

**QUESTION PAPER**  
**CSIR NET LIFE SCIENCES**

**December-2017**

21. 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.
22. Indicate the INCORRECT statement from the following:
- (a) Allosteric enzymes function through reversible noncovalent binding of allosteric modulators or effectors.
  - (b) Monoclonal antibodies that catalyze hydrolysis of esters or carbonates can be produced.
  - (c) Enzymes are not inhibited irreversibly by heavy metals such as  $\text{Hg}^{2+}$ ,  $\text{Ag}^+$ .
  - (d) Acid phosphatases hydrolyze biological phosphate esters at  $\sim \text{pH } 5.0$ .
23. What is the effect of sudden increase in the levels of ATP and citrate on an erythrocyte undergoing glycolysis?
- (a) It inhibits glycolysis.
  - (b) It stimulates glycolysis.
  - (c) The rate of glycolysis remains unaltered.
  - (d) The rate of glycolysis increases gradually.
24. The  $\phi$  and  $\psi$  values of a  $\beta$ -strand composed of all D-amino acids will mainly occupy which quadrant in the Ramachandran plot?
- (a) upper left
  - (b) upper right
  - (c) lower left
  - (d) lower right
25. In a signalling event, binding of an extracellular ligand activates G-protein coupled receptor (GPCR) that eventually activates phospholipase C- $\beta$ . Which one of the following statements truly reflects the function of phospholipase C- $\beta$ ?
- (a) Phospholipase C- $\beta$  converts  $\text{PI}(3, 4, 5)\text{P}_3$  to  $\text{PI}(4,5)\text{P}_2$
  - (b) Phospholipase C- $\beta$  converts  $\text{PI}(4)\text{P}$  to  $\text{PI}(4,5)\text{P}_2$
  - (c) Phospholipase C- $\beta$  converts  $\text{PI}(4,5)\text{P}_2$  to diacylglycerol and  $\text{IP}_3$
  - (d) Phospholipase C- $\beta$  converts  $\text{PI}(5)\text{P}$  to  $\text{PI}(4,5)\text{P}_2$
26. Select a cellular body which is **NOT** a part of the nuclear bodies:
- (a) P-bodies
  - (b) Nucleolus
  - (c) Cajal bodies
  - (d) Interchromatin granule clusters
27. Which one of the following statements about chromatin is NOT true?
- (a) DNA winds approximately 1.65 times around the nucleosomes
  - (b) H2A-H2B bind to both the entry and exit ends of DNA in nucleosomes
  - (c) Covalent modification of histones influence chromatin compaction
  - (d) Non-histone proteins are part of mitotic chromosomes
28. During eukaryotic cell division, metaphase to anaphase transition is regulated by degradation of
- (a) Cyclin B1
  - (b) CDK1
  - (c) Aurora A kinase
  - (d) Polo-like kinase

29. One of the mechanisms used by bacteria for adaptation to changed environment is altering transcription of their genes. In this regard, which one of the following responses is NOT found in bacteria?
- (a) A gene with two different promoters for expression in different conditions  
 (b) Use of different sigma factors for transcription of genes  
 (c) Expression of alternate  $\alpha$ ,  $\beta$  and  $\beta'$  subunits  
 (d) Expression of anti-sigma factors
30. Which one of the following  $\lambda$  proteins acts both as an activator and repressor of transcription?
- (a) cI protein                      (b) N protein                      (c) cII protein                      (d) Q protein
31. 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
32. During eukaryotic protein synthesis, stress conditions result in activation of specific kinases leading to phosphorylation of a key translation initiation factor that inhibits protein synthesis from a large number of cellular mRNA. Which one of the following factors is the target of the kinase?
- (a) eIF4E                      (b) eIF4G                      (c) eIF2 $\alpha$                       (d) Gcn4
33. Proteins with cytoplasmic domains having tyrosine kinase activity do NOT act as receptors for
- (a) Epidermal growth factor (EGF)                      (b) Platelet-derived growth factor (PDGF)  
 (c) Insulin                      (d) Transferrin
34. Which one of the following is a group of signalling molecules that act as morphogens during development of an organism and its effects are mediated through the receptor Patched and its binding partner Smoothed?
- (a) Hedgehog protein                      (b) Notch protein                      (c) Wnt protein                      (d)  $\beta$ -catenin
35. Junctions which tether cytoskeletal filaments inside the cell are known as
- (a) anchoring junctions                      (b) occluding junctions  
 (c) channel – forming junctions                      (d) signal – relaying junctions
36. Which one of the following human serum immunoglobulins takes part in classical complement fixation pathway?
- (a) IgD                      (b) IgE                      (c) IgA                      (d) IgG
37. Match the following cleavage patterns with the species in which they occur.

	Species		Cleavage Pattern
A.	Flatworm	i.	Meroblastic discoidal
B.	Frog	ii.	Meroblastic superficial
C.	Birds	iii.	Holoblastic displaced radial
D.	Insect	iv.	Holoblastic spiral

- (a) A – iv, B – iii, C – i, D – ii                      (b) A – iii, B – i, C – iv, D – ii  
 (c) A – ii, B – iii, C – i, D – iv                      (d) A – ii, B – iv, C – iii, D – i
38. 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.  
 (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

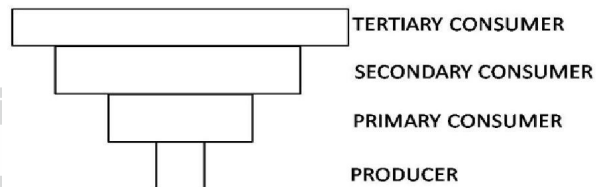
39. Based on ABC model during flower development, loss of class A activity results in the formation of only stamen and carpel. Which of the following floral organ identity genes controls the class A activity?  
(a) *APETALA 1* and *APETALA 2* (b) *APETALA 3* and *PISTILLATA*  
(c) Only *PISTILLATA* (d) Only *AGAMOUS*
40. In a given experiment, transplantation of micromeres from the vegetal pole of a 16-cell sea urchin embryo onto the animal pole of a host 16-cell sea urchin embryo would initiate :  
(a) the transplanted micromeres to invaginate into the blastocoel to create a new set of skeletogenic mesenchyme cells  
(b) the transplanted micromeres to ingress into the blastocoel to create a new set of skeletogenic mesenchymal cells  
(c) the transplanted micromeres will mingle with the host micromeres to ingress into the blastocoel to create skeletogenic mesenchyme cells.  
(d) the transplanted micromeres will form the secondary archenteron.
41. Which one of the following is NOT a phenotype of dark-grown seedlings that are etiolated?  
(a) Short hypocotyls (b) An apical hook  
(c) Closed cotyledons (d) Non-photosynthetic proplastids
42. Which one of the following is the correct function of JAZ (JASMONATE ZIM-DOMAIN) protein family, a key regulator of Jasmonic Acid (JA) signalling response?  
(a) Binds to MYC2 and represses the JA dependent genes.  
(b) Binds to MYC2 and transcribes JA dependent genes.  
(c) Acts as receptor of JA signal.  
(d) Involved in directly inducing JA dependent genes.
43. The plant hormone, Gibberellic Acid is generally NOT associated with  
(a) stem elongation (b) parthenocarpy (c) parthenogenesis (d) malt production
44. Which one of the following statements is NOT correct for Casparian strip?  
(a) It breaks the continuity of water movement through the apoplast pathway  
(b) It is formed in the growing part of the root  
(c) It is formed several millimetres or several centimetres behind the root tip  
(d) It is a band within the radial cell walls of the endodermis that is impregnated with lignin
45. Which one of the following is NOT involved with the absorption of iron in the intestine?  
(a) Divalent metal transporter (b) Ferroportin 1  
(c) Hephaestin (d) Transferrin
46. In which one of the body fluids is  $K^+$  concentration higher than that of  $Na^+$ ?  
(a) Plasma (b) Perilymph (c) Endolymph (d) Cerebrospinal fluid
47. Mammillary bodies are present in  
(a) thalamus (b) epithalamus (c) hypothalamus (d) midbrain
48. Reflex ovulation does NOT occur in  
(a) cats (b) rabbits (c) mink (d) rats
49. Two mutant plants, both bearing white flowers, were crossed. All  $F_1$  plants had red coloured flowers. When an  $F_1$  plant was selfed it produced progeny with either red or white coloured flowers in 9 : 7 ratio. Based on this information, which one of the following conclusions is correct?  
(a) The mutations in the parents do not complement each other  
(b) The mutations in the parents are allelic  
(c) The mutations in the parents are non-allelic  
(d) The mutations in the parents are linked

50. In a linkage map, two genes A and B, are 70 cM apart. If individuals heterozygous for both the genes are test crossed number of progeny with parental phenotype will be:
- equal to the number of progeny with recombinant phenotype
  - more than the number of progeny with recombinant phenotype
  - less than the number of progeny with recombinant phenotype
  - could be more or less than the number of progeny with recombinant phenotype depending on whether the genes are linked in *cis* or *trans*, respectively
51. A researcher exposed *Drosophila* larvae to 37°C during their growth. One of the adult flies that emerged had a crossveinless phenotype. Crossveinless is a known mutant in *Drosophila*. When this crossveinless fly was crossed to a known crossveinless mutant fly all the progeny had normal phenotype. The observed phenotype can be best explained as an example of
- Conditional mutant
  - Phenocopy
  - Penetrance
  - Pleiotropy
52. Phages are collected from an infected *E. coli* donor strain of genotype  $cys^+ leu^+ thr^+$  and used to transduce a recipient of genotype  $cys^- leu^- thr^-$ . The treated recipient population is plated on a minimal medium supplemented with leucine and threonine. Many colonies grew. Which one of the following combination of genotypes are appropriate for the colonies that grew?
- $cys^+ leu^+ thr^+$ ,  $cys^+ leu^- thr^+$ ,  $cys^- leu^+ thr^-$
  - $cys^- leu^+ thr^+$ ,  $cys^+ leu^- thr^-$ ,  $cys^+ leu^+ thr^-$
  - $cys^- leu^- thr^-$ ,  $cys^- leu^- thr^+$ ,  $cys^- leu^+ thr^-$
  - $cys^+ leu^- thr^-$ ,  $cys^+ leu^- thr^+$ ,  $cys^+ leu^+ thr^-$
53. Given below are growth equations where  $dN/dt$  is defined as
- $rN/K$
  - $rN$
  - $rN[(K-N)/N]$
  - $rN[(K-N)/K]$
- With reference to the above equations, which one of the following statements is correct?
- B represents exponential growth and A represents logistic growth
  - B represents exponential growth and D represents logistic growth
  - B represents zero growth and C represents logistic growth
  - A represents exponential growth and D represents logistic growth
54. Among the following statements, which is the correct one that refers to a Holotype?
- Specimens collected from different locations and designated as type specimens by the author
  - A single specimen or illustration upon which name is based and designated as nomenclature type by the author
  - Specimens collected from different places and designated as type specimen
  - A single specimen designated to serve as nomenclatural type when all of the materials on which the name of the taxon was based is missing
55. Which one of the following statements is true about xylem in plants?
- It is characterized by the presence of tracheary elements responsible for the conduction of water in vascular plants
  - It is responsible for the transport of water and characterized by sieve elements like parenchyma cells and sclereids
  - It is responsible for the transport of assimilates in the vascular plants and characterized by tracheary elements.
  - It is responsible for the transport of assimilates in both vascular and non-vascular plants
56. Identify the plant species from which artemisinin, an anti-malarial drug, is extracted.
- Artemisia maritima*
  - Artemisia scoparia*
  - Artemisia annua*
  - Cinchona officinalis*
57. Which of the following statements is IN-CORRECT about a keystone species?
- Species other than consumers can be a keystone species
  - Keystone species has influence on a community proportionate to its abundance
  - Removing a keystone species can reduce species richness of a community
  - Removing a keystone species can effect successive trophic levels causing a trophic cascade

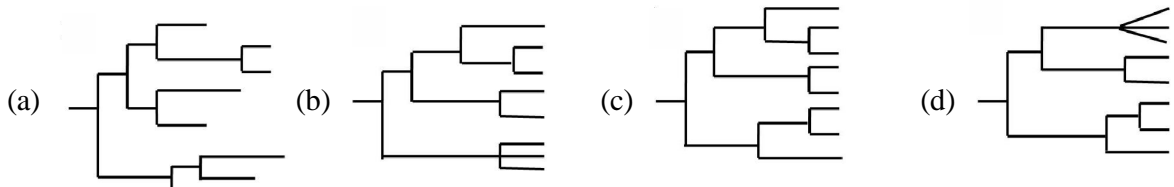
58. A species whose life history strategies allow for high intrinsic rates of increase (r-strategist) will also exhibit the following EXCEPT
- (a) high tolerance for both environmental instability and low quality resources.
  - (b) short period of exponential population growth (r)
  - (c) reproductive strategy that involves random mating, semelparity and little or no parental investment
  - (d) survivorship that show density-dependent mortality, typically exhibiting Type 1 or 2 survivorship curves.
59. In the context of diversity patterns of species, which one of the following statements is INCORRECT?
- (a) Alpha diversity is diversity within a single community
  - (b) Beta diversity is a measure of the change in species composition from one community or habitat to another
  - (c) Alpha diversity is the regional diversity found among range of communities in a geographical region
  - (d) Gamma diversity is the regional diversity found among range of communities/habitats in a geographical region

60. Given below is an ecological pyramid.

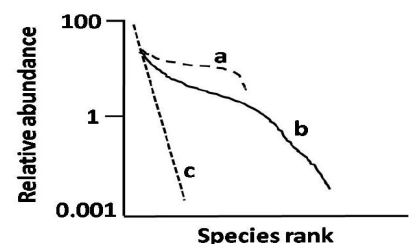
The above pyramid represents:



- (a) Pyramid of number of a parasitic food chain and pyramid of biomass of a pond ecosystem
  - (b) Pyramid of number of a pond ecosystem and pyramid of biomass of a forest ecosystem
  - (c) Pyramid of energy of a grassland and pyramid of biomass of an open ocean ecosystem
  - (d) Pyramid of biomass of a grassland and pyramid of number of a tropical forest ecosystem
61. Which one of the following statements is NOT TRUE about the Neutral Theory as proposed by Motoo Kimura?
- (a) Except for advantageous mutations, most alleles are under neutral selection
  - (b) The rate of evolution for most genes will be equal to the neutral mutation rate
  - (c) Advantageous mutations are exceedingly rare
  - (d) At the level of DNA sequences, genetic drift dominates evolution
62. Which one of the following statements is NOT TRUE about homologous characters?
- (a) Similar traits may not be homologous
  - (b) Similar traits may be a result of convergent evolution
  - (c) A homologous trait that is derived and shared from a common ancestor is called an autapomorphy
  - (d) Homologous characters may show structural similarity but functional diversity
63. Which one of the following trees represents a fully resolved phylogram?



64. The rank/abundance plot given below illustrates three well known species abundance curves (a, b, c). Based on the shapes of the curves select the correct option.



- (a) a-exponential, b-log normal, c-geometric series
- (b) a-broken stick, b-geometric series, c-log normal
- (c) a-broken stick, b-log normal, c-geometric series
- (d) a-exponential, b-geometric series, c-log normal

65. Which one of the following microscopes would you use to visualize a protein fused to an appropriate reporter in a living cell?  
 (a) Fluorescence microscope (b) Scanning electron microscope  
 (c) Differential interference contrast microscope (d) Phase contrast microscope
66. Which one of the following statements regarding use of hybrid nucleases for plant genome engineering is INCORRECT?  
 (a) For gene knock out experiments, the nuclease is expressed without a donor DNA template.  
 (b) Hybrid nucleases typically comprise two protein subunits that dimerize at their nuclease domain.  
 (c) Zinc finger nucleases (ZFNs) can efficiently target all nuclear genes with equal efficiency.  
 (d) Both ZFNs and TALENs are fused with cleavage domains of FokI endonuclease.
67. Which one of the following statements regarding proteins is CORRECT?  
 (a)  $n \rightarrow \sigma^*$  transition requires less energy than  $n \rightarrow \pi^*$  transition and can be monitored by mass spectrometry.  
 (b)  $n \rightarrow \sigma^*$  transition requires more energy than  $\pi \rightarrow \pi^*$  transition and can be monitored by UV-Vis spectroscopy.  
 (c)  $\pi \rightarrow \pi^*$  transition requires less energy than  $n \rightarrow \sigma^*$  transition and can be monitored by CD spectroscopy.  
 (d)  $\sigma \rightarrow \sigma^*$  transition requires less energy than  $n \rightarrow \pi^*$  transition and can be monitored by CD spectroscopy
68. Which of the following host system is best suited to express large amounts of glycosylated protein for structural studies ?  
 (a) GST fusion protein in *E. coli* (b) His-tagged protein in *E. coli*  
 (c) Native protein baculovirus (d) Native protein in *Pseudomonas*
69. Which of the following statements about YACs is FALSE?  
 (a) YACs can carry DNA fragments of 1Mb  
 (b) A single yeast may contain more than one YAC  
 (c) Rearrangements in YACs are rare because recombination is poor in yeast  
 (d) YACs have to be transferred to bacteria for subsequent DNA manipulations
70. In an intact cell patch-clamp experiment,  
 (a) two electrodes are inserted into the cytosol but at different depths.  
 (b) one electrode is applied to the plasma membrane in a region containing only lipids and one into the cytosol.  
 (c) two electrodes are applied to the plasma membrane, one in a region containing only lipids and the other in a region containing one or few ion channels.  
 (d) one electrode is applied to the plasma membrane containing one or few ion channels and one electrode inserted into the cytosol.
71. Match the coenzymes in column I serving as transient carriers of specific atoms or functional groups in column II

Column I		Column II	
A.	Coenzyme A	(i)	Aldehyde groups
B.	Flavin adenine dinucleotide	(ii)	Amino groups
C.	Pyridoxal phosphate	(iii)	Hydrogen atoms
D.	Thiamine pyrophosphate	(iv)	Acyl groups

Select correct combinations from the options given below:

- |     | A     | B     | C     | D     |
|-----|-------|-------|-------|-------|
| (a) | (iv)  | (iii) | (ii)  | (i)   |
| (b) | (iii) | (iv)  | (i)   | (ii)  |
| (c) | (i)   | (ii)  | (iii) | (iv)  |
| (d) | (ii)  | (i)   | (iv)  | (iii) |

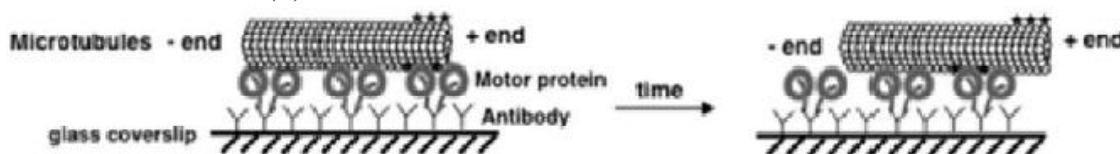
72. Out of the statements mentioned below
- L-threonine and L-*allo*-threonine interact identically with plane polarized light.
  - van der Waals' interactions are always attractive.
  - Poly (pro) II-helix is not stabilized by intermolecular hydrogen bonds.
  - The folding of a protein is associated with an overall positive change in free energy and negative change in entropy.
  - 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
73. The following statements are made:
- $\alpha$  and  $\beta$  anomers of glucose are inter-convertible and the ratio of their abundance is 1 : 2, respectively.
  - Single chain lipids ( $\geq C_{14}$ ) form micelles and double chain lipids form bilayers in water.
  - Proline is energetically favoured at the C-termini of an  $\alpha$ -helix than at the N-termini.
  - Major groove of DNA readily accommodates several common structural motifs in protein than the minor groove.
  - Replacement of a canonical Watson-Crick pairing by Wobble base pairs does not change the surface properties in t-RNA.
- Which one of the following combinations is INCORRECT?
- (a) A and D                      (b) B and E                      (c) C and E                      (d) B and C
74. From the following statements
- Enzymes enhance reaction rates by a factor of 2 to 10.
  - The activation energy for a reaction is lowered by enzymes.
  - The interactions between enzymes and substrates are hydrogen bonding, hydrophobic and ionic.
  - Substrate concentration does not affect the rate of enzyme catalyzed reactions.
- Pick the combination with all INCORRECT statements.
- (a) A, B                      (b) B, C                      (c) A, C                      (d) A, D
75. Match the chemical agents that interfere in oxidative phosphorylation process with their respective mode of action.

Column I		Column II	
A.	Antimycin A	(i)	Inhibits $F_0$ component of ATP synthase
B.	Oligomycin	(ii)	Disrupts inner mitochondrial membrane potential
C.	Valinomycin	(iii)	Prevent electron transport from Fe/S cluster to ubiquinone
D.	Rotenone	(iv)	Blocks electron transfer from cytochrome b to cytochrome c.
		(v)	Inhibits adenine nucleotide translocase

Choose the correct combination from below:

- |     |          |          |          |          |     |          |          |          |          |
|-----|----------|----------|----------|----------|-----|----------|----------|----------|----------|
|     | <b>A</b> | <b>B</b> | <b>C</b> | <b>D</b> |     | <b>A</b> | <b>B</b> | <b>C</b> | <b>D</b> |
| (a) | (ii)     | (iv)     | (v)      | (iii)    | (b) | (iv)     | (i)      | (ii)     | (iii)    |
| (c) | (i)      | (iii)    | (ii)     | (v)      | (d) | (v)      | (ii)     | (i)      | (ii)     |
76. A polymer is synthesized from an achiral amino acid. Conformation of the polymer can be investigated by the following techniques.
- Fibre diffraction
  - Nuclear magnetic resonance spectroscopy
  - Circular dichroism spectroscopy
  - Differential scanning calorimetry
- Choose the combination which would indicate that the polymer adopts a helical conformation
- (a) A, C                      (b) B, D                      (c) A, B                      (d) C, D

77. Sphingolipids (S) and cholesterol (C) molecules of the lipid bilayer aggregate into multiple tiny rafts instead of a single large one. Considering that size of a lipid raft depends on the affinity of S and C for one another and other lipids in the membrane, choose the option that best describes this property.
- S and C bind to one another tightly and independent of any other lipid molecules.
  - S and C bind to one another with same affinity as they bind to other lipid species of the membrane.
  - S and C bind to one another with high affinity under the influence of some cytoskeletal elements.
  - S and C have slightly higher affinity than other lipid molecules of the membrane and are in dynamic equilibrium with their free forms.
78. To understand the microtubule-dependent motor activity of a freshly purified motor protein from budding yeast, a researcher set up microtubule based gliding assay. In such an assay where microtubules are fluorescently tagged at its (+) end, the researcher observed that this motor protein moves the microtubule in the direction of its (+) end as shown below:



The newly identified motor protein is

- Dynein
  - Myosin
  - Kinesin-1
  - Either Dynein or Kinesin 1
79. Given below are organelles (Column A) and properties associated with the organelles (column B).

**Column A**

- Lysosomes
- cis*-Golgi
- trans*-Golgi
- Cop II vesicles
- Endocytic vesicles

**Column II**

- Anterograde transport from ER to Golgi
- Clathrin – coated vesicles
- Cop I vesicle budding
- Mannose-6 phosphate receptor
- Protein aggregate for secretion

Choose the option that matches the organelles with the most appropriate property.

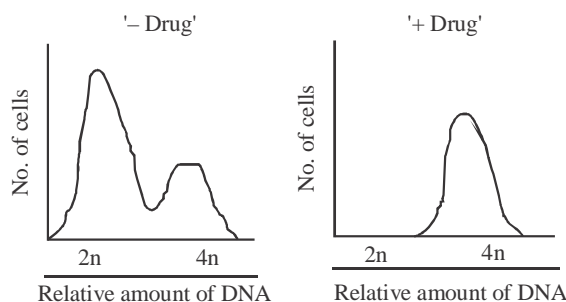
- A – (iv); B-(iii); C – (v); D – (i); E-(ii)
  - A – (v); B-(iv); C – (i); D – (v); E-(ii)
  - A – (iii); B-(v); C – (i); D – (iv); E-(ii)
  - A – (iv); B-(v); C – (ii); D – (i); E-(iii)
80. Cell cycle checkpoints are surveillance mechanisms that ensure order and fidelity of events of the cell cycle. Given below are some of the checkpoint proteins and their functions.
- Mad2
  - Tem1
  - ATM, ATR
- Prevention of Cdc 14 activation
  - Prevention of Cdc20 activation
  - Inhibition p21<sup>CIP</sup>
  - Inhibition of separase action

**Match the checkpoint protein with its function.**

- A – (iv); B-(i) and (ii); C – (iii)
  - A – (ii) and (iv); B-(i); C – (iii)
  - A – (ii); B-(i) and (iii); C – (iv)
  - A – (ii) and (iv); B-(iii); C – (i)
81. You have discovered a new transposon, TnX, and would like to identify its mode of replication. A heteroduplex of the TnX sequence is made with a few mismatches and introduced into bacteria. The newly transposed genomic loci are sequenced. You find that the sequence of the transposon matched exactly with one of its parent strands. This suggests that
- TnX transposes by conservative transposition mechanism.
  - TnX transposes using a site-specific recombination mechanism.
  - single-strands of the duplex are inserted.
  - TnX transposes by replicative mechanism.



82. To assess the impact of a newly identified drug when added to a culture of subconfluent HeLa cells, a researcher analyzes the fluorescence activated cell sorting (FACS) profile of untreated (–Drug) versus treated (+ Drug) cells.



Based on the FACS profile shown above, this drug inhibits.

- (a)  $G_1$  phase of the cell cycle (b) S phase of the cell cycle  
(c)  $G_2/M$  phase of the cell cycle (d)  $G_0$  phase of cell cycle
83. Following table lists the two major forms of DNA duplexes, conformation of base attached to the sugar and the nature of major and minor grooves.

DNA duplex	Properties
(A) A form	(i) Syn conformation of the base to sugar
(B) B form	(ii) Anti conformation of the base to sugar
	(iii) Wide major groove
	(iv) Narrow major groove
	(v) Wide minor groove
	(vi) Narrow minor groove

Which of the following combination correctly depicts the types of DNA duplexes and their properties (numbered within bracket)?

- (a) A - (i) (iii) (vi); B - (ii) (iii) (vi) (b) A - (i) (iii) (vi); B - (ii) (iii) (v)  
(c) A - (ii) (iv) (v); B - (ii) (iii) (vi) (d) A - (ii) (iv) (v); B - (i) (iii) (vi)
84. Imagine the following RNA sequence is translated in the mammalian cytosol and mitochondria.

RNA sequence:

AUG AUA CUG UGA CUU AGG CUC UAA

Following are some sequences putative peptide

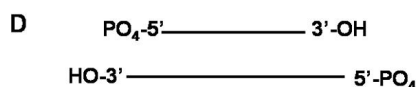
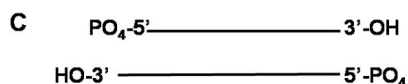
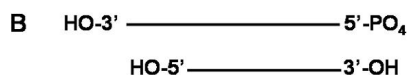
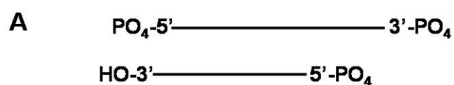
Cytosol	Mitochondria
(a) Met-Ile-Leu	(i) Met-Ile-Leu-Trp-Leu-Arg-Leu
(b) Met-Ile-Leu-Trp-Leu-Arg-Leu	(ii) Met-Met-Leu-Trp-Leu

Find out the correct combination of peptides made in the cytosol and mitochondria.

- (a) (a) (i) (b) (a) (ii) (c) (b) (i) (d) (b) (ii)
85. In all organisms, it is critical that replication initiation be tightly controlled to ensure that chromosome number and cell number remain appropriately balanced. Given below are several statements regarding regulation of replication in *E. coli*.
- A. Hemimethylation and sequestration of oriC (origin of replication) by a protein called SeqA prevents initiation of replication.  
B. Availability of DnaA protein is an important requirement for initiation of replication.  
C. The ratio of ADP : ATP is important as high level of ADP is required for initiation of replication.  
D. Recruitment of Hda protein by sliding clamp inhibits ATP hydrolysis required for initiation of replication.
- Which of the above statements are NOT true?

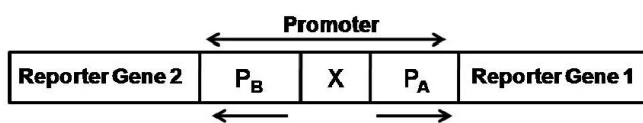
- (a) A and B (b) B and C (c) C and D (d) D and A

86. In *E. coli*, though DNA polymerase I (Pol I) plays an essential role in the replication process, it is not the major polymerase. Instead, the enzyme responsible for advancement of replication fork is Pol III. From the four DNA structures (A, B, C and D) given below, students made several interpretations about the shorter extended by Pol I and/or Pol III.

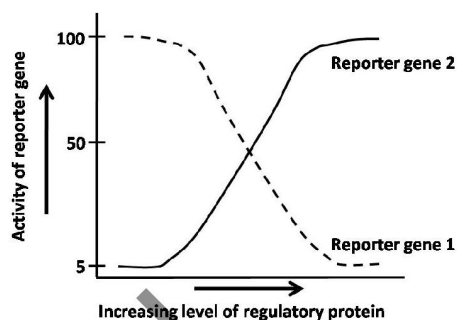


Which one of the interpretation written below is correct?

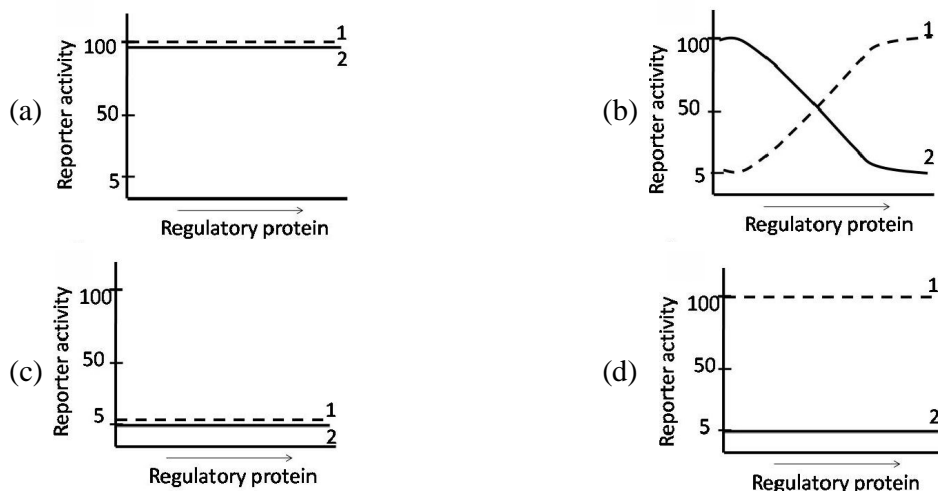
- (a) A will be extended by Pol III but not by Pol I.  
 (b) Neither B nor C will be extended by either Pol I or Pol III.  
 (c) C will be extended by both Pol I and Pol III.  
 (d) D will be extended only by Pol I, but not by Pol III.
87. tRNA genes of a Gram positive bacteria were sequenced. While some of the genes possessed sequence corresponding to the -CCA end of the tRNA, others did not. Interestingly, even the genes that lacked the sequence corresponding to the -CCA end of the tRNA were found to code for a functional tRNA. This is because
- (a) the -CCA end in the tRNA is not essential for its function.  
 (b) the genes that do not possess sequence corresponding to the -CCA ends of the tRNA are repaired prior to their transcription.  
 (c) the -CCA end is added to the tRNA during their maturation.  
 (d) the primary transcripts of the genes lacking sequence corresponding to the -CCA end are subjected to g-RNA mediated editing prior to their maturation.
88. A construct (shown below) was generated to access the activity of bidirectional promoter (A and B) which has a common regulatory DNA element (X). The construct was used to transform *E. coli*.



The activity of the promoter (as shown in the graph below) is recorded in the presence of increasing levels of an *E. coli* encoded regulatory protein which binds to DNA element X.

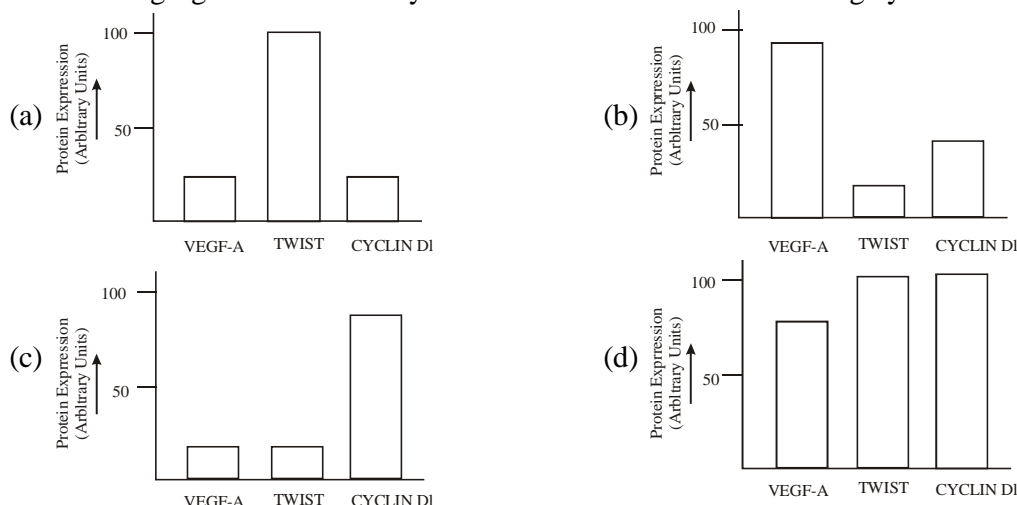


The above experiment is repeated in a mutant *E. coli* with mutation which abolishes binding of the regulatory protein to element X. Which one of the following graphs best the activity of the reporter genes in mutant strain?



89. In a type of signal transduction pathway, ligand binding to a receptor triggers activation of a receptor-associated kinase. This kinase may be an intrinsic part of the receptor protein or tightly bound to the receptor. Receptors in which the tyrosine kinase is an intrinsic part of its polypeptide chain are called the receptor tyrosine kinase (RTK). Which one of the following statements regarding RTK is **INCORRECT**?
- (a) All RTKs have three essential components: an extracellular domain containing ligand binding site, a transmembrane domain and a cytoplasmic segment that includes a domain with protein tyrosine kinase activity.
- (b) Most RTKs are monomeric and ligand binding to the extracellular domain induces formation of receptor dimers.
- (c) All cytokine receptors belong to RTKs and cytokine binding activates tyrosine kinase and receptor dimerization.
- (d) Ligand binding to RTK leads to autophosphorylation of the protein tyrosine kinase in the cytoplasmic domain. The activated kinase then phosphorylates several tyrosine residues in the receptor's cytoplasmic domain.
90. Two classes of genes - proto-oncogene and tumor suppressor gene usually contribute to the development of cancer. Following are some of the statements regarding both the genes.
- A. Proto-oncogenes result in the development of cancer by gain-of function mutation whereas tumor suppressor gene leads to cancer development by loss-of-function mutation.
- B. Proto-oncogenes result in development of cancer by loss-of function mutation whereas tumor suppressor gene leads to cancer development by gain of-function mutation.
- C. Mutation in both the alleles of a protooncogene is required for induction of cancer whereas mutation in one of the two alleles in tumor suppressor gene is sufficient for promoting tumorigenesis.
- D. Mutation in one of the two alleles in proto-oncogene is sufficient for induction of cancer whereas mutation in both the alleles of a tumor suppressor gene is required for promoting tumorigenesis.
- Which combinations of the above statements are true for both the genes?
- (a) A and B                      (b) A and C                      (c) A and D                      (d) B and C

91. Two important features which aid the development of a tumor and its metastasis are epithelial-to-mesenchymal transition and angiogenesis. A student tested **four cell** lines to determine their invasiveness and proliferation capability by checking the expression of **VEGF-A**, **TWIST** and **Cyclin D1**. Which one of the following figures is most likely to exhibit the characteristics of a highly metastatic cancer cell?



92. Several types of molecules including the transmembrane glycoproteins can function as matrix receptors and co-receptors. However, the principal receptors on animal cells for binding most extracellular matrix proteins are the integrins. Which of the following statements is **NOT** true for integrins?
- Integrins are transmembrane linker proteins that link to the cytoskeleton.
  - An integrin molecule is composed of two non-covalently associated glycoprotein subunits and . Both subunits span the cell membrane, with short intracellular C-terminal tails and large N-terminal extracellular domains.
  - The extracellular portion of the integrin dimer binds to specific carbohydrate residues in extracellular matrix proteins or to ligands on the surface of other cells.
  - The intracellular portion binds to a complex of proteins that form a linkage to the cytoskeleton.
93. Major histocompatibility complex (MHC) molecules are encoded by a cluster of genes called MHC locus. There are several reasons why an MHC molecule on the surface of a cell is important. Which one of the following reasons is **INCORRECT**?
- To display self class I to demonstrate that the cell is normal and healthy.
  - To display foreign-peptide in class I to show that the cell is infected and to engage with T helper cells.
  - To display a self-peptide in class I and II to test developing T cells for autoreactivity.
  - To display a self-peptide in class I and II to maintain tolerance to self-proteins.
94. Oncogenic viruses could have either DNA or RNA genomes. Listed below are some oncogenic viruses (Column A), their genome types (Column B) and the cancers caused by these viruses (Column C).

A	B	C
(a) Hepatitis B	(i) DNA	(x) Burkitt's lymphoma
(b) Epstein- Barr Virus	(ii) RNA	(y) T cell leukaemia
(c) HTLV		(z) Hepatocellular carcinoma

Find out the correct combination.

- (a) (i) (x), (b) (ii) (y), (c) (ii) (z)
  - (a) (ii) (y), (b) (i) (z), (c) (ii) (x)
  - (a) (ii) (y), (b) (ii) (z), (c) (i) (y)
  - (a) (i) (z), (b) (i) (x), (c) (ii) (y)
95. Identification of genes that are associated with the development of male and/or female gametophyte and embryogenesis in plants is facilitated by T-DNA mediated insertional mutagenesis. In an experiment, a transgenic plant was generated by insertion of T-DNA (containing a Kanamycin-resistance gene) into a gene "A". Self pollination of the  $T_0$  plant generated  $F_1$  progeny that segregated in a 2 : 1 ratio for

resistance:sensitivity to Kanamycin. These observations indicate that

- (a) the mutant allele did not segregate from the wild type allele.
- (b) mutation in gene "A" induces lethality in the male gametophyte.
- (c) mutation in gene "A" induces lethality in the female gametophyte.
- (d) mutation in gene "A" induces zygotic lethality.

96. During vulva development in *C. elegans*, the anchor cell produces Lin-3 protein which interacts with the Let-23 protein present on the six vulval precursor cells (VPCs) that form an equivalence group. The central lineage cell ( $P_6.p$ ) adopts the primary fate, the adjacent VPCs ( $P_5.p$  and  $P_7.p$ ) adopt the secondary fate and the rest VPCs adopt the tertiary fate. Few mutants (Column A) and phenotypes (Column B) are listed in the table given below.

	Column A		Column B
A.	Loss of function of <i>lin-3</i>	i.	$P_5.p$ , $P_6.p$ and $P_7.p$ adopt primary fate, $P_4.p$ and $P_8.p$ adopt secondary fate
B.	Loss of function of <i>lin-3</i> and gain of function of <i>let-23</i>	ii.	Multivulva
C.	Reduced function of <i>lin-3</i>	iii.	$P_6.p$ adopt primary fate and the rest of the VPCs adopt tertiary fate
D.	Overexpression of <i>lin-3</i>	iv.	All VPCs adopt tertiary fate

Match the correct mutant with the observed phenotype.

- (a) A-iv, B-ii, C-iii, D-i
- (b) A-iv, B-iii, C-i, D-ii
- (c) A-ii, B-iii, C-iv, D-i
- (d) A-iii, B-i, C-ii, D-iv

97. *C. elegans* embryo uses both autonomous and conditional modes of specification. Conditional specification at the 4-cell stage can be seen in the development of the endoderm cell lineage and also in the establishment of dorsal-ventral axis. Following are few statements regarding this:

- A. If the P2 cell is removed at the early 4-cell stage, the EMS cell will divide into two MS cells and no endoderm will be made.
- B. In *pop-1* deficient embryos, both EMS daughter cells become E cells.
- C. When the position of ABa and ABp was reversed, their fates get reversed and no normal embryo forms.
- D. In embryos whose mother have mutant *glp-1*, ABp is transformed into ABa cell.

Which of the above statements are true?

- (a) A, B and D
- (b) A, B and C
- (c) B, C and D
- (d) A, C and D

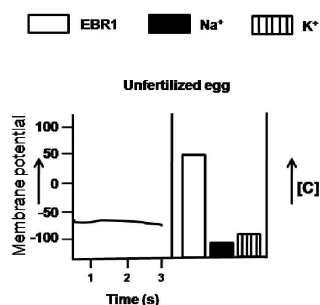
98. Following are the events that might take place during dorso-ventral axis specification in early embryonic development of *Drosophila*:

- A. 'Torpedo' receptor activation
- B. 'Pipe' synthesis
- C. A cascade of protease activity
- D. 'Cactus' dephosphorylation
- E. Entry of 'Dorsal' in the nuclei of syncytial blastoderm stage embryo.

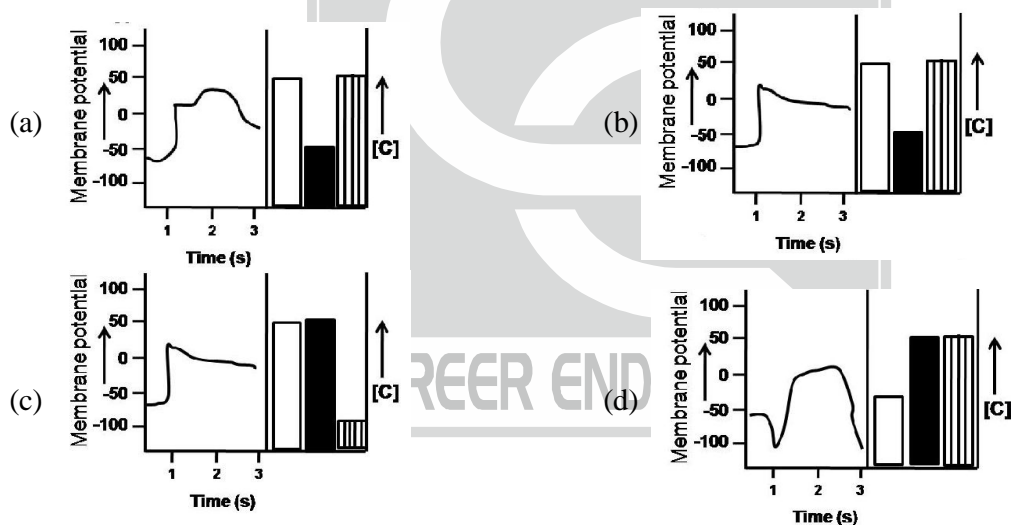
Which combination of the above events will occur in the presumptive dorsal side of the embryo deficient in maternal *gurken*?

- (a) A only
- (b) B and C only
- (c) B, C and E only
- (d) B, C, D and E only

99. What would be the effect on newt limb regeneration, if more than 90% of the nerve supply is severed before amputation?
- The apical ectodermal cap stimulates growth of the blastema by secreting FGF8 but regeneration does not take place.
  - Limb regeneration will take place and form a limb with no nerve supply.
  - Outgrowth will occur but the identity of the limb formed will be lost with no clear anterior-posterior polarity.
  - Limb regeneration with nerve supply will take place.
100. Fertilization in sea urchin involves interaction of sperm Bindin with its receptor EBR1, a 350 kDa glycoprotein on the egg vitelline membrane. The plot given below shows the status of membrane potential and levels of EBR1, Na<sup>+</sup> and K<sup>+</sup> in an unfertilized egg.



Which one of the following graphs best represents the condition within an egg 1-3 seconds after fertilization?



101. A specific Mitogen Activated Protein Kinase (MAPK) cascade comprising MEKK1 (a MAP3K), MKK1 (a MAP2K) and MPK6 (a MAPK) is activated sequentially in that order in Arabidopsis plants upon perceiving certain abiotic stress stimuli. The activated MPK6 phosphorylates and activates a transcription factor 'X', thereby making plant tolerant to the abiotic stress. Two different variants of MKK1 protein, a kinase inactive (KI) and a constitutively active (CA) forms were expressed independently in *mkk1* mutant Arabidopsis plant. Considering above facts, which one of the following statements is CORRECT?
- 'X' will be activated even in the absence of stimuli in CA plants
  - 'X' will not be activated in the absence of stimuli in CA plants
  - 'X' will be activated in the absence of stimuli in KI plants
  - The KI plants will be tolerant to the abiotic stress.

- 102.** Given below are some statements on secondary metabolites in plants.
- A. Glucosinolates are synthesized by elongation in the length of side chains of their precursor amino acids.  
 B. All terpenes produced in herbs and spices are sticky, oily liquids which reduces the palatability (edible value) of these plants.  
 C. Cyanogenic glycosides are produced and stored in a toxic form in plants and are therefore more effective in defense against invading pathogens and herbivores.  
 D. The defense molecules, alkaloids (or their precursors), are gathered from plants and used by some insects for their own protection against predators.

Which one of the following represents correct statements?

- (a) B and C only      (b) A and B only      (c) C only      (d) A and D only
- 103.** A researcher developed quadruple mutant that disrupted the function of all phytochrome interacting factor (PIF) family members. The following hypotheses were proposed regarding the phenotype of the mutant plants when grown in dark:
- A. Plants would show short hypocotyls      B. Plants would be etiolated  
 C. Light induced genes would be activated      D. The cotyledons would be open

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

- (a) A, B and C      (b) A, B and D      (c) A, C and D      (d) B, C and D
- 104.** The photon intensity captured by green plants is used in the following processes:
- (i) Photosynthesis  
 (ii) Generation of heat  
 (iii) Production of toxic products such as superoxide, singlet oxygen etc.  
 (iv) Damage to D1 protein of PSII

Based on the above facts, photoinhibition will happen when the

- (a) entire photon intensity is used for photosynthesis  
 (b) excess photon intensity is completely used for heat generation  
 (c) excess photon intensity is used for heat generation and formation of toxic products  
 (d) excess photon intensity leads to the damage of D1 protein
- 105.** With reference to plant biotic interactions, match the terms of Column I with the most appropriate term of Column II

	Column I		Column II
A.	Phytoliths of Poaceae	(i)	Phloem feeders
B.	Salicylic acid signalling pathway	(ii)	Decrease in stomatal aperture
C.	MAMP	(iii)	R genes/NBS-LRR receptor
D.	Effector – triggered immunity	(iv)	Mechanical barrier to herbivory

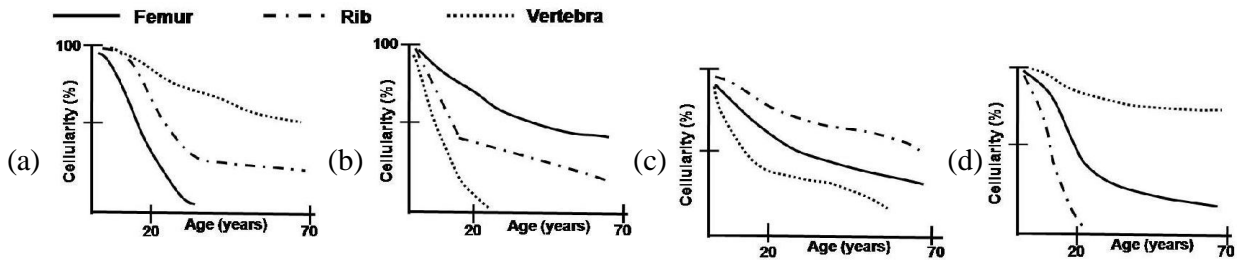
- (a) A – (ii), B – (iv), C – (i), D – (iii)      (b) A – (iii), B – (i), C – (ii), D – (iv)  
 (c) A – (iv), B – (ii), C – (iii), D – (i)      (d) A – (iv), B – (i), C – (ii), D – (iii)
- 106.** Transgenic tobacco plants over-expressing isopentenyl transferase (*IPT*) under the control of promoter region of Senescence-Associated Receptor kinase ( $P_{SARK}$ ) were exposed to drought for 15 days followed by re-watering for 7 days. The following hypotheses were proposed regarding changes in the transgenic plants at the end of 7 days of re-watering:
- A. The plants would be wilted and fail to survive.  
 B. The plants would be healthy and survive.  
 C. The plants would show higher production of cytokinin compared to wild type plants.  
 D. The plants would show higher production of abscisic acid compared to wild type plants.
- Which one of the following combinations of the above hypotheses is correct?
- (a) A and C      (b) A and D      (c) B and C      (d) B and D

- 107.** The following statements describe the possible functions of the outer hair cells (OHC) of organ of Corti:
- A. The outer hair cells (OHC) are depolarized or hyperpolarized depending on the direction of movement of stereocilia.
  - B. The OHC are lengthened in depolarization and shortened in hyperpolarization
  - C. The OHC decrease the amplitude and clarity of sound by shortening and lengthening.
  - D. The efferent nerve fibers of olivocochlear bundle modulate the sensitivity of the OHC
  - E. The effect of stimulation of olivocochlear bundle on the OHC is excitatory.
- Which one of the options given below represents the correct statements?
- (a) A and B                      (b) C and D                      (c) A and D                      (d) D and E
- 108.** The pacemaker cells of sinoatrial node (SA node) are inhibited by the stimulation of vagus nerve. The probable mechanisms of this inhibition are stated as follows:
- A. The acetylcholine- regulated  $K^+$  channels are activated
  - B. The outward  $K^+$  causes hyperpolarization of pacemaker cells
  - C. The inward “funny current” of pacemaker potential is increased
  - D. The increased intracellular cAMP, induced by activation of  $M_2$  muscarinic receptors, slows the opening of  $Ca^{++}$  channels
- Choose the answer with correct statements.
- (a) A and C                      (b) B and C                      (c) A and B                      (d) C and D
- 109.** In the glomerular capillary (GC), fluid moves into Bowman’s capsule through its almost entire length. But in the muscle capillary (MC), fluid moves into interstitial space at its arteriolar end. The difference between these two capillaries is explained in the following proposed statements:
- A. Afferent and efferent arterioles are present on the two ends of GC, but in MC, arteriole and venule are present on two ends.
  - B. The hydrostatic pressure in GC is higher than that in MC.
  - C. The efferent arteriole in GC has a relatively low resistance, but venules in MC has a high resistance.
  - D. The difference of hydrostatic pressure between two ends of GC is relatively more but it is negligible in MC.
  - E. The difference of oncotic pressure between two ends of MC is negligible but it is relatively more in GC.
  - F. The net filtration pressure falls to zero at the efferent end of GC but it is 9 mm Hg inward at the venular end of MC.
- Which of the above statements are INCORRECT?
- (a) A and B                      (b) C and D                      (c) E and F                      (d) B and F
- 110.** When a skeletal muscle was passively stretched, it contracted reflexly. However, when the muscle was over stretched in this way it showed sudden cessation of contraction followed by relaxation. The following statements provided the possible explanation of these observations:
- A. The passive stretching of muscle caused stretching of muscle spindle
  - B. The over stretching of muscle stimulated Golgi tendon organ
  - C. Group 1b sensory nerve fibers were stimulated by stretching of muscle spindle
  - D. Group 1b sensory nerve fibers stimulated  $\alpha$ -motor neurons that supplied the muscle from which these fibers arose.
  - E. Group 1a sensory nerve fibers were connected to Golgi tendon organ.
  - F. The stimulation of group 1a sensory fibers led to the production of IPSP on the  $\alpha$ - motor neurons that supplied the muscle from which these fibers arose.
- Which of the above statement(s) is/are correct?
- (a) A and B                      (b) C and D                      (c) E and F                      (d) C and F

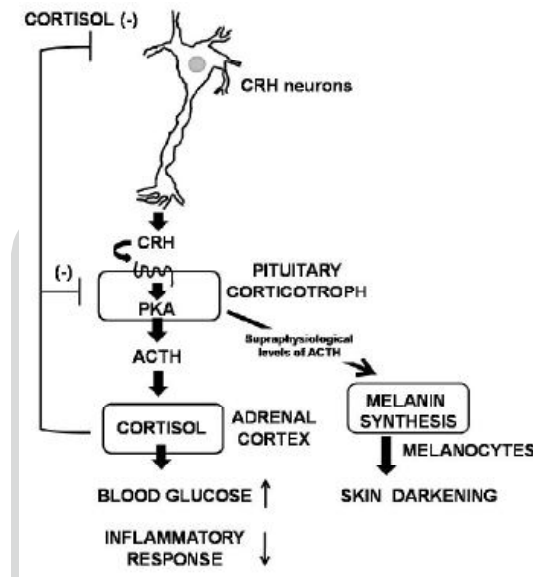


111. Relative rates of red blood cells production in bone marrow of different bones of different ages are shown below:

Identify the correct figure.



112. The above figure depicts the regulation of hypothalamo-pituitary-adrenal (HPA) axis. Changes in cortisol level in Addison's disease can lead to



- (a) suppressed immune system and increased blood glucose level
- (b) gain of body weight and lightening of skin
- (c) loss of body weight, reduced blood glucose level and hyperpigmentation
- (d) increased blood glucose and activated immune system

113. The following table shows mapping data from three interrupted mating experiments using three different Hfr strains and an F strain:

(Time is represented in minutes)

The distance between are derived:

The order of genes is

- A. e g b d c f
- B. f g b d c e

The following answers

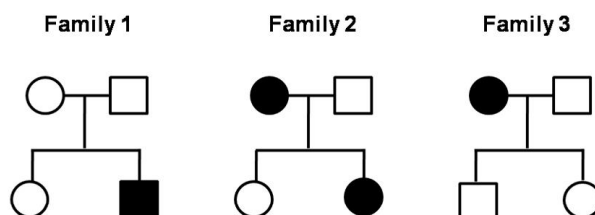
- C. f and g is 32 min is 30 min and between f and b
- D. c and e is 28 min is 20 min and between b and c

The correct combination of answers is

- (a) A, C and D
- (b) B and C
- (c) A and B
- (d) B and D

		Appearance of genes in F <sup>-</sup> cells				
Hfr 1	Genes	e <sup>+</sup>	f <sup>+</sup>	c <sup>+</sup>	d <sup>+</sup>	b <sup>+</sup>
	Time	6	24	34	49	54
Hfr 2	Genes	b <sup>+</sup>	d <sup>+</sup>	c <sup>+</sup>	f <sup>+</sup>	g <sup>+</sup>
	Time	1	6	21	31	63
Hfr 3	Genes	d <sup>+</sup>	c <sup>+</sup>	f <sup>+</sup>	e <sup>+</sup>	g <sup>+</sup>
	Time	4	19	29	47	61

114. The inheritance of a given disorder is recorded in three small families shown below:



Based on the above limited information, which one of the following inheritance pattern best explains the observations?

- (a) X-linked recessive (b) X-linked dominant  
(c) Autosomal recessive (d) Autosomal dominant
115. A new mutant called early ripening (EL) is identified in a plant. The wild type phenotype is late ripening (LR). Further DNA marker(s) is/are observed to be polymorphic between EL and LR plants. A cross was made between pure lines of LR and ER. The  $F_1$  progeny was test crossed and its progeny was analyzed. The parental,  $F_1$  and progeny of test cross were also analyzed for the DNA marker. The table below summarizes the phenotype of the progeny and the pattern of DNA marker observed in each case:

Generation	Parent		$F_1$	Progeny of test cross			
	ER	LR		LR only	LR	ER	ER
Phenotype							
No. of progeny				52	48		
Pattern of DNA marker on gel electrophoresis	—	—	—	—	—	—	—
No. of progeny for each pattern				25	27	23	25

Based on the above information, the following statements were made:

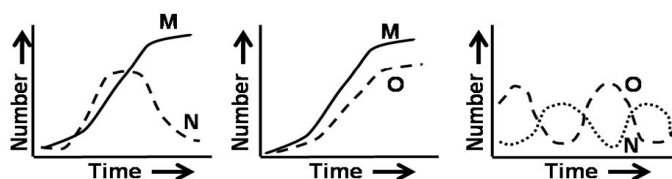
- A. LR is dominant to ER B. The DNA marker used is a dominant marker  
C. The DNA marker is linked to the phenotype

Which of the above statements are correct?

- (a) A only (b) A and B only (c) A and C only (d) A, B and C only
116. In Burkitt's Lymphoma a reciprocal translocation between chromosome 8 and 14 is observed. If an individual is heterozygous for this translocation, the consequence in meiosis will be as follows:
- A. Four chromosomes, i.e., normal chromosome 8 and 14, and translocated chromosome 8 and 14, pair together  
B. The two normal chromosomes 8 and 14, and two translocated chromosomes pair separately  
C. All gametes produced from this meiosis are non-viable as they have deletions and duplications  
D. In one of the cross configurations called "alternate segregation" all gametes having normal or translocated chromosomes, survive  
E. The gametes having normal chromosomes only survive while all gametes having translocated chromosomes are non-viable, hence the translocations are used as crossover suppressors
- Which of the following combinations best describes the meiotic consequences for the translocation described above?
- (a) B and E (b) B, C and E (c) A, C and E (d) A and D

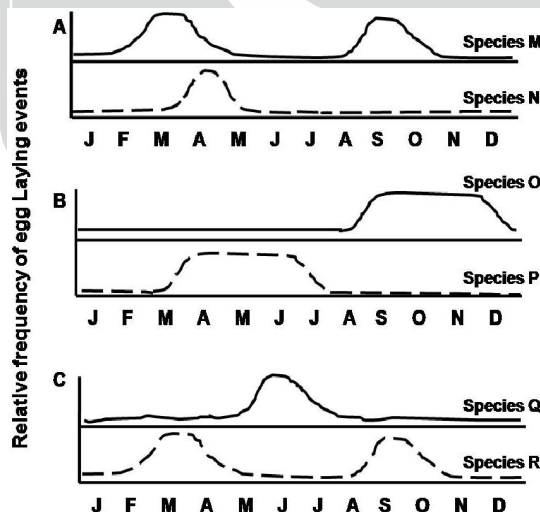


122. Given below are larval stages and phylum to which they belong. Select the INCORRECT combination.
- Parenchyma and Amphiblastula - Phylum Porifera
  - Bipinnaria and Auricularia- Phylum Echinodermata
  - Tornasia and Axolotl- Phylum Hemichordata
  - Planula and Ephyra- Phylum Cnidaria
123. During the course of evolution, the jawbones got modified into three ear ossicles in mammals. Which one of the following is a correct match of all three ear ossicles and their jawbones?
- stapes – articular; incus – quadrate; malleus – hyomandibular.
  - stapes – quadrate; incus – articular; malleus – hyomandibular
  - stapes – articular; incus – hyomandibular; malleus – quadrate
  - stapes – hyomandibular; incus – quadrate; malleus – articular
124. Three species M, N and O when grown independently in a laboratory showed typical logistic growth curves. However, when grown in pairs, the following growth curves were observed.



What interpretation regarding the interspecific relationship between M, N and O can be deduced from the above observations?

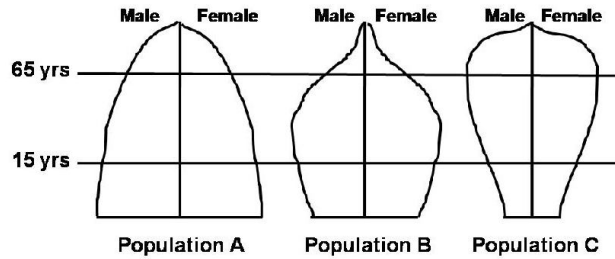
- N predate over O and therefore can also predate on M.
  - N is competed out by M and O.
  - N and O possibly have a prey-predator relationship.
  - M and O exhibit prey-predator relationship.
125. Temporal isolation in breeding seasons between closely related species leads to reproductive isolation. Given below are breeding seasons of different species of frogs.



Which of the above plots represents temporal isolation in breeding seasons among closely related sympatric species?

- Plot A
- Plots A and B
- Plots B and C
- Plots A and C

126. Given below are the population pyramids of three different populations A, B and C depicting the relationship between birth and death rates in each.



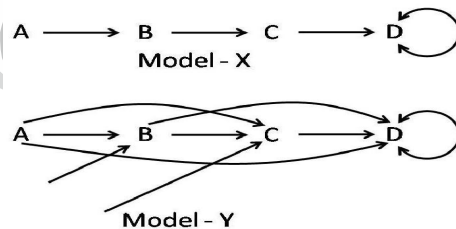
Based on the population pyramids given above, which one of the following is INCORRECT?

- (a) Population B has slower growth rate than population A.
  - (b) Population C has birth rate higher than its death rate.
  - (c) Population A represents a rapidly growing population.
  - (d) Population B has the highest death rate among the three populations.
127. Given below are names of some of the National Parks of India and their key protected animals.

Name of the National Park		Key protected animal	
A	Dibru-Saikhowa National Park, Assam	(i)	Indian Rhinoceros
B	Jaldapara National Park, West Bengal	(ii)	Hangul
C	Mukurthi National Park, Tamil Nadu	(iii)	Feral Horse
D	Dachigam National Park, Jammu and Kashmir	(iv)	Asiatic Lion
E	Gir Forest National Park, Gujarat	(v)	Nilgiri Tahr

Based on the table given above, which of the following options represents the correct match?

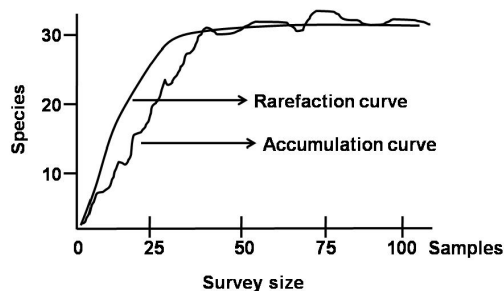
- (a) A-(iii); B-(i); C-(iv); D-(ii); E-(v)
  - (b) A-(i); B-(ii); C-(v); D-(iii); E-(iv)
  - (c) A-(i); B-(ii); C-(iii); D-(iv); E-(v)
  - (d) A-(iii); B-(i); C-(v); D-(ii); E-(iv)
128. Given below are two patterns of ecological succession. Four species are represented by A, B, C and D. An arrow indicates “is replaced by”.



In the context of ecological succession, which of the following statements is INCORRECT with respect to the figures given above.

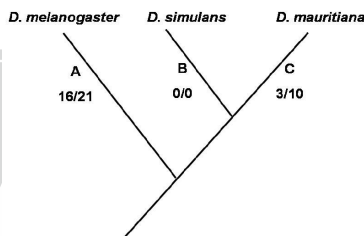
- (a) Model - X represents facilitation model and Model - Y represents tolerance model.
- (b) Model - X represents tolerance model and Model - Y represents inhibition model.
- (c) As per Model - Y, C can out-compete B but can also invade a habitat in their absence.
- (d) As per the Model - X, A makes the environments more suitable for B to invade.

129. Given below are the species accumulation curves and rarefaction curves measured in an ecological community.



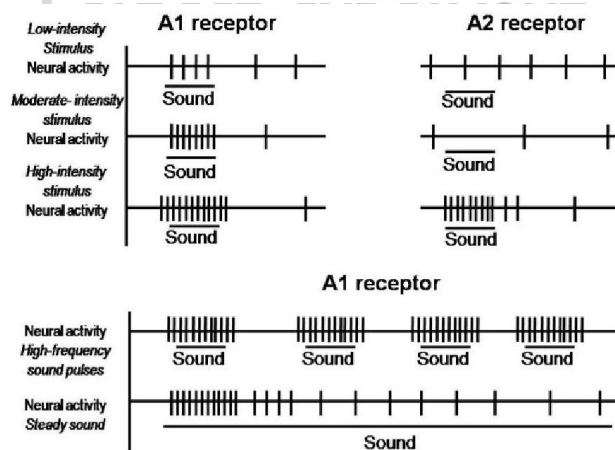
Which one of the following statements is INCORRECT about the two curves?

- (a) Species accumulation curve moves from left to right and rarefaction curve moves from right to left.  
 (b) Species accumulation curve represents the total species richness of the assemblage.  
 (c) Rarefaction curve represents the mean of repeated resampling of all pooled samples.  
 (d) Rarefaction curve is the realized accumulation value of the total species in a community.
130. A gene 'X' in *Drosophila* contributes to inviability of hybrids. The phylogeny below shows the evolutionary history of gene 'X' and on each branch the numbers indicate the non-synonymous/synonymous substitutions.



Based on the above information, select the correct statement from the choices below:

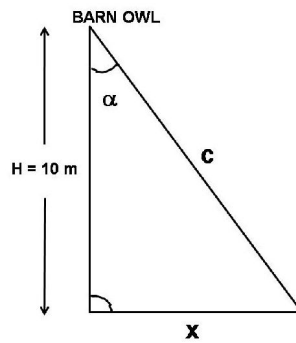
- (a) High proportion of non-synonymous changes at A indicates evolution by natural selection.  
 (b) High proportion of synonymous changes at A indicates absence of natural selection.  
 (c) Equal proportion of non-synonymous and synonymous changes at B indicates deleterious selection.  
 (d) Low proportion of non-synonymous changes at C indicates positive selection.
131. When the electrical response of the two receptors A1 and A2 in a noctuid moth that was exposed to a variety of sounds was measured, it produced the following patterns:



Given this, which one of the following statements is INCORRECT:

- (a) The A1 receptor is sensitive to sound of low to high intensity.  
 (b) A2 receptor begins to produce action potentials only when a sound is loud.  
 (c) Both the receptors have similar response to high intensity sound.  
 (d) The A1 receptor fires much more frequently to steady, uninterrupted sounds than to high frequency pulses of sound.

132. A barn owl sits on its perch 10m above ground. It hears a mouse underneath on the ground at an angle  $\alpha$  as shown in the figure below.



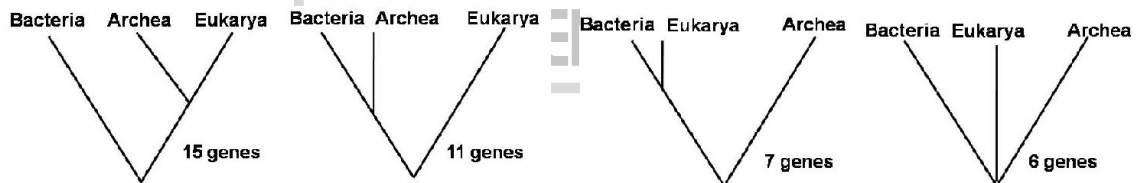
The error range with which it can locate the mouse on the ground is given by

- (a)  $\tan \alpha = X/H$       (b)  $\cos \alpha = X/H$       (c)  $\sin \alpha = X/H$       (d)  $\cos \alpha = X/C$
133. A 20-week old infant was exposed to the following stimuli and the responses were measured.

Stimuli	Mean No. of responses elicited
	100
..	15
	25
	10

Based on the response patterns shown above to the given stimuli, select the correct theory that best describes the observed responses.

- (a) Heterogenous summation      (b) Gestalt principle  
 (c) Supernormal stimuli      (d) Sign stimulus
134. When James R Brown and W Ford Doolittle (1997) reconstructed the tree of life using a variety of different genes, they found that different genes gave fundamentally different phylogenies as shown below. Note that the genes are unique to the specific trees.



From the given options select the process that best explains the observed discrepancies between the trees.

- (a) polyploidization      (b) horizontal gene transfer  
 (c) allopatric speciation      (d) localized extinctions
135. Orchids of the genus *Cryptostylis* are known to maintain reproductive isolation because their flowers look and smell like females of the wasps of genus *Lissopimpla*. When the male wasp visits and attempts to mate with the flower, the shape of anther and stigma allows correct placement and transfer of pollen to the wasp, which then transfers the pollen to species specific flower that it next attempts to mate with. This prezygotic barrier that prevents inter-species cross-pollination in *Cryptostylis* is best explained by:
- (a) behavioural isolation through mimicry      (b) mechanical isolation through mimicry  
 (c) temporal isolation      (d) habitat isolation

136. Some of the following transgenic approaches could be used for functional characterization of endogenous genes in plants:
- Transformation using a binary vector containing a strong enhancer element and lacking the right border of T-DNA
  - Transformation using a binary vector containing a promoter-less reporter gene sequence and a selection marker gene cassette within the T-DNA.
  - Transformation using a binary vector containing only a strong enhancer element and a selection marker gene cassette within the T-DNA.
  - Transformation using a binary vector lacking a reporter gene as well as both the left and right borders of T-DNA.

Which one of the following combinations can be used ?

- (a) A and B only      (b) B and C only      (c) C and D only      (d) A and D only

137. Match the following Vir proteins with their correct function during *Agrobacterium* mediated transfer of T-DNA to plant cells.

Vir protein	Function
A. Vir G	(i) Nucleus targeting of T-DNA
B. Vir D2	(ii) Component of membrane structure (transfer apparatus) for T-DNA transfer
C. Vir B1	(iii) Proteasome mediated destruction of proteins coating T-DNA complex
D. Vir F	(iv) Induction of Vir genes

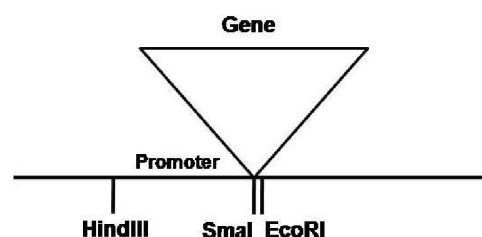
- (a) A-(i), B-(ii), C-(iii), D-(iv)      (b) A-(iv), B-(i), C-(ii), D-(iii)  
 (c) A-(i), B-(iii), C-(iv), D-(ii)      (d) A-(iii), B-(ii), C-(i), D-(iv)

138. Match the technique with its appropriate application/use from the list of options given below

Technique	Application
A. ChIP	(i) Analysis of methylation sites
B. Bisulphite sequencing	(ii) Identification of 5' and/or 3' ends of transcripts
C. ELISA	(iii) Identification of binding sites of transcription factors
D. RLMRACE	(iv) Quantification of transgene expression

- (a) A-(iii), B-(i), C-(iv), D-(ii)      (b) A-(ii), B-(iii), C-(i), D-(iv)  
 (c) A-(iv), B-(i), C-(iii), D-(ii)      (d) A-(iii), B-(iv), C-(ii), D-(i)

139. A researcher attempted to clone a 630bp coding sequence of a gene downstream to a bacterial promoter (500bp in length) for over expression and purification of the encoded protein. The gene sequence was isolated as a SmaI fragment (Recognition sequence: CCC↓GGG; arrow indicates the site of restriction) and cloned at a SmaI site located downstream to the promoter. The gene sequence contained a single site for EcoRI located 30bp downstream to the start codon. A schematic representation of the plasmid along with location(s) of some restriction enzyme sites of the vector is given below.



The researcher screened the obtained colonies by a double digestion using HindIII and EcoRI. Which one of the following restriction digestion patterns would represent the restriction profile of the desired clone that could be used for overexpression?

- (a) ~530bp + ~600bp + vector backbone      (b) ~1100bp + ~30bp + vector backbone  
 (c) ~500bp + vector backbone      (d) ~1130bp + vector backbone



140. To achieve a best resolution using a fluorescence microscope, what combination of wavelength of emitted light ( $\lambda$ ), refractive index and the angle ( $2\theta$ ) 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;  $2\theta = 180^\circ$

141. Given below are spatial and temporal techniques (column I) used to detect brain activity (column II)

Column I		Column II	
A	Functional magnetic resonance imaging	(i)	Uses short-lived radioactive material to map functional processes in brain
B	Positron emission tomography	(ii)	Measure the fluctuation of dipole voltage in neurons of brain
C	Computed tomography	(iii)	Detects changes in blood oxygenation and flow due to neural activity
D	Electroencephalogram	(iv)	Images of brain obtained by differential absorption of X-rays

Select the correct set of combination

- (a) A-(i), B-(ii), C-(iii), D-(iv)      (b) A-(iii), B-(i), C-(iv), D-(ii)  
 (c) A-(iv), B-(iii), C-(ii), D-(i)      (d) A-(ii), B-(iv), C-(i), D-(iii)
142. Following observations are made regarding a peptide sequence.
- The peptide is inert to Ellman's reagent. However, on reacting with  $\beta$ -mercaptoethanol, the peptide gives a positive Ellman's test.
  - The peptide sequence gives a broad minimum around 211 nm in the CD spectrum.
  - With increasing concentration of the peptide, the melting temperature of the peptide increases.
  - On treating the peptide with D<sub>2</sub>O, half the total number of amides get exchanged.
- Which one of the following statements is correct?
- (a) It is an  $\alpha$ -helical peptide that undergoes aggregation  
 (b) It is an  $\alpha$ -helical disulfide bridged peptide that undergoes aggregation  
 (c) It is an  $\beta$ -hairpin peptide, which is stabilized by a disulfide bridge  
 (d) The peptide is composed of an  $\alpha$ -helix and  $\beta$ -sheet connected by a disulfide bridge
143. If a metabolically active cell is challenged with <sup>55</sup>Fe radioisotope label, which of the following proteins CANNOT be detected by autoradiography?
- (a) Aconitase and lipoic acid synthase      (b) Cytochrome C and DNA primase  
 (c) Calmodulin and Calcineurin      (d) Myoglobin and Homoaconitase
144. Diagnosis of influenza virus infections can be done using some of the following techniques:
- A. Western blot and Southern blot      B. Northern blot and western blot  
 C. ELISA and RT-PCR      D. PCR and electron microscopy
- Choose the combination of techniques that correctly lists the detection methods.
- (a) A and B only      (b) C and D only      (c) B and C only      (d) A and D only
145. 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