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# **DBT-JRF BET**

**Previous Year Paper  
2016**



## BET-2016

### Section- A

All 50 questions are compulsory

1. Two sides of an isosceles triangle measure 3 cm and 7 cm. Which one of the following is the measure (cm) of the third side?

- (A) 9
- (B) 7
- (C) 5
- (D) 3

2. At 9 AM, the shadow of a 5' (feet) tall boy is 8'. At the same time, shadow of a flagpole beside is 28 feet. What is height of the flagpole?

- (A) 8.5'
- (B) 16'
- (C) 17.5'
- (D) 20'

3. What number should appear next in this series: 8, 12, 10, 14, 12, 16....?

- (A) 10
- (B) 14
- (C) 18
- (D) 12

4. Two numbers are more than a third number by 20 % and 50 %, respectively. The ratio of the first two numbers is

- (A) 2:4
- (B) 3:5
- (C) 4:5
- (D) 5:7

5. Identify from the options given below the unwritten number (?) in the series: 360, ?, 180, 60, 15, 3
- (A) 180  
(B) 300  
(C) 360  
(D) 320
6. For the chemical reaction  $\text{C}_2\text{H}_5\text{OH}(\ell) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}(\ell)$ , if change in internal energy at 298K is 1368 KJ/mole, the change in enthalpy will be
- (A) greater than 1368  
(B) less than 1368  
(C) equal to zero  
(D) negative
7. If a drop of sweat evaporates from body, the work done is
- (A)  $w = \Delta U$   
(B)  $w = \Delta H$   
(C)  $w = \Delta G$   
(D)  $w = P(V_2 - V_1)$
8. Dissociation of an aqueous acid (HA) gives  $\text{HA} + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{A}^-$ , then  $\text{pK}_a$  is
- (A)  $\Delta G^\circ_R$   
(B)  $\Delta H^\circ_R$   
(C)  $\Delta G^\circ/2.303RT$   
(D) Equilibrium constant  $K_a$
9. The sides of a rectangle are in the ratio of 4:3 and its area is  $108 \text{ cm}^2$ . The perimeter of the rectangle in cm is
- (A) 22  
(B) 32  
(C) 42  
(D) 52
10. If each side of a cube is increased by 1%, the percentage change in the volume would be approximately
- (A) 1  
(B) 2  
(C) 3  
(D) 4

11. A brick weighs  $\frac{3}{4}$  of itself and  $\frac{3}{4}$  of a Kg. The weight of the brick in Kg is
- (A) 2
  - (B) 3
  - (C) 4
  - (D) 5
12. In an enzyme assay, the corrected absorbance reading obtained on addition of 100  $\mu$ l of the enzyme extract is 0.025. Given that one unit of the enzyme is the amount of enzyme required to increase the absorbance by 0.001 units under assay conditions, the enzyme activity (units/ml) of the extract is:
- (A) 2.5
  - (B) 2500
  - (C) 25
  - (D) 250
13. The cell-free extract prepared from *E. coli* cells over-expressing enzyme  $\beta$ -glucosidase showed the activity of 1.5 units per ml (protein concentration 2 mg per ml). The Ni-NTA purified preparation showed the activity of 75 units per ml (protein concentration 100  $\mu$ g per ml). Calculate the fold purification of the enzyme achieved?
- (A) 0.001
  - (B) 0.02
  - (C) 50
  - (D) 1000
14. Enzyme X showed its activity on substrate A (375 units per ml), substrate B (185 units per ml) and substrate C (75 units per ml). With respect to substrate A, the percent activities on substrate B and C are -----, respectively.
- (A) 0.49 & 0.2
  - (B) 2.02 & 5
  - (C) 49 & 20
  - (D) 202 & 500

15. Protein 'A' from *Pseudomonas putida* contains 135 amino acids. The number of nucleotides present in the gene encoding the protein will be ----.
- (A) 405
  - (B) 408
  - (C) 411
  - (D) 421
16. The molarity of a 15 % of NaCl solution in water is ----.
- (A) 2.56
  - (B) 0.256
  - (C) 25.6
  - (D) 0.025
17. The reaction velocity, (V) vs substrate concentration [S] profile was performed for Enzyme A using 1  $\mu\text{g}$  enzyme per assay. Similar experiment was carried out under identical conditions except that the concentration of enzyme used was 2  $\mu\text{g}$  per assay. Under these conditions, the kinetic constants
- (A)  $K_m$  and  $V_{\max}$  will remain unchanged
  - (B)  $K_m$  will change while  $V_{\max}$  will remain same
  - (C)  $K_m$  will remain same but  $V_{\max}$  will increase
  - (D)  $K_m$  and  $V_{\max}$  will increase
18. Which one of the following bacterial cell suspension at  $A_{540\text{nm}} = 0.2$  will have the maximum number of cells per ml?
- (A) *Mycoplasma*
  - (B) *Pseudomonas*
  - (C) *Streptococcus*
  - (D) *Bacillus*
19. Two solutions of a substance (non-electrolyte) are mixed in the following manner: 480 ml of 1.5 M first solution + 520 ml of 1.2 M second solution. What is the molarity (M) of the final mixture?
- (A) 1.250
  - (B) 1.344
  - (C) 1.433
  - (D) 1.479

20. A 29 %  $\text{H}_2\text{SO}_4$  solution having a molarity of 3.60, would have a density ( $\text{g.ml}^{-1}$ ) of --.  
(MW of  $\text{H}_2\text{SO}_4$  is 98)
- (A) 1.45  
(B) 1.64  
(C) 1.88  
(D) 1.22
21. Calculate the turnover number ( $\text{sec}^{-1}$ ) for an enzyme, if  $K_m = 0.001 \mu\text{M}$ ;  $V_{\max} = 10 \mu\text{M/sec}$ ; and  $E_0 = 0.001 \mu\text{M}$ .
- (A)  $1 \times 10^4$   
(B)  $1 \times 10^5$   
(C)  $1 \times 10^6$   
(D)  $1 \times 10^7$
22. *Zymomonas mobilis* cells are grown in a chemostat culture in a 60 litre (l) fermenter. The  $K_s$  and  $\mu_{\max}$  for the organism is  $0.2 \text{ g.l}^{-1}$  and  $0.2 \text{ h}^{-1}$ , respectively. What flow rate ( $\text{l.h}^{-1}$ ) is required for a steady-state substrate concentration of  $0.2 \text{ g.l}^{-1}$ ?
- (A) 6  
(B) 8  
(C) 10  
(D) 12
23. Consider three independently assorting gene pairs, A/a, B/b, and C/c. The probability of obtaining an offspring of AABbCc from parents that are AaBbCC and AABbCc is
- (A) 4/9  
(B) 3/4  
(C) 1/8  
(D) 1/9
24. Given that husband and wife are both heterozygous for a recessive allele for albinism. If they have dizygotic twins, the probability that both the twins will have the same phenotype for pigmentation will be
- (A) 5/8  
(B) 1/4  
(C) 3/4  
(D) 1/16

25. In a family with three children, what is the probability that two are boys and one is a girl?

- (A)  $\frac{2}{3}$
- (B)  $\frac{1}{2}$
- (C)  $\frac{3}{8}$
- (D)  $\frac{1}{3}$

26. LDL binds with cell surface receptor and gets internalized via clathrin-mediated endocytosis. This process helps in maintaining the cholesterol-LDL level in the plasma. However, in a disease known as familial hypercholesterolemia (FH), very high levels of plasma cholesterol is found. This could be due to mutation in which one of the following genes in FH patients?

- (A) Clathrin
- (B) LDL
- (C) LDL receptor
- (D) Adaptor

27. Digestion of a 5Kb linear DNA fragment with EcoRI generates two fragments of 2 Kb and 3 Kb, while digestion of the same molecule with HindIII yields three fragments of 0.7 Kb, 3.5 Kb and 0.8 Kb. When the same DNA is digested with both the enzymes, it yields fragments of 0.7 Kb, 1.3 Kb, 2.2 Kb and 0.8 Kb. The right sequence of restriction sites in the DNA fragment is

- (A) One EcoRI site in between two HindIII sites
- (B) One HindIII site in between two EcoRI sites
- (C) Two HindIII sites followed by only one EcoRI site
- (D) One EcoRI site followed by two HindIII sites.

28. GFP, when overexpressed in a cell, remains mostly in the cytosol. A GFP construct is modified such that the resultant GFP protein will have a conjugated peptide Pro-Lys-Lys-Lys-Arg-Lys-Val at its N-terminus. If such a GFP construct is expressed in a cell, the modified GFP protein will be localized in the

- (A) lysosome
- (B) Golgi bodies
- (C) nucleus
- (D) endoplasmic reticulum

29. Succinate dehydrogenase converts succinate to fumarate. Which one of the following is TRUE when the competitive inhibitor malonate is added in the reaction mixture?



- (A) Both  $K_m$  and  $V_{max}$  increase.
- (B) Both  $K_m$  and  $V_{max}$  decrease.
- (C)  $K_m$  increases and  $V_{max}$  remains the same.
- (D)  $K_m$  increases and  $V_{max}$  decreases.

30. In a mammalian cell, protein synthesis is regulated at the level of initiation by various kinases. During viral infection, which one of the following kinases is involved in regulating the step of formation of eIF2.GTP.Met tRNA<sub>i</sub> ternary complex in the host?

- (A) Heme-regulated inhibitor kinase (HRI)
- (B) Protein kinase RNA dependent (PKR)
- (C) GCN2-like kinase
- (D) PKR-like endoplasmic reticulum kinase (PERK)

31. Which one of the following side chains of an amino acid is responsible for fluorescence in proteins?

- (A) Indole ring
- (B) Guanidino group
- (C) Phenolic group
- (D) Imidazole group

32. DNA molecules labeled with  $^{15}\text{N}$  and  $^{14}\text{N}$  can be separated by

- (A) Pulse field gel electrophoresis
- (B) Density gradient ultracentrifugation
- (C) Capillary electrophoresis
- (D) Differential centrifugation

33. Match the chromatographic technique from Group A with the appropriate elution conditions given in Group B

Group A  
 (P) Chromatofocusing  
 (Q) DEAE-Sephadex  
 (R) G-150 Sephadex  
 (S) Phenyl Speharose

Group B  
 (i) Decreasing  $[(\text{NH}_4)_2\text{SO}_4]$  gradient  
 (ii) pH gradient  
 (iii) Isocratic gradient  
 (iv) Increasing NaCl gradient

- (A) P-ii, Q-iv, R-iii, S-i
- (B) P-i, Q-iv, R-iii, S-ii
- (C) P-iv, Q-iii, R-ii, S-i
- (D) P-iii, Q-i, R-ii, S-iv

34. Cytoskeletal organization of a cell is regulated by

- (A) Ras GTPase
- (B) Rab GTPase
- (C) Rho GTPase
- (D) Ran GTPase

35. In comparison to animals residing in a warm climate, animals living in cold climate need thermal insulation. The cell membranes of the latter would have a relatively higher content of .....

- (A) sphingolipid
- (B) saturated fatty acid
- (C) unsaturated fatty acid
- (D) cholesterol

36. In glycolysis, the conversion of 1 mol of fructose 1,6-biphosphate to 2 mol of pyruvate results in the formation of

- (A) 1 mol NAD<sup>+</sup> and 2 mol of ATP
- (B) 2 mol of NAD<sup>+</sup> and 4 mol of ATP
- (C) 2 mol of NADH and 2 mol of ATP
- (D) 2 mol of NADH and 4 mol of ATP

37. In diabetic ketoacidosis, increase in which of the following would cause elevated production of ketone bodies?

- (A) Proteolysis
- (B) Urea production
- (C) Insulin release
- (D) Lipolysis

38. Which one of the following modes of inheritance is seen in Cystic Fibrosis?

- (A) Autosomal recessive
- (B) Autosomal dominant
- (C) Sex linked
- (D) Spontaneous mutation

39. Statins are very effective against hypercholesterolemia, a major cause of atherosclerosis. These drugs reduce plasma cholesterol levels by

- (A) Preventing absorption of cholesterol from the intestine.
- (B) Increasing the excretion of cholesterol from the body via conversion to bile acids.
- (C) Inhibiting the conversion of 3-hydroxy-3-methylglutaryl-CoA to mevalonate in the pathway for cholesterol biosynthesis.
- (D) Increasing the rate of degradation of 3-hydroxy-3-methylglutaryl CoA reductase.

40. Measles, Mumps, Rubella-MMR combined vaccine represents which one of following vaccine categories?

- (A) Inactivated/killed
- (B) Live, attenuated
- (C) Subunit
- (D) Toxoid (inactivated toxin)

41. A haemophiliac man marries a normal woman. They have a daughter who does not show symptoms of haemophilia. If she marries a haemophiliac man, what will be the probability of their son displaying symptoms of haemophilia?

- (A) 0%
- (B) 25%
- (C) 50%
- (D) 100%

42. The conventional treatment for methanol toxicity is to administer ethanol. Which of the following explains the basis of this treatment?

- (A) Ethanol acts as a competitive inhibitor to methanol
- (B) Ethanol acts as a non-competitive inhibitor to methanol
- (C) Ethanol destroys the enzymatic activity of alcohol dehydrogenase
- (D) Ethanol blocks the entry of methanol within the cells.

43. What will be the angular velocity of a rotor in a centrifuge operating at 6000 revolution per minute?

- (A) 62.8 radians per second
- (B) 628 radians per second
- (C) 6.28 radians per second
- (D) 6280 radians per second

44. Lysosomes of a cell were labelled with lysotracker Red. Subsequently, these cells were infected with GFP-transfected Mycobacterium and observed under a fluorescence microscope. What will you observe?

- (A) GFP-Mycobacterium will be colocalized with lysotracker Red labeled lysosomes.
- (B) GFP-Mycobacterium will be separated from lysotracker Red labeled lysosomes.
- (C) GFP-Mycobacterium will not be detected as they are degraded in the cell.
- (D) Lysotracker Red labeled lysosomes will be degraded in GFP-Mycobacterium infected cells

45. A linear DNA fragment which has 3 restriction sites for BamH1, is labeled only at the 5' end. This DNA is partially digested with BamH1 in such a way that all kinds of fragments are generated. Under these conditions, how many labeled and unlabeled fragments will be produced?

- (A) 3 labeled and 4 unlabeled
- (B) 3 labeled and 5 unlabeled
- (C) 4 labeled and 5 unlabeled
- (D) 4 labeled and 6 unlabeled

46. In the preparation of humanized antibody, part of the antibody molecule is taken from mouse and the remaining is taken from that of human, through genetic engineering technique. Which one of the following statements is true for humanized antibody?

- (A) CDRs of mouse IgG is fused with framework regions of human IgG
- (B) CDRs of human IgG is fused with framework regions of mouse IgG
- (C) CDRs of mouse IgG is fused with CDRs of human IgG
- (D) framework regions of mouse IgG is fused with framework regions of human IgG

47. Approximately how many molecules of CO<sub>2</sub> are produced daily by oxidative metabolism in adult human? Avagadro's number is  $6.02 \times 10^{23}$ .

- (A)  $1.2 \times 10^{24}$
- (B)  $1.2 \times 10^{23}$
- (C)  $1.2 \times 10^{26}$
- (D)  $1.2 \times 10^{25}$

48. A 25-year old man undertakes a prolonged fast for religious reasons. Which one of the following metabolites will be elevated in his blood plasma after 24 hours?

- (A) Lactic acid
- (B) Glycogen
- (C) Ketone bodies
- (D) Non-esterified fatty acids

49. Which one of the following is not a deficiency disorder?

- (A) Beriberi
- (B) Night Blindness
- (C) Poliomyelitis
- (D) Pernicious Anemia

50. Electrophoresis of a purified protein in SDS-PAGE in the presence of 2-mercaptoethanol yields two bands of 35 kDa and 45 kDa. However, in a gel filtration chromatography, the same protein elutes as 80 kDa. What conclusion will you draw from the results?

- (A) The protein is not purified to homogeneity.
- (B) Two bands generated in SDS-PAGE due to degradation.
- (C) The protein is a homodimer
- (D) The protein is a heterodimer

### Section-B

(Answer any 50 out of 150 questions)

51. Which one of the following virus is the odd one out?

- (A) Epstein-Barr Virus
- (B) Human Immunodeficiency Virus.
- (C) Human Papilloma Virus
- (D) Human T-cell leukemia Virus

52. DAPI 4',6-diamidino-2-phenylindole is a fluorescent stain used for staining of:

- (A) DNA only
- (B) DNA and RNA
- (C) DNA and proteins
- (D) protein Only

53. During antigen presentation by antigen presenting cells, viral antigens are processed and presented to T cells in the context of MHC antigens. Viral antigens are processed

- (A) By proteasomes and are presented along with MHC class I antigen
- (B) In endosomes and are presented along with MHC class I antigen
- (C) In endosomes and are presented along with MHC class II antigen
- (D) By proteasomes and are presented along with MHC class II antigen

54. Which of the following is not specifically protected by intellectual property legislation?

- (A) Industrial designs.
- (B) Patents.
- (C) Trademarks.
- (D) Trade secrets.

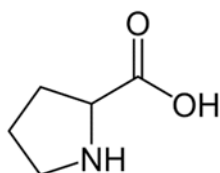
55. Teichoic acid possibly plays a role in growth of bacterial cell by regulating the activity of

- (A) lysin
- (B) autolysin
- (C) peptidase
- (D) protease

56. The fungus that causes athlete's foot is

- (A) *Aspergillus*
- (B) *Trichophyton*
- (C) *Neurospora*
- (D) *Trichoderma*

57. The following amino acid is



- (A) hydrophobic
- (B) nucleophilic
- (C) aromatic
- (D) basic

58. A DNA fragment was cloned at the *EcoRI* restriction site of a plasmid vector that contains antibiotic resistance genes, *kan<sup>R</sup>* and *spec<sup>R</sup>*. It was observed that all the positive clones (containing the DNA fragment of interest) grew on medium with kanamycin but not on media containing spectinomycin. In the absence of any other confounding factors, which one of the following statements would explain this observation?

- (A) The *spec<sup>R</sup>* gene contains a mutation, which generates a stop codon within the gene.
- (B) The *EcoRI* site was located within the *spec<sup>R</sup>* gene.
- (C) The cloned fragment of interest produces a protein, which confers resistance to spectinomycin.
- (D) The cloned DNA fragment was lethal to the cell.

59. A cDNA encoding an eukaryotic gene was ligated to an expression vector which was then introduced into *E. coli* for expression of the protein. The experiment resulted in poor expression of the protein. However, expression improved significantly in a Rosetta strain of *E. coli* which demonstrate that the initial poor level expression was due to

- (A) absence of capping at 5' end of the transcript
- (B) absence of polyadenylation at 3' end of the transcript
- (C) codon bias
- (D) lack of splicing machinery in *E. coli*.

60. In *Drosophila* embryogenesis, the signal received from Gurken proteins by follicle cells results in posteriorization of these cells. Knocking out the gene for Gurken in *Drosophila* will NOT result in failure of

- (A) Accumulation of maternal mRNAs
- (B) rearrangement of maternal mRNA at the two ends of the embryo
- (C) establishment of gradients of Gurken
- (D) establishment of anterior-posterior axis

61. A patient suffering from an infectious disease had high levels of TNF alpha and IL-6. Assuming there are no other interactions, which T cell population is likely to dominate in his blood sample?

- (A) Th2
- (B) Th17
- (C) Treg
- (D) Naive T cells

62. The niche of stem cells in human skin is the

- (A) dermal papillae region of hair follicle
- (B) bulge region of the hair follicle
- (C) sebaceous gland
- (D) malpighian layer

63. In persons suffering from sickle cell anemia, the 6<sup>th</sup> amino acid of beta globin protein is valine instead of glutamic acid. This has occurred due to substitution mutation leading to a change in glutamic acid codon to valine codon in the gene. The mutation is a

- (A) transition where a purine base changes to another purine base
- (B) transition where pyrimidine base changes to another pyrimidine base
- (C) transversion where pyrimidine base changes to a purine base
- (D) transition where purine base changes to a pyrimidine base

64. A covalently closed circular DNA was in relaxed state in water at 30°C. What will happen to the supercoiling state of the molecule, if water temp increases to 60°C or decreases to 10°C?

- (A) The DNA will remain in relaxed state also at 60°C as well as at 10°C
- (B) The DNA will undergo positive supercoiling at 60°C as well as at 10°C



- (C ) The DNA will undergo positive supercoiling at 60<sup>0</sup>C and will undergo negative supercoiling at 10<sup>0</sup>C  
(D) The DNA will undergo negative supercoiling at 60<sup>0</sup>C and will undergo positive supercoiling at 10<sup>0</sup>C

65. 1000 color blind males underwent random mating with 1000 normal females (neither carrier nor color blind). After how many generations, the allele frequency in both the sexes in the population will reach equilibrium?

- (A) One  
(B) Two  
(C ) Three  
(D ) More than three

66. Acclimatization to high altitude in humans induces differentiation of

- (A) basophil  
(B) platelets  
(C) erythrocytes  
(D) neutrophils

67. The protection against smallpox afforded by prior infection with cowpox presents

- (A) specificity.  
(B) antigenic cross-reactivity.  
(C) innate immunity.  
(D) passive protection.

68. What is glycosuria?

- (A) Low amount of sugar in urine  
(B) Low amount of fat in urine  
(C) Average amount of carbohydrate in urine  
(D) High amount of sugar in urine

69. The mechanism that permits immunoglobulins to be synthesized in either a membrane bound or secreted form is

- (A) allelic exclusion

- (B) codominant expression
- (C) differential RNA processing
- (D) class switching

70. Which of the following is NOT involved in antigen- antibody complexes?

- (A) Van der Waals forces
- (B) Hydrogen bonds
- (C) Covalent bonds
- (D) Electrostatic interactions

71. Iron uptake by the cells from extracellular environment is mediated through

- (A) LDL receptor
- (B) Mannose receptor
- (C) Transferrin receptor
- (D) Mannose 6-phosphate receptor

72. Which of following viruses causes liver cancer?

- (A) Papilloma virus.
- (B) Herpes simplex virus.
- (C) Hepatitis B virus.
- (D) Hepatitis C virus.

73. Which one of the following enzymes is an established intracellular anti-oxidant?

- (A) Lactate dehydrogenase
- (B) Phenylalanine hydroxylase
- (C) Superoxide dismutase
- (D)  $\gamma$ -Secretase

74. A given cytokine has different biological effects on different target cells. This is known as

- (A) pleiotropy
- (B) redundancy
- (C) synergy
- (D) totipotency

75. Influenza virus contains 11 proteins, of which the two major glycoproteins are H and N. What do H and N stand for in influenza strains nomenclature?

- (A) H: Hemagglutinin; N: Nucleoprotein
- (B) H: Hemagglutinin; N: Neuraminidase
- (C) H: Hyaluronidase; N: Nucleoprotein
- (D) H: Hyaluronidase; N: Neuraminidase

76. Inosine in the tRNA anticodon will base pair with all **except** which one of the following bases in the codon of mRNA?

- (A) adenine
- (B) uracil
- (C) cytosine
- (D) guanine

77. In Electrophoresis if the buffer pH is above the isoelectric point of the protein, the protein will

- (A) migrate towards the anode
- (B) migrate towards the cathode
- (C) not migrate at all
- (D) migrate partly to anode and partly to cathode

78. In the ABO blood group system in humans, alleles  $I^A$  and  $I^B$  are codominant and both are dominant to the allele  $i$ . If a type B with genotype ( $I^B i$ ) woman marries a type A with genotype ( $I^A i$ ). The probable children to the couple would be of the type

- (A) A, B, O and AB
- (B) A and B only
- (C) A and AB only
- (D) O and AB only

79. Circulating testosterone is mostly present in bound form, which of the following proteins binds weakly to the major amount of circulating testosterone?

- (A) Transferrin
- (B) Prothrombin
- (C) Fibrinogen
- (D) Albumin

80. *T. brucei* complex transmitted to man by bite of several species of tsetse fly can cause

- (A) Thymoma
- (B) Sleeping sickness
- (C) Toxoplasmosis
- (D) Leishmaniasis

81. In immune responses at mucosal surfaces, particularly in the context of gut immunology, which of the following is NOT true?

- (A) Mucosal surfaces have continuous and close contact with numerous and diverse commensal microorganisms.
- (B) M cells transport microbes and antigens from the gut lumen to gut associated lymphoid tissue.
- (C) B cells activated in mucosal tissues give rise to plasma cells preferentially secreting IgG.
- (D) Inflammation is prevented at mucosal surfaces, generally by recruitment of T regulatory cells.

82. You have developed a H-2 k/d mouse model with grafted thymus for studying T cell maturation. The phenotype of the grafted thymus is H-2d/d. You have immunized the mouse with antigens derived from *Listeria monocytogenes* and would like to assess the activation of cytotoxic T cells. Which among the following would be your choice of target cell?

- (A) Cells expressing MHC class I molecules taken from H-2k/k mouse
- (B) Cells expressing MHC class II molecules taken from H-2k/k mouse
- (C) Cells expressing MHC class I molecules taken from H-2d/k mouse
- (D) Cells expressing MHC class II molecules taken from H-2d/k mouse

83. While analyzing protein sequences of *rpoB* gene among different bacteria, different changes in amino acid sequences were observed among the homologs due to base substitution. If transition is more frequent than transversion, single mutation is more frequent than double mutation, which one of the following changes will occur most frequently than others?

- (A) Ala → Gly
- (B) Ala → Ser
- (C) Ala → Leu
- (D) Ala → Val

84. If G2/M check point and DNA repair proteins are working optimally in a cell and there are some DNA damages during G2 phase, which one of the following would be the response of the cells to damage?
- (A) Cell cycle will continue and cell will undergo mitosis.
  - (B) Cell will undergo cytokinesis.
  - (C) Cells will enter into mitosis and arrest at metaphase.
  - (D) Cells will arrest at G2 until the damages are repaired.
85. Transferrin binds with its receptor and recruits clathrin via which one of the following proteins?
- (A) Caveolin
  - (B) AP1 adaptor
  - (C) AP2 adaptor
  - (D) Dynamin
86. Which one of the following is the major product of fatty acid synthase?
- (A) Acetyl-CoA
  - (B) Palmitoyl-CoA
  - (C) Acetoacetate
  - (D) Palmitate
87. Intracellular transport in mammalian cells through vesicular fusion is regulated by which among the following GTPases?
- (A) Rho
  - (B) Ran
  - (C) Rab
  - (D) Ras
88. Which one of the following processes is NOT regulated by the kidney?
- (A) Body temperature
  - (B) Blood pressure
  - (C) Coordinated muscle movement
  - (D) Ionic balance of the blood

89. Rapid removal of large quantities of blood will cause an animal to go into hypovolemic shock and may even cause death. If the weight of a mouse is 20 gms, what is the amount of maximum blood one can withdraw from a single bleed to prevent the mouse from going into hypovolemic shock?
- (A) 2.0 ml
  - (B) 3.0 ml
  - (C) 0.2 ml
  - (D) 1.0 ml
90. In order to have a desired shRNA cassette integrated in target cells, which of the following gene transfer vectors is preferable?
- (A) Baculovirus vector
  - (B) Herpes virus vector
  - (C) Adenoviral vector
  - (D) Lentiviral vector
91. Which one of the following statements regarding naturally occurring *Agrobacterium* strains is true?
- (A) The T-DNA region of *Agrobacterium* does not contain functional genes.
  - (B) All the *virulence* genes of *Agrobacterium* are constitutively expressed.
  - (C) *Agrobacterium*-induced galls require exogenous application of phytohormones for their growth.
  - (D) *Agrobacterium*-induced galls in nature do not require bacterial persistence for their growth.
92. The integration of T-DNA in the plant nuclear genome is most likely due to
- (A) homologous recombination
  - (B) non-homologous recombination
  - (C) non-homologous end joining
  - (D) single-stranded recombination during transcription

93. Variation in transgene expression levels among independent transgenic events generated using the same transgene construct could be due to
- (i) position effects
  - (ii) strength of the promoter used to express the transgene
  - (iii) variation in copy number of the transgene
  - (iv) presence of restriction enzyme sites in the transgene sequence
- (A) (i) and (iv)
  - (B) (ii) and (iii)
  - (C) (i) and (iii)
  - (D) (iii) and (iv)
94. A typical flowering plant has a combination of sporophytic (diploid) and gametophytic (haploid) tissues. Which of the following types of plant tissues do NOT contribute to the formation of a mature fruit?
- (A) sporophytic tissue from the previous generation
  - (B) gametophytic tissue from the previous generation
  - (C) sporophytic tissue from the next generation
  - (D) gametophytic tissue from the next generation
95. The submerged leaves of an aquatic plant are feathery (to avoid damage due to flowing underwater currents) while leaves on the surface are padded (to help in floatation). The correct statement related to the above phenotype is
- (A) The gene content of the submerged leaves is different from that of leaves on the surface.
  - (B) The submerged and floating leaves have differential expression of structural and/or regulatory genes.
  - (C) The observed phenotypic variation in leaves is not influenced by diverse growth conditions.
  - (D) These phenotypic variations are due to transient somatic mutations.
96. Which one of the following statements related to the development of insect-resistant transgenic plants is correct?
- (A) The targeted insects cannot develop resistance against transgenic plants generated using a single candidate gene.
  - (B) A transgenic plant developed using multiple genes might be more effective in inducing and maintaining resistance.
  - (C) The level of transgene expression does not influence the efficacy of the transgenic plant.
  - (D) It is easier to propagate and maintain multi-copy integration events than single copy events of insect resistant plants.

97. When the gene and the promoter used for modification of a plant using transformation technology are derived from sexually compatible species, the modified plant thus generated is known as a
- (A) cisgenic plant
  - (B) selfgenic plant
  - (C) intragenic plant
  - (D) hemilogous plant
98. A transgenic plant segregates in a 3:1 ratio for the transgenic: non-transgenic phenotype in  $T_1$  progeny derived by self-pollination. This indicates that
- (A) the transgenic plant cannot contain more than one copy of the transgene.
  - (B) the transgenic plant may contain two unlinked copies of the transgene.
  - (C) the transgenic plant contains more than two unlinked copies of the transgene.
  - (D) the transgenic plant may contain two tightly linked copies of the transgene.
99. Which one of the following reporter genes can be used for real-time visualization of living cells/tissues in transgenic plants?
- (A) *gus*
  - (B) *gfp*
  - (C) *cat*
  - (D) *beta-galactosidase*
100. Which of the following statements represent correct features of sexual and asexual modes of reproduction in flowering plants?
- (i) In sexual reproduction, progeny are genetically different from each other.
  - (ii) In asexual mode of reproduction, progeny are genetically identical to each other but different from the parent.
  - (iii) Development of greater adaptive ability is possible only in case of progeny derived by sexual reproduction.
  - (iv) A minor change in the habitat may adversely affect all offspring derived by asexual reproduction.
- (A) i, iii and iv
  - (B) i, ii and iii



- (C) ii and iv
- (D) ii, iii and iv

101. Which one of the options given below represents the correct combination of plant defense responses listed in Column A and Column B?

	Column A		Column B
(i)	Anatomical defense	(1)	salicylic acid
(ii)	Elicitors	(2)	chitinases
(iii)	Systemic response	(3)	waxes
(iv)	PR proteins	(4)	beta-glucans

- (A) i – 2, ii – 3, iii – 1, iv - 4
- (B) i - 3, ii – 4, iii – 1, iv – 2
- (C) i – 4, ii – 1, iii – 2, iv - 3
- (D) ii – 3, iii – 4, i – 2, iv - 1

102. Non-conditional, negative selection marker genes are usually expressed under a

- (A) developmentally regulated promoter
- (B) substrate-induced promoter
- (C) constitutive promoter
- (D) minimal promoter

103. A method in which a strong enhancer is randomly inserted in a plant genome by transformation, resulting in mutant plants with dominant phenotypes, is known as

- (A) enhancer trapping
- (B) TILLING
- (C) activation tagging
- (D) gene trapping

104. Which one of the following organisms is used by plant biologists to study translocation in phloem?

- (A) aphids
- (B) nematodes
- (C) grasshoppers
- (D) butterflies

105. In a genetic transformation experiment, a researcher failed to add the antibiotic selection agent in the shoot regeneration medium for selection of transgenic plants. In the absence of any other confounding factors, which one of the following statements is expected to be correct?

- (A) The number of regenerating shoots would be reduced in this experiment as compared to those in which the antibiotic is added.
  - (B) The number of regenerating shoots is comparable to results obtained in the “negative control” of the experiment.
  - (C) Transgenic plants cannot be generated from the above experiment.
  - (D) The regenerating shoots would consist of a mixture of transgenic and non-transgenic plants.
106. Orientation of a cloned passenger gene cassette in a binary plasmid vector, containing the expression cassette of a selectable marker gene, can be checked by PCR using
- (A) passenger gene-specific primers
  - (B) selectable marker gene-specific primers
  - (C) a combination of passenger gene-specific and vector-specific primers
  - (D) vector-specific primers
107. Somatic hybrid plants with full or nearly full complement of the two parental species are called
- (A) asymmetric hybrids
  - (B) symmetric hybrids
  - (C) complete hybrids
  - (D) chimeric hybrids
108. In CAGE,
- (A) only 5'-end information of the transcript is analysed
  - (B) only 3'-end information of the transcript is analysed
  - (C) both 5'-end and 3'-end information of the transcript are analysed
  - (D) complete exonic sequence of the transcript is analysed.
109. Which one of the following statements about associative nitrogen fixing bacteria is NOT true?
- (A) *Rhodobacter* and *Rhodospirillum* are autotrophic photosynthetic N-fixing bacteria
  - (B) *Clostridium*, *Desulfotomaculum* and *Desulfovibrio* are heterotrophic anaerobic N-fixing bacteria
  - (C) *Azospirillum* is an associative autotrophic microaerophilic nitrogen fixing bacteria
  - (D) *Beijerinckia* is an heterotrophic aerobic associative nitrogen fixing bacteria

110. According to the Seeds Act of 1966, which one of the following functions is NOT applicable to a Seed Certification Agency?

- (A) It should be an autonomous body.
- (B) It should involve itself in the production and marketing of seeds.
- (C) It should have close linkages with technical and other related institutions.
- (D) Its long-term objective should be to operate on no-profit no-loss basis.

111. Which one of the combinations given below represents populations with a similar genetic composition?

- (A)  $F_1$  and  $F_2$
- (B)  $F_2$  and  $BC_1F_2$
- (C) RIL and DH
- (D) DH and  $F_2$

112. Which one of the following statements represents a correct definition of Gene Pyramiding?

- (A) Introducing different genes for resistance to a specific pest in a single genotype
- (B) Introducing different genes for resistance to a specific pest in different genotypes
- (C) Introducing a single gene for resistance to multiple pests in a single genotype
- (D) Introducing multiple genes conferring resistance to multiple pests in different genotypes.

113. A marker closely linked to the gene of interest for an agronomic trait will be used for

- (A) foreground selection
- (B) background selection
- (C) both foreground and background selection
- (D) selection of unlinked genes

114. The vitrification of cultured explants is generally caused by

- A. low light irradiance, high temperature and intensive sterilization

- B. high auxin, low temperature and high light irradiance
- C. high agar, high nutrients and high pH
- D. low pH, low temperature and low micronutrient concentration

115. The *Rht* mutations in wheat that were pivotal for 'Green Revolution' reduce plant height due to impairment in

- (A) gibberellic acid biosynthesis pathway
- (B) gibberellic acid signaling pathway
- (C) auxin biosynthetic pathway
- (D) auxin response pathway

116. Steady state for a closed system implies

- (A) Input = Output
- (B) Accumulation = 0
- (C) Input – Output = Accumulation
- (D) System is in equilibrium

117. In a lab scale reactor, the size of the air bubbles in the reactor is primarily determined by

- (A) agitator speed
- (B) viscosity of the broth
- (C) density of the broth
- (D) size of the holes in the sparger

118. Generally fungal fermentations are pseudoplastic. Hence in large reactors the cells

- (A) are better aerated near walls of the reactor
- (B) are better aerated in the centre of the reactor
- (C) are evenly aerated
- (D) get better aerated at the top rather than bottom

119. Mixing time increases with the volume of the reactor because of increase in the

- (A) circulation time
- (B) shear

- (C) turbulence
- (D) flow rate

120. The Reynolds number is a ratio of

- (A) external forces/inertial forces
- (B) inertial forces/axial dispersion
- (C) inertial forces/viscous forces
- (D) external forces/ viscous forces

121. The equation  $\tau = \mu \, du/dy$  is also termed as

- (A) pressure flux equation
- (B) force flux equation
- (C) mass flux equation
- (D) momentum flux equation

122. Match the Transport process with appropriate time constants given below.

Transport process		Time constants	
1.	Oxygen transfer	p.	$V/Q$
2.	Heat transfer	q.	$4V/(1.5ND^3)$
3.	Flow	r.	$V\rho C_p/UA$
4.	Mixing	s.	$1/K_L a$

Where V is volume; Q is pumping rate; N is agitation rate; D is diameter of the impeller; A is area and  $\rho$  is the density of the liquid

- (A) 1-s, 2-r, 3-p, 4-q
- (B) 1-s, 2-r, 3-q, 4-p
- (C) 1-s, 2-q, 3-p, 4-r
- (D) 1-q, 2-r, 3-p, 4-s

123. When a liquid of density  $1200 \, \text{kg/m}^3$  and viscosity  $0.01 \, \text{kg m}^{-1}\text{s}^{-1}$  flows through a 1 cm ID pipe at 0.2 m/s, the flow is referred as a

- (A) Piston flow
- (B) Turbulent flow
- (C) Laminar flow
- (D) Transition flow

124. In a dynamic gassing out technique for determination of  $K_La$  in a bioreactor, upon restart of the aeration the increase in DO slows down with time because

- (A) the cultures specific OUR declines to reach a steady state
- (B)  $K_La$  changes when the cells get sufficient oxygen supply
- (C)  $C^*-C_L$  increases
- (D)  $C^*-C_L$  decreases

125. Under unaerated conditions in a fermenter, the power consumed by a single impeller is 10 KW and upon changing the agitation rate from 200 to 600 rpm, the new power consumption (KW) would be ----- . (Assuming that the power number remains constant)

- (A) 270
- (B) 90
- (C) 30
- (D) 10

126. Fill in the blanks with appropriate option: Vinegar is a liquid consisting of acetic acid produced by the fermentation of \_\_\_\_\_ by \_\_\_\_\_.

- (A) glucose, *S. cerevisiae*
- (B) ethanol, *A. aceti*
- (C) lactose, *L. acidophilus*
- (D) starch, *B. amyloliquefaciens*

127. A food stored in a refrigerator has caused an outbreak of food borne illness. Which one of the following is most likely to be the pathogen responsible for this?

- (A) *S. typhimurium*
- (B) *E. coli*
- (C) *L. monocytogenes*
- (D) *B. cereus*

128. To reduce the tartness in wine due to malic acid, a secondary fermentation is carried out using

- (A) *Saccharomyces cerevisiae*
- (B) *Oenococcus oeni*

- (C) *Aspergillus niger*
- (D) *Pichia pastoris*

129. Which one of the following statements is INCORRECT with respect to food rheology?

- (A) Yoghurt demonstrates thixotropy
- (B) Ketchup is an example of shear thinning, pseudoplastic liquid
- (C) Wheat dough is viscoelastic
- (D) Molten chocolate is a perfect Newtonian fluid

130. Which one of the following enzyme(s) would result in high glucose yield from starch hydrolysis?

- (A)  $\alpha$ - amylase
- (B)  $\beta$ - amylase
- (C)  $\alpha$ - amylase and amyloglucosidase
- (D)  $\alpha$ - amylase and  $\beta$ - amylase

131. The major metabolite formed and the succession of microorganisms responsible for Sauerkraut fermentation are

- (A) citric acid, yeast- Coliform- Leuconostoc
- (B) acetic acid, *Aspergillus*- Lactobacilli- Leuconostoc
- (C) lactic acid, Coliform- Leuconostoc- Lactobacilli
- (D) malic acid, Leuconostoc- Lactobacilli- Coliform

132. Omega 3 fats are good for health and play an important role in prevention of heart disease. If you have to formulate a food product rich in omega 3 fats which one of the following options would you choose?

- (A) rice bran oil because it contains C 18:2  $\Delta^9c, 12c$
- (B) flax seed oil because it contains C 18:3  $\Delta^9c, 12c, 15c$
- (C) olive oil because it contains C 18:1  $\Delta^9c$
- (D) black- currant seed oil because it contains C 18:3  $\Delta^6c, 9c, 12c$

133. For a well-established enzyme assay method where the reaction kinetics should remain zero order, what percentage of substrate is converted to product during the incubation period?

- (A) 80 – 90%
- (B) 50 – 60%

- (C) 30 – 20%
- (D) 6 – 10%

134. As the viscosity increases, the method used for mixing is changed in the following order

- (A) Paddle, Turbine, Propeller, Helical ribbon and Screw
- (B) Propeller, Turbine, Paddle, Helical ribbon and Screw
- (C) Propeller, Paddle, Turbine, Helical ribbon and Screw
- (D) Propeller, Turbine, Paddle, Screw and Helical ribbon

135. On scale up, the effective area available for heat transfer in a bioreactor

- (A) Increases
- (B) Decreases
- (C) Depends on viscosity of the medium
- (D) Remains constant

136. A fermenter produces 100 kg lysine per day. If the volumetric productivity is  $0.8 \text{ g l}^{-1} \text{ h}^{-1}$ , what is the volume of the fermenter in liter?

- (A) 2200
- (B) 3200
- (C) 4200
- (D) 5200

137. Chemostat cultivation is carried out at steady state with a dilution rate of  $0.1 \text{ h}^{-1}$ . Given  $\mu_m = 1.1 \text{ h}^{-1}$  and  $K_s = 0.1 \text{ g/L}$ . What will be steady state substrate concentration?

- (A) 0.01 g/L
- (B) 0.1 g/L
- (C) 1.0 g/L
- (D) 10.0 g/L

138. For degradation of crude oil in ocean by microorganisms, the two limiting nutrients are

- (A) nitrates and ammonia
- (B) nitrates and phosphates
- (C) sulphates and iron



(D) phosphates and nitrites

139. The first circumpolar expedition in the history of Marine Sciences was

- (A) Challenger
- (B) Beagle
- (C) International Indian Ocean Expedition
- (D) Voyager

140. Paralytic shellfish poisoning (PSP) is caused by the consumption of molluscan Shellfish contaminated with

- (A) Brevetoxins
- (B) Domoic Acid
- (C) Saxitoxins
- (D) Okadaic acid

141. Biofilm/capsular material produced by the soil bacteria is detected by

- (A) Saffranin
- (B) Malachite green
- (C) Basic fuchsin
- (D) Congo red

142. A compound secreted by a soil bacterium capable of reducing the surface tension at air-water interface is called as

- (A) Osmolyte
- (B) Detergent
- (C) Primary metabolite
- (D) Biosurfactant

143. Match the organism in Group A with the appropriate habitat from Group B.

- | Group A                  | Group B         |
|--------------------------|-----------------|
| P) <i>Pseudomonas</i>    | i) Hot springs  |
| Q) <i>Thermus</i>        | ii) Rhizosphere |
| R) <i>Photobacterium</i> | iii) Soil       |
| S) <i>Thiobacillus</i>   | iv) Marine      |

- (A) P-ii, Q-i R-iv S-iii
- (B) P-i, Q-iii, R-ii, S-iv
- (C) P-iv, Q-iii, R-ii, S-i
- (D) P-ii, Q-iv, R-ii S-i

144. Match the type of Organism in Group A with appropriate phenotype/property from Group B.

Group A  
 P) *Pseudomonas aeruginosa*  
 Q) *Staphylococcus aureus*  
 R) *Thiobacillus ferrooxidans*  
 S) *Bradyrhizobium*

Group B  
 i) Sulfur oxidizing organism  
 ii) Elemental N<sub>2</sub> fixation  
 iii) Biofilm formation  
 iv) Quorum sensing

- (A) P-ii, Q-iii, R-iv, S-i
- (B) P-iii, Q-iv, R-i, S-ii
- (C) P-iii, Q-iv, R-ii, S-i
- (D) P-i, Q-iii, R-ii, S-iv

145. Which one of the following reactions is performed by Cytochrome-P450 to detoxify the xenobiotics?

- (A) Hydroxylation
- (B) Ligation
- (C) Hydrolysis
- (D) Group transfer

146. Which one of the following is NOT true regarding Zika virus?

- (A) It was first isolated in Uganda
- (B) It is transmitted by *Anopheles* mosquito
- (C) It is an RNA virus
- (D) It may result in microcephaly

147. The vaccine currently used in India's Pulse polio campaign is

- (A) heat killed
- (B) chemically attenuated
- (C) live attenuated
- (D) vaccine with adjuvant

148. Which one of the following enzymes helps in the survival of *Helicobacter pylori* in the stomach?

- (A) carbonic anhydrase
- (B)  $\beta$ -lactamase
- (C) urease
- (D) transpeptidase

149. Which one of the following is INCORRECT about Streptokinase?

- (A) It was originally obtained from  $\beta$  hemolytic streptococci
- (B) It is highly antigenic
- (C) It is used as a therapeutic anti-thrombogenic agent
- (D) It is used as a therapeutic fibrinolytic agent

150. The utility of positron emission tomography to diagnose tumors is based on

- (A) uptake of 2-fluoro-2 deoxyfructose
- (B) uptake of 2-fluoro-2-deoxyglucose
- (C) activation of hypoxia-inducible transcription factor HIF-1
- (D) detection of hypoxia by pimonidazole

151. Which one of the following imaging techniques is non-invasive?

- (A) Ultrasound imaging
- (B) Contrast CT imaging
- (C) Nuclear imaging
- (D) PET imaging

152. Amphotericin B is clinically used against which one of the following pathogens?

- (A) Herpes simplex virus I
- (B) *M. tuberculosis*
- (C) *Candida* spp.
- (D) *P. vivax*

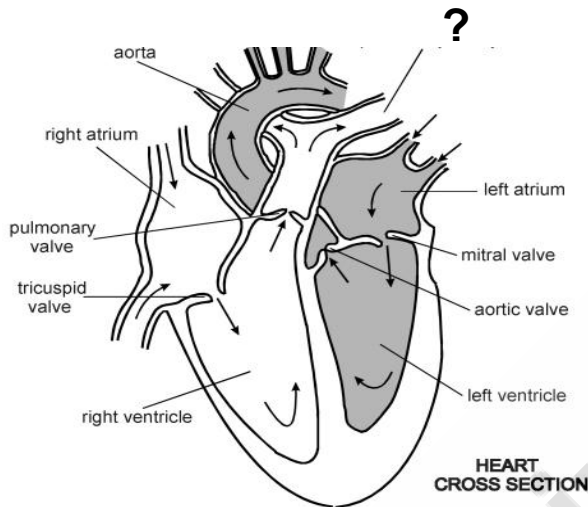
153. The therapeutic index (TI) indicates the relative margin of safety of a drug and it is deduced from the values of mean lethal dose (LD<sub>50</sub>) and median effective dose (ED<sub>50</sub>). Which of the following represents TI of a drug?

- (A)  $TI = LD_{50} \times ED_{50}$
- (B)  $TI = LD_{50} + ED_{50}$
- (C)  $TI = LD_{50} / ED_{50}$
- (D)  $TI = LD_{50} - ED_{50}$

154. Which one of the following is a frequently used radio-opaque dye?

- (A) Barium chloride
- (B) Barium sulphate
- (C) Barium nitrite
- (D) Barium iodide

155. The name of the blood vessel marked [?] in the figure below is



- (A) pulmonary vein
- (B) pulmonary artery
- (C) cardiac vein
- (D) cardiac artery

156. Which one of the following is a reason for administering general anesthesia to experimental animals?

- (A) It reduces the toxicity of a test drug
- (B) It provides reasonable degree of muscle relaxation
- (C) It maintains the normal level of haemoglobin
- (D) It maintains the normal body temperature

157. During the pathogenesis of rabies, the replication of virus first starts in the

- (A) Spinal ganglia
- (B) Muscle fibers and connective tissues
- (C) Lungs
- (D) Central nervous system

158. Route of entry for canine distemper virus is

- (A) Skin dermal fibroblasts
- (B) Respiratory epithelial cells
- (C) Lymphocytes
- (D) Mesenchymal stem cells

159. Callipyge gene mutation in sheep leads to increased muscle growth. The gene presents a typical case of Polar over-dominance. Which of the four genotypes given below shows increased muscle growth? (N= wild type allele, C= mutant allele for callipyge)

- (A)  $N^{\text{mat}} C^{\text{pat}}$
- (B)  $N^{\text{pat}} C^{\text{mat}}$
- (C)  $C^{\text{mat}} C^{\text{pat}}$
- (D)  $N^{\text{Pat}} N^{\text{pat}}$

160. The technique used in animal biotechnology for the rapid multiplication and production of animals with a desirable genotype is:

- (A) protoplast fusion and embryo transfer
- (B) hybrid selection and embryo transfer
- (C) in vitro fertilization and embryo transfer
- (D) artificial insemination

161. A primary culture of neurons isolated from the mouse brain responded positively when exposed to a chemical for a few seconds, but the neurons were less responsive and eventually stopped responding when exposed to the same chemical for prolonged duration. However, if the culture was left for some time and washed, the neurons started responding to the same chemical at the same concentration as before. The reduced response was due to

- (A) increased apoptosis of the neurons.
- (B) necrosis of the neurons.
- (C) change in the pH of the medium.
- (D) desensitization/down-regulation of the receptors.

162. If a neuron is tyrosine hydroxylase positive, it could be either:

- (A) Noradrenergic or Histaminergic
- (B) Dopaminergic or Serotonergic
- (C) Noradrenergic or Dopaminergic
- (D) Serotonergic or Noradrenergic

163. Pain sensation is a subjective and conscious feeling. However, although the autonomic organs viz. brain, heart etc. do not get represented in the cerebral cortex, one feels pain in those parts as well. The reason is

- (A) these parts receive less blood supply.
- (B) increased pH in those parts.
- (C) it is a referred pain.
- (D) these organs are metabolically compromised.

164. Neurons are formed from precursor proneural cells due to

- (A) relatively low level notch activity.
- (B) relatively high level notch activity.
- (C) inactivation of notch.
- (D) activation of delta.

165. A neuron at resting state when treated with "X" showed transmembrane potential -50mV, while when treated with "Y" it showed -90mV. Given such a condition, which of the following statements would be most appropriate?

- (A) "X" induced depolarization, while "Y" induced hyperpolarization.
- (B) The threshold for inducing a response by the neuron was higher for "X" than that for "Y".
- (C) Both the treatments induced depolarization of the neuron.
- (D) Both the treatments induced hyperpolarization of the neuron.

166. In a population which is in Hardy-Weinberg equilibrium, the frequency of a recessive allele for a certain genetic trait is 0.40. What percentage of individuals would be expected to show the dominant trait in the next generation?

- (A) 16%
- (B) 32%
- (C) 84%
- (D) 96%

167. Color blindness in human is a sex-linked recessive trait. If two individuals with normal color vision have a color blind son, what will be the genotypes of the parents?

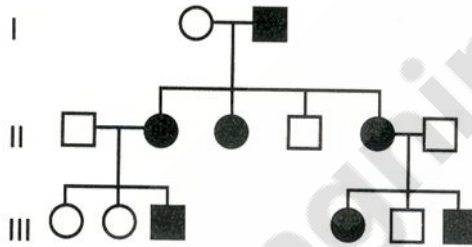
- (A)  $X_cX_c$  and  $X_cY$
- (B)  $XCX_c$  and  $XCY$
- (C)  $X_cX_c$  and  $XCY$

(D) XCXC and XcY

168. A human is phenotypically female, but her interphase somatic nuclei do not display the existence of Barr bodies. Which of the following conditions could explain the above feature?

- (A) Klinefelter syndrome
- (B)  $2n+XXX$
- (C) Turner syndrome.
- (D)  $2n+YY$

169. For the pedigree depicted below, which mode(s) of inheritance CANNOT be possible?



- (A) X-linked dominant
- (B) Autosomal dominant
- (C) X-linked recessive
- (D) Autosomal recessive

170. C banding of human chromosomes specifically reveals

- (A) polymorphism of constitutive heterochromatin of chromosomes 1, 9, 16 and Y
- (B) polymorphism of constitutive heterochromatin of chromosomes 3, 7, 12 and X
- (C) polymorphism of facultative heterochromatin of chromosome X
- (D) satellite sequences

171. Which one of the following expressions is likely to retrieve more matches in a database search?

- (A) D-A-V-I-D
- (B) [DE]-A-V-I-[DE]
- (C) [DE]-[AVILM]-X-E
- (D) D-A-V-E

172. Which substitution matrices should you prefer to find distantly related orthologs through BLAST search?

- (A) BLOSUM 40 and PAM 250
- (B) BLOSUM 82 and PAM 250
- (C) BLOSUM 40 and PAM 120
- (D) BLOSUM 60 and PAM 120

173. Match the items in Group 1 with an appropriate description in Group 2

Group 1

P. UPGMA

Q. CLUSTALW

R. SWISS-PROT

S. RasMol

Group 2

1. Protein sequence database

2. Phylogenetic Analysis

3. 3-D structure visualization

4. Multiple sequence alignment

- (A) P-4, Q-1, R-2, S-3
- (B) P-2, Q-4, R-1, S-3
- (C) P-2, Q-3, R-1, S-4
- (D) P-2, Q-1, R-4, S-3

174. The rate of substitutions in a certain region of DNA of length 1000 bases is estimated as  $10^{-9}$  per base per year. If two species diverged approximately 10 million years ago, the fraction of sites that differ between them should be approximately

- (A) 0.2%
- (B) 2%
- (C) 20%
- (D) 25%

175. When searching the Blocks and PRINTS databases, a match is judged significant if

- (A) a single motif is matched
- (B) two motifs are matched
- (C) the E-value is above  $e^{-4}$
- (D) a combined E-value above a given threshold is reported for a multiple -motif match



176. Two species are found to share a cluster of 8 genes, but the genes are in different orders in the two species. The orders are represented by signed permutations as given below:

Species X    1,2,3,4,5,6,7,8  
Species Y    1, 2,-5,-4,-3,8,6,7

The transformation between the two gene orders

- (A) cannot be achieved by inversions alone.
- (B) can be achieved by one translocation and one inversion.
- (C) can be achieved by three inversions.
- (D) requires six separate genome rearrangement events.

177. As the E value of a BLAST search becomes smaller

- (A) the value K also becomes smaller
- (B) the score tends to be larger
- (C) the probability  $p$  tends to be larger
- (D) the extreme value distribution becomes less skewed

178. In a genome with average GC-content 40%, the expected frequency of occurrence of the tetranucleotide AACG is

- (A) 0.24 %
- (B) 0.36 %
- (C) 0.42 %
- (D) 0

179. Consider that you have collected X-ray diffraction data on three different protein crystals, referred to as Protein A, B and C. Data set for crystal A has the best diffraction spot at 8Å, crystal B at 5Å and crystal C has the best diffraction at 3Å. Which data set is likely to yield a higher resolution crystal structure?

- (A) Protein A
- (B) Protein B
- (C) Crystal C
- (D) All will have same resolution structure

180. In a protein crystallization experiment, you have identified an optimal protein concentration and precipitant concentration which yield crystals. Now if you are asked to grow crystals again with a protein solution that is four times more concentrated, how will you alter the precipitant concentration?

- (A) Increase precipitant concentration
- (B) Decrease precipitant concentration
- (C) Keep the precipitant concentration the same
- (D) Remove the precipitant altogether

181. Which of the following statements is true for two different tripeptides consisting of either glycine or proline?

- (A) Glycine tripeptide will have relatively larger allowed area on the Ramachandran plot.
- (B) Proline tripeptide will have relatively larger allowed area on the Ramachandran plot.
- (C) Both the tripeptides will fall primarily in the disallowed regions of the Ramachandran plot.
- (D) Both the tripeptides will fall primarily in the overlapping allowed regions of the Ramachandran plot.

182. In a Fluorescence Resonance Energy Transfer (FRET) experiment, the donor is Cyan Fluorescent Protein (CFP) which has excitation and emission maxima at 435 and 485 nm, respectively. The acceptor in this experiment is Yellow Fluorescent Protein (YFP) that has excitation and emission maxima at 513 and 545 nm, respectively. Under the conditions, where a significant FRET is observed, what will happen to the FRET signal if the emission maxima of CFP is made to shift to 475nm.

- (A) Increase
- (B) Decrease
- (C) Remains unchanged
- (D) May increase or decrease

183. Consider that the following polypeptides are being analyzed by Mass-spectrometry (MS). These peptides are generated by proteolytic cleavage of a protein that is expressed in mammalian cells and it has undergone glycosylation, phosphorylation and acetylation. What will the expected positioning of the spectra corresponding to these peptides (smaller to larger)?

- (A) Asn-Lys-Ser/Asn-Lys-Thr/ Ser-Lys-Asn/ Thr-Arg-Asn
- (B) Thr-Arg-Asn/ Ser-Lys-Asn/ Asn-Lys-Thr/ Asn-Lys-Ser
- (C) Asn-Lys-Thr/ Asn-Lys-Ser/ Thr-Arg-Asn/ Ser-Lys-Asn
- (D) Ser-Lys-Asn/ Asn-Lys-Thr/ Asn-Lys-Ser/ Thr-Arg-Asn

184. Assuming that the sequence of CDRs of an antibody are heavily enriched with Tyrosine and Serine, what is likely to be the driving force stabilizing its interaction with the antigen?

- (A) Hydrophobic interaction
- (B) Hydrogen bonding
- (C) Van-der Waals interaction
- (D) Covalent interactions

185. Hydrophobic amino acids are prevalent in transmembrane regions of membrane embedded proteins because

- (A) Hydrophobic amino acids destabilize the membrane bilayer and increase membrane fluidity
- (B) Phospholipid tails are hydrophobic and therefore membrane embedded regions can be stabilized through hydrophobic interactions
- (C) The side chains of hydrophobic amino acids interact covalently with phospholipids
- (D) It is just a random occurrence originated from heavy bias of hydrophobic amino acids in protein sequences

186. Bryostatin is an anticancer agent obtained from

- (A) *Tethya crypta*
- (B) *Salinospora tropica*
- (C) *Bugula neritina*
- (D) *Trididemnum solidum*

187. Synthesis of White spot syndrome virus envelop takes place in

- (A) endoplasmic reticulum
- (B) nucleus
- (C) mitochondria
- (D) cytoplasm

188. Primary etiology of Epizootic Ulcerative Syndrome is a Fungus *Aphanomyces invadans*. Its zoospores have the property to

- (A) colonize gill epithelium
- (B) cause ulcerations on skin
- (C) travel long distances and penetrate deep in to the tissue
- (D) cause multiple infections with protozoans

189. Gonad Inhibiting Hormone (GIH) in crustaceans is synthesized in

- (A) Thoracic ganglion
- (B) Sinus gland
- (C) X-organ
- (D) Y-organ

190. The synthetic equivalent of neuro-pharmacologically active peptides obtained from the marine snail *Conus magus* is

- (A) Zinconotide
- (B) Discodermin
- (C) Didemnins
- (D) Dolastatins

191. Viral encephalopathy and retinopathy in fishes are caused by

- (A) Betanodavirus
- (B) Rhabdovirus
- (C) Baculovirus
- (D) Rotavirus

192. A pigment isolated from marine red algae that finds application in flow cytometry is

- (A) Xanthophyll
- (B) Phycoerythrin
- (C) Chlorophyll
- (D) Fluorescamine

193. Which of the following electron acceptor that is used by the bacteria is mainly responsible for marine corrosion?

- A)  $O_2$
- B)  $NO_3^-$
- C)  $SO_4^{2-}$
- D)  $CO_2$

194. Which one of the following bacterial species is responsible for the Scombroid fish poisoning?

- (A) *Aeromonas hydrophila*
- (B) *Photobacterium phosphoreum*
- (C) *Vibrio parahaemolyticus*
- (D) *E. coli*

195. The larval stage of *Macrobrachium rosenbergii* is referred to as

- (A) Nauplii
- (B) Zoea
- (C) Mysis
- (D) Megalopa

196. The group of marine algae which have urea cycle is

- (A) Green algae
- (B) Cyanobacteria
- (C) Diatoms
- (D) Red algae

197. Which of the following algae is responsible for the red color of RED SEA?

- (A) *Trichodesmium erythraeum*
- (B) *Noctiluca scintillans*
- (C) *Karenia brevis*
- (D) *Chaetoceros* sp.

198. An oligotrophic lake has

- (A) High level of nutrients in water
- (B) High aquatic productivity
- (C) Algal blooms
- (D) Low nutrients and low productivity

199. After sodium chloride, which one of the following compounds has the maximum concentration in sea water?

- (A) Magnesium sulphate
- (B) Calcium sulphate
- (C) Magnesium chloride
- (D) Potassium sulphate

200. Which of the following is an example of an intellectual property right?

- (A) A book that you own
- (B) The copyright on a book
- (C) The deed to a plot of land
- (D) An airline ticket



Q. No.	Key
1	2
2	3
3	2
4	3
5	3
6	2
7	4
8	3
9	3
10	3
11	2 ✓
12	4
13	4
14	3
15	2 ✓
16	1
17	3
18	1
19	2
20	4
21	1
22	1
23	3
24	1
25	3
26	3 ✓
27	1
28	3 ✓
29	3
30	2
31	1 ✓
32	2
33	1
34	3
35	3 ✓
36	4
37	4
38	1
39	3 ✓
40	2

Q. No.	Key
41	3 ✓
42	1 ✓
43	2
44	1 ***
45	4
46	1
47	4
48	4 ✓
49	3
50	4
51	2 ✓
52	1 or 2 **
53	1
54	4 ✓
55	2
56	2
57	1 ✓
58	2
59	3
60	1
61	2 ✓
62	2
63	*
64	3 ✓
65	4
66	3
67	2
68	4 ✓
69	3
70	3
71	3
72	3 or 4 **
73	3
74	1
75	2
76	4
77	1
78	1
79	4
80	2

Q. No.	Key
81	3
82	3
83	4
84	4
85	3
86	4
87	3
88	3 ✓
89	3
90	4
91	4 ✓
92	3 ✓
93	3 ✓
94	4
95	2
96	2
97	3
98	4 ✓
99	2 ✓
100	1
101	2
102	1
103	3
104	1
105	4
106	3
107	2
108	1
109	2 ***
110	2
111	3
112	1 ✓
113	1 ✓
114	1
115	2
116	4 ✓
117	1
118	2
119	1
120	3

Q. No.	Key
121	4
122	1
123	3
124	4
125	1
126	2
127	3✓
128	2
129	4
130	3
131	3
132	2
133	4
134	2✓
135	2
136	4
137	1***
138	2
139	*
140	3
141	4
142	4
143	1
144	2
145	1
146	2✓
147	3
148	1 or 3**
149	3✓
150	2
151	1
152	3
153	3
154	2
155	2
156	2
157	2
158	2
159	1
160	3

Q. No.	Key
161	4
162	3
163	3
164	1
165	1
166	3
167	2✓
168	3
169	3✓
170	1
171	3
172	1
173	2
174	2
175	4
176	1 or 2**
177	2
178	2
179	3
180	2
181	1✓
182	2
183	2
184	2
185	2
186	3
187	2
188	3
189	3
190	1
191	1
192	2
193	3
194	*
195	2***
196	3
197	1
198	4
199	1
200	2

\* Benefit of marks to all those candidates who attempted    \*\*Both options are correct

\*\*\*Option changed

✓ No Change