SECTION-A

[Multiple Choice Questions (MCQ)]

Q. 1 – Q. 10 carry one mark each.

1. In a plant, the allele for tall stalk is dominant over short stalks and the allele for wide leaves is dominant over thin leaves. What would be the best way to determine the genotype of a plant with tall stalk and wide leaves?
   (a) Perform a testcross with the plant that has short stalk and thin leaves
   (b) Perform a testcross with the plant that has tall stalk and wide leaves
   (c) Perform a testcross with a known heterozygous plant
   (d) Perform a testcross with plant that has a tall stalk and thin leaves
2. In the ABO blood system in humans, if a person of type-B blood has children with a person of type-AB blood, what blood types could their children have?
   (a) AB, A, B (b) A and B
   (c) A and AB (d) AB, A, B, O
3. A gene for corn has two alleles, one for yellow kernels and one for white kernels. Cross pollination of yellow corn and white corn results in ears of corn that have an approximately even mix of yellow and white kernels. Which term best describes the relationship between the two alleles?
   (a) Incomplete dominance (b) Genetic recombination
   (c) Mosaicism (d) Codominance
4. In a breed of dog, the allele for black coat color (B) is dominant to the allele for brown coat color(b). If it has two copies of a recessive pigment producing gene (e), it will have yellow coat color. What proportion of the progency has yellow coat color if two heterozygous (BbEe × BbEe) dogs are crossed?
   (a) $\frac{1}{16}$ (b) $\frac{9}{16}$ (c) $\frac{1}{4}$ (d) $\frac{1}{2}$
5. In pea plants, the allele for tall stalks (T) is dominant over the allele for short stalks (*t*). A cross between a tall pea plant and a short pea plant produces 40 tall offspring and 42 short offspring. If one of the tall offspring is crossed with one of the short offspring, what ratio of genotypes would be most likely in their offspring.
   (a) 1TT : 2Tt : 1tt (b) 3Tt : 1tt
   (c) 1Tt : 1tt (d) All Tt
6. Pigmentation in moth is paternally affected where a^+ is the allele for pigmentation. A mother with genotype a^+/a and a father with genotype *aa* will produce a progeny which is
   (a) All unpigmented at larval stage
   (b) All pigmented at larval stage
   (c) Half of the larvae are pigmented at larval stage
   (d) Three-fourths of the larvae are pigmented at larval stage
7. Phages are collected from an infected *E.coli* donor strain of genotypes Cys^+ Leu^+ Thr^+ and used to transduce a recipient of genotype Cys^- Leu^- Thr^-. The treated recipient population is plated on a minimal medium supplemented with leucine and threonine. Many colonies grew. Which one of the following combination of genotypes are appropriate for the colonies that grew?
   (a) Cys^- Leu^+ Thr^+, Cys^+ Leu^- Thr^-, Cys^+ Leu^+ Thr^-
   (b) Cys^+ Leu^+ Thr^-, Cys^+ Leu^- Thr^-, Cys^+ Leu^- Thr^+

(c) Cys^+ Leu^- Thr^+, Cys^- Leu^+ Thr^-, Cys^+ Leu^+ Thr^+
(d) Cys^- Leu^- Thr^-, Cys^- Leu^- Thr^+, Cys^- Leu^+ Thr^-

8. Organisms which use light as energy source and organic molecule as the principal carbon source is called
(a) Chemoautotrophs (b) Photoautotrophs
(c) Photoheterotrophs (d) Chemoheterotrophs

9. Which of the following fungus is used as a source of hallucinogenic drug
(a) Aspergillus (b) Mucor
(c) Claviceps (d) Penicillium

10. In a microbial culture, the maximum synthesis of antibiotics occurs in
(a) Exponential phase (b) Death phase
(c) Stationary phase (d) Log phase

Q. 11 – Q. 30 carry two marks each.

11. In the penicillium enrichment method, auxotrophic mutants are isolated based on the following principle.
(a) only the auxotroph growth is supported by minimal medium
(b) while the prototroph grows readily, auxotroph grows with a lag phase
(c) only the prototroph grows and gets killed while the auxotroph remains unaffected
(d) both the auxotroph and prototroph grow but at different rates in the minimal medium

12. A virion is a
(a) complete, infectious virus particle (b) nucleic acid without a capsid
(c) naked, infectious piece of RNA (d) a naked, infectious piece of DNA

13. Parvovirus DNA is sensitive to digestion with S1 nuclease. This signifies that
(a) The DNA is single stranded (b) The DNA has hairpin loop
(c) The DNA is linear (d) The DNA is circular

14. The role of cI gene of λ phage is
(a) it encodes the cI protein which activates the lytic cycle
(b) it codes for protein, which is required for phage assembly
(c) it codes for λ repressor, which represses the lytic cycle
(d) it codes for protein, which helps the λ phage DNA to integrate into the host genome

15. Which of the following statement is true about intermediate filaments?
(a) They undergo dynamic instability
(b) They involve in vesicle transport
(c) They are composed of a single type of subunit
(d) They have primarily a structural function

16. The growth phase of a cell cycle is known as
(a) Metaphase (b) Interphase
(c) Telophase (d) M-phase

17. Which of the following proteins is involved in transport of proteins from the cytosol to nucleus?
(a) Histone (b) Ran
(c) B-actin (d) Ran and B-actin both

18. Which of the following processes requires a supply of metabolic energy?
(a) Simple diffusion (b) Facilitated diffusion
(c) Osmosis (d) Primary active transport

19. The plasma membrane of a typical cell is least permeable to which of the following
(a) Carbon dioxide (b) Oxygen
(c) Sodium ions (d) Ethanol

20. The plasma membrane of a cell separates
(a) Organelles from cytosol (b) Extracellular fluid from blood plasma
(c) Cytosol from extracellular fluid (d) From the environment

21. This region of nephron has expression of AQP-1 and AQP-7. It is major site of reabsorption in renal nephrons and shows brush border epithelium. The region is
(a) Convoluted tubule but not proximal (b) Collecting duct
(c) Convoluted tubule but not distal (d) Loop of Henle

22. Find **incorrect** statement about neurilemma
(a) It is found on myelinated neurons in PNS (b) It is found on unmyelinated neurons in PNS
(c) It is found in PNS (d) It is found in CNS

23. Primary auditory area is found in which region of cerebral cortex
(a) Superior temporal gyrus (b) Medial occipital lobe
(c) Frontal cortex (d) Limbic system

24. Which of the following is **true** for contracted skeletal muscle fiber
(a) Thin filaments do not overlap each other (b) Only A-band is present
(c) I-bands are present (d) A-band is absent

25. Deficiency of vitamin-K leads to poor blood clotting and prolonged bleeding tendency. This is because vitamin-K is must for
(a) Synthesis of prothrombin and other clotting factors in liver
(b) Initiation of clot formation reaction
(c) Makes Ca^{2+} ions available for clotting
(d) Must for polymerization of fibrin monomers

26. Find correct option w.r.t. generation of heart sounds
(a) Lub : AV valve open; Dub: AV valve closure
(b) Lub : AV valve closure; Dub: AV valve open
(c) Lub : AV valve open; Dub: semiclunar valve open
(d) Lub : semilunar valve close; Dub: AV valve open

27. A hormone with cytosolic receptor is
(a) Glucagon (b) Insulin (c) Testosterone (d) Nitric oxide

28. **Incorrect** statement about liver is
(a) Liver lacks capillaries and has sinuses
(b) Liver opens into small intestine via common bile duct
(c) It is located in left hypochondric region
(d) It produces bile that is stored in gall bladder

29. Let $f(x)=\begin{cases}|x|, & \text{if } 0<|x|\le 2\\ 1, & \text{if } x=0\end{cases}$. Then at $x=0$, f has
(a) A local maximum (b) No local maximum
(c) A local minimum (d) No extremum

30. The area bounded by the curves $y = |x| - 1$ and $y = -|x| + 1$ is

(a) 1 (b) 2 (c) $2\sqrt{2}$ (d) 4

SECTION-B

[Multiple Select Questions (MSQ)]

Q. 31 – Q. 40 carry two marks each.

31. Which of the following happens during crossing over?
(a) It occurs between homologous chromosomes
(b) It occurs between non-homologous chromosomes
(c) Gene is replicated and inserted into the other chromosome
(d) It involves breakage of DNA molecules and their subsequent rejoining in reciprocal non-parental combinations.

32. Which of the following represent different ways in which two genes are linked?
(a) When two dominant alleles are present on same homolog, it is known as *cis*-conformation
(b) When the dominant alleles are present on different homologs, it is known as *trans*-conformation
(c) When the dominant alleles are present on same homolog, it is known as *trans*-conformation
(d) When the dominant alleles are present on different homologs, it is known as *cis*-conformation

33. Which of the following chemical agent (s) is/are correctly paired with its / their mode of action.
(a) Antimycin A - Blocks electron transfer from cytochrome *b* to cytochrome C_1
(b) Valinomycin - Inhibits F_0 component of ATP synthase
(c) Oligomycin - Disrupt inner mitochondrial membrane potential
(d) Rotenone - Prevent electron transport from Fe / S cluster to ubiquinone

34. Following enzyme (s) allows some bacteria to utilize acetate through glyoxylate pathway.
(a) Succinyl CoA synthetase (b) Malate synthase
(c) Isocitrate dehydrogenase (d) Isocitrate lyase

35. Which of the following is not true for transmembrane proteins
(a) These are peripheral proteins
(b) Excluded from lipid bilayer
(c) Attached to carbohydrates that lie on the cytosolic side of the membrane
(d) Integral proteins that span the lipid bilayer.

36. Which of the following statements are true for the function of plasma membrane
(a) Synthesize protein for the cell
(b) Transport water and solutes into and out of the cell
(c) Keep the composition of the cytosol different from extracellular fluid
(d) Structurally link cell together

37. The menstrual cycle in women is an integration of 3 different cycles. These cycles are
(a) Ovarian cycle (b) Uterine cycle
(c) Estrus cycle (d) Cervical cycle

38. Female oocyte has its own unique pattern of growth and division. It shows following features
(a) Primary oocytes are formed during gestation and their numbers correspond to ovarian reserve
(b) Primary oocyte is frozen at diplotene of meiosio-I and it is called dictyate stage
(c) Oocyte matures into Graffian follicle and within it meiosis-I is completed
(d) Meiosis-II is completed only in secondary oocyte and that too when fertilization happens

39. Among the following which properties are applicable to small intestine
(a) It is located between stomach and large intestine
(b) Its brush border epithelium enhances surface area for digestion
(c) Its brush border epithelium contains enzymes to improve digestion in small intestine
(d) It is main site for digestion of fats and absorption of all nutrients

40. Let $\vec{a}$ and $\vec{b}$ be two non-zero vectors such that $|\vec{a}\cdot\vec{b}|=|\vec{a}\times\vec{b}|$, then the angle between $\vec{a}$ and $\vec{b}$ is

(a) $\frac{\pi}{4}$ (b) $\frac{3\pi}{4}$ (c) $\frac{5\pi}{4}$ (d) $\frac{7\pi}{4}$

SECTION-C

[Numerical Answer Type (NAT)]

Q. 41 – Q. 50 carry one mark each.

41. In a cross between two F_1 heterozygous tall plants, the F_2 progeny consisted of tall and dwarf plants in the ratio 3 : 1. What is the probability that out of four plants chosen at random, two would be tall and two would be short? _____

42. In a cross between a pure tall pea plant with green pods and a pure drawf pea plant with yellow pods, how many plants in F_2 generation will be tall out of 16? _____

43. The allele for black hair B is dominant over the allele for red hair *b*. If both the parents have black hair, what is the probability that the child will have red hair? _____

44. If two triple heterozygote (AaBbCc) individuals are crossed, the frequency of AaBbCc among the progeny would be _____

45. A microbe doubles its population in every 2 minutes, it takes 20 minutes to completely fill the cup. Calculate the time required to fill half of the cup _____ minutes.

46. Initial cell density in a bacterial cell culture was 2×10^3 cells/ml. Its generation time is 40 minutes. The cell density after 2 hours will be _____ cells / ml.

47. A bacterium of cocci group has a diameter of $2\mu m$. Calculate the ratio of its surface area to volume (in μm^{-1}) _____

48. 0.2 ml of a microbial culture was diluted by adding 9.8 ml of buffer to 10ml. 0.1ml of this was further diluted by adding 9.9ml of buffer to 10ml. Plating 0.5ml from 2nd tube yields 80 colonies. Cell density in original culture was _____ million.

49. GPCR signalling work in most of the Eukaryotes. How many α-helices are present in the G-protein coupled receptor? _____

50. If there are 24 chromosomes in any cell and this cell got signal for division. So after reaching from G_1 to S phase of cell cycles, how many chromosomes will be in S-phase? _____

Q. 51 – Q. 60 carry two marks each.

51. In maize diploid chromosome number is 20. What will be at metaphase? _____

52. A person has a plasma concentration of creatinine at 0.02 mg/ml and in 1 hour produces 30 ml of urine with a creatinine concentration of 1.25 mg/ml. What is creatinine clearance and GFR? _____ml/min.

53. During a cardiac cycle, each ventricle pumps about 75 ml of blood. If heart rate is 72, then what is the cardiac output? _____ mls.

54. The sum of roots of equation $x^4 + x^2 - 2 = 0$ is _____

55. The value of complex number $i^{125} + i^{-125}$ is _____

56. If $\vec{a}$ and $\vec{b}$ are unit vectors and $\vec{a} \perp \vec{b}$, then the magnitude of $4\vec{a} + 3\vec{b}$ is _____

57. A circle is given by $x^2 + y^2 - 4y - 5 = 0$. The volume of a cube whose edge is equal to the radius of circle is _____

58. Using the letters in the word "EQUATION", a new word containing eight distinct letters is formed such that the vowels and consonants occurs together. The number of such distinct arrangements are _____

59. The plane $x + y + z = 0$ intersect the sphere $x^2 + y^2 + z^2 = 9$ along a circle. If $(2, y, z)$ is a point on a circle then value of $2yz$ is _____

60. The value of $\lim_{x \to 1}(x-1)[\log x + \operatorname{cosec}(x-1)]$ is _____

END OF THE QUESTION PAPER

SPACE FOR ROUGH WORK

IIT-JAM BIOTECHNOLOGY - BT

TEST SERIES - 2

(Genetics + Microbiology + Cell Biology + Animal Physiology + Mathematics)

Time : 3 Hours **Date : 07-01-2018**

M.M. : 100

ANSWER KEY

SECTION-A

[Multiple Choice Questions (MCQ)]

1. (a)	**2.** (a)	**3.** (d)	**4.** (c)	**5.** (c)
6. (b)	**7.** (b)	**8.** (c)	**9.** (c)	**10.** (c)
11. (c)	**12.** (a)	**13.** (a)	**14.** (a)	**15.** (d)
16. (d)	**17.** (b)	**18.** (d)	**19.** (c)	**20.** (c)
21. (c)	**22.** (d)	**23.** (a)	**24.** (b)	**25.** (a)
26. (b)	**27.** (d)	**28.** (c)	**29.** (d)	**30.** (b)

SECTION-B

[Multiple Select Questions (MSQ)]

31. (a, d)	**32.** (a, b)	**33.** (a, d)	**34.** (b, c)
35. (a, b, c)	**36.** (b, c, d)	**37.** (a, b, d)	**38.** (a, b, c, d)
39. (a, b, c, d)	**40.** (a, b)		

SECTION-C

[Numerical Answer Type (NAT)]

41. (0.210)	**42.** (12)	**43.** (0.25)	**44.** (0.125)
45. (28 to 28)	**46.** (1.6×10^4)	**47.** (3 to 3)	**48.** (0.8 to 0.8)
49. (7)	**50.** (24)	**51.** (40)	**52.** (31.25)
53. (5,400)	**54.** (zero)	**55.** (zero)	**56.** (5)
57. (27)	**58.** (1440)	**59.** (–1)	**60.** (1)