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ROLL No.

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TEST BOOKLET No.

080

TEST FOR POST GRADUATE PROGRAMMES

LIFE SCIECNES

Time: 2 Hours

Maximum Marks: 450

INSTRUCTIONS TO CANDIDATES

1. You are provided with a Test Booklet and an Optical Mark Reader (OMR) Answer Sheet to mark your responses. Do not soil the Answer Sheet. Read carefully all the instructions given on the Answer Sheet.
 2. Write your Roll Number in the space provided on the top of this page.
 3. Also write your Roll Number, Test Code, and Test Subject in the columns provided for the same on the Answer Sheet. Darken the appropriate bubbles with a **Ball Point Pen**.
 4. The paper consists of 150 objective type questions. All questions carry equal marks.
 5. Each question has four alternative responses marked **A, B, C** and **D** and you have to **darken** the bubble fully by a **Ball Point Pen** corresponding to the correct response as indicated in the example shown on the Answer Sheet.
 6. Each correct answer carries 3 marks and each wrong answer carries 1 minus mark.
 7. Please do your rough work only on the space provided for it at the end of this Test Booklet.
 8. You should return the Answer Sheet to the Invigilator before you leave the examination hall. However, you can retain the Test Booklet.
 9. Every precaution has been taken to avoid errors in the Test Booklet. In the event of such unforeseen happenings the same may be brought to the notice of the Observer/Chief Superintendent in writing. Suitable remedial measures will be taken at the time of evaluation, if necessary.
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SEAL

LIFE SCIENCES

1. Trapping of iodine in a coiled molecule consisting of several glucose molecule linked together which produces a bluish-black colour is a confirmatory test for
 - (A) peptide
 - (B) starch
 - (C) lipids
 - (D) cellulose

2. Infectious particle of virus is called
 - (A) capsid
 - (B) virion
 - (C) capsomere
 - (D) nucleocapsid

3. Basic principle behind Lowry method of protein estimation is
 - (A) biuret reaction
 - (B) bichichonic acid reaction
 - (C) dye binding reaction
 - (D) reduction reaction

4. Fish-out the largest bacteria of the Universe
 - (A) *Epulopisium fisulsonii*
 - (B) *Thiomargarita namibiensis*
 - (C) *Methanobacterium thermoautotrophicum*
 - (D) *Bacillus megaterium*

5. Name the first fully sequenced organism
 - (A) *Methanococcus volutae*
 - (B) *Candida albicans*
 - (C) *Escherichia coli*
 - (D) *Pseudomonas aeruginosa*

6. Cell wall of algae contains
 - (A) chitin
 - (B) mycolic acid
 - (C) cellulose
 - (D) peptidoglycan

7. "Suicide Sacs" of the cell is called as
 - (A) ribosomes
 - (B) lysosomes
 - (C) polysomes
 - (D) microtubules



8. Distance between the tip of the objective lens and the object is
- (A) working distance (B) working volume
(C) numerical aperture (D) oil space
9. The test used to identify lipids is
- (A) biuret test (B) sudan test
(C) iodine test (D) benedict's test
10. Rule-out the eubacteria from the following
- (A) *Mycobacterium tuberculosis* (B) *Stenotrophomonas maltophilia*
(C) *Corenybacterium diphtherium* (D) *Streptomyces griseus*
11. Complete lysis of blood occurs when the blood is mixed with
- (A) saline (B) water
(C) starch solution (D) ringer solution
12. Regulation of stomatal opening is performed by
- (A) epidermal cells (B) cambial cells
(C) guard cells (D) aeranchyma cells
13. A boxed figure determines the probability of genotypes and phenotypes in offspring is called as
- (A) Ramachandran's plot (B) phenogeno square
(C) punnet square (D) hybrid square
14. Poliovirus receptors are found in
- (A) cells of all tissues
(B) spinal cord anterior horn cells only
(C) nasopharynx, gut, and spinal cord anterior horn cells
(D) gut cells only



15. Long flagella extending from both ends of a spirochete that often overlap in the centre third of the organism is called
- (A) protoplasmic cylinder (B) reticulate body
(C) elementary body (D) axial fibrils
16. Gamete-producing bodies that can fuse to form a zygote during sexual reproduction of some fungi are called as
- (A) gametangia (B) gamete sac
(C) zygomycetes (D) sporangia
17. Because of the lack of an observable sexual reproductive cycle, the Deuteromycetes are also referred to as
- (A) fungi deficienti (B) fungi imperfecti
(C) fungi havnofuni (D) fungi incompleti
18. Which of the following is not true about fatty acids?
- (A) Fatty acids are monocarboxylic acids
(B) Fatty acids have long alkyl chains
(C) Microbial fatty acids are always straight chained
(D) Fatty acids usually have an even number of carbons
19. Inhibitors that stop ATP synthesis without inhibiting electron transport are
- (A) uncouplers (B) Pasteur effect
(C) couplers (D) enzymes
20. The time in minutes at a specific temperature needed to kill a population of cells or spores is
- (A) D-value (B) F-value
(C) Z-value (D) TDT
21. More than one codon will specify a particular amino acid and therefore, the codon is said to be
- (A) ambiguous codon (B) degenerate codon
(C) multiplicative codon (D) repetition codon



22. Proteins produced by bacteria that destroy other bacteria are called
- (A) siderophores (B) bacteriocins
(C) bacteriolysin (D) plasmolysins
23. Transfer of bacterial genes by an 'F' plasmid is often called
- (A) transduction (B) sexduction
(C) transfection (D) transformation
24. H1N1 belongs to
- (A) Hepatitis-A virus (B) Arenavirus
(C) Influenza-A virus (D) Adenovirus
25. Which of the following accumulates sulfur granules within the cell?
- (A) Purple bacteria (B) Green bacteria
(C) Cyanobacteria (D) All of the above
26. Small organic molecules that are not themselves antigenic but they will stimulate an immune response when coupled to a larger carrier molecule are called as
- (A) antigens (B) mitogens
(C) adjuvants (D) haptens
27. The only immunoglobulin able to cross the placenta is
- (A) IgG (B) IgM
(C) IgA (D) IgD
28. Neutralizing antibody against toxin is referred to as a (an)
- (A) antitoxin (B) toxoid
(C) antitoxoid (D) neutrotox
29. The ratio of therapeutic dose to toxic dose is called
- (A) therapeutic index (B) toxic index
(C) dose index (D) minimal lethal concentration

30. A disease that occurs occasionally at irregular intervals in a human population is referred to as
- (A) outbreak (B) hyperdemic
(C) pandemic (D) sporadic
31. Masses of viruses found in neurons infected with rabies virus
- (A) koplic spot (B) negri bodies
(C) hemorrhage (D) encephalitis
32. Peptic ulcer is caused by
- (A) *Helicobacter pylori* (B) *Escherichia coli*
(C) *Shigella boydii* (D) *Salmonella typhi*
33. The process of toxic compound accumulation in organism of a food chain such that the top level consumers ingest concentrations higher than those that are normally found in the environment
- (A) bioaccumulation (B) biomagnification
(C) bioamplification (D) bioconcentration
34. Which of the following group does not have a functional TCA cycle?
- (A) Methanogens (B) Extreme halophiles
(C) Extreme thermophiles (D) All of the above
35. Microbially produced glycolipids that can be used as dispersing agents are
- (A) biocatalyst (B) biospreader
(C) biosurfactant (D) biofats
36. Dipicolinic acid is present in
- (A) endospore (B) conidiospore
(C) ascospore (D) basidiospore
37. Arrangement of xylem in dicot root is
- (A) radial (B) linear
(C) bundles of sphere (D) square



38. Insipissation is a process to sterilize
- (A) blood (B) water
(C) tissues (D) serum
39. Transfer of naked DNA into a bacterial cell through a pore is called
- (A) nucleopore (B) membrane pores
(C) adhesion zone (D) insertion zone
40. Allergic contact dermatitis, such as the rash associated with poison ivy, is an example of which of the following type of hypersensitivities?
- (A) Type – I (Anaphylaxis) (B) Type – II (Cytotoxic)
(C) Type – III (Immune complex) (D) Type – IV (Cell mediated)
41. Which one of the following is immunologically privileged site?
- (A) Spinal cord (B) Brain
(C) Cornea (D) Kidney
42. In Poly Acrylamide Gel Electrophoresis, the polymerization reaction mediated by APS and TEMED is referred as
- (A) photochemical reaction (B) chemical reaction
(C) photobiochemical reaction (D) biochemical reaction
43. The integration of series of slits in spectrophotometer to achieve a specific wavelength of light is called as
- (A) prism (B) colour filter unit
(C) diffraction grating (D) slit mound
44. Which of the following is not an edible mushroom?
- (A) Puff balls (B) *Aminata verna*
(C) *Pleurotus oeus* (D) *Agaricus bisporus*
45. The fungi commonly used in genetic study
- (A) *Aspergillus sp.* (B) *Neurospora sp.*
(C) *Penicillium notatum* (D) *Mucor sp.*

46. Red-rot disease of sugar cane is caused by
- (A) *Coletotrichum sp.* (B) *Fusarium sp.*
(C) *Cercospora sp.* (D) *Rhodococcus sp.*
47. Rhodophyceae members are commonly called as
- (A) blue-green algae (B) brown algae
(C) red algae (D) green algae
48. During onset of Dengu fever
- (A) neutrophiles number decreases
(B) total white blood cells increases
(C) platelets number decreases
(D) haemoglobin number decreases
49. The hemorrhagic fever causing *Ebola* virus belongs to
- (A) filoviridae (B) picornaviridae
(C) reteroviridae (D) rhinoviridae
50. Siderophores produced by STD causing *Neisseria* is called
- (A) coccobactin (B) mycobactin
(C) meningobactin (D) gonobactin
51. The method of demonstrating the causative organisms in insects, which is allowed to feed on patient's blood is referred to as
- (A) zodiagnosis (B) xenodiagnosis
(C) petroff's method (D) arthrodiagnosis
52. Nucleotide replacement and single nucleotide deletion or insertion is known as
- (A) gene mutation (B) lethal mutation
(C) point mutation (D) replacement mutation
53. pBR322 contains the following antibiotic markers:
- (A) ampicillin and kanamycin (B) kanamycin and tetracyclin
(C) kanamycin and penicillin g (D) ampicillin and tetracyclin



54. Rule out a non-green house gas:
- (A) nitrogen (B) carbon dioxide
(C) methane (D) carbon monoxide
55. A complete Biomethanation is carried out by
- (A) *Methanosarcina sp.* (B) *Methanobacterium sp.*
(C) *Clostridium sp.* (D) a consortium of microorganisms
56. Hot springs water contains high content of
- (A) magnesium (B) sulfur
(C) gold (D) cadmium
57. Lampbrush chromosome is found in
- (A) amphibian oocyte (B) ovary of cucurbitaceae
(C) flower of cruciferae (D) ovary of woman
58. Mutation was first noted in
- (A) bacteriophage (B) *Drosophila melanogaster*
(C) *Oenothera lamarckiana* (D) *Triticum vulgare*
59. One Giga byte equals
- (A) 1000 MB (B) 1012 MB
(C) 1024 MB (D) 1072 MB.
60. Causative organism of Dental caries is
- (A) *Staphylococcus aureus* (B) *Streptococcus mutans*
(C) *Klebsiella sp* (D) *Candida sp*
61. Bowman's capsule is present in
- (A) intestine (B) mouth
(C) kidney (D) knee



62. *Leguminase* family contains the following type of root apex:
- (A) casuarina type (B) ranalian type
(C) maize type (D) None of the above
63. What is the proper term to describe a mutation that changes the codon AAG (the codon for lysine) to the sequence UAG (now a 'stop' codon)?
- (A) Transversion mutation (B) Transition mutation
(C) Frameshift mutation (D) Missense mutation
64. Which of the following vaccines is live?
- (A) Salk (B) Sabin
(C) TAB (D) Human diploid cell rabies vaccine
65. The first synthetic bacterial cell is
- (A) *Mycoplasma genitalium* (B) *Mycoplasma mycoides*
(C) *Mycobacterium avium* (D) *Mycobacterium leprae*
66. Which of the following technique is non-PCR method used in molecular characterization?
- (A) RAPD (B) AFLP
(C) RFLP (D) ARDRA
67. Klenow fragment has the activities of
- (A) 5'→3' polymerase and 5'→3' exonuclease activity
(B) 5'→3' polymerase and 3'→5' exonuclease activity
(C) Both (A) and (B)
(D) None of the above
68. Molecular size of Lambda DNA is
- (A) 485 Kb (B) 48.5 Kb
(C) 4.85 Kb (D) None of the above

69. Phenotypic selection of recombinants by lac Z marker gene is by
- (A) appearance of blue colonies (B) appearance of white colonies
(C) appearance of brown colonies (D) appearance of green colonies
70. Which of the following is the most potent activator of macrophages?
- (A) IFN- γ (B) IFN- α
(C) IL-1 (D) IL-6
71. HLA genes are present in
- (A) chromosome - 2 (B) chromosome - 6
(C) chromosome - 14 (D) chromosome - 17
72. The prominent amino acids in the hinge region of the immunoglobulin molecules are
- (A) proline and cysteine (B) histidine and valine
(C) proline and valine (D) histidine and cysteine
73. One of the symptoms of Grave's disease is
- (A) hyperthyroidism (B) anemia
(C) inflammation in the joints (D) skin rashes
74. Nitrogenase enzyme is an equilibrium mixture of
- (A) Mo-Fe protein and Fe-protein (B) Co-Fe protein and Fe-protein
(C) Wo-Fe protein and Fe-protein (D) Ag-Fe protein and Fe-protein
75. The number of chromosomes can be increased in plants by applying
- (A) thermo treatment mechanism (B) colchicine treatment
(C) hormone treatment (D) hybrid vigor
76. Vitamin D is also called
- (A) antirachitic (B) ascorbic acid
(C) retinol (D) folic acid

77. Antibiotic that interferes with DNA synthesis:
- (A) penicillins (B) cephalosporins
(C) aminoglycosides (D) nalidixic acid
78. A group of organisms that use carbon dioxide as a sole carbon source
- (A) auxotroph (B) autotroph
(C) chemolithotroph (D) organotroph
79. The correct order of the phases in mitosis is
- (A) prophase, telophase, metaphase, anaphase
(B) prophase, metaphase, anaphase, telophase
(C) telophase, anaphase, metaphase, prophase
(D) prophase, telophase, anaphase, metaphase
80. The exudation of liquid water from leaves due to root pressure:
- (A) stress drop (B) rhizo drop
(C) guttation (D) rhizotation
81. Centrosomes are present in
- (A) plant cells only (B) animal cells only
(C) in both plant and animal cells (D) in neither plant nor animal cells
82. Down syndrome in human is due to
- (A) monosomy (B) three copies of chromosome 21
(C) three x chromosomes (D) two y chromosomes
83. Archaeopteryx is linking the
- (A) reptiles and avian (B) reptile and mammals
(C) avian and mammals (D) invertebrates and vertebrates
84. The mitochondria of eukaryotic cells most likely arose as a result of endosymbiosis between a eukaryotic cell and a
- (A) blue-green alga (B) nonsulfur purple bacterium
(C) red alga (D) brown alga



85. The central part of the blastula stage of vertebrate embryo is
- (A) blastocoels (B) blastopore
(C) blastomere (D) blastodisc
86. A tubular cavity of the inner ear containing hair cells and sensory nerves is
- (A) round window (B) oval window
(C) cochlea (D) tympanic membrane
87. An autosomal disorder, characterized by secretion of thick mucus that clogs passageways in the lungs, liver, and pancreas is
- (A) sickle cell anemia (B) cystic fibrosis
(C) SCID (D) None of the above
88. One of the paired lateral processes on each side of most segments in polychaete annelids is
- (A) pseudopodia (B) parapodia
(C) eupodia (D) bipodia
89. One of the following is a totipotent cell:
- (A) xylem (B) meristem
(C) hematopoietic stem cell (D) embryonic stem cell
90. Growth response to gravity in plants is called
- (A) phototropism (B) gravitropism
(C) ecotropism (D) chemotropism
91. Plant hormone that controls cell elongation is
- (A) gibberlins (B) cytokinin
(C) auxin (D) BAP
92. In pteridophytes the sporangia are formed in a special structure called
- (A) sporangiophore (B) conidiophores
(C) strobilus (D) pteridophore



93. The female reproductive structure of bryophytes are called
- (A) antheridium (B) archegonium
(C) oogonium (D) gametangia
94. Atomic number of chlorine:
- (A) 15 (B) 17
(C) 16 (D) 32
95. Which one of the following is not a hydrophobic aminoacid?
- (A) Methionine (B) Serine
(C) Tyrosine (D) Histidine
96. More number of stem cells is present in
- (A) placenta (B) cord blood
(C) menstrual fluid (D) stomach
97. If phosphrous is added to oligotrophic water, what organisms will play a major role in nutrient accumulation?
- (A) Eubacteria (B) Eukaryotic algae
(C) Cyanobacteria (D) Archaeobacteria
98. Layer of bacteria and nutrients adhering to surface are called as
- (A) bioadsorption (B) bioscaling
(C) biofilms (D) biobulking
99. Urinary bladder is absent in
- (A) aves (B) reptiles
(C) amphibians (D) mammals
100. Skin from a patient's thigh is used to cover a burn on the patient's face is called
- (A) isograft (B) autograft
(C) allograft (D) xenograft



101. Molecule on the surface of a pathogen that mediate attachment to host cells or tissues is
- (A) adhesins (B) defensins
(C) selectins (D) integrins
102. Elephantiasis disease is transmitted by
- (A) Sand-fly (B) Tse-tse fly
(C) Culex mosquito (D) Aedes mosquito
103. A volatile substance produced by members of the genus *Streptomyces* that imparts the characteristic odour of moist earth:
- (A) fruticosin (B) lepticin
(C) geosmin (D) None of the above
104. Which one of the following organism is used for industrial alcohol production?
- (A) *Escherichia coli*
(B) *Saccharomyces cerevisiae*
(C) *Klebsiella pneumonia*
(D) *Kluveromyces lactis*
105. Algal classification was proposed by
- (A) Alexopolus (B) Carl Linnaeus
(C) Fritsch (D) Desikachary
106. A classification based on evolutionary relationships:
- (A) phenetic classification (B) phylogenetic classification
(C) numerical taxonomy (D) chemotaxonomy
107. The most common type of molecule functioning as an animal virus receptor is a
- (A) glycoprotein (B) phosphoprotein
(C) lipoprotein (D) teichoic acid

108. Which of the following is the most common pathway for degradation of glucose to pyruvate?
- (A) Entner-Doudoroff pathway (B) Pentose phosphate pathway
(C) Phosphogluconate pathway (D) Embden-Meyerhof pathway
109. The amount of heat energy needed to raise 1.0 gram of water from 14.5°C to 15.5°C is
- (A) Joule (B) Calorie
(C) Erg (D) Thermal unit
110. The term describes the velocity of a reaction when all available enzyme molecules are binding substrate and converting it to product as rapidly as possible
- (A) V_{max} (B) μ_{max}
(C) K_m (D) None of the above
111. describes organisms that have a small range of growth temperature.
- (A) Eurythermal (B) Stenothermal
(C) Thermoduric (D) Thermostatic
112. The structure that helps bacteria in escaping of phagocytic defence
- (A) fimbriae (B) capsule
(C) flagella (D) pili
113. After Gram's staining *Streptomyces sp.* will appear
- (A) pink (B) purple
(C) unstained (D) pale pink
114. A molecule composed entirely of carbon, in the form of a hollow sphere
- (A) fullerite (B) carbon nanotubes
(C) bucky balls (D) carbon nanosphere

115. The non-specific cleavage of the specific restriction enzyme
- (A) non-sense activity (B) non-specific activity
(C) star activity (D) non-canonical activity
116. Rule out the defined media from the following list
- (A) Czepak Dox medium (B) Muller Hinton medium
(C) nutrient medium (D) brain heart infusion medium
117. Darling's disease is caused by
- (A) fungi (B) bacteria
(C) protozoa (D) actinomycete
118. End to end migration of DNA on agarose gel is referred to as
- (A) aviation (B) end to end shift
(C) reptation (D) electromobility
119. One of the following is RNase inhibitor:
- (A) vanadyl ribonucleoside (B) vanadyl chloride
(C) EDTA (D) trizol
120. Vent polymerase enzyme is extracted from
- (A) *Thermus aquaticus* (B) *Thermos flavus*
(C) *Pyrococcus furiosis* (D) *Pyrococcus woesii*
121. One of the following is not a carotenoid pigment:
- (A) lycopene (B) lutein
(C) astaxanthin (D) chlorophyll
122. Chromosomes can be stained by
- (A) Gram's staining (B) Giemsa staining
(C) Lactophenol cotton blue staining (D) Schaeffer-Fulton method



123. The algae found in rapidly flowing water is termed as
- (A) edaphophytic algae (B) fluviatile algae
(C) epactiphytic algae (D) benthophytic algae
124. *Micrographie* is published by
- (A) ASM press (B) Elsevier press
(C) EMBO (D) Springer
125. The calomel electrode of pH meter contains
- (A) saturated KCl, mercurous chloride and mercury
(B) silver chloride, 0.1N HCl and silver
(C) saturated KCl, silver chloride and silver
(D) mercurous chloride, 0.1N HCl and mercury
126. The structure formed during replication of circular DNA molecule appears like
- (A) Θ (Theta) (B) Φ (Phi)
(C) Σ (Sigma) (D) Ω (Omega)
127. A thick walled, binucleate resting spores of rusts and smuts are called
- (A) teliospore (B) ascospore
(C) bispore (D) basidiospore
128. The conjugated enzymic proteins have a non-protein part for which these enzymes are known as
- (A) apoenzyme (B) holoenzymes
(C) prosthetic group (D) chymotrypsinogen
129. In albuminous seeds, food is stored in
- (A) plumule (B) testa
(C) endosperm (D) cotyledon



130. Detachment of older leaves or leaf fall is a common phenomenon in plants. This is called
- (A) vernalization (B) abscission of leaves
(C) devernalization (D) All of the above
131. Which one of the organism is involved in food spoilage?
- (A) *Saccharomyces sp.* (B) *Bacillus cereus*
(C) *Oscillatoria sp.* (D) *Bacillus subtilis*
132. 'Cytochrome pump theory' for mineral salts absorption was proposed by
- (A) Blackman (B) Jolly and Dixon
(C) Lundegardh (D) Bennet-Clark
133. Velamen is a
- (A) root hair
(B) part of a leaf
(C) tissue which can absorb moisture from the atmosphere
(D) flower of larger size containing 3 anther and 1 ovary
134. Little leaf of brinjal is caused by
- (A) algae (B) mycoplasma
(C) fungus (D) virus
135. In the members of sphaerocarpaceae, the absorption of water and solutes take place by
- (A) stem (B) leaf
(C) rhizoids (D) All of the above
136. What is called the lowest atmosphere in which temperature decreases with height, bounded by land or sea surface below and by tropopause above?
- (A) stratosphere (B) thermosphere
(C) mesosphere (D) troposphere



137. Which of the following is a granulocyte?
- (A) Eosinophil (B) Basophile
(C) Lymphocyte (D) Neutrophile
138. The pace maker in heart is called
- (A) papillary muscle (B) purkinje fibres
(C) sino-atrial node (D) atrio-ventricular node
139. Riboflavin is
- (A) vitamin B1 (B) vitamin B2
(C) vitamin B6 (D) vitamin B12
140. Who discovered DNA for the first time?
- (A) Watson and Crick (B) Altman
(C) Meischer (D) Mc Donald
141. Which of the following is called as Amber?
- (A) UAA (B) AUG
(C) UGA (D) UAG
142. Which of the following keeps the oldest evolutionary history?
- (A) Man (B) Reptiles
(C) Amphibians (D) Aves
143. Thromboplastin is related with
- (A) heart (B) platelet
(C) spleen (D) RBC
144. Allergic reactions are related with
- (A) IgE (B) IgA
(C) IgM (D) IgD



145. In transplantation, the tissue rejection is related with
- (A) helper T-cells (B) cytotoxic T-cells
(C) suppressor T-cells (D) natural killer cells
146. Which of the followings is (are) essential for accuracy of Chi-square test?
- (A) Lundegardh's cytochrome theory
(B) Yate's correction
(C) Vernalization
(D) All of the above
147. "Tip Burn" disease of conifers is caused by
- (A) fluoride (B) mercury
(C) lead (D) cadmium
148. The amount of oxygen required for oxidation by microbes in any unit volume of water is called
- (A) dissolved oxygen (DO)
(B) biological oxygen demand (BOD)
(C) chemical oxygen demand (COD)
(D) eutrophication
149. Biological carbon sequestration can be performed by
- (A) water (B) *Pseudomonas aeruginosa*
(C) *E.coli* (D) algae
150. Who explained for the first time the process of gene regulation?
- (A) T.H.Morghan (B) Jacob and Monad
(C) Tautam and Beadle (D) Punnet and Bateson