

# **CSIR NET - Life Science (June 2022)**

**First shift (PART-B)**

## **QUESTION PAPER ANALYSIS**

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**Pathfinder Academy**

**Question ID: 21**



**In crystalline NaCl, how many chloride ions surround each sodium ion?**

- a. Four**
- b. Six**
- c. Eight**
- d. Ten**



**Answer b**

In a crystalline NaCl, each sodium ion is surrounded by six chloride ions, and each chloride ion is surrounded by six sodium ions.

## Question ID: 22

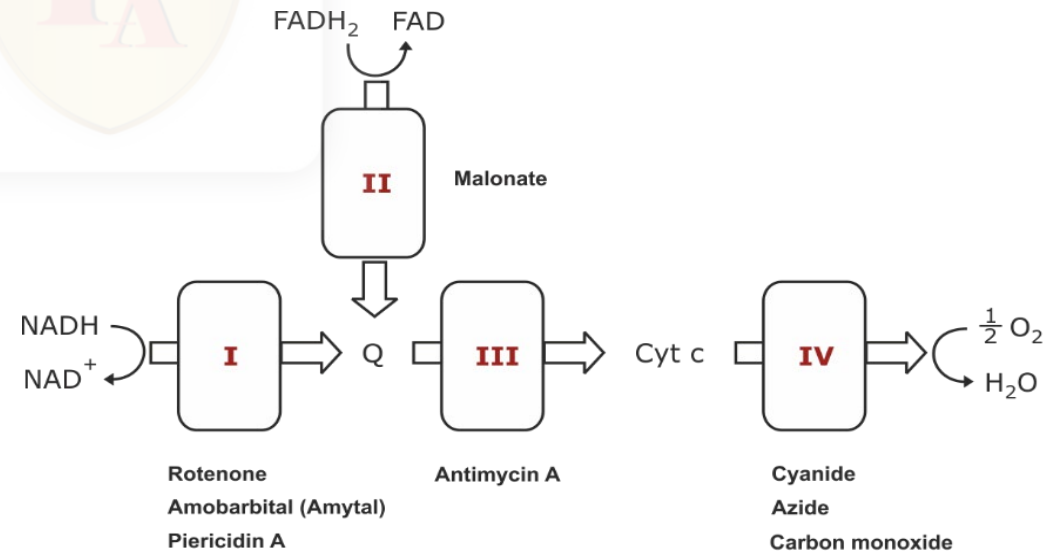


At which one of the following electron transport chain complexes does Antimycin A typically inhibit the respiratory chain?

- a. Complex I
- b. Complex II
- c. Complex III
- d. Complex IV

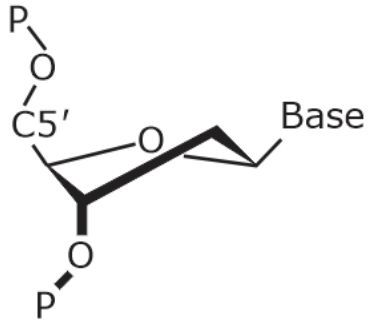
### Answer c

Antimycin A, a naturally occurring antibiotic, acts by binding to the cytochrome b of the enzyme complex III (also known as the cytochrome bc<sub>1</sub> complex).





Identify the ribose conformation in the nucleotide shown below:



- a. C2'-endo
- c. C3'-endo

- b. C2'-exo
- d. C5'-exo

**Answer:** Answer given by NTA is a

Although the figure shows C2'-endo, but the given nucleotide contains ribose sugar and ribose sugar present in RNA. In this case, the C3'-endo conformation is characterized by the C3' carbon atom pointing inward towards the base. The C3'-endo conformation is the most common sugar pucker in RNA.

## Question ID: 24



Which one of the following *correctly* describes the effect of a mutation in phosphofructokinase (PFK), that leads only to the loss of allosteric regulation by ATP?

- a. Decrease in the activity of PFK.
- b. Increase in the activity of PFK.
- c. Decrease in the amount of ADP generated by PFK.
- d. Increase in the amount of ATP generated by PFK.

### Answer b

ATP is an allosteric inhibitor of PFK, meaning that its binding to PFK reduces the enzyme's activity. Therefore, a mutation in PFK that specifically results in the loss of allosteric regulation by ATP will increase the activity of PFK.

Enzyme	Activator	Inhibitor
Hexokinase	-----	Glucose-6-phosphate
PFK-1	F2,6-BP, AMP	Citrate, ATP
Pyruvate kinase	F1,6-BP, AMP	Acetyl-CoA, ATP

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**Question ID: 25**



**A few organelles that are present in a eukaryotic cell are mentioned below:**

- P. Centrosomes**
- Q. Peroxisomes**
- R. Nucleolus**
- S. Endosomes**

**Which one of the following options represents organelles that are *not* membrane-bound?**

- a. P and Q**
- b. Q and R**
- c. P and R**
- d. P and S**

**Answer c**

Centrosome and nucleolus are both non-membrane-bound organelles whereas, peroxisome and endosome are single membrane-bound organelles.



Individual chromosomes are clearly seen during which phase of the cell cycle?

- a.  $G_0$
- b.  $G_1$
- c. S
- d. M



**Answer d**

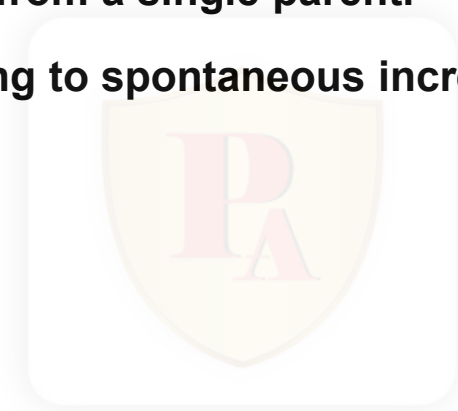
The cell cycle has two main phases – *interphase* and *M-phase*. The period of actual division, corresponding to the visible mitosis, is called **M phase** (mitosis phase). During the M phase, the chromosomes condense and become visible under a light microscope.





Which one of the following conditions represents autopolyploidy?

- a. More than two sets of chromosomes, both of which are from the same parental species.
- b. More than two sets of chromosomes, both of which are from the different parental species.
- c. More than two sets of chromosomes only from a single parent.
- d. Duplication of a chromosomal locus leading to spontaneous increase in the copy number of a gene.



**Answer a**

Polyploidy is of two types: *autopolyploidy* and *allopolyploidy*. *Autopolyploidy* is the polyploidy condition resulting from the multiplication of the same genome. *Allopolyploidy* is a polyploid condition formed by crossing different species and doubling the chromosomes of the hybrid.



Which one of the following statements about the recognition of tRNAs by their cognate aminoacyl-tRNA synthetases is *correct*?

- a. Aminoacyl-tRNA synthetases recognize their cognate tRNAs by the exclusive recognition of their anticodons.
- b. Aminoacyl-tRNA synthetases recognize their cognate tRNAs by recognition of their anticodons in some tRNAs only.
- c. Aminoacyl-tRNA synthetases cannot aminoacylate a tRNA that lacks the conserved modifications in the T $\phi$ C loop.
- d. Aminoacyl-tRNA synthetases cannot aminoacylate a tRNA that lacks the conserved modifications in the DHU loop.

**Answer b**

Attachment of an amino acid to tRNA involves a covalent linkage between the carboxyl group of the amino acid and the 2' or 3'-hydroxyl group of the adenine containing nucleotide at the 3' end of the tRNA. This process (called *aminoacylation*) is catalyzed by an enzyme called **aminoacyl-tRNA synthetase** (also known as *aminoacyl-tRNA ligase*). In general, aminoacyl-tRNA synthetases recognize the anticodon loops and acceptor arms of tRNA molecules.

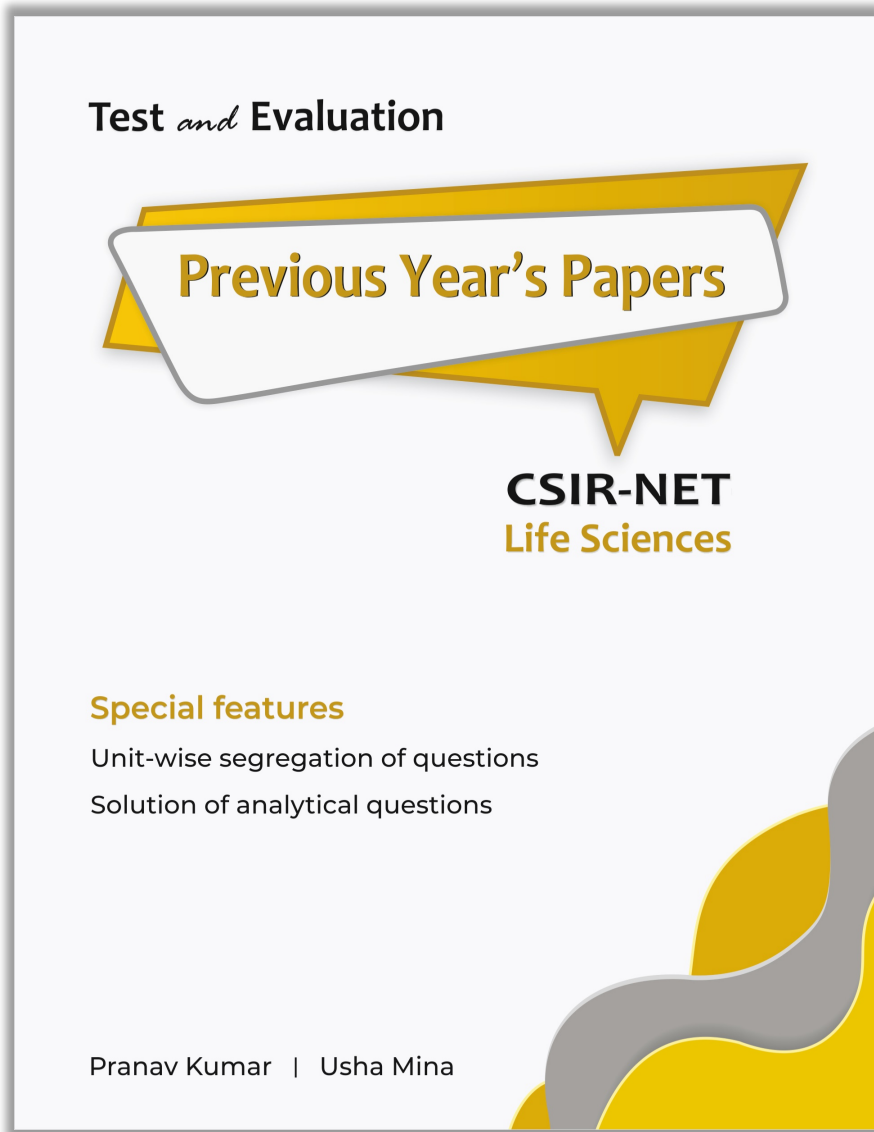


Histone variants play important roles in chromatin function in mammalian cells. Which one of the following statements is *correct* in the context of the histone variants?

- a. Histone variants have been reported for H3 and H4 but not for H2A and H2B.
- b. Histone variants have been reported for H3, H4, H2A but not for H2B.
- c. Histone variants have been reported for H3, H4, H2B but not for H2A.
- d. Histone variants have been reported for H3, H4, H2A and H2B.

**Answer d**

Histone variants have been reported for **H3** (H3.1, H3.2, H3.3, H3.4, CENP-A), **H4** (H4.1, H4.2, H4.3, H4.4), **H2A** (H2A.X, H2A.Z) and **H2B** (H2B.1, H2B.2, H2B.3).



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Find detailed explanations

**Pathfinder Publication**

<https://pathfinderacademy.in/book/CSIR-UGC-NET-Life-Sciences-Test-Evaluation-6.html>

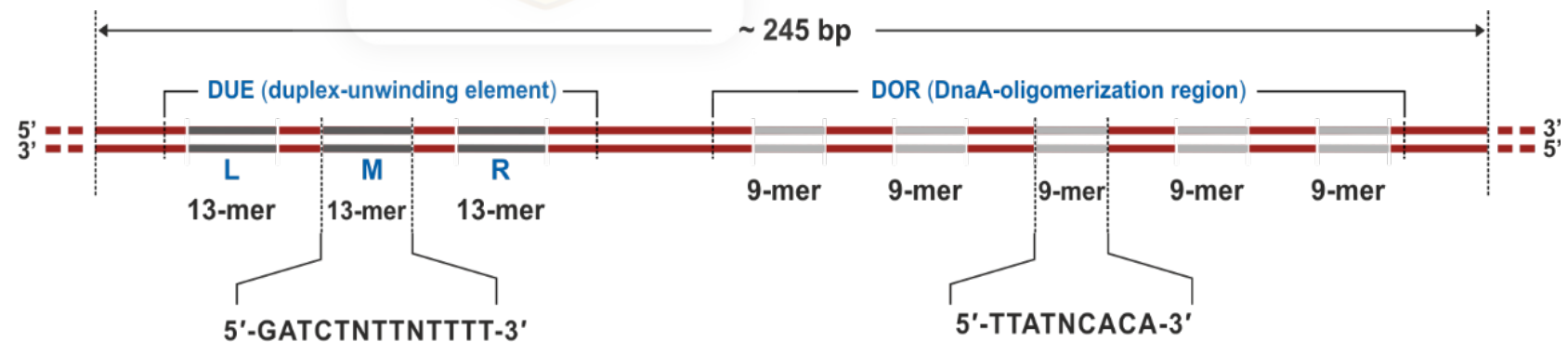


Which one of the following statements made about the bacterial replisome is *incorrect*?

- The rate of forward movement of DnaB helicase along the template DNA increases 10-fold when DnaB and DNA Pol III interact, thus ensuring that the helicase does not move ahead rapidly without the polymerase.
- The transient interaction of the primase with the helicase allows activation of primase activity by 1000-fold, promoting RNA primer synthesis.
- The length of the Okazaki fragments is typically restricted to 1000-2000 nucleotides.
- The *E. coli* *oriC* carries repeats of two sequence motifs: repeats of a 9-mer that form the site at which the origin first becomes single-stranded, and repeats of a 13-mer to which the DnaA initiator protein binds.

### Answer d

The 9-mer repeats bind with DnaA protein. Binding of DnaA to the 9-mer repeats facilitates the unwinding of the DNA strands at *13-mer* region.



## Question ID: 31



Which of the options *correctly* matches the proteins involved in transcription (Column A) with the DNA binding domains they carry (Column B)?

	<i>Column A</i>		<i>Column B</i>
A.	TFIIIA	1.	Helix-turn-helix
B.	MyoD	2.	Zinc finger
C.	Jun	3.	Helix-loop-helix
D.	Cro	4.	Leucine zipper

- a. A-4, B-3, C-1, D-2
- c. A-3, B-1, C-2, D-4

- b. A-2, B-1, C-4, D-3
- d. A-2, B-3, C-4, D-1

### Answer d

TFIIIA, MyoD and Jun are all transcription factors that bind to DNA as DNA binding proteins and regulate the expression of genes. Cro protein is a repressor protein that is encoded by the bacteriophage lambda *cro gene*. It is a DNA binding protein with helix turn helix motif.



Which one of the following combinations of CD molecules and their associated functions is matched *incorrectly*?

- a. CD1: Antigen-presenting proteins that present antigenic peptides to T-cell receptors on natural killer T-cells (NKT).
- b. CD8: Thymic differentiation marker for T-cells.
- c. CD11a: A membrane glycoprotein that provides cell-cell adhesion by interaction with ICAM 1 (intercellular adhesion molecule 1).
- d. CD14: Activates innate immune responses by transferring LPS-LBP complex to TLR4.

Answer a

- |                               |                                                                                                                              |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| <b>Conventional T cells</b>   | Cytotoxic T cells: Peptide antigens presented by class I MHC.<br>Helper T cells: Peptide antigens presented by class II MHC. |
| <b>Natural killer T cells</b> | Non-peptide antigens presented by class I MHC-related protein CD1.                                                           |

**Question ID: 33**



Which one of the following is a small sulfated peptide that is secreted by a rice pathogenic bacterium, *Xanthomonas oryzae* to modulate motility, biofilm formation and virulence?

- a. Coronatine
- b. N-acylhomoserine lactones
- c. Ax21
- d. EPS



**Answer c**

Ax21 is a small sulfated peptide that is secreted by the rice pathogenic bacterium *Xanthomonas oryzae*. It is a quorum sensing molecule, which means that it is released by the bacteria in response to a certain population density.





Which one of the following small molecule neurotransmitters is *not* synthesized from tyrosine?

- a. Epinephrine
- b. Dopamine
- c. Serotonin
- d. Norepinephrine



**Answer c**

Catecholamines (Dopamine, norepinephrine and epinephrine) : Tyrosine

Serotonin : Tryptophan

## Question ID: 35



While studying pathogenic bacteria, a protein with the following features was identified:

- A. It was secreted during infection conditions, but not in in-vitro cultures.
- B. It was also observed to be present in the membranous fraction in traces, which was released upon bacterial lysis.
- C. It had a heat labile N-terminal enzymatic domain that binds MHC molecules, stimulating T-cells non-specifically.
- D. It had a C-terminal non-enzymatic domain which was highly antigenic and heat-stable.

How will you *best* classify the toxic nature of this protein?

- a. An endotoxin
- b. Superantigen
- c. Pore-forming toxin
- d. A-B toxin

### Answer b

*Superantigen* is a class of microbial toxin or protein that binds to the variable region of the T-cell receptor (TCR) and major histocompatibility complex (MHC) class II molecules, resulting in the non-specific activation of a large number of T cells.

*Pore-forming toxins* insert itself into the host cell membrane and make an open channel (pore).

*A-B toxins* are intracellular toxins. The *B-subunit* attaches to target regions on cell membranes and the *A-subunit* enters through the membrane and possesses enzymatic activity.

## Question ID: 36



Which one of the following statements is *incorrect*?

- a. Transient rise in  $\text{Ca}^{2+}$  is necessary for egg activation in mammals.
- b. Sperm induces egg activation and does not involve  $\text{Ca}^{2+}$ .
- c. In many organisms, eggs secrete diffusible molecules that attract and activate sperm.
- d. Capacitated mammalian sperm can penetrate the cumulus and bind the zona pellucida.

### Answer b

Fertilization generally consists of four major events:

1. Contact and recognition between sperm and egg.
2. Regulation of sperm entry into the egg.
3. Fusion of the genetic material of sperm and egg.
4. Activation of egg metabolism to start development – Calcium plays a crucial role in the activation of egg metabolism during fertilization and early development.



**Question ID: 37**



In which one of the following developmental events, the fate of maternal somatic cell is determined first, which then determines the fate of the developing embryo?

- a. The specification of primary organizer in amphibian embryo.
- b. The specification of dorso-ventral axis in *Drosophila*.
- c. The formation of the vulval precursor cells during development of *C. elegans*.
- d. Specification of the micromeres in case of sea urchin.



**Answer b**

## Question ID: 38



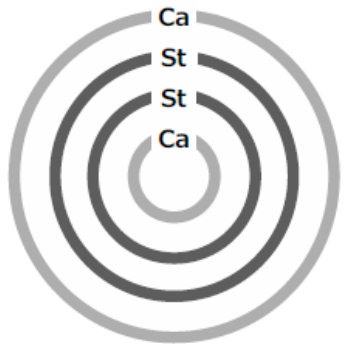
Which one of the following floral mutants shows the pattern 'sepals-petals-petals' repeated several times?

- a. agamous (ag)
- b. apetala1 (ap1)
- c. apetala3 (ap3)
- d. pistillata (pi)

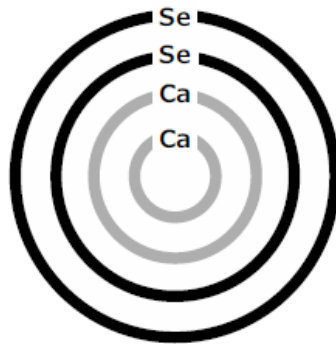
### Answer a

Class A genes are responsible for specifying the identity of sepals and petals. The class A genes include APETALA1 (AP1) in *Arabidopsis*. Class B genes play a role in determining the identity of petals and stamens. Class B genes include APETALA3 (AP3) and PISTILLATA (PI) in *Arabidopsis*. Class C genes are involved in specifying the identity of stamens and carpels. The class C genes include AGAMOUS (AG) in *Arabidopsis*. The expression of class A genes and class C genes is postulated to be mutually antagonistic.

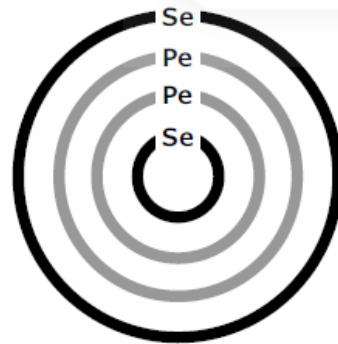
Loss-of-function mutation  
in class A genes



Loss-of-function mutation  
in class B genes



Loss-of-function mutation  
in class C genes





The table below lists cleavage pattern and names of species.

	<i>Cleavage pattern</i>		<i>Species</i>
A.	Isolecithal bilateral	1.	Amphibians
B.	Mesolecithal radial	2.	Birds
C.	Centrolecithal superficial	3.	Tunicates
D.	Telolecithal discoidal	4.	Insects

Match the cleavage patterns with the species.

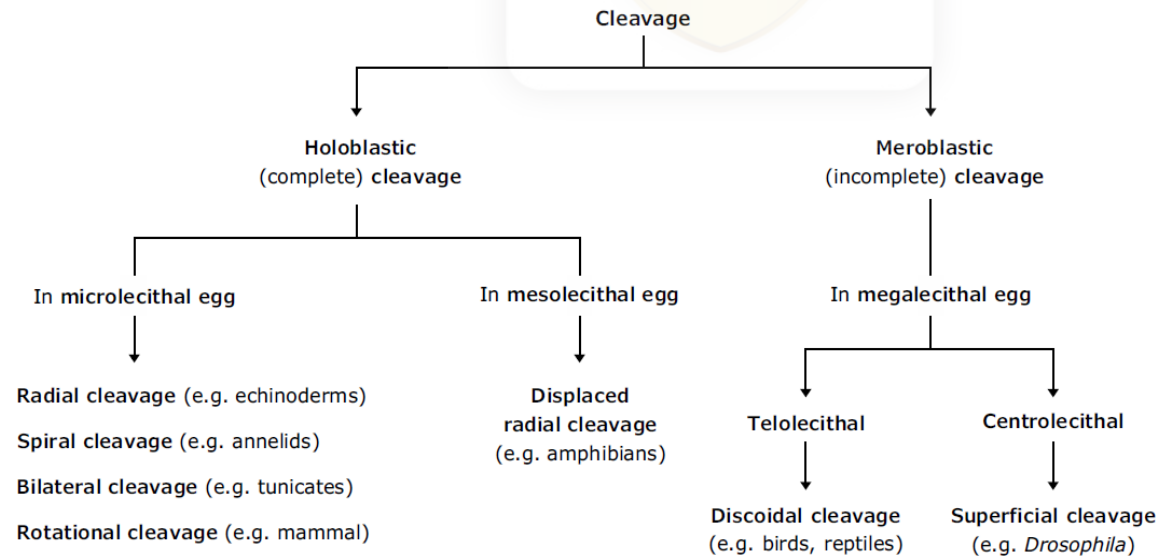
a. A-1, B-2, C-3, D-4

b. A-2, B-4, C-1, D-3

c. A-4, B-1, C-3, D-2

d. A-3, B-1, C-4, D-2

Answer d



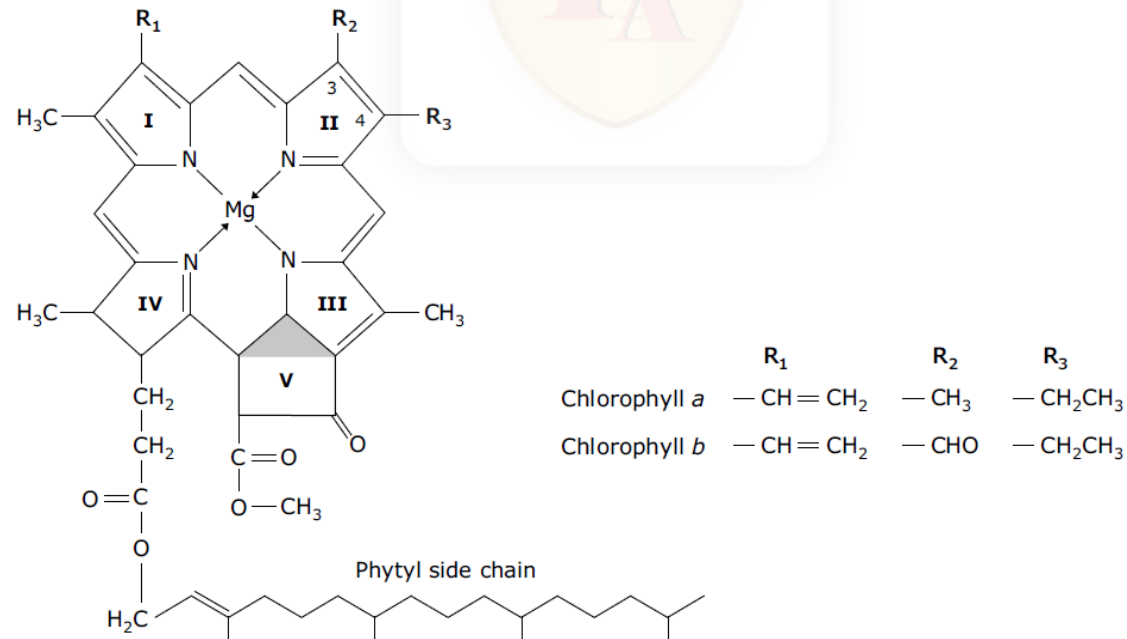
## Question ID: 40



Which of the following statements regarding chlorophyll is *not* correct?

- Chlorophyll-a has a  $-\text{CH}_3$  group in its porphyrin-like ring structure.
- Chlorophyll-b has  $-\text{CHO}$  group in its porphyrin-like ring structure.
- Only chlorophyll-a, but not chlorophyll-b, has a  $\text{Mg}^{++}$  coordinated at the centre of the porphyrin-like ring structure.
- The long hydrocarbon tails of chlorophyll anchors them in the photosynthetic membrane.

Answer c





Which of the following nitrogen containing compounds is formed during deamination of organic nitrogen in plants?

- a. NO
- b.  $\text{NO}_2^-$
- c.  $\text{NO}_3^-$
- d.  $\text{NH}_4^+$



**Answer d**

The product of deamination of organic nitrogen in plants is ammonia. Deamination is a process that removes an amino group from an organic molecule. The amino group is removed from the amino acid and converted to ammonia.





The product of *nahG* gene of *Pseudomonas putida* catalyzes the metabolism of salicylic acid to which one of the following compounds?

- a. Benzoic acid
- b. Methyl salicylate
- c. Catechol
- d. Benzoyl-CoA



**Answer c**

The product of the *nahG* gene of *Pseudomonas putida* catalyzes the metabolism of salicylic acid. The *nahG* gene encodes the enzyme salicylate 1-monooxygenase (a flavin-dependent monooxygenase), which catalyzes the oxidation of salicylic acid to catechol.

**Question ID: 43**



***Lr34*, a broad-spectrum disease resistance gene in wheat, encodes for a putative:**

- a. Serine hydroxymethyl transferase**
- b. ABC transporter**
- c. Host-specific toxin**
- d. TIR-NB-LRR protein**



**Answer b**

*Lr34* is a broad-spectrum disease resistance gene in wheat that encodes for an ABC transporter.



The activities of baroreceptors present in the carotid sinus are carried by the afferent fibers of neurons located in

- a. nodose ganglion
- b. geniculate ganglion
- c. petrosal ganglion
- d. spiral ganglion



**Answer c**

The petrosal ganglion is a sensory ganglion of the glossopharyngeal nerve. The activities of baroreceptors present in the carotid sinus are carried by the afferent fibers of neurons located in the petrosal ganglion.



Which one is *not* a true response of pulmonary J-receptor stimulation by hyperventilation of lung?

- a. Bronchodilation
- b. Decreased heart rate
- c. Apnoea followed by rapid breathing
- d. Low blood pressure



**Answer a**

Pulmonary J-receptors are located in the interstitial tissues of the lungs, near the pulmonary capillaries. They are stimulated by a decrease in lung volume, such as that which occurs during hyperventilation.

**Question ID: 46**



**Which one *does not* occur as a physiological adjustment during heat acclimatization?**

- a. Lowered threshold for start of sweating**
- b. Effective distribution of cardiac output**
- c. Improved skin blood flow**
- d. Increased salt concentration of sweat**



**Answer d**



**Absorbed monosaccharides in intestinal epithelial cells exit via which one of the following transporters?**

- a. GLUT2
- b. GLUT3
- c. GLUT4
- d. GLUT5



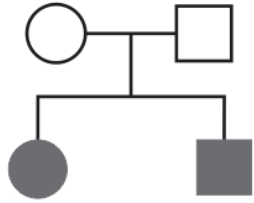
**Answer a**

GLUT2 is a glucose transporter protein that is primarily responsible for the transport of glucose. It is located on the basolateral membrane of the intestinal epithelial cells. It allows the glucose molecules to leave the cell by facilitated diffusion into the extracellular fluid on the other side of the epithelium.

## Question ID: 48



Given below is a pedigree indicating a pattern of inheritance:



Which one of the following options *correctly* describes the pattern of inheritance shown in the above pedigree?

- a. X-linked recessive
- b. Autosomal recessive
- c. X-linked dominant
- d. Autosomal dominant

**Answer b**

*Autosomal recessive traits*

Trait often skips generations.

An almost equal number of affected males and females.

If both parents are affected, all children should be affected.

## Question ID: 49



In a conjugation experiment between bacterial Hfr strain 'X' and F<sup>-</sup> cell, lac gene enters the recipient in 4 minutes, but the F<sup>-</sup> cells remain auxotrophic for Leu, Trp, Ura, Glu, Phe and Gly. The mating is then allowed to proceed for 20 minutes and lac<sup>+</sup> excojugants are selected. Of the lac<sup>+</sup> cells,

35% are leu<sup>+</sup>

98% are trp<sup>+</sup>

10% are ura<sup>+</sup>

65% are glu<sup>+</sup>

0% are phe<sup>+</sup>

81% are gly<sup>+</sup>

Select the *correct* order of the genes as they enter, from the choices given below:

a. trp<sup>+</sup>, gly<sup>+</sup>, glu<sup>+</sup>, leu<sup>+</sup>, ura<sup>+</sup>, phe<sup>+</sup>, lac<sup>+</sup>

b. lac<sup>+</sup>, phe<sup>+</sup>, ura<sup>+</sup>, leu<sup>+</sup>, glu<sup>+</sup>, gly<sup>+</sup>, trp<sup>+</sup>

c. phe<sup>+</sup>, ura<sup>+</sup>, leu<sup>+</sup>, glu<sup>+</sup>, gly<sup>+</sup>, trp<sup>+</sup>, lac<sup>+</sup>

d. lac<sup>+</sup>, trp<sup>+</sup>, gly<sup>+</sup>, glu<sup>+</sup>, leu<sup>+</sup>, ura<sup>+</sup>, phe<sup>+</sup>

### Answer d

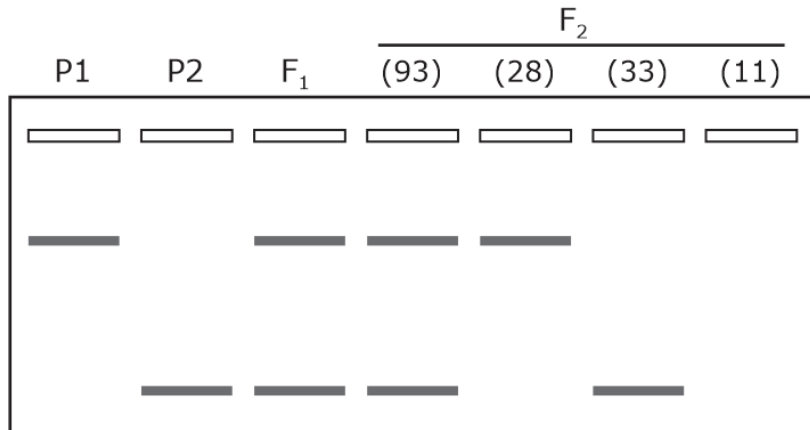
Conjugation between different Hfr and F<sup>-</sup> strains can be used to map the relative positions of genes in the bacterial chromosome. The mapping procedure is based on the fact that genes closer to the origin of transfer will be transferred at a higher frequency than genes farther away from the origin of transfer.



## Question ID: 50



The following picture represents a gel profile of a pair of DNA markers observed in parents P1 and P2, their F1 progeny and F2 progeny. Four different profiles were observed in case of F2. The number of F2 progeny showing a given profile is indicated in brackets.



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

- Co-dominant DNA markers were used for this study.
- The polymorphic DNA bands represents two independent genes.
- If the P1 parent was crossed to the F1 individual, the progeny will show all the four profiles as observed in the case of F2 progeny.
- If an F2 progeny which does not show either of the DNA markers (last lane of the above gel) is crossed to a P1 individual, the obtained progeny will have two types of individual, one which shows a band and the other where no band is observed.

### Answer b

The F2 progeny exhibiting a Mendelian phenotypic ratio of 9:3:3:1 suggests the independent assortment of two genes and complete dominance in their allelic relationship. This means that each gene is inherited independently of the other, and the dominant allele will always be expressed over the recessive allele.

## Question ID: 51



The additive nature of a genetic map as suggested by Alfred Sturtevant and T. H. Morgan is possible if there is

- a. no interference in crossovers.
- b. complete interference in crossovers.
- c. partial interference in crossovers.
- d. variable interference in crossovers dependent on the genetic distances.

### Answer b

Interference refers to the phenomenon where a crossover event in one region of a chromosome affects the likelihood of a crossover occurring in nearby regions. If there is *no interference* in crossovers, it means that the occurrence of one crossover event does not affect the likelihood of another crossover event happening nearby. If there is complete interference in crossovers, it means that the occurrence of one crossover event prevents any additional crossovers from occurring in nearby regions. The additive nature of a genetic map is possible if there is complete interference in crossovers.



Which one of the following forest type occupies the largest area in India?

- a. Tropical rain forest
- b. Tropical dry deciduous forest
- c. Temperate deciduous forest
- d. Temperate evergreen forest



**Answer b**

A tropical dry deciduous forest is a type of forest ecosystem found in regions with a distinct dry season and a wet season. It is characterized by the shedding of leaves by most trees during the dry season as a response to water scarcity.



**Which one of the following biome is known to occur in India?**

- a. Tundra**
- b. Boreal forest**
- c. Taiga**
- d. Alpine grasslands**



**Answer d**

India does not have tundra, boreal forests, or taiga biomes. These biomes are typically found in high-latitude regions with cold climates. However, India does have alpine grasslands, which are found in the high mountain regions of the Himalayas.

## Question ID: 54



The following are selected plant apomorphies:

- A. Development of xylem.
- B. Development of cuticle.
- C. Development of independent sporophyte.
- D. Development of eustele.

Which option represents the *correct* evolutionary sequence of the above?

- a. A-D-B-C
- b. C-A-B-D
- c. B-C-A-D
- d. C-B-D-A

**Answer c**

The *development of cuticle* is considered one of the earliest apomorphies in the plant kingdom, providing a protective waxy layer on the surface of the plant to reduce water loss. The development of an *independent sporophyte* was next major evolutionary development that allowed plants to colonize land. the development of xylem, responsible for transporting water and minerals, can be considered as a subsequent apomorphy that evolved after the establishment of an independent sporophyte. The development of a eustele was a later evolutionary innovation that allowed plants to grow taller.

## Question ID: 55



The biological species concept defines species as a group of populations that are reproductively isolated from others. However, this definition is not applicable to groups where sexual reproduction has not been observed yet or is extremely rare. Choose the *correct* option of organisms where biological species concept may therefore not apply:

- a. Monocots and basal angiosperms
- b. Ascomycetes and oligochaetes
- c. Mosses and liverworts
- d. Cyanobacteria and Euglenophyta



### Answer d

The biological species concept, defines species in terms of interbreeding. According to Ernst Mayr, species are groups of interbreeding natural populations that are reproductively isolated from other such groups. Reproductively isolated means that members of the species do not interbreed with members of other species. Biological species concept is not applicable in bacteria due to the lack of sexual reproduction.



Which of the following is typically *true* of invasive species?

- a. They are r-selected
- b. They are K-selected
- c. They are habitat specialists
- d. They are always introduced by humans

**Answer a**

Invasive species (also called introduced, exotic, non-native) can be any kind of living organism that is not native to an ecosystem and which has a tendency to change the structure and function of the ecosystem. They can be introduced to an area intentionally or accidentally, and they can quickly become established and spread. A typical invasive species has features similar to r-selected species such as:

Rapid reproduction and growth,

High dispersal ability,

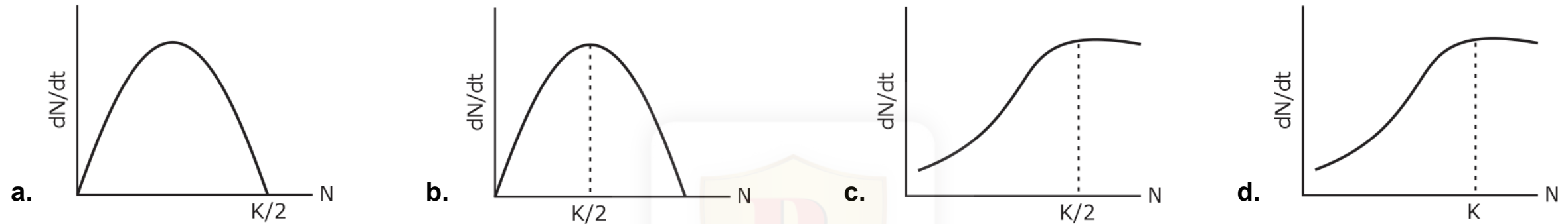
Phenotypic plasticity,

Ability to survive in a wide range of environmental conditions.

## Question ID: 57



Which of the following *correctly* represents the relationship between the rate of population growth and population size?

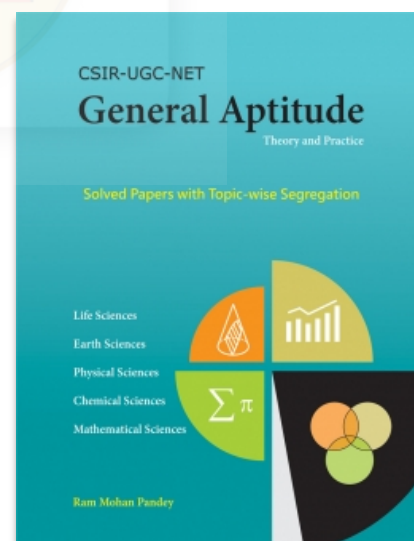
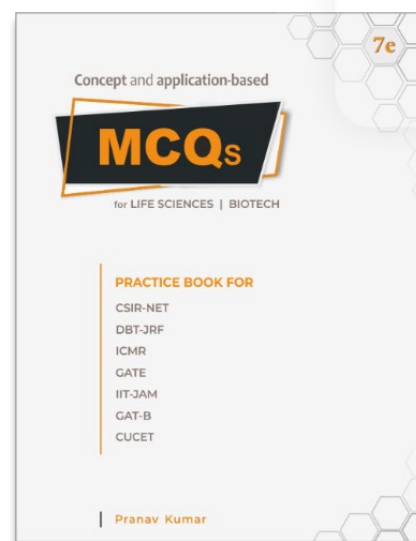
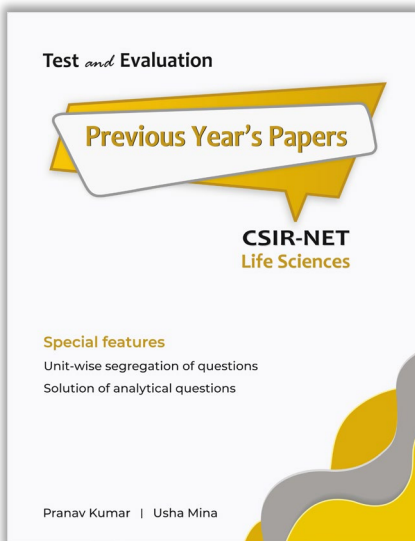
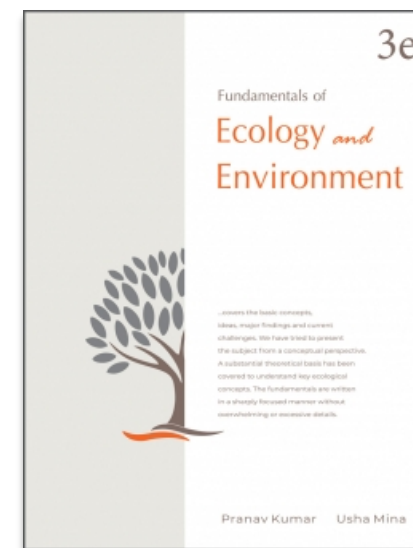
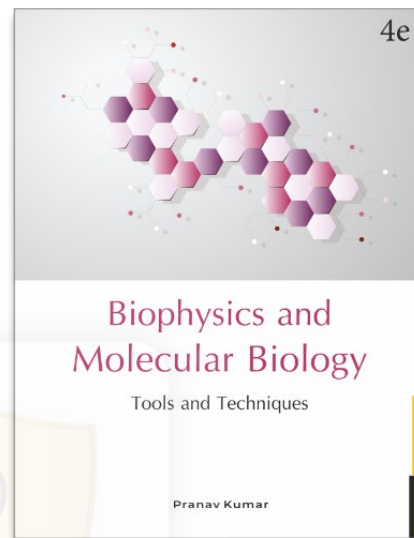
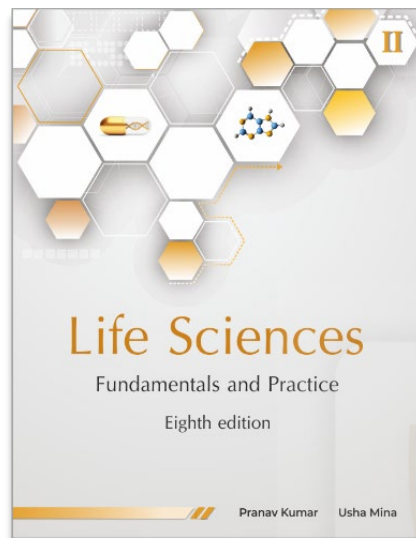
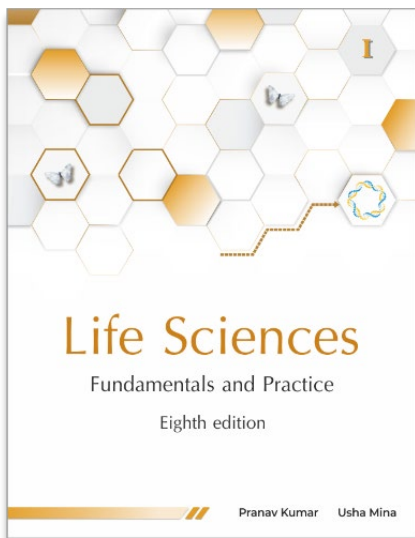


**Answer b**

The relationship between the rate of population growth,  $dN/dt$  and population size,  $N$ , takes the form of a parabola, reaching a maximum value at a population size of  $N = K/2$ . The rate of population growth ( $dN/dt$ ) is at its highest when  $N = K/2$  (called the *inflection point*) and then decreases as it approaches the carrying capacity ( $K$ ).



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**Question ID: 58**



**The Biodiversity Management Committees (BMCs) envisaged under the Biological Diversity Act (2002) and Rules (2004) are constituted at which one of the following administrative levels?**

- a. Village**
- b. Tehsil / Taluka**
- c. District**
- d. State**

**Answer a, b, c**



## Question ID: 59



There is a species that is critically endangered, found in the Russian Far East. It is solitary, but it has been reported that some males stay with females after mating, and may even help with rearing the young. Identify this species.

- a. Amur leopard
- b. Snow leopard
- c. Arctic fox
- d. Black-footed ferret



**Answer a**

A species is *critically endangered* when facing an extremely high risk of extinction in the wild in the immediate future. The Amur leopard is a leopard subspecies native to the Primorye region of south-eastern Russia and northern China.



Species richness can be measured with the

- a. abundance of species in an area
- b. number and the abundance of species in an area
- c. number of species in an area
- d. density of species in an area



**Answer c**

Number of species in a community (i.e., richness).

Relative abundance of each species (i.e., evenness).



The measurement of distance based on counting steps or number of vertical bars by insects for navigation is called

- a. path integration
- b. allocentric coding
- c. odometry
- d. alignment image-matching



**Answer c**

Odometry refers to the process by which an organism estimates its position or distance traveled based on internal sensory information. Insects, such as ants, bees, and desert ants, use odometry as a navigational strategy to keep track of their movement. They count their steps or use other internal mechanisms to estimate the distance they have traveled, allowing them to navigate back to their nest or a desired location.

**Question ID: 62\***



The *correct* hierarchy of geological times is

- a. eon > era > period > epoch
- b. period > era > epoch
- c. epoch > period > era > eon
- d. era > eon > period



**Answer \***

## Question ID: 63



Consider a predator species foraging for prey in a habitat, where there are two prey species A and B. Assume the foraging predator can choose from a high-value prey A and low-value prey B. A and B occur at different frequencies in the environment, so it may take different average times to find the next A or B individual. Choose the *correct* option based on the optimal foraging theory.

- a. If it takes too long to search for A, predators may switch to eating B only.
- b. If it takes too long to search for A, predators may eat both A and B, whichever is encountered.
- c. Predators will only feed on B, regardless of search time.
- d. Predators will never feed on B, irrespective of its relative frequency.

### Answer b

Animals search (forage), sense, detect and consume foods. For animals, foraging involves a balance between a food's energy content and the cost of obtaining it. Foraging behavior can directly influence energy intake and individual fitness. In above scenario, if it takes too long to search for the high-value prey species A, predators would not exclusively focus on searching for A but would also consume the low-value prey species B when encountered. This behavior allows them to maximize their energy intake by exploiting the available resources efficiently.



Any movie that features dinosaurs should also have which of the following combinations of geological age-appropriate organisms? Choose the *correct* combination.

- a. Humans, angiosperms and gymnosperms, birds.
- b. Early diverging angiosperms, reptiles, amphibians.
- c. Apes, gymnosperms, birds.
- d. Early diverging gymnosperms, amphibians, reptiles.



**Answer d** (However, answer given by NTA is **b**)

Dinosaurs existed during the Mesozoic Era, which is divided into three geological periods: the Triassic, Jurassic, and Cretaceous. During this time, early angiosperms (flowering plants) had not yet diversified or become dominant. They emerged later in the Mesozoic and experienced significant diversification during the Cretaceous period. Reptiles and amphibians, on the other hand, were indeed present during the time of dinosaurs.



## Question ID: 65



If you want to selectively kill the newly dividing mammalian cells in a cell culture assay, which of the following methods will you use?

- a. Exposure to UV radiation at 250 nm.
- b. Treatment with 5-ethynyl-2'-deoxyuridine (EdU), followed by doxorubicin hydrochloride treatment.
- c. Treatment with 5-bromo-2-deoxyuridine (BrdU), followed by UV-A exposure.
- d. Tritiated thymidine treatment followed by vinblastine treatment.

### Answer c

5-bromo-2-deoxyuridine (BrdU) is a thymidine analog that is incorporated into DNA during the S phase of the cell cycle. When BrdU-labeled cells are exposed to UV-A light, the BrdU is converted to a photoreactive compound that damages the DNA, leading to cell death. This method is selective for newly dividing cells because only cells that are actively incorporating BrdU into their DNA will be killed.



Which one of the following traits would hypothetically *not* be considered for preferential selection during domestication of the corresponding crops listed below?

- a. Increased fruit size of tomato
- b. Reduced spininess in okra
- c. Shattering seeds of corn
- d. Increased oil content of mustard



**Answer c**

Shattering seeds are seeds that disperse naturally when they are ripe. However, it is not a desirable trait in domesticated plants, as it makes it difficult to collect the seeds. Therefore, farmers would not preferentially select for shattering seeds in corn. Instead, they would select for seeds that do not shatter, so that they can be easily collected and stored.

## Question ID: 67



In remote sensing, which one of the following formulae is used for the calculation of normalized difference vegetation index (NDVI)?

- a.  $RED / (NIR + RED)$
- b.  $RED / (NIR - RED)$
- c.  $(NIR + RED) / (NIR - RED)$
- d.  $(NIR - RED) / (NIR + RED)$

**Answer d**

$$NDVI = (NIR - RED) / (NIR + RED)$$

NIR – light reflected in the near-infrared region

RED – light reflected in the red region



## Question ID: 68



The radioactive isotope of an element has a half-life of 100 hours. How many hours will it take for 15/16 of the source amount to decay?

- a. 50  
b. 400  
c. 250  
d. 1000

**Answer b**

Given initial amount ( $N_0$ ) = 1,  $N_t = 15/16$ , final amount ( $N$ ) =  $1 - 15/16 = 1/16$

$N/N_0 = 1/16$  or,  $N_0/N = 16$

$$\lambda = \frac{\ln 2}{t_{1/2}} = \frac{\ln 2}{100}$$

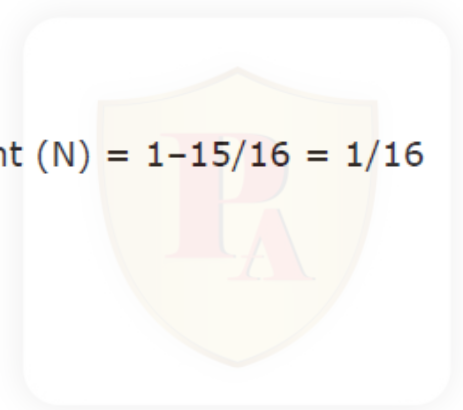
As we know that,  $N = N_0 e^{-\lambda t}$  or,  $N/N_0 = e^{-\lambda t}$

Taking natural log on both sides, we have

$\ln N/N_0 = -\lambda t$  or,  $\ln N_0/N = \lambda t$

$$\ln 16 = \frac{\ln 2}{100} \times t \quad \text{or,} \quad 4 \ln 2 = \frac{\ln 2}{100} \times t$$

$$t = 4 \times 100 = 400 \text{ hours}$$





Which one of the following *correctly* describes the spectroscopic experiment that would help distinguish between a  $\alpha$ -helix, a  $3_{10}$  helix and a  $\pi$ -helix?

- a. Near UV absorption spectrum between 250-300 nm.
- b. Fluorescence emission spectra between 350-400 nm.
- c.  $^1\text{H}$  NMR spectroscopy involving Hydrogen/Deuterium exchange.
- d. Near UV Circular Dichroism spectrum between 250-300 nm.

**Answer d** (However, answer given by NTA is c)

Circular Dichroism (CD) spectroscopy is a technique commonly used to study the secondary structure of proteins. It measures the differential absorption of left-handed and right-handed circularly polarized light by a molecule. The near UV region (250-300 nm) of the CD spectrum is particularly informative for analyzing protein secondary structures such as  $3_{10}$  and  $\pi$ -helices.



What is the 50<sup>th</sup> percentile of the numbers 9, 5, 11, 3 and 2?

- a. Five
- b. Six
- c. Nine
- d. Fifteen



**Answer a**

50th percentile is known as the median and it cuts the data set in half. Half of the given numbers lie below the median and half lie above the median. So, the 50th percentile of the numbers is 5.

# Performance at a glance



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Anupam  
329559



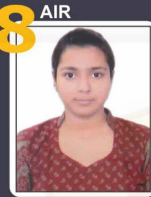
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Chandni Sood  
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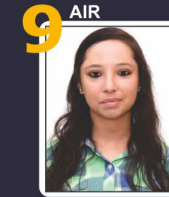
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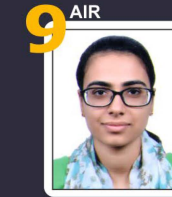
9 AIR  
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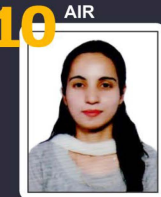
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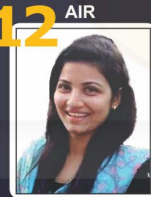
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12 AIR  
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Basit Gulzar  
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Sinjini Dhang  
344373



13 AIR  
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329376



14 AIR  
Piyush Pachauri  
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