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, IMMUNO E2, November 17, 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 1-32: [4 POINTS] MULTIPLE CHOICE Choose the single best answer

1) In working up a case of possible Rh-incompatibility, you would carry out a Direct Coombs’ Test on:
   a) child’s RBCs
   b) mother’s RBCs
   c) child’s serum
   d) mother’s serum

2) Surgical removal of the Bursa of Fabricius in a developing chicken embryo will produce an adult chicken with a defect in the development of:
   a) T-cells
   b) B-cells
   c) both
   d) neither

3) Members of the immunoglobulin superfamily include
   a) MHC Class II
   b) β2-microglobulin
   c) T-cell receptor
   d) all of the above
   e) none of the above

4) A newborn infant’s blood will show near-adult levels of:
   a) IgG
   b) IgA
   c) IgG and IgM
   d) IgG, IgM and IgA
   e) IgA and IgM

5) Rituxan is a therapeutic monoclonal antibody to CD20, a marker expressed on all B-cells. This antibody is likely to be therapeutically effective for:
   a) Treating SLE
   b) Preventing kidney graft rejection
   c) both
   d) neither
6) Activation of dendritic cells by microbial cell wall components is important in triggering:
   a) innate immunity
   b) adaptive immunity
   c) both
   d) neither

7) The maximum number of different kinds of HLA-B molecules that can be expressed on single B-cell is:
   a) 0
   b) 1
   c) 2
   d) 6
   e) 16

8) A mother is blood type A,Rh+, her child is O, Rh−. The child’s blood at one year of age is likely to contain substantial amounts of which of the following antibodies?
   a) anti-A
   b) anti-A and anti-B
   c) anti-Rh
   d) all of the above
   e) none of the above

9) The late Frank Zappa was HLA-typed as A(3,9);B(14,16), his wife Adelaide as A(3,11);B(17), and their daughter Moon Unit as A(3,9);B14). The least likely HLA phenotype for their son Dweezil is:
   a) A(3,9);B(14)
   b) A(3,9);B(14,17)
   c) A(3,11);B(16,17)
   d) A(3);B(16)
   e) A(9,11);B(14,17)

10) The effector cells which carry out ADCC (“antibody-dependent cell-mediated cytotoxicity”) must express membrane-bound:
   a) Complement receptors
   b) Fc receptors
   c) T cell receptors
   d) Antigen-specific Ig
   e) CD28
11) Which of the following vaccines must be avoided in a potentially immunosuppressed recipient?
   a) DPT  
   b) MMR  
   c) Influenza  
   d) Polio (Salk)

12) Events which are part of the normal process of lymphocyte recirculation include:
   a) T-cell enters the bloodstream from a lymph node through a high endothelial venule (HEV)  
   b) Blood-borne pre-T cell enters the thymus  
   c) B-cell leaves a lymph node through the efferent lymphatic  
   d) Newly formed B-cell leaves the bone marrow to enter the bloodstream.

13) Kidney damage in a patient suffering from serum sickness is the result of an immune reaction classified as Gell & Coombs:
   a) Type I  
   b) Type II  
   c) Type III  
   d) Type IV

14) In the cell interaction required to produce a primary humoral immune response, “signal 2” is provided to the B-cell by:
   a) binding of antigen to Ig receptors  
   b) binding of MHC Class II-associated peptide by the TcR  
   c) binding of CD28 to B7  
   d) soluble IL-4  
   e) soluble IL-2

15) The major population of T-cells within a normal thymus is:
   a) CD8+, CD4+  
   b) CD8+, CD4−  
   c) CD8−, CD4+  
   d) CD8−, CD4−
16) Histological examination of a lymph node from a four month old patient suffering from DiGeorge syndrome (thymic aplasia) should display intact:

a) primary follicles  
b) germinal centers  
c) parafollicular cortex  
d) all of the above  
e) none of the above

17) One might expect the transient appearance of autoimmune disease in the newborn children of mothers suffering from which of the following?

a) Myasthenia gravis  
b) Multiple sclerosis  
c) both  
d) neither

18) “Nude” (nu/nu) mice should produce an effective humoral response when immunized with a:

a) T-dependent antigen  
b) T-independent antigen  
c) both  
d) neither

19) Th1 cells specific for Mycobacterium are important in the development of immunity to this pathogen. During this process, the TcRs of these cells must recognize mycobacterium antigen in the peptide-binding groove of:

a) MHC Class II on a CD8+ T cell  
b) MHC Class I on a CD8+ T cell  
c) MHC Class I on a macrophage  
d) MHC Class II on a macrophage  
e) MHC Class II on a B-cell

20) Contributors to the swelling seen at the site of a positive allergy skin test twelve hours after its initiation are likely to include:

a) infiltration by PMNs and eosinophils  
b) accumulation of fluid from the vasculature  
c) both  
d) neither
21) A cell can become a target for killing by NK cells if it:
   a) loses expression of HLA-DP
   b) downregulates expression of HLA-B
   c) both
   d) neither

22) Once it has been initiated, an allergic reaction will be most effectively controlled by administration of:
   a) antihistamine
   b) epinephrine
   c) anti-CD3
   d) cromolyn sodium

23) The mechanism of receptor blockade is most likely to play a significant role in maintaining self-tolerance to:
   a) HLA-DR
   b) complement C3
   c) Rh antigen
   d) eye lens protein
   e) TcR

24) You would like to find a monoclonal antibody which can be administered to severely allergic patients to reduce their sensitivity to peanuts. Which of the following should be the most effective?
   a) monoclonal IgG against the Fcγ receptor of monocytes
   b) monoclonal IgE against a purified peanut protein allergen
   c) monoclonal IgG against the Fc region of IgE
   d) monoclonal IgE against a Km epitope present the patient’s serum

25) Bacterial “superantigens” trigger toxic shock syndrome by simultaneously binding to:
   a) MHC Class I and TcR
   b) MHC Class II and TcR
   c) MHC Class II and TLR-4
   d) MHC Class I and TLR-4
   e) TLR-4 and TcR
26) If expression of MHC Class I on thymic epithelial cells were blocked, this would cause a failure of which of the following events in the development of CD8+ T-cells?

a) positive selection  
b) negative selection  
c) both  
d) neither  

27) Iatrogenic immunodeficiency is most likely to be seen in:

a) a patient with a genetic defect of complement  
b) the recipient of a transplanted kidney shortly after receiving the graft  
c) a severely malnourished child  
d) a cancer patient shortly before the start of therapy  

28) To produce a Prauznitz-Küstner reaction, a recipient is injected intradermally with a small amount of serum from an allergic donor, and twenty-four hours later injected in the same spot with antigen. This twenty-four hour “latent period” allows time for:

a) antigen to bind to IgE  
b) IgE to bind to mast cells  
c) plasma cells to produce IgE  
d) mast cells to degranulate  

29) If “natural” antibody to the A and B blood group antigens were IgG, then hemolytic disease of the newborn could occur in the children of:

a) O mothers and O fathers.  
b) A mothers and A fathers.  
c) AB mothers and O fathers.  
d) O mothers and AB fathers.  
e) none of the above.  

30) Whole human blood must be irradiated to eliminate the risk of causing GvH before given to:

a) A recipient with deficiency in cell-mediated immunity  
b) A healthy newborn infant  
c) both  
d) neither
31) A young female patient who has two brothers is being considered for a kidney transplant. You set up an MLR (Mixed Lymphocyte Reaction) by mixing her leukocytes together with irradiated leukocytes from various potential donors. After five days in culture you add $^3$H-TdR (radioactively labeled thymidine) and measure its incorporation into DNA. The results are shown below:

<table>
<thead>
<tr>
<th>Donor cells</th>
<th>$^3$H-TdR incorporation (counts per minute)</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>2,200</td>
</tr>
<tr>
<td>unrelated donor</td>
<td>87,300</td>
</tr>
<tr>
<td>father</td>
<td>43,500</td>
</tr>
<tr>
<td>mother</td>
<td>17,100</td>
</tr>
<tr>
<td>brother #1</td>
<td>3,700</td>
</tr>
<tr>
<td>brother #2</td>
<td>27,600</td>
</tr>
</tbody>
</table>

If you had to make a decision based only on the data shown here, which potential kidney donor would you choose?

a) unrelated donor
b) father
c) mother
d) brother #1
e) brother #2

32) Production of hybridomas involves “HAT selection” using cell culture medium containing hypoxanthine, aminopterin and thymidine. The presence of hypoxanthine and thymidine:

a) inhibits the growth of unfused plasmacytoma cells
b) inhibits the growth of unfused B-cells
c) is required for the growth of fused cells
d) facilitates use of the “de novo” pathway for DNA synthesis
e) inhibits the growth of fused cells which produce undesired antibodies
QUESTIONS 33-43: [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

33) Cell surface molecules expressed by both B-cells and macrophages include:

1) MHC Class II  
2) immunoglobulin  
3) MHC Class I  
4) CD3

34) A GvH reaction is likely to be produced if spleen cells from an (AKRxDBA)F1 mouse are infused into which of the following recipients? (AKR, DBA and SJL are unrelated inbred strains).

1) healthy adult AKR  
2) irradiated adult DBA  
3) newborn AKR  
4) newborn (AKRxBALB)F1

35) Bare Lymphocyte Syndrome, Type II (absence of HLA Class II expression) results in:

1) Reduced numbers of circulating CD4+ T-cells  
2) Reduced levels of serum IgG and IgM  
3) Increased susceptibility to viral infections.  
4) Decreased likelihood of developing GvH after receiving a bone-marrow transplant

36) In the Dougherty/Zinkernagel experiments which first demonstrated MHC-associated recognition, virus-specific Tc-cells taken from a mouse of the BALB/c strain should be able to kill which of the following target cells?

1) uninfected (BALB/c x AKR)F1  
2) virus-infected (BALB/c x AKR)F1  
3) uninfected BALB/c  
4) virus-infected BALB/c
37) IgE:

1) may reach serum levels in allergic patients comparable to IgM.
2) can be produced either as monomers or dimers
3) can fix complement by the classical pathway
4) is unusually sensitive to heat denaturation

38) During the interaction of a virus-specific Tc cell with a virally infected target, the T cell receptor must make direct contact with which of the following molecules on the target cell?

1) viral peptide
2) CD8
3) MHC Class I
4) CD3

39) “Antigen-Independent” differentiation includes the process by which:

1) B-cells develop into plasma cells
2) Pre-T-cells develop into naïve T-cells
3) B-cells develop into memory cells
4) Hematopoietic stem cells develop into B-cells

40) A successful hematopoietic stem cell transplant would cure which of the following diseases?

1) Severe Combined Immunodeficiency (SCID)
2) Complement C3 deficiency
3) Bruton’s Agammaglobulinemia
4) Thymic Aplasia

41) “Conjugate vaccines” (carbohydrate antigens coupled to a protein carrier) were developed in order to:

1) Decrease the cost of vaccine production
2) Increase the efficiency of MHC Class I presentation
3) Decrease the risk of causing disease
4) Increase the likelihood of isotype switching
42) A fluorescent antibody to human CD3 should stain the majority of lymphocytes in:

1) primary follicles
2) parafollicular cortex
3) “mantle” of secondary follicles
4) blood

43) A research report in 2003 described the first case of human non-identical twins who had shared a single placenta and prenatal circulatory system. If you studied these two siblings as adults, you would expect to find that:

1) each sibling is unable to reject skin grafts from the other
2) they are both uniformly homozygous at all genetic loci
3) virus-specific Tc cells from each of them can kill virus-infected target cells obtained from the other
4) each sibling is unable to reject skin grafts from either parents
QUESTION 44-52. TRUE/FALSE [2 points]  A = TRUE, B = FALSE

44______ The presence of rheumatoid factor is a highly specific marker for RA (rheumatoid arthritis).

45______ Graft rejection is generally a manifestation of cell-mediated immunity.

46______ During “cross-presentation”, viral peptides which travel through gap junction channels from an infected cell to an adjacent non-infected cell will be displayed predominantly in MHC Class I.

47______ Germinal centers are an important site of V/D/J gene rearrangement.

48______ Primary follicles contain HEV’s through which B-cells enter the lymph node.

49______ IgA can be transferred across the wall of the human small intestine to the blood only during the first few weeks after birth.

50______ Influenza vaccine consists of killed virus.

51______ The role of TREG cells is to maintain central tolerance.

52______ The Mixed Lymphocyte Reaction is used mainly for typing of HLA Class II antigens.