PH.D ENTRANCE TEST.
MODEL QUESTION PAPER.
SUBJECT:- BIO-SCIENCES
(BIO-CHEMISTRY, BIO-TECHNOLOGY, BOTANY, MICROBIOLOGY, ZOOLOGY)

SECTION – I

Choose the most appropriate answer. **(10 x 1 = 10 marks)**

1. The scientific method frequently involves the hypothetico-deductive method. After observing natural phenomena and formulating questions about these phenomena, the next step would be to do which of the following?
   (a) Collect data (b) Draw conclusions
   (c) Generate hypotheses (d) Write a paper explaining your observations

2. The mass of a molecular ion $[M + 2H]^{-2}$ with *m/z* 300 is
   a) 298 Da b) 600 Da c) 598 Da d) 602 Da

3. Chromosomes can be counted best at the stage of
   (a) Metaphase (b) Late anaphase (c)Telophase (d) Late prophase

4. Which of the following cellular structures always disappears during mitosis and meiosis?
   (a) Plasma membrane (b) Nucleolus and nuclear envelope
   (c) Plastids (d) None of these

5. Which one of the following pairs, is not correctly matched?
   (a) IAA – Cell wall elongation
   (b) Abscisic acid – Stomatal closure
   (c) Gibberellic acid – Leaf fall
   (d) Cytokinin – Cell division

6. The plant which needs light period shorter than critical photo period is called
   (a) Short day plant (SDP)
   (b) Long day plant (LDP)
   (c) Day neutral plant (DNP)
   (d) Short long day plant (SLDP)

7. Which of the following terms does NOT describe asexual reproduction?
   (a) Mitosis (b) Meiosis (c) Binary fission (d) Budding

8. Mammals descended from a group of mammal-like reptiles called...
   (a) Dicynodonts (b) Therapsids (c) Thecodonts (d) Archosaurs

9. Which of the following techniques was useful in the discovery of DNA structure by Watson & Crick?
   (a) Density gradient centrifugation (b) Radiolabelling
   (c) X ray diffraction analysis (d) Electron microscopy

10. Which of the following bio molecules is least stable?
    (a) Protein (b) DNA
    (c) mRNA (d) tRNA

SECTION – II

Choose the most appropriate answer. **(40 x 1 = 40 marks)**

1. The result of spermatogenesis is which of the following?
   (a) Four genetically identical sperm cells
   (b) Four genetically non-identical sperm cells
   (c) One sperm cell and three polar bodies
   (d) One sperm cell and three genetically identical polar bodies

2. Crustaceans...
   (a)Breathe by means of tracheae (b) Excrete by means of Malpighian tubules
   (c) Have an open circulatory system (d) Are hermaphroditic

3. The process of transfer of DNA from one bacterium to another bacterium through bacteriophage is called
   (a) Transfection (b) Transfusion
   (c) Transduction (d) Transformation

4. Which of the following is important trait for bacterial pathogenesis?
   (a) Biofilm formation (b) Siderophore production
   (c) Toxin production (d) All of the above

5. When ethidium bromide intercalates between base pairs in dsDNA, the distance between adjacent base pairs
   (a) Decreases (b) Increases
   (c) Does not change (d) May increase or decrease

6. β-lactum antibiotics kill the bacteria by
   (a) Inhibiting quorum sensing
   (b) Interfering with protein synthesis
   (c) Inhibiting cell wall synthesis
   (d) Inhibiting DNA replication

7. Bacterial genes can be mapped based on their cotransduction frequency which is _____ proportional to distance between two genes.
   (a) Directly (b) Inversely
   (c) Not (d) None of the above

8. A particular Type II restriction endonuclease recognizes 4 bp sequence. If this 4 bp sequence is distributed randomly on a 30 Kb linear DNA fragment, how many fragments of DNA will be formed upon its complete digestion with this restriction endonuclease. Note: the DNA has equal distribution of all the four bases.
   (a) 50 (b) 118 (c) 129 (d) 11

9. A laboratory medium for bacteria can be enriched by
   (a) Adding ATP (b) Adding blood
   (c) Including salt (d) Increasing level of potassium

10. MacConkeys agar medium is an example of
(a) Differential medium (b) Enriched medium
(c) Enrichment medium (d) Differential as well as selective medium

11. Which of the following genotypes would you not expect to find among the offspring of a SsYy x ssyy test cross:
(a) SsYy (b) Ssyy (c) ssYy (d) SsYY

12. In a cross between a white-eyed female fruit fly and red-eyed male, what percent of the female offspring will have white eyes? (White eyes are X-linked, recessive)
(a) 0% (b) 100% (c) 50% (d) 75%

13. Which of the following organelles is involved in cell walls synthesis?
(a) Mitochondria
(b) Chloroplast
(c) Golgi apparatus
(d) Lysosome

14. The most appropriate animal model for the study of cell specification and differentiation during development is
(a) Sea urchin (b) Drosophila (c) Frog (d)*Caenorhabditis elegans*

15. Microfilaments can be disrupted by
(a) Colchicine (b) Taxol (c) Cytochalasin (d) Mitomycin C

16. Skin-blistering disease in human is caused due to mutation in
(a) Vimentin (b) Desmin (c) Lamin (d) Keratin

17. One of the major site of proton pump is the membrane of
(a) Mitochondria (b) Golgi (c) ER (d) Lysosomes

18. The junction in blood brain barrier that plays very important role in drug delivery to brain is
(a) Tight junction (b) Adherence junction (c) Desmosome (d) Gap junction

19. Nicotine can bind with higher affinity to the receptor of
(a) Glutamate (b) Serotonin (c) Acetylcholine (d) Glycine

20. The apoptotic cell exhibit externalization of
(a) Phosphatidylcholine (b) Phosphatidylethanolamine
(c) Phosphatidylserine (d) Phosphatidylinositol

21. The human ABO blood group pattern is determined by
(a) Glycoprotein (b) Proteoglycan (c) Phospholipid (d) Glycolipid

22. The scales of a bony fish is a derivative of
(a) Epidermis (b) Dermis (c) Hypodermis (d) Bone

23. The concept of chemolithotrophic autotrophy was first conceived by....
(a) M. Beijerinck
(b) Robert Koch
(c) S. Winogradsky
(d) S. Waksman

24. Which of the following organisms carry out anoxygenic photosynthesis?
(a) Cyanobacteia
(b) Green sulfur bacteria
(c) Higher algae
(d) None of the above

25. Dead sea is a habitat for.....
(a) Hyperthermophiles
(b) Halophilic archaea
(c) Acidophiles
(d) All of the above

26. Which of the following is not a substrate for nitrogenase enzyme?
(a) Dinitrogen (b) Cyanide (c) Acetylene (d) Ethylene

27. The signal molecules produced by Rhizobia which induce the nodulation in legume plants are.....
(a) Flavenoids (b) Lipochitooligosaccharides
(c) Fatty acids (d) Carboxylic acids

28. As the proportion of lipid to protein increase in lipoprotein, its density
(a) Decreases (b) Increases
(c) Doesn't change (d) depends on blood glucose level

29. Which of the following fattyacids cannot be synthesized in mammals?
(a) α-linolenic acid (18:3 $\Delta^{9,12,15}$) (b) linolate (18:2, $\Delta^{9,12}$)
(c) Oleate (18:1, Δ^{9}) (d) both a & b

30. A basic protein would contain high percentage of
(a) Glycine & alanine (b) Lysine & Arginine
(c) Histidine & Proline (d)Cystine & Glycine

31. Prediction of secondary structure of proteins by Ramchandran plot is on the basis of rotation around
(a) Peptide bond (b) Phi & Psi bonds
(c) disulphide bonds (d) weak bonds

32. During prolonged fasting conditions, which enzyme of glycolysis is inhibited by FFAs?
(a) Glucokinase (b) Fructose 1,6-bisphosphatase
(c) PFK (d) PK

33. Plant cell walls are made up of
(a) Cellulose, hemicelluloses and pectin (b) Cellulose and chitin
(c) Cellulose, hemicelluloses and chitin (d) Cellulose only

34. When blood glucose level becomes lower than normal, it is replenished by glycogen breakdown from
(a) Liver (b) Muscle (c) Liver or Muscle (d) none of the above

35. The type of restriction enzymes, which are most commonly used in r DNA technology and cleave within or at short specific distances from recognition site are
(a) Type I restriction endonucleases (b) Type II restriction endonucleases
(c) Type III restriction endonucleases (d) Type IV restriction endonucleases

36. In electron transfer, only the quinone portion of ubiquinone undergoes oxidation-reduction, the isoprenoid side chain
(a) Is useless (b) Allows UQ to diffuse in the membrane
(c) Also carrier electrons (d) None of the above

37. The lateral meristem in plants is responsible for
(a) Primary growth (b) Secondary growth
(c) Exponential growth (d) Growth in elongation

38. Which of the following factors do NOT affect the enzyme activity?
(a) Temperature of the reaction (b) pH
(c) Concentration of substrate (d) None of the above

39. Which one of the following is surrounded by a callose wall?
(a) Male gamete (b) Microspore mother cell
(c) Pollen grain (d) Egg

40. Which of the following supporting materials is used for electrophoresis?
(a) Polyacrylamide (b) Agarose
(c) Paper (d) All of the above

SECTION- III

Attempt 'ANY FIVE of the following: **(5 x 5 = 25 Marks)**

1. What are the endocrine components of pancreas? Describe briefly the histological features of endocrine pancreas.

2. What are *in situ* and *ex situ* methods of conservation? Explain giving suitable examples for animal conservation

3. Explain Holliday model for recombination with a note on molecular mechanism of homologous recombination

4. Describe the growth pattern of microorganisms in a batch culture in detail.

5. How will you sterilize following materials? Give appropriate justifications for your answer.
   a) water b) soil c) milk d) oil e) Penicillin

6. Discuss the role of auxin-cytokinin interaction in *in vitro* morphogenesis in plants

7. How do the rough endoplasmic reticulum and the Golgi apparatus act in the production and release of proteins?

8. With reference to their biological function what is the difference between mitosis and meiosis?

9. How do plants control the opening and closing of their stomata?.

10. Differentiate SDS-PAGE and Native PAGE with reference to their principle and applications.

SECTION - IV

Attempt ANY ONE of the following: **(25 marks each)**

1. a) Describe different types of stem cells with examples. Define stem cell niche and write their applications. (10)

   b) Write the structure and applications of green fluorescent protein. (10)

   c) What is LD_{50}? How do you determine the LD_{50} value of a given compound? (05)

2. Suppose an amino acid sequence of a protein from *Plasmodium falciparum* is given to you and you are asked to clone a gene which encodes this protein. Answer the following questions?

a) Design the PCR based strategy for amplifying the referred gene. (05)

b) Design the cloning strategy for expression of the referred gene in Yeast. Also include the downstream processing of expressed protein. (10)

c) What problems do you anticipate in expression of Plasmodium gene in Yeast? Discuss strategies you would use to address them. (10)

3. a) Changes that occur either at structural level during mitosis or at the number during meiosis in chromosomes lead to genetic variation. What are those changes? Explain in detail all the changes with suitable examples? (10)

b) Define somaclonal variation. Explain its applications in crop production (07)

c) Briefly explain tropisms in plants (08)

4. a) Explain the biological mechanisms of metal removal from polluted environments. (13)

b) Write in detail on : Functions of plant growth promoting rhizobacteria (PGPR) (12)

5. a) What are monoclonal antibodies? Describe the principles and methods followed for their production (10)

b) Explain the strategies and/or techniques used for purification of enzymes (10)

c) What are phospholipids? Explain their structure and functions. (05)