

PRATIYOGITA
SAHITYA

CSIR-UGC NET 15 SOLVED PAPERS

Life Science (Part-A, B & C)



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PRATIYOGITA
SAHITYA

CSIR-UGC NET

Joint Test for Junior Research Fellowship
and Eligibility for Lectureship

15 SOLVED PAPERS

June 2018 - June 2011

With Authentic & Detailed Solutions

Life Science

(Part-A, B & C)

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for Part A, B & C

15 Solved Papers

June, 2018—June, 2011

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By

D. Sabitha Rajan

 **PRATIYOGITA SAHITYA**
SERIES

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Important Information About Test

• Educational Qualification

M. Sc. or equivalent degree/ Integrated BS-MS/BS-4 years/BE/B. Tech/B. Pharma/MBBS with at least 55% marks for General (UR) and OBC candidates and 50% for SC/ST, Persons with disability (PwD) candidates.

Candidates enrolled for M. Sc. or having completed 10+2+3 years of the above qualifying examination are also eligible to apply in the above subject under the Result Awaited (RA) category on the condition that they complete the qualifying degree with requisite percentage of marks within the validity period of two years to avail the fellowship from the effective date of award.

Such candidates will have to submit the attestation format (Given at the reverse of the application form) duly certified by the Head of the Department/Institute from where the candidate is appearing or has appeared.

B. Sc. (Hons) or equivalent degree holders or students enrolled in Integrated MS-PhD program with at least 55% marks for General (UR) and OBC candidates; 50% marks for SC/ST, Persons with disability (PwD) candidates are also eligible to apply. Candidates with bachelor's degree will be eligible for CSIR fellowship only after getting registered/enrolled for PhD/Integrated PhD program within the validity period of two years.

Candidates having Bachelor's degree only shall not be eligible for Lectureship.

The eligibility for lectureship of NET qualified candidates will be subject to fulfilling the criteria laid down by UGC. PhD degree holders who have passed Master's degree prior to 19th September 1991, with at least 50% marks are eligible to apply for Lectureship only.

• Age Limit & Relaxation

For JRF (NET) : Maximum 28 years (upper age limit may be relaxed up to 5 years in case of SC/ST/Persons with disability (PwD)/ female applicants and 03 years in case of OBC (non creamy layer) applicants)

For LS (NET) : No upper age limit.

• Scheme of the Test

The single paper MCQ based test will be held as under :

Subject	Marks
(i) Life Sciences (ii) Earth, Atmospheric, Ocean and Planetary Sciences (iii) Mathematical Sciences (iv) Chemical Sciences (v) Physical Sciences	200

The Test Booklet shall be divided in three parts. (A, B & C) as per Syllabus & Scheme of Exam.

Part 'A' shall be common to all subjects. This part shall contain questions pertaining to General Aptitude with emphasis on logical reasoning, graphical analysis, analytical and numerical ability, quantitative comparison, series formation, puzzles etc.

Part 'B' shall contain subject-related conventional Multiple Choice Questions (MCQs), generally covering the topics given in the syllabus.

Part 'C' shall contain higher value questions that may test the candidate's knowledge of scientific concepts and/or application of the scientific concepts. The questions shall be of analytical nature where a candidate is expected to apply the scientific knowledge to arrive at the solution to the given scientific problem.

Syllabus & Scheme of Exam of single MCQ Paper may be seen at CSIR HRDG website : www.csirhrdg.res.in.

Note : The Exam Scheme for Chemical Sciences has been revised from June, 2017 CSIR-UGC (NET) Exam onwards. The revised exam scheme and model Question paper may be seen at CSIR HRDG website www.csirhrdg.res.in

Negative marking for wrong answers, wherever required, shall be applicable as per subject wise scheme of Exam.

If a question for any reason found wrong, the benefit of marks will be given to only those candidates who attempt the question.

SYLLABUS

1. MOLECULES AND THEIR INTERACTION RELEVANT TO BIOLOGY

- (A) Structure of atoms, molecules and chemical bonds.
- (B) Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
- (C) Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).
- (D) Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties).
- (E) Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.
- (F) Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes
- (G) Conformation of proteins (Ramachandran plot, secondary structure, domains, motif and folds).
- (H) Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).
- (I) Stability of proteins and nucleic acids.
- (J) Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.

2. CELLULAR ORGANIZATION

- (A) **Membrane structure and function** : Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.
- (B) **Structural organization and function of intracellular organelles** : Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.
- (C) **Organization of genes and chromosomes** : Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons).
- (D) **Cell division and cell cycle** (Mitosis and meiosis, their regulation, steps in cell cycle, regulation and control of cell cycle).
- (E) **Microbial Physiology** : Growth yield and characteristics, strategies of cell division, stress response.

3. FUNDAMENTAL PROCESSES

- (A) **DNA replication, repair and recombination** : Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination.
- (B) **RNA synthesis and processing** : transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport.
- (C) **Protein synthesis and processing** : Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post-translational modification of proteins.
- (D) **Control of gene expression at transcription and translation level** : regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.

4. CELL COMMUNICATION AND CELL SIGNALING

- (A) **Host parasite interaction** : Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.
- (B) **Cell signaling** : Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.

- (C) **Cellular communication** : Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.
- (D) **Cancer** : Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.
- (E) **Innate and adaptive immune system** : Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

5. DEVELOPMENTAL BIOLOGY

- (A) **Basic concepts of development** : Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development
- (B) **Gametogenesis, fertilization and early development** : Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.
- (C) **Morphogenesis and organogenesis in animals** : Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination).
- (D) **Morphogenesis and organogenesis in plants** : Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*
- (E) **Programmed cell death, aging and senescence**

6. SYSTEM PHYSIOLOGY - PLANT

- (A) **Photosynthesis** : Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO₂ fixation-C₃, C₄ and CAM pathways.
- (B) **Respiration and photorespiration** : Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.
- (C) **Nitrogen metabolism** : Nitrate and ammonium assimilation; amino acid biosynthesis.
- (D) **Plant hormones** : Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.
- (E) **Sensory photobiology** : Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.
- (F) **Solute transport and photoassimilate translocation** : Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.
- (G) **Secondary metabolites** : Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.
- (H) **Stress physiology** : Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

7. SYSTEM PHYSIOLOGY - ANIMAL

- (A) **Blood and circulation** : Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.
- (B) **Cardiovascular System** : Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

- (C) **Respiratory system** : Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.
- (D) **Nervous system** : Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.
- (E) **Sense organs** : Vision, hearing and tactile response.
- (F) **Excretory system** : Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.
- (G) **Thermoregulation** : Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.
- (H) **Stress and adaptation**
- (I) **Digestive system** : Digestion, absorption, energy balance, BMR.
- (J) **Endocrinology and reproduction** : Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, gametogenesis, ovulation, neuroendocrine regulation

8. INHERITANCE BIOLOGY

- (A) **Mendelian principles** : Dominance, segregation, independent assortment.
- (B) **Concept of gene** : Allele, multiple alleles, pseudoallele, complementation tests
- (C) **Extensions of Mendelian principles** : Codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, penetrance and expressivity, phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.
- (D) **Gene mapping methods** : Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.
- (E) **Extra chromosomal inheritance** : Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.
- (F) **Microbial genetics** : Methods of genetic transfers – transformation, conjugation, transduction and sexduction, mapping genes by interrupted mating, fine structure analysis of genes.
- (G) **Human genetics** : Pedigree analysis, lod score for linkage testing, karyotypes, genetic disorders.
- (H) **Quantitative genetics** : Polygenic inheritance, heritability and its measurements, QTL mapping.
- (I) **Mutation** : Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis.
- (J) **Structural and numerical alterations of chromosomes** : Deletion, duplication, inversion, translocation, ploidy and their genetic implications.
- (K) **Recombination** : Homologous and non-homologous recombination including transposition.

9. DIVERSITY OF LIFE FORMS

- (A) **Principles & methods of taxonomy** : Concepts of species and hierarchical taxa, biological nomenclature, classical & quantitative methods of taxonomy of plants, animals and microorganisms.
- (B) **Levels of structural organization** : Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Comparative anatomy, adaptive radiation, adaptive modifications.
- (C) **Outline classification of plants, animals & microorganisms** : Important criteria used for classification in each taxon. Classification of plants, animals and microorganisms. Evolutionary relationships among taxa.
- (D) **Natural history of Indian subcontinent** : Major habitat types of the subcontinent, geographic origins and migrations of species. Common Indian mammals, birds. Seasonality and phenology of the subcontinent.
- (E) **Organisms of health & agricultural importance** : Common parasites and pathogens of humans, domestic animals and crops.
- (F) **Organisms of conservation concern** : Rare, endangered species. Conservation strategies.

10. ECOLOGICAL PRINCIPLES

- (A) **The Environment** : Physical environment; biotic environment; biotic and abiotic interactions.
- (B) **Habitat and Niche** : Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning ; character displacement.
- (C) **Population Ecology** : Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

- (D) **Species Interactions :** Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.
- (E) **Community Ecology :** Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.
- (F) **Ecological Succession:** Types; mechanisms; changes involved in succession; concept of climax.
- (G) **Ecosystem Ecology:** Ecosystem structure; ecosystem function; energy flow and mineral cycling (C,N,P); primary production and decomposition; structure and function of some Indian ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).
- (H) **Biogeography:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.
- (I) **Applied Ecology:** Environmental pollution; global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches.
- (J) **Conservation Biology:** Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

11. EVOLUTION AND BEHAVIOUR

- (A) **Emergence of evolutionary thoughts :** Lamarck; Darwin—concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.
- (B) **Origin of cells and unicellular evolution :** Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiment of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.
- (C) **Paleontology and Evolutionary History :** The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo.
- (D) **Molecular Evolution :** Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.
- (E) **The Mechanisms :** Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.
- (F) **Brain, Behavior and Evolution :** Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.

12. APPLIED BIOLOGY :

- (A) Microbial fermentation and production of small and macro molecules.
- (B) Application of immunological principles, vaccines, diagnostics. Tissue and cell culture methods for plants and animals.
- (C) Transgenic animals and plants, molecular approaches to diagnosis and strain identification.
- (D) Genomics and its application to health and agriculture, including gene therapy.
- (E) Bioresource and uses of biodiversity.
- (F) Breeding in plants and animals, including marker – assisted selection
- (G) Bioremediation and phytoremediation
- (H) Biosensors

13. METHODS IN BIOLOGY

- (A) **Molecular Biology and Recombinant DNA methods:**
Isolation and purification of RNA , DNA (genomic and plasmid) and proteins, different separation methods. Analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, Isoelectric focusing gels.
Molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems.
Expression of recombinant proteins using bacterial, animal and plant vectors.

Isolation of specific nucleic acid sequences

Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors.

In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms.

Protein sequencing methods, detection of post translation modification of proteins.

DNA sequencing methods, strategies for genome sequencing.

Methods for analysis of gene expression at RNA and protein level, large scale expression, such as micro array based techniques

Isolation, separation and analysis of carbohydrate and lipid molecules

RFLP, RAPD and AFLP techniques

(B) **Histochemical and Immunotechniques**

Antibody generation, Detection of molecules using ELISA, RIA, western blot, immunoprecipitation, fluocytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.

(C) **Biophysical Method :**

Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy Molecular structure determination using X-ray diffraction and NMR, Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

(D) **Statistical Methods :**

Measures of central tendency and dispersal; probability distributions (Binomial, Poisson and normal); Sampling distribution; Difference between parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance; X2 test;; Basic introduction to Multivariate statistics, etc.

(E) **Radiolabeling techniques:**

Detection and measurement of different types of radioisotopes normally used in biology, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

(F) **Microscopic techniques:**

Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze- fracture methods for EM, image processing methods in microscopy.

(G) **Electrophysiological methods:**

Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT .

(H) **Methods in field biology:**

Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization: ground and remote sensing methods.

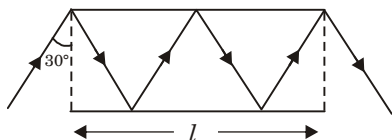
CSIR-UGC-JRF/NET Examination, June 2018
LIFE SCIENCES
SOLVED PAPER

PART - A

1. What is the value of $(1 + 3 + 5 + 7 + \dots + 4033) + 7983 \times 2017$?

(A) 20170000 (B) 20172017
(C) 20171720 (D) 20172020

2. Path of a ray of light between two mirrors is shown in the diagram. If the length of each mirror is l , what is the total path length of the ray between the mirrors?



(A) $\frac{3}{4}l$ (B) $\frac{4}{3}l$
(C) $\frac{3}{2}l$ (D) $2l$

3. In a group of 11 persons, each shakes hand with every other once and only once. What is the total number of such handshakes?

(A) 110 (B) 121 (C) 55 (D) 66

4. Suppose (i) " $A * B$ " means "A is the father of B", (ii) " $A \Delta B$ " means "A is the husband of B", (iii) " $A \nabla B$ " means "A is the wife of B" and (iv) " $A \square B$ ", means "A is the sister of B". Which of the following represents "C is the father-in-law of the sister of D"?

(A) $C \nabla E * F \square D$ (B) $C * E \nabla F \square D$
(C) $C \Delta E * F \square D$ (D) $C * E \Delta F \square D$

5. In a 100 m race A beats B by 10 m, B beats C, by 5 m. By how many meters does A beat C?

(A) 15.0 m (B) 5.5 m
(C) 10.5 m (D) 14.5 m

6. When a farmer was asked as to how many animals he had, he replied that all but two were cows, all but two were horses and all but two were pigs. How many animals did he have?

(A) 3 (B) 6
(C) 8 (D) 12

7. Nine-eleventh of the member of a parliamentary committee are men. Of the men, two-thirds are from the Rajya Shabha, Further, $7/11$ of the total committee members are from the Rajya Sabha. What fraction of the total number are women from the Lok Sabha?

(A) $1/11$ (B) $6/11$
(C) $2/11$ (D) $3/11$

8. A librarian is arranging a thirteen-volume encyclopaedia on the shelf from left to right in the following order of volume numbers : 8, 11, 5, 4, 9, 1, 7, 6, 10, 3, 12, 2. In this pattern, where should the volume 13 be placed?

(A) Leftmost (B) Rightmost
(C) Between 10 and 3 (D) Between 9 and 1

9. Pick the correct statement :

(A) The sky is blue because Sir C.V. Raman gave the correct explanation.
(B) Copernicus believed that the Sun, and not the Earth, was at the centre of the Solar system.
(C) The sky appears blue when seen from the Moon.
(D) No solar eclipse is visible for an astronaut standing on the Moon.

10. What is the last digit of $(2017)^{2017}$?

(A) 1 (B) 3
(C) 7 (D) 9

11. The university needs to appoint a new Vice Chancellor which will be based on seniority. Ms. West is less senior to Mr. North but more senior to Ms. East. Mr. South is senior to Ms. West but junior to Mr. North. If the senior-most declines the assignment, then who will be the new Vice Chancellor of the University?

(A) Mr. North (B) Ms. East
(C) Ms. West (D) Mr. South

12. The prices of diamonds having a particular colour and clarity are tabulated below :

Weight of diamond (in carats)	Price of diamond (in rupees/carats)
0.25	1 lakh
0.5	2 lakh
1	4 lakh
2	8 lakh

How many 0.25 carat diamonds can be purchased for the price of a 2 carat diamond?

(A) 8 (B) 16
(C) 32 (D) 64

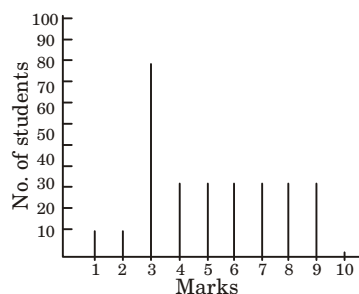
13. In a sequence of 24 positive integers, the product of any two consecutive integers is 24. If the 17th member of the sequence is 6, the 7th member is :

(A) 24 (B) 4
(C) 6 (D) 17

14. Mohan lent Geeta as much money as she already had. She then spent ₹ 10. Next day, he again lent as much money as Geeta now had, and she spent ₹ 10 again. On the third day, Mohan again lent as much money as Geeta now had, and she again spent ₹ 10. If Geeta was left with one money at the end of the third day, how much money did she have initially ?

(A) ₹ 11.25 (B) ₹ 10
(C) ₹ 7.75 (D) ₹ 8.75

15. The distribution of marks of students in a class is given by the following chart :

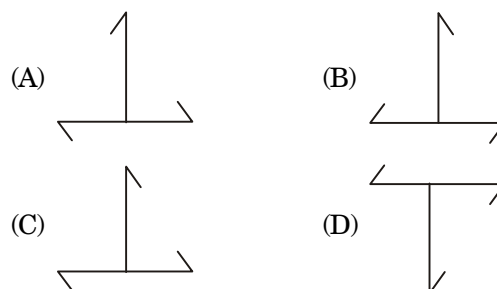
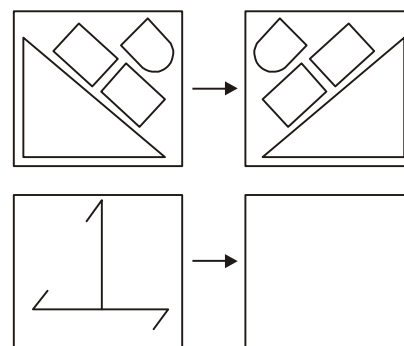


If 3.30 marks is the passing score in a 10 mark question paper, which of the following is false ?

- (A) Majority of the students have scored above the pass mark.
(B) Mode of the distribution is 3.
(C) Average marks of passing students is above 5 %.
(D) Average marks of students who have failed is below 20%.
16. If all the angles of a triangle are prime numbers, which of the following could be one such angle ?
(A) 89° (B) 79°
(C) 59° (D) 29°
17. A water tank that is 40% empty holds 40 L more water than when it is 40% full. How much water does it hold when it is full ?
(A) 100 L (B) 75 L
(C) 102 L (D) 200 L

18. How much gold and copper (in g), respectively, are required to make a 120 g bar of 22 carat gold ?
(A) 90 and 30
(B) 100 and 20
(C) 110 and 10
(D) 120 and 0

19. Which should be the correct pattern in the empty square ?



20. Areas of the three rectangles inside the full rectangle are given in the diagram :

	8
12	4

What is the area of the full rectangle ?

(A) 36 (B) 48
(C) 72 (D) 96

PART - B

21. The $[\text{OH}^-]$ of 0.1 N HCl solution is :
(A) 10^{-14} M (B) 10^{-13} M
(C) 10^{-12} M (D) 10^{-7} M
22. Ability of a membrane protein to span the lipid bilayer strictly depends on the presence of :
(A) Zinc finger domain (B) α helices
(C) Parallel β sheet (D) Antiparallel β sheet
23. Which one of the listed below is a P-type ion transporter ?
(A) Mg^{+2} and Fe^{+2}
(B) Mg^{+2} and Fe^{+3}
(C) Mg^{+2} and Cl^-
(D) $\text{Na}^+ - \text{K}^+$, Ca^{+2} and H^+

24. The cell maintains a high concentration of protons inside the lysosome because of :

(A) Antiporter in the lysosomal membrane
(B) ATP-powered proton pump in the lysosomal membrane
(C) Facilitated diffusion proton channel in the lysosomal membrane
(D) Facilitated diffusion proton uniporter in the lysosomal membrane

25. It is known that there is a large difference in the DNA content between two organisms with similar developmental complexity. This is due to large differences in the number of :

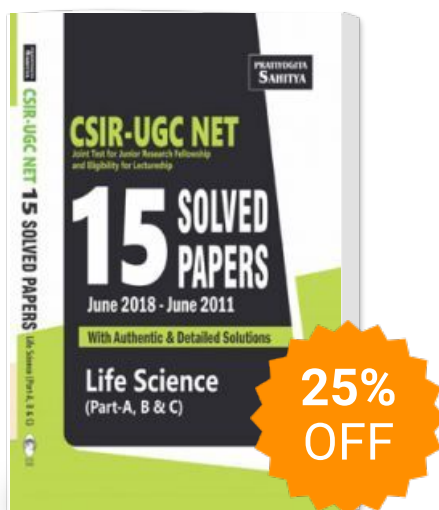
(A) Transposable elements, repetitive DNA and coding sequences

- (B) Transposable elements and repetitive DNA
(C) Introns and coding sequences
(D) Introns and transposable elements
26. A uracil containing plasmid was constructed and was used in transformation into the wild type (*ung*⁺) and uracil-N-glycosylase mutated (*ung*⁺) *E. coli* cells and scored for transformants in the presence of appropriate antibiotics. Which one of the following statements correctly describes the experimental outcome ?
(A) *ung*⁺ cells will have fewer transformants compared to *ung*⁻ cells
(B) *ung*⁺ cells will give fewer transformants compared to *ung*⁻ cells
(C) No transformants will be obtained in *ung*⁻ cells as uracil excision repair will not occur and the plasmid would not replicate
(D) Presence of uracil in DNA is unnatural and the plasmid DNA with uracils in it will not produce transformants in either *ung*⁺ or *ung*⁻ cells
27. Which one of the following peptides can coexist in both cis-and trans-conformation ?
(A) Ala-Ala-CONH₂ (B) Pro-Gly-CONH₂
(C) Asn-GLy-CONH₂ (D) Val-Pro-CONH₂
28. Which one of the following statements is **NOT** correct ?
(A) Allosteric enzymes do not obey Michaelis-Menten kinetics.
(B) The free-energy change provides information about the spontaneity but not rate of a reaction.
(C) Competitive and non-competitive inhibitions are kinetically indistinguishable.
(D) A k_{cat}/K_M ($M^{-1} s^{-1}$) of $\sim 2 \times 10^8$ for an enzyme indicates that the value is close to diffusion-controlled rate of encounter.
29. Which one of the following pairs of amino acids are glucogenic and ketogenic in nature ?
(A) Alanine and Lysine
(B) Lysine and Leucine
(C) Isoleucine and Phenylalanine
(D) Aspartate and Lysine
30. Cervical cancer-causing **papilloma virus** produces two oncoproteins E6 and E7 which are responsible for interfering with cell cycle regulation by :
(A) Inactivating pRb and p53, respectively
(B) Modulating p53 and pRb, respectively
(C) Binding to cyclin D1 and CDK4
(D) Activating expression of p21
31. Which one of the following permits the rapid diffusion of small, water-soluble molecules between the cytoplasm of adjacent cells ?
(A) Tight junctions (B) Anchoring junctions
(C) Adherens junctions (D) Gap junctions
32. Which one of the following is **NOT** true for alternative pathway of **complement activation** ?
(A) Alternative pathway uses the same membrane-attack complex as the classical pathway.
(B) Alternative pathway does not require antigen-antibody interactions.
(C) Alternative pathway produce C3 by the same route as the classical pathway.
(D) Certain microbial surfaces have physico-chemical properties that may result in activation of alternative pathway.
33. *E. coli* takes 40 min. to duplicate its genome using a bi-directional mode of replication. If *E. coli* were to use uni-directional mode of replication to synthesize a full copy of DNA complementary to just one of the strands of the genome, it would take :
(A) 40 min (B) 80 min
(C) 20 min (D) 60 min
34. Transcriptional regulation of *trp* operon by tryptophan involves binding of tryptophan to :
(A) The repressor protein and inhibition of transcription by its interaction with the operator region.
(B) RNA polymerase and inhibition of transcription.
(C) The repressor protein leading to structural changes and its degradation by proteases.
(D) The repressor protein leading to its interaction with the sigma subunit and inhibition of transcription.
35. Phosphorylation of eIF2 α subunits (at Ser 51) leads to :
(A) Inactivation of Met-tRNA_i binding activity of eIF2B.
(B) Sequestration of eIF2B because of tight binding between eIF2 and eIF2B.
(C) Degradation of eIF2B.
(D) Enhanced guanine exchange activity of eIF2B.
36. If a disease caused by an intracellular pathogen is associated with host anti-inflammatory response, which one of the following may lead to an effective therapeutic approach ?
(A) Treatment with TGF- β
(B) Treatment with macrophage activating agent
(C) Depletion of IFN- γ from the system
(D) Treatment with IL-4 and IL-10
37. Which one of the following secondary metabolites is characterized by the presence of a central carbon atom that is bound by a sulphur to a glycone group, and by a nitrogen to sulfonated oxime group ?
(A) Alkaloids (B) Terpenes
(C) Phenolics (D) Glucosinolates
38. Dark grown *Arabidopsis* seedlings show 'triple response' when exposed to ethylene hormone. Which one of the following options is characteristic of 'triple response' ?
(A) Reduced shoot elongation, increased shoot thickness and tightening of apical hook.

- (B) Reduced shoot elongation, reduced shoot thickness and loosening of apical hook.
 (C) Increased shoot elongation, increased shoot thickness and loosening of apical hook.
 (D) Increased shoot elongation, reduced shoot thickness and tightening of apical hook.
39. Brassinosteroids are a group of steroid hormones that function in a variety of cellular and developmental contexts in plants. Which one of the following acts as an inhibitor of the brassinosteroid receptor ?
 (A) BRI 1 (B) BKI 1
 (C) BAK 1 (D) BSK 1
40. Which one of the following metabolites moves from mitochondria to peroxisome during the operation of the C_2 oxidative photosynthetic cycle ?
 (A) Glycerate (B) Glycolate
 (C) Glycine (D) Serine
41. Sympathetic post-ganglionic neurons that are cholinergic, innervate :
 (A) Sweat glands (B) Parotid glands
 (C) Hair follicles (D) Pancreas
42. Fertilization in sea urchin eggs involves Ca^{2+} release from the endoplasmic reticulum for cortical granule reactivation. The major molecule responsible for releasing Ca^{2+} from intracellular stores is :
 (A) Zona pellucida glycoproteins
 (B) Protamines
 (C) Inositol 1, 4, 5-trisphosphate
 (D) N-acetylglucosaminidase
43. What is the observed phenotype when the *ultrabithorax* gene is deleted in *Drosophila* ?
 (A) The third thoracic segment is transformed into another second thoracic segment resulting in a fly with four wings.
 (B) Since it specifies the second thoracic segment, instead of antenna leg grows out of the head socket.
 (C) Since it specifies the third thoracic segment, a fly with two pairs of halteres develop.
 (D) Since this gene fails to be expressed in the second thoracic segment, the antennae sprout in the leg position.
44. Which one of the following statements with respect to amphibian development is correct ?
 (A) The organizer is itself induced by the Nieuwkoop Centre located in the dorsal-most mesodermal cells.
 (B) The organizer functions by secreting proteins like Noggin, Chordin and Follistatin that blocks BMP signal that would otherwise dorsalize the mesoderm.
 (C) In the presence of BMP activations the ectodermal cells form neural tissue.
 (D) Wnt signalling causes a gradient of β -catenin along the anterior-posterior axis of the neural tube that appears to specify the regionalization of the neural tube.
45. Which one of the following statements related to components/features of senescence in plants is **INCORRECT** ?
 (A) Programmed cell death in plants may generate functional cells or tissues.
 (B) Senescence can be induced by application of cytokinins and delayed by overexpression of salicylic acid.
 (C) Plants defective in autophagy demonstrate accelerated plant senescence.
 (D) Leaf senescence is regulated by NAC and WRK Y genes families.
46. In an organism, allele for red eye colour is dominant over the allele for white eye colour. A cross is made between a white eyed male and a red eyed female. In the progeny all males are red eyed while the females are white eyed. The reciprocal cross leads to all red eyed progeny. Based on the above information which one of the following conclusions is correct ?
 (A) This is a sex-limited trait, and the male is the homomorphic sex.
 (B) This is a sex-linked trait, with male being the homomorphic sex.
 (C) This is a sex-linked trait with female being the homomorphic sex.
 (D) This is a case of autosomal inheritance, with complete penetrance.
47. Melanopsin is found in which cell of the retina ?
 (A) Cones (B) Rods
 (C) Ganglion cells (D) Bipolar cells
48. Prestin, a membrane protein, is found in which one of the following cells of the organ of Corti ?
 (A) Inner hair cells (B) Inner phalangeal cells
 (C) Outer hair cells (D) Outer phalangeal cells
49. Two individuals A and B, each of 75 kg body weight, have similar volume of body water. Both of them had high salt snack. However, individual A also had a glass of alcoholic drink. Based on this information, which one of the following statements is true ?
 (A) A will have lower circulating level of antidiuretic hormone (ADH) than B.
 (B) B will have lower circulating level of ADH than A.
 (C) The level of ADH will not change in these two individuals.
 (D) The reabsorption of water in kidney will be more in A than B.
50. An intron was cloned within a transposable element. Absence of the intron following transposition of the element, will indicate that it :
 (A) follows conservative mode of transposition
 (B) follows replicative mode of transposition
 (C) is a retrotransposon
 (D) is an insertion element

51. A male snail homozygous for dextral alleles is crossed with a female homozygous for sinistral alleles. All the F1 individuals showed sinistral phenotype. When F1 progeny snails were self fertilized all individuals of F2 progeny had dextral coiling. This experiment demonstrated :
- Dominant epistasis as dextral allele is dominant over sinistral allele.
 - Recessive epistasis as in F2 dextral allele appeared in homozygous condition.
 - Maternal effect as the nuclear genotype of the F1 mother has governed the phenotype of the F2 individuals.
 - Maternal inheritance as the mitochondrial genes of the F1 mother has governed the phenotype of the F2 individuals.
52. Bipinnaria and brachiolaria are the larval forms of :
- Crustacea
 - Arthropoda and Mollusca, respectively
 - Ophiuroidea and Holothuroidea, respectively
 - Asteroidea
53. In a sample from a population there were 65 individuals with BB genotype, 30 individuals with Bb genotype and 15 individuals with bb genotype. The frequency of 'b' allele is :
- 0.59
 - 0.27
 - 0.41
 - 0.73
54. Ruderal species are those which are found in the environments with :
- Low disturbance, high competition
 - High disturbance, low competition
 - Low disturbance, low competition
 - High disturbance, high competition
55. Scientists discovered two new plant species, "A" and "B" that look similar except that, species "A" bears flowers and leaves that are twice the size of those in species "B". Which method should the scientists use to appropriately investigate if species "A" is a result of gene duplication in species "B"?
- Sequence similarity, gene structure and gene size.
 - Plant size, physical proximity of gene and genome size.
 - Sequence similarity, physical proximity of gene, genome size.
 - Sequence length, gene structure and chromosome count.
56. A group of palaeontologists digging in an area discovers a pre-historic human burial site. The same group, while exploring a nearby area, discovered fossil remains of what appeared to be more than 100 million year old dinosaur bones. Which of the following combinations of modern radiometric dating techniques should they use to calculate the age of these fossils most accurately ?
- ^{14}C dating for human remains and ^{235}U dating for dinosaur remains.
 - ^{87}Rb dating for both human and dinosaur remains.
 - ^{14}C dating for both human and dinosaur remains.
 - ^{129}I dating for human remains and ^{129}Xe for dinosaur remains.
57. Given below are statements related to the two competing hypotheses on the origin of modern humans; the Out-of-Africa hypothesis and the multi-regional hypothesis. Which of the following statements is **INCORRECT**?
- Both the hypotheses support that *Homo erectus* originated in Africa and expanded to Eurasia.
 - Mitochondrial DNA (mtDNA) and Y chromosome DNA evidence support the 'Out-of-Africa' hypothesis.
 - The principal conflict between the two hypotheses is that multi-regional hypothesis does not support African origin of *Homo erectus*.
 - The multi-regional hypothesis states the independent multiple origins occurred in the million year since *Homo erectus* came out of Africa.
58. Which one of the following statements is TRUE for positive-frequency dependent selection ?
- Fitness of a genotype increases as it becomes less common.
 - Fitness of a genotype increases as it becomes more common.
 - Fitness of a genotype decreases as it becomes less common.
 - Fitness of a genotype decreases as it becomes common and gets fixed.
59. The animals belonging to phylum Onychophora :
- Have arthropodan characteristics and thus also considered as a class of Arthropoda.
 - Have both annelidan and arthropodan characteristics.
 - Have both arthropodan and molluscan characteristics.
 - Serve as a connecting link between Annelida and Mollusca.
60. Which one of the following parameters is **NOT** used in phenetic classification of bacteria ?
- Trophism
 - Susceptibility of a bacteria to a particular bacteriophage
 - Reaction to a particular antibody
 - 16S rRNA sequence
61. Which of the following groups represents SAR clade of protists ?
- Euglenozoans, Red algae, Parabasilids
 - Brown algae, Forams, Radiolarians
 - Slime moulds, Entamoebas, Diplomonads
 - Charophytes, Choanoflagellates, Tubulinids
62. Given below are biodiversity hotspots in decreasing order of endemic plant species recorded in them. Select the correct order.

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