

E

Str.No.

001130

SUBJECT CODE BOOKLET CODE

2013(II)G  
LIFE SCIENCES  
TEST BOOKLET

3

A

Time : 3:00 Hours

Maximum Marks: 200

**INSTRUCTIONS**

1. You have opted for English as medium of Question Paper. This Test Booklet contains one hundred and forty five (20 Part 'A' + 50 Part 'B' + 75 Part 'C') Multiple Choice Questions (MCQs). You are required to answer a maximum of 15, 35 and 25 questions from part 'A' 'B' and 'C' respectively. If more than required number of questions are answered, only first 15, 35 and 25 questions in Parts 'A' 'B' and 'C' respectively, will be taken up for evaluation.
2. Answer sheet has been provided separately. Before you start filling up your particulars, please ensure that the booklet contains requisite number of pages and that these are not torn or mutilated. If it is so, you may request the Invigilator to change the booklet of the same code. Likewise, check the answer sheet also. Sheets for rough work have been appended to the test booklet.
3. Write your Roll No., Name and Serial Number of this Test Booklet on the Answer sheet in the space provided. Also put your signatures in the space earmarked.
4. You must darken the appropriate circles with a black ball pen related to Roll Number, Subject Code, Booklet Code and Centre Code on the OMR answer sheet. It is the sole responsibility of the candidate to meticulously follow the instructions given on the Answer Sheet, failing which, the computer shall not be able to decipher the correct details which may ultimately result in loss, including rejection of the OMR answer sheet.
5. Each question in Part 'A' and 'B' carries 2 marks and Part 'C' questions carry 4 marks each respectively. There will be negative marking @ 25% for each wrong answer.
6. Below each question in Part 'A', 'B' and 'C' four alternatives or responses are given. Only one of these alternatives is the "correct" option to the question. You have to find, for each question, the correct or the best answer.
7. Candidates found copying or resorting to any unfair means are liable to be disqualified from this and future examinations.
8. Candidate should not write anything anywhere except on answer sheet or sheets for rough work.
9. Use of calculator is not permitted.
10. After the test is over, at the perforation point, tear the OMR answer sheet, hand over the original OMR answer sheet to the invigilator and retain the carbonless copy for your record.
11. Candidates who sit for the entire duration of the exam will only be permitted to carry their Test booklet.

Roll No. ....

Name .....

OMR Answer Sheet No. ....

I have verified all the information filled in by the candidate.

*[Signature]*

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**PART 'A'**

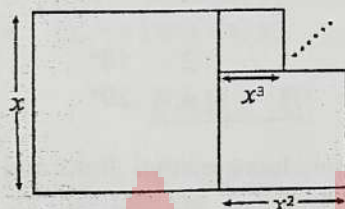
01. Given that  $x + y + z = 1$  where  $x, y, z$  are real, which of the following is true?

1.  $x^2 + y^2 + z^2 < 0$
2.  $xy + yz + zx < 1$
3.  $xy + yz + zx > 1$
4.  $x > y > z$

02. Three circles of radius one unit each are touching one another externally. The area of the region bounded by them and not interior to any of them in square units is

1.  $\sqrt{3} - \pi/2$
2.  $2\sqrt{3} - \pi$
3.  $\pi - \sqrt{3}$
4.  $\sqrt{3} - \pi/3$

03. A series of squares whose sides are  $x, x^2, x^3, \dots$ , where  $x < 1$ , is available. It is found that the squares can be tiled to cover a rectangle of area  $x$ . Arrangement of the three largest tiles is as shown in the figure. Find  $x$



1.  $\sqrt{3}/2$
2.  $1/\sqrt{2}$
3.  $(\sqrt{5} - 1)/2$
4.  $3/4$

04. A chord of length 5 cm subtends an angle of  $30^\circ$  at the circumference of the circle. Another chord whose length is 10 cm subtends at the circumference an angle of

1.  $30^\circ$
2.  $60^\circ$
3.  $90^\circ$
4.  $120^\circ$

05. Put inside a cube the largest sphere it can accommodate. Then put inside this sphere the largest cube it can accommodate. The ratio of the volume of the outer cube to the volume of the inner cube is

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

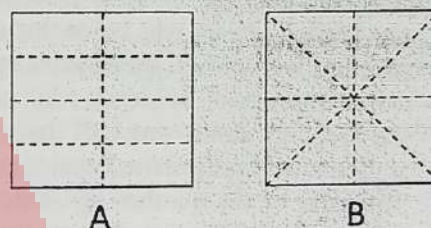
3.  $\frac{1}{2\sqrt{2}}$

4.  $3\sqrt{3}$

06. A man standing under a hemispherical dome at its periphery fires a gun. His friend is also standing under the dome but at a diametrically opposite point. The radius of the dome is 165 m. What is the longest time upto which his friend can hear the echo of the sound reflected once from the dome? (speed of sound is 330 m/s)

1. 1 s
2. 0.5 s
3.  $0.5\sqrt{3}$  s
4.  $\sqrt{2}$  s

07. A cubic cake has a thin icing layer on the top and the sides. It is proposed to share it equally among 8 persons in one of the following ways (top view is shown)



Which of the two is a fair division?

1. Both A and B are fair divisions
2. A is a fair division, but B is not
3. B is a fair division but A is not
4. Neither A, nor B is a fair division

08. If  $1 + x + x^2 + x^3 + \dots = 2$ , then  $1 - x + x^2 - x^3 + \dots =$

1. 0
2. 1
3.  $2/3$
4.  $1/2$

09. Inner and outer diameters of a roll of cellophane tape are 6 cm and 8 cm respectively. Thickness of the cellophane tape is 0.1 mm. What will be the approximate length of cellophane tape in the roll?

1. 10 m
2. 11 m
3. 19 m
4. 22 m



10. Consider a test with 20 multiple choice questions. For each question a student will get 2 marks if the answer is correct, -1 if it is incorrect, and 0 if it is unanswered. If a student answers all questions, which of the following scores is NOT possible?

- |       |       |
|-------|-------|
| 1. 11 | 2. -8 |
| 3. 1  | 4. 8  |

11.  $\frac{3}{7}$ th of the number of students who passed the Geology exam is the same as  $\frac{6}{7}$ th of the number of students who passed the Physics exam. Which of the following is necessarily true?

- The same number of students passed the Geology and Physics exams
- Total number of students who passed the Geology exam was twice that of the students who passed the Physics exam
- Total number of students who passed the Geology exam was half that of the students who passed the Physics exam
- The ratio of the number of Geology to the number of Physics students was 7:3

12. ABCD is a cyclic quadrilateral, right angled at B. AB = 8 cm, BC = 6 cm and D is at the distance of 3 cm from AC. The area of the quadrilateral (in sq.cm.) is

- |       |       |
|-------|-------|
| 1. 63 | 2. 48 |
| 3. 39 | 4. 24 |

13. The three sides  $a, b, c$  of a triangle satisfy the equation  $a^3 + b^3 + c^3 = 3abc$ . Then the triangle

- must be equilateral
- is isosceles, but not equilateral
- must be right angled
- is neither equilateral nor isosceles

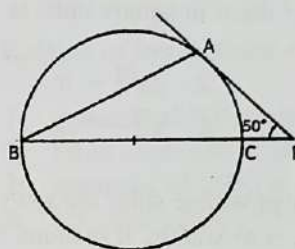
14. LPG cylinders having diameter of 40 cm are to be loaded in upright position in a single layer in a vehicle whose storage area is 160 cm  $\times$  110 cm. What is the maximum number of cylinders that can be loaded on the vehicle?

- |       |       |
|-------|-------|
| 1. 8  | 2. 12 |
| 3. 10 | 4. 11 |

15. A fixed square is divided into a  $64 \times 64$  grid of tiny squares. A tiny square may be either filled or empty. Each pattern of filled and empty squares furnishes a code. The number of distinct codes that can be created is

- |                     |                       |
|---------------------|-----------------------|
| 1. $2^{128}$        | 2. $64^2$             |
| 3. $128 \times 128$ | 4. $2^{64 \times 64}$ |

- 16.



PA is a tangent to a circle and a line PCB passes through its centre (see figure). If  $\angle P = 50^\circ$ ,  $\angle B =$

- |               |               |
|---------------|---------------|
| 1. $45^\circ$ | 2. $50^\circ$ |
| 3. $40^\circ$ | 4. $20^\circ$ |

17. A and B are two hexadecimal digits and the numbers X, Y and Z are defined by the relations

$$X = \frac{BBBB}{AAAA}, Y = \frac{BBB}{AAA}, Z = \frac{BB}{AA}$$

Then

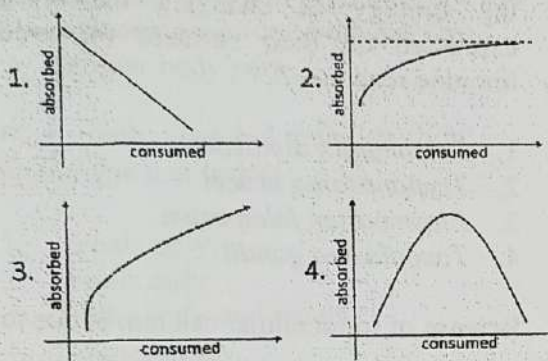
- |                |                |
|----------------|----------------|
| 1. $X = Y = Z$ | 2. $X > Y > Z$ |
| 3. $X < Y < Z$ | 4. $X > Y < Z$ |

18. I walked some distance East and then turned and walked some distance North. I am now 10 km from my starting point. What could be the maximum distance walked by me, approximately?

- |          |          |
|----------|----------|
| 1. 15 km | 2. 14 km |
| 3. 10 km | 4. 11 km |



19. For a drug the fraction absorbed can be given as a linear function of the amount consumed at a time with a negative slope. Which graph relates the amount consumed with the amount absorbed?



20. An object kept at a point  $(x, y)$  is reflected in a mirror kept along  $x$ -axis. If the mirror is now rotated to be along  $y$ -axis, the image would move from

1.  $(x, y)$  to  $(x, -y)$
2.  $(-x, y)$  to  $(-x, -y)$
3.  $(-x, -y)$  to  $(x, y)$
4.  $(x, -y)$  to  $(-x, y)$

### PART 'B'

21. According to Coulomb's law, two point charges  $5.5 \text{ A}^\circ$  apart in vacuum would interact giving rise to energy of  $60 \text{ kcal/mole}$ . The energy of interaction of the same system in water (dielectric constant of water is  $80$  at  $20^\circ\text{C}$ ) is

1.  $4800 \text{ kcal/mole}$ .
2.  $60 \text{ kcal/mole}$ .
3.  $0.75 \text{ kcal/mole}$ .
4.  $140 \text{ kcal/mole}$ .

22. A buffer is prepared by mixing  $50 \text{ ml}$  of  $0.20 \text{ M}$  acetic acid and  $50 \text{ ml}$  of  $0.20 \text{ M}$  sodium acetate. The  $\text{pH}$  of the buffer is  $4.75$  which is equal to the value of  $\text{pK}_a$  of the acid. The molarity of the buffer is

1.  $0.10$ .
2.  $0.15$ .
3.  $0.20$ .
4.  $0.40$ .

23. If the product of an enzyme binds to the enzyme-substrate complex to exhibit its activity through a decrease in both  $K_m$  and  $V_{max}$ , this type of inhibition is called

1. competitive inhibition.
2. non-competitive inhibition.
3. uncompetitive inhibition.
4. partially-competitive inhibition.

24. The B-form of double helix has not been observed in RNA due to

1. the presence of U.
2. the presence of I.
3. absence of base stacking.
4. altered conformation of the ribose ring.

25. One population of large unilamellar vesicles (LUV), labeled with a fluorephore attached to phosphatidyl ethanolamine is mixed with a population of unlabelled LUV in the ratio of  $1:5$ . A protein is added to these lipid vesicles. Considerable enhancement in fluorescence is observed. This is due to

1. redistribution of the fluorephore between the vesicles as a result of membrane fusion.
2. translocation of a population of fluorephore to the unlabelled vesicles due to vesicle aggregation.
3. extrusion of the fluorephore from the vesicles into buffer.
4. formation of micelles from the vesicles.

26. Mitochondrial proteins are first fully synthesized as mitochondrial precursor proteins in the cytosol and then translocated into mitochondria through signal sequences. Which one of the following is true for mitochondrial precursor proteins?

1. They remain unfolded in the cytosol.
2. They form a folded structure.
3. They do not form amphiphilic  $\alpha$ -helix.
4. They form  $\beta$ -pleated sheets.



27. The tryptophan operon in *E. coli* is an example of

1. inducible operon, controlled by a repressor protein and attenuation.
2. repressible operon, controlled by a repressor protein and attenuation.
3. inducible operon, controlled by an activator protein and aporepressor protein.
4. repressible operon, controlled by a repressor protein and anti-termination.

28. If the total DNA content of a cell at interphase is  $4C$ , what will be the DNA content of the cell when it is at Anaphase II?

1.  $2C$
2.  $C$
3.  $\frac{1}{2}C$
4.  $\frac{1}{4}C$

29. In *E. coli*, the major DNA unwinding protein helicase, DnaB translocates in

1.  $5' \rightarrow 3'$  direction along the lagging strand template.
2.  $3' \rightarrow 5'$  direction along the lagging strand template.
3.  $5' \rightarrow 3'$  direction along the leading strand template.
4.  $3' \rightarrow 5'$  direction along the leading strand template.

30. A meiotic recombination does not involve

1. formation of Holliday junction.
2. newly replicated identical DNA duplexes.
3. gene conversion.
4. crossover and non-crossover.

31. CENP-A, a histone variant associated with nucleosomes in the centromeric region, replaces the histone subunit

1. H1.
2. H2A.
3. H3.
4. H4.

32. Bacteriophage T4 transcribe the viral genes immediately after infection using

1. host RNA polymerase.
2. viral RNA polymerase.
3. modified host RNA polymerase.
4. RNA transcriptase.

33. Which of the following pathogens adopt the strategy of changing the antigens expressed on their surfaces for evading immune response?

1. *Leishmania donovani*
2. *Trypanosoma brucei*
3. *Plasmodium falciparum*
4. *Toxoplasma gondii*

34. Release of intracellular calcium is due to

1. absence of  $PIP_2$  hydrolysis.
2. rapid dephosphorylation of  $IP_3$ .
3. retention of DAG in the cytosol.
4. activation of  $IP_3$  receptors.

35. Which of the following is most likely to be activated in the non-canonical Wnt pathway?

1. Disheveled and GSK-3.
2. RhoA and PLC.
3. GSK-3 and RhoA.
4. Disheveled and APC.

36. An efficient vaccine candidate is

1. a hapten-like small molecule.
2. an unconjugated peptide.
3. a polysaccharide.
4. a polypeptide.

37. Amphibian zygote will generally undergo

1. holoblastic radial cleavage.
2. holoblastic rotational cleavage.
3. meroblastic bilateral cleavage.
4. meroblastic rotational cleavage.

38. With respect to development of any organism, "conditional specification" would result in which type of development?

1. Regulative
2. Mosaic
3. Syncytial
4. Definitive



39. During embryogenesis, a *Drosophila* embryo with a mutation in a homeotic gene shows

1. changed polarity of each segment.
2. defects in dorso-ventral polarity.
3. deletion of several segments in a row.
4. replacement of one body part by another body part.

40. Plants with *apetala2* mutation show a phenotype that lacks

1. sepals only.
2. petals only.
3. both sepals and petals.
4. stamens only.

41. Which one of the following is the function of cytochrome *b<sub>6</sub>f* complex?

1. Oxidation of water to O<sub>2</sub>
2. Oxidation of plastoquinone (PQH<sub>2</sub>).
3. Reduction of NADP<sup>+</sup> to NADPH.
4. Production of ATP.

42. Pyruvate dehydrogenase complex has sophisticated regulatory mechanisms including reversible phosphorylation. Various metabolites are also able to modulate the dehydrogenase complex. Which one of the following statements is NOT correct?

1. Pyruvate stimulates the kinase.
2. Pyruvate inhibits the kinase.
3. Ammonia stimulates the kinase.
4. Ammonia inhibits pyruvate oxidation.

43. Which one of the following is a precursor for the biosynthesis of tyrosine, phenylalanine and tryptophan?

1. 3-Phosphoglycerate.
2. Phosphoenolpyruvate.
3. Pyruvate.
4. Oxaloacetate.

44. Which one of the following statements is correct for the transport of cytokinin in plants?

1. It takes place only from root to shoot.
2. It takes place only from shoot to root.
3. Root and shoot make their own cytokinin therefore, no transport is required.
4. Transport can occur from root to shoot and *vice versa*.

45. The volume of RBCs in venous blood is greater than that of arterial blood, as water accumulates in these cells. Which one of the following is true for the accumulation of water in venous RBCs?

1. Proton pump.
2. Sodium-potassium pump.
3. Chloride/bicarbonate exchanger.
4. Calcium/magnesium exchanger.

46. Menstrual blood does not contain clots due to higher level of

1. Plasmin.
2. Fibrinogen.
3. Heparin.
4. Prothrombin.

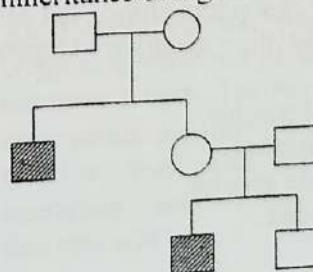
47. Desert rattlesnakes live in extremely dry environment. In order to conserve body water, they are adapted to convert ammonia to

1. urea.
2. purines.
3. uric acid.
4. amino acids.

48. When ATP remains attached with the myosin head, which one of the following event happens in the skeletal muscle?

1. Muscle contraction.
2. Muscle relaxation.
3. Muscle rigor.
4. Muscle spasm.

49. The following pedigree chart shows inheritance of a given trait.





This can be taken as an example of

1. Y-linked inheritance.
2. X-linked recessive as well as autosomal recessive inheritance.
3. Autosomal dominant inheritance.
4. X-linked dominant inheritance.

50. Two mutants of *Drosophila melanogaster*, one showing light red eye colour and the other showing dark brown eye colour, were crossed. In  $F_1$  all flies showed normal red eye colour. This indicated that the two mutations are

1. allelic.
2. non allelic.
3. linked.
4. unlinked.

51. Turner syndrome results from

1. monosomy of sex-chromosome.
2. monosomy of autosome.
3. nullisomy of sex-chromosome.
4. trisomy of autosome.

52. Conjugation involves transfer of DNA from one cell to another. In *E. coli*, the cells that cannot transfer their DNA into the recipient cell are

1. Hfr.
2.  $F'$ .
3.  $F^+$ .
4.  $F^-$ .

53. Which groups of prokaryotic organisms are mainly classified based on morphology?

1. Cyanobacteria and Actinomycetes.
2. Archaea and Enteric bacteria.
3. Nitrogen fixing bacteria.
4. Yeast and Molds.

54. Species that cannot be diagnosed as separate species based on their morphological characters alone, but can be distinguished by other means are known as

1. typological species.
2. Linnaean species.
3. phylogenetic species.
4. sibling species.

55. The species which is considered sister to all extant angiosperms is

1. Amborellaceae.
2. Ceratophyllaceae.
3. Magnoliaceae.
4. Hydatellaceae.

56. The character that is shared by Arthropoda and Annelida is

1. joint appendages.
2. segmental arrangement of muscles.
3. exoskeleton made up of chitin.
4. open circulatory system.

57. Which of the following characterizes natural communities under equilibrium?

1. Biotic decoupling.
2. Species independence.
3. Large stochastic effects.
4. Density dependence.

58. From population dynamics point of view, what would be the effective population size of a population of 150 breeding females and 50 breeding males?

1. 200
2. 100
3. 150
4. 50

59. Based on the selected physicochemical features of four water bodies given in the following table, which of the following statements is correct?

PARAMETER	WATER BODIES			
	A	B	C	D
Total dissolved solids (ppm)	25	75	300	400
NO <sub>3</sub> -N (µg/L)	200	300	400	500
PO <sub>4</sub> -P (µg/L)	1	15	20	50

1. Water bodies A and B are oligotrophic whereas water bodies C and D are eutrophic.
2. Only water body A is oligotrophic and all other water bodies are eutrophic.



69. An observation was being made under a compound microscope using light of 500 nm wave length. The refractive index of the observation medium was 1.5. The  $\sin \alpha$  of the lens used was 0.94. The limit of resolution ( $\mu\text{m}$ ) of the microscope using this lens will be



1. 0.216.
2. 216.
3. 0.94.
4. 1.41.

70. In order to most efficiently quantitate an antigen available at low concentration in a biological fluid, which of the following ELISA would be preferred?
1. Coating the plate with the fluid containing the antigen, followed by antigen-specific antibody-enzyme conjugate.
  2. A sandwich ELISA, capturing the antigen using an antibody specific for the antigen.
  3. A sandwich ELISA, capturing the antigen using an antibody and detecting the antigen with an antibody, which is biotinylated.
  4. Plating the biological fluid on an ELISA plate coated with the antigen, followed by regular steps of ELISA.

### PART 'C'

71.  $H_2O$  is a liquid whereas  $H_2S$  is a gas at  $25^\circ C$ . The reason for this is

1. the number of electrons in the outermost electron shells of oxygen and sulfur are different.
2. lack of hydrogen bonds in  $H_2O$ .
3. the hydrogen-sulfur bond is more polar than the hydrogen-oxygen bond.
4. lack of hydrogen bonds in  $H_2S$ .

72. The length of DNA comprising of  $6.4 \times 10^9$  base pairs with the base pairs occurring at intervals of 0.34 nm along the DNA helix

1. cannot be calculated unless further information is provided.
2. is  $\sim 2.18 \mu m$ .
3. is  $\sim 2.18 m$ .
4. depends on base composition.

73.  $AsO_4^{3-}$  is chemically very similar to  $PO_4^{3-}$  and could be used as an alternate substrate by phosphate requiring enzymes. When 1,3-bisphosphoglycerate is converted to 3-phosphoglycerate, ATP is generated.

However, ATP is not formed when 1-arseno-3-phosphoglycerate is converted to 3-phosphoglycerate. The reason for this could be

1. The bond between arsenate and carboxylic acid can be hydrolyzed only at  $50^\circ C$ .
2. 3-phosphoglycerate is formed non-enzymatically due to rapid hydrolysis of the bond between arsenate and carboxylic acid group.
3. Enzymes cannot hydrolyze the bond between arsenate and carboxylic acid.
4. The bond between arsenate and carboxylic acid can be hydrolyzed only by conversion of GDP to GTP.

74. The  $K_{cat}/K_m$  values of an enzyme-catalyzed reaction when plotted as a function of pH yielded a bell-shaped curve with a maximum around pH 6.0. Which of the following conclusions best describes the above observation?

1. A His residue may be important for catalysis.
2. The enzyme would be highly stable at pH 6.0.
3. The enzyme would be most active below and above pH 6.0.
4. The enzyme will require a metal ion as cofactor for catalysis.

75. Tryptic digestion of a heptapeptide produced a dipeptide and a pentapeptide. Chymotryptic cleavage of the same heptapeptide yielded a tripeptide and a tetrapeptide. The tripeptide was found to be composed of two Thr (T) and one Lys (K) residue. The tetrapeptide contained one Ala (A), one Met (M), one Arg (R) and one Tyr (Y) residue. Which of the following sequence fits the heptapeptide?

1. AKMYTTTR
2. ARMYTTK
3. AYMKTTR
4. MYARTKT



76. Ribonuclease A (RNase A) consists of 124 amino acid residues. RNase A is cleaved by subtilisin (a protease) in a quantitative fashion at Ala 20 – Ser 21 peptide bond generating two fragments of 20 and 104 residues respectively. However, gel-filtration chromatography of the subtilisin-treated reaction mixture yields a single peak that elutes at the same position of the full-length RNase A. Notably, under identical chromatographic conditions as above, similar size fragments (20, 104, 124 residues) are seen to separate well. Which of the following is the most likely explanation for this observation?

1. The smaller fragment is formed in vanishingly small amounts and cannot be detected.
2. The smaller 20-residue fragment is unstable and degraded.
3. The two fragments are non-covalently bound despite the cleavage of 20-21 peptide bond.
4. The two fragments are linked by disulfide bonds after subtilisin cleavage.

77. A new protein "X" has been discovered in erythrocyte plasma membrane. The following observation are made about "X".

- (a) It can be extracted from disrupted erythrocyte membranes into a concentrated salt solution (NaCl), and it can be cleaved into fragments by proteinase K.
- (b) Treatment of erythrocytes with proteinase K followed by disruption and extraction of membrane components yields intact X.
- (c) However, treatment of erythrocyte "ghosts" (which consist of just plasma membranes, produced by disrupting the cells and washing out the hemoglobin) with proteinase K followed by disruption and extraction yields extensively fragmented "X".

What do these findings indicate about the location of "X" in the plasma membrane? Identify the correct answer.

1. Integral membrane protein with both N- and C- terminal exposed outside the cell.
2. Peripheral outer membrane
3. Integral membrane protein
4. Peripheral inner membrane

78. At pH 7.0, tryptophan crosses a lipid bilayer at about one thousandth the rate of the closely related substance indole. The correct explanation for this observation at pH 7.0 is:

1. Tryptophan bears a net negative charge
2. Tryptophan bears a net positive charge
3. Tryptophan bears a positive and a negative charge
4. Tryptophan cannot bind to its transporter in the lipid bilayer

79. In an experiment, spinach chloroplasts are illuminated in the absence of ADP and  $P_i$ , then the light is turned off and ADP and  $P_i$  are added. Identify the correct statement regarding the status of ATP synthesis

1. The rate of hydrolysis of ATP will be enhanced in dark
2. No synthesis of the ATP at all in the dark
3. ATP cannot be synthesized from ADP and  $P_i$  without the addition of appropriate enzyme
4. ATP is synthesized for a short time in the dark

80. *E. coli* cells are growing in a medium containing lactose but no glucose. Indicate the expression status of the *lac* operon if glucose is added to the culture.

1. Decreased expression
2. Increased expression
3. No changes in expression level
4. Initial rapid increase followed by sharp drop



81. *E. coli* cells are growing in a medium with glucose as the sole carbon source. Tryptophan is suddenly added. The cells continue to grow, and divide every 30 minutes. What will be the status of tryptophan synthase activity in the cells over time if the *trp* mRNA remains stable.

1. Low
2. High
3. No change
4. No activity

82. Toward the end of M phase the concentration of M phase cyclins drops precipitously and remains low until the next cell cycle. In this case how M-Cdk activity coordinates the activities of Cdc20- anaphase promoting complex (APC)?

1. M phase cyclins are destroyed by proteasome digestion following ubiquitination by Cdc20- APC
2. M phase cyclins are not destroyed by proteasome digestion following ubiquitination by Cdc20- APC
3. Cdc20-APC never influences M phase cyclins
4. M phase cyclins are influenced by Cdc20-APC following fatty acylation

83. The high processivity of DNA polymerases during replication is because of their association with proteins called sliding clamps. For loading onto DNA, sliding clamps require sliding clamp-loaders. Which of the following is true about sliding clamp-loaders, after they successfully load sliding clamps?

1. With sliding clamps, the processivity of DNA polymerase is very high, hence sliding clamp- loaders cannot compete and fall off.
2. Binding of DNA with clamp/clamp-loader complex is followed by dissociation of the clamp-loader from the clamp, but it remains attached to the PT (Primer-template) junction.
3. Once recruited, Sliding clamp-loaders remain associated with sliding clamps during replication.

4. Binding of DNA with the clamp/clamp-loader complex is followed by ATP hydrolysis and subsequent release of the sliding clamp loader.

84. Which of the following statement about selenocysteine, the 21<sup>st</sup> amino acid present in several enzymes is true?

1. Selenium is enzymatically transferred to cysteine residue only after the full functional protein gets synthesized.
2. selenocysteine is encoded by the same codon/codons specific for cysteine with the help of a special tRNA molecule.
3. selenocysteine is encoded by the stop codon UGA with the help of a special tRNA molecule.
4. A special pool of selenocysteine exists in the cell from where it is incorporated in the polypeptide chain by AUG with the help of a special tRNA molecule.

85. Infection with certain viruses inhibits small nuclear RNA (snRNA) processing in eukaryotic host. This favours the expression of viral genes in host because

1. inhibition of snRNA destabilizes host mRNA thus favouring viral protein synthesis.
2. inhibition of snRNA interferes with splicing of host mRNA and prevent antiviral protein synthesis.
3. inhibition of snRNA inhibits host mRNA transport thus favouring viral mRNA translation.
4. snRNA inhibits only virus mRNA processing. Therefore inhibition of snRNA favours viral mRNA translation.

86. You are studying a transcriptional activator which is phosphorylated at serine residue that inactivates its nuclear localization signal. Which one of the following will be true if the serine residue in the transcription factor will be replaced by alanine?

1. No phosphorylation of the transcription factor and constitutive activation of the target gene expression.



2. No phosphorylation of the transcription factor and target gene expression will be inhibited.
3. No change in phosphorylation and target gene expression.
4. Increased phosphorylation of the transcription factor with concomitant increase of the target gene expression

87. The following statements were made about bacterial DNA gyrase, which introduces negative supercoiling in DNA.

- A. If gyrase activity is inhibited, there is an increase in replication initiation at the origin.
- B. If gyrase activity is inhibited, there is a decrease in replication initiation at the origin.
- C. Gyrases are usually ATP-dependent.
- D. When gyrase introduces negative supercoils, it decreases the linking number of a DNA loop by two.

Which of the above statement(s) is/are **NOT** true?

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

88. cDNA clones of one of the gene product of an organism was sequenced. The sequence was searched for the homology in the genomic sequence available in the database. The sequence did not match with any of the genes or any of the complete exon of a gene in the database. The following causes may explain the sequence changes in the transcript:

- A. Alternate splicing
- B. Errors occurring in the process of transcription
- C. Trans-splicing
- D. RNA editing

Which of the above cause or combination of causes may explain such result?

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

89. When a primary antibody response and cell-mediated response were induced by a protein in its native conformation, the secondary antibody response could be induced only by the native antigen whereas the secondary cell-mediated immune response could be induced by the native antigen as well as by the denatured antigen. This discrepancy may only be attributed to

1. T cell memory
2. Antigen recognition
3. Antigen processing
4. B cell memory

90. The platelet-derived growth factor (PDGF) is a dimer consisting of two identical polypeptides. On binding to its cell surface receptor, it induces dimerization of the receptor by binding to two receptor molecules. If the intracellular C-terminal domain of the receptor is truncated, which one of the following is most likely to occur?

1. Both ligand binding and receptor dimerization will be hampered.
2. Ligand binding will take place followed by consequent signal transduction.
3. Ligand binding will be hampered.
4. Ligand binding will take place but no downstream signaling will be triggered.

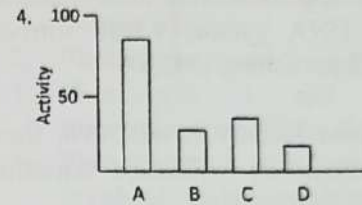
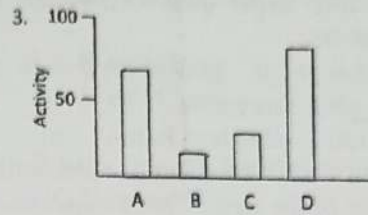
91. Cytochalasins are the drugs that inhibit actin polymerization into microfilaments. Colchicine blocks tubulin subunit interaction. Which of the following combinations is true for the effect of cytochalasin and colchicine on mammalian cell division?

1. Cytochalasin inhibits mitosis and colchicine inhibits cytokinesis.
2. Cytochalasin inhibits cytokinesis and colchicine inhibits mitosis.
3. Both cytochalasin and colchicine inhibit mitosis.
4. Both cytochalasin and colchicine inhibit cytokinesis.



92. Methotrexate is an anti cancer compound which targets dihydrofolate reductase (DHFR). It acts as

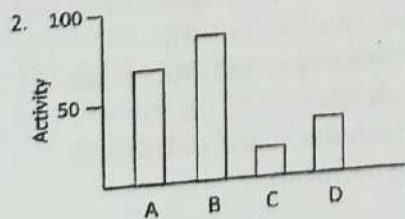
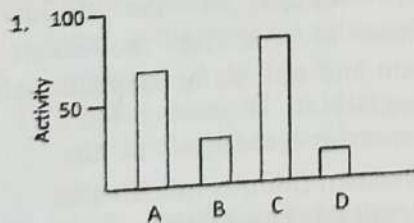
1. a competitive inhibitor of DHFR and is therefore cytotoxic during S phase of the cell cycle.
2. a non-competitive inhibitor of DHFR and is therefore cytotoxic during G1 phase of the cell cycle.
3. an activator of DHFR and is therefore cytotoxic during S phase of the cell cycle.
4. an activator of DHFR and is therefore helps in the proliferation of cancer cells.



93. NF- $\kappa$ B is a transcription factor that plays a pivotal role in immune response and inflammatory response. In its resting state, NF- $\kappa$ B is rendered inactive in the cytosol by bound with I $\kappa$ B. When cell is treated with TNF- $\alpha$ , I $\kappa$ B gets phosphorylated by IKK and subsequently degraded by proteasome. NF- $\kappa$ B thus becomes free and translocates to the nucleus and gets activated. In an experiment, a cell is subjected to the following treatment:

- A. TNF- $\alpha$
- B. TNF- $\alpha$  + proteasome inhibitor
- C. siRNA for I $\kappa$ B + TNF- $\alpha$
- D. siRNA for IKK + TNF- $\alpha$

What will be the best-fit graph for NF- $\kappa$ B activity if it is measured by NF- $\kappa$ B luciferase assay?



94. Physical attachment between cell to cell or between cells to extracellular matrix imparts rigidity to a tissue. Which of the following characteristic is NOT true for cell junction?

1. Desmosomes are cell-cell anchoring junctions connecting intermediate filament in one cell with that in the next cell.
2. Hemidesmosomes are cell matrix anchoring junctions connecting actin filament in one cell with that in the next cell.
3. Gap junctions in animals and plasmodesmata in plants are channel-forming junctions.
4. Occluding junctions seal the gaps between cells to make the cell sheet into an impermeable barrier.

95. Gradients of morphogens determine the future dorsal-ventral and anterior-posterior axes of the developing embryo in many organisms. How is the anterior-posterior axis developed in *C. elegans*?

1. Sperm entry leads to reorganization of the cytoskeleton and redistribution of naturally packed PAR proteins, which in turn determine the anterior-posterior axis.



2. After fertilization  $\beta$ -catenin gets localized into the nucleus of the future anterior cells.
  3. The P-granules are localized in a way consistent with a role as a morphogenetic determinant and they act through translational regulation to initiate anterior-posterior axis.
  4. The localization of the maternally expressed polypeptide SKN-1 is responsible for the anterior-posterior axis.
96. How will the regeneration of a newt limb be affected if the nerve supply is severed before amputation?
1. Partial regeneration will occur where only the proximal structures will be formed.
  2. Regeneration of most of tissues of the limb occurs normally but the regeneration of the nerve will fail.
  3. Regeneration will occur but the identity of the limb is lost and normal proximal-distal patterning will not occur.
  4. A blastema will form but not grow and regeneration will fail.
97. The mechanisms specifying the three axes of a tetrapod limb are interrelated and coordinated. In case of chick limb development the following statements were made:
- A In the positive feedback loop, the fibroblast growth factor (FGF) from the apical ectodermal ridge (AER) activates sonic hedgehog (Shh) transcription thereby stabilizing the zone of polarizing activity (ZPA).
  - B In the inhibitory loop, Shh from the ZPA inhibits Gremlin which blocks the bone morphogenetic proteins (BMPs) thus preventing the BMP mediated inactivation of the FGFs in the AER.
  - C The dorsal-ventral axis is formed by the expression of Wnt7a in the ventral portion of the limb ectoderm.
- D The BMPs are involved both in inducing apoptosis and in differentiating the mesenchymal cells into cartilage.
- Which of the above combination of statements is true?
1. A and B
  2. A and D
  3. B and C
  4. C and D
98. Flower development is controlled by multiple developmental pathways in *Arabidopsis thaliana*. Which of the following statement on flower development is **NOT** correct?
1. Gibberellins can affect flowering.
  2. Photoperiod, such as short day cycle (8 hour light and 16 hour darkness), promotes flowering.
  3. Vernalization or low temperatures control flowering.
  4. FT protein plays a key role in flowering.
99. The following experiments related to vulva development in *C. elegans* were performed:
- When the anchor cell was killed by laser beam at early embryonic development and embryo was allowed to develop, a vulva did not form.
  - When any three out of the six hypodermal cells were killed and embryo was allowed to develop, a normal vulva formed.
  - When any four out of six hypodermal cells were killed and embryo was allowed to develop a normal vulva did not form.
  - When anchor cell as well as any one of the six hypodermal cells were killed, the vulva did not form.
- Based on the above observations, the following conclusions were made:
- A. Out of six hypodermal cells, any three get involved in vulva formation.



- B. The fourth hypodermal cell plays a major role in vulva formation.  
C. Anchor cell as well as the middle three hypodermal cells only has the ability to participate in vulva formation.  
D. Anchor cell is essential for vulva formation.

Which of the above statement or combination of statements is correct?

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

100. In two major ways the neural plate is converted into a neural tube, primary neurulation and secondary neurulation.

- A. In primary neurulation, a hollow neural tube is formed.  
B. In secondary neurulation, the neural tube arises from the coalescence of mesenchymal cells into a solid cord.  
C. The solid cord formed in secondary neurulation subsequently gets hollowed.

Which of the above processes is/are involved in brain development in vertebrates?

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

101. Given below are a few statements regarding light reaction of photosynthesis

- A. Photosystem II oxidizes water to  $O_2$  and in the process releases protons into lumen.  
B. Photosystem II oxidizes water to  $O_2$  and in the process releases protons into stroma.  
C. ATP synthase produces ATP while protons go back through it from lumen to stroma.  
D. ATP synthase produces ATP while protons go back through it from stroma to lumen.

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

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

102. Which one of the following statements is NOT correct?

1. Phototropins are autophosphorylating protein kinases.
2. Phototropin 1 and 2 are flavoproteins.
3. Phototropin 1 and 2 are the photoreceptors of blue light.
4. Phototropin 1 and 2 are not directly involved in phototropic movements.

103. Jasmonic acids (JA) that are known to activate many defense responses in plants are biosynthesized in chloroplast and peroxisome. Which one of the following reactions is confined to peroxisome only during biosynthesis of JA?

1. Conversion of 12, 13-epoxy linolenic acid to 12-oxo-phytodienoic acid by the action of allene oxide cyclase.
2. Conversion of 12-oxo-phytodienoic acid to 3-oxo-2(2' [Z]-pentenyl) - cyclopentane-1-octanoate by the action of oxo-phytodienoate reductase.
3. Conversion of linolenic acid to 13-hydroperoxy linolenic acid by lipoxygenase.
4. Conversion of 13-hydroperoxy linolenic acid to 12,13-Epoxy linolenic acid by allene oxide synthase.

104. Following are some enzyme-substrate combinations involved in the conversion of photosynthetically formed triose-phosphate to sucrose.

- A. Fructose-1, 6-bisphosphate aldolase: Dihydroxyacetone phosphate.  
B. UDP-glucose pyrophosphorylase: UDP-Glucose.  
C. Sucrose 6-phosphate synthase: Fructose-6-phosphate.  
D. Phosphofructo kinase: Fructose 6-phosphate



Which one of the following combinations of above enzyme-substrate combinations is correct?

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

105. Nitrate reductase is a key enzyme of nitrate assimilation process. Which of the following statements is **INCORRECT** about the nitrate reductase?

1. Nitrate reductase-mediated reaction involves the transfer of one electron.
2. Nitrate reductase is influenced by nitrate and carbohydrate.
3. Nitrate reductase converts nitrate to nitrite in the cytosol.
4. Nitrate reductase is influenced by light.

106. Which one of the following statements on plant hormones is **INCORRECT**?

1. Salicylic acid is intimately involved in shoot and root elongation.
2. Ethylene is involved in senescence and fruit ripening.
3. Abscissic acid plays a key role in seed germination and drought responses.
4. Jasmonic acid inhibits root growth and is involved in pathogenesis.

107. SNARE complexes are important for guiding synaptic transmission and  $\text{Ca}^{2+}$  binding is essential for activation of neurotransmitter release from the pre-synaptic terminal. In lieu of the above, identify the components of the SNARE complex that are activated in a sequential manner in order to facilitate neurotransmitter uptake, docking and release.

1. Syntaxin  $\rightarrow$  synaptotagmin  $\rightarrow$  synaptobrevin
2. Synaptotagmin  $\rightarrow$  synaptobrevin  $\rightarrow$  SNAP-25
3. Synaptobrevin  $\rightarrow$  syntaxin  $\rightarrow$  SNAP-25
4. SNAP-25  $\rightarrow$  synaptotagmin  $\rightarrow$  syntaxin

108. A steroid hormone receptor contains a functional nuclear localization signal in the ligand-binding domain. A specific hormone-based drug for that receptor, which was seen to enter the cytosol, could not efficiently carry out its function in tumors. This could be due to the following reasons:

- A. Mutations in the ubiquitous bipartite signal clusters.
- B. Lack of communication between importin- $\alpha$  and importin- $\beta$ .
- C. Pairing of the NLS with proline-tyrosine.
- D. Presence of Ran-GTP prior to entry of the complex through the nuclear pore.

Which one of the following combinations stated above is correct?

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

109. On investigating the excretory organs of an organism that was found in an office backyard, the following structures were identified. A funnel-like structure to collect the waste, duct-like structures to carry the waste to nephrostomes and finally nephridiopores through which waste leaves the body. What species could the organism be?

- |              |            |
|--------------|------------|
| 1. Earthworm | 2. Ascaris |
| 3. Snail     | 4. Spider  |

110. The following statements may be proposed for respiration in humans:

- A. Capacity of lungs depends on the height, age, sex and weight of a person.
- B. People born and living at sea level have higher lung capacity than people living at high altitudes.
- C. Human lungs are 'overbuilt' and have tremendous reserve volume as compared to oxygen exchange requirements when at rest.
- D. Apnea prevents absorption of oxygen and releases  $\text{CO}_2$  from the lungs.



Which combination of the above statements is **INCORRECT**?

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

111. A cardiac patient was admitted to the hospital after a heart block was detected, specifically 'infra-Hisian block'. The doctors identified the problem in the bundle of His. Which one of the following statements is true regarding the bundle of His?

1. The bundle of His is a collection of specialized nerve fibres which help in electrical conduction.
2. The intrinsic rate of the bundle of His is 20 or less beats per minute.
3. The bundle is located only in the ventricles to allow for contraction.
4. The bundle arises in blood vessels that are connected to the lung and bring  $O_2$  to the heart.

112. In the process of respiration the oxygen inspired reaches the cells through haemoglobin of blood.

- A. The oxygen is used to oxidize various toxic substances in the peroxisomes.
- B. The molecular oxygen enters in Krebs cycle occurring in the mitochondrial matrix and forms  $CO_2$ .
- C. The oxygen combines with  $H^+$  ions entering through ATP synthase in the matrix and forms water.
- D.  $H^+$  ions combine with electrons donated by electron transport chain forming molecular hydrogen.

Which of the above four statement(s) is/are correct for utilization of oxygen in respiration?

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

113. *Drosophila melanogaster* males ( $\sigma$ ) with normal wing size and grey body colour is crossed with females ( $\phi$ ) having vestigial

wings and yellow body colour. Vestigial wing and yellow body colour are recessive characters. The  $F_1$  progeny is sib-mated. In the  $F_2$  progeny the following phenotypes are observed in the ratios given below:

S.No.	Phenotype		Sex	Ratio
	Wing shape	Body colour		
1.	Normal	Grey	Male	3
2.	Normal	Yellow	Male	3
3.	Normal	Grey	Female	3
4.	Normal	Yellow	Female	3
5.	Vestigial	Grey	Male	1
6.	Vestigial	Yellow	Male	1
7.	Vestigial	Grey	Female	1
8.	Vestigial	Yellow	Female	1

The above observation suggests:

1. Yellow body colour is X-linked, while vestigial wing is an autosomal character.
2. Yellow body colour is autosomal, while vestigial wing is an X-linked character.
3. Both yellow body and vestigial wing are X-linked character.
4. Both yellow body and vestigial wing are autosomal and un-linked.

114. A cross is made between an  $Hfr$  strain that is  $met^+ thi^+ pur^+$  and an  $F^-$  that is  $met^- thi^- pur^-$ . The recombinants are selected on medium that contains supplements that satisfy only the requirements for  $pur$  and  $thi$  and not for  $met$ . These recombinants are tested for the presence of the  $thi^+$  and  $pur^+$  alleles. The following number of colonies are found for each genotype:

$met^+ thi^+ pur^+$	200
$met^+ thi^+ pur^-$	0
$met^+ thi^- pur^+$	7
$met^+ thi^- pur^-$	60

What is the order of genes in the  $Hfr$  strain?

1.  $met^+ pur^+ thi^+$
2.  $met^+ thi^+ pur^+$
3.  $thi^+ met^+ pur^+$
4.  $pur^+ met^+ thi^+$

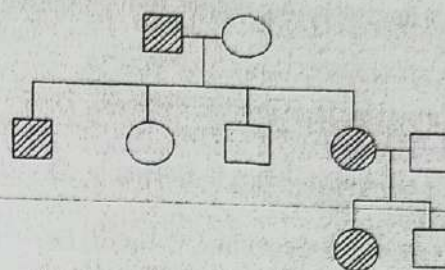


115. Of the following meiotic events

- (A) formation of synaptonemal complex
- (B) crossing over
- (C) arrangements of chromosomes at the equatorial plate at Metaphase I
- (D) separation of chromatids at Anaphase II

which one(s) lead to variation?

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



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

116. The results of a complementation test for five independent mutants (1 to 5) are summarized below:

1	2	3	4	5	
0	0	0	+	+	1
	0	0	+	+	2
		0	+	+	3
			0	0	4
				0	5

‘+’ represents complementation; ‘0’ represents non-complementation.

Based on the above, which one of the following conclusion is correct?

1. There are two cistrons. Mutations 1, 2 and 3 belong to one cistron; while 4 and 5 belong to a second cistron.
2. There is a single cistron. Mutations 1, 2 and 3 can recombine out from 4 and 5.
3. Each mutation represents a cistron.
4. There are two linkage groups. 1, 2, 3 comprise one group while 4 and 5 comprise the second group.

117. Following are four modes of inheritance:

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

Which of the above modes can explain the inheritance of a common trait shown in the pedigree below?

118. When gamete formation occurs in individuals heterozygous for an inversion, some of the following possibilities may occur:

- (A) A pericentric inversion heterozygote results in an acentric and a dicentric chromosome at the end of meiosis I
- (B) A paracentric inversion heterozygote also results in an acentric and a dicentric chromosome at the end of meiosis I
- (C) 25% of gametes formed in inversion heterozygotes are non-viable
- (D) Inversions are considered as cross-over suppressors because the gametes having a cross over product do not survive

Which combination of the above statements is correct to explain the meiotic consequence in translocation heterozygote?

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

119. The special features of 4 different aquatic invertebrates (A, B, C, D) are given below.

- A. It is sessile as adult but free-swimming in larval stage.
- B. It reproduces both sexually and asexually.
- C. It undergoes a torsion of internal organs during development.
- D. Its respiratory organs are called book lungs.



Which of the following names the 4 animals correctly?

1. A-Barnacle, B-Daphnia, C-Snail, D-Scorpion
2. A-Snail, B-Daphnia, C-Barnacle, D-Scorpion
3. A-Daphnia, B-Scorpion, C-Snail, D-Barnacle
4. A-Snail, B-Barnacle, C-Scorpion, D-Daphnia

1. A=Cambium, B=Carpel, C=Euphyll  
D=Seed (ovule), E=Double Fertilization
2. A=Euphyll, B=Cambium, C=Seed (ovule)  
D=Carpel, E=Double Fertilization
3. A=Carpel, B=Euphyll, C=Cambium  
D=Double Fertilization E=Seed (ovule)
4. A=Carpel, B=Double Fertilization, C=Euphyll  
D=Seed (ovule), E=Cambium

120. Following is a coded matrix representing threatened plants and animals of India.

	Endangered	Vulnerable
Plants	A	B
Animals	C	D

In the above matrix, letters A, B, C and D represent

1. A= *Capparis pachyphylla*,  
B= *Myristica malabarica*  
C= *Macaca silenus*,  
D= *Equus hemionus*
2. A= *Saraca asoca*,  
B= *Madhuca diplostemon*  
C= *Ursus thibetanus*,  
D= *Ailurus fulgens*
3. A= *Pterocarpus santalinus*,  
B= *Berberis nilghiriensis*  
C= *Elephas maximus*,  
D= *Viverra civettina*
4. A= *Cupressus cashmeriana*,  
B= *Dipterocarpus grandiflorus*  
C= *Ursus thibetanus*,  
D= *Sus salvanius*

122. Summary of characters between two taxa based on presence (1) and absence (0) data is given below:

	Taxon A		
		1	0
	Taxon B	1	0
		30	10
		0	25
		35	

Based on above, the Jaccard's coefficient of association will be

1. 0.35.
2. 0.25.
3. 0.55.
4. 0.65.

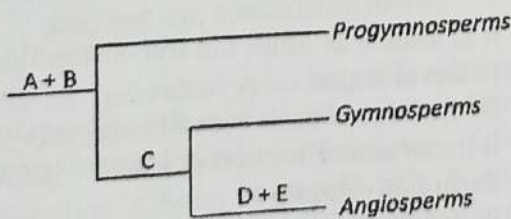
123. Following table shows plants and animals commonly associated with a biogeographic zone of India:

Biogeographic Zone	Plant	Animal
A	<i>Salvadora oleoides</i>	<i>Equus hemionus</i>
B	<i>Tectona grandis</i>	<i>Elephas maximus</i>
C	<i>Quercus leucotrichophora</i>	<i>Ailurus fulgens</i>

Which of the following represents three biogeographic zones correctly?

1. A. Deccan Peninsula, B. Gangetic Plains, C. Himalaya.
2. A. Western Ghats, B. Gangetic Plains, C. Trans-Himalaya
3. A. Indian Desert, B. Deccan Peninsula, C. Himalaya
4. A. Western Ghats, B. Gangetic Plains, C. Northeast India

121. Following is a diagram showing phylogenetic relationship among plant taxa.



In the above diagram, symbols A, B, C, D and E represent:



124. Select the correct match of larval forms to the given sequence of animals-

Molluscs, Cnidarians, Crustaceans, Starfishes and Sea urchin.

- A. Glochidium, Planula, Zoea, Bipinnaria, Echinopluteus
- B. Glochidium, Actinula, Zoca, Brachiolaria, Echinopluteus
- C. Ammocoete, Megalopa, Maggot, Bipinnaria, Ophiopleuteus
- D. Bipinnaria, Planula, Glochidium, Brachiolaria, Zoca

Which of the above order or combination orders of larval forms match with the given sequence of animals:

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

125. For a dominance-diversity relationship curve of a community, species sequence was plotted on the X axis and relative importance on the log Y axis. The relationship resulted in a straight line, which represents the

- 1. geometric model and niche pre-emption hypothesis.
- 2. log normal model and random-niche boundary hypothesis.
- 3. broken stick model and random-niche boundary hypothesis.
- 4. lognormal model and niche pre-emption hypothesis.

126. In tolerance model of succession, environment modified by early occupants is

- 1. less suitable for subsequent recruitment of Early Successional Species (ESS), but has little or no effect on the subsequent recruitment of Late Successional Species (LSS).

- 2. less suitable for subsequent recruitment of ESS and more suitable for the recruitment of LSS.
- 3. more suitable for subsequent recruitment of ESS and less suitable for the recruitment of LSS.
- 4. less suitable for the subsequent recruitment of both ESS and LSS.

127. Which of the following statements is correct according to the plant vigor hypothesis dealing with herbivore-plant interaction?

- 1. Herbivores prefer to attack slow growing stressed plants which produce leaves that are higher in nitrogen.
- 2. Herbivores prefer to attack fast-growing plants rather than slow growing, stressed plants.
- 3. Small amount of grazing will increase plant growth and fitness rather than cause harm to the plants.
- 4. Higher plant growth rates will result in less investment in defensive chemicals.

128. In a 3-species interaction, assume that it leads to competition in habitat A, but to facilitation in habitat B. Which of the following is true about the niches of these species?

- 1. Fundamental niches are larger than realized niches in habitat A but the opposite in habitat B.
- 2. Fundamental niches are smaller than realized niches in habitat A, but opposite in habitat B.
- 3. Fundamental niche and realized niches are equal in habitat B, but fundamental niches are larger than realized niches in habitat A.
- 4. Fundamental niches and realized niches are equal in habitat A, but realized niches are larger than fundamental niches in habitat B.



129. The Lotka-Volterra model of competition between species A and B is given by the equations

$$\text{Species A: } \frac{dN_A}{dt} = r_A N_A \left( \frac{K_A - N_A - \alpha N_B}{K_A} \right)$$

$$\text{Species B: } \frac{dN_B}{dt} = r_B N_B \left( \frac{K_B - N_B - \beta N_A}{K_B} \right)$$

Given that species A always wins, which of the following is true according to the model

1.  $K_2 > K_1/\beta$  and  $K_1 < K_2/\alpha$
2.  $K_2 > K_1/\alpha$  and  $K_1 < K_2/\beta$
3.  $K_2 < K_1/\beta$  and  $K_1 > K_2/\alpha$
4.  $K_2 < K_1/\alpha$  and  $K_1 > K_2/\beta$

130. The birth rates and death rates of an insect are 0.25 and 0.05 respectively. In a habitat with a carrying capacity of 500, when the population density is 100, by how much does the insect population size increase per unit time if (a) the growth is exponential and (b) growth is logistic?

1. a: 16, b: 20
2. a: 20, b: 20
3. a: 20, b: 16
4. a: 25, b: 20

131. Which of the following attributes increase the extinction risk for a species?

1. High trophic status, limited geographical distribution, specialized niche
2. Low trophic status, limited geographical distribution, specialized niche
3. High trophic status, wide geographical distribution, specialized niche
4. Low trophic status, wide geographical distribution, specialized niche

132. For an individual A to help his relative B or C, the fitness benefits and costs are 50 and 20 units, respectively. However, following Hamilton's Rule, A should help B only but not C. How are B and C genetically related to A?

1. B-Son, C-Nephew
2. B- Son, C-Brother
3. B- Sister, C- Nephew
4. B- Father, C-Mother

133. Species serving as a proxy for entire communities and ecosystems, so that the entire system is conserved if they are conserved, are known as:

1. indicator species.
2. flagship species.
3. keystone species.
4. umbrella species.

134. How is genetic variation in a population related to inbreeding and finite population size?

1. Both finite population size and inbreeding lead to decrease in genetic variation.
2. Only inbreeding leads to a decrease in genetic variation, population size has no effect.
3. Both inbreeding and finite population size lead to an increase in genetic variation.
4. Neither of the two factors has any effect on genetic variation in the population.

135. In a population, alleles p and q are known to be in a ratio of 0.7p : 0.3q. At Hardy-Weinberg equilibrium how many heterozygotes (pq) can be expected in a sample of 60?

1. 25
2. 42
3. 49
4. 9

136. In order to study evolutionary relatedness between two given individuals, homology and analogy are considered. By this study we may observe the following possible information:

- A. Presence of homologous structures indicate adaptive radiation.
- B. Presence of analogous structure indicate convergent evolution.



- C. Homology also refers to divergent evolution.
- D. Analogous structures develop due to the fact that different unrelated groups of organism evolved under similar environmental conditions.

Which of the above possibilities correctly explain the evolutionary process?

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

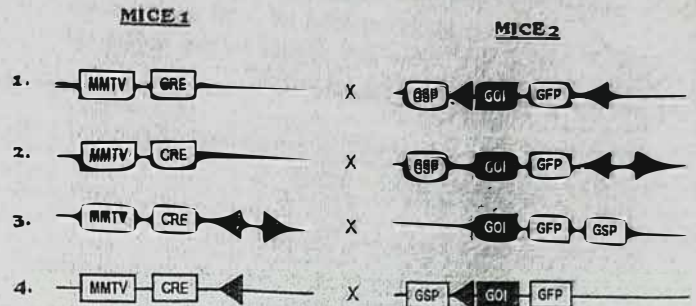
137. Following are some statements related to raising transgenic plants

- A. T-DNA of *Agrobacterium* contains oncogenes and opine synthesis genes
- B. All 8 operons present in vir region of *Agrobacterium* is essential for virulence
- C. The CaMV35S RNA promoter is a very strong constitutive promoter used in plant transformation
- D. Conjugative transfer (oriT or tra) region functions in conjugative transfer of the Ti-plasmids

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

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

In order to create an animal whose prostate gland is devoid of the p53 gene, engineered animals were created by cloning specially designed knock-out cassettes. Identify the most appropriate cassette combination for creating the knock out animal by breeding.



MMTV = Mouse Mammary Tumor Virus  
GRE = Cre recombinase  
GSP = Gene specific promoter  
GCI = Gene of interest  
= loxP site

139. Microorganisms having nitrilase activity can be enriched from soil samples by supplying nitriles as the sole nitrogen or carbon source in the growth medium. A problem with this approach is that false-positive strains may be isolated, which use nitriles to produce amide with the help of a different enzyme activity such as

1. phosphorylases
2. phosphatases
3. hydratases
4. phosphoesterases

140. The average size of human genome is about  $3.2 \times 10^9$  base pairs. Considering 60% of it is made up of A-T base pairs, what will be the frequency of the following restriction sites to be present in human genome in high to low order?

X = 5'-GAATTC-3'  
Y = 5'-ACCGGT-3'  
Z = 5'-CGCG-3'

1. X > Y > Z
2. Z > X > Y
3. Y > Z > X
4. Z > Y > X



141. The circular dichroism spectrum of a polypeptide composed of ~50 amino acids does not show any signal in the region of 185-250 nm. The reason is:

1. the polypeptide is composed of only achiral amino acids
2. there is no helix or  $\beta$  sheet conformation, only beta-turns are present
3. the polypeptide is in random conformation
4. the % of helix and  $\beta$  sheet are equal

142. In an oil immersion microscope, a drop of oil must be placed between the tip of objective lens and the specimen. The oil

- A. reduces the numerical aperture of the objective lens.
- B. increases the numerical aperture of the objective lens.
- C. prevents light from bending (refraction) as it passes through the specimen.
- D. improves the resolving power by a factor of  $1/n$  (n being the refractive index of oil).

Which of the above statement/s is/are true for an oil-immersion microscope?

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

143. You have isolated spleen cells and purified your desired enzyme from the spleen cell extract by a sequence of steps involving ammonium sulfate fractionation and gel chromatography. You found an increase in the specific activity of the enzyme in the purified fraction compared to cell free extract and made the following speculations:

- A. Cell free extract contained inhibitor bound enzyme
- B. Structure of the enzyme was modified during the course of purification

- C. Purification steps gradually removed the inhibitors
- D. The final fraction contained concentrated enzyme preparation

Which one of the following combination is appropriate?

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

144. In an attempt to follow up the time dependent expression of a new protein "X" following transfection of its gene into an animal cell in culture, total protein was extracted at various time points. Next, it was decided to run the protein mixture in a SDS - PAGE followed by western blotting to assess its expression (time dependent). A trend of increase in band intensity was observed in the blot. To confirm this increase, one important aspect was missing. Identify this aspect from the list below.

1. Equal loading controls
2. Use of appropriate primary antibody
3. Use of appropriate secondary antibody conjugated to enzyme
4. Use low affinity secondary antibody conjugated to enzyme

145. In the population of an insect species, 50% are known to be female. How many females should turn up in a random sample of 40 insects to reject the null hypothesis ( $\chi^2$  value for rejection is  $\geq 3.84$ )?

1. 6
2.  $\leq 26$  or  $\leq 8$
3. 25
4.  $\leq 7$  or  $\geq 27$



ANSWER KEY									
LIFE SCIENCES (ENGLISH-GUWHATI)									
QNO	KEY	QNO	KEY	QNO	KEY	QNO	KEY	QNO	KEY
1	2	36	4	71	6	106	2	141	1
2	1	37	2	72	2	107	2	142	1
3	2	38	1	73	2	108	4	143	2
4	3	39	4	74	1	109	1	144	1
5	4	40	3	75	2	110	3	145	4
6	4	41	2	76	3	111	2		
7	3	42	1	77	6	112	4		
8	3	43	2	78	3	113	1		
9	4	44	4	79	4	114	1		
10	4	45	5	80	1	115	2		
11	2	46	1	81	2	116	1		
12	3	47	3	82	1	117	2		
13	1	48	2	83	4	118	1		
14	4	49	2	84	2	119	1		
15	4	50	2	85	2	120	1		
16	4	51	1	86	1	121	2		
17	1	52	4	87	4	122	4		
18	2	53	1	88	2	123	3		
19	4	54	4	89	3	124	2		
20	4	55	1	90	4	125	1		
21	3	56	2	91	2	126	1		
22	3	57	4	92	1	127	2		
23	3	58	2	93	1	128	1		
24	4	59	2	94	2	129	4		
25	1	60	3	95	1	130	3		
26	1	61	1	96	4	131	1		
27	2	62	2	97	2	132	1		
28	2	63	4	98	2	133	4		
29	1	64	4	99	3	134	1		
30	2	65	3	100	1	135	1		
31	3	66	4	101	4	136	4		
32	1	67	3	102	4	137	2		
33	2	68	2	103	2	138	1		
34	4	69	1	104	3	139	3		
35	2	70	3	105	1	140	2		