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O.M.R. Serial No. | | | | | | | | |

Question Booklet Number

M.Sc. (SEM.-III) (NEP) (SUPPLE.)EXAMINATION, 2024-25

BIOTECHNOLOGY

(Animal Cell Culture and Medical Biotechnology)

(Elective-2)

Paper Code							
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Question Booklet Series

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Time : 1 : 30 Hours **Max. 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.
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 :

(Remaining instructions on last page)

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, उसे तुरन्त बदल लें।
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 उत्तर-पत्रक में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

(शेष निर्देश अन्तिम पृष्ठ पर)

1. Who is credited with the first true tissue culture experiment in 1907?
   (A) Louis Pasteur
   (B) Alexis Carrel
   (C) Ross Harrison
   (D) George Gey
2. Which scientist established the first human continuous cell line (HeLa)?
   (A) Watson
   (B) George Gey
   (C) Harrison
   (D) Roux
3. Which cell culture medium is considered a chemically defined medium?
   (A) Plasma extract
   (B) Tissue extract
   (C) Eagle's Minimum Essential Medium (MEM)
   (D) Fetal Bovine Serum (FBS)
4. Which pH indicator is most commonly used in cell culture media?
   (A) Bromothymol Blue
   (B) Phenol Red
   (C) Cresol Red
   (D) Methyl Orange
5. Which freezer temperature is used for long-term cryopreservation of cells?
   (A) –20 °C
   (B) –80 °C
   (C) 4 °C
   (D) –196 °C
6. Why are antibiotics like penicillin and streptomycin added to cell culture?
   (A) To promote cell growth
   (B) To prevent contamination
   (C) To act as nutrients
   (D) To stabilize pH
7. Primary cultures are considered valuable because:
   (A) They retain in vivo characteristics of tissues
   (B) They proliferate indefinitely
   (C) They are always homogeneous
   (D) They require no attachment surface
8. Why is L-glutamine important in culture media?
   (A) Functions as a buffer
   (B) Provides energy source
   (C) Essential for protein synthesis
   (D) Prevents contamination
9. What is the main disadvantage of using FBS in culture media?
   (A) Provides hormones
   (B) Contains attachment factors
   (C) Batch-to-batch variation and undefined composition
   (D) Prevents cell adhesion
10. Why is a CO_2 incubator used in cell culture?
   (A) To sterilize glassware
   (B) To maintain osmotic pressure
   (C) To reduce oxygen levels
   (D) To balance bicarbonate buffer and maintain pH

11. If phenol red in the culture medium turns yellow, what does it indicate?

(A) Normal pH (7.2–7.4)

(B) Basic medium due to low metabolism

(C) Presence of antibiotics

(D) Acidic medium due to lactic acid accumulation

12. A researcher observes that cells in culture have stopped dividing after ~20 passages. What is the most likely explanation?

(A) Transformation occurred

(B) Hayflick limit reached (senescence)

(C) Cells are contaminated

(D) Serum concentration is too high

13. A student adds too much $NaHCO_3$ in culture media without a CO_2 incubator. What happens?

(A) The pH becomes alkaline

(B) The pH becomes acidic

(C) Cells proliferate faster

(D) Cells stop requiring oxygen

14. Which instrument should be used to check the confluence of adherent cells in a culture flask?

(A) Laminar air flow cabinet

(B) Autoclave

(C) Inverted microscope

(D) Centrifuge

15. A researcher wants to prevent ice crystal formation during cryopreservation. Which chemical should be used?

(A) Ethanol

(B) DMSO

(C) NaCl

(D) Heparin

16. Compare primary culture and continuous cell lines: which of the following is correct?

(A) Primary cultures proliferate indefinitely, continuous lines senesce

(B) Continuous lines are finite, primary cultures are immortal

(C) Primary cultures resemble original tissue, continuous lines often show altered morphology

(D) Both show the same chromosome number and morphology as in vivo cells

17. Which condition will most likely lead to contamination being overlooked?

(A) Use of serum-free medium

(B) Use of antibiotics routinely in cultures

(C) Incubating at 37 °C

(D) Storing cells in liquid nitrogen

18. A researcher notices abnormal morphology and uncontrolled proliferation in cultured cells. Which is the most likely cause?

(A) Nutrient deficiency

(B) Cell transformation (immortalization)

(C) Oxygen limitation

(D) Buffering failure

19. If a laminar airflow system (BSC) fails, which risk is highest?

(A) Medium instability

(B) Increased microbial contamination

(C) Reduced CO_2 supply

(D) Loss of serum proteins

20. Why is HEPES buffer sometimes preferred over $NaHCO_3$ in culture media?

(A) It requires CO_2 incubation

(B) It is unstable at 37 °C

(C) It maintains pH without dependence on CO_2

(D) It prevents osmotic imbalance

21. A finite cell line is different from a primary culture because:

(A) It is derived directly from tissue

(B) It is obtained after the first subculture

(C) It is immortal

(D) It always grows in suspension

22. A student forgets to pre-warm media before adding it to cells. Which is the most likely outcome?

(A) Cells undergo thermal shock and viability decreases

(B) Cells proliferate faster

(C) Cells become immortalized

(D) Cells detach permanently from flask

23. Which combination of properties defines Class II biosafety cabinets?

(A) Protects user only

(B) Protects sample only

(C) Protects sample, user and environment

(D) No protection provided

24. An immortalized cell line shows aneuploidy. What does this indicate?

(A) Normal diploid condition

(B) Abnormal chromosome number

(C) Enhanced anchorage dependence

(D) Cells will senesce after few passages

25. Why should good aseptic technique be prioritized over relying on antibiotics?

(A) Antibiotics make cells grow faster

(B) Antibiotics cause cells to immortalize

(C) Aseptic technique reduces need for serum

(D) Aseptic technique prevents resistance and hidden contamination

26. Which chemical is most commonly used as a cryoprotectant in cell culture?

(A) Ethanol

(B) DMSO

(C) Formaldehyde

(D) Methanol

27. Who is most commonly responsible for cell line cross-contamination in labs?

(A) Viral infections

(B) Improper labeling and handling

(C) Freezer malfunction

(D) Serum impurities

28. Trypsin cleaves peptide bonds at which amino acid residues?

(A) Glycine and serine

(B) Lysine and arginine

(C) Proline and threonine

(D) Aspartate and glutamate

29. The most common contaminant in cell culture that does not cause turbidity is:

(A) Bacteria

(B) Fungi

(C) Mycoplasma

(D) Yeast

30. Which of the following is a primary requirement for maintaining mammalian cell cultures?

(A) 80% nitrogen

(B) 5% CO_2 atmosphere

(C) High oxygen pressure

(D) Anaerobic conditions

31. Why is slow cooling (-1°C per minute) essential during cryopreservation?

(A) To allow faster metabolic activity

(B) To avoid ice crystal formation inside cells

(C) To promote serum absorption

(D) To maintain high oxygen levels

32. What is the main role of EDTA in trypsinization?

(A) Neutralizes trypsin activity

(B) Chelates calcium and magnesium, weakening cell adhesion

(C) Provides nutrients during detachment

(D) Acts as a cryoprotectant

33. Which principle does density gradient centrifugation rely on?

(A) Antigen-antibody binding

(B) Buoyant density differences

(C) Charge distribution

(D) Enzyme digestion

34. Why must serum be removed before adding trypsin?

(A) Serum enhances trypsin activity

(B) Serum inhibits trypsin activity

(C) Serum increases pH drastically

(D) Serum damages cell membranes

35. Which factor best explains why mycoplasma is difficult to detect in cultures?

(A) It grows too fast

(B) It does not change the pH of the medium

(C) It does not cause turbidity

(D) It cannot survive without serum

36. A researcher wants to isolate T lymphocytes from peripheral blood. Which method is most suitable?

(A) Density gradient centrifugation

(B) Adherence-based separation

(C) FACS with CD3 marker

(D) Chemical precipitation

37. You observe fibroblast-like cells attaching strongly to the culture dish, while lymphocytes remain floating. Which separation technique is being applied?

(A) Immunomagnetic separation

(B) Differential adhesion

(C) Flow cytometry

(D) Cryopreservation

38. A lab technician freezes cells directly in liquid nitrogen without controlled cooling. What is the most likely outcome?

(A) Increased viability

(B) No effect

(C) Formation of ice crystals leading to cell death

(D) Faster proliferation after thawing

39. A scientist finds fungal filaments in the culture flask. Which corrective step is most appropriate?

(A) Add extra serum

(B) Increase CO_2 concentration

(C) Discard culture and disinfect the hood

(D) Dilute the contaminant with PBS

40. A newly established cell line shows abnormal chromosome numbers during karyotyping. What does this indicate?

(A) The cells are completely normal

(B) Genetic instability

(C) Mycoplasma contamination

(D) Successful authentication

41. If a culture shows rapid medium turbidity, acidic pH, and foul smell, which contaminant is most likely responsible?

(A) Mycoplasma

(B) Yeast

(C) Bacteria

(D) Cross-contaminated cells

42. A researcher compares MACS and FACS. Which feature is unique to FACS?

(A) Use of antibodies

(B) Multiparametric analysis and sorting

(C) Magnetic beads for separation

(D) Gentle handling of cells

43. A cell culture flask shows no turbidity, but PCR testing reveals contamination. Which type of contaminant is suspected?

(A) Yeast

(B) Mycoplasma

(C) Bacteria

(D) Mold

44. A lab reports poor reproducibility in results across cell culture experiments. Which factor is the most likely cause?

(A) Frequent cross-contamination

(B) High-quality media

(C) Proper use of STR profiling

(D) Low passage number

45. A student fails to detach adherent cells despite prolonged trypsinization. On analysis, it is found that trypsin was inactivated. What could be the reason?

(A) Residual serum not washed away before trypsinization

(B) EDTA concentration was too high

(C) Cells were at low confluence

(D) Cryoprotectant interfered with trypsin

46. Which type of stem cells can differentiate into all embryonic and extraembryonic tissues?

(A) Pluripotent

(B) Totipotent

(C) Multipotent

(D) Unipotent

47. The transcription factors OCT4, SOX2, KLF4, and c-MYC are used for generating:

(A) Hematopoietic stem cells

(B) Embryonic stem cells

(C) Neural stem cells

(D) Induced pluripotent stem cells (iPSCs)

48. Dolly the sheep was cloned by which technique?

(A) IVF

(B) iPSC technology

(C) Embryo culture

(D) Somatic Cell Nuclear Transfer (SCNT)

49. Hematopoietic stem cells are an example of:

(A) Totipotent stem cells

(B) Pluripotent stem cells

(C) Multipotent stem cells

(D) Unipotent stem cells

50. Why are feeder layers used in embryonic stem cell culture?

(A) To provide nutrients

(B) To prevent microbial contamination

(C) To secrete growth factors that maintain pluripotency

(D) To promote differentiation

51. Why is mycoplasma contamination particularly dangerous in stem cell culture?

(A) It changes cell morphology drastically

(B) It competes for oxygen

(C) It alters gene expression and differentiation potential

(D) It induces apoptosis rapidly

52. Which statement best explains the difference between therapeutic and reproductive cloning?

(A) Both aim to produce an entire organism

(B) Therapeutic cloning produces patient-specific stem cells, while reproductive cloning produces a full organism

(C) Both use IVF as the core method

(D) Therapeutic cloning is limited to plants

53. Why are pluripotent stem cells more tumorigenic compared to multipotent stem cells?

(A) They have longer doubling times

(B) They carry bacterial genes

(C) They can differentiate into multiple cell types uncontrollably

(D) They lack mitochondria

54. In IVF, why are embryos cultured before transfer into the uterus?

(A) To eliminate all abnormal cells

(B) To allow fertilization to occur naturally

(C) To assess embryo quality and select the healthiest

(D) To reduce oxygen concentration

55. A researcher wants to generate neurons in vitro from stem cells. Which approach is most suitable?

(A) Maintain pluripotent stem cells in feeder conditions

(B) Directed differentiation using specific growth factors

(C) Freeze cells immediately after culture

(D) Perform SCNT with a fibroblast nucleus

56. In a clinical setting, which stem cell type would be best for treating leukemia?

(A) Neural stem cells

(B) Mesenchymal stem cells

(C) Hematopoietic stem cells

(D) iPSCs

57. A patient requires red blood cell transfusion but blood supply is unavailable. Which research-based option may be explored?

(A) Stem cell-derived RBCs

(B) SCNT

(C) Neural stem cells

(D) IVF

58. A scientist is testing artificial blood based on perfluorocarbon (PFC) emulsions. What property of PFCs makes them suitable?

(A) High protein-binding capacity

(B) Ability to dissolve large amounts of oxygen

(C) Strong antigenic response

(D) Rapid degradation in plasma

59. A couple undergoing IVF faces repeated implantation failures. Which advanced technique may help identify viable embryos?

(A) Time-lapse embryo imaging

(B) Direct embryo cloning

(C) Mesenchymal stem cell injection

(D) Embryoid body formation

60. A culture of embryonic stem cells begins differentiating spontaneously. Which factor is most likely missing from the medium?

(A) LIF or bFGF

(B) Trypsin

(C) Perfluorocarbons

(D) STR markers

61. A patient with Parkinson's disease is enrolled in a stem cell therapy trial. Which cell type is most likely being transplanted?

(A) Hematopoietic stem cells

(B) Dopaminergic neurons derived from pluripotent stem cells

(C) iPSCs reprogrammed into RBCs

(D) Embryoid bodies without differentiation

62. A stem cell researcher notes that ESCs and iPSCs both can generate neurons, hepatocytes, and cardiomyocytes. What conclusion can be drawn?

(A) Both are multipotent

(B) Both are pluripotent

(C) Both are totipotent

(D) Both are unipotent

63. A cloned embryo created via SCNT fails to develop beyond the 8-cell stage. What is the most likely reason?
(A) Lack of nutrients in the medium
(B) Improper epigenetic reprogramming of the donor nucleus
(C) Oxygen toxicity
(D) Excess growth factors

64. What is the primary defining feature of a transgenic animal?
(A) An animal produced via somatic cell nuclear transfer (SCNT)
(B) An animal that has had its genome edited to correct a single mutation
(C) An animal that has deliberately incorporated exogenous genetic material into its genome
(D) An animal used as a model for human disease

65. Which of the following viral vectors is known for its site-specific integration into human chromosome 19?
(A) Adenovirus
(B) Retrovirus
(C) Adeno-associated virus (AAV)
(D) Lentivirus

66. The first successfully cloned mammal, Dolly the sheep, was produced using which technique?
(A) Pronuclear Microinjection
(B) Embryonic Stem Cell Transfer
(C) Sperm-Mediated Gene Transfer
(D) Somatic Cell Nuclear Transfer (SCNT)

67. In the context of molecular pharming, the mammary gland of a transgenic goat used to produce a therapeutic protein is an example of a:
(A) Vector
(B) Bioreactor
(C) Surrogate
(D) Clonal population

68. What is the main safety concern associated with the use of retroviral vectors for gene transfer?
(A) They trigger a strong immune response
(B) They have a very small cargo capacity
(C) They risk insertional mutagenesis
(D) They only provide transient expression

69. The low efficiency of pronuclear microinjection is best explained by:
(A) The high cost of the equipment required
(B) The random and unpredictable nature of DNA integration into the host genome
(C) The inability of the injected DNA to replicate
(D) The need for surrogate mothers of a different species

70. Why is Somatic Cell Nuclear Transfer (SCNT) considered a powerful method for creating transgenic livestock, unlike Embryonic Stem (ES) cell methods?

(A) SCNT is a much quicker process

(B) SCNT does not require surrogate mothers

(C) Well-characterized, pluripotent ES cell lines are not readily available for most livestock species

(D) SCNT results in 100% identical clones, eliminating genetic diversity

71. A researcher aims to create a transgenic mouse model to study a neurodegenerative disease over the animal's entire lifespan.

Which vector would be LEAST suitable due to the nature of its genetic persistence?

(A) Lentivirus

(B) Adenovirus

(C) Retrovirus

(D) Adeno-associated virus (AAV)

72. The ethical debate surrounding therapeutic cloning primarily focuses on:

(A) The health and welfare of the surrogate mother.

(B) The moral status of the human SCNT embryo created for research.

(C) The high financial cost of the procedure.

(D) The risk of creating genetically identical humans.

73. What is the key functional difference between reproductive and therapeutic cloning?

(A) The source of the somatic cell nucleus

(B) The method used to activate the reconstructed embryo

(C) The intended outcome (live birth vs. stem cell derivation)

(D) The species in which the procedure is performed

74. A biotech company wants to produce a large, complex human glycoprotein that requires specific mammalian post-translational modifications to be functional. Which production system would be most appropriate?

(A) Bacterial culture

(B) Transgenic E. coli

(C) Yeast expression systems

(D) Molecular pharming in transgenic goats

75. A scientist has successfully knocked out a gene in murine embryonic stem (ES) cells via homologous recombination. What is the next critical step to generate a stable, germlinetransmitting knockout mouse line?

(A) Perform pronuclear microinjection of the targeting construct

(B) Inject the modified ES cells into a host blastocyst and breed the resulting chimeras

(C) Subject the ES cells to Somatic Cell Nuclear Transfer (SCNT)

(D) Directly implant the ES cells into a surrogate mother

76. In a gene therapy trial for a monogenic disease, a vector is needed that provides longterm expression in non-dividing cells (like neurons) and has a low risk of inducing an inflammatory response. The best choice would be:

(A) Adenovirus

(B) Retrovirus

(C) Adeno-associated virus (AAV)

(D) A vector delivered via pronuclear microinjection

77. A farmer wishes to rapidly propagate a bull with exceptional genetic traits for meat quality. The most direct, albeitt echnologically advanced, method to achieve this would be:

(A) Selective breeding over several generations

(B) Artificial insemination using the bull's semen

(C) Reproductive cloning of the bull via SCNT

(D) Creating a transgenic bull using pronuclear microinjection

78. If a transgenic animal produced by pronuclear microinjection does not express the transgene, a likely explanation related to the method itself is:

(A) The surrogate mother rejected the embryo.

(B) The transgene integrated into a transcriptionally silent region of the genome (position effect)

(C) The animal is not a true genetic chimera

(D) The wrong viral vector was selected

79. Pronuclear microinjection and SCNT-based transgenesis both result in transgenic animals, but they differ fundamentally. The primary analytical distinction is that:

(A) SCNT guarantees transgene integration, while microinjection does not.

(B) Microinjection is faster, but SCNT is more ethical.

(C) SCNT involves genetic modification of a somatic cell before cloning, allowing for precise selection, whereas microinjection introduces DNA directly into the zygote with random integration.

(D) Microinjection can only be used on females, while SCNT can use male or female donors.

80. Comparing the use of transgenic mice versus transgenic pigs for studying a human metabolic disorder, the major advantage of the pig model lies in its:

(A) Shorter gestation period and larger litter size.

(B) Lower maintenance costs and ease of handling.

(C) More complex and human-like physiology and organ size.

(D) Fully sequenced genome and availability of ES cells.

81. Analyzing the challenges of xenotransplantation, a key strategy involves genetically modifying donor pigs. The most critical initial genetic modification would be one that:

(A) Increases the pig's growth rate.

(B) Reduces the antigenicity of pig cells to prevent hyperacute rejection by the human immune system.

(C) Allows for the production of human antibodies in the pig's blood.

(D) Makes the pig's organs smaller to fit human recipients.

82. When evaluating the statement "Therapeutic cloning avoids the ethical issues of reproductive cloning," a valid criticism would be:

(A) It is scientifically impossible to derive stem cells from a cloned embryo.

(B) Therapeutic cloning is more expensive than reproductive cloning.

(C) Therapeutic cloning leads to the birth of children with genetic abnormalities.

(D) Both techniques require the creation and subsequent destruction of a human embryo, which is the central ethical concern for many.

83. A researcher observes that a line of transgenic animals produced via pronuclear microinjection shows highly variable levels of the therapeutic protein in their milk. The most plausible scientific explanation for this variability is:

(A) Differences in the diet of the individual animals

(B) The random integration site and copy number of the transgene in each founder animal, leading to differential expression (position effect)

(C) Contamination of the milk samples during collection

(D) The use of an inappropriate promoter in the transgene construct

84. What is the primary advantage of using mammalian cell lines like CHO cells for producing pharmaceutical proteins over bacterial systems?

(A) Faster growth and lower cost

(B) Ability to perform complex post-translational modifications (e.g., human-like glycosylation)

(C) Higher protein yield per liter of culture

(D) Reduced risk of viral contamination.

85. Which of the following is a key application of cell culture technology in the production of inactivated vaccines?

(A) Genetically engineering the pathogen to be weaker

(B) Growing large quantities of the pathogen for subsequent chemical inactivation

(C) Using the host's own cells to produce antibodies

(D) Synthesizing antigenic peptides artificially

86. The radioisotope Technetium-99m (99mTc) is most commonly associated with which diagnostic imaging modality?

(A) Magnetic Resonance Imaging (MRI)

(B) Positron Emission Tomography (PET)

(C) Computed Tomography (CT)

(D) Single-Photon Emission Computed Tomography (SPECT)

87. What does the acronym PCR stand for?

(A) Protein Counting Reaction

(B) Polymerase Chain Reaction

(C) Pathogen Concentration Ratio

(D) Primary Cell Replication

88. In the context of molecular medicine, what does CAR-T cell therapy involve?

(A) Using antibiotics to target cancer cells.

(B) Genetically engineering a patient's own T-cells to target cancer antigens.

(C) Transplanting bone-marrow from a healthy donor.

(D) Using radioactive isotopes to kill tumor cells.

89. Why is qPCR (quantitative PCR) particularly valuable in viral disease management?

(A) It can identify the specific strain of any virus without prior knowledge.

(B) It amplifies the entire viral genome for sequencing.

(C) It can quantify the amount of viral nucleic acid, allowing for viral load monitoring.

(D) It is the cheapest and fastest molecular diagnostic method.

90. The fundamental principle behind using Iodine-131 (^{131}I) for therapy is that it:

(A) Enhances the visibility of the thyroid gland on a CT scan.

(B) Is a stable isotope that replaces dietary iodine.

(C) Is selectively taken up by thyroid cells, where its radiation destroys the tissue.

(D) Stimulates the immune system to attack the thyroid.

91. What is the primary reason for the shift from egg-based to cell culture-based vaccine production?

(A) Eggs are no longer available in sufficient quantities.

(B) Cell culture is inherently safer and cannot be contaminated.

(C) It offers greater scalability, speed, and control over the production process.

(D) Vaccines produced in cell culture do not require refrigeration.

92. Metagenomic sequencing is a powerful tool for environmental pathogen detection because it:

(A) Requires prior knowledge of the pathogen to design specific probes.

(B) Can detect and identify all genetic material in a sample, including unexpected pathogens.

(C) Provides results much faster than traditional PCR methods.

(D) Is primarily used for quantifying the number of viable bacteria.

93. Pharmacogenomics is best described as the study of:

(A) The development of new pharmaceutical drugs.

(B) The use of genomics to discover new protein drugs.

(C) How a person's genetic makeup affects their individual response to drugs.

(D) The manufacturing process of drugs in cell cultures.

94. A patient with prostate cancer that has spread to the bones is experiencing significant pain. Which radioisotope therapy would be most appropriate to target these bone metastases?

(A) Iodine-131 (^{131}I)

(B) Fluorine-18 (^{18}F)

(C) Radium-223 (^{223}Ra)

(D) Technetium-99m (99mTc)

95. A biotechnology company needs to produce a complex monoclonal antibody that requires

specific glycosylation patterns to be clinically effective. The most suitable production system would be:

(A) E. coli bacterial culture

(B) Transgenic plant leaves

(C) Chinese Hamster Ovary (CHO) cell culture

(D) Yeast fermentation

96. During an outbreak of a novel respiratory illness in cattle, a sample from a shared water source needs to be tested for potential pathogens. The most appropriate initial diagnostic approach to identify unknown infectious agents is:

(A) Quantitative PCR (qPCR) for a specific virus

(B) An ELISA test for common antibodies

(C) Metagenomic sequencing

(D) Culture on standard bacterial growth media

97. A researcher wants to non-invasively monitor the metabolic activity of a tumor in a live mouse model over time to assess treatment response. The ideal imaging technique for this purpose is:

(A) Ultrasound

(B) Magnetic Resonance Imaging (MRI).

(C) Positron Emission Tomography (PET) with 18F-FDG

(D) Computed Tomography (CT)

98. Comparing the production of a subunit vaccine (like HPV VLPs) in insect cells versus the production of a monoclonal antibody in CHO cells, a key analytical difference is:

(A) Insect cells are mammalian, while CHO cells are not

(B) The subunit vaccine is a recombinant protein product, while the monoclonal antibody is not

(C) The goal for the vaccine is to express a single antigenic protein that self-assembles, while the goal for the mAb is to secrete a complex functional antibody

(D) CHO cell cultures are less expensive than insect cell cultures

99. When evaluating the statement "Cell culture technology enables personalized medicine,"the strongest supporting evidence is the development of:

(A) Broad-spectrum antibiotics

(B) Inactivated vaccines for mass vaccination programs

(C) CAR-T cell therapies, which involve modifying a patient's own cells ex vivo

(D) Standardized growth media for CHO cells

100. A key challenge in downstream processing of pharmaceutical proteins from mammalian cell culture is the need for robust purification steps. The most significant reason for this is to:

(A) Increase the volume of the final product

(B) Remove host cell proteins, DNA, and potential viruses to ensure patient safety

(C) Change the glycosylation pattern of the protein

(D) Activate the protein's therapeutic function

Rough Work / रफ कार्य

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

Example :

Question :

Q.1 Ⓐ ● Ⓒ Ⓓ

Q.2 Ⓐ Ⓑ ● Ⓓ

Q.3 Ⓐ ● Ⓒ Ⓓ

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

5. In case the candidate does not fill the appropriate circle in the OMR Answer-Sheet and leave blank 'Zero' mark will be given.

6. The candidate has to mark answers on the OMR Answer-Sheet with black or blue ball point pen only carefully as per directions.

7. There will be no negative marking.

8. Examinee should handover the OMR Answer-Sheet alogwith used booklet to the invigilator before leaving the examination hall.

9. Rough work, if any, should be done on the blank page provided for the purpose at the end of booklet.

10. Write your Roll Number and other required details in the space provided on the title page of the booklet and on the OMR Answer-Sheet with ball point pen. **Do not use lead pencil.**

11. To bring and use of log-book, calculator, pager & mobile phone in examination hall is prohibited.

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

उदाहरण :

प्रश्न :

प्रश्न 1 Ⓐ ● Ⓒ Ⓓ

प्रश्न 2 Ⓐ Ⓑ ● Ⓓ

प्रश्न 3 Ⓐ ● Ⓒ Ⓓ

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

5. यदि परीक्षार्थी OMR आन्सर-शीट में उपयुक्त गोले को नहीं भरता है और आन्सर-शीट को खाली छोड़ देता है, तो 'शून्य' अंक प्रदान किया जाएगा।

6. अभ्यर्थी को प्रश्नों के उत्तर OMR आन्सर-शीट पर केवल काले या नीले बाल प्वांइट पेन से सावधानीपूर्वक निर्देशानुसार अंकित करने होंगे।

7. निगेटिव मार्किंग नहीं है।

8. परीक्षार्थी OMR उत्तर-पत्रक तथा प्रयुक्त प्रश्न-पुस्तिका परीक्षा भवन छोड़ने से पहले कक्ष-निरीक्षक को सौंप दें।

9. कोई भी रफ कार्य, प्रश्न-पुस्तिका के अन्त में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।

10. प्रश्न-पुस्तिका के मुख पृष्ठ पर तथा OMR आन्सर-शीट पर निर्धारित स्थान में अनुक्रमांक तथा अन्य विवरण बाल प्वांइट पेन से ही भरें। **पेन्सिल का प्रयोग न करें।**

11. परीक्षा-कक्ष में लॉग-बुक, कैल्कुलेटर, पेजर तथा मोबाइल फोन ले जाना तथा उसका उपयोग करना वर्जित है।