



**GYAN BINDU ACADEMY PVT. LTD.**  
**(The Concept Based Teaching Institute)**  
**9350172220**

**Time : 3 Hours**

**Maximum Marks : 200**

**INSTRUCTIONS**

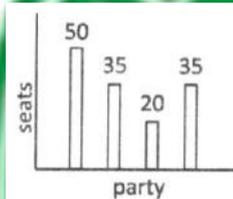
1. You have opted for English as medium of Question Paper. This Test Booklet contains one hundred and forty five (20 Part A + 50 Part B + 75 Part C). Multiple Choice Questions (MCQs). You required to answer a maximum of 15, 35 and 25 questions from part A, B and C respectively. If more than required 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. OMR 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 OMR 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 OMR 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, Subjected 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 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.

**PART A**

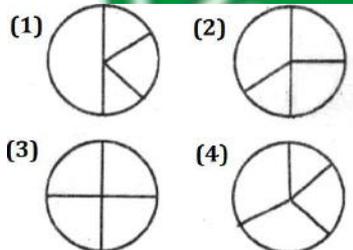
- Two cockroaches of the same species have the same thickness but different lengths and widths. Their ability to survive in oxygen deficient environments will be compromised if:
  - Their thickness increases, and the rest of the size remains the same.
  - Their thickness remains unchanged, but their length increases
  - Their thickness remains unchanged, but their width decreases.
  - Their thickness decreases, but the rest of the size remains unchanged

**Ans: (1) As the thickness will increase the diffusion of oxygen will become difficult and cockroach will not be able survive in oxygen deficient environments.**

- The bar chart shows number of seats won by four political parties in a state legislative assembly.



Which of the following pie-charts correctly depicts this information? (2)



**Ans: (2) First and third bar = 50 %**

- The random errors associated with the measurement of P and Q are 10% and 2% , respectively . What is the percentage random error in P/Q?

- 12.0
- 9.8
- 8.0
- 10.2

**Ans: (1) Error % of numerator and denominator will get added up. So error % in P/Q will become 10+2 = 12%.**

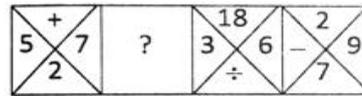
- In how many distinguishable ways can the letters of the word CHANGE be arranged?

- 120
- 720
- 360
- 240

**Ans: (3) Chance = 6!/2! = 6×5×4×3×2×1/ 2×1 = 360.**

- Find the missing term. (Answer 1)

[Type text]



- (1)
- (2)
- (3)
- (4)

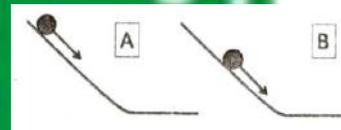
**Ans: (1) If we move in clockwise direction then answer will be 1. In first square, 2+5=7, in second square it will be 7×2=14 (answer 1), in third, it is 18/6=3 and in fourth square, 9-7=2.**

- Seeds when soaked in water gain about 20% by weight and 10% by volume. By what factor does the density increase?

- 1.20
- 1.10
- 1.11
- 1.09

**Ans: (4) Density = M/V = 12/11= 1.09 D**

- Retarding frictional force,  $f$ , on a moving ball, is proportional to its velocity,  $V$ . Two identical balls roll down identical slopes (A & B) from different heights. Compare the retarding forces and the velocities of the balls at the bases of the slopes.



- $f_A > f_B ; V_A > V_B$
- $f_A > f_B ; V_B > V_A$
- $f_B > f_A ; V_B > V_A$
- $f_B > f_A ; V_A > V_B$

**Ans: (1) (Potential energy is converted into kinetic energy  $v^2$  is proportional to  $h$  so  $v_a > v_b$ , and since  $f$  is proportional to  $V$ , so  $f_a > f_b$ ).**

- A river is 4.1 km wide. A bridge built across it has 1/7 of its length on one bank and 1/8 of its length on the other bank. What is the total length of the bridge?

- 5.1 km
- 4.9 km
- 5.6 km
- 5.4 km

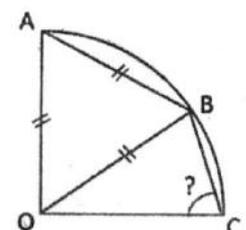
**Ans: (3) Length of the bridge is x,**

$$X = 4.1 + x/7 + x/8, x - x/7 - x/8 = 4.1, 56x - 8x - 7x/56 = 4.1, 41x/56 = 4.1, x = 5.6$$

- OA, OB and OC are radii of the quarter circle shown in the figure. AB is also equal to the radius.

What is angle OCB?

- 60°
- 75°
- 55°
- 65°



**Ans: (2) ΔAOB is an equilateral triangle so all the angles will be 60°.**

[Type text]

OB = OC as both are radius.

Now  $\angle OCB = \angle OBC$

Now  $\angle AOC = 90^\circ$

$\angle BOC = 90 - 60 = 30^\circ$

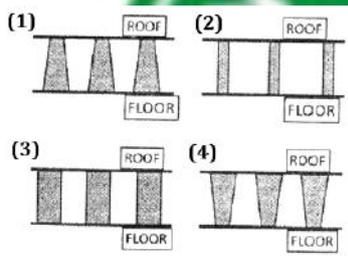
$30^\circ + \angle OCB + \angle OBC = 180^\circ$ ,  $\angle OCB = 180 - 30 / 2 = 75^\circ$ .

10. Intravenous (IV) fluid has to be administered to a child of 12 kg with dehydration, at a dose of 20 mg of fluid per kg of body weight, in 1 hour. What should be the drip rate (in drops/min) of IV fluid? (1 mg = 20 drops)

- (1) 7 (2) 80  
(3) 120 (4) 4

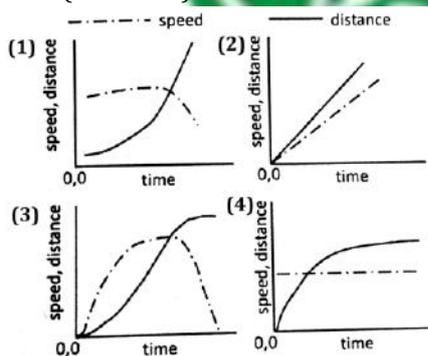
Ans: (2) For 1Kg= 20mg, For 12Kg= 240 mg. 240 mg= 4800 drops/hour, 4800/60 = 80 drops/min

11. A hall with a high roof is supported by an array of identical columns such that, to a person lying on the floor and looking at the ceiling, the columns appear parallel to each other. Which of the following designs conforms to this? (Answer 1)



Ans: (1)

12. Which of the following graphs correctly shows the speed and the corresponding distance covered by an object moving along a straight line? (Answer 3)



Ans: (3) As speed will become zero, distance will become constant.

13. A normal TV screen has a width to height ratio of 4:3, while a high definition TV screen has a ratio of 16:9. What is the approximate ratio of their diagonals, if the heights of the two types of screens are the same?

- (1) 5:9 (2) 5:18  
(3) 5:15 (4) 5:6

Ans: (4)

14. Comparing numerical values, which of the following is different from the rest?

- (1) The ratio of the circumference of a circle to its diameter.  
(2) The sum of the three angles of a plane triangle expressed in radians.  
(3) 22/7  
(4) The net volume of a hemisphere of unit radius, and a cone of unit radius and unit height.

Ans: (3) Numerical value has given.

15. If a person travels x% faster than normal, he reaches y minutes earlier than normal. What is his normal time of travel?

- (1)  $\left(\frac{100}{x} + 1\right)y$  minutes  
(2)  $\left(\frac{x}{100} + 1\right)y$  minutes  
(3)  $\left(\frac{y}{100} + 1\right)x$  minutes  
(4)  $\left(\frac{100}{y} + 1\right)x$  minutes

Ans: (1) Normally considering, distance = speed × time

Modified case, (speed + x × speed/100) = distance/(time-y) or, speed (1+x/100) = distance/(time-y)

Substituting for distance, speed (1+x/100) = speed × time / (time-y) on cancelling speed on RHS and LHS,

$1 + x/100 = \text{time} / \text{time} - y \text{time} = \text{time} - y + x(\text{time} - y) / 100$

16. A and B walk up an escalator one step at a time, while the escalator itself move up at a constant speed. A walks twice as fast as B. A reaches the top in 40 steps and B in 30 steps. How many steps of the escalator can be seen when it is not moving?

- (1) 30 (2) 40  
(3) 50 (4) 60

Ans: (4) The number of Steps B walked =  $40 \times \frac{1}{2} = 20$ . Thus B has to take  $40 - 20 = 20$  steps to reach to the top. But B takes =  $30 - 20 = 10$  steps only. Thus remaining is the speed of the escalator i.e.  $20 - 10 = 10$  steps. Speed of B: Speed of escalator = 10:10 = 1:1, Speed of A : Speed of B : Speed of escalator 2:1: 1, So speed of B = speed of escalator Which means when escalator is not moving then B has to climb double the steps it moves when escalator is moving  $30 \times 2 = 60$  steps

17. Two iron spheres of radii 12 cm and 1 cm are melted and fused. Two new spheres are made

without any loss of iron. Their possible radii could be:

- (1) 9 and 4 cm                      (2) 9 and 10 cm
- (3) 8 and 5 cm                      (4) 2 and 11 cm

**Ans: (2) New combined volume =  $\frac{4}{3} \pi (12^2+1^3) = \frac{4}{3} \pi (1728+1)$  or  $\frac{4}{3} \pi (1000+729)$ , so the final volumes of two newly made spheres =  $\frac{4}{3} \pi (10^3+ 9^3)$ .**

18. A man buys alcohol at Rs. 75/cL, adds water, and sells it at Rs. 75/cL making a profit of 50%. What is the ratio of alcohol to water?

- (1) 2:1                                      (2) 1:2
- (3) 3:2                                      (4) 2:3

**Ans: (1) CP = 75/cL rs Profit = 50 % ; SP = 75 x 1.5 = 112.5**

**Quantity sold =  $112.5/75 = 1.5$ ; Therefore ratio of alcohol: water = 2:1**

19. The sum of digits of a two-digit numbers is 9. If the fraction formed by taking 9 less than the number as numerator and 9 more than the number as denominator is  $\frac{3}{4}$ , what is the number?

- (1) 36                                      (2) 63
- (3) 45                                      (4) 54

**Ans: (2) Let the number be  $10x+y, x+y = 9$   
 $10x+y-9/10x+y+9 = \frac{3}{4}, 40x+4y-36 = 30x+3y+27,$   
 $10x+y = 36+27 = 63.$**

20. The distance between X and Y is 1000km. A person flies from X at 8 AM local time and reaches Y at 10 AM local time. He flies back after a halt of 4 hours at Y and reaches X at 4 PM local time on the same day. What is his average speed for the duration he is in the air?

- (1) 500 km/hour                      (2) 250 km/hour
- (3) 750 km/hour
- (4) Cannot be calculated with the given information

**Ans: (1) Distance = 1000+1000 = 2000 Km**

**Time = 2 hr + 2 hr = 4 hr, so speed =  $2000/4 = 500$  Km/Hr.**

**PART-B**

21. RNA editing, a post transcriptional process, is achieved with the help of guide RNA (g RNA) which one of the following statement about the process is NOT true?

- (1) g RNA dependant RNA editing happens in the kinetoplast of DNA.
- (2) g-RNA is involved in chemical modification of t-RNA.

(3) This process involves insertion or deletion of uridines.

(4) Sequences edited once may be re-edited using second g-RNA.

**Ans: (2) Guiding RNA edit the mitochondrial DNA, which other way also called kinetoplast as well. This process involves insertion and deletion of uridines. Guiding RNA never modify the t-RNA. That's the wrong option.**

22. Telomerase, a RNA- protein complex which completes the replication of telomeres during DNA synthesis, is a specialized

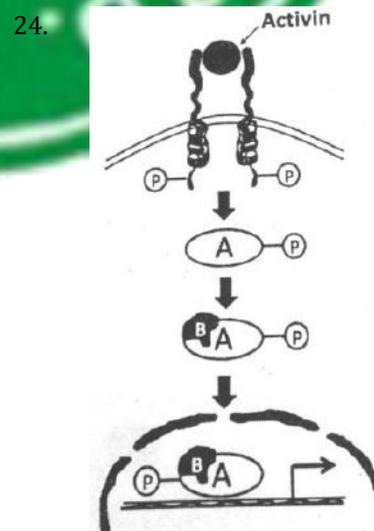
- (1) RNA dependent DNA polymerase
- (2) DNA dependent DNA polymerase
- (3) DNA dependent RNA polymerase
- (4) RNA dependent RNA polymerase

**Ans: (1) Telomerase synthesize only one strand, it already has its own RNA primer so we call it RNA dependent DNA polymerase.**

23. Consider a short double-stranded linear DNA molecule of 10 complete turns with 10.5 bp/turn. The ends of the DNA molecule are sealed together to make a relaxed circle. This relaxed circle will have a linking number of

- (1) 105                                      (2) 20.5
- (3) 10.0                                      (4) 10.5

**Ans: (3) For Relaxed DNA the linking number is equal to the number of twist in DNA molecule. As number of turns is equal to 10 so the linking number will be 10.  $Lk = Tw + Wr$**



In the above signaling cascade, which of the following molecules is denoted by 'B'?

- (1) STAT 5                                      (2) SMAD 6
- (3) GSK 3  $\beta$                                       (4) SMAD 4

**Ans: (4) Activin/TGF-beta activates TypeI and TypeII receptor. Which in turn activates Smad1 and Smad3. Smad4 is Co-Smad in TGF/Activin signalling which is always required for Smad-dimer formation. (Cooper-Cell)**

25. The secondary antibodies routinely used for the detection of primary antibodies in western blotting experiment are

- (1) anti-allotypic                      (2) anti-idiotypic
- (3) anti-isotypic                        (4) anti-paratypic

**Ans: (3) Secondary antibody are raised in different host. Therefore it is anti-isotypic. Isotypic antibodies have same constant region in same species. Therefore different species inherit different constant region of HC and LC. If primary antibody is raised in mouse secondary should of different host may be rabbit or goat. (Kuby)**

26. Which of the following events will NOT usually lead to transformation of a normal cell into a cancer cell

- (1) Gain of function of oncogenes
- (2) Loss of function of tumor suppressors
- (3) Gain of function of genes involved in nucleotide excision repair
- (4) Loss of function of pro-apoptosis related genes

**Ans: 3) DNA repair enzymes are like tumor suppressor genes in which loss of function mutation result in cancer. Rest all options promotes cancer development.**

27. Which of the following a food borne toxin

- (1) Tetanus toxin                      (2) Botulinum toxin
- (3) Cholera toxin                        (4) Diptheria toxin

**Ans: (2 and 3) Botulinum toxin is a food borne toxin, generally. Cholera toxin is water born, some time it is food born but not generally.**

28. Excess oxygen consumed after a vigorous exercise is

- (1) to pump out lactic acid from muscle
- (2) to increase the concentration of lactic acid in muscle
- (3) to reduce dissolved carbon dioxide in blood
- (4) to make ATP for gluconeogenesis

**Ans: (4) After exercise has stopped, extra oxygen is required to metabolize lactic acid; to replenish ATP, phosphocreatine, and glycogen; and to pay back any oxygen that has been borrowed from hemoglobin, myoglobin (an iron-containing substance**

**similar to hemoglobin that is found in muscle fibres), air in the lungs, and body fluid.**

29. Which one of the following describes the primary function of flippases?

- (1) Help in increasing lipid protein interaction in the outer leaflet of the bilayer
- (2) Move certain phospholipids from one leaflet of the membrane to another
- (3) Localize more negatively charged membrane proteins in the lipid bilayer
- (4) Cause uncoupling of v-SNARES and t-SNARES after fusion of incoming vesicle with target membrane

**Ans: (2) Flippases are the enzyme responsible for movement of proteins across lipid bilayer. It is required for maintaining asymmetric lipid bilayer structure. (REF- Molecular Cell book )**

30. Mitotic cyclin-CDK activity peaks in M phase. This is because

- (1) Mitotic cyclin is synthesized only in M phase.
- (2) Threshold level of mitotic cyclin accumulates only in late G<sub>2</sub>.
- (3) Cyclin subunit is activated by phosphorylation only in M phase.
- (4) The kinase subunit is activated by dephosphorylation only in M phase.

**Ans: (4) CDK1-Cyclin B synthesis occurs in late G2 phase but its activated by Cdc25P in M phase. Inhibitory phosphate group is attached on Thr-15 or Tyr-14 in mammalian CDK1 by Wee-1 kinases in lateG2 phase. But during M phase transition Cdc25Phosphatases removes inhibitory phosphate and CDK1 becomes activated in M-phase. (REF- Molecular Cell)**

31. Choose the most appropriate pH at which the net charge is 0 for the molecule from the data shown below.



- (2) miRNA and snoRNA
- (3) mRNA and snoRNA
- (4) tRNA and 5S rRNA

**Ans: (4) Factual question.**

37. Apical ectodermal ridge induction is essential tetrapod limb development. Which of the following is NOT essential for the formation of a functional limb?

- (1) Tbx genes and Wnt
- (2) Androsterone
- (3) Apoptotic gene
- (4) Fibroblast growth factor

**Ans: (2) Androsterone is a indigenous steroid hormone which doesn't take part in the limb formation. Tetrapode limb development is a complex process of organogenesis which initiate with the formation of a concentration gradient of Retinoic acid which lead to the expression of different set of hox genes from anterior to posterior somites. Tbx genes are essential for differentiation of the hind limbs and fore limbs and FGF play a very important role in the development of AER during limb development.**

38. Which of the following statement is WRONG?

- (1) Megasporocyte develops within the megasporangium of the ovule
- (2) Megasporocyte undergoes meiosis to produce four haploid megaspores
- (3) All the four megaspore undergo several mitotic division to form female gametophyte in most angiosperms
- (4) Female gametophyte is haploid

**Ans: (3) In most angiosperms only one megaspore develops to produce mega-gametophyte.**

39. Certain proteins or mRNAs that are regionally localized within the unfertilized egg and regulate development are called

- (1) gene regulators.
- (2) morphometric determinants .
- (3) cytoplasmic determinants.
- (4) mosaic forming factors.

**Ans: (3) In drosophila, unfertilized egg contains certain maternal mRNAs which are located in different regions of egg and play an important role in the formation of anterior-posterior and dorsal-ventral symmetry in embryo. These maternal mRNAs are called cytoplasmic determinants.**

40. Cell to cell communication is important in development of an organism. The ability of cells to respond to a specific inductive signal is called
- (1) Regional specificity of induction
  - (2) Competence
  - (3) Juxtracrine signalling
  - (4) Instructive interaction

**Ans: (2) Competence is ability to respond.**

41. Which one of the following compounds is NOT a part of alkaloid class of secondary metabolites?

- (1) Lignin
- (2) Indole
- (3) Tropane
- (4) Pyrroidine

**Ans: (1) Indole, Tropane and pyrrolidone all are alkaloid class of molecules. Lignin is a phenolic compound.**

42. Which one of the following best describe the symplast pathway of water flow from the epidermis to endodermis in plant root?

- (1) Water moves through cell walls and extracellular spaces without crossing any membrane
- (2) Water travel across the root cortex via the plasmodesmata
- (3) Water crosses the plasma membrane of each cell in its path twice, once on entering and once on exiting
- (4) Transport across the tonoplast

**Ans: (2) Symplast is living pathway of cells connected through plasmodesmata.**

43. The herbicide, dichlorophenyldimethylurea, is an inhibitor of

- (1) Shikimate pathway for biosynthesis of aromatic amino acids.
- (2) Electron transport from P680 to P700.
- (3) Branch in amino acid pathway.
- (4) Electron transport from P700 to ferredoxin.

**Ans: (2) DCDU stops the electron transport from PS II to PS I, so PS I is P700 and PS II is P680, So third option is correct.**

44. Vasopressin secretion does NOT increase with

- (1) Exercise
- (2) An increase in extracellular fluid volume
- (3) Standing
- (4) Vommiting

**Ans: (2) Vasopressin or ADH helps in water conservation in the body and thus is secreted under conditions like sweating, diarrrohea, vommiting etc. Vassopressin secretion is also affected by body posture with a progressive increase in secretion while standing. Moreover, a decrease in extracellular**

**volume and not an increase will cause ADH secretion.**

45. Which one of the following does NOT occur due to stimulation of baroreceptors?

- (1) Bradycardia                      (2) Hypotension  
(3) Venodilation                      (4) Vasoconstriction

**Ans: (4) Baroreceptors or pressoreceptors, which are located in the wall of each internal carotid artery at the carotid sinus, and in the wall of the aortic arch. After the baroreceptor signals have entered the medulla, secondary signals eventually inhibit the vasoconstrictor centre of the medulla and excite the vagal centre. The net effects are vasodilatation of the veins and arterioles throughout the peripheral circulatory system and decreased heart rate and strength of heart contraction.**

46. Serum has essentially the same composition as plasma EXCEPT that it lacks

- (1) Albumin  
(2) Stuart-Prower factor  
(3) Antihemophilic factor  
(4) Hageman factor

**Ans: (3) Serum doesn't have fibrinogen, Clotting factor II, V and VIII. Factor VIII is called anti-hemophilic factor.**

47. Which type of cells located in gastric glands is responsible for the release of histamine?

- (1) Mucus neck cells  
(2) Enterochromaffin like cells  
(3) Chief cells  
(4) Parietal cells

**Ans: (2) Histamine in the stomach occurs in endocrine cells (so-called enterochromaffin-like (ECL) cells. Local release of histamine is thought to be necessary for the stimulation of parietal cells. They are located basally in the oxyntic gland area, in the chief-cell-rich region.**

48. Which one of the following plant derived signalling molecule induces hyphal branching of arbuscular mycorrhizal fungi, a phenomenon that is observed at the initial stages of colonisation of these fungi?

- (1) Salicylic acid                      (2) Abscisic acid  
(3) Strigolactones                      (4) Systemin

**Ans: (3) Strigolactones promotes VAM.**

49. If non-disjunction occurs in meiosis I, which of the following scenario is most likely to occur?

- (1) Two gametes will be n+1 and two will be n-1  
(2) One gametes will be n+1, two will be 'n' and one will be n-1

(3) Two gametes will be normal and two will be n-1

(4) Two gametes will be normal and two will be n+1

**Ans: (1) Nondisjunction is that a chromosome pair failed to separate during the meiotic division. This will create one daughter cell with an extra chromosome and another daughter cell with one less chromosomes. If the nondisjunction occurs during the first meiotic division (meiosis I), all the gametes derived will be abnormal.**

50. Which one of the following is true for cells harbouring F' plasmid?

- (1) Their F plasmid is non-functional.  
(2) They exhibit increased rates of transfer of all chromosomal genes.  
(3) They are merodiploids.  
(4) They fail to survive as the chromosomal origin of replication is inactivated.

**Ans: (3) F' plasmids have extra-chromosomal DNA, which gets wrongly excised. If any bacteria has fertility factors they r called merodiploids.**

51. Maternal inheritance of coiling of shell in snail (*limnaea peregra*) is well established. The dextral coiling depends on dominant allele *D* and sinistral coiling depends upon recessive allele *d*. A female F1 progeny of dextral(*Dd*) type is crossed with a male sinistral snail. What will be the ratio of heterozygous : homozygous individuals in its F2 progeny?

- (1) 3:1                                      (2) 1:1  
(3) 1:3                                      (4) 1:2:1

**Ans: (2) The inheritance pattern for certain genes in which the genotype of the mother directly determines the phenotype of the offspring is called maternal type of inheritance. 1 DD: 2 Dd: 1 dd-all are dextral the ratio between heterozygous and homozygous will be 1:1.**

52. Which of the following mutagens is most likely to results in a single amino acid change in a gene product?

- (1) Acridine orange  
(2) X-rays  
(3) Ethylmethane sulphonate (EMS)  
(4) Ethidium bromide

**Ans: (3) EMS is alkylating agent.**

53. Which one of the following statements supports the concepts of trade-off in the evolution of life history trades?

- (1) Level of parental care and clutch size are positively correlated.  
(2) Animals mature in early tend to live longer

- (3) An increase in the seed size is usually associated with the decrease in the seed number.  
 (4) Allocation of higher energy for reproduction leads to higher population growth

**Ans: (3) A trade-off in evolution means one trait cannot increase without a decrease in another (or vice versa).**

54. A plot of  $dN/dt$  as a function of population density yields a  
 (1) rectangular hyperbola  
 (2) negative exponential curve  
 (3) positive rectilinear curve  
 (4) bell-shaped curve

**Ans: (4) Plot of  $dN/dt$  or change in the population size, first increases with increase in the population size, reaches to max at half carrying capacity after that decreases as the population size approach carrying capacity.**

55. For a species having logistic growth, if  $K = 20,000$  and  $r = 0.15$ , the maximum sustainable yield will be (\* question)  
 (1) 450 (2) 1500  
 (3) 3000 (4) 6000

**Ans: (All the options are wrong) Logistic Growth Equation incorporates changes in growth rate as population size approaches carrying capacity.**

$$\frac{dN}{dt} = rN \left(1 - \frac{N}{K}\right)$$

**Overall population growth rate is highest at half of carrying capacity ("maximum sustained yield") i.e.  $K/2$**

**Putting  $N = K/2$  in the above equation,**

$$\frac{dN}{dt} = r \frac{K}{2} \left(1 - \frac{K/2}{K}\right) \quad \text{or} \quad \frac{dN}{dt} = r \frac{K}{2} \left(1 - \frac{1}{2}\right)$$

$$\text{or} \quad \frac{dN}{dt} = r \frac{K}{4} \quad \text{or} \quad \frac{dN}{dt} = r \frac{K}{2} \left(\frac{1}{2}\right)$$

**Putting the given values of  $r$  and  $K$   $\frac{0.15 \times 20,000}{4} = 750$**

56. which of the following is a correct ranking of ecosystems based on the roots: shoot ratio of plants?  
 (1) Tropical wet forest > Tropical dry forest > Temperate grassland > Tropical grassland  
 (2) Temperate grass land > Tropical grassland > Tropical wet forest > Tropical dry forest  
 (3) Tropical dry forest > Tropical wet forest > Tropical grassland > Temperate grassland  
 (4) Temperate grass land > Tropical grassland > Tropical dry forest > Tropical wet forest

**Ans: (4) In majority of the ecosystems root biomass resides in the upper 1 m of the soil. Grasslands allocate a large proportion of their biomass below ground, resulting in large root to shoot ratios. For forests the**

**root:shoot ratios decreases because of the accumulation of standing aboveground biomass, such as in the stems of forest trees.**

57. Which of the following periods is known as "Age of fishes"?  
 (1) Devonian (2) Jurassic  
 (3) Cambrian (4) Carboniferous

**Ans: (1) Age of Fishes. In Devonian time, from about 415 to 355 million years ago**

58. Which of the following is NOT an assumption of the Hardy-Weinberg model?  
 (1) Population mates at random with respect to the locus in question  
 (2) Selection is not acting on the locus in question.  
 (3) One allele is dominant and other is recessive at this locus  
 (4) The population is effectively infinite in size

**Ans: (3) Hardy Weinberg principle states If an infinitely large, random mating population is free from outside evolutionary forces (i.e. mutation, migration and natural selection), then the gene frequencies will not change over time.**

59. Which of the following geographical periods is characterized by the first appearance of mammals?  
 (1) Tertiary (2) Cretaceous  
 (3) Permian (4) Triassic

**Ans: (1) The Tertiary period has been origin and still is the age of mammals.**

60. An alga having chlorophyll a, floridean starch as storage product and lacking flagellate cells belongs to the class  
 (1) Phaeophyceae (2) Chlorophyceae  
 (3) Rhodophyceae (4) Xanthophyceae

**Ans: (3) Floridean starch is characteristic feature of red algae.**

61. Which of the following is NOT true for monocots?  
 (1) Sieve tube members with companion cells  
 (2) Vasculature atactostelic  
 (3) Tricolpate pollen  
 (4) Vascular cambium absent.

**Ans: (3) Tricolpate pollens are a characteristic of eu-dicots.**

62. Individuals occupying a particular habitat and adapted to it phenotypically but not genotypically are known as  
 (1) Ecophenes (2) Ecotypes  
 (3) Ecospecies (4) Coenospecies

**Ans: (1) Morphological forms are ecophenes (ecads).**

63. Different leads are used to record ECG of humans. Which one of the following is NOT unipolar leads?

- (1) Augmented limb leads
- (2) V1 and V2 leads
- (3) Standard limb leads
- (4) VR and VL leads

**Ans: (3) Standard limb lead is not unipolar lead, rest all are unipolar**

64. The presence and distribution of specific mRNAs within a cell can be detected by
- (1) Northern blot analysis
  - (2) RNase protection assay
  - (3) In situ hybridization
  - (4) Real-time PCR

**Ans: (3) Within the cell one has to do in-situ hybridisation. In in-situ hybridisation we try to see the molecular interactions directly. Rest methods are outside the cellular systems or in-vitro methods involving molecular biology.**

65. In which of the following mating systems there is likely to be NO conflict of interest over reproductive success between the sexes?
- (1) polyandry
  - (2) monogamy
  - (3) promiscuity
  - (4) polygamy

**Ans: (2) Monogamy is one to one mating.**

66. Which one of the following analytical techniques does NOT involve an optical measurement?
- (1) ELISA
  - (2) Microarray
  - (3) Flow cytometry
  - (4) Differential Scanning Calorimetry

**Ans: (4) DSC is a thermo-analytical technique in which the difference in the amount of heat required to increase the temperature of a sample and reference is measured as a function of temperature. Rest all techniques uses optical detectors.**

67. Which genes have been introduced in Bollgard II cotton to get resistance against cotton bollworm, tobacco bollworm and pink bollworm?
- (1) cry 1Ab + cry 1Ac
  - (2) cry 1Ac + cry 2 Ab
  - (3) cry 1Ab + cry 2 Ab
  - (4) cry9 C cry 1Ab

**Ans: (2) Factual Question**

68. An optical measurement of protein is taken both before and after digestion of the protein by a protease. In which of the following spectroscopic measurement the signal change, i.e., before v/s after protease treatment, could be the maximum?
- (1) Absorbance at 280 nm
  - (2) Circular dichromism
  - (3) Absorbance at 340nm
  - (4) Fluorescence value

**Ans: (1) Proteins in solution absorb ultraviolet light with absorbance maxima at 280 nm, once peptide is degraded absorbance will increase as aromatic amino acids will become free from the protein.**

69. The tetanus vaccine given to humans in the case of a deep cut is a
- (1) DNA vaccine
  - (2) Recombinant vector vaccine
  - (3) Subunit vaccine
  - (4) Toxoid vaccine

**Ans: (4) Tetanus vaccine is a toxoid type.**

70. The electrospray ionization spectrum of a mixture of two peptides show peak with m/z values 301, 401, 501 and 601. The molecular weight of the peptides are
- (1) 1200 and 1250
  - (2) 1200 and 1500
  - (3) 1350 and 1500
  - (4) 1220 and 1350

**Ans: (2) ESI gives multiple charge species so peptide molecular weight can vary from its original molecular weight. A mass spectrum gives M/Z ration where M is mass and Z is charge. So 301, 401 and 601 are representing one peptide 1200 M. and 501 is representing 1500 one.**

### PART-C

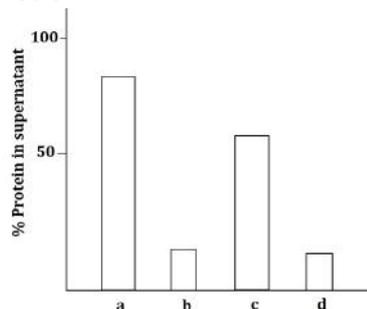
71. From the following statements,
- A. For a reaction to occur spontaneously the free energy change must be negative
  - B. The interaction between two nitrogen molecules in the gaseous state is predominantly electrostatic
  - C. By knowing the bond energies, it is possible to deduce whether the bond is covalent or hydrogen bond
  - D. Hydrophobic interactions are not important in a folded globular protein.

Pick the combination with ALL WRONG statements.

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

**Ans: (4) Hydrophobic interaction are responsible for proper folding. Nitrogen is apolar so no electrostatic interactions.**

72. A researcher investigated the a set of conditions for a protein with an isoelectric point of 6.5 and also bind to calcium. This protein was subjected to four independent treatments: (i) pH 6.4, (ii) 10% glycerol, (iii) 10mM CaCl<sub>2</sub>, (iv) 40% ammonium sulphate. This was followed by centrifugation and estimation of protein in supernatant. The results are depicted in the graph below:

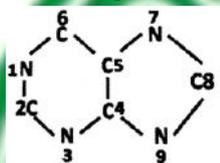


Which of the following treatments best represents the results shown in the graph?

- (1) a = ammonium sulphate, b = glycerol, c = pH 6.4, d = CaCl<sub>2</sub>
- (2) a = CaCl<sub>2</sub>, b = glycerol, c = ammonium sulphate, d = pH 6.4
- (3) a = pH 6.4, b = CaCl<sub>2</sub>, c = ammonium sulphate, d = glycerol
- (4) a = CaCl<sub>2</sub>, b = pH 6.4, c = glycerol, d = ammonium sulphate

**Ans: (4) Protein near their PI value gets precipitated, as pH 6.4 is very near to its PI value so we will get minimum protein in the supernatant, which is either b or d. Ammonium sulphate also precipitates the proteins, so minimum protein in the supernatant. CaCl<sub>2</sub> and glycerol will help in the solubilization they max protein will be present in the supernatant. So only correct is fourth option.**

73. In the biosynthesis of purine:



- (1) All N atoms, C4 and C5 from Aspartic acid
- (2) N1 is from aspartic acid; N3 and N9 are from Glutamine side- chain; N7, C4 and C5 are from Glycine
- (3) N1 is from Aspartic acid; N3 from Glutamine side- chain ; N9 from N attached to C $\alpha$  of Glutamine; N7, C4 and C5 from Glycine
- (4) N1 is from Glutamine; N3 from Glutamine side- chain; N9 from N attached to C $\alpha$  of Glutamine; N7, C4 and C5 from Glycine

**Ans: (2) Nitrogen N1 comes from aspartic acid, N3 and N9 comes from of glutamine, N7 C4 and C5 comes from Glycine.**

74. Consider from the following statements,

- A. Hydrogen, Deuterium and Tritium differ in the number of protons
- B. Hydrogen, Deuterium and Tritium differ in the number of neutrons
- C. Both Deuterium and Tritium are radioactive and decay to Hydrogen and Deuterium, respectively.
- D. Tritium is radioactive and decays to Helium
- E. Carbon-14 decays to Nitrogen-14
- F. Carbon-14 decays to Carbon-13

Pick the combination with ALL correct statements

- (1) A, B and F
- (2) B, D and E
- (3) A, C and D
- (4) C, E and F

**Ans: (2) Hydrogen, Deuterium and Tritium differ in neutrons. Tritium is radioactive and it decays**

**to form helium. Carbon-14 decays to nitrogen-14.**

75. The following are four statements on the peptides/proteins conformation:

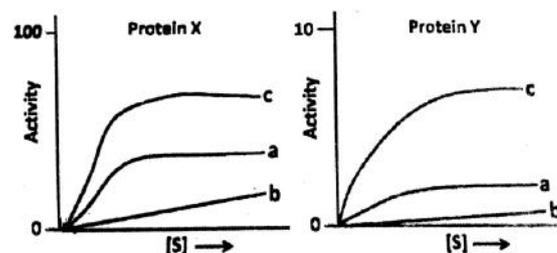
- A. Glycine has a largest area of conformationally allowed space in the Ramachandran plot of  $\Phi$  and  $\Psi$
- B. A 20-residue peptide that is acetylated at the N- terminus and amidated at the C- terminus has  $\Phi = -600 (\pm 5)$ ,  $\Psi = -300 (\pm 5)$  for all the residues. It can be concluded that conformation of the peptide is helix-turn-strand
- C. The allowed values of  $\Phi$ ,  $\Psi$  for amino acids in a protein are not valid for short peptide
- D. A peptide Acetyl-A<sub>1</sub> - A<sub>2</sub> -A<sub>3</sub> -A<sub>4</sub>-CONH<sub>2</sub> (A<sub>1</sub>-A<sub>4</sub> are amino acids) adopts well defined  $\beta$ -turn. The dihedral angles of A<sub>2</sub> and A<sub>3</sub> determined the type of  $\beta$ -turn

Choose the combination of correct statements.

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

**Ans: (3) Glycine is the most flexible amino acid so that's why it has the largest area in the Ramachandran plot. The peptide which has 20 residues and it acetylated and amidated at N and C terminals, phi value of -60 and psi value of -30 shows that it has helical conformation only, not helix turn strand. The short peptides are highly unstable structure so they form random structures, which can be present in disallowed regions as well. We can confirm type of beta turn with the help of dihedral angles.**

76. A researcher was investigating the substrate specificity of two different enzymes, X and Y, on the same substrate. Both the enzymes were subjected to treatment with either heat or an inhibitor which inhibits the enzyme activity. Following are the results obtained where, a= inhibitor treatment, b = heat treatment, c= control.



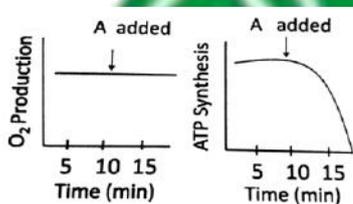
Which of the following statements is correct?

- (1) Only protein X is specific for the substrate, S
- (2) Only protein Y is specific for the substrate, S

- (3) Both X and Y are specific for the substrate, S
- (4) Both X and Y are non-specific for the substrate, S

**Ans: (1) As it can be observed from the heat treatment b plots of both that protein X showing more stability in the presence of its substrate. Protein Y is less stable as compared to protein X during heat treatment, so protein X is much more specific. Protein X is showing higher turnover number of  $V_{max}$  also shows that it is much more specific.**

77. 'A' is an inhibitor of chloroplast function. The production of  $O_2$  and synthesis of ATP are measured in illuminated chloroplast before and after addition of 'A' as shown below.



Which statement is correct?

- (1) 'A' inhibits the reduction of  $NADP^+$
- (2) 'A' inhibits the proton gradient and the reduction of  $NADP^+$
- (3) 'A' inhibits the proton gradient but not the reduction of  $NADP^+$
- (4) 'A' inhibits neither the proton gradient nor the reduction of  $NADP^+$

**Ans: (3) As from the plots it can be observed that there is no change in the  $O_2$  production but there is inhibition of ATP synthesis, so this inhibitor is reducing or inhibiting proton gradient which is responsible for the ATP synthesis, but not the reduction of  $NADP^+$ .**

78. During cell cycle progression from  $G_1$  to S, cyclin D-CDK4 phosphorylates Rb and reduces its affinity for E2F. E2F dissociates from Rb and activates S-phase gene expression. Overexpression of protein 'A' arrests  $G_1$  phase progression. Which of the following statement is true?

- (1) 'A' inhibits Rb-E2F interaction
- (2) 'A' inhibits CDK4 activity
- (3) 'A' phosphorylates E2F
- (4) 'A' degrades Rb

**Ans: (2) If A inhibits CDK4 it will cease  $G_1$  progression. CDK4 in the active form will be**

**required for the progression of cell cycle from  $G_1$  phase to S phase.**

79. Cells in S- phase of the cell cycle were fused to cells in the following stages of cell cycle: (a)  $G_1$  phase, (b)  $G_2$  phase, (c) M phase these cells were then grown in the medium containing tritiated thymidine. The maximal amount of freshly labelled DNA is likely to be obtained in S- phase cells fused with
- (1)  $G_1$  phase cells
  - (2)  $G_2$  phase cells
  - (3) M phase cells
  - (4) Both  $G_1$  and  $G_2$  phase cells

**Ans: (1)  $G_1$  fusion with S phase nucleus will promote early entry of  $G_1$  phase cells into S phase and therefore more radiolabelled DNA will be produced. Cell cycle progression occurs in the order of  $G_1$ -S- $G_2$ -M. Cells in  $G_2$  phase cannot come back to S phase if fused with S phase nucleus, since progression is unidirectional. (Molecular Cell)**

80. Addition of antibiotic cephalaxin to growing *E. coli* cells lead to filamentation of the cells, followed by lysis. Cephalaxin is an inhibitor of
- (1) Protein synthesis
  - (2) DNA synthesis
  - (3) Peptidoglycan synthesis
  - (4) RNA polymerase

**Ans: (3) Cephalaxin is responsible for the inhibition of peptidoglycan synthesis. If proper cell wall is not formed than *E. coli* cells will get lysed.**

81. Fluorescently tagged protein was used to study protein secretion in yeast. Fluorescence was observed in:
- (a) the Golgi
  - (b) the secretory vesicles
  - (c) the rough ER.

Which of the following describes the best sequence in which these events occur?

- (1)  $a \rightarrow b \rightarrow c$
- (2)  $b \rightarrow c \rightarrow a$
- (3)  $c \rightarrow a \rightarrow b$
- (4)  $c \rightarrow b \rightarrow a$

**Ans: (3) Sequence is from ER-Golgi-Secretory vesicles. Movement of secretory molecules occurs from RER-cisGN-trans-GN-Secretory vesicles and finally to the plasma membrane. (Molecular Cell)**

82. In order to ensure that only fully processed mature mRNAs are allowed to be exported to cytosol, pre-mRNAs associated with snRNPs are retained in the nucleus. To demonstrate this, an experiment was performed where the gene coding a pre-mRNA, with a single intron was mutated either at 5' or 3' splice sites or both the splice site.

Given below are a few possible outcomes:



- (1) Methylation of cytosine does not prevent the binding of RNA Pol II with the promoter, so housekeeping genes are expressed.
- (2) During housekeeping gene expression, the enzyme methyl transferase is temporarily silenced by mi-RNA, thus shutting down global methylation.
- (3) Unlike within the coding region of a gene, CG rich sequences present in the promoters of active genes are usually not methylated.
- (4) As soon as the Cytosine is methylated in the promoter region, the enzymes of DNA repair pathways remove the methyl group, thereby ensuring gene expression.

**Ans: (3) Housekeeping genes are essential for the survival of the cell, so these genes will not be methylated at any point of time.**

87. In an experiment, red blood cells were subjected to lysis and any unbroken cells were removed by centrifugation at 600g. The supernatant was taken and centrifuged at 100,000g, the pellet was extracted with 5M NaCl and again centrifuged at 100,000g. Which of the following protein will be present in supernatant?

- (1) Band3
- (2) Glycophorin
- (3) G protein-coupled receptor
- (4) Spectrin

**Ans: (4) Rest all three proteins are membrane linked and Spectrin is a cytosolic protein. Membrane proteins are high density proteins are therefore will pellet down at low RPM during sub-cellular fractionation of RBC. Only cytosolic proteins will remain in the supernatant. (Molecular Cell)**

88. In order to study intracellular trafficking of protein 'A', it was tagged with GFP (A-GFP). Fluorescence microscopy showed that A-GFP co-localizes with LAMP1. In the presence of bafilomycin A, an inhibitor of H<sup>+</sup>-ATPase, A-GFP does not co-localize with LAMP1. Instead, it localizes with LC3 puncta. Which one of the following statements is true?

- (1) A-GFP targets to the ER in the absence of bafilomycin A.
- (2) Autophagy is required for trafficking of A-GFP to lysosome.
- (3) Bafilomycin A facilitates targeting of A-GFP to ER.
- (4) Bafilomycin A facilitates targeting of A-GFP to mitochondria.

**Ans: LAMP and LC3 are autophagosome protein.**

89. In animals, four separate families of cell-cell adhesion proteins are listed in Column A and

their functional characteristics are given in Column B

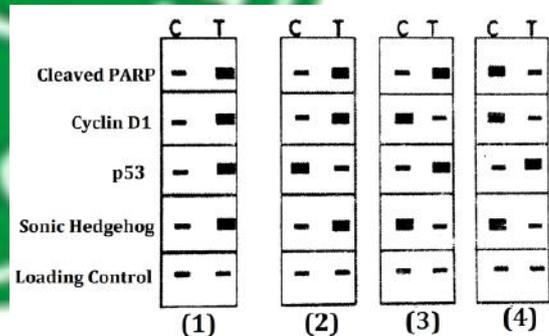
Column A	Column B
(a) Integrin	(i) Lectins that mediates a variety of transient, cell-cell adhesion interactions in the blood stream
(b) Cadherin	(ii) Contains extracellular Ig-like domain and are mainly involved in the fine tuning of cell-cell adhesive interaction during development and regeneration.
(c) Ig-superfamily	(iii) Mediates Ca <sup>2+</sup> -dependent strong homophilic cell-cell adhesion.
(d) Selectin	(iv) Transmembrane cell adhesion proteins that acts as a extracellular matrix receptor

Which one of the following is the correct combination?

- (1) a - (i), b - (ii), c - (iii), d - (iv)
- (2) a - (ii), b - (iii), c - (iv), d - (i)
- (3) a - (iii), b - (iv), c - (i), d - (ii)
- (4) a - (iv), b - (iii), c - (ii), d - (i)

**Ans: (4) Factual question**

90. A student treated cancer cells with an anticancer drug and perform western blot analysis. Which one of the following blots is the best representation under the control (C) and treated (T) samples? (Answer 3)



**Ans: (3) Level of D1 should be less and p53 should be more in presence of anti-cancerous drugs. p53 is a tumor suppressor protein and therefore its level should increase upon administrating anti-cancerous drug. CyclinD1 is G1 phase cyclin and required for cell cycle progression. If the level are reduced cells will get arrested in G1 phase and cancer will be inhibited. PARP is an enzyme required for DNA repair and therefore level should increase to inhibit cancer.**

91. In Trypanosomes, a 35 base leader sequence is joined with several different transcripts making

functional mRNAs. The leader sequence is joined with the other RNAs by

- (1) A specific RNA ligase
- (2) The process of trans-splicing
- (3) A nucleophilic attack caused by free guanine nucleotide
- (4) A nucleophilic attack caused by 2' OH of an internal A present in the leader sequence

**Ans: (2) In protozoan's when exon of one gene gets attached with exon of another gene or RNA the process is called trans-splicing.**

92. Following are the list of the pathogens (column A) and the unique mechanisms they employ for invading the immune response (column B).

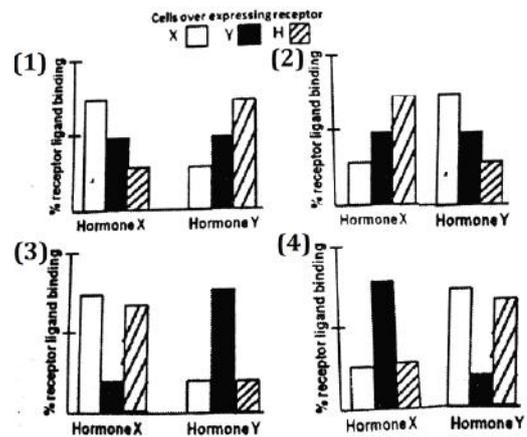
Column A	Column B
(a) <i>Trypanosoma brucei</i>	(i) Capable of employing unusual genetic processes by which they generate extensive variations in their surface glycoproteins (VSG)
(b) <i>Plasmodium falciparum</i>	(ii) Capable of continually undergoing maturational changes in transformation to two different forms which allow the organism to change its surface molecules
(c) <i>Haemophilus influenza</i>	(iii) Capable of invading immune response by frequent antigenic changes in its hemagglutinin and neuraminidase glycol-proteins

Which of the following is the correct match between the organism and their respective mechanism to evade immune response?

- (1) a - (i), b - (ii), c - (iii)
- (2) a - (ii), b - (iii), c - (i)
- (3) a - (iii), b - (i), c - (ii)
- (4) a - (i), b - (iii), c - (ii)

**Ans: (1) Factual question (Take reference online)**

93. Two steroid hormone receptors X and Y both contain a ligand binding domain. Using recombinant DNA technology, a modified hybrid receptor H is prepared such that it contains the ligand binding domain of X and DNA binding domain of Y. three sets of cells overexpressing receptors X, Y and H were then treated separately either with hormone X or with hormone Y. assuming that there is no cross-reactivity, which one of the following graphs best represent the receptor - ligand binding in each case?



**Ans: (3) Hybrid H protein will only be able to bind X hormone, because it has only X ligand binding domain. Third option shows high ligand bind in case of receptor X and H, both have binding sites for X. In case of Y hormone treatment, the ligand will only be able to bind to the Y receptor not X and H. Data based evaluation .**

94. A protein X is kept inactive state in cytosol as complexed with protein Y. Under certain stress stimuli, Y gets phosphorylated resulting in its proteasomal degradation. X becomes free, translocates to the nucleus and results in the transcription of a gene which causes cell death by apoptosis. Stress stimuli were given to the following four different cases

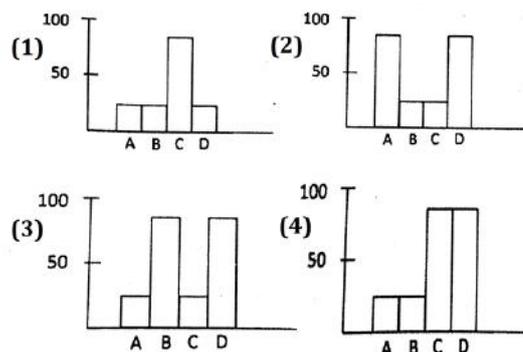
**Case A:** Protein Y has a mutation such that phosphorylation leading to proteasomal degradation does not occur.

**Case B:** Cells are transfected with a gene which encodes for a protein L that inhibits the translocation of protein Y to the nucleus.

**Case C:** Cells are transfected only with a empty vector used to transfect the gene for protein L

**Case D:** Cells are treated with Z-VAD-FMK, a broad spectrum caspase inhibitor

Which of the following graphs best describes the apoptotic state of the cells in the above cases? Y-axis represents % apoptotic cells.



**Ans: (1) Case A says that if protein Y will not get phosphorylated it will not get detached from**

protein X, so X protein will not get translocated to nucleus and will not result in the transcription of gene which is responsible for the synthesis of apoptosis. Case B says that cells are transfected with a gene which codes for protein L which inhibits the translocation of Y, the % of apoptotic cells will be low. Empty vector cells won't synthesize protein L, it means protein Y will get translocated inside the nucleus and transcription of the gene responsible for apoptosis will happen, so % of apoptotic cells will be high. Case D will inhibit all the caspases which are responsible for cell death, in this case also % of apoptotic cells will be low. Apoptosis will occur only in empty vector transfected cells. In option 2,3 and 4 apoptosis will not occur.

95. Consider the following events which occur during fertilization of sea urchin eggs.
- Resact/Speract are peptides released from the egg jelly and help in sperm attraction.
  - Bindin, an acrosomal protein interacts in a species specific manner, with eggs.
  - A "respiratory burst" occurs during cross-linking of the fertilization envelope, where a calcium- dependent increase in oxygen level is observed.
  - IP3, which is formed at site of sperm entry, sequesters calcium leading to cortical granule exocytosis.

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

- (1) Only C
- (2) A and C
- (3) Only D
- (4) B and D

**Ans: (1) The peptide Resact/superact acts as a chemo-attractant for sea urchin sperm. In the sea urchin, contact with egg jelly initiates the acrosomal reaction, which is a mediated by calcium. The acrosomal vesicle fuses with plasma membrane, release enzymes from the tip of the sperm that degrade the egg jelly. At this time, bindin is deposited on the surface of the acrosome-reacted sperm. One of the hallmarks of fertilization is that it is species-specific: sperm from one species cannot fertilize eggs of another. Sea urchin eggs synthesize H<sub>2</sub>O<sub>2</sub> in a "respiratory burst" at fertilization, as an extracellular oxidant for cross linking their protective surface envelopes. The slow block to poly-spermy in sea urchin egg is mediated by PIP2 second messenger.**

96. Following statement were given regarding decisions taken during development of mammalian embryos
- Pluripotency of inner cell mass is maintain by a core of three transcription factors, Oct 4, Sox 2 and nanog.
  - Prior to blastocyst formation each blastomere expresses both Cdx 2 and the Oct 4 transcription factors and appears to be capable of becoming either ICM or trophoblast.
  - Both ICM and trophoblast cells synthesize transcription factors Cdx 2.
  - Oct4 activates Cdx2 expression enabling some cells to become trophoblast and other cells to become ICM.

Which of the above statement are true?

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

**Ans: (3) Nanog, Oct4, and Sox2 are the core regulators of ESC pluripotency. Oct4 expression is plentiful and uniform in all cells of the embryo right through the morula stage. Nevertheless, as the outer cells of the embryo differentiate into the tropho-ectoderm (TE), Oct4 expression becomes down-regulated and limited to cells of the ICM in the blastocyst.**

97. Apoptosis during early development is essential for proper formation of different structures. In C. elegans, apoptosis is accentuated by ced-3 and ced-4 genes, which in turn are negatively regulated by ced-9 and eventually Egl-1. When compared to mammals, functionally similar homolog has been identified. Accordingly, which one of the following statements is NOT correct?

- (1) CED-4 resembles Apaf-1
- (2) CED-9 resembles Bcl-XL
- (3) CED-3 resembles caspase-3
- (4) CED-4 resembles caspase-9

**Ans: (4) In C elegans ced-9 blocks the apoptotic protein similarly as Bcl-XI in mammals, so CED-9 is homolog of Bcl-XI, while CED-3 is act as the effector caspase like mammalan caspase -3. CED-4 is the initiator protein function to activate effector apoptotic protein CED-3 like in mammals Apaf-1 functions to activate effector caspase 9. So All given**

**option are correct except option 4 as CED-4 is homolog of mammalian Apaf-1.**

98. Which one of the following statements regarding B cell receptor (BCR) and T cell receptor (TCR) is not true?

- (1) TCR is membrane bound and does not appear as soluble form as does the BCR
- (2) Unlike BCR, most of the TCR are not specific for antigen alone but for antigen combined with MHC
- (3) In order to activate signal transduction, BCR associates itself with Ig- $\alpha$ /Ig- $\beta$  whereas TCR associates with CD3
- (4) Antigen binding interaction of BCR is much weaker than TCR

**Ans: (4) BCR is MHC independent and therefore involves stronger interactions. ( Kuby)**

99. In case amphibians, the dorsal cells and their derivatives are called as "Spemann - Mangold organizer". Following statements are related to the "organizer" were made:

- A. It induces the host's ventral tissues to change their fates to form neural tube and dorsal mesodermal tissues.
- B. It cannot organize the host and donor tissues into a secondary embryo.
- C. It does not have the ability to self-differentiate into dorsal mesoderm
- D. It has ability to initiate the movements of gastrulation.
- E. Both  $\beta$ -catenin and Chordin are produced by the organizer

Which of the above statements are correct?

- (1) A and D                      (2) D and E
- (3) A and E                      (4) B and C

**Ans: (1) Spemann referred to the dorsal lip cells and their derivatives (notochord, prechordal mesoderm) as the organizer because they induced the host's ventral tissues to change their fates to form a neural tube and dorsal mesodermal tissue (such as somites), and they organized host and donor tissues into a secondary embryo with clear anterior-posterior and dorsal-ventral axes and have the ability to induce movements of gastrulation.**

100. Driesch performed famous "pressure plate" experiments involving intricate recombination with 8-celled Sea urchin embryo. This procedure reshuffled the nuclei that normally would have been in the region destined to form endoderm into the presumptive ectoderm region. If segregation of nuclear determinants had occurred, resulting embryo should have been disordered. However, Driesch obtained normal larvae from these embryos possible interpretations regarding the 8-celled sea urchin embryo are:

- A. The prospective potency of an isolated blastomere is greater than its actual prospective fate
- B. The prospective potency and prospective fate of blastomere were identical
- C. Sea-urchin embryo is a "harmoniously equipotential system" because all of its potentially independent parts interacted together to form single embryo.
- D. Regulative development occurs where location of a cell in the embryo determines its fate.

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

- (1) Only A                      (2) Only D
- (3) Only A and B              (4) A, C and D

**Ans: (4) Driesch had established that the prospective potency of an isolated blastomere (from those cell types it was possible to form it) is greater than its probable fate (those cell types it would normally give rise to over the unchanged route of its development). Next, Driesch concluded that the sea urchin embryo is a "harmonious equi-potential system" because all of its potentially self-governing parts functioned together to form a single organism. Third, he concluded that the fate of a nucleus depend solely on its location in the embryo.**

101. Read the following statements related to plant pathogen interaction

- A. Systemic acquired resistance is observed following infection by compatible pathogen
- B. Induce systemic resistance is activated following infection by compatible pathogen

- C. A bacterial infection can induce effector triggered immunity (ETI) leading to hypersensitive response locally
- D. NPR1 monomers that are released in cytosol due to salicylic acid accumulation is rapidly translocated to nucleus

Which combination of above statements is correct?

- (1) A, B and C                      (2) A, C and D
- (3) A, B and D                      (4) B, C and D

**Ans: (2) ISR is caused by non-infective microbes.**

102. Given below are statements describing various features of solute transport and photoassimilate translocation in plants:
- A. Apoplastic phloem loading of sucrose happens between cells with no plasmodesmatal connections.
  - B. Growing vegetative sinks (e.g. young leaves and roots) usually undergo symplastic phloem unloading
  - C. Movement of water between the phloem and xylem occurs only at the source and sink regions
  - D. Symplastic loading of sugars into the phloem occurs in the absences of plasmodesmatal connections

Select the option that gives combination of correct statements:

- (1) Only A and C                      (2) Only B and C
- (3) Only B and D                      (4) Only A and B

**Ans: (4) Plants can use either the symplastic or apoplastic pathway for sugar loading into phloem. Cells that lack cytoplasmic connections i.e plamodesmata go for the apoplastic pathway. Movement of water between xylem and phloem occurs usually only at the source where water moves into sieve elements through osmosis building the internal pressure which helps in movement of sugar through the phloem from source to sink (Pressure-flow mechanism). Young leaves which act as sinks usually undergo through the symplastic mode of phloem unloading.**

103. Given below are names of phytohormones in column I and their associated features / effects / function in column II.

Column I	Column II
<b>A. Auxin</b>	i. Delayed leaf senescence
<b>B. Gibberellins</b>	ii. Epinastic bending of leaves
<b>C. Cytokinin</b>	iii. Polar transport
<b>D. Ethylene</b>	iv. Removal of seed dormancy.

Select the correct set of combinations from the options given below;

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

**Ans: (3) Auxin is the only plant growth hormone that is transported unidirectionally, i.e. IAA is synthesized primarily in the apical bud and is transported unidirectionally to root. Gibberellins remove seed dormancy and promote seed germination, it activates the production of various hydrolases, particularly alpha-amylase by aleurone layers of germination cereal grains. Cytokinin delay leaf senescence. Ethylene mimics high concentration of auxin by inhibition of stem growth and cause epinasty.**

104. If in a blood transfusion, type A donor blood is given to recipient having type B blood, the red blood cells (RBC) of donor blood would agglutinate but the recipients RBCs would be least affected. These observations can be explained in the following statements.

- A. Agglutinins in recipient's plasma caused agglutination by binding with type A agglutinogens.
- B. The agglutinins of donor blood was diluted in recipient's plasma resulting in low agglutination.
- C. Low titre of anti-A agglutinins is the cause of low agglutinations of recipients RBC's.
- D. High agglutination of donor RBC's is the outcome high titre of anti-B agglutinins

Which of the above statement(s) is/are INCORRECT?

- (1) Only A                                      (2) A and B
- (3) Only B                                      (4) C and D

**Ans: (4) Both C and D options are incorrect.**

105. The arterial pressure usually raises and falls 4 to 6 mm Hg in a wave like manner causing "respiratory waves". The probable mechanism of



a chlorophyll (A0) and a bound phylloquinone (A1) to a set of 4Fe-4S clusters. From these clusters the electron is transferred to ferredoxin (Fd). The flow of electron occur from water to photosystem-II, from photosystem-II to photosystem-I and PS-I to NADP+ and arrangement is described as Z-scheme.

109. Phytochrome-mediated control of photomorphogenesis is linked to many other gene functions. The following statements are made on the mechanism of phytochrome action:
- A. Phytochrome function requires COP1, an E3 ubiquitin ligase that brings about protein degradation.
  - B. COP1 is slowly exported from the nucleus to the cytoplasm in the presence of light.
  - C. HY5 is targeted by COP1 for degradation in the presence of light.
  - D. HY5 is a transcription factor involved in photomorphogenetic response.

Which of the following combinations is correct?

- (1) A, B and C
- (2) B, C and D
- (3) A, B and D
- (4) A, C and D

**Ans: (c) Hy5 is targeted by COP1 during dark.**

110. The C<sub>4</sub> carbon cycle is a CO<sub>2</sub> concentrating mechanism evolved to reduce photorespiration. The following are stated as important features of the C<sub>4</sub> pathway:
- A. The leaves of C<sub>4</sub> plants have Kranz anatomy that distinguishes mesophyll and bundle sheath cells.
  - B. In the peripheral mesophyll cells, atmospheric CO<sub>2</sub> is fixed by phosphoenol pyruvate carboxylase yielding a four-carbon acid.
  - C. In the inner layer of mesophyll, NAD-malic enzyme decarboxylates four-carbon acid and releases CO<sub>2</sub>.
  - D. CO<sub>2</sub> is again re-fixed through Calvin cycle in the bundle sheath cells.

Which one of the following combinations is correct?

- (1) B, C and D
- (2) A, B and C
- (3) A, B and D
- (4) A, C and D

**Ans: (3) Decarboxylation does not occur in mesophyll.**

111. External pressure given on a mixed nerve causes loss of touch sensation while pain sensation remains relatively intact. On the other hand, application of local anesthetics on the same

nerve, induces loss of pain sensation keeping touch sensation least affected. These observations can be explained by the following statements:

- A. External pressure causes loss of conduction of impulses in small diameter sensory nerve fibres.
  - B. Local anesthetics depress the conduction of impulses in large diameter sensory nerve fibres.
  - C. Touch-induced impulses are carried by fibre Type A
  - D. Fibre type C is responsible for pain sensation
- Which of the above statement(s) is/are INCORRECT?

- (1) A and B
- (2) C and D
- (3) Only C
- (4) Only D

Ans: ( )

112. The probable effects of lesion of left optic tract on the vision of a human subject are given below. Identify the correct statement.

- (1) Blindness in the left eye but the visual field of right remains intact.
- (2) Blindness in the right half of the visual fields of both the eyes.
- (3) Blindness in the left half of the visual field of left eye and blindness in the right half of the visual field of the right eye.
- (4) Blindness in the left half of the visual field of both the eyes.

Ans: ( )

113. Inversions are considered as cross-over suppressors because:

- (1) Homozygous inversions are lethal and thus they do not appear in next generation.
- (2) Inversion heterozygotes, i.e., one copy having normal chromosome and its homologue having inversion, does not allow crossing over to occur as they cannot pair at all.
- (3) Due to inversion present, four chromosomes take part in the pairing and crossing over events and make the structure difficult for separation and gamete formation.
- (4) The pairing and crossing overs do occur in inversion heterozygotes but the gametes having cross over products are lethal.

**Ans: (3) It produces dicentric bridge which is recombinant and chromatids get broken.**

114. Three *met-* *E. coli* mutant strains were isolated. To study the nature of mutation these mutant strains were treated with mutagens EMS or

proflavins and scored for revertants. The results obtained are summarized below:

Mutant Strain	Mutagen treatment	
	EMS	Proflavin
A	-	+
B	+	-
C	-	-

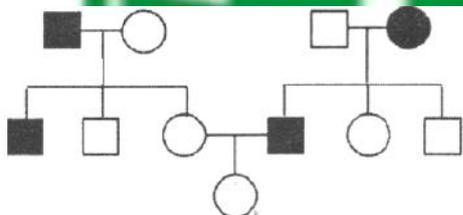
(+ stands for revertants of the original mutants and - stands for no revertants obtained).

Based on the above and the typical mutagenic effects of EMS and proflavin, what was the nature of the original mutation in each strain?

- (1) A-Transversion; B- Insertion or deletion of a single base; C- Deletion of multiple bases
- (2) A-Transition; B- Transversion; C- Insertion or deletion of a single base
- (3) A- Insertion or deletion of a single base; B- Transition; C- Deletion of multiple bases
- (4) A-Transition; B- Insertion or deletion of a multiple bases; C- Transversion

Ans: (3) proflavin is a intercalating agent so it results in insertion or deletion.

115. The following pedigree shows the inheritance pattern of a trait.



From the following select the possible mode of inheritance and the probability that the daughter in generation III will show the trait.

- (1) X-linked recessive, probability is 1/2
- (2) X-linked recessive, probability is 1/4
- (3) Autosomal recessive, probability is 1/2
- (4) Autosomal recessive, probability is 1/3

Ans: (2) The trait cannot be X-linked as it father to son transmission is not possible so must be an autosomal trait. the normal parent must be heterozygous; Aa (otherwise the trait would not be seen in the II generation) I aa X Aa Aa X aa II aa Aa X aa Aa Aa and aa. thus the probability is 1/2.

116. A pair of alleles govern seed size in a crop plant. 'B' allele responsible for bold seed is dominant over 'b' allele controlling small seed. An experiment was carried out to test if an identified dominant DNA marker (5kb band) is linked to alleles controlling seed size. A plant heterozygous for the marker and the alleles was crossed to a

small seeded plant lacking the 5kb band. 100 progeny obtained from the cross were analysed for the presence and absence of the DNA marker.

The result are tabulated below:

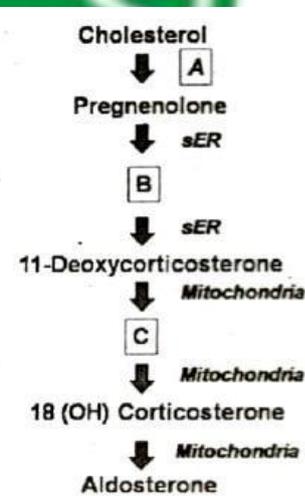
Phenotype	Plant with bold seed		Plant with small seed	
	Present	Absent	Present	Absent
No. of progeny showing presence or absence of DNA marker	22	23	27	28

Based on the above observations which one of the following conclusions is correct?

- (1) The DNA marker assort independently of the phenotype
- (2) The 5kb band is linked to the allele 'B'
- (3) The 5kb band is linked to the allele 'b'
- (4) The DNA marker assort independently with bold seed but is linked to the small seed trait.

Ans: (1) Test cross ratio is 1:1:1:1, so independent assortment.

117. The following diagram represents steroidogenic pathway in the Zona Glomerulosa of the adrenal cortex:

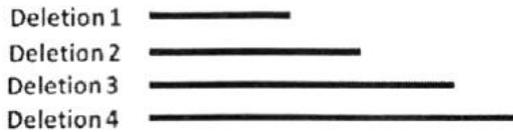


What do A, B and C represents, respectively?

- (1) sER, Progesterone, 11(OH) cortisol
- (2) Mitochondria, Progesterone, Corticosterone
- (3) Mitochondria, 3β-pregnenolone, 11(OH) cortisol
- (4) sER, Progesterone, Corticosterone

Ans: (2) Cortical mitochondria contain various oxidases which alter cholesterol to pregnenolone. Further pregnenolone converted to progesterone. 11-Deoxycorticosterone converted to corticosterone.

118. The following scheme represents deletions (1-4) in the rII locus of phage T4 from a common reference point:



(The bars represent the extent of deletion in each case)

Four point mutations (a to d) are tested against four deletions for their ability (+) or inability (-) to give wild type (rII+) recombinants. The results are summarized below:

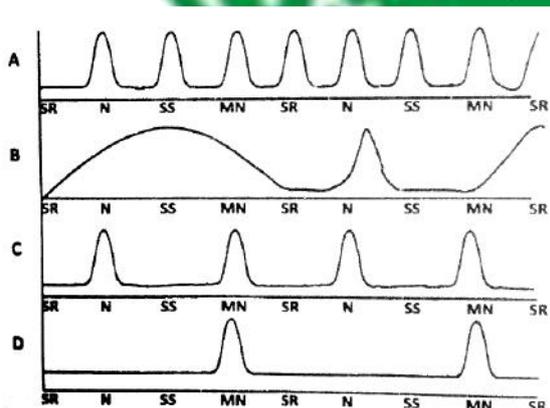
	a	b	c	d
1	+	+	+	+
2	+	+	+	-
3	+	-	+	-
4	-	-	+	-

Based on the above the predicted order of the point mutations is:

- (1) b-d-a-c                      (2) d-b-a-c  
 (3) d-b-c-a                      (4) c-d-a-b

Ans: (2) Deletion 4 (largest deletion) result in the ability of point mutation c to produce wild type phenotype (c+) deletion 3-result in c+ and a+ deletion 2-result in c+, a+ and b+ deletion 1-c+,a+,b+ and d+ so the correct order will be d-b-a-c.

119. Following are the plots representing biological rhythms at different time points depicted as: SR = Sunrise ; N= Noon ; SS = Sunset ; MN = Midnight



Which of the plot(s) represents the ultradian biological rhythm(s)?

- (1) Plot B                      (2) Plots A and C  
 (3) Plots C and D              (4) Plot D

Ans: (2) The rhythms which repeat itself in less than 24 hours are called ultradian rhythms.

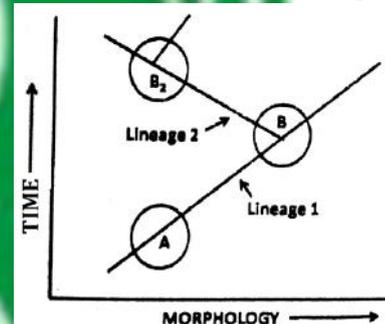
120. The Population of the Non-poisonous butterflies have the same the color pattern as some highly poisonous butterflies. Assume that the

population of non-poisonous butterflies is higher than the poisonous butterflies. Given this, what will be the impact of this mimicry on the fitness of the population of the poisonous butterflies in the presence of the predator?

- (1) It will lower the fitness, that is, fitness of the mimic is negatively frequency – dependent  
 (2) It will increase the fitness, that is, fitness of the mimic is positively frequency dependent  
 (3) It will not affect the fitness, that is, fitness of the mimic is frequency independent  
 (4) It will increase fitness, that is, fitness of the mimic is negatively frequency dependent

Ans: (1) In this mimicry, the mimic benefits but the model may actually find its survival threatened, specially if the harmless mimic becomes too common.

121. The given below is the graphical representation of the changes in morphological features over a period of the geological time scale, where population A accumulates heritable morphological features and give rise to distinct species B. Population B splits in to a distinct species B2



Which of the following lineage represent the pattern of speciation by cladogenesis?

- (1) Lineage 1  
 (2) Both lineage 1 And 2  
 (3) Lineage 2  
 (4) Neither of the lineage 1 and 2

Ans: (3) Cladogenesis is branching of lineage which occurred in lineage 2.

122. Red hair is a recessive trait in human. In a randomly mating population in Hardy-Weinberg equilibrium approximately 9% of individuals are red- haired. What is the frequency of the heterozygotes?

- (1) 81%                      (2) 49%  
 (3) 42%                      (4) 18%

Ans: (3) For a population in genetic equilibrium:  $p + q = 1.0$  (The sum of the frequencies of both alleles is 100%.)

$(p + q)^2 = 1$   
 so  $p^2 + 2pq + q^2 = 1$   
 $p^2 =$  frequency of AA (homozygous dominant)

2pq = frequency of Aa (heterozygous)  
 q<sup>2</sup> = frequency of aa (homozygous recessive)  
 here we have q<sup>2</sup> = 9 / 100 = 0.09  
 q = 0.3 p + 0.3 = 1;  
 thus 0.7 frequency of heterozygotes = 2pq = 2 X 0.3 X 0.7 = 0.42 OR 42%

123. Interrupted mating experiments were performed using three different *Hfr* strains (1-3). The three strains have different combinations of selectable markers. The time of entry for markers for each strain is shown in the table given.

Strain	Time of Entry				
<i>Hfr</i>	<i>met</i> (5')	<i>thr</i> (17')	<i>strr</i> (25')	<i>phe</i> (30')	<i>pro</i> (45')
<i>Hfr</i>	<i>strr</i> (15')	<i>pur</i> (28')	<i>pro</i> (35')	<i>his</i> (45')	<i>met</i> (55')
<i>Hfr</i>	<i>pro</i> (2')	<i>his</i> (12')	<i>met</i> (22')	<i>strr</i> (42')	<i>phe</i> (47')

Using the above data, predict the correct sequence of markers on the *E. coli* chromosome.

- (1) *met-thr-strr-phe-pro-purr-his*
- (2) *purrr-pro-his-met-thr-strr-phe*
- (3) *strr-purr-his-met-phe-pro-strr*
- (4) *his-met-phe-thr-pro-strr-purr*

Ans: (2) By the given time intervals between markers of all strains, we can calculate the distance between these markers which will be, *met-thr-12, thr-strr-8, strr-phe-5, phe-pur-8, pur-pro-5, pro-his-10* and *his-met-10* so by arrange the markers with respect to their distance we will get the order of markers. Because these markers are in circular DNA so there transfer depend on mating time. Order will be, *pur-pro-his-met-thr-strr-phe*.

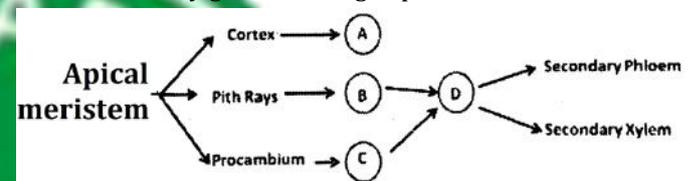
124. Paripatus is an interesting living animal having unjointed legs, nephridia, haemocoel, trachea, dorsal tubular heart, claws, jaws, continuous muscle layers in body wall. This is considered as a connecting link between

- (1) Nematoda and Annelida: continuous muscle layers in body wall, unjointed legs and nephridia being nematode character while haemocoel, trachea and dorsal tubular heart being annelid character.
- (2) Annelida and Arthropoda: unjointed legs and nephridia being annelid characters while claws, jaws, haemocoel, trachea and dorsal tubular heart being arthropod characters.
- (3) Arthropod and Mollusca: unjointed legs and nephridia being mollusca characters while claws, jaws, trachea, dorsal tubular heart being arthropod characters

- (4) Nematoda and Arthropoda: contentious muscles layers, unjointed legs and nephridia being nematode characters while claws, jaws, haemocoel, trachea and dorsal tubular heart being arthropod characters

Ans: (2) **Peripatus is the living connecting link between arthropods and annelids. Its arthropods have claws, jaws, haemocoel, tracheae and dorsal tubular heart. The annelids have continuous muscle layers in the body wall, unjointed legs and nephridia.**

125. The following schematic diagram represents secondary growth in angiosperms



Based on above scheme which of the following option represents correct identity of the cambia labelled as A, B, C and D

- (1) A-Inter-fascicular, B-Fascicular, C-Vascular, D-Cork
- (2) A-Fascicular, B-Inter-fascicular, C-Vascular, D-Cork
- (3) A-Cork, B-Inter-fascicular, C-Fascicular, D-Vascular
- (4) A-Cork, B-Fascicular, C-Inter-fascicular, D-Vascular

Ans: (3) **The vascular cambium produces secondary xylem and secondary phloem, and the cork cambium (phellogen) produces cork cells**

126. The table below list the major fungal groups and their characteristics:

Fungal Groups		Characteristics	
A	Ascomycota	i	Hyphae aseptate, coenocytic, asexual reproduction by sporangiophores
B	Chytrids	ii	Hyphae aseptate, coenocytic, asexual reproduction by zoospores
C	Glomeromycetes	ii	Hyphae aseptate, coenocytic, no sexual spores
D	Zygomycetes	i v	Hyphae septate or unicellular, asexual reproduction by conidia

Which of the following represents the appropriate match between the fungal group and their characteristics?

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

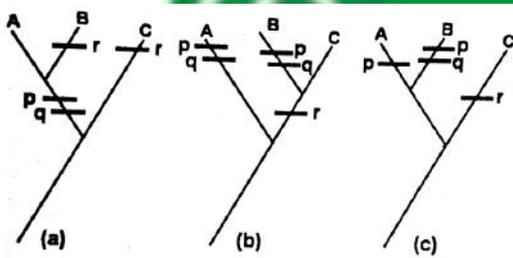
(3) A- i, B-iv, C-iii, D-ii (4) A-ii, B-iv, C-iii, D-i

Ans: (2) Factual question. Ascomycetes reproduces asexually by conidia, hyphae septate or unicellular (yeast). Zygomycetes hyphae aseptate, coenocytic and asexual reproduction by sporangiophores.

127. As a biologist you want to classify three taxa, A, B and C. You have the information of the three traits, p, q and r. The trait that is ancestral is counted "0" and the trait that is derived is counted as "1". The distribution of the trait found in the three taxa given below:

	A	B	C
p	1	1	0
q	1	1	0
r	0	1	1

Based on the above table the following cladograms were drawn:



Based on the trait distribution and the principle of parsimony select the correct option:

- (1) Both 'a' and 'b' cladograms are possible
- (2) Only 'b' cladogram is possible
- (3) Only 'c' cladogram is possible
- (4) Only 'a' cladogram is possible

Ans: (4) Only first cladogram is possible, because p and q character are matching between A and B species. A is close to B, so B can not be close C.

128. Given below are some pathogens and diseases of humans, animals and plants.

Pathogen		Disease	
A	<i>Bordetella pertusis</i>	i	Lyme disease of humans
B	<i>Tilletia indica</i>	ii	Grain rot in rice
C	<i>Borrelia burgdorferi</i>	iii	Karnal blunt of wheat
D	<i>Anaplasma marginale</i>	iv	Whooping cough in Humans
E	<i>Burkholderia glumae</i>	v	Hemolytic anemia in Cattle

Which of the following is the match between the pathogen and the disease caused?

- (1) A- iv, B-iii, C-i, D-v, E-ii
- (2) A-iv, B- v, C- i , D-ii, E-iii

(3) A- iii, B-iv, C-v, D-i, E- ii

(4) A-ii, B-v, C-i, D-iii, E-iv

Ans: (1) Factual question. *Bordetella pertusis* cause the Whooping cough, *Tilletia indica* causes Karnal bunt of wheat, *Borrelia burgdorferi* causes Lyme disease, *Anaplasma* cause hemolytic anemia in cattle, *Burkholderia glumae* causes Grain rot in rice.

129. Given below are statements pertaining to organisms belonging to three domains of life. Identify INCORRECT statement.

- (1) Unlike Bacteria and Eukarya, some Archeal membrane lipids contain long chain hydrocarbons connected to Glycerol molecule by ether linkage
- (2) Peptidoglycans are absent in cell wall of Archea
- (3) Proteobacteria include many species bacteriochlorophyll containing sulphur using Photoautotrophs
- (4) Mycoplasma, a group of low GC content gram positive bacteria lack the cell wall, belonging to same family of gram positive of mycobacteriaceae

Ans: Mycoplasma is a gram+ bacteria which lack cell wall as well as has low GC content but mycoplasmataceae is the family not mycobacteriaceae. Mycobacteriaceae if for mycobacterium. That why it is false statement. Other statements are true.

130. You observed the two species of barnacles, species 1 and species 2, occupy upper and lower strata of intertidal rocks, respectively. Only when species 2 was removed by you from the lowers strata, species 1 could occupy both the upper and lower strata. From the choice given below what would be your inference from these observations.

- (1) Upper strata of intertidal rocks is the realised niche of the species1
- (2) Upper strata of intertidal rocks is the fundamental niche of the species1
- (3) Species 1 and species 2 exhibit mutualism
- (4) Species 1 can compete out species 2

Ans: (1) If species 1 is removed from upper strata, than species 2 occupy this area means for species 1 it is realized niche.

131. In natural system, a species producing large number of offsprings with little or no parental

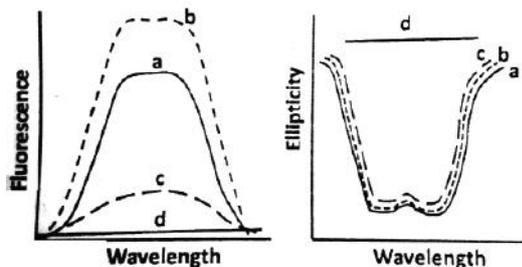


sufficiently filled, additional species have no or only minor effects on the degree of ecosystem functioning. According to this hypothesis, each species is unique in its role. Thus ecosystem function changes when diversity changes but the magnitude and direction of change is unpredictable because the roles of individual species are complex and varied. . Thus if a keystone species is removed then ecosystem functioning will drop rapidly. A positive trajectory in case of keystone species implies that a keystone species contribute positively to ecosystem functioning.

136. Agrobacterium Ti plasmid vectors are used to generate transgenic plants. The following are examples of vir gene encoded proteins that are important for transfer of T-DNA in to plants.  
 A- vir E, single stranded DNA binding protein  
 B- virD2 that generates T-strands  
 C- vir A that sense plant phenolic compounds  
 D- vir F which directs T complex proteins for destruction in proteasome  
 Which one of the following combination of the proteins functions inside the plant cell?  
 (1) Only A and C (2) A, B and C  
 (3) Only B and C (4) A, B and D

Ans: (4) VirA functions only in bacterial cells. VirD2 is functional in both bacteria and plant cell, VirE is solely functional in plant cells and VirF is functional in plant cells only.

137. Researcher is investigating structural changes in protein by following tryptophan fluorescence and by Circular dichorism. Fluorescence and CD spectra of pure protein were obtaining the absence of any treatment (a), in the presence of 0.5 molar urea (b), upon adding acrylamide, a quencher of tryptophan (c) and upon heating (d) the data are shown below.



- Which one of the following statements is correct?  
 (1) CD is more sensitive to structural changes than fluorescence

- (2) Fluorescence is more sensitive to structural changes than CD  
 (3) Both the methods are equally responsive to structural changes  
 (4) Acrylamide alter the secondary structure of the protein

Ans: (2) As it can be easily observed from the plot that structural changes occurring in different conditions are showing more changes in fluorescence spectra, so fluorescence is more sensitive to structural changes.

138. Polynucleotide kinase (PNK) is frequently used for radio labeling DNA or RNA by phosphorylating 5' end of non-phosphorylated polynucleotide gene. Which of the following statements about PNK is NOT true?

- (1) PNK catalyse the transfer of alpha phosphate from ATP to 5' end of polypeptide chains of (DNA or RNA)  
 (2) PNK has three phosphatase activity  
 (3) PNK is inhibited by small amount of ammonium ions  
 (4) PNK is T4 bacteriophage encoded enzyme

Ans: (1) PNK catalyses transfers of gamma phosphate. PNK enzyme only uses ATP as a phosphate donor and catalyses transfer/exchange of phosphate group at the 5' end of DNA.

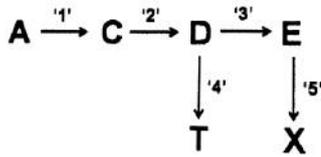
139. A gene encoding for protein X was cloned in an expression vector under the T7 RNA polymerase promoter and lac operator. Cells were incubated by the addition of 1 mM IPTG at 370 c for 6 h. Cells were lysed and fractionised into insoluble bodies. Which one of the following strategies would you use to express protein X in the soluble fraction (cell free supernatant)?

- (1) Increase the duration of induction with 1mM IPTG  
 (2) Grow cells at lower temperature after induction with 1mM IPTG  
 (3) Increase the concentration of IPTG  
 (4) Grow cells at higher temperature after induction with 1 mM IPTG

Ans: (2) Growing cells under low temperature will stabilize the protein. At low temperature protein will not aggregate and will be produced in its native state thus will not go to pellet or inclusion bodies.

140. Engineering of metabolic pathways in plants can be achieved by introduction and overexpression of appropriate candidate gene(s) using transgenic technology. The figure given below represents a biochemical pathway in plants where a precursor molecule 'A' is converted in to

products 'T' and 'X' through a series of enzymatic reactions. Enzymes 1-5 are involved in this pathway. Scientists attempted to increase the levels of 'X' by introducing additional copy of the gene for enzyme '5' under transcriptional control of a strong constitutive promoter. However, the developed transgenic plants did not display a proportionate increase in the level of 'X'.



The following statements were proposed for explaining the above results:

A-Enzyme '4' has greater affinity for D than enzyme '3'

B-Feedback inhibition of enzyme '5' by compound X

C- Substrate limitation for enzyme '5'

Which of the above statement could represent probable reasons for NOT obtaining proportionate increase in the amount of 'X' in the transgenic plants?

- (1) Only C
- (2) Only A and B
- (3) Only A
- (4) A, B and C

**Ans: (4)** As enzyme 4 has greater affinity for D, so it will convert more amount of D into T, and little amount will get converted into E by 3 enzyme. It will limit the availability of E for enzyme 5 to convert it into X. If enzyme 5 gets inhibited by small amount of X again the over-expression of this enzyme wont have any effect on the production of X.

141. A single copy homozygous transgenic plant containing the transgene 'A' for fungal resistance was subsequently re-transformed with another gene 'B' for conforming resistance to salt stress. The selection marker genes used for both the transformation experiment were different. Transgenic plant obtained following the retransformation experiment were screened for salt stress resistance and single copy event were identified by southern hybridization. These single copy event were self - pollinated. In the event of the two T-DNA (containing the A and B transgenes) getting integrated in unlinked location in all transgenic plants, the phenotypic ratios among the T1 progeny would be:

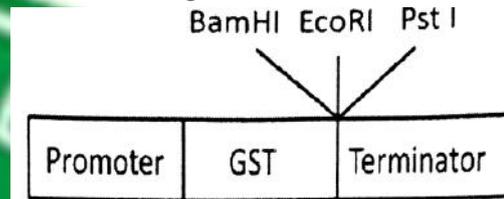
- (1) 3 (fungal resistant + salt- stress resistant): 1(fungal resistant)
- (2) 1 (fungal resistant): 2 (fungal resistant + salt resistant): 1(salt- stress resistant)

[Type text]

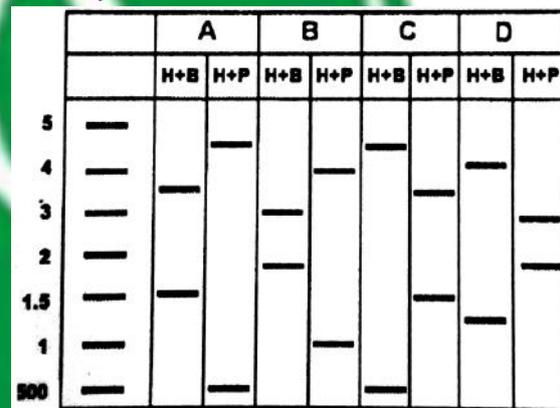
- (3) 3 (salt -stress resistant): 1 (fungal resistant)
- (4) 1 (fungal resistant) :1(salt- stress resistant): 1(fungal resistant+ salt stress resistant)

**Ans: (1)**

142. You are inserting a gene of 2 kb length in to a vector of 3kb to make a GST fusion protein the gene is being inserted at the *E. coli* site and the insert has a Hind III site 500bp downstream of the first codon. You are screening for the clone with the correct orientation by a restriction digestion of the plasmid using Hind III plus Bam HI (H+P) and Hind iii plus PSTI (H+P) the map of the relevant region of the vector is shown below



Which of the following given below is the pattern following the restriction digestion of a plasmid isolated from four independent clones. (A, B, C or D)



Which of the plasmid shown above represents the clone in the correct orientation?

- (1) A
- (2) B
- (3) C
- (4) D

**Ans: (3)** Based of gel picture.

143. The frequency of M-N blood types in a population of 6129 individuals is as follows:

Blood type	Genotype	Number of individuals
M	LMLM	1787
MN	LMLN	3039
M	LNLN	1303

The frequency of LN allele in this population is

- (1) 0.4605
- (2) 0.2121
- (3) 0.5395
- (4) 0.2911

**Ans: (1)** Individuals with L<sup>N</sup>L<sup>N</sup> = 1303, so q<sup>2</sup>= 1303/6129 = 0.21 take under root of that you

[Type text]

will get 0.46, which will be the frequency of  $L^N$  allele.

144. Mayfair genes (HYPOTHETICAL) consist of a superfamily of transcription factors. They are found in 4 clusters in mammals; in 2 clusters in insects; and in a single cluster in an ancestor to insects. These data consistent with all of the following explanations EXCEPT:

- (1) Two successive genome duplication event occurred between ancestral organisms and vertebrates
- (2) the first duplication may have taken place before divergence of vertebrates
- (3) exon shuffling exclusively produced such cluster
- (4) whole genome duplication could lead to such observation.

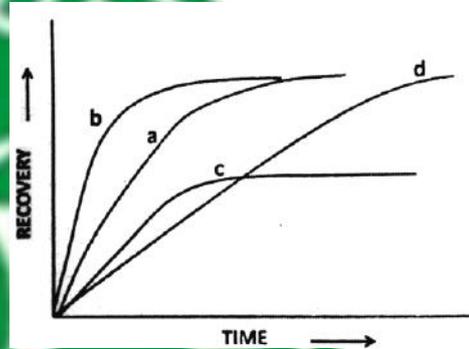
**Ans: (3)** This question can be explained through the following example. The developmental control genes containing an Antennapedia-type homeobox are clustered in insects and vertebrates. Subsequent duplication events generated a cluster of at least five homeobox genes in the last common ancestor of insects and vertebrates. At the time of the insect/vertebrate divergence two of the resulting genes had already undergone a further duplication, while the Abdominal-B precursor remained singular. Later in the evolution of vertebrates and insects,

gene duplications in all three of the original classes.

145. Fluorescence recovery after photo bleaching (FRAP) is a method to estimate the diffusion of molecules in a membrane. Fluorescently labelled in a membrane such as

- i) a receptor tagged with green fluorescent protein (GFP)
- ii) a receptor labelled with GFP which interacts with cytoskeleton
- iii) a labelled lipid
- iv) a labelled protein that binds to the membrane surface are photo bleached and the recovery profiles ( a-d) were obtained to estimate their diffusion coefficients

The following data were obtained.



Which one of the combination is correct?

- (1) a = i; b = ii
- (2) b = iii; a = iv
- (3) c = iii; d = iv
- (4) d = ii; b = i

**Ans: (4)**

Space For Rough Work

ANSWERS

