) IgE heavy chains

24. The cellular infiltrate at the site of a TB skin test 48 hours after introduction of antigen will contain predominantly:

   a) eosinophils  
   b) polymorphonuclear neutrophils  
   c) mast cells  
   d) B lymphocytes  
   e) mononuclear cells

QUESTIONS 25-28: [2 POINTS] MULTIPLE CHOICE Choose the single best answer

The results of a FACS analysis of cells from a human blood sample are shown below. For each of the following choose the quadrant (a, b, c or d) in which the cells in question would appear.

25. _____B cells
26. _____NK cells
27. _____monocytes/macrophages
28. _____Th2 cells

QUESTIONS 29-35: [4 POINTS] MULTIPLE CHOICE Choose the single best answer

29. One important autoantibody frequently found in Rheumatoid arthritis patients is *Rheumatoid Factor*, which is an antibody directed against:

   a) nuclear antigens  
   b) Fc of IgG  
   c) primarily IgA  
   d) CD4+ helper cells
30. Development of a rash following exposure to the leaves of poison oak indicates:

a) an IgE mediated allergic response  
b) non-immune response to a toxic molecule  
c) deposition of immune complexes in skin  
d) a cell-mediated immune reaction  
e) complement-mediated inflammation

31. Which of the following represents part of the process of lymphocyte "recirculation"?

a) entry of pre-T-cell from blood into thymus  
b) entry of naïve B-cell from blood into lymph node  
c) entry of a PMN into an inflamed tissue  
d) both (a) and (b)  
e) all of the above

32. Which of the following statements is FALSE regarding opportunistic infections in adult patients with AIDS:

a) There is an increase in the number of infections with obligate intracellular bacteria (such as *Mycobacterium avium intracellulare*) because cytokines produced by CD4+ lymphocytes are necessary for cytotoxic T lymphocyte-mediated killing of infected cells  
b) There is a substantial increase in the number of infections with common extracellular bacteria, such as *Streptococcus pneumoniae*, because cytokines produced by CD4+ lymphocytes are necessary for maturation of the antibody response  
c) Reactivation of DNA viruses such as Varicella zoster (shingles) occurs because cytokines produced by CD4+ lymphocytes are necessary for maintenance of the latent viral state  
d) Fungal infections with yeast, such as *Pneumocystis carinii* (pneumonia), occur because cytokines produced by CD4+ lymphocytes are important in the cytotoxic T lymphocyte response that is responsible for killing yeast infected cells  
e) All of the above are correct

33. The maximum number of different HLA Class I molecules that may be expressed by a single TH cell is close to:

a) 1  
b) 2  
c) 4  
d) 6  
e) 16
34. The main target structure(s) damaged in Rheumatoid arthritis is/are:
   a) skin and dendritic cells  
   b) cartilage  
   c) synovium  
   d) blood vessels

35. In order to effectively trigger an adaptive immune response, a dendritic cell must first receive a signal delivered by:
   a) cytokines produced by a Th cell  
   b) microbe-derived molecules  
   c) cross-linking of antigen-specific membrane Ig  
   d) B7/CD28 interaction  
   e) CD3

QUESTIONS 36-40: [4 POINTS] ANSWER USING THE FOLLOWING KEY:

   a) If 1, 2 and 3 are correct  
   b) If 1 and 3 are correct  
   c) If 2 and 4 are correct  
   d) If only 4 is correct  
   e) If all are correct

36. Cell surface markers expressed by both Th1 cells and macrophages include:
   1) immunoglobulin  
   2) CD3  
   3) TcR  
   4) MHC Class I

37. A mouse has been immunized with HSA, and separately with ARS-KLH. Which of the following would elicit a strong anti-ARS IgG response if the mouse is challenged four weeks later? (HSA=human serum albumin; ARS=arsonate hapten; KLH=the protein keyhole limpet hemocyanin; the two proteins are unrelated).
   1) ARS-KLH alone  
   2) ARS-HSA alone  
   3) ARS-HSA together with KLH  
   4) KLH alone
KEY: (a) 1, 2 and 3; (b) 1 and 3; (c) 2 and 4; (d) 4 only; (e) all correct

38. Immunodeficiency diseases which would be cured by a successful hematopoietic stem cell transplant include:

   1) Bruton’s agammaglobulinemia
   2) C3 deficiency
   3) Chronic granulomatous disease
   4) DiGeorge’s syndrome

39. Leukocytes that enter lymph nodes through high endothelial venules (HEVs) include:

   1) TH cells
   2) B-cells
   3) TC cells
   4) monocytes

40. Development of a GvH reaction is a significant risk following transplantation of which of the following organs into an immunosuppressed recipient?

   1) bone marrow
   2) liver
   3) heart/lung
   4) kidney
QUESTIONS 41-54. TRUE/FALSE [2 points] A = TRUE, B = FALSE

41. _______ A human infant is born with a functioning set of primary, secondary and tertiary lymphoid tissues.

42. _______ Histological examination of Ig deposited in kidney glomeruli during immune complex disease will show a “lumpy bumpy” distribution.

43. _______ The process of “positive selection” in the thymus facilitates maintenance of tolerance by the mechanism of receptor blockade.

44. _______ The low levels of polymorphism typically exhibited by the MHC tend to limit the fortuitous generation of autoimmune diseases.

45. _______ Specialized Fc receptors in the gut of a newborn human infant transport IgG into its circulation only during the first few weeks after birth.

46. _______ Although variolation is an intrinsically safer procedure than vaccination, it is more difficult to carry out in large populations.

47. _______ The olfactory influence on mating choice appears to induce people to select partners who are different from themselves in their MHC alleles.

48. _______ The Nitro Blue Tetrazolium (NBT) test is used to evaluate neutrophil function.

49. _______ Germinal centers will not develop in immune responses to T-independent antigens.

50. _______ Different cancers induced by the same chemical carcinogen will typically express very similar tumor-associated antigens.

51. _______ One-shot serum sickness is the result of a Gell & Coombs Type III immune reaction.

52. _______ Removal of the Bursa of Fabricius in birds before hatching results in an immunodeficiency condition closely resembling human Bruton’s disease.

53. _______ The development of TH1 and TH2 cells from hematopoietic stem cells is part of the process of “antigen dependent” differentiation.

54. _______ Cells that can differentiate into memory cells include TH2 cells and NK cells.