

CSIR MMT Question Paper 3



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Q.1)

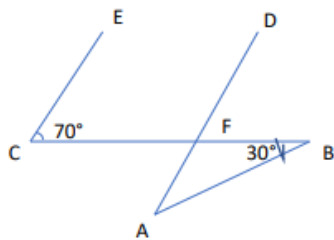
On what date of September 1999 will sunday fall?

- A. ☐ 3, 10, 17, 24, 31
- B. ☐ 4, 11, 18, 25
- C. ☐ 5, 12, 19, 26
- D. ☐ 2, 9, 16, 23, 30

Q.2) $(100 \div 5 + 6 - 4 \times 6) + (12 \times 5 - 15) = ?$

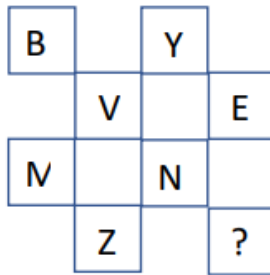
- A. ☐ 32
- B. ☐ 47
- C. ☐ 79
- D. ☐ 85

- Q.3) In the given diagram, CE is parallel to AD and the measures of two angles at B and C have been indicated. Then find $\angle DAB$



- A. ☐ 30°
- B. ☐ 35°
- C. ☐ 40°
- D. ☐ 50°
- Q.4) The digit in the unit place of the number $(871 - 241)$ will be :-
- A. ☐ 0
- B. ☐ 2
- C. ☐ 4
- D. ☐ 6
- Q.5) The three sides a, b, c of a triangle satisfy the equation $a^3 + b^3 + c^3 = 3abc$. Then the triangle:-
- A. ☐ Must be equilateral
- B. ☐ Is isosceles, but not equilateral
- C. ☐ Must be right angled
- D. ☐ Is neither equilateral nor isosceles

Q.6) Find the missing letter?



- A. ☐ W
- B. ☐ A
- C. ☐ X
- D. ☐ B

Q.7) 5 kg of adulterated rice has 2% stones in it and the rest is rice. Half of the stone content was removed. Now the percentage of stones content in it is:-

- A. ☐ 0.99%
- B. ☐ 1%
- C. ☐ 1.1%
- D. ☐ 1.01%

Q.8) In a bag containing only blue, red and green marbles, all but 15 are blue, all but 13 are red and all but 12 are green. How many are red?

- A. ☐ 13
- B. ☐ 7
- C. ☐ 25
- D. ☐ 20

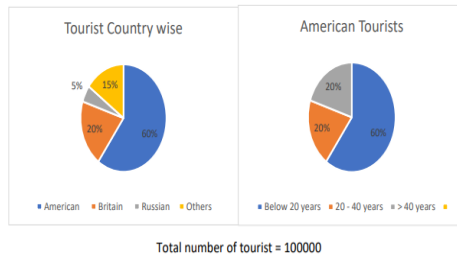
Q.9) Two trains 150 m and 170 m long run at the speed of 90 km/hr and 70 km/hr respectively in opposite directions on parallel tracks. The time (in seconds) which they take to cross each other is:-

- A. ☐ 6.2
- B. ☐ 6.6
- C. ☐ 7
- D. ☐ 7.2

Q.10) A total of 28 hand shakes was exchanged at the conclusion of the party. Assuming that each participant was equally polite towards all the others the number of people present there are:-

- A. ☐ 14
- B. ☐ 28
- C. ☐ 56
- D. ☐ 8

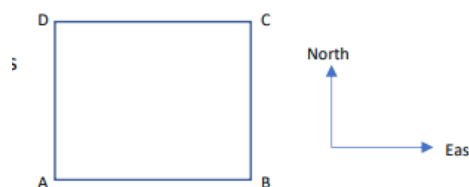
Q.11) The characteristics of foreign tourists in one year is given in the following pie chart:-



From the pie charts, find the number of American tourists in the age group 20 – 40 who visited during the year?

- A. ☐ 12000
- B. ☐ 20000
- C. ☐ 40000
- D. ☐ 60000

Q.12) A person has to cross a square field by going from A to C. the person is only allowed to move towards the east or towards the North or use a combination of these movements. The total distance travelled by the person:-



- A. ☐ Depends on the length of each step
- B. ☐ Depends on the total number of steps
- C. ☐ Is different for different paths
- D. ☐ Is the same for all paths

Q.13) At what time after 4 O'clock, the hour and the minute hand will lie opposite to each other?

- A. ☐ 4 – 50' – 31''
- B. ☐ 4 – 52' – 51''
- C. ☐ 4 – 53' – 23''
- D. ☐ 4 – 54' – 33''

Q.14) For a journey, the cost of child ticket is 1/3rd of the cost of an adult ticket. If the cost of tickets for 4 adults and 5 children is Rs 85, the cost of the child ticket is 60% 20% 5% 15% Tourist Country wise American Britain Russian Others 60% 20% 20% American Tourists Below 20 years 20 - 40 years > 40 years D A B C North East:-

- A. ☐ Rs. 5
- B. ☐ Rs. 6
- C. ☐ Rs. 10
- D. ☐ Rs. 15

Q.15)

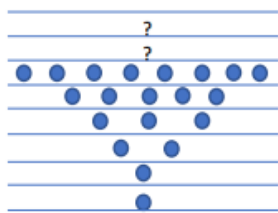
Six people – Akhil, Ajay, Dileep, Murali, Sobin and Toby – were all born on the same day of the year, but each was born in a different year, during a single six year period. Akhil is older than Dileep. Sobin is older than both Toby and Ajay. Murali is two year older than Toby. Akhil was born either in 1962 or in 1963. The oldest member of the group was born in 1960. If Murali is the oldest in the group, then which of the following must be true?

- A. ☐ Dileep was born in 1964
- B. ☐ Akhil was born in 1962
- C. ☐ Toby was born in 1961
- D. ☐ Sobin was born in 1961

Q.16) If $1 + x + x^2 + \dots = 2$, then $1 - x + x^2 - x^3 + \dots = ?$

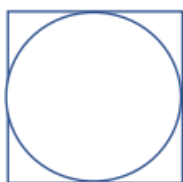
- A. ☐ 0
- B. ☐ 1
- C. ☐ $\frac{2}{3}$
- D. ☐ $\frac{1}{2}$

Q.17) In the figure, the number of circle in the blank row must be ?



- A. ☐ 12 and 20
- B. ☐ 13 and 20
- C. ☐ 13 and 21
- D. ☐ 10 and 11

Q.18) What does the diagram establish? Note: the diagram is a circle inside a square ?



- A. ☐ $\pi > 3$
- B. ☐ $\pi \geq 2\sqrt{2}$
- C. ☐ $\pi < 4$
- D. ☐ π is closer to 3 than to 4

Q.19) How many nine digit positive integers are there, the sum of squares of whose digits is 2?

- A. ☐ 8
- B. ☐ 9
- C. ☐ 10
- D. ☐ 11

Q.20) Choose the correct statement from the following:

- A. ☐ Disulfide bonds in a 20-residue peptide can be formed only if the cysteines are adjacent to each other.
- B. ☐ The amino acid isoleucine has only one chiral centre.
- C. ☐ Both bases and sugar contribute to chirality of nucleic acids.
- D. ☐ The pI of aspartic acid is less than that of glutamic acid.

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The pI of aspartic acid is less than that of glutamic acid.

Q.21) There are 2 hills, A and B, in a region. If hill A is located N30°E of hill B, what will be the direction of hill B when observed from hill A? (N30°E means from North towards east?)

- A. ☐ S30°W
- B. ☐ S60°W
- C. ☐ S30°E
- D. ☐ S60°E



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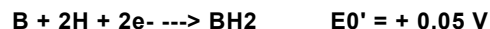


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Q.22)

Three electron acceptors 'X', 'Y' and 'Z' have redox potential (E_0') of +0.15V, +0.05 V and -.1 V respectively. For a reaction



Which of these electron acceptors are appropriate?

[Useful equation : $\Delta G_0' = -nFE_0'$

$\Delta G_0'$ = free energy change; n = number of electrons ; F = Faraday constant]

- A. ☐ X and Y
- B. ☐ Only X
- C. ☐ Y and Z
- D. ☐ Only Z

Q.23) In a 30-residue peptide, the dihedral angles ϕ/ψ have been determined by one or more methods. When their values are examined in the Ramachandran plot, it is

- A. ☐ not possible for ϕ/ψ values to be distributed in the helical as well as beta sheet region.
- B. ☐ possible that the ϕ/ψ values are all in the helical region although circular dichroism spectral studies indicate beta sheet conformation.
- C. ☐ possible to conclude that the peptide is composed of entirely D-amino acids.
- D. ☐ not possible to conclude if the peptide is entirely helical or entirely in beta sheet conformation

Q.24)

Calculate the pH of a mixture of 25cm³ of 0.1M NaOH and 22cm³ of 0.1M CH₃COOH

- A. ☐ 12.6
- B. ☐ 11.8
- C. ☐ 10.4
- D. ☐ 3.6

Q.25)

Sting of a bee causes pain, redness and swelling. Melittin is a major peptide in bee venom. Melittin is a membrane binding peptide that is involved in activating phospholipases in the membrane. The possible target phospholipase that is activated by melittin is

- A. ☐ Phospholipase C to generate inositol phosphates.
- B. ☐ Phospholipase A₂ to generate arachidonic acid.
- C. ☐ Phospholipase D to generate 1', 3'- inositol.
- D. ☐ Phospholipase A₁ to generate palmitic acid

Q.26)

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

- A. ☐ 105
- B. ☐ 20.5
- C. ☐ 10.0
- D. ☐ 10.5

Q.27)

An enzyme catalyzes a reaction at a velocity of 20 micromol/min when the concentration of substrate is 0.01 M. The K_m for this substrate is 1×10^{-5} M. Assuming that Michaelis-Menten kinetics are followed, what will be the reaction velocity when the concentration of S is 1×10^{-5} M

- A. ☐ 0.1uM/min
- B. ☐ 0.01uM/min
- C. ☐ 1.0uM/min
- D. ☐ 0.001uM/min

- Q.28) A cell line deficient in salvage pathway for nucleotide biosynthesis was fed with medium containing ^{15}N labelled amino acids. Purines were then extracted. Treatment with which one of the following amino acids is likely to produce ^{15}N labelled purines?
- A. ☐ Aspartic acid
 - B. ☐ Glycine
 - C. ☐ Glutamine
 - D. ☐ Aspartamine
- Q.29) Out of the list given below, which is the correct order of increasing lipid bilayer permeability?
- A. ☐ $\text{N}_2 > \text{Ethanol} > \text{H}_2\text{O} > \text{Glucose} > \text{Ca}^{2+} > \text{RNA}$
 - B. ☐ $\text{H}_2\text{O} > \text{Glucose} > \text{Ethanol} > \text{N}_2 > \text{Ca}^{2+} > \text{RNA}$
 - C. ☐ $\text{Ca}^{2+} > \text{RNA} > \text{N}_2 > \text{Ethanol} > \text{H}_2\text{O} > \text{Glucose}$
 - D. ☐ $\text{Ethanol} > \text{RNA} > \text{Ca}^{2+} > \text{H}_2\text{O} > \text{N}_2$
- Q.30) Which of the following statement regarding membrane transport is FALSE?
- A. ☐ Polar and charged solutes will not cross cell membranes effectively without specific protein carriers.
 - B. ☐ Each protein carrier will only bind and transport one (or a few very similar) type of solute.
 - C. ☐ Sugars such as glucose are always transported by active transport rather than facilitated diffusion carrier.
 - D. ☐ Ions are typically transported by special proteins that form membrane channels.

Q.31) Given below are some statements about

prokaryotic and eukaryotic mobile genetic elements

or transposons.

A. Most mobile genetic elements in bacteria transpose

via an RNA intermediate.

B. Most mobile genetic elements in bacteria are DNA.

C. Mobile genetic elements in eukaryotes are only

retrotransposons.

D. Both, RNA and DNA transposons are found in

eukaryotes.

Choose the correct combination.

A. ☐ A and C

B. ☐ B and C

C. ☐ A and D

D. ☐ B and D

Q.32) Cystic fibrosis transmembrane conductance regulator (CFTR) is known to control the transport of which ion?

- A. ☐ Ca^{2+}
- B. ☐ Mg^{2+}
- C. ☐ HCO_3^-
- D. ☐ Cl^-

Q.33) Regarding microtubule assembly and disassembly during cell division, which will be the most appropriate answer?

- A. ☐ Once formed, kinetochore microtubules depolymerize at the plus ends throughout mitosis
- B. ☐ Once formed, kinetochore microtubules polymerize at the plus ends throughout mitosis
- C. ☐ Kinetochore microtubules polymerize at their plus ends up to anaphase, at which point they begin to depolymerize
- D. ☐ Kinetochore microtubules polymerize at their minus ends up to cytokinesis, at which point they depolymerize

Q.34) A highly specific inhibitor that targets the phosphorylation activity of TFIIF is added to an in vitro transcription reaction. Which one of the following steps is most likely to be affected?

- A. ☐ Binding of RNA polymerase to promoter sequence
- B. ☐ Promoter clearance
- C. ☐ Recruitment of TFIID
- D. ☐ Open promoter complex formation

Q.35) **Histone acetylase and chromatin remodeling complexes are recruited to specific regions of chromatin by**

- A. ☐ gene activator proteins
- B. ☐ specific promoter sequence
- C. ☐ phosphorylation of histone acetylase
- D. ☐ dephosphorylation of chromatin remodeling complexes

Q.36) **If you are asked to create genetic code with only A and T, then what would be the minimum number of nucleotides required to make a codon?**

- A. ☐ 16
- B. ☐ 32
- C. ☐ 64
- D. ☐ 80

Q.37) **Amino acid selenocysteine (Sec) is incorporated into polypeptide chain during translation by:**

- A. ☐ charging of Sec into tRNA^{ser} followed by incorporation through serine codon
- B. ☐ charging of serine into tRNA^{ser} followed by modification of serine into selenocysteine and the incorporation through serine codon
- C. ☐ charging of Sec into tRNA^{ser} and then incorporation through selenocysteine codon
- D. ☐ charging of serine into tRNA^{ser} followed by modification of serine into selenocysteine and then incorporation through a specially placed stop codon

Q.38) In type II splicing

- A. ☐ a 'G-OH' from outside makes a nucleophilic attack on 5'-P of first base of intron
- B. ☐ a free 2'-OH of an internal adenosine makes a nucleophilic attack on 5'-P of first base of intron
- C. ☐ A 3'-OH of an internal adenosine makes a nucleophilic attack on 5'-P of first base of intron
- D. ☐ the hydrolysis of last base of exon is carried out by U2/U4/U6

Q.39) Which one of the following is NOT related to immediate hypersensitivity reactions?

- A. ☐ Mast cell degranulation results in histamine-mediated allergic reactions
- B. ☐ Reaginic antibodies trigger allergic reactions
- C. ☐ Granulomatous reaction is a key to contain infection
- D. ☐ Anaphylactic reaction is triggered primarily by IgE

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Q.40) Following are list of some proteins

1. BCL-2

2. BCL-XL

3. A1

4. BAX

Which of the protein(s) is/are NOT anti-apoptotic?

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

Q.41) Which one of the following cells generally does NOT secrete IFN-g ?

- A. ☐ CD8+ T cells
- B. ☐ Th1 cells
- C. ☐ NK cells
- D. ☐ TH2

Q.42) Cholera toxin increases cAMP levels by

- A. ☐ modifying Gi protein
- B. ☐ modifying Gs protein
- C. ☐ binding to adenylate cyclase
- D. ☐ activating cAMP phosphodiesterase

Q.43) Gram-positive bacteria are generally resistant to complement-mediated lysis because

- A. ☐ thick peptidoglycan layer prevents insertion of membrane attack complex into the inner membrane
- B. ☐ Gram-positive bacteria import the membrane attack complex and inactivate it
- C. ☐ membrane attack complex is degraded by the proteases produced by the Gram-positive bacteria
- D. ☐ Gram-positive bacteria cannot activate the complement pathway

Q.44) Which of the following events will NOT usually lead to transformation of a normal cell into a cancer cell?

- A. ☐ Gain of function of oncogenes
- B. ☐ Loss of function of tumor suppressors
- C. ☐ Gain of function of genes involved in nucleotide excision repair
- D. ☐ Loss of function of pro-apoptosis related genes

Q.45) The homologue of β -catenin in *Drosophila* is

- A. ☐ Engraile
- B. ☐ Fushi tarazu
- C. ☐ Armadillo
- D. ☐ Cubitus interruptus

Q.46)

Which protein is involved in controlling the fate of EMS blastomere in *C.elegans*, the cell that generates the posterior pharynx?

- A. ☐ SKN-1
- B. ☐ PAL-1
- C. ☐ PIE-1
- D. ☐ ABA-2

Q.47)

A gap gene mutation might cause which of the following defects in the embryonic body plan ?

- A. ☐ Every other segment would be missing, resulting in T1, T3, A2, A4, etc. but no T2, A1, A3, and so on.
- B. ☐ Segments A2 through A6 would be missing, but the rest of the pattern is essentially normal.
- C. ☐ No segmentation would be evident.
- D. ☐ Patterning within each segment would be abnormal, causing for example denticle belts to form across the entire segment

Q.48)

One of the most important gene, involved in dorsal– ventral axis determination in *Drosophila* is dorsal. It codes Dorsal protein which

- A. ☐ is taken up into the nuclei of cells and this side will become the ventral side
- B. ☐ remains in the cytoplasm of cell and this side will become ventral side.
- C. ☐ is taken up into the nuclei of cells and this side will become the dorsal side.
- D. ☐ degraded in one side and that will become dorsal side

Q.49)

What would happen as a result of a transplantation experiment in a chick embryo in which cells determined to become a forelimb were replaced by some cells determined to become a hindlimb?

- A. ☐ A hindlimb would form in the region where the forelimb should be.
- B. ☐ A forelimb would form in the region where the hindlimb should be.
- C. ☐ Nothing; The forelimb would form normally.
- D. ☐ Neither a forelimb nor a hindlimb would form because the cells were already determined.

Q.50)

What would be the effect on newt limb regeneration, if more than 90% of the nerve supply is severed before amputation?

- A. ☐ The apical ectodermal cap stimulates growth of the blastema by secreting FGF8 but regeneration does not take place
- B. ☐ Limb regeneration will take place and form a limb with no nerve supply
- C. ☐ Outgrowth will occur but the identity of the limb formed will be lost with no clear anterior-posterior polarity
- D. ☐ Limb regeneration with nerve supply will take place

Q.51)

The presence of β -catenin in the nuclei of blastomeres in the dorsal portion of the amphibian embryo is one of the determinants for laying down the dorso-ventral axis. What will be the outcome of expressing a dominant negative form of GSK3 in the ventral cells of early embryo?

- A. ☐ The dorsal cells will be ventralized
- B. ☐ A second axis will be formed
- C. ☐ The primary organizer will not be formed
- D. ☐ The embryo will develop normally

Q.52)

Individual and overlapping expression of homoeotic genes in adjacent whorls of a flower determine the pattern of floral organ development. In an Arabidopsis mutant, floral organs are distributed as follows:

Whorl 1 (outer most) – carpel

Whorl 2 – stamens

Whorl 3 – stamens

Whorl 4 (inner most) – carpel

Loss of function mutation in which one of the following genes would have caused the above pattern of floral organ development?

- A. ☐ APETALA 2
- B. ☐ APETALA 3
- C. ☐ PISTILLATA
- D. ☐ AGAMOUS

Q.53)

Which one of the following statements regarding limb development in mice is true?

- A. ☐ The gene encoding Tbx5 is transcribed in the limb fields of the hindlimbs

The gene encoding Tbx5 is transcribed in the limb fields of the hindlimbs

The gene encoding Tbx5 is transcribed in the limb fields of the hindlimbs

The gene encoding Tbx5 is transcribed in the limb fields of the hindlimbs
- B. ☐ The gene encoding Tbx4 is transcribed in the limb fields of the forelimbs
- C. ☐ Genes encoding Islet 1, Tbx4 and Pitx are expressed in the presumptive hindlimb
- D. ☐ Genes encoding Islet 1, Tbx4 and Pitx are expressed in the presumptive forelimb.

Q.54) **NCED (9- cis epoxycarotenoid dioxygenase) is involved in:**

- A. ☐ ABA biosynthesis
- B. ☐ GA biosynthesis
- C. ☐ Auxin biosynthesis
- D. ☐ Ethylene biosynthesis

Q.55) **Photosystem II functions as a light dependent water-plastoquinone reductase. What are the names of two reaction center proteins that bind electron transfer prosthetic groups such as P680, phaeophytin and plastoquinone?**

- A. ☐ CP43 and CP47
- B. ☐ D1 and D2
- C. ☐ 33 kDa and 23 kDa
- D. ☐ FA and FB

Q.56)

A plant hormone that promotes the acquisition of dessication tolerance in developing seed is:

- A. ☐ ABA
- B. ☐ Ethylene
- C. ☐ IAA
- D. ☐ GA3

- Q.57) Which of the following plant hormones can mimic the *det1* mutation, causing de-etiolation and chloroplast development in dark?
- A. ☐ Cytokinin
 - B. ☐ Gibberellin
 - C. ☐ Auxin
 - D. ☐ Ethylene
- Q.58) During the development of embryos in plants, PIN proteins are involved in:
- A. ☐ Establishment of auxin gradients
 - B. ☐ Regulation of gene expression
 - C. ☐ Induction of programmed cell death
 - D. ☐ Induction of cell division
- Q.59) The plant hormone indole-3-acetic acid (IAA) is present in most plants. The structure of this hormone is related to which one of the following amino acids?
- A. ☐ Glutamic acid
 - B. ☐ Aspartic acid
 - C. ☐ Lysine
 - D. ☐ Tryptophan
- Q.60) Alveolar cells of the lung arise from which one of the following layer(s)?
- A. ☐ Mesoderm
 - B. ☐ Endoderm
 - C. ☐ Ectoderm
 - D. ☐ Both ectoderm and endoderm

Q.61) Which of the following statements is true ?

- A. ☐ There is a lesser probability for a crossover to occur between 2 genes farther apart from the genes nearer to each other.
- B. ☐ There is a greater probability for a crossover to occur between 2 genes farther apart from the genes nearer to each other.
- C. ☐ Probability of crossover between 2 genes is not related to the distance between them.
- D. ☐ Maximum frequency of recombination that can result from crossing over between linked genes is 100%.

Q.62) Which of the following types of genetic changes is least likely to be found in an oncogene in a tumor ?

- A. ☐ Gene amplification
- B. ☐ Chromosomal translocation
- C. ☐ Missense mutation
- D. ☐ Nonsense mutation

Q.63) Monotremes are unique among mammals because they:

- A. ☐ have claws
- B. ☐ lay eggs
- C. ☐ possess hair
- D. ☐ produce milk

Q.64) Temperate organisms have wider tolerance ranges for temperature than do tropical organisms. If temperatures increase across the globe by 2°C, which of the following is possible ?

- A. ☐ Temperate organisms will be more negatively affected than tropical organisms
- B. ☐ Tropical organisms will be more negatively affected than temperate organisms
- C. ☐ The effects on tropical and temperate organisms will be the same
- D. ☐ This will have no effect on temperate or tropical organisms

- Q. 65) Christian Bergmann, a 19th century biologist, observed that related taxa showed increasing body size with increasing latitude. One explanation for this pattern, also called 'Bergmann's Rule', is
- A. ☐ lower body mass in the tropics is a result of lower mass-specific metabolic rates
 - B. ☐ species at higher latitudes have greater access to resources and, therefore, have larger sizes
 - C. ☐ greater competition at higher latitudes results in larger organisms
 - D. ☐ lower surface area to volume ratios in larger animals help conserve heat
- Q. 66) In which one of the following evolutionary processes, random changes in allele frequency can lead to a loss of genetic diversity?
- A. ☐ Recombinational event
 - B. ☐ Frequency –dependent selection
 - C. ☐ Genetic drift
 - D. ☐ Spontaneous selection
- Q. 67) The Asian mongoose and the American skunk evolved independently of each other, but show similar structures and features, for e.g., ability to spray their attacker with musk. The similarities between the two organisms are most likely the result of:
- A. ☐ genetic drift
 - B. ☐ divergent evolution
 - C. ☐ allopatric speciation
 - D. ☐ convergent evolution
- Q. 68) A fruit fly population has a gene with two alleles, A1 and A2. Tests show that 70% of the gametes produced in the population contain the A1 allele. If the population is in Hardy-Weinberg equilibrium, what proportion of the flies carry both A1 and A2 ?
- A. ☐ 0.7
 - B. ☐ 0.49
 - C. ☐ 0.21
 - D. ☐ 0.42

Q.69)

The single stranded nick in DNA during TDNA transfer is initiated by:

- A. ☐ vir C
- B. ☐ vir B
- C. ☐ vir D
- D. ☐ vir E

Q.70)

Which of the following does not represent a strategy of phytoremediation?

- A. ☐ Phytodegradation
- B. ☐ Phytomining
- C. ☐ Continuous removal through hyper accumulators
- D. ☐ Chelate mediated extraction of pollutants

Q.71)

Which type of microscope would allow the viewer to see ribosomes inside a cell?

- A. ☐ A light microscope, transmission electron microscope, and scanning electron microscope can all view ribosomes inside a cell.
- B. ☐ A light microscope
- C. ☐ A transmission electron microscope
- D. ☐ A scanning electron microscope

Q.72) **Fluorescence recovery after photobleaching in live cells is used to determine:**

- A. ☐ co-localization of proteins
- B. ☐ distance between two organelles
- C. ☐ diffusion of proteins
- D. ☐ nucleic acid compactness

Q.73)

Which among the following is the simplest method to estimate the concentration of glycerol in an aqueous solution of glycerol?

- A. ☐ UV absorption spectroscopy
- B. ☐ Gas chromatography
- C. ☐ pH measurement
- D. ☐ Viscosity measurement

Q.74)

Two 18-residue helical peptides A and B are enantiomers. They can be distinguished by:

- A. ☐ Recording their MALDI mass spectrum
- B. ☐ Hydrolysis followed by amino acid analysis
- C. ☐ Sequencing by Edman's method
- D. ☐ Examining their circular dichroism spectra

Q.75) **Electron microscopes have much higher resolution than any type of light microscope because:**

- A. ☐ Of their higher magnification.
- B. ☐ The lenses used are of much higher quality.
- C. ☐ Of very short wavelength of electrons.
- D. ☐ The images are viewed on screen rather than directly using an eyepiece.

Q.76)

If a cell has an adequate supply of adenine nucleotides but requires more guanine nucleotides for protein synthesis:

1. **Glutamine-PRPP amidotransferase will not be fully inhibited.**
2. **AMP will be a feedback inhibitor of the condensation of IMP with aspartate.**
3. **ATP will stimulate the production of GMP from IMP.**
4. **ATP will inhibit nucleoside diphosphate reductase.**

- A. ☐ A, B and C
- B. ☐ A and C
- C. ☐ B and D
- D. ☐ D only

Q.77)

A practical class was going on where the students were demonstrating ATP synthesis in vitro using active mitochondria. Some students added one of the following to their tubes

A. Dinitrophenol (DNP), an uncoupler

B. Mild acidification of the medium

C. Glutiferone, that permeabilizes both the membranes

D. An outer membrane permeable H^+ quencher compound, Elila

In which one of the above, ATP synthesis will be detected?

A. ☐ A

B. ☐ B

C. ☐ C

D. ☐ D

Q.78)

During gluconeogenesis, the three irreversible steps of glycolysis have to be bypassed. First step is the conversion of pyruvate to phosphoenol pyruvate. Following are some statement regarding the reaction step?

- A. This reaction involves two step process catalyzed by pyruvate carboxylase and phosphoenolpyruvate carboxykinase
- B. Conversion of oxaloacetate from pyruvate occurs in mitochondria and shuttled into cytosol.
- C. Phosphoenol pyruvate utilizes both ATP and GTP as energy source.
- D. Acetyl CoA is an inhibitor of enzyme pyruvate carboxylase.

Which of these are false?

- A. ☐ A and B
- B. ☐ B and C
- C. ☐ C and D
- D. ☐ B and D

Q.79) A protein contains 2 tryptophan and 4 tyrosine residues. The molar mass of the protein is 17000D and that of Trp and Tyr are 204 and 180D. Values of $E(1\%, 1\text{cm})$, the absorption coefficient of 1%(g/v)-solutions of Trp and Tyr in 1cm cell at 280nm are 269.60 and 83.33 respectively. The absorption of 1mg/ml protein solution in 1cm cell at 280nm will be:

- A. ☐ 0.1
- B. ☐ 1.0
- C. ☐ 0.7
- D. ☐ 1.7

Q. 80)

79. The following statements are made on nucleic acid structure:

- A. In the B-form of DNA, the sugar pucker is C2' endo
- B. In RNA, the sugar pucker is C3' exo
- C. The wobble base pair is formed between G and A in RNA
- D. A change in the sugar pucker from C2' endo in the B-form of DNA to C3' endo alters the width and depth of the major groove.

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

- A. ☐ A and C
- B. ☐ B and D
- C. ☐ A and D
- D. ☐ B and C

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Q.81)

Out of the statements mentioned below

- A. L-threonine and L-allo-threonine interact identically with plane polarized light.
- B. van der Waals' interactions are always attractive.
- C. Poly (pro) II-helix is not stabilized by intermolecular hydrogen bonds.
- D. The folding of a protein is associated with an overall positive change in free energy and negative change in entropy.
- E. Lysine acetylation on histone is associated with loosening of the histone complex from DNA.

Which of the following combinations is CORRECT?

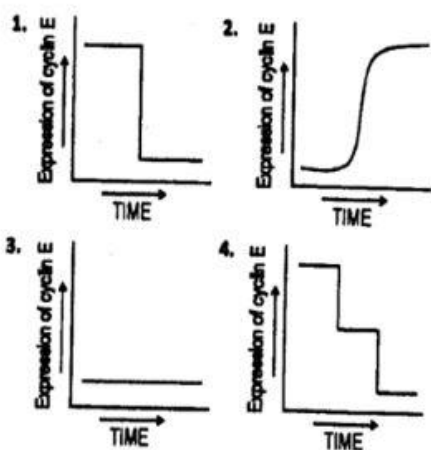
- A. ☐ A and C
- B. ☐ B and D
- C. ☐ C and E
- D. ☐ D and E

Q.82) ATP-driven pumps hydrolyze ATP to ADP and phosphate and use the energy released to pump ions or solutes across a membrane. There are many classes of these pumps and representatives of each are found in all prokaryotic and eukaryotic cells. Which of the following statements about these pumps is not correct?

- A. ☐ P-type pumps are multipass transmembrane proteins which phosphorylate themselves during pumping and involve in ion transport
- B. ☐ F-type pumps normally use the H^+ gradient across the membrane to drive the synthesis of ATP
- C. ☐ V-type pumps normally use voltage gradient for transport of small molecules
- D. ☐ ABC transport primarily pump small molecules across cell membrane

Q. 83)

Cell cycle is regulated by various cyclins and cyclin dependent kinases (CDK). On receiving mitotic stimuli, cyclin D, the first cyclin expressed, binds with existing CDK4 to form the active cyclin D- CDK4 complex. This in turn phosphorylates retinoblastoma protein (Rb) which activates E2f to further activate the transcription of various downstream cyclins. In a particular cell type there is a mutation in Rb such that it cannot be phosphorylated. What will be the correct expression pattern of cyclin E in these cells after mitotic stimulation?



- A. ☐ 1
B. ☐ 2
C. ☐ 3
D. ☐ 4

Q. 84)

In order to prove that liposome can serve as a model membrane (mimicking cellular plasma membrane) and can be used as a target for complement-mediated immunolysis, an experiment as below is designed. To initiate such experiment, hapten-conjugated liposomes are made and loaded with umbelliferyl phosphate (UMP; hydrolysed product of UMP is umbelliferone and is fluorescent). Such loaded, hapten-conjugated liposomes in 10 mM Tris, buffered saline, pH 7.4 were mixed with anti-hapten antibodies and fresh guinea pig serum (as a source of complement) to induce immunolysis of liposomal membrane. To quantify only the membrane lysis component which of the assay sequences below is MOST appropriate?

- A. ☐ Mixture is ultracentrifuged and the supernatant reacted with alkaline phosphatase and fluorescence measured
B. ☐ Mixture is sequentially reacted with phospholipase and alkaline phosphatase followed by fluorescence measurements
C. ☐ Mixture is directly subjected to fluorescence measurement
D. ☐ Mixture is treated with Triton X-100 and fluorescence measured

- Q.85) Glycolipids and sphingomyelin are produced by the addition of sugars or phosphorylcholine to ceramide on cytosolic and luminal surfaces respectively, of the Golgi apparatus. Finally, after such modifications, these molecules are located on the outer half of the plasma membrane. What key events are responsible for such localization?
- A. ☐ Membrane fusion only
 - B. ☐ Action of Flippase and membrane fusion
 - C. ☐ Action of only Flippase
 - D. ☐ Flip flop of these molecules in the golgi membrane catalyzed by proton pump

Q.86)

Lipid rafts are involved in signal transduction in cells. Rafts have composition different from rest of the membrane. Rafts were isolated and found to have cholesterol to sphingolipid ratio of 2:1. The estimated size of the raft is 35 nm². If the surface areas of cholesterol is 40 Å² and sphingolipid is 60 Å², how many cholesterol and sphingolipids are present in one raft?

- A. ☐ 50 cholesterol; 25 sphingolipid
- B. ☐ 200 cholesterol: 100 sphingolipid
- C. ☐ 40 cholesterol : 20 sphingolipid
- D. ☐ 20 cholesterol: 10 sphingolipid

Q.87)

In prokaryotes, the initiator t-RNA is first charged with a methionine, followed by the addition of a formyl group to the methionine by the enzyme Met-tRNA transformylase. Given below are several statements in this context.

- A. All prokaryotic proteins have formyl methionine at their amino-terminal end.
- B. Deformylase removes the formyl group from the amino terminal methionine.
- C. All prokaryotic proteins have methionine at their amino terminal end.
- D. Aminopeptidases often remove the amino terminal methionine.
- E. Aminopeptidases remove amino terminal formyl methionine.

Which of the above statement(s) are most likely to be true?

- A. ☐ A only
- B. ☐ B and C
- C. ☐ E only
- D. ☐ B and D

Q.88)

Aminoacyl tRNA synthetases face two important challenges:

- i) They must recognize the correct set of tRNAs for a particular amino acid.**
- ii) They must charge all of these isoaccepting tRNAs with the correct amino acid.**

Both of these processes are carried out with high fidelity by the following possible mechanisms:

- A. The discrimination ability resides predominantly at the acceptor stem of the tRNAs.**
- B. The specificity is contributed by the anticodon loop in tRNAs.**
- C. The specificity is embedded in the amino acyl synthetase at the 'N' terminus**
- D. The specificity is contributed by the variable loop of the tRNA.**

Which of the following is correct?

- A. ☐ A and B**
- B. ☐ A and C**
- C. ☐ B and C**
- D. ☐ A and D**

Q. 89)

Mutants of lac Y (Y-) gene of E. coli do not synthesize the lactose permease protein. The following statements refer to the behaviour of lac Y- mutants under different experimental conditions.

- A. No synthesis of β -galactosidase when Y- cells are induced with lactose.
- B. Synthesis of β -galactosidase when cells are induced with lactose.
- C. No synthesis of β -galactosidase when cells are induced with IPTG.
- D. Synthesis of β -galactosidase when cells are induced with IPTG.
- E. The cells induced with IPTG cannot grow in the presence of TONPG (TONPG is a compound, whose uptake is mediated by lactose permease and cleaved by β -galactosidase to release a toxic compound).
- F. Cells induced with IPTG Can grow in the presence of TONPG.

Which combination of the above statements is correct?

- A. ☐ A, D and F
- B. ☐ B, C and E
- C. ☐ A, C and F
- D. ☐ A, C and E

Q.90)

The lambda (λ) and P22 phages are two related lambdoid bacteriophages. A recombinant lambda phage (λ Mut) was derived from the wild type lambda (λ WT) by replacing its C_I repressor gene and the C_I binding site with those from the P22 phage. Both the wild type and mutant were used independently to infect E.coli strain over-producing lambda WT C_I repressor. Following outcomes were surmised

1. Infection with wild type will lyse the E.coli used
2. Infection with wild type will establish lysogeny the E.coli used
3. Infection with mutant will lyse the E. coli used
4. Infection with mutant will establish lysogeny the E. coli used

Which combination of the above statements is correct?

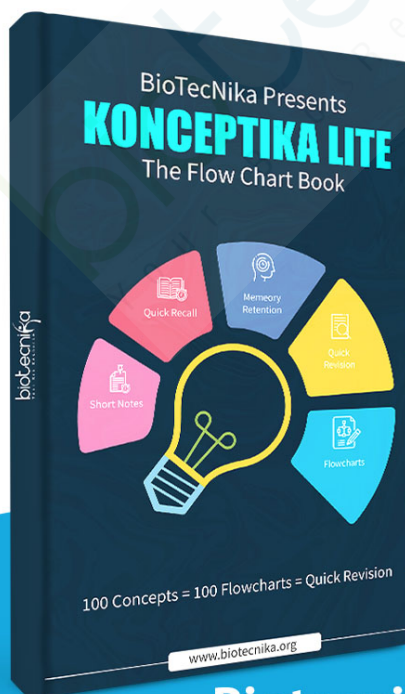
- A. ☐ 1 and 2
- B. ☐ 2 and 3
- C. ☐ 3 and 4
- D. ☐ 4 and 1

Q.91) An eukaryotic cell undergoing mRNA synthesis and processing was incubated with ^{32}P labeled ATP, with the label at the β -position. Where do you think the radioactive isotope will appear in the mature mRNA?

- A. ☐ ^{32}P will not appear in the mature mRNA under any circumstances because β and γ phosphates are released during transcription.
- B. ☐ Phosphate groups of the phosphodiester backbone of the mRNA will be uniformly labeled as only γ phosphates are released during transcription
- C. ☐ ^{32}P will appear at the 5' end of the mRNA if only it has "A" as the first nucleotide
- D. ☐ No ^{32}P will appear in the mature mRNA because the 5'-terminal phosphate of an "A" residue will be further removed during the capping process.

- Q.92) Although ribonucleoside triphosphates (rNTPs) are present at approximately 10-fold higher concentration than deoxyribonucleoside triphosphates (dNTPs) in the cell, but they are incorporated into DNA at a rate that is more than 1000-fold lower than dNTPs. This is because
- A. ☐ DNA polymerase cannot discriminate between dNTPs and rNTPs. But as soon as rNTPs are incorporated in the DNA chain, they are hydrolyzed due to the presence of 2'-OH group.
 - B. ☐ DNA polymerase cannot discriminate between dNTPs and rNTPs. But as soon as rNTPs are incorporated in the DNA chain, they are excised by the proof reading activity of DNA polymerase.
 - C. ☐ DNA polymerase efficiently discriminates between rNTPs and dNTPs, because its nucleotide binding pocket cannot accommodate a 2'-OH on the incoming nucleotide
 - D. ☐ DNA polymerase cannot discriminate between rNTPs and dNTPs. Since the rate of transcription in cell is 106 times faster than replication, it cannot compete with RNA polymerase for rNTPs.

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Q.93)

A ligand recognizes two different cell surface receptors, A and B, on the same cell type. Receptor A, after binding with the ligand is internalized along with the ligand whereas B, after binding with the ligand, initiates tyrosine kinase activity of the intracellular domain. One particular disease is associated with the loss of receptor-mediated signal transduction of the ligand. Different observers inferred that the disease may be resulted due to

1. loss of binding affinity of the receptor A due to mutation in the extracellular domain
2. loss of binding affinity of the receptor B due to mutation in the extracellular domain
3. mutation in the tyrosine kinase domain rendering it inactive
4. mutation in the intracellular domain rendering it incapable of endocytosis

Which of the above statement(s) is/are most likely to be true

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

Q.94) Dendritic cells (DC) from BALB/c mice were treated with IL-10 or with IFN- γ . Similarly, dendritic cells from β 2-microglobulin-deficient mice were also treated with IL-10 or with IFN- γ . These cells were co-cultured with CD8⁺ T cells from hen egg lysozyme (HEL)-specific T cell receptor transgenic mice in presence of HEL peptide. Five days later, CD8⁺ T cells were assayed for target cell lysis. Which one of the following combinations will have the highest target cytotoxicity?

- A. ☐ DC (BALB/c)IL-10 X CD8⁺ T
- B. ☐ DC (BALB/c)IFN- γ X CD8⁺ T
- C. ☐ DC (β 2-microglobulin-deficient)IL-10 x CD8⁺ T
- D. ☐ . DC (β 2-microglobulin-deficient)IFN- γ x CD8⁺ T

Q.95)

Clearance of phagocytosed intracellular parasite like *Leishmania* requires the involvement of reactive oxygen species (ROS) and reactive nitrogen species (RNS). Administration of IFN γ to macrophages harbouring an intracellular pathogen leads to the production of ROS and RNS by JAK/STAT pathway. A macrophage cell line J774 infected with *Leishmania* is given the following treatments.

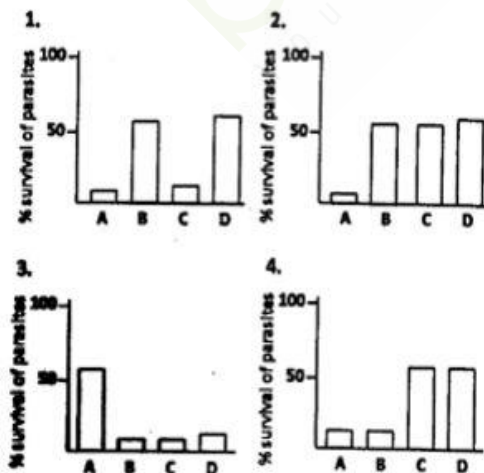
A. IFN-g

B. IFN-g + AMT, a potent iNOS inhibitor

C. IFN-g + apocyanin, a NADPH oxidase inhibitor

D. IFN-g + NMMA, an arginine analogue

What will be the most appropriate graph showing the survival of parasites after these treatments?



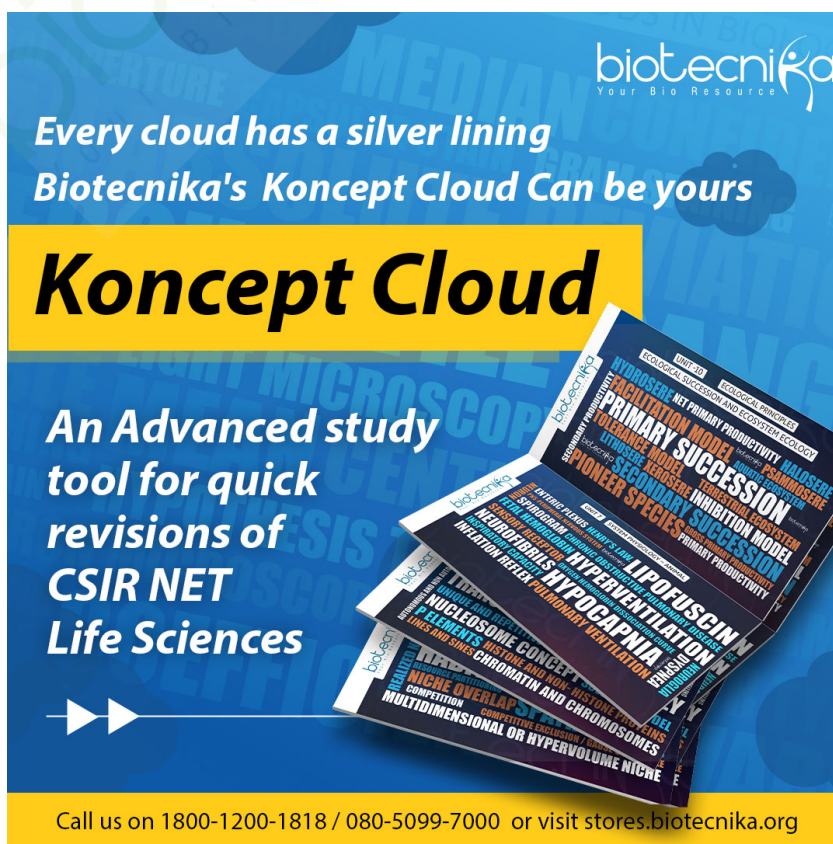
A. ☐ 1

B. ☐ 2

C. ☐ 3

D. ☐ 4

- Q.96) In cells having G protein coupled receptor, inhibition of protein kinase A by siRNA technology led to diminished transcription of androgen binding protein (ABP) and CREB protein. Addition of cAMP, which is a second messenger, will lead to
- A. ☐ increased transcription of ABP
 - B. ☐ increased phosphorylation of CREB protein
 - C. ☐ no change in transcription level
 - D. ☐ increased ATPase activity of Ga subunit
- Q.97) Vascular endothelial (VE) cadherin is an important cell adhesion molecule for endothelial cells. Endothelial cells that are unable to express VE-cadherin still can adhere to one another via N-cadherin (neural cadherin), but these cells do not survive. Which of the following is the most appropriate reason for this?
- A. ☐ N-cadherin uses VE-cadherin as co-receptor for adhesion
 - B. ☐ VE-cadherin acts as co-receptor for VEGF mediated signal transduction in endothelial cells
 - C. ☐ VE-cadherin is important for desmosome formation and interaction of intermediate filaments
 - D. ☐ Loss of VE-cadherin impairs Ca^{2+} homeostasis of vascular endothelial cells leading to their death



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- Q.98) p24 is an important core protein of HIV. This protein is abundant during active replication of virus. The serum of an HIV patient was examined for the presence of p24 and antibody against p24 for proper diagnosis of the infection stage. Match the clinical observations in column A with the inferences in columnB.

Column A**Column B**

A. p24 is present in the serum

a. Viral latency

B. Anti-p24 antibody is high in the serum

b. progression of HIV from latency to lytic stage

C. Anti-p24 antibody begins to decline with corresponding increase in p24

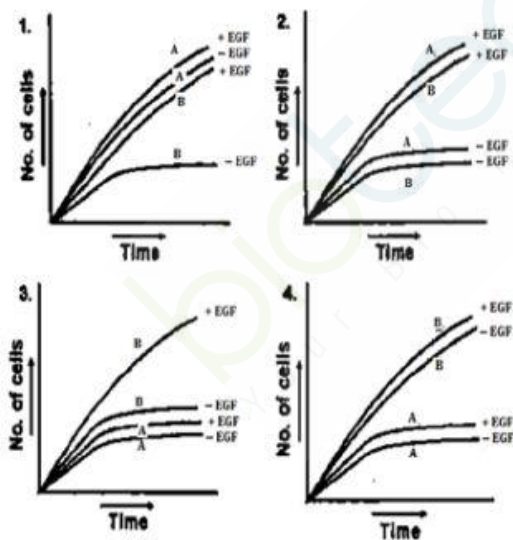
c. early stage of infection

Choose the correct matching

- A. ☐ A-a, B-b, C-c
 B. ☐ A-b, B-a, C-c
 C. ☐ A-c, B-a, C-b
 D. ☐ A-c, B-b, C-a

Q.99)

Epidermal growth factor (EGF) is needed for growth of almost all cells. EGF receptor is a transmembrane protein having an extracellular ligand-binding domain, a transmembrane domain and a cytosolic domain of protein tyrosine kinase (PTK). Binding of EGF to the receptor activates PTK resulting in activation of transcription factors through intracellular transducers. In cell type A, much of the extra-cellular ligand binding domain is deleted by proteases such that cytosolic domain of PTK becomes constitutively active whereas cell type B is having normal EGF receptor. What will be the best-fit graph for the growth of the cultures of cell type A and B in complete medium in presence (+) and absence (-) of EGF?



- A. ☐ 1
 B. ☐ 2
 C. ☐ 3
 D. ☐ 4

Q.100)

Extensive molecular genetic studies on miR156, miR172, SPL genes and AP2-like genes have yielded the following functional model on the juvenile --> adult--> reproductive transition in Arabidopsis : Fig 1.

Based on these results, the following schematic diagram has been proposed to predict the expression kinetics of these genetic factors: Fig 2.

Which of the following combinations is most likely to be correct?

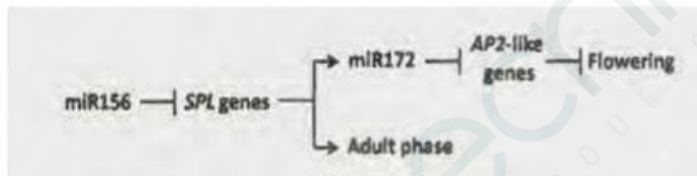


Fig. 1

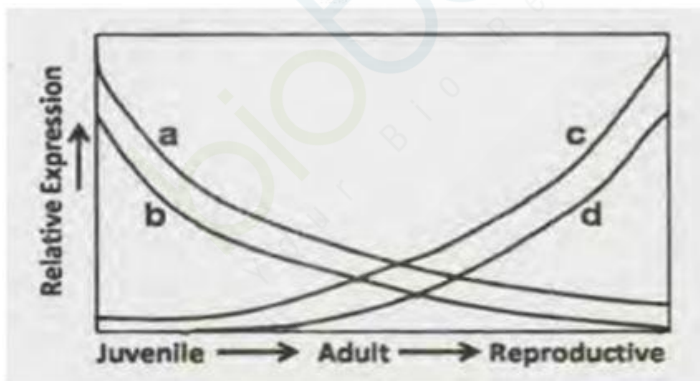


Fig. 2

- A. ☐ a - miR156; b - SPL genes; c - miR172; d - AP2 like genes
- B. ☐ a- miR156; b - miR172; c - SPL gene; d - AP2 like genes
- C. ☐ a- miR172; b - SPL genes; c - AP2 like genes; d - miR156
- D. ☐ a- miR156; b - AP2 like genes; c - miR172; d - SPL genes

Q.101) The figure below represents a late zebrafish gastrula.

The following concepts may be proposed during further development of the embryo.

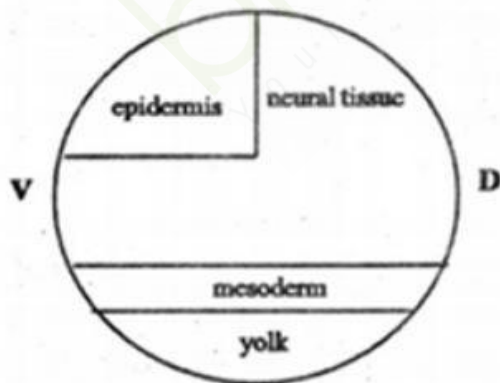
A. The concentration of FGF decreases from the yolk towards the epidermis, along with the increase of BMP activity from the dorsal to the ventral axis.

B. Increase in FGF activity in the epidermis with concomitant decrease in BMP activity towards the ventral axis.

C. Neural induction in zebrafish is independent of the organizer and depends on activation of BMP signalling.

D. In comparison, both *Xenopus* and chick embryos require activation of FGF for neural induction to occur in addition to BMP inhibition.

Which of the above statements are true?



A. ☐ A and C

B. ☐ B and C

C. ☐ A and D

D. ☐ C and D

Q.102)

Following statements were given regarding the decisions taken during the development of mammalian embryos:

A. The pluripotency of the inner cell mass (ICM) is maintained by a core of three transcription factors, Oct 4, Sox 2 and Nanog.

B. 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.

C. Both ICM and trophoblast cells synthesize transcription factor Cdx 2.

D. Oct 4 activates Cdx 2 expression enabling some cells to become trophoblast and other cells to become ICM.

Which of the above statements are true?

A. ☐ A and B

B. ☐ A and C

C. ☐ B and D

D. ☐ B and C

Q.103) During lens formation in the *Xenopus*, the following statements have been proposed :

A. Lens induction can be achieved in the absence of optic vesicle after priming of head ectoderm by the anterior neural plate

B. The optic vesicle can induce the presumptive trunk ectoderm to form the lens.

C. Only the head ectoderm can respond to direct signals from the optic vesicle to form the lens.

D. The anterior neural plate primes the head ectoderm via BMP4 and Fgf8 prior to signals from the optic vesicle

Which of the above combinations is correct?

A. ☐ C and D

B. ☐ B and D

C. ☐ A and D

D. ☐ A and C

Q.104) The following are statements regarding the development and maintenance of anterior and posterior

compartments in each segment of *Drosophila*:

A. Expression of wingless and engrailed is activated by pair-rule genes

B. Continued expression of wingless and engrailed is maintained by interaction between the cells expressing engrailed and Wingless proteins

C. Hedgehog is expressed in wingless expressing cells and forms short range gradient

D. Hedgehog is a transcription factor

E. Engrailed is a secretory factor and binds with the patched receptor for the wingless expressing cells.

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

A. ☐ C and E

B. ☐ C, D and E

C. ☐ D and E

D. ☐ A and B

Q.105)

Instructive and permissive interactions are two major modes of inductive interaction during development. The following compares some properties of cell lines and cord blood stem cells. Cell lines, which are stored in liquid nitrogen, can be retrieved for experiments, where they behave as per their original self. Cord blood can also be retrieved from liquid nitrogen for procuring stem cells. Unlike cell lines, the stem cells can be additionally induced to undergo differentiation into desired lineages, which are very different from their original self. The behavior of cell lines and stem cells is analogous to which of the interactions?

- A. ☐ Both cell lines and stem cells show instructive interaction
- B. ☐ Cell lines show instructive interactions whereas stem cells show permissive interaction
- C. ☐ Cell lines show permissive interaction whereas stem cells show instructive interaction
- D. ☐ Both types of cells show permissive instruction



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Q.106)

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

- A. It induces the host's ventral tissues to change their fates to form a 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 the ability to initiate the movements of gastrulation.
- E. Both b-catenin and Chordin are produced by the organizer.

Which of the above statements are correct?

- A. ☐ A and D
- B. ☐ D and E
- C. ☐ A and E
- D. ☐ B and C

Q.107) Light is an important factor for plant growth and development. There are several photoreceptors in higher plants such as *Arabidopsis thaliana* involved in perception of various wavelengths of light. Some statements are given below related to photoreceptors

A. Red light photoreceptors are represented by a gene family.

B. Phytochrome C is the most prominent photoreceptor to perceive red light.

C. Cryptochrome 1 and cryptochrome 2 have evolved from bacterial photolyases.

D. Far-red light is perceived by phytochrome D. Which one of the following combinations of above statements is correct?

A. ☐ A and B

B. ☐ B and C

C. ☐ C and D

D. ☐ A and C

Q.108) Which of the following options match the plant tissue type with its correct function in vascular plants?

Tissue	Function
A. Tracheids	(i) Chief water-conducting element in gymnosperms
B. Vessel elements	(ii) Chief water-conducting element in angiosperms
C. Sieve tube element	(iii) Food-conducting element in gymnosperms
D. Sieve cell	(iv) Food-conducting element in angiosperms

A. ☐ A-(i) B-(ii) C-(iv) D-(iii)

B. ☐ A-(ii) B-(i) C-(iii) D-(iv)

C. ☐ A-(i) B-(ii) C-(iii) D-(iv)

D. ☐ A-(i) B-(iii) C-(iv) D-(ii)

Q.109) Carbohydrates synthesized by photosynthesis are converted into sucrose and transported via phloem to other parts of the plant. The following aspects are associated with sucrose uploading in phloem and its transport:

- A. Both reducing and non-reducing sugars are transported efficiently through phloem.
- B. Sucrose uploading can be both symplastic and apoplastic.
- C. The route of phloem uploading is: Mesophyll cells phloem parenchyma companion cells sieve tubes
- D. Transport in sieve tubes is as per the 'pressure flow model'.

Which one of the following combinations is correct?

- A. ☐ A, B and C
- B. ☐ B, C and D
- C. ☐ C, D and A
- D. ☐ D, B and A

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Q.110) The table below represents the types of intercellular transport in “Column I” in land plants and their transport pathways in “Column II”.

Which one of the following combinations matches Column I correctly with Column II.

I		II
A.	Apoplastic	i. Via interconnecting plasmodesmata.
B.	Symplastic	ii. Via the water filled spaces of the cell wall matrices and lumen of xylem tracheary elements.
C.	Transcellular transport	iii. Via the vacuole across the tonoplast followed by exit across the plasma membrane before regaining entry to the adjacent cell through the plasma membrane.

A. ☐ A-(i), B-(ii), C-(iii)

B. ☐ A-(ii), B-(i), C-(iii)

C. ☐ A-(iii), B-(ii), C-(i)

D. ☐ A-(i), B-(iii), C-(ii)

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Q.111) The nodulation (nod) genes are classified as common nod genes or host specific nod genes. Some statements related to such classification are given below:

A. nodA is a common nod gene and nodC is a host specific gene.

B. nodB is a common nod gene and nodP is a host specific gene.

C. nodQ is a common nod gene and nodA is a host specific gene.

D. nodH is a common nod gene and nodQ is a host specific gene.

Choose the correct answer from the above statements:

A. ☐ A and B

B. ☐ C and D

C. ☐ A only

D. ☐ B only

Q.112) For a normal heart, the time taken for atrial systole and diastole are A_s and A_d seconds, respectively, while the same for ventricular systole and diastole are V_s and V_d . Which one of the following equations are correct?

A. ☐ $A_s + A_d = V_s + V_d$

B. ☐ $A_s + A_d < V_s + V_d$

C. ☐ $A_s + A_d - V_s + V_d = 0$

D. ☐ D. $A_s + A_d > V_s + V$

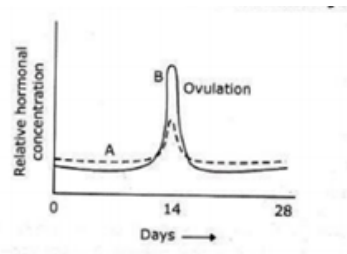
Q.113) A person has been suffering from night blindness. On consultation, the doctor advised the person to eat carrots and/or cod fish oil. After some time, having seen no improvement, the doctor gave the person vitamin A injection. Still no marked improvement was seen. The doctor mooted several suggestions indicating lack of the following enzymes for the failure of treatment:

- A. Retinol dehydrogenase
- B. Retinal reductase
- C. Retinal isomerase
- D. Retinal synthase

Which one of the following is correct?

- A. ☐ A only
- B. ☐ B only
- C. ☐ B and C
- D. ☐ C and D

Q.114) The graph represents relative plasma concentration of hormones (A and B) during reproductive cycle in a normal female. Which one of the following combinations is correct?



- A. ☐ (A) is FSH and (B) is estrogen
- B. ☐ (A) is estrogen and (B) is LH
- C. ☐ (A) is FSH and (B) is LH
- D. ☐ (A) is LH and (B) is FSH

Q.115) Desert animals have longer loop of Henle compared to that of humans. It may be due to the following reasons:

- A. Long loop of Henle is associated with greater amount of vasopressin secretion
- B. In long loop of Henle, the counter-current exchanger is more effective
- C. Long loop of Henle conserves more water
- D. Long loop of Henle stimulates production of angiotensin II

Which of the above reason (s) is/are correct?

- A. ☐ A and B
- B. ☐ B and C
- C. ☐ C and D
- D. ☐ Only D

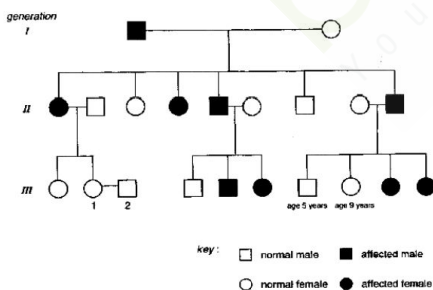
Q.116) The intestinal absorption of glucose is impaired by the use of ouabain, an inhibitor of Na^+/K^+ ATPase. Indicate the correct explanation.

- A. ☐ The inhibitor has blocked the transport of Na^+ from intestinal lumen to epithelial cells
- B. ☐ The inhibitor has blocked the transport of Na^+ from epithelial cells to intestinal lumen
- C. ☐ The inhibitor has blocked the transport of Na^+ from epithelial cells to the interstitial space
- D. ☐ The inhibitor has blocked the transport of Na^+ from the interstitial space to epithelial cells

Q.117) A newly discovered, recessively-inherited disease-susceptibility trait (DS) is observed only in cotton plants with white flowers, although the flower colour (R) and DS are independently inherited. In a breeding programme, one variety that is homozygous for the absence of DS, but heterozygous for R was mated to another having white flowers but heterozygous for DS. What is the probability that a given plant among the cross progeny will be susceptible to the disease?

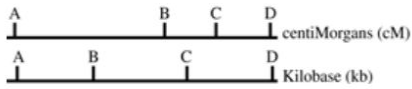
- A. ☐ 25 %
- B. ☐ 12.5 %
- C. ☐ 75 %
- D. ☐ 0 %

Q.118) Identify the pattern of Inheritance from the following pedigree chart.



- A. ☐ Autosomal dominant
- B. ☐ Autosomal recessive
- C. ☐ Sex linked dominant
- D. ☐ Sex linked recessive

- Q. 119) The upper line in the figure shows the locations of four genes on the genetic map of an organism; the lower line shows the locations of the same four genes on a physical map derived from the nucleotide sequence of the the DNA of the same organism. The maps are not identical because:



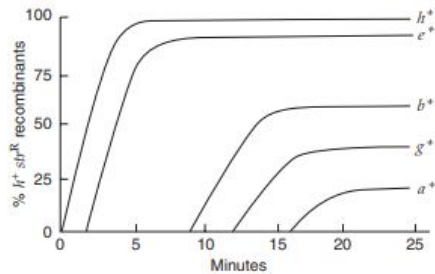
3. The farther apart the genes are, the more likely they are to recombine.
4. The closer the two genes are, the more likely they are to recombine
- A. ☐ A genetic map can not provide any information about the gene positions.
- B. ☐ Recombination frequencies per kb of DNA are not uniform across the chromosome
- C. ☐ The farther apart the genes are, the more likely they are to recombine.
- D. ☐ The closer the two genes are, the more likely they are to recombine

Q. 120)

At time zero, an Hfr strain (Hfr 1) was mixed with an F-strain, and at various times after mixing, samples were removed and agitated to separate conjugating cells. The cross may be written as

Hfr 1: $a^+ b^+ c^+ d^+ e^+ f^+ g^+ h^+$ str S

F-: $a b c d e f g h$ str R



(No order is implied in listing the markers.) The samples were then plated onto selective media to measure the frequency of h^+ strR recombinants that had received certain genes from the Hfr cell. A graph of the number of recombinants against time is shown in the accompanying figure and the following statements are interpreted..

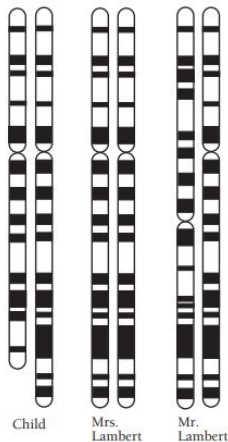
- F- cells that received a^+ from the Hfr in the chromosome transfer process must also have received b^+ .
- The order of gene transfer from Hfr to was a^+ (first), then g^+ , then b^+ , then e^+ , and, finally, h^+ .
- The distance between h^+ and e^+ is more than distance between b^+ and g^+ .
- None of the b^+ strR recombinants plated at 15 minutes are also a^+ .

Which of the following combinations is CORRECT ?

- ☐ i, ii, iii
- ☐ i and iv
- ☐ i, iii and iv
- ☐ ii and iii

Q.121)

Mr. and Mrs. Lambert have not yet been able to produce a viable child. They have had two miscarriages and one severely defective child who died soon after birth. Studies of banded chromosomes of father, mother, and child showed that all chromosomes were normal except for pair number 6. The number 6 chromosomes of mother, father, and child are shown in the following figure:



The following conclusions were made.

- A. There is a paracentric inversion in the maternal chromosome 6
- B. There is a pericentric inversion in the paternal chromosome 6.
- C. The child has one recombinant copy of the paternal chromosome.
- D. The child has a normal copy of the maternal chromosome.
- E. The child has a normal copy of paternal chromosome.

Which of the combinations of the statements is INCORRECT ..?

- A. ☐ A,C,D
- B. ☐ B,C,E
- C. ☐ B and E
- D. ☐ A and E

Q.122) Multiple crosses were made between true-breeding lines of black and yellow Labrador retrievers. All the F₁ progeny were black.

When these F₁ progeny were intercrossed, they produced an F₂ consisting of 91 black, 39 yellow, and 30 chocolate.

Following conclusions were made based on the test result.

- A. This is an example of duplicate recessive epistasis.
- B. Two linked gene pairs are involved in controlling the trait.
- C. Two independently assorting gene pairs are involved in controlling the trait.
- D. This is an example of recessive epistasis.
- E. Yellow is the intermediate and chocolate is the recessive character.
- F. Yellow is the recessive and chocolate is the intermediate character.

Which of the combinations is Correct ?

- A. ☐ C, D, F
- B. ☐ A, C, E
- C. ☐ A, B, F
- D. ☐ C, D, E



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Q.123) Some key characteristics of the four classes of phylum Mollusca are listed below:

- a. They have two lateral (left and right) shells (valves) hinged together dorsally; they do not have distinct head or radula; they disperse from place to place largely as larvae.
- b. They generally creep on their foot; the heads of most of this group have a pair of tentacles with eyes at the end; during embryological development, they undergo torsion
- c. They have oval bodies with overlapping calcareous plates; underneath the plates, the body is not segmented; they creep along using a broad, flat foot surrounded by a groove or mantle cavity in which the gills are arranged.
- d. They have highly developed nervous system; most members of this class have closed circulatory systems.

The correct match of the above characteristics with the classes of Mollusca is

- A. ☐ a - Polyplacophora b – Bivalvia c - Gastropoda d – Cephalopoda
- B. ☐ a - Cephalopoda b – Polyplacophora c - Bivalvia d - Gastropoda
- C. ☐ a- Bivalvia b- Gastropoda c- Polyplacophora d- Cephalopoda
- D. ☐ a-Gastropoda b – Bivalvia c - Cephalopoda d – Polyplacophora

Q.124) Match the following human diseases with their causal organisms

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

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

Q.125) Following are the characteristics of species that make them more or less prone to extinction:

Rare – a

Common – b

Good dispersal rate – c

Poor dispersal rate – d

Low specialization – e

High specialization – f

High variability – g

Low variability – h

Low trophic status – i

High trophic status – j

Long life span – k

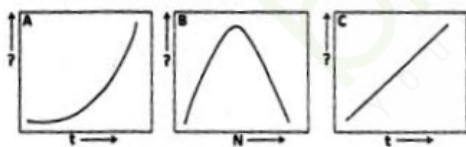
Short life span – l

High reproductive output – m Low reproductive output – n

Which of the following is the correct combination of characteristics that makes the species more prone to extinction ?

- A. ☐ a d f g j l n
- B. ☐ a e f h i k m
- C. ☐ b d e g i l n
- D. ☐ b c f h j k m

Q.126) The three graphs (A, B, C) show population growth (N) patterns in relation to N or time (t)



Which of the following is correct with reference to the Y-axis label and the type of population growth?

- A. ☐ A: Y-axis: Nt , exponential growth B: Y-axis: dN/dt , logistic growth C: Y-axis: $\ln(N)$, exponential growth
- B. ☐ A: Y-axis: dN/dt , exponential growth B: Y-axis: $\ln(N)$, logistic growth C: Y-axis: Nt , exponential growth
- C. ☐ A: Y-axis: $\ln(N)$, exponential growth B: Y-axis: dN/dt , logistic growth C: Y-axis: Nt , exponential growth
- D. ☐ A: Y-axis: dN/dt , exponential growth B: Y-axis: $\ln(N)$, logistic growth C: Y-axis: Nt , exponential growth

Q.127) Identify the pollinators for the flowers with the following pollination syndromes.

A. Flowers dull coloured, located away from folliages and floral parts turgid

B. Flowers bright red, crowded turgid, nector watery and sucrose rich

C. Flowers white with pleasant odour, corrola tube long, night blooming

A. ☐ A- Bird, B- Bat, C- Butterfly

B. ☐ A-Bat, B- Bird, C- Moth

C. ☐ A-Bat, B-Bird, C-Bee

D. ☐ A- Bat, B- Bird, C- Carrion fly

Q.128) In the Lotka-Voltera competition model for two species

Where N- population size, r- growth rate, K-carrying capacity for species 1 and 2, the interspecific competition coefficient $\alpha_{12} < 1$ will mean

- A. ☐ Individuals of species 2 have less inhibiting effect on individuals of species 1 than individual of species 1 on others of their own species
- B. ☐ Individuals of species 2 have greater inhibiting effect on individuals of species 1 than individual of species 1 on others of their own species
- C. ☐ Individuals of species 1 have less inhibiting effect on individuals of species 2 than individual of species 1 on others of their own species
- D. ☐ Individuals of species 1 have greater inhibiting effect on individuals of species 2 than individual of species 1 on others of their own species

Q.129) Match the following evolutionary biologists with their respective theory

I) August Weisman i) Neutral theory of molecular evolution

II) Jean-Baptiste Lamarck ii) Handicap principle

III) Amotz Zahavi iii) Germ plasm theory

IV) Motoo Kimura iv) Inheritance of acquired characteristics

A. ☐ I-ii, II-iv, III-i, IV-iii

B. ☐ I-iii, II-iv, III-ii, IV-i

C. ☐ I-iii, II-iv, III-i, IV-ii

D. ☐ I-iii, II-i, III-iv, IV-ii

Q.130)

The body weight of adult female of a strain of *Drosophila* is 1.8 ± 0.45 mg (mean \pm standard deviation). In a laboratory experiment, each of the 3 groups (A, B, C) of this strain was subjected to a different type of selection pressure having influence on the female body weight. After many generations of experimental selection pressure, the body weight changed as follows:

Group A: Body weight distribution - Normal, 1.8 ± 0.08 mg

Group B: Body weight distribution - Bimodal at 1.4 and 2.2 mg

Group C: Body weight distribution - Normal, 2.2 ± 0.08 mg

Which of the following correctly gives the types of selection that have occurred in the three groups?

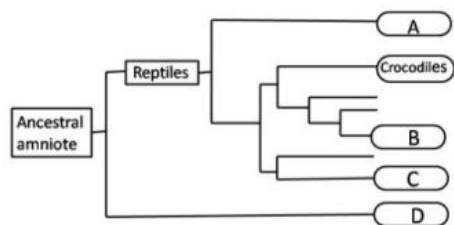
- A. ☐ Group A: Directional; Group B: Stabilizing; Group C: Disruptive
- B. ☐ Group A: Disruptive; Group B: Directional; Group C: Stabilizing
- C. ☐ Group A: Stabilizing; Group B: Disruptive; Group C: Directional
- D. ☐ Group A: Directional; Group B: Disruptive; Group C: Stabilizing

Q.131) Match major events in the history of life with Earth's geological period.

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

- A. ☐ A – (v); B – (i); C – (ii); D – (v)
- B. ☐ A – (v); B – (iv); C – (i); D – (vi)
- C. ☐ A – (vi); B – (iv); C – (ii); D – (vi)
- D. ☐ A – (iii); B – (i); C – (vi); D – (v)

Q.132) The phylogenetic tree of amniote vertebrates is given in the following diagram



The groups labelled A, B, C, D are

- A. ☐ A-Snakes, B-Turtles, C-Birds, D-Mammals
- B. ☐ A-Snakes, B-Turtles, C-Mammals, D-Birds
- C. ☐ A-Turtles, B-Birds, C-Snakes, D-Mammals
- D. ☐ A-Birds, B-Turtles, C-Snakes, D-Mammals

Q.133) Individual A can derive 'fitness' benefit of 160 units by helping Individual B, but incurs a 'fitness' cost of 50 units in doing so. Following Hamilton's Rule, A should help B ONLY if B is his

- A. ☐ brother or sister.
- B. ☐ First cousin only
- C. ☐ cousin or uncle
- D. ☐ nephew or niece



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Q.134) The following statements are related to plant tissue culture:

- A. Friable callus provides the inoculum to form cell-suspension cultures.
- B. The process known as 'habituation' refers to the property of callus losing the requirement of auxin and/or cytokinin during long term culture.
- C. Cellulase and pectinase enzymes are usually used for generating protoplast cultures.
- D. During somatic embryo development, torpedo stage embryo is formed before heart stage embryo.

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

- A. ☐ A, B and C
- B. ☐ A, B and D
- C. ☐ A, C and D
- D. ☐ B, C and D

Q.135) A student noted the following points regarding *Agrobacterium tumefaciens*:

- A. *A. tumefaciens* is a gram-negative soil bacterium.
- B. Opine catabolism genes are present in TDNA region of Ti-plasmid.
- C. Opines are synthesized by condensation of amino acids and -ketoacids or amino acids and sugars.
- D. A callus culture of crown gall tissue caused by *A. tumefaciens* in plants can be multiplied without adding phytohormones.

Which one of the combinations of above statements is correct?

- A. ☐ A, B and C
- B. ☐ A, B and D
- C. ☐ B, C and D
- D. ☐ A, C and D

Q.136) Following are certain statements regarding the use of Agrobacterium in plant transformation.

A.A. tumefaciens causes crown gall disease and A. rhizogenes causes hairy root disease.

B.Region A in Ti plasmid is responsible for replication.

C.Region D in Ti plasmid is responsible for virulence.

D.Oncogenic (onc) region in TDNA is responsible for unusual amino acid synthesis.

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

A. ☐ P and Q

B. ☐ R and S

C. ☐ P and R

D. ☐ Q and S

Q.137) Following are certain statements regarding somatic hybridization, a technique used for plant improvement.

A.Protoplasts of only sexually compatible plant species can be fused.

B.Hybrids are produced with variable and asymmetric amounts of genetic material of parental species.

C.Protoplast fusion permits transfer of gene block or chromosomes.

D.Genes to be transferred need to be identified and isolated.

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

A. ☐ P and R

B. ☐ Q and R

C. ☐ P and S

D. ☐ Q and S

Q.138) The most important property of any microscope is its resolution (D) and can be calculated from the formula:

$$D = 0.61\lambda/N \sin \alpha$$

Where D is minimum distance between two distinguishable objects, λ is the wavelength of incident light, α is the angular aperture and N is the refractive index of the medium. Given below are several suggestions to improve the resolution of a microscope:

A. Decrease the wavelength of incident light

B. Increase the wavelength of incident light

C. Use oil which has a higher refractive index

D. Use oil because of its lower refractive index

Which one is the correct suggestion?

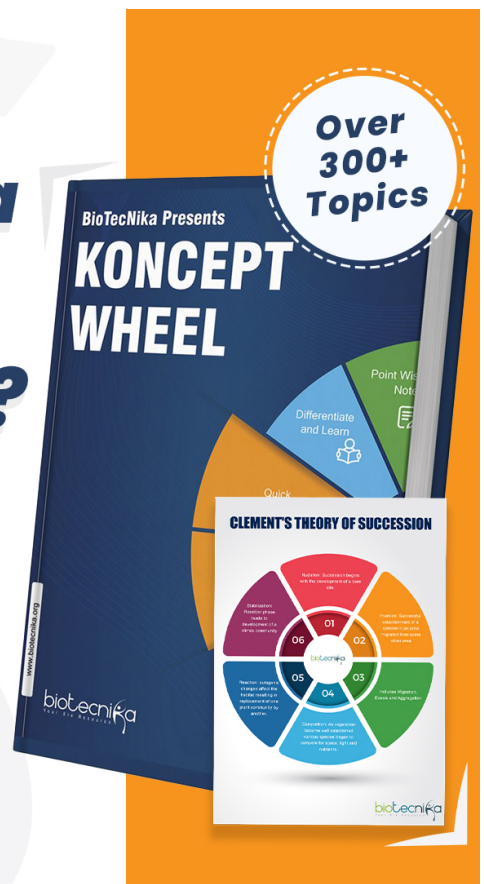
- A. ☐ A and C
- B. ☐ Only B
- C. ☐ Only D
- D. ☐ B and D

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Q.139) In order to visualize the intracellular organization of a cell, one can utilize various microscopy-based techniques. These include:

A. Differential Interference Contrast (DIC) microscopy

B. Phase contrast microscopy

C. Dark field microscopy

D. Epifluorescence microscopy

E. Scanning electron microscopy

F. Transmission electron microscopy

G. Confocal microscopy

Which of the above mentioned microscopes can be used to study the intracellular dynamics using live cell imaging?

A. ☐ A, B, E, F, G

B. ☐ A, B, C, D, G

C. ☐ A, D, E, F, G

D. ☐ C, D, E, F, G

Q.140) During an experiment, a student found increased activity of a protein, for which there were three possible explanations, viz., increased expression of the protein, increased phosphorylation, or increased interaction with other effector proteins. After conducting several experiments, the student concluded that increased activity was due to increased phosphorylation.

Which one of the following experiments will NOT support/provide the correct explanation drawn by the student?

- A. ☐ Western blot analysis
- B. ☐ Analysis of transcription rate
- C. ☐ Mass spectroscopy
- D. ☐ Phospho amino acid analysis

Q.141) Which one of the following statements is correct?

- A. ☐ Electrospray ionization mass spectrum of a compound can be obtained only if it has a net positive charge at pH 7.4
- B. ☐ Helical content of a tryptophan containing peptide can be obtained by examining the fluorescence spectrum of tryptophan
- C. ☐ The occurrence of beta sheet in a protein can be inferred from its circular dichroism spectrum
- D. ☐ The chemical shift spread for a compound is more in its ^1H NMR spectrum as compared to its ^{13}C NMR spectrum

Q.142) The most important property of a microscope is its power of resolution, which is numerically equivalent to D , the minimum distance between two distinguishable objects. D depends on three parameters, namely, the angular aperture, α , the refractive index, N , and wavelength, λ , of the incident light. Below are given few possible options to increase the resolution of the microscope.

A. Decrease the value of λ or increase either N or α to increase resolution.

B. Moving the objective lens closer to the specimen will decrease $\sin \alpha$ and improve the resolution.

C. Using a medium of high refractive index between the specimen and the objective lens to improve the resolution.

D. Increase the wavelength of the incident light to improve the resolution.

Which of the following combination of the above statements is correct?

A. ☐ A and C

B. ☐ B and C

C. ☐ A and D

D. ☐ C and D

Q.143) A fluorophore when transferred from solvent A to solvent B results in an increase in the number of vibrational states in the ground state without any change in the mean energies of either the ground or excited state. What would be the change seen in the fluorophore's emission spectrum?

A. ☐ An increase in emission intensity

B. ☐ An increase in emission bandwidth

C. ☐ An increase in emission wavelength

D. ☐ A decrease in emission wavelength

Q.144) From the following statements:

(A) Coloured images can be obtained by transmission electron microscopy by fluorescent labelling of the specimen

(B) Scanning electron microscopy requires sectioning of the sample

(C) Confocal microscopy uses optical methods to obtain images from a specific focal plane and excludes light from other planes

(D) Differential-interference microscopy relies on interference between polarized light due to differences in the refractive index of the object and surrounding medium

(E) Visualization in epifluorescence microscopy requires staining by heavy metal atoms

Choose the combination with two correct and one incorrect statements.

A. ☐ B, C, E

B. ☐ A, B, E

C. ☐ A, C, D

D. ☐ B, D, E

Q.145) To achieve a best resolution using a fluorescence microscope, what combination of wavelength of emitted light (λ), refractive index and the angle (2θ) by which light enters into the microscope would be the best choice for the user:

A. ☐ $\lambda=405$; refractive index=1.33; $2\theta=90^\circ$

B. ☐ $\lambda=420$; refractive index=1.51; $2\theta=180^\circ$

C. ☐ $\lambda=520$; refractive index=1.51; $2\theta=90^\circ$

D. ☐ $\lambda=405$; refractive index=1.51; $2\theta=180^\circ$

