Roll No. .....

Question Booklet Number

O. M. R. Serial No.

M. Sc. (Microbiology)
(Fourth Semester) EXAMINATION, 2025-26
(Old Syllabus Effective from 2022)
(Only Back Paper Students)
ADVANCED IMMUNOLOGY AND IMMUNOSTECHNIQUES

Paper Code							
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Questions Booklet Series
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Time : 1:30 Hours] [*Maximum Marks : 75*

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.

2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.

3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।

2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।

3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(Remaining instructions on the last page) **(शेष निर्देश अन्तिम पृष्ठ पर)**

(Only for Rough Work)

1. The primary difference between a primary and secondary lymphoid organ is that :

   (A) Primary organs are the sites of antigen-dependent activation.

   (B) Secondary organs are where lymphocytes undergo somatically rearranged maturation.

   (C) Primary organs provide the environment for antigen-independent stem cell differentiation.

   (D) Secondary organs are responsible for the initial production of all myeloid cells.

2. Which of the following is a characteristic of the "Innate" immune response ?

   (A) High specificity for unique peptide epitopes.

   (B) Recognition of highly conserved PAMPs via germline-encoded receptors.

   (C) The ability to undergo class-switching to produce IgG.

   (D) A delayed response time requiring several days for peak activity.

3. In the context of hematopoiesis, the Common Lymphoid Progenitor (CLP) gives rise to :

   (A) Neutrophils, Basophils, and Eosinophils.

   (B) B-cells. T-cells, and Natural Killer (NK) cells.

   (C) Erythrocytes and Megakaryocytes.

   (D) Monocytes and specialized Macrophages.

4. Which cytokine is known as the "Endogenous Pyrogen" due to its role in inducing fever during inflammation ?

   (A) Interleukin-1 (IL-1)

   (B) Interferon-gamma (IFN-γ)

   (C) Interleukin-10 (IL-10)

   (D) Transforming Growth Factor-beta (TGF-β)

5. Antimicrobial peptides (AMPs) like cathelicidins primarily kill pathogens by :

   (A) Inhibiting viral reverse transcriptase.

   (B) Neutralizing bacterial toxins in the extracellular matrix.

   (C) Inducing apoptosis in virally infected host cells.

   (D) Forming pores in the microbial lipid bilayer to cause osmotic lysis.

6. The process of "Thymic Education" involves negative selection, which ensures :

(A) T-cells can recognize MHC molecules.

(B) T-cells that react strongly to "self" antigens are eliminated.

(C) B-cells switch from producing IgM to IgA.

(D) Neutrophils gain the ability to perform diapedesis.

7. A neonate receives antibodies through the mother's colostrum. This is a classic example of :

(A) Natural Passive Immunity.

(B) Artificial Active Immunity.

(C) Natural Active Immunity.

(D) Artificial Passive Immunity.

8. Following an acute bacterial infection, a patient's blood work shows "Neutrophilia." This is likely driven by :

(A) Increased levels of Erythropoietin (EPO) .

(B) Accelerated myeloid hematopoiesis in response to G-CSF and inflammatory cytokines.

(C) Massive apoptosis of B-lympho-cytes in the spleen.

(D) A deficiency in the production of antimicrobial peptides.

9. A patient has a mutation in the IFN-γ receptor. Which immune process will be most compromised ?

(A) The ability of B-cells to recognize soluble antigens.

(B) The formation of the Membrane Attack Complex (MAC).

(C) The activation of macrophages to kill intracellular pathogens.

(D) The initial physical barrier provided by the skin epithelium.

10. During the inflammatory response, "Rubor" (redness) is clinically observed because of :

(A) Localized vasoconstriction to prevent pathogen spread.

(B) The accumulation of dead leukocytes forming pus.

(C) The localized vasodilation of small blood vessels to increase blood flow.

(D) The release of IL-10 to dampen the immune response.

11. A child is accidentally pricked by a rusted nail and is given a Tetanus Toxoid vaccine. This intervention aims to induce :

(A) Natural Passive Immunity.

(B) Natural Active Immunity.

(C) Artificial Passive Immunity.

(D) Artificial Active Immunity.

12. Compare the role of the Spleen and the Lymph Nodes. Which statement is accurate ?

(A) Lymph nodes monitor blood-borne pathogens; the spleen monitors tissue-borne pathogens.

(B) The spleen is a primary lymphoid organ; lymph nodes are secondary.

(C) The spleen filters antigens from the blood; lymph nodes filter antigens from the lymph.

(D) Only lymph nodes contain germinal centers for B-cell proliferation.

13. Analyze the relationship between NK cells and T_C (Cytotoxic T) cells. How do they differ ?

(A) NK cells are innate effectors lacking antigen-specific TCRs; T_C cells are adaptive and recognize specific MHC-peptide complexes.

(B) NK cells are derived from the myeloid line; T_C cells are derived from the lymphoid line.

(C) Only T_C cells have the ability to induce apoptosis in target cells.

(D) NK cells require prior sensitization/exposure, whereas T_C cells do not.

14. What happens to the immune system if the "Negative Selection" phase in the thymus is defective ?

(A) The individual will be unable to produce any T-cells.

(B) There will be a massive increase in the production of neutrophils.

(C) Self-reactive T-cells will enter the circulation. lending to systemic auto immunity.

(D) The individual will become highly resistant to all viral infections.

15. Evaluate the impact of "Cytokine Pleiotropy." Which example best illustrates this concept ?

(A) Multiple cytokines (e.g., IL-1, IL-6) all inducing the same fever response.

(B) A single cytokine (e.g., IL-4) acting on B-cells, T-cells. and mast cells to produce different effects.

(C) A cytokine that only acts on the specific cell that secreted it.

(D) The total absence of cytokines in the innate immune response.

16. Distinguish between PAMPs (Pathogen-Associated Molecular Patterns) and Epitopes :

(A) Epitopes are found on pathogens; PAMPs are found on host cells.

(B) PAMPs are recognized by the adaptive system; Epitopes by the innate system.

(C) PAMPs are broad structural patterns shared by many microbes; Epitopes are unique molecular shapes recognized by specific clones of B/T cells.

(D) There is no structural or functional difference between PAMPs and Epitopes.

17. Analyze the consequence of severe "Lymphopenia" (low lymphocyte count) in a postgraduate clinical context :

(A) Impaired immediate inflammatory response to a cut.

(B) Failure to mount an adaptive immune response and lack of immunological memory.

(C) Overproduction of erythrocytes leading to thick blood.

(D) Immediate failure of the Na+/K+ pump in neurons.

18. How does “Complement C3” serve as a hub for both innate and adaptive functions ?

(A) It acts as a neurotransmitter in the hypothalamus.

(B) It is required for the maturation of T-cells in the thymus.

(C) It facilitates opsonization (innate) and can be activated by antibody-antigen complexes (adaptive) .

(D) It is the primary cytokine responsible for hematopoiesis.

19. Contrast the Bone Marrow and the Spleen :

(A) Bone marrow is a primary lymphoid organ; the spleen is secondary.

(B) The spleen produces all blood cells; the bone marrow filters them.

(C) Both are primary lymphoid organs.

(D) Bone marrow is where T-cells encounter antigens.

20. What is the significance of “MALT” (Mucosa-Associated Lymphoid Tissue) ?

(A) It is where red blood cells are recycled.

(B) It provides a specialized immune defense for vulnerable mucosal surfaces (gut, lungs) .

(C) It is the primary site of hematopoiesis in adults.

(D) It secretes steroid hormones to regulate the immune response.

21. Analyze the effect of “Type I Interferons” on viral replication :

(A) They directly digest the viral protein coat.

(B) They induce host cells to degrade viral mRNA and inhibit protein synthesis.

(C) They stimulate B-cells to produce antibodies against the virus.

(D) They increase the temperature of the body to kill the virus.

22. Which lineage is primarily responsible for "Humoral Immunity" ?

(A) The Myeloid lineage via ncutrophils.

(B) The Lymphoid lineage via B-lymphocytes and plasma cells.

(C) The Erythroid lineage via hemoglobin.

(D) The Megakaryocyte lineage via platelets.

23. If "Hematopoietic Stem Cells" (HSCs) are destroyed by radiation, why is the immune response lost ?

(A) Because the skin can no longer produce sweat.

(B) Because antibodies already in the blood turn into toxins.

(C) Because there is no source for the continuous replenishment of innate and adaptive immune cells.

(D) Because the hypothalamus stops regulating body temperature.

24. In the context of humoral immunity, what is the primary structural difference between an isotype and an idiotype ?

(A) Isotypes are defined by variations in the light chain, while idiotypes are defined by the heavy chain.

(B) Isotypes are variations in the constant region of the heavy chain, while idiotypes are unique to the variable region's antigen-binding site.

(C) Isotypes vary between individuals of a species, while idiotypes are the same for all members of a species.

(D) Isotypes determine the antigen specificity, while idiotypes determine the effector function like complement activation.

25. According to Burnet's Clonal Selection Theory, what happens to lymphocytes that possess receptors for "self" molecules during early development ?

(A) They are induced to proliferate rapidly to ensure self recognition.

(B) They are deleted or inactivated to maintain immunological tolerance.

(C) They are converted into myeloid progenitor cells.

(D) They are stored in the yellow bone marrow for emergency use.

26. What is the physiological role of the "ITAMs" found on the Igα and Igβ components of the B-cell receptor complex ?

(A) They act as the primary binding site for large polysaccharide antigens.

(B) They provide the structural disulfide bonds that hold the heavy and light chains together.

(C) They serve as docking sites for tyrosine kinases to initiate intracellular signaling cascades.

(D) They facilitate the transport of the antibody across the placenta.

27. In muscle physiology, the "All-or-None Rule" specifically dictates that :

(A) An entire muscle group must contract at once to move a bone.

(B) If a stimulus reaches the threshold, an individual muscle fiber will contract to its full extent.

(C) All ATP in the sarcoplasm must be consumed before relaxation can begin.

(D) The heart will only beat if every single cardiac cell is stimulated by the vagus nerve.

28. Which mechanism is primarily responsible for the "Saltatory Conduction" observed in myelinated neurons ?

(A) The continuous flow of ions along the entire length of the axonal membrane.

(B) The rapid opening of chemically-gated channels in the dendrites.

(C) The depolarization of the membrane occurring only at the uninsulated Nodes of Ranvier.

(D) The backward flow of sodium ions toward the soma.

29. The "Ornithine Cycle" (Urea Cycle) is a metabolic pathway that primarily serves to :

(A) Convert glucose into lactic acid during anaerobic exercise.

(B) Synthesize essential amino acids from carbon dioxide.

(C) Detoxify ammonia by converting it into urea for excretion.

(D) Produce ATP through the oxidation of fatty acids in the mitochondria.

30. If a researcher applies a chemical that blocks the "AChE" (Acetyl-cholinesterase) enzyme at the neuromuscular junction, what will happen to the muscle ?

(A) The muscle will fail to contract because ACh cannot bind to receptors.

(B) The muscle will undergo prolonged contraction or spasms because ACh remains in the cleft.

(C) The muscle will atrophy immediately due to lack of blood flow.

(D) The muscle will switch from aerobic to anaerobic respiration instantly.

31. In a clinical study, a subject is given a drug that prevents the "Receptor Editing" process in B-cells. This subject is now at a higher risk for :

(A) Developing a primary immunodeficiency.

(B) Releasing self-reactive B-cells into the periphery, increasing autoimmune risk.

(C) A significant decrease in the production of all plasma proteins.

(D) Developing hypercalcemia due to bone resorption.

32. A mountain climber ascending to 18,000 feet experiences a drop in blood oxygen levels. How will the kidneys respond to maintain homeostasis ?

(A) By increasing the secretion of ADH to conserve water.

(B) By decreasing the glomerular filtration rate to save energy.

(C) By releasing Erythropoietin (EPO) to stimulate the production of more red blood cells.

(D) By excreting more sodium to lower the blood pressure.

33. During a laboratory test, it is noted that a patient's T-cells can bind to antigens but fail to proliferate because the APCs lack "B7" molecules. This state of T-cell non-responsiveness is called :

(A) Chemotaxis.

(B) Anergy.

(C) Opsonization.

(D) Diapedesis.

34. A patient has a condition that causes the over-secretion of Aldosterone. Which physiological change would you expect to see ?

(A) Low blood pressure and high potassium levels.

(B) Increased excretion of glucose in the urine.

(C) High blood pressure and increased sodium reabsorption in the kidneys.

(D) Decreased cardiac output and slow heart rate.

35. Compare the "Intrinsic" and "Extrinsic" pathways of blood coagulation. Which statement correctly identifies their relationship ?

(A) They are entirely independent and never interact.

(B) The Intrinsic pathway is triggered by tissue trauma, while the Extrinsic is triggered by collagen exposure.

(C) Only the Extrinsic pathway requires calcium ions (Ca^{2+}).

(D) Both pathways converge at the activation of Factor X to form the common pathway.

36. What is the functional consequence if the "AV Nodal Delay" is shortened to 0.01 seconds instead of the normal 0.1 seconds ?

(A) The ventricles will have more time to fill with blood.

(B) The atria and ventricles will contract almost simultaneously, reducing the efficiency of ventricular filling.

(C) The heart rate will drop to 30 beats per minute.

(D) The aortic valve will remain permanently closed.

37. Analyze the role of "Tropomyosin" in a resting skeletal muscle. What prevents contraction from occurring" ?

(A) Tropomyosin covers the myosin-binding sites on the actin filament.

(B) Tropomyosin hydrolyzes all available ATP.

(C) Tropomyosin pulls the Z-discs further apart.

(D) Tropomyosin prevents the release of calcium from the sarcoplasmic reticulum.

38. Which of the following would occur if the "Glomerular Hydrostatic Pressure" were to drop below the "Colloid Osmotic Pressure" ?

(A) The rate of urine formation would increase significantly.

(B) Ultrafiltration would cease because the net filtration pressure would become zero or negative.

(C) Glucose would be actively secreted into the Bowman's capsule.

(D) The efferent arteriole would constrict to lower the pressure further.

39. Distinguish between the mechanisms of "Insulin" and "Steroid" hormones. Which statement is correct ?

(A) Insulin acts as a transcription factor in the nucleus, while steroids bind to membrane receptors.

(B) Steroid hormones are faster-acting because they do not require protein synthesis.

(C) Both hormones are lipid-soluble and cross the cell membrane freely.

(D) Insulin uses a second-messenger system (Tyrosine Kinase) , while steroids bind to intracellular receptors to alter gene expression.

40. What is the significance of the "Hypervariable Regions" (CDRs) in an antibody molecule ?

(A) They determine the allotype of the antibody.

(B) They allow the antibody to bind to the Fc receptor on macrophages.

(C) They provide the specific chemical environment and shape to bind a particular epitope.

(D) They ensure that the antibody can cross the blood-brain barrier.

41. Analyze the impact of "Hypokalemia" (low blood potassium) on the resting membrane potential of a neuron :

(A) The RMP becomes more positive (depolarize), making the neuron fire more easily.

(B) The RMP becomes more negative (hyperpolarize), making the neuron more difficult to stimulate.

(C) The RMP stays at 0 mV because the Na+/K+ pump stops.

(D) The myelin sheath begins to dissolve inmediately.

42. In the "Sliding Filament Theory," what event specifically causes the "Power Stroke" (the pulling of actin) ?

(A) The binding of a new ATP molecule to the myosin head.

(B) The release of Pi (inorganic phosphate) from the myosin head.

(C) The hydrolysis of ATP into ADP.

(D) The movement of calcium back into the sarcoplasmic reticulum.

43. What is the likely immunological outcome of "Molecular Mimicry" after a bacterial infection ?

(A) The host becomes immune to all future bacterial infections.

(B) The production of B-cells is permanently halted in the bone marrow.

(C) The bacteria are converted into beneficial gut microbiota.

(D) The immune system mistakenly attacks self-tissues that resemble the bacterial antigens.

44. How does the "Countercurrent Multiplier" in the Loop of Henle contribute to osmoregulation ?

(A) It pumps water into the medulla to keep it dilute.

(B) It establishes a high osmotic pressure in the medullary interstitium, allowing for water reabsorption in the collecting duct.

(C) It ensures that the urine is always exactly the same concentration as the blood.

(D) It prevents the reabsorption of sodium in the distal tubule.

45. Distinguish between the "Classical" and "Alternative" pathways of complement activation :

(A) The Classical pathway is innate; the Alternative is adaptive.

(B) The Alternative pathway is only found in invertebrates.

(C) Only the Classical pathway leads to the formation of the Membrane Attack Complex (MAC) .

(D) The Classical pathway requires antibody-antigen complexes; the Alternative is triggered directly by microbial surfaces.

46. What would happen to the "Cardiac Output" if the Heart Rate increased significantly but the Stroke Volume dropped proportionally due to poor filling ?

(A) Cardiac Output would increase.

(B) Cardiac Output would remain relatively unchanged.

(C) Cardiac Output would decrease significantly.

(D) The blood pressure would instantly drop to zero.

47. Which enzyme is specifically responsible for adding non-templated "N-nucleotides" to the junctions of V, D, and J segments ?

(A) DNA Polymerase delta

(B) RAG-1/RAG-2 Complex

(C) Terminal Deoxynucleotidyl Transferase (TdT)

(D) Activation-Induced Cytidine Deaminase (AID)

48. The "MHC Class I" molecules are characterized by which of the following ?

(A) They are expressed only on professional antigen-presenting cells.

(B) They consist of an α chain and a β-microglobulin chain.

(C) They primarily present exogenous peptides to CD_4^+ T-cells.

(D) They are encoded by the HLA-DR, DQ, and DP loci.

49. In the context of B-cell development, "Somatic Hypermutation" primarily occurs :

(A) In the bone marrow during the antigen-independent phase.

(B) During the initial transition from a stem cell to a pro-B cell.

(C) In the thymus during the negative selection of T-cells.

(D) Within the germinal centers of secondary lymphoid organs after antigen encounter.

50. The term "Haplotype" in HLA geneties refers to :

(A) The total number of different HLA alleles present in a population.

(B) A specific set of HLA genes inherited together from a single parent.

(C) The process of switching from IgM to IgG production.

(D) The unique binding pocket formed by the CDR3 region of a TCR.

51. What is the primary role of "Type I Interferons" (IFN- α/β) in immunity to viruses ?

(A) They act as opsonins to enhance phagocytosis of viral capsids.

(B) They directly lyse the lipid envelope of enveloped viruses.

(C) They trigger the maturation of B-cells into plasma cells.

(D) They induce an "antiviral state" in neighboring cells by inhibiting protein synthesis.

52. A patient with a mutation in the "Btk" (Bruton's Tyrosine Kinase) gene will likely present with :

(A) A total absence of T-cells but normal B-cell counts.

(B) High levels of IgE and frequent allergic reactions.

(C) A failure of B-cells to mature beyond the pre-B stage, resulting in no circulating antibodies.

(D) Overactive NK cells leading to tissue destruction.

53. A patient requires a bone marrow transplant. If the donor T-cells recognize the recipient's HLA molecules as foreign and attack the host tissues, the condition is known as :

(A) Acute Myeloid Leukemia.

(B) Graft-versus-Host Disease (GVHD).

(C) Hyperacute Rejection.

(D) Central Tolerance failure.

54. In a laboratory experiment, the "RAG-1" gene is knocked out in a mouse. What is the expected phenotype ?

(A) The mouse will lack both mature B and T lymphocytes.

(B) The mouse will produce only IgM antibodies.

(C) The mouse will have an overactive innate inmune system.

(D) The mouse will be unable to produce any cytokines.

55. A 25-year-old male presents with chronic back pain and stiffness. Genetic testing reveals he is positive for the "HLA-B27" allele. This strongly associates him with :

(A) Systemic Lupus Erythematosus (SLE) .

(B) Type 1 Diabetes Mellitus.

(C) Ankylosing Spondylitis.

(D) Myasthenia Gravis.

56. Tumor cells often upregulate "PD-L1" on their surface. What is the immunological consequence of this expression ?

(A) It makes the tumor cell more susceptible to lysis by complement.

(B) It acts as a "stop" signal to T-cells, leading to T-cell exhaustion and immune evasion.

(C) li attracts more Dendritic Cells to the tumor site.

(D) It triggers the production of high-affinity neoantigens.

57. A child is diagnosed with "ADA-SCID" (Adenosine Deaminase deficiency) . Why does this lead to immunodeficiency ?

(A) It prevents the liver from producing complement proteins.

(B) It causes the hyper-secretion of cortisol.

(C) It blocks the transport of IgG across the placenta.

(D) Toxic metabolites (dATP) accumulate and are lethal to developing B and T cells.

58. During a "Mixed Lymphocyte Reaction" (MLR) test, if cells from two individuals proliferate significantly when mixed, it indicates :

(A) That the individuals are identical twins.

(B) That the individuals have highly mismatched HLA Class II alleles.

(C) That both individuals have a deficiency in NK cells.

(D) That the cells have entered a state of anergy.

59. Analyze the process of "Affinity Maturation." Which enzyme and cell-cell interaction are essential for this to occur ?

(A) TdT and Macrophage-T cell interaction.

(B) AID and B cell-Follicular Helper T (T_{FH}) cell interaction.

(C) RAG-1 and Thymic epithelial cell interaction.

(D) Caspase-3 and NK cell interaction.

60. Compare the genetic basis of "Central Tolerance" versus "Peripheral Tolerance." Which statement is accurate ?

(A) Both rely exclusively on the AIRE gene expression in the spleen.

(B) There is no genetic component to peripheral tolerance.

(C) Peripheral tolerance occurs in the bone marrow, while central tolerance occurs in the lymph nodes.

(D) Central tolerance involves the AIRE-mediated expression of tissue-specific antigens in the thymus; peripheral tolerance involves anergy and Tregs.

61. What is the significance of "MHC Polymorphism" at the population level ?

(A) It ensures that every individual has exactly the same immune response to a virus.

(B) It increases the likelihood that at least some individuals in a population will be able to present a particular pathogen's peptides.

(C) It prevents the occurrence of all autoimmune diseases.

(D) It eliminates the need for T-cell co-stimulation.

62. Analyze the "Immune Evasion" strategy where a virus downregulates MHC Class I expression on the host cell. How does the innate system counter this ?

(A) B-cells produce more IgM.

(B) Macrophages increase their phagocytic rate.

(C) NK cells detect the "missing self" (lack of MHC I) and lyse the cell.

(D) The cell undergoes spontaneous mitosis.

63. In "Systemic Lupus Erythematosus" (SLE) , the pathogenesis involves the failure to clear apoptotic debris. What is the systemic result ?

(A) A lack of inflammation in the joints.

(B) Exposure of self-nuclear antigens (like dsDNA) leading to autoantibody formation and immune complex deposition.

(C) The permanent activation of the Pineal gland.

(D) The conversion of B-cells into muscle fibers.

64. What is the likely consequence of a genetic defect in the "IL-2 Receptor γ-chain" ?

(A) Only a mild allergy to peanuts.

(B) X-linked Severe Combined Immunodeficiency (X-SCID) due to failed cytokine signaling in lymphocyte development.

(C) A significant increase in the production of red blood cells.

(D) The inability of the blood to clot.

65. Analyze the "Molecular Mimicry" hypothesis in the context of Rheumatic Fever :

(A) The bacteria mimic host cytokines to suppress the immune system.

(B) Antibodies against Streptococcal M-protein cross-react with self-antigens in the heart (myosin) .

(C) The host's DNA changes to match the bacterial DNA.

(D) B-cells stop producing antibodies and start producing toxins.

66. Which HLA class is primarily involved in presenting "Endogenous" antigens like viral proteins synthesized inside the cell ?

(A) HLA Class I (A, B, C)

(B) HLA Class II (DR, DQ, DP)

(C) HLA Class III (Complement)

(D) The TCR-α locus

67. Distinguish between the mechanisms of "Central" and "Peripheral" B-cell tolerance :

(A) Central occurs via receptor editing/deletion in the bone marrow; Peripheral occurs via anergy/exclusion in the spleen/lymph nodes.

(B) Both occur only in the thymus.

(C) Central tolerance uses AIRE; Peripheral tolerance does not.

(D) There is no such thing as B-cell tolerance.

68. In "Immunity to Parasites", which genetic program is typically activated ?

(A) The T_H 1 pathway leading to IgG and macrophage activation.

(B) The T_H 2 pathway leading to IgE production and eosinophil recruitment.

(C) The T_H 17 pathway leading to neutrophil influx.

(D) The anaerobic glycolytic pathway.

69. What would be the effect of a mutation that prevents "MHC Class II" expression (Bare Lymphocyte Syndrome Type II) ?

(A) A total lack of $CD8^+$ Cytotoxic T-cells.

(B) Faster wound healing.

(C) Over-secretion of Calcitonin.

(D) A failure to develop $CD4^+$ Helper T-cells, leading to a loss of both cellular and humoral control.

70. In the HAT selection medium for hybridoma production, Aminopterin serves to :

(A) Act as a source of hypoxanthine for the salvage pathway.

(B) Block the *de novo* pathway of nucleotide synthesis.

(C) Enhance the fusion rate between B-cells and myeloma cells.

(D) Selectively kill the primary B-lymphocytes.

71. Which technique is most appropriate for determining the "identity" or "non-identity" between two different antigen preparations ?

(A) Radial Immunodiffusion (Mancini Technique) .

(B) Complement Fixation Test.

(C) Ouchterlony Double Diffusion.

(D) Sandwich ELISA.

72. In Flow Cytometry, the Side Scatter (SSC) signal is primarily indicative of a cell's :

(A) Relative size and volume.

(B) Surface expression of CD markers.

(C) DNA content and cell cycle stage.

(D) Internal complexity and granularity.

73. The "Prozone Effect" in a precipitation reaction occurs when :

(A) There is a significant excess of antibody over antigen.

(B) There is a significant excess of antigen over antibody.

(C) The antigen and antibody are in the zone of equivalence.

(D) The temperature of the reaction is below 4°C.

74. What is the primary advantage of a "Sandwich ELISA" over an "Indirect ELISA" ?

(A) It is faster to perform.

(B) It specifically measures the concentration of an antigen rather than an antibody.

(C) It does not require a secondary antibody.

(D) It uses radioisotopes for higher sensitivity.

75. Immunoelectron microscopy utilizes "Immunogold" particles because :

(A) Gold is highly fluorescent.

(B) Gold is electron-dense and appears as distinct black dots under the beam.

(C) Gold stimulates the release of cytokines from the sample.

(D) Gold binds covalently to the lipid bilayer.

76. A researcher wants to quantify the number of individual B-cells secreting anti-tetanus antibodies in a patient. Which technique should be used ?

(A) ELISPOT

(B) Western Blotting

(C) Flow Cytometry (FSC/SSC only)

(D) Agglutination

77. To detect a specific chromosomal translocation in a tumor biopsy in situ, a pathologist would most likely use :

(A) Immunohistochemistry (IHC)

(B) Fluorescent In Situ Hybridization (FISH)

(C) Radioimmunoassay (RIA)

(D) Complement Fixation

78. A patient's serum fails to lyse indicator RBCs in a Complement Fixation Test for syphilis. How should this result be interpreted ?

(A) The test is positive for syphilis.

(B) The test is negative for syphilis.

(C) The complement was inactivated by heat.

(D) The patient has an underlying immunodeficiency.

79. During a FACS experiment, a scientist wants to isolate CD4+ T_{regs} that also express intracellular FoxP3. What must be done before staining for FoxP3 ?

(A) The cells must be heated to 95°C.

(B) The cells must be alive and actively dividing.

(C) The cells must be fixed and permeabilized.

(D) The cells must be treated with insulin.

80. A lab is developing a new diagnostic kit to detect very low levels (picograms) of a thyroid hormone. Which method offers the highest sensitivity for small molecules ?

(A) Precipitation in agar.

(B) Radioimmunoassay (RIA).

(C) Direct Agglutination.

(D) Immunoelectrophoresis.

81. Annexin V staining is used in flow cytometry to detect which stage of cell death ?

(A) Necrosis

(B) Late-stage DNA fragmentation

(C) Early apoptosis (phosphatidyl-serine flipping)

(D) Cell senescence

82. Which technique would be best to compare the "proteome-wide" antibody response in a vaccinated individual ?

(A) Immunomics (Protein Microarrays)

(B) GISH

(C) Intracellular Cytokine Staining

(D) Radial Immunodiffusion

83. In a "Knock-out" mouse project, the goal is to delete the (RAG-2) gene. What is the expected immunological phenotype of this mouse ?

(A) Excessive production of IgG.

(B) A total lack of mature B and T lymphocytes.

(C) Overactive macrophages and neutrophils.

(D) Absence of MHC Class II molecules.

84. Compare Polyclonal (pAbs) and Monoclonal (mAbs) antibodies. Which statement is true regarding their diagnostic use ?

(A) pAbs are more specific for a single epitope.

(B) mAbs provide higher sensitivity for detecting low-abundance antigens because they bind multiple sites.

(C) mAbs provide higher consistency and batch-to-batch reproducibility.

(D) pAbs are produced using hybridoma technology.

85. An IHC slide shows intense staining in the nucleus for a protein that should be cytoplasmic. What is a likely technical error ?

(A) High background due to inadequate blocking of endogenous peroxidases.

(B) The secondary antibody was omitted.

(C) The primary antibody was used at too low a concentration.

(D) Non-specific binding or cross-reactivity with nuclear proteins.

86. What is the functional difference between FSC and SSC in flow cytometry ?

(A) FSC measures fluorescence; SSC measures size.

(B) FSC measures cell size; SSC measures internal complexity.

(C) Both measure the same parameter from different angles.

(D) FSC is used for sorting; SSC is only for counting.

87. In the TUNEL assay, the enzyme Terminal Deoxynucleotidyl Transferase (TdT) is used to :

(A) Generate diversity in B-cells.

(B) Phosphorylate the TCR signaling complex.

(C) Lyse the cell membrane of tumor cells.

(D) Add labeled nucleotides to the 3′ ends of fragmented DNA in apoptotic cells.

88. Analyze the use of "Brefeldin A" in Intracellular Cytokine Staining (ICS) . Why is it added ?

(A) To stimulate the cell to produce more cytokines.

(B) To block protein transport from the ER to the Golgi, trapping cytokines inside the cell.

(C) To kill the cells so the antibody can enter.

(D) To act as a fluorescent label for the Golgi apparatus.

89. Distinguish between FISH and GISH.

(A) FISH is for RNA; GISH is for DNA.

(B) FISH uses specific gene probes; GISH uses total genomic DNA to distinguish species in hybrids.

(C) GISH is only used in human medicine.

(D) FISH is a type of ELISA.

90. Why is "Transgenic" mouse technology preferred over "Knock-out" for studying the gain-of-function of a human oncogene ?

(A) Transgenic mice are easier to make.

(B) Knock-outs cannot be performed on human genes.

(C) Transgenics involve the insertion and overexpression of a foreign gene, whereas knock-outs involve gene deletion.

(D) Transgenic mice do not have an immune system.

91. In Immunoinformatics, "MHC Binding Prediction" algorithms are used primarily to :

(A) Predict which peptides will fit into the HLA groove for vaccine design.

(B) Design better growth media for bacteria.

(C) Calculate the molecular weight of an antibody.

(D) Determine the age of a patient based on their HLA type.

92. Which assay would you use to measure the "Cytotoxic T-lymphocyte" (CTL) activity against a specific tumor target ?

(A) Agglutination assay

(B) ^{51}Cr release assay or LDH release assay

(C) Radial Immunodiffusion

(D) Mancini test

93. What would be the effect of omitting the "Blocking" step in an ELISA or Western Blot ?

(A) No signal would be detected.

(B) The enzyme would stop working.

(C) The antigen would be washed away.

(D) High non-specific background signal across the entire plate or membrane.

94. Which of the following best describes the function of an "Adjuvant" like Alum in a vaccine formulation ?

(A) It acts as a preservative to prevent bacterial contamination of the vial.

(B) It creates an antigen depot and stimulates the innate immune system to enhance the adaptive response.

(C) It provides passive immunity by introducing pre-formed antibodies into the host.

(D) It specifically largets and kills the pathogen before it can infect host cells.

95. What is a defining characteristic of "mRNA Vaccines" compared to traditional live- attenuated vaccines ?

(A) They require a cold chain and are much more stable at room temperature.

(B) They use a lipid nanoparticle to deliver genetic instructions for a specific protein, rather than the whole virus.

(C) They carry the risk of reverting to a virulent form and causing the disease.

(D) They only provide passive, short-term immunity without creating memory cells.

96. In the context of cancer treatment. "Checkpoint Inhibitors" (like anti-PD-1) work by :

(A) Directly lysing tumor cells through osmotic shock.

(B) Blocking inhibitory signals that tumors use to suppress T-cell activity.

(C) Preventing the bone marrow from producing any new white blood cells.

(D) Converting T-helper cells into regulatory T-cells.

97. Which type of immunization is provided by the administration of "Anti-venom" following a snake bite ?

(A) Natural Active Immunization.

(B) Artificial Active Immunization.

(C) Natural Passive Immunization.

(D) Artificial Passive Immunization.

98. "Edible Vaccines" produced in transgenic plants primarily aim to induce immunity at which site ?

(A) The systemic circulation via intramuscular absorption.

(B) The mucosal surfaces of the gut through oral administration.

(C) The central nervous system across the blood-brain barrier.

(D) The hair follicles and sebaceous glands.

99. The "Theranostic" approach in immunology is best defined as :

(A) Treating a disease using only thermal energy.

(B) Using a single agent for both the diagnosis and targeted therapy of a disease.

(C) The study of how the immune system reacts to different types of exercise.

(D) The process of identifying new bacterial species in soil.

100. During a CAR-T cell manufacturing process, why are the patient's T-cells modified with a "Chimeric Antigen Receptor" ?

(A) To allow them to produce insulin for the patient.

(B) To enable them to recognize tumor antigens independently of MHC presentation.

(C) To make the T-cells invisible to the patient's own immune system.

(D) To prevent the T-cells from ever undergoing apoptosis.

(Only for Rough Work)

4. Four alternative answers are mentioned for each question as—A, B, C & D in the booklet. The candidate has to choose the correct answer and mark the same in the OMR Answer-Sheet as per the direction :

Example :

Question :

Q. 1 (A) ● (C) (D)
Q. 2 (A) (B) ● (D)
Q. 3 (A) ● (C) (D)

Illegible answers with cutting and over-writing or half filled circle will be cancelled.

5. Each question carries equal marks. Marks will be awarded according to the number of correct answers you have.
6. All answers are to be given on OMR Answer Sheet only. Answers given anywhere other than the place specified in the answer sheet will not be considered valid.
7. Before writing anything on the OMR Answer Sheet, all the instructions given in it should be read carefully.
8. After the completion of the examination candidates should leave the examination hall only after providing their OMR Answer Sheet to the invigilator. Candidate can carry their Question Booklet.
9. There will be no negative marking.
10. Rough work, if any, should be done on the blank pages provided for the purpose in the booklet.
11. To bring and use of log-book, calculator, pager and cellular phone in examination hall is prohibited.
12. In case of any difference found in English and Hindi version of the question, the English version of the question will be held authentic.

Impt. : On opening the question booklet, first check that all the pages of the question booklet are printed properly. If there is any discrepancy in the question Booklet, then after showing it to the invigilator, get another question Booklet of the same series.

4. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर—A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से सही उत्तर छाँटना है। उत्तर को OMR आन्सर-शीट में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

उदाहरण :

प्रश्न :

प्रश्न 1 (A) ● (C) (D)
प्रश्न 2 (A) (B) ● (D)
प्रश्न 3 (A) ● (C) (D)

अपठनीय उत्तर या ऐसे उत्तर जिन्हें काटा या बदला गया है, या गोले में आधा भरकर दिया गया, उन्हें निरस्त कर दिया जाएगा।

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।
6. सभी उत्तर केवल ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर ही दिये जाने हैं। उत्तर-पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।
7. ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाये।
8. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी OMR Answer Sheet उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें। परीक्षार्थी अपने साथ प्रश्न-पुस्तिका ले जा सकते हैं।
9. निगेटिव मार्किंग नहीं है।
10. कोई भी रफ कार्य, प्रश्न-पुस्तिका के अन्त में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।
11. परीक्षा-कक्ष में लॉग-बुक, कैलकुलेटर, पेजर तथा सेल्युलर फोन ले जाना तथा उसका उपयोग करना वर्जित है।
12. प्रश्न के हिन्दी एवं अंग्रेजी रूपान्तरण में भिन्नता होने की दशा में प्रश्न का अंग्रेजी रूपान्तरण ही मान्य होगा।

महत्वपूर्ण : प्रश्नपुस्तिका खोलने पर प्रथमतः जाँच कर देख लें कि प्रश्न-पुस्तिका के सभी पृष्ठ भलीभाँति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्षनिरीक्षक को दिखाकर उसी सिरीज की दूसरी प्रश्न-पुस्तिका प्राप्त कर लें।