PART -A

1. An infinite number of identical circular discs each of radius $\frac{1}{2}$ are tightly packed such that the centres of the discs are at integer values of coordinates x and y. The ratio of the area of the uncovered patches to the total area is

1. $1 - \pi/4$ 2. $\pi/4$

3. $1 - \pi$ 4. π

2. It takes 5 days for a steamboat to travel from A to B along a river. It takes 7 days to return from B to A. How many days will it take for a raft to drift from A to B (all speeds stay constant)?

1. 13 2. 35

3. 6 4. 12

3. "My friend Raju has more than 1000 books", said Ram. "Oh no, he has less than 1000 books", said Shyam. "Well, Raju certainly has at least one book", said Geeta. If only one of these statements is true, how many books does Raju have?

1. 1 2. 1000

3. 999 4. 1001

4. Of the following, which is the odd one out?

1. Cone 2. Torus

3. Sphere 4. Ellipsoid

5. A student appearing for an exam is declared to have failed the exam if his/her score is less than half the median score. This implies

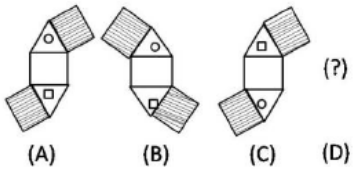
1. 1/4 of the students appearing for the exam always fail.

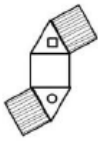
2. if a student scores less than 1/4 of the maximum score, he/she always fails.

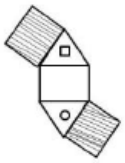
3. if a student scores more than 1/2 of the maximum score, he/she always passes.

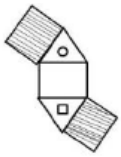
4. it is possible that no one fails.

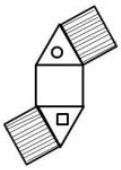
6. Find the next figure 'D"



1. 

2. 

3. 

4. 

7. *N* is a four digit number. If the leftmost digit is removed, the resulting three digit number is 1/9th of *N*. How many such *N* are possible?

1. 10 2. 9

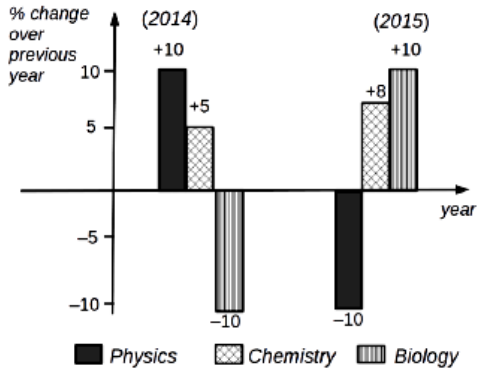
3. 8 4. 7

8. AB and CD are two chords of a circle subtending 60^o and 120^o respectively at the same point on the circumference of the circle. Then AB : CD is

1. $\sqrt{3} : 1$ 2. $\sqrt{2} : 1$

3. 1 : 1 4. $\sqrt{3} : \sqrt{2}$

9.



Which of the following inferences can be drawn from the above graph?

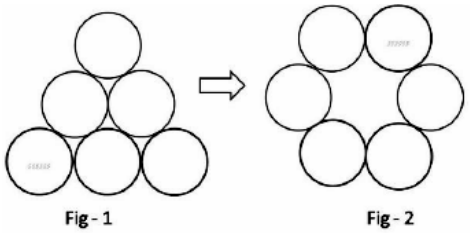
1. The total number of students qualifying in Physics in 2015 and 2014 is the same

2. The number of students qualifying in Biology in 2015 is less than that in 2013

3. The number of Chemistry students qualifying in 2015 must be more than the number of students who qualified in Biology in 2014

4. The number of students qualifying in Physics in 2015 is equal to the number of students in Biology that qualified in 2014

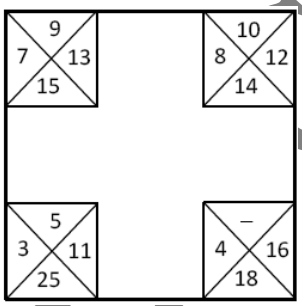
10. What is the minimum number of moves required to transform figure 1 to figure 2? A move is defined as removing a coin and placing it such that it touches two other coins in its new position.



1. 1 2. 2

3. 3 4. 4

11. The relationship among the numbers in each corner square is the same as that in the other corner squares. Find the missing number.



1. 10 2. 8

3. 6 4. 12

12. Which of the following best approximates sin (0.5°)?

1. 0.5 2. $0.5 \times \frac{\pi}{90}$

3. $0.5 \times \frac{\pi}{180}$ 4. $0.5 \times \frac{\pi}{360}$

13. What comes next in the sequence?

1.  2. 

3.  4. 

14. Which of the following statements is logically **incorrect**?

1. I always speak the truth

2. I occasionally lie

3. I occasionally speak the truth

4. I always lie

15. How many times starting at 1:00 pm would the minute and hour hands of a clock make an angle of 40° with each other in the next 6 hours?

1. 6 2. 7

3. 11 4. 12

16. Brothers Santa and Chris walk to school from their house. The former takes 40 minutes while the latter, 30 minutes. One day Santa started 5 minutes earlier than Chris. In how many minutes would Chris overtake Santa?

1. 5 2. 15

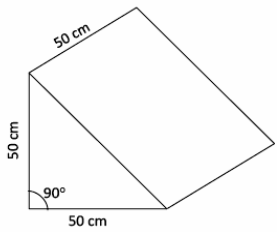
3. 20 4. 25

17. The set of numbers (5, 6, 7, *m*, 6, 7, 8, *n*) has an arithmetic mean of 6 and mode (most frequently occurring number) of 7. Then m × n =

1. 18 2. 35

3. 28 4. 14

18. The diagram shows a block of marble having the shape of a triangular prism. What is the maximum number of slabs of 10 × 10 × 5 cm^3 size that can be cut parallel to the face on which the block is resting?



1. 50 2. 100

3. 125 4. 250

19. A solid contains a spherical cavity. The cavity is filled with a liquid and includes a spherical bubble of gas. The radii of cavity and gas bubble are 2 mm and 1 mm, respectively. What proportion of the cavity is filled with liquid?

1. $\frac{1}{8}$ 2. $\frac{3}{8}$

3. $\frac{5}{8}$ 4. $\frac{7}{8}$

20. Fill in the blank : F2, ……., D8, C16, B32, A64

1. C4 2. E4

3. C2 4. G16

PART – B

21. The solubility of gases in water depends on their interaction with water molecules. Four gases i.e. carbon dioxide, oxygen, sulphur dioxide and ammonia are dissolved in water. In terms of their solubility which of the following statements is correct?

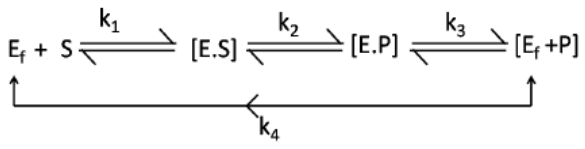
1. Ammonia > Oxygen > Sulphur dioxide > Carbon dioxide

2. Oxygen > Carbon dioxide > Sulphur dioxide > Ammonia

3. Sulphur dioxide > Oxygen > Ammonia > Carbon dioxide

4. Ammonia > Sulphur dioxide > Carbon dioxide > Oxygen

22. Penicillin acts as a suicide substrate. Which one of the following steps of catalysis does a suicide inhibitor affect?



1. k_1 2. k_2

3. k_3 4. k_4

23. Which of the following is **NOT** true for cholesterol metabolism?

1. HMG-CoA reductase is the key regulator of cholesterol biosynthesis.

2. Biosynthesis takes place in the cytoplasm.

3. Reduction reactions use NADH as cofactor.

4. Cholesterol is transported by LDL in plasma.

24. Predominant interactions between phospholipids that stabilize a biological membrane include

1. hydrogen bonds and covalent interactions.

2. van der Waal and ionic interactions.

3.hydrophobic interactions and hydrogen bonding.

4. covalent and hydrophobic interactions.

25. Entry of enveloped viruses into its host cells is mediated by:

1. Only endocytosis

2. Both endocytosis and phagocytosis

3. Both endocytosis and membrane fusion

4. Only pinocytosis

26. Lateral diffusion of proteins in membrane can be followed and diffusion rate calculated by

1. Atomic force microscopy

2. Scanning electron microscopy

3. Transmission electron microscopy

4. FRAP

27. Histone deacytalase (HDAC) catalyses the removal of acetyl group from N-terminal of histones. Which amino acid of histone is involved in this process?

1. Lysine 2. Arginine

3. Asparagine 4. Histidine

28. Labelling of membrane spanning domain of any integral membrane protein in a given plasma membrane vesicle (without disrupting its structure) is successfully carried out by

1. immunochemical methods.

2. metabolic labelling with radioisotopes.

3. hydrophobic photoaffinity labelling.

4. limited proteolysis followed by metabolic labelling.

29. *E.coli* is being grown in a medium containing both glucose and lactose. On depletion of glucose, expression of β-galactoside will

1. remain unchanged
2. increase
3. decrease
4. initially decrease and then increase

30. Error-free repair of double strand breaks in DNA is accomplished by

1. non-homologous end-joining.
2. base excision repair.
3. homologous recombination.
4. mismatch repair.

31. The –COOH group of cellular amino acids can form which of the following bonds inside the cell?

1. Ether and ester bonds.
2. Ester and amide bonds.
3. Amide and ether bonds.
4. Amide and carboxylic anhydride bonds.

32. RNA interference is mediated by both siRNA and miRNA. Which one of the following statement about them is **NOT** true?

1. Both siRNA and miRNA are processed by DICER.
2. Both siRNA and miRNA usually guide silencing of the same genetic loci from which they originate.
3. miRNA is a natural molecule while siRNA is either natural or a synthetic one.
4. miRNA, but not siRNA is processed by Drosha.

33. Following are some of the characteristics of MHC class I and class II molecules except one which is applicable only for MHC class I. Identify the appropriate statement.

1. They are expressed constitutively an all nucleated cells.
2. They are glycosylated polypeptides with domain structure.
3. They are involved in presentation of antigen fragments to cells.
4. They are expressed on surface membrane of B cells.

34. Which of the following bacteria has subcellular localization in lysosomes?

1. *Salmonella typhi*
2. *Streptococcus pneumoniae*
3. *Vibrio cholerae*
4. *Mycobacterium tuberculosis*

35. Which one of the following best defines an oncogene?

1. An oncogene never codes for a cell cycle protein, which promotes cell proliferation.
2. Oncogenes are always involved in inherited forms of cancer.
3. An oncogene codes for a protein that prevents a cell from undergoing apoptosis.
4. An oncogene is a dominantly expressed mutated gene that renders a cell advantageous towards survival.

36. Which one of the following statements about receptor – enzyme is **FALSE**?

1. A receptor – enzyme has an extracellular ligand binding domain, a transmembrane domain and an intracellular catalytic (enzyme) domain.
2. Many types of receptor enzymes are found in animals.
3. The signal transduction pathways of receptor – enzyme involve phosphorylation cascades.
4. Receptor – enzymes interact directly with intracellular G-proteins.

37. Bones of vertebrates are derived from embryonic

1. ectoderm 2.epiderm
3. mesoderm 4.endoderm

38. During development, if a cell has committed to a particular fate, it is said to be

1. pluripotent 2. totipotent
3. determined 4.differentiated

39. The initial dorsal-ventral axis in amphibian embryos is determined by

1. the point of sperm entry.
2. gravity.
3. the point of contact with the uterus.
4. genetic differences in the cells.

40. Sperm cell behaviour during double fertilezation in *Arabidopsis* can be stated as follows. Identify the **INCORRECT** statement:

1. Pollen tube bursts and discharges sperm cells.
2. Sperm cells produce pollen tubes and enter into female gametophyte.
3. The receptive antipodal cells break down when pollen tube enters the female gametophyte.
4. One sperm nucleus fuses with the egg cell and the other fuses with the central cells.

41. Rhizobial genes that participate in legume nodule formation are called *nodulation* (*nod*) gens. The *nod*D-encoded protein

1. is an acetyl transferase that adds a fatty acyl chain to the Nod factor.
2. binds to the *nod* box and induces transcription of all *nod* genes.
3. catalyzes the linkage of N-acetyl glucosamine residues.
4. influences the host specificity of *Rhizobium*.

42. Which one of the following plant hormones use the two-component histidine kinase receptor system for signal transduction?

1. Auxin 2.Gibberellin
3. Cytokinin 4.Abscisic acid

43. Which one of the following photoreceptors plays a role in day length perception and circadian rhythms?

1. Zeitlupe family
2. Cryptochromes
3. Phototropins
4. UV Resistance locus 8

44. Which one of the following is the correct order of electron transport during light reaction in the thylakoid membrane of chloroplast?

1. P680 → Cytochrome b_6f → PC → PQ
2. P680 → PC → Cytochrome b_6f → PQ
3. P680 → PQ → PC → Cytochrome b_6f
4. P680 → PQ → Cytochrome b_6f → PC

45. Insulin increases facilitated diffusion of glucose in muscle cells by:-

1. phosphorylation of glucose transporters.
2. translocation of glucose transporter- containing endosomes into the cell membrane.
3. inhibition of the synthesis of mRNA for glucose transporters.
4. dephosphorylation of glucose transporters.

46. The transport of fructose into the enterocytes is mediated by:-

1. sodium-dependent glucose transporter 1 (SGLT 1).
2. glucose transporter 5 (GLUT5).
3. SGLT 2.
4. GLUT 4.

47. The cell bodies of sympathetic preganglionic neurons are located in:-

1. Intermediolateral cell column of spinal cord
2. Posterior cell column of spinal cord
3. Celiac ganglion
4. Paravertebral ganglion

48. The di- and tripeptides are transported in the enterocytes by peptide transporter 1 that requires:-

1. Na^+ 2. Ca^{++}
3. H^+ 4. Cl^-

49. Which one of the following statements is **INCORRECT**?

1. Quantitative inheritance results in a range of measurable phenotypes for a polygenic trait.

2. Polygenic traits often demonstrate continuous variation.

3. Certain alleles of quantitative trait loci (QTL) have an additive effect on the character/trait.

4. Alleles governing quantitative traits do not segregate and assort independently.

50. A mouse carrying two alleles of insulin-like growth factor II (IgF2) is normal in size; whereas a mouse that carries two mutant alleles lacking the growth factor is dwarf. The size of a heterozygous mouse carrying one normal and one mutant allele depends on the parental origin of the wild type allele. Such pattern of inheritance is known as

1. Sex-linked inheritance
2. Genomic imprinting
3. Gene-environment interaction
4. Cytoplasm inheritance

51. Which one of the following statements is **INCORRECT**?

1. Loss of genetic variation occurs within a small population due to genetic drift.

2. The number of deleterious alleles present in the gene pool of a population is called the genetic load.

3. Genetic erosion is a reduction in levels of homozygosity.

4. Inbreeding depression results from increased homozygosity for deleterious alleles.

52. What is the genotype of a male Drosophila fly that has yellow body colour and red eyes.

Brown (y^+) is dominant over yellow (y) and red (w^+) is dominant over white (w). Both are carried on X chromosome.

1. $X^{w+y}Y$ 2. $X^{wy}Y$

3. $X^{wy+}Y$ 4. $X^{wy+}X^{wy+}Y$

53. Which of the following statements is **NOT** true regarding the closer affinity of Archaea to Eukarya than to Bacteria?

1. Both Archaea and Eukarya lack peptide- glycan in their cell walls.

2. The initiator amino acid for protein synthesis is methionine in both Archaea and Eukarya.

3. Histones associated with DNA are absent in both Archaea and Eukarya.

4. In both Archaea and Eukarya the RNA polymerase is of several kinds.

54. Match the following larval forms with the phyla that they occur in

	Larva		Phylum
(a)	Amphiblastula	(i)	Mollusca
(b)	Nauplius	(ii)	Echinodermata
(c)	Glochidium	(iii)	Porifera
(d)	Bipinnaria	(iv)	Arthropoda
		(v)	Annelida

1. a – iii, b – iv, c – i, d – ii
2. a – iv, b – iii, c – i, d – v
3. a – ii, b – v, c – iv, d – i
4. a – v, b – i, c – ii, d – iii

55. Which of the following National parks has the highest density of tigers among protected areas in the world?

1. Jim Corbett 2.Kaziranga
3. Keoladeo Ghana 4.Manas

56. Which of the following is **NOT** a prediction arising out of Wilson-MacArthur's Theory of Island Biogeography?

1. The number of species on an island should increase with its size/area.

2. The number of species should decrease with increasing distance of the island from the source pool.

3. The turnover of species should be common and frequent.

4. Species richness on an island should be related to its average distance to the neighbouring islands.

57. During which of the following major mass extinction events, over 95% of the marine species disappeared from the planet Earth?

1. Ordovician 2.Devonian
3. Permian 4.Triassic

58. Which of the following global hotspots of biodiversity has the highest number of endemic plants and vertebrates?

1. Sundaland
2. Tropical Andes
3. Brazil's Atlantic Forest
4. Mesoamerican forests

59. For a population growing exponentially with a growth rate r, its population doubling time is

1. $(N_0 \times 2)/r$ 2. In 2/r
3. λ In 2 4. In r × 2

60. Fossils of the same species of fresh water reptiles have been found in South America and Africa. Based on the current understanding, which of the following is the best possible explanation for this pattern?

1. The same species originated and evolved independently in these two places.
2. Species migrated from Africa to establish new populations in South America.
3. Species migrated from South America to establish new populations in Africa.
4. South America and Africa were joined at some point in Earth's history.

61. In which ecosystem is the autotroph-fixed energy likely to reach the primary carnivore level in the shortest time?

1. Temperate deciduous forest
2. Grassland
3. Ocean
4. Tropical rain forest

62. The utilization or consumption efficiency of herbivores is highest in

1. plankton communities of ocean waters.
2. mature temperate forests.
3. managed grasslands.
4. managed rangelands.

63. Which of the following is NOT an attribute of a species that makes it vulnerable to extinction?

1. Specialized diet
2. Low dispersal ability
3. Low trophic status
4. Variable population density

64. TILLING is a reverse genetics approach used in functional genomics. Which one of the following is used for TILLING?

1. T-DNA tagging by Agrobacterium-mediated transformation.
2. Transposon tagging using Ac/Ds elements.
3. Mutagenesis with ethylmethane sulphonate.
4. Protoplast transformation by electroporation.

65. Which one of the following will be observed when auxin to cytokinin ratio is increased in the culture medium during organogenesis from tobacco pith callus?

1. Adventitious roots will form.
2. Adventitious shoot will form.
3. There will be no root formation.
4. There will be no shoot formation.

66. Which of the following is wild relative of wheat?

1. Triticum monococcum
2. Triticum compactum
3. Triticum vulgare
4. Triticum boeoticum

67. A and B are two enantiomeric helical peptides. Their chirality can be determined by recording their

1. circular dichroism spectrum.
2. UV spectrum.
3. fluorescence spectrum.
4. Edman sequencing.

68. The use of Kruskat Wallis test is most appropriate in which of these cases?

1. There are more than two groups and each group is normally distributed.

2. There are more than two groups and the distribution in each group is not normal.

3. There are two groups and each group is normally distributed.

4. There are two groups and the distribution in each group is not normal.

69. Which one of the following can be analysed using Surface Plasmon Resonance method?

1. Radiolabelled DNA probes.

2. Protein structure.

3. Optical density of a solution.

4. Label-free bimolecular interaction.

70. Which one of the following statements is correct for amplified-fragment length polymorphism (AFLP)?

1. PCR using a combination of random and gene-specific primers.

2. PCR amplification followed by digestion with restriction enzymes.

3. Digestion of DNA with restriction enzymes followed by one PCR step.

4. Digestion of DNA with restriction enzymes followed by two PCR steps.

PART – C

71. The standard free energy change (ΔG_0) per mole for the reaction A⇌B at 30°C in an open system is -1000 cal/mole. What is the approximate free energy change (ΔG) when the concentration of A and B are 100 micromolar and 100 millimolar, respectively?

1. 3160 2.316

3. 31610 4.– 3160

72. Indicate which one of the following statements about nucleic acids and protein structures is correct.

1. Hydrogen bonding between the bases in the major and minor grooves of DNA is absent.

2. Both uracil and thymine have a methyl group but at different positions.

3. The backbone dihedral angles of α-helices and β-sheets are very similar. Only the hydrogen bonding pattern is different.

4. A β-turn is formed by four amino acids. The type of β-turn is determined by the dihedral angles of the second and third amino acid.

73. In a mitochondrial respiration experiment, a researcher observed the following profile of oxygen consumption upon addition of following compounds at times I, II and III.

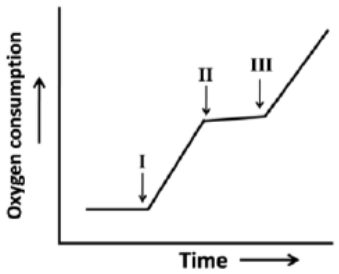
(a) ADP + Pi

(b) Dinitrophenol, an uncoupler

(c) Oligomycin, an ATPase inhibitor

(d) Cyanide

(e) Succinate

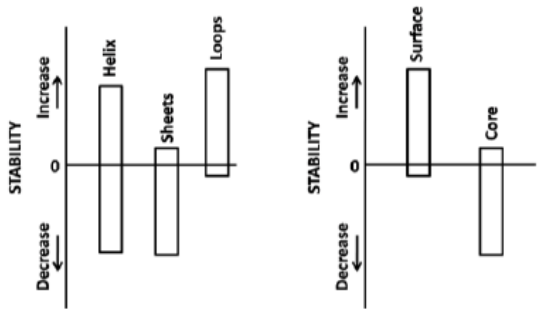


Which of the following describes the profile appropriately?

1. I – b; II – d; III – e 2. I – a; II – d; III – c

3. I – a; II – e; III – c 4. I – a; II – c; III – b

74. A researcher has developed a program to evaluate the stability of a protein by substituting each amino acid at a time by the other 19 amino acids. For a protein, a researcher has observed the following changes in stability upon substitution of amino acids in loops, helices, sheets, protein core and on the protein surface.



Substitutions in

a) loops are more tolerant

b) sheets are more tolerant

c) core is less tolerant

d) helices are less tolerant

e) surface is more tolerant

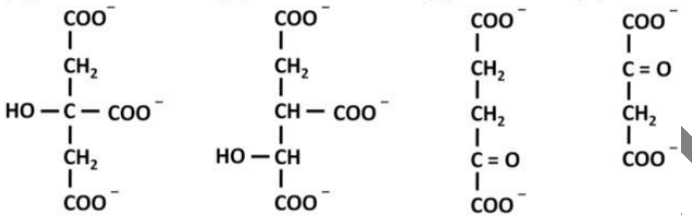
Which of the above statements are correct?

1. a and c 2. c and d

3. b and e 4. a and b

75. Indicate the names of the following molecules

(A) (B) (C) (D)



1. A= isocitrate, B = α-ketoglutarate, C = oxaloacetate, D = citrate

2. A= citrate, B = isocitrate, C = α-ketoglutarate, D = oxaloacetate

3. A= isocitrate, B = citrate, C = α-ketoglutarate, D = oxaloacetate

4. A= citrate, B = isocitrate, C = oxaloacetate, D = α- ketoglutarate

76. The turnover number and specific activity of an enzyme (molecular weight 40,000 D) in a reaction (V_{max} = 4μmol of substrate reacted / min. enzyme amount = 2μg) are

1. 80,000/min 2×10^3 μ mol substrate / min

2. 80,000/min, 2×10^3 μ mol substrate/second

3. 40,000/min, 1×10^3 μ mol substrate/min

4. 40,000/min, 2×10^3 μ mol substrate/min

77. Both sphingomyelin and phosphoglycerides are phospholipids. Which one of the following statements is **NOT** correct?

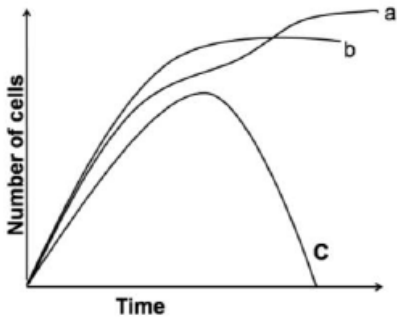
1. While one has a fatty acid tail attached via an ester bond, in another, the fatty acid tail is attached via an amide bond.

2. The hydrophilicity of both is dependent on the phosphate group and other head groups attached to the phosphate group.

3. Only one of them may contain a carbon- carbon double bond (C=C).

4. Both may have choline as head group.

78. E. coli was grown in three different experimental conditions. In one, it was grown in medium containing glucose as carbon source; in the second in medium containing both glucose and galactose; and in third was infected with phage. Match the curves shown below to the treatment



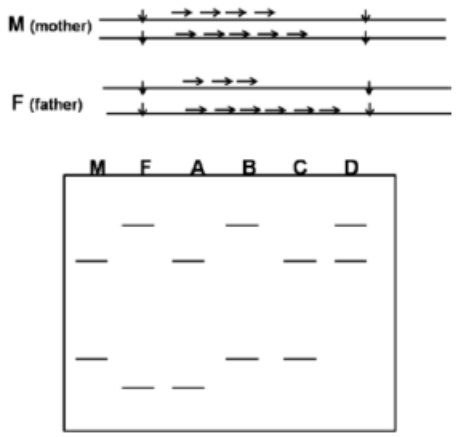
1. a is grown in glucose; b is grown in glucose and galactose; c is infected with phage

2. a is grown in glucose and galactose; b in glucose; c is infected with phage

3. a is infected with phage; b is grown in glucose and galactose; c in glucose

4. a is infected with phage; b is grown in glucose; c in glucose and galactose

79. Minisatellites are used as marker for identifying individuals via DNA fingerprinting as the alleles may differ in the number of repeats. From the Southern blot shown below identify the progeny (A, B, C and D) for the given parents (M= mother, F= father).



1. A, B, C and D 2.A, B and D
3. A and D only 4.B, C and D

80. It is well established that "Band 3" protein of red blood cell membrane is solely responsible for Cl^- transport across membrane. A lysine group in the Cl^- binding site of "Band 3" is crucial for this event. Keeping this in mind what is the most appropriate way to load and retain a small anionic fluorescent probe (x) inside the red blood cells (RBCs) suspended in phosphate buffered saline (PBS), pH 7.4.

1. Incubate the RBCs with x in phosphate buffered saline (PBS, pH 7.4) at 37°C for 30 min.
2. Incubate the RBCs with x in PBS at 4°C for 30 min.
3. Incubate the RBCs with x in Hepes sulfate buffer (pH 7.4) at 37°C for 30 min.
4. Incubate the RBCs with x in Hepes sulfate buffer (pH 7.4) at 37°C for 30 min followed by treatment with a NH_2 group modifying agent (covalent modification).

81. Influenza virus (IV), a well known enveloped animal virus, enters its host cells through membrane fusion process catalyzed by haemagluttinin (HA) protein inside endosomes at 37°C. HA is localized in the lipid bilayer membrane of the IV as an integral membrane protein and is responsible for binding and fusion of IV membrane with the endosomal membrane of host cells. Upon binding, IV is internalized into host cells through receptor mediated endocytosis followed by fusion of the IV membrane with endosome membrane catalyzed by HA. In a situation, if we wish to fuse IV membrane with its host cells (deficient in endocytosis) at the plasma membrane, mention the correct condition out of the following:

1. Pre-treat IV in pH 5.0 followed by its binding and fusion with host cells at pH 7.4 and 37°C.
2. Allow the IV to bind and fuse with host cells at pH 7.4 and 37°C.
3. IV and host cells are allowed to bind and fuse at pH 5.0 and 37°C.
4. IV is subjected to incubation at 60°C for 30 minutes and allowed to bind and fuse with host cells at pH 5.0 and 37°C.

82. Glycophorin of red blood cell (RBC) membrane spans the membrane only once and the N-terminal is projected extracellularly and the C-terminal is exposed to the cytosolic side. With the help of antibodies (labelled with fluorophors) against N-terminal and C-terminal peptides, orientation of glycophorin across membrane can be verified. Which one of the following statements is correct?

1. Intact RBC can be labelled with C- terminal antibody.
2. Permeabilized RBC can be labelled with C-terminal antibodies as well as N- terminal antibodies.
3. Intact RBC cannot be labelled with N- terminal antibodies.
4. Inside out ghost of RBC can be labelled with N-terminal antibodies.

83. Each aminoacyl-tRNA synthetase is precisely able to match an amino acid with the tRNA containing the correct corresponding anticodon. Most organisms have 20 different tRNA synthetases, however some bacteria lack the synthetase for

charging the tRNA for glutamine ($tRNA^{Gln}$) with its cognate amino acid. How do these bacteria manage to incorporate glutamine in their proteins? Choose the correct answer.

1. Glutamine is not present in the newly synthesized bacterial protein. Post translational modification converts glutamate to glutamine at the required sites.

2. In these bacteria, the aminoacyl tRNA synthetase specific for tRNA glutamate ($tRNA^{glu}$) also charges $tRNA^{gln}$ with glutamine.

3. In these bacteria, the aminoacyl tRNA synthetase specific for $tRNA^{glu}$ also charges $tRNA^{gln}$ with glutamate. A second enzyme then converts the glutamate of the charged $tRNA^{gln}$ to glutamine.

4. In these bacteria, the aminoacyl tRNA synthetase charges $tRNA^{glu}$ with either glutamate or glutamine according to their requirement during protein synthesis.

84. As topoisomerases play an important role during replication, a large number of anticancer drugs have been developed that inhibit the activity of these enzymes. Which of the following statements is **NOT** true about topoisomerases as a potential anticancer drug target?

1. As cancer cells are rapidly growing cells, they usually contain higher level of topoisomerases.

2. The transient DNA breaks created by topoisomerases are usually converted to permanent breaks in the genome in the presence of topoisomerase targeted drugs.

3. As cancer cells often have impaired DNA repair pathways, they are more susceptible towards topoisomerase targeted drugs.

4. The drugs which specifically target topoisomerases, usually do not affect normal fast growing cells.

85. Transposons can be primarily categorized into two types, DNA transposons and retrotransposons. Given below is some information regarding the above.

A. Eukaryotic DNA transposons excise themselves from one place in the genome and integrate into another site.

B. Retrotransposons are RNA sequences that are first reverse transcribed into cDNA and then integrate into the genome.

C. Retrotransposons move by a copy and paste mechanism through an RNA intermediate.

D. As DNA transposons move via a cut and paste mechanism, there can never be an increase in the copy number of a transposon.

Which of the statement(s) is/are true?

1. A and C
2. B and D
3. B only
4. D only

86. Some errors occur during DNA replication that are not corrected by proof reading activity of DNA polymerase. These are corrected by specialized repair pathways. Defect in the activities of some of the following enzymes impair this process.

A. DNA polymerase III and DNA ligase

B. AP endonuclease and DNA glycosidase

C. Mut S and Mut L

D. Rec A and Rec F

Defect in which of the above enzymes impair the process?

1. A, B, and C
2. D and B
3. A and D
4. A and C

87. An eukaryotic cell undergoing mRNA synthesis and processing was incubated with ^{32}P labelled ATP, with the label at the β-position. Where do you think the radioactive isotope will appear in the mature mRNA?

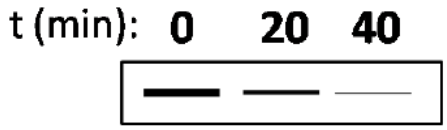
1. ^{32}P will not appear in the mature mRNA under any circumstances because β and γ phosphates are released during transcription.

2. Phosphate groups of the phoshodiester backbone of the mRNA will be uniformly labelled as only α phosphates are released during transcription.

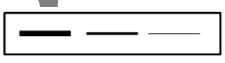
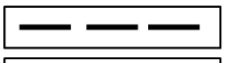
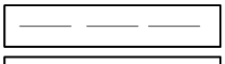
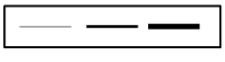
3. ^{32}P will appear at the 5' end of the mRNA if only it has "A" as the first nucleotide.

4. No ^{32}P will appear in the mature mRNA because the 5'-terminal phosphate of an "A" residue will be further removed during the capping process.

88. One of the cellular events that TOR, a kinase, positively regulates is the rate of rRNA synthesis. TOR regulates the association of a transcription factor to a Pol I subunit. When TOR is inhibited by the drug rapamycin, the transcription factor dissociates from Pol I. A yeast strain is engineered, which expresses a fusion of the transcription factor and the Pol I subunit. The level of rRNA synthesis is monitored in these cells using pulse labelling following rapamycin addition for the times indicated below. The transcript profile of rRNA observed for the wild type cells is given below:



Identify the pattern expected in the engineered strain.

1. 
2. 
3. 
4. 

89. Immunoglobulins have therapeutic applications in cancer treatment, infection clearance and targeted drug delivery. For this reason, immunoglobulins are briefly cleaved by the enzyme pepsin. Following are some of the statements regarding the brief digestion of immunoglobulin by pepsin.

(i) $F(ab)_2$ fragment is generated which retains the antigen binding activity.

(ii) F(ab) fragment having antigen binding activity and the crystallisable F_c fragment are generated.

(iii) The fragment generated on incubation with a proper antigen forms a visible precipitate.

(iv)The fragment generated is incapable of forming a visible precipitate on incubation with a proper antigen.

Which of the above statements are correct?

1. (i) and (ii)
2. (i) and (iii)
3. (i) and (iv)
4. (ii) and (iii)

90. In an experiment peritoneal macrophages were isolated from strain A of guinea pig. These cells were then incubated with an antigen. After the antigen pulsed macrophages processed the antigen and presented it on their surface, these were mixed with T cells from (i) strain A or (ii) strain B (a different strain of guinea pig) or (iii) F1 progeny of strain A × B. T cell proliferation was measured in response to antigen pulsed macrophages. T cells of which strain of guinea pig will be activated?

1. Strain A only
2. Strain B only
3. Strain A and F1 progeny
4. Strain B and F1 progeny

91. Cadherins mediate Ca^{2+}-dependent cell-cell adhesion and play an important role in embryonic development by changing the adhesive properties of cell. Aggregation of nerve cells to form an epithelium is correlated with the appearance of N-cadherins on cell surface and vice versa. N-CAM (neural cell adhesion

molecules) belongs to Ig-SF (immunoglobulin super family) and involved in fine tuning of adhesive interactions. In order to see the effect of mutations of N-cadherin and N-CAM, two sets of mice were generated. Set A - mice with mutation in N-cadherin and set B - mice with mutation in N-CAM. Which of the following results is most likely to occur?

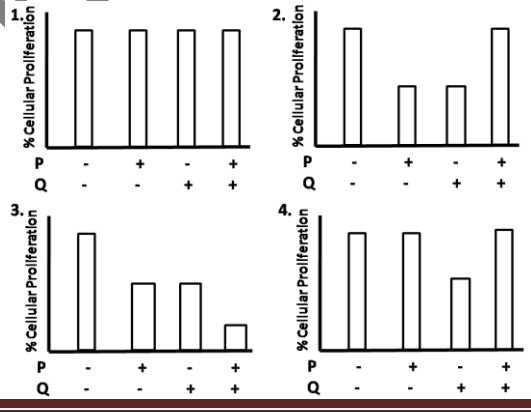
1. Mice of both set A and set B will die in early development.

2. Mice of set A will die in early development but mice of set B will develop normally and show mild abnormalities in the development of nervous system.

3. Mice of Set A will show mild abnormalities in the development of nervous system whereas mice of set B will die early in development.

4. Mice of both set A and set B develop normally as other cell adhesion molecules will compensate for the mutations.

92. A virus infects a particular cell type, integrates its genome into a site that contains a proto-oncogene, transforms the cell and increases the level of a protein 'X', which increases cellular proliferation. A compound 'P' is known to increase the level of tumor suppressor proteins in that cell type whereas a compound 'Q' helps in stimulating a protein 'Z' that can bind to 'X' rendering it inactive. Which one of the following graphs correctly represents the mode of action of 'P' and 'Q'?



93. Which one of the following combinations is the correct pairing of ligands with their receptors?

(i)	FGF	(a)	Patched
(ii)	Hedgehog	(b)	Frizzled
(iii)	Wnt	(c)	Receptor tyrosine kinase

1. i – c, ii – a, iii – b 2. i – a, ii – c, iii – b

3. i – b, ii – c, iii – a 4. i – c, ii – b, iii – a

94. Cancer is often believed to arise from stem cells rather than fully differentiated cells. Following are certain views related to the above statement. Which one of the following is **NOT** correct?

1. Stem cells do not divide and therefore require fewer changes to become a cancer cell.

2. Cancer stem cells can self-renew as well as generate the non-stem cell populations of the tumor.

3. Teratocarcinomas prove tumors arise from stem cells without further mutations.

4. Stemness genes can often function as oncogenes.

95. Given are certain facts which define 'determination' of a developing embryo.

A. Cells have made a commitment to a differentiation program.

B. A phase where specific biochemical actions occur in embryonic cells.

C. The cell cannot respond to differentiation signals.

D. A phase where inductive signals trigger cell differentiation.

Which of the above statements best define determination?

1. B and D 2.A and C

3. Only A 4.Only B

96. What would happen as a result of a transplantation experiment in a chick embryo where the leg mesenchyme is placed directly beneath the wing apical ectodermal ridge (AER)?

1. Distal hindlimb structures develop at the end of the limb.

2. A complete hindlimb will form in the region where the forelimb should be.

3. The forelimb would form normally.

4. Neither a forelimb nor a hindlimb would form since the cells are already determined.

97. If you remove a set of cells from an early embryo, you observe that the adult organism lacks the structure that would have been produced from those cells. Therefore, the organism seems to have undergone

1. autonomous specification.

2. conditional specification.

3. morphogenic specification.

4. syncytial specification.

98. Dose-dependence of retinoic acid treatment supports the notion that a gradient of retinoic acid can act as a morphogen along the proximo-distal axis in a developing limb. Following are certain facts related to the above notion.

A. Treatment with high level of retinoic acid causes a proximal blastema to be respecified as a distal blastema and only distal structures are regenerated.

B. Treatment with high level of retinoic acid causes a distal blastema to be respecified as a proximal blastema and regeneration of a full limb may be initiated.

C. Treatment with retinoic acid affects only distal blastemas and causes them to form only proximal structures.

D. Treatment with high level of retinoic acid causes any blastema to form only distal structures.

Which one of the following is correct?

1. B and D
2. Only C
3. A and C
4. Only B

99. Match the two columns following asexual reproduction of plants and apomixes:

A.	Agamospermy	(i)	No seed formation
B.	Clonal propagation	(ii)	Seed formation
C.	Embryo sac formed from nucellus or integument of the ovule	(iii)	Diplospory
D.	Gametophyte develops without fertilization from unreduced megaspore	(iv)	Apospory

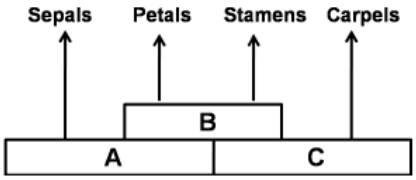
1. A – (i); B – (ii); C – (iii); D – (iv)

2. A – (ii); B – (iii); C – (iv); D – (i)

3. A – (ii); B – (i); C – (iii); D – (iv)

4. A – (ii); B – (i); C – (iv); D – (iii)

100. According to the ABC model of floral development in *Arabidopsis* as shown below,



several genes/transcription factors e.g. AP1, AP2, AP3, AG etc., are involved. Which one of the following statements is correct?

1. Apetala 2 (AP2) transcripts expressed during sepal and petal development.

2. Agamous AG is considered as class A gene.

3. AP1 expressed during carpel development.

4. AP3 expressed during sepal development.

101. Following are certain statements that describe plant-pathogen interactions:

A. Hemibiotrophic pathogens are characterized by initially keeping host cells alive followed by extensive tissue damage during the later part of the infection.

B. Effectors are molecules present in host plants that act against the pathogen attack.

C. Plants possess pattern recognition receptors (PRRs) that perceive microbe-associated molecular patterns (MAMPs) present in specific class of microorganisms but are absent in the hosts.

D. Phytoalexin production is a common mechanism of resistance to pathogenic microbes in a wide range of plants.

Which one of the following combinations is correct?

1. A, B and C 2. A, C and D
3. B, C and D 4. A, B and D

102. Constitutive photomorphogenesis (COP1) protein, an E3 ubiquitin ligase, regulates the turnover of proteins required for photomorphogenic development. Following are certain independent statements related to the function of COP1 protein:

A. In light, COP1 along with SPA1 adds ubiquitin tags to a subset of nuclear proteins.

B. The proteins ubiquinated by COP1 and SPA1 are targeted for degradation by the 26S proteasome.

C. In dark COP1 is slowly exported to the cytosol from nucleus.

D. The absence of COP1 in the nucleus permits the accumulation of transcriptional activators necessary for photomorphogenic development.

Which one of the following combinations is correct?

1. A and C 2. A and D
3. B and C 4. B and D

103. The following statements are made to describe auxin signal transduction pathway, from receptor binding to the physiological response:

A. Auxin response factors (ARFs) are nuclear proteins that bind to auxin response elements (Aux REs) to activate or repress gene transcription.

B. AUX/IAA proteins are secondary regulators of auxin-induced gene expression. Binding of AUX/IAA proteins to the ARF protein blocks its transcription regulation.

C. Auxin binding to TIR1/AFB promotes ubiquitin-mediated degradation and removal of AUX/IAA proteins.

D. Auxin binding to auxin response factors (ARFs) causes their destruction by the 26S proteasome pathway.

Which one of the following combinations of above statements is correct?

1. A, B and C 2. A, C and D
3. B, C and D 4. A, B and D

104. Light reactions of photosynthesis are carried out by four major protein complexes: Photosystem I (PSI), photosystem II (PSII), the cytochrome b_6f complex and ATP synthase. The following are certain statements on PSI:

A. PSI reaction centre and PSII reaction centre are uniformly distributed in the granal lamellae and stromal lamellae.

B. The electron donor for the P700 of PSI is plastocyanin and electron acceptor of P700* is a chlorophyll known as A_0.

C. The core antenna and P700 are bound to two key proteins PsaA and PsaB.

D. Cyclic electron flow occurs from the reducing side of PSI via plastohydroquinone and b_6f complex. This supports ATP synthesis but does not reduce $NADP^+$.

Which one of the following combinations of the above statements is correct?

1. A, B and C 2. A, C and D
3. A, B and D 4. B, C and D

105. Ribulose bisphosphate carboxylase (Rubisco) catalyzes both carboxylation and oxygenation of ribulose-1, 5-bisphosphate. The latter reaction initiates a physiological process known as

'photorespiration'. The following are certain statements on photorespiration:

A. The active sites on Rubisco for carboxylation and oxygenation are different.

B. One of the steps in photorespiration is conversion of glycine to serine.

C. 50% of carbon lost in chloroplast due to oxygenation is recovered through photo-respiration.

D. The pathway of photorespiration involves chloroplast, peroxisome and mitochondria.

Which one of the following combinations of above statements is correct?

1. A and C 2. A and D
3. B and D 4. C and D

106. Several transport steps are involved in the movement of photosynthate from the chloro-plasts. Following are certain statements regarding the transport of photosynthate:

A. Pentose phosphate formed by photosynthesis during the day is transported from the chloroplast to the cytosol, where it is converted to sucrose.

B. Carbon stored as starch exits the chloroplast at night primarily in the form of maltose and is converted to sucrose in cytosol.

C. During short distance transport, sucrose moves from producing cells in the mesophyll to cells in the vicinity of the sieve elements in the smallest veins of the leaf.

D. In the process of phloem loading, sugars are transported into phloem parenchyma cells.

Which one of following combinations of above statements is correct?

1. A and B 2. B and C
3. C and D 4. A and D

107. A majority of humans with normal colour vision was found to be more sensitive to red light in Rayleigh match where the subject mixed variable amount of red and green light to match monochromatic orange. Which one of the following statements is **NOT** true to explain the observation?

1. There are variations in the sensitivity of long-wave cone pigments.

2. The short-wave cone opsin in red- sensitive subjects is different from others.

3. The absorption curve of long-wave cone pigment peaks at 556 nm in red-sensitive subjects while it peaks at 552 nm in others.

4. The long-wave cone opsin in red- sensitive subjects is different in primary structure from that of others.

108. The membrane potential in a giant squid axon recorded intracellularly at the resting condition (-70 mV) was reversed at the peak of action potential (+35 mV) after stimulation of the nerve fibre with a threshold electrical stimulus. This overshoot of the membrane potential has been explained in the following proposed statements:

A. The rapid increase in Na+-conductance during early phase of action potential causes membrane potential to move toward the equilibrium potential of Na+ (+45 mV).

B. The Na^+ -conductance quickly decreases toward resting level after peak in the early phase and Na^+-ions are not able to attain its equilibrium potential within this short time.

C. The conductance of K^+ at the early phase of action potential is increased and that leads to the reversal of membrane potential.

D. The increase of K^+ - conductance due to stimulation of nerve occurs before the changes of Na^+ - conductance is initiated and thus causes overshoot at the peak of action potential.

Which one of the following is correct?

1. A only 2. A and B
3. C only 4. C and D

109. A person showed the symptoms of diarrhea, gas and pain whenever milk was consumed. The doctor advised the person to take curd instead of milk and subsequently the symptoms mostly disappeared due to this change of dairy product. The following statements are proposed to explain this observation:

A. The person has deficiency in the intestinal sucrase-maltase

B. Curd is not deficient in sucrose and maltose

C. The person has deficiency in the intestinal lactase

D. The bacteria in curd contain lactase

Which one of the following is true?

1. A only 2. A and B
3. C only 4. C and D

110. A diabetic patient has a high blood glucose level due to reduced entry of glucose into various peripheral tissues in addition to other causes. There is no problem of glucose absorption, however, in the small intestine of these patients. The following statements are put forward to explain this observation:

A. Glucose is transported into the cells of muscles by glucose transporters (GLUTs) which are influenced by insulin receptor activation.

B. Glucose transport into the enterocytes is mediated by sodium-dependent glucose transporters (SGLTs) which are not dependent on insulin.

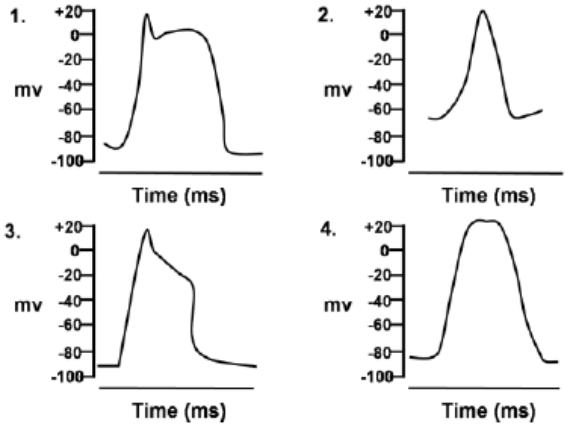
C. Glucose molecules are transported in the small intestine by facilitated diffusion.

D. The secondary active transport of glucose occurs in muscles.

Which one of the above statement(s) is **INCORRECT** ?

1. Only A 2. A and B
3. Only C 4. C and D

111. Action potentials were recorded intracellularly from different parts of mammalian heart and these are shown below. Which one of these has been recorded from sinoatrial node?



112. Which one of the following options correctly relates the source gland/organ with its respective hormone as well as function?

	Source gland	Hormone	Function
1	Thyroid	Thyroxine	Regulates blood calcium level
2	Anterior pituitary	Oxytocin	Contraction of uterine muscles
3	Posterior pituitary	Vasopressin	Resorption of water in distal tubules of nephron
4	Corpus luteum	Estrogen	Supports pregnancy

113. Poplar is a dioecious plant. A wild plant with 3 genes AABBCC was crossed with a triple recessive mutant aabbcc. The F1 male hybrid (AaBbCc) was then back crossed with the triple mutant and the phenotypes recorded are as follows:

AaBbCc	300
aaBbCc	100
aaBbcc	16
AabbCc	14
AaBbcc	65
aabbCc	75
aabbcc	310
Aabbcc	120

The distance in map unit (mu) between A to B and B to C is

1. 25 and 17 mu, respectively
2. 33 and 14 mu, respectively
3. 25 and 14 mu, respectively
4. 33 and 17 mu, respectively

114. Fruit colour of wild *Solanum nigrum* is controlled by two alleles of a gene (A and a). The frequency of A, p=0.8 and a, q=0.2. In a neighbouring field a tetraploid genotype of *S. nigrum* was found. After critical examination five distinct genotypes were found; which are AAAA, AAAa, AAaa, Aaaa and aaaa. Following Hardy Weinberg principle and assuming the same allele frequency as that of diploid population, the numbers of phenotypes calculated within a population of 1000 plants are close to one of the following:

AAAA : AAAa : AAaa : Aaaa : aaaa

1. 409 : 409 : 154 : 26 : 2
2. 420 : 420 : 140 : 18 : 2
3. 409 : 409 : 144 : 36 : 2
4. 409 : 420 : 144 : 25 : 2

115. A three point test cross was carried out in *Drosophila melanogaster* involving three adjacent genes X, Y and Z, arranged in the same order. The distance between X to Y is 32.5 map unit (mu) and that between X to Y is 20.5 map. The coefficient of coincidence = 0.886.What is the percentage of double recombinants in the progeny obtained from the testcross?

1. ~6%
2. ~8%
3. ~12%
4. ~16%

116. Two interacting genes (independently assorting) were involved in the same pathway. Absence of either genes function leads to absence of the end product of the pathway. A dihybrid cross involving the two genes is carried out. What fraction of the F2 progeny will show the presence of the end product?

1. 1/4
2. 3/4
3. 9/16
4. 15/16

117. A male mouse cell line has a large translocation from X chromosome into chromosome 1. When a GFP containing transgene is inserted in this chromosome 1 with translocation, it is often silenced. However when inserted in the other homologue of chromosome 1 that does not contain the translocation, it is almost always expressed. Which of the following phenomenon best describes this effect?

1. Genome imprinting
2. Gene balance
3. Sex-specific expression
4. Dosage compensation

118. Five bacterial markers were followed for a co-transduction experiment. The following table documents the observations of this experiment. '+' denotes co-transduction and '-'denotes lack thereof; 'ND' stands for not determined.

	arg	*leu*	*str*	*met*
gal	+	–	+	–
leu	*ND*		+	+
arg		ND	–	ND
str	–	+		ND

Pick the correct order in which the genes are arranged on the bacterial chromosome

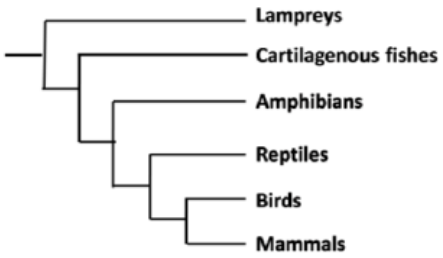
1. *str – gal – leu – arg – met*
2. *leu – met – arg – str – gal*
3. *leu – str – met – gal – arg*
4. *arg – gal – str – leu – met*

119. Based on the table given below, which of the f ollowing option represents the correct match?

Category		Plant Species	
A.	Critically endangered	(i)	*Chromolaena odorata*
B.	Vulnerable	(ii)	*Dipterocarpus grandiflorus*
C.	Extinct	(iii)	*Euphorbia mayuranthanii*
D.	Invasive	(iv)	*Saraca asoka*

1. A – (i); B – (iv); C – (iii); D – (ii)
2. A – (ii); B – (iii); C – (iv); D – (i)
3. A – (i); B – (iv); C – (ii); D – (iii)
4. A – (ii); B – (iv); C – (iii); D – (i)

120.



With reference to the phylogenetic tree presented above, which of the following statements is true?

1. Amphibians, reptiles, birds and mammals share a common ancestor.
2. Birds are more closely related to reptiles than to mammals.
3. Cartilagenous fishes are the ancestors of amphibians.
4. Lampreys and mammals are not related.

121. For the following invertebrate structures/organs, identify their major function and the animal group in which they are found:

Nematocyst (A), Protonephridia (B), Malpighian Tubules (C) Radula (D)

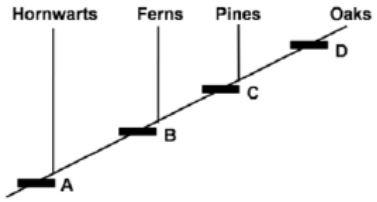
1. A – Porifera, Skeletal Support; B – Mollusca, excretion C – Insecta, respiration; D – Anthozoa, prey capture
2. A – Anthozoa, prey capture; B – Planaria, excretion C – Mollusca, excretion; D – Insecta, food processing
3. A – Planaria, excretion; B – Mollusca, respiration; C – Insecta, respiration; D – Porifera, prey capture
4. A – Anthozoa, prey capture; B – Planaria, excretion; C – Insecta, excretion; D – Mollusca, food processing

122. Match major events in the history of life with Earth's geological period.

Event		Geological Period	
A.	First reptiles	(i)	Quarternary
B.	First mammals	(ii)	Tertiary
C.	First humans	(iii)	Cretaceous
D.	First amphibians	(iv)	Triassic
		(v)	Carboniferous
		(vi)	Devonian

1. A – (v); B – (i); C – (ii); D – (v)
2. A – (v); B – (iv); C – (i); D – (vi)
3. A – (vi); B – (iv); C – (ii); D – (vi)
4. A – (iii); B – (i); C – (vi); D – (v)

123. Following is a cladogram showing phylogenetic relationships among a group of plants:



In the above representation, A, B, C and D respectively represent

1. xylem and phloem, embryo, flower, seed.
2. embryo, xylem and phloem, seed, flowers.
3. embryo, xylem and phloem, flower, seed.
4. xylem and phloem, flower, embryo, seed.

124. Match the following human diseases with their causal organisms

A.	Sleeping Sickness	(i)	*Trypanosoma cruzi*
B.	Chagas disease	(ii)	*Trypanosoma brucei*
C.	Elephantiasis	(iii)	*Borrelia burgdorfei*
D.	Lyme disease	(iv)	*Wuchereria bancrofti*

1. A – (ii); B – (iv); C – (iii); D – (i)
2. A – (i); B – (ii); C – (iv); D – (iii)

3. A – (ii); B – (i); C – (iv); D – (iii)

4. A – (ii); B – (iv); C – (i); D – (iii)

125. If gypsy moth egg density is 160 at time t and 200 at t + 1, what will be its value at time t + 3, assuming that egg density continues to increase at constant rate?

1. 250 2. 280

3. 312 4. 390

126. The approximate P:B (Net Primary Production: Biomass) ratios in four different ecosystems (A, B, C, D) are

A – 0.29; B – 0.042, C – 16.48; D – 8.2

The four ecosystems are

1. A – Ocean; B – Lake; C – Grassland; D – Tropical forest

2. A – Grassland; B – Tropical forest; C – Ocean; D – Lake

3. A – Tropical forest; B – Ocean; C – Grassland; D – Lake

4. A – Grassland; B – Ocean; C – Lake; D – Tropical forest

127. The following table shows the mean and variance of population densities of species A, B and C.

Statistic	Spec-ies A	Spec-ies B	Spe-cies C
Mean $\bar{x}$	5.30	7.05	5.30
Variance s^2	5.05	0.35	50.5

Based on the above, which of the following statements is correct?

1. Species A and B show uniform distribution, whereas species C shows clumped distribution.

2. Species A shows random distribution, species B shows uniform distribution, and species C shows clumped distribution.

3. Species A and B show clumped distribution, whereas species C shows uniform distribution.

4. Species A shows clumped distribution, species B shows random distribution, and species C shows uniform distribution.

128. Match the following associations involved in dinitrogen fixation with their representative genera

Associations		Genera	
A.	Heterotrophic nodulate	(i)	*Azotobacter*
B.	Heterotrophic Non-nodulate	(ii)	*Frankia*
C.	Phototrophic associative	(iii)	*Nostoc*
D.	Phototrophic free-living	(iv)	*Rhodospirillum*

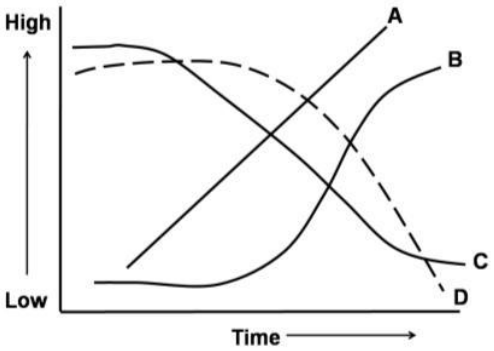
1. A – (ii); B – (i); C – (iv); D – (iii)

2. A – (iii); B – (i); C – (ii); D – (iv)

3. A – (i); B – (ii); C – (iii); D – (iv)

4. A – (ii); B – (i); C – (iii); D – (iv)

129. In a lake subjected to progressive eutrophication, temporal changes in the magnitude of selected parameters (A, B, C, D) are shown in the graph



The parameters A, B, C, D are

1. A-Green algal biomass, B – Cyano- bacterial biomass, C – Dissolved Oxygen concentration, D – Biological Oxygen Demand

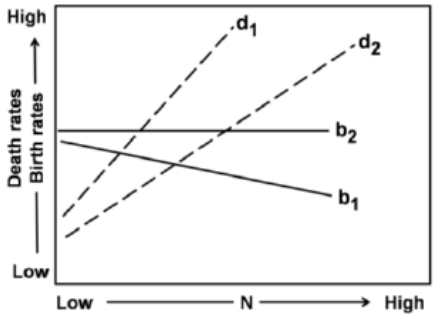
2. A- Biological Oxygen Demand, B – Cyanobacterial biomass, C – Dissolved Oxygen concentration, D – Green algal biomass

3. A- Biological Oxygen demand, B – Green algal biomass, C – Cyanobacterial biomass, D – Dissolved Oxygen concentration

4. A- Cyanobacterial biomass, B – Biological Oxygen Demand, C – Green algal biomass, D – Dissolved Oxygen concentration

130. The birth rates (b) and death rates (d) of two species 1and 2 in relation to population density

(N) are shown in the graph. Which of the following is **NOT** true about the density dependent effects on birth rates and death rates?



1 Birth rates are density-dependent in species 1 and density-independent in species 2.

2. Death rates are density-dependent in both the species.

3. Density-dependent effect on birth rate is stronger in species 1 than in species 2.

4. The density-dependent effects on death rates are similar in both the species.

131. For two species A and B in competition, the carrying capacities and competition co-efficients are

$K_A = 150$ $K_B = 200$

$\alpha = 1.0$ $\beta = 1.3$

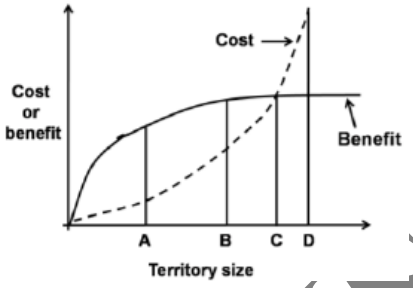
According to the Lotka-Volterra model of interspecific competition, the outcome of competition will be

1. Species A wins.
2. Species B wins.
3. Both species reach a stable equilibrium.
4. Both species reach an unstable equilibrium.

132. Consider an autosomal locus with two alleles A_1 and A_2 at frequencies of 0.6 and 0.4 respectively. Each generation A_1 mutates of A_2 at a rate of $\mu = 1 \times 10^{-5}$ while A_2 mutates to A_1 at a rate of $= 2 \times 10^{-5}$. Assume that the population is infinitely large and no other evolutionary force is acting. The equilibrium frequency of allele A_1 is

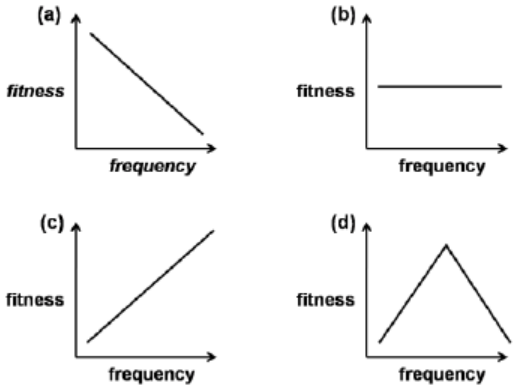
1. 1.0
2. 0.5
3. 0.67
4. 0.33

133. With reference to the graph given below, identify the optimal territory size.



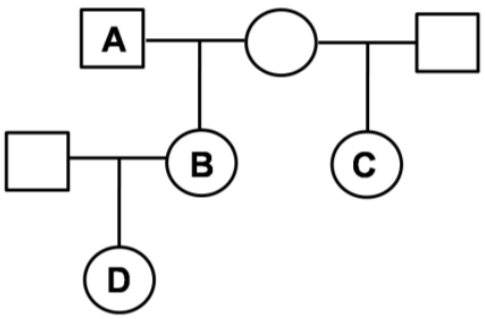
1. A
2. B
3. C
4. D

134. A particular behavioural variant affects fitness of an organism. The relationship between the frequency of the variant in the population and fitness are plotted below. In which of these cases is the behavioural variant most likely to reach a frequency of 1?



1. Only b
2. Only c
3. b and d
4. a and d

135.



The coefficient of relatedness between individuals A and B, A and D, and between D and C is

1. 0.5, 0.25, 0.125 respectively.

2. 0.5, 0.5, 0.25 respectively.

3. 0.5, 0.25, 0.75 respectively.

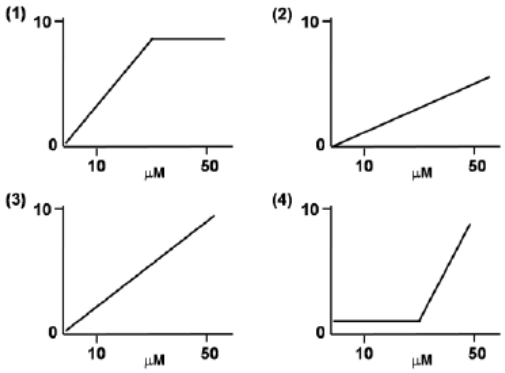
4. 0.125, 0.5, 0.5 respectively.

136. One hundred independent populations of *Drosophila* are established with 10 individuals in each population, of which, one individual is of *Aa* genotype and the other nine are of *AA* genotype. If random genetic drift is the only mechanism acting on these populations, then, after a large number of generations, the expected number of populations fixed for the "*a*" allele is

1. 75 2. 50

3. 25 4. 5

137. Performance of biosensor is evaluated by their response to the presence of an analyte. The physiological relevant concentration of analyte is between 10μM and 50μM . Which among the following biosensor responses is best?



138. Molecular polymorphic markers are already known with respect to tobacco mosaic virus (TMV) resistance in tobacco. Among these, which marker system you will select that will be simple, economic and less time consuming:

1. RAPD 2. RFLP

3. AFLP 4. EST-SSR

139. In an effort to produce gene knockout mice, a gene targeted homologous recombination was tried with the exogenous DNA containing neo^r gene (confer G-418 resistance) tk^{Hsv} and gene (confers sensitivity to the cytotoxic nucleotide analog ganciclovir). If the neo^r gene was inserted within the target gene in the exogenous DNA and considering that both homologous and non-homologous recombination (random integration) is taking place, which one of the following statements is **NOT** correct about the possible outcome of the experiment?

1. Cells with non-homologous insertion will be sensitive to ganciclovir.

2. Non-recombinant cells will be sensitive towards G-418 and resistant to ganciclovir.

3. Homologous recombination will ensure that cells will be resistant to both ganciclovir and G-418.

4. Homologous recombinants will grow in G- 418 containing media but will be sensitive towards ganciclovir.

140. In a typical gene cloning experiment, by mistake a researcher introduced the DNA of interest within ampicilin resistant gene instead of *lac z* gene. The competent cells were allowed to take up the plasmid and then plated in the media containing ampicilin, X-gal and IPTG and subjected to blue-white screening. Considering all plasmids were recombinant which one of the following statements correctly describes the outcome of the experiment?

1. The bacteria which took up the plasmids would grow and give blue colonies.

2. The bacteria which took up the plasmids would not grow.

3. The bacteria which took up the plasmids would form white colonies.

4. All of the bacteria would grow and give white colonies.

141. The sequence of the peptide KGLITRTGLIKR can be unequivocally determined by

1. Only Edman degradation.

2. Amino acid analysis and MALDI MS/MS mass spectrometry.

3. MALDI MS/MS mass spectrometry.

4. MALDI mass spectrometry after treatment of the peptide with trypsin.

142. From statements on protein structure and interactions detailed below, indicate the correct statement

1. The concentration of a tryptophan containing protein can be determined by monitoring the fluorescence spectrum of the protein.

2. A peptide with equal number of Glu and Lys amino acids can show multiple charged species in its electrospray ionization mass spectrum.

3. The circular dichroism spectrum of a protein shows predominantly helical conformation. Analysis of its two dimensional NMR spectrum shows predominantly β-structure.

4. Binding constant can be determined by two interacting molecules by the technique of surface plasma resonance only if there is strong hydrophobic interactions between them.

143. Radioimmuno assay (RIA) can be employed for the detection of insulin in blood plasma. For this, ^{125}I-labelled insulin is mixed and allowed to bind with a known concentration of anti-insulin antibody. A known volume of patients' blood plasma is then added to the conjugate and allowed to compete with the antigen binding sites of antibody. The bound antigen is then separated from unbound ones and the radioactivity of free antigen is then measured by gamma counter. Following are some of the statements made about this assay.

(i) The ratio of radioactive count for unbound antigen to the bound one is more at the end of reaction.

(ii) The ratio of radioactive count for unbound antigen to the bound one is less at the end of reaction.

(iii) For a diabetic patient, the radioactive count for free antigen is less than that for a normal individual.

(iv) For a diabetic patient, the radioactive count for free antigen is more than that for a normal individual.

Which of the above statements are true?

1. (i) and (iii)
2. (i) and (iv)
3. (ii) and (iii)
4. (ii) and (iv)

144. It is hypothesized that the mean (μ_0) dry weight of a female in a Drosophila population is 4.5 mg. In a sample of 16 female with $\bar{Y}$ = 4.8 mg and s = 0.8 mg, what dry weight values would lead to rejection of the null hypothesis at p = 0.05 level? (take $t_{0.05}$ = 2.1)

1. Values lower than 4.0 and values higher than 5.6
2. Values lower than 3.20 and values higher than 6.40
3. Values lower than 4.38 and values higher than 5.22
4. Values lower than 3.22 and values higher than 6.48

145. A researcher wants to obtain complete chemical information, i.e., head groups and fatty acids of phospholipids from liver tissues. Phospholipids have fatty acids of different lengths and unsaturation and also the head groups are of different chemistries. Which of the following combination of techniques would provide complete chemical description of phospholipids?

1. Only thin layer chromatography (TLC)
2. TLC and gas chromatography
3. Paper and thin layer chromatography
4. Only paper chromatography