

# Centre For Excellence In Basic Sciences

## Notations :

- Options shown in green color and with ✓ icon are correct.
- Options shown in red color and with ✗ icon are incorrect.

|                                  |                                                             |
|----------------------------------|-------------------------------------------------------------|
| Question Paper Name :            | National Entrance Screening Test 2023 24th Jun 2023 Shift 2 |
| Subject Name :                   | National Entrance Screening Test 2023                       |
| Creation Date :                  | 2023-06-24 19:55:01                                         |
| Duration :                       | 210                                                         |
| Total Marks :                    | 200                                                         |
| Display Marks:                   | Yes                                                         |
| Actual Answer Key :              | Yes                                                         |
| Calculator :                     | Normal                                                      |
| Magnifying Glass Required? :     | No                                                          |
| Ruler Required? :                | No                                                          |
| Eraser Required? :               | No                                                          |
| Scratch Pad Required? :          | No                                                          |
| Rough Sketch/Notepad Required? : | No                                                          |
| Protractor Required? :           | No                                                          |
| Show Watermark on Console? :     | Yes                                                         |
| Highlighter :                    | No                                                          |
| Auto Save on Console?            | Yes                                                         |
| Change Font Color :              | No                                                          |
| Change Background Color :        | No                                                          |
| Change Theme :                   | No                                                          |
| Help Button :                    | No                                                          |

## National Entrance Screening Test 2023

|                                                 |           |
|-------------------------------------------------|-----------|
| Group Number :                                  | 1         |
| Group Id :                                      | 41466420  |
| Group Maximum Duration :                        | 0         |
| Group Minimum Duration :                        | 120       |
| Show Attended Group? :                          | No        |
| Edit Attended Group? :                          | No        |
| Break time :                                    | 0         |
| Group Marks :                                   | 200       |
| Is this Group for Examiner? :                   | No        |
| Examiner permission :                           | Cant View |
| Show Progress Bar? :                            | No        |
| Revisit allowed for group Instructions? :       | No        |
| Maximum Instruction Time :                      | 0         |
| Minimum Instruction Time :                      | 0         |
| Navigate To Group Summary From Last Question? : | No        |
| Disable Submit Button During Assessment? :      | No        |
| Section Selection Time? :                       | 0         |
| No of Optional sections to be attempted :       | 0         |

## Biology

|                  |          |
|------------------|----------|
| Section Id :     | 41466486 |
| Section Number : | 1        |
| Section type :   | Online   |

|                                                                     |           |
|---------------------------------------------------------------------|-----------|
| <b>Mandatory or Optional :</b>                                      | Mandatory |
| <b>Number of Questions :</b>                                        | 17        |
| <b>Number of Questions to be attempted :</b>                        | 17        |
| <b>Section Marks :</b>                                              | 50        |
| <b>Enable Mark as Answered Mark for Review and Clear Response :</b> | Yes       |
| <b>Maximum Instruction Time :</b>                                   | 0         |
| <b>Sub-Section Number :</b>                                         | 1         |
| <b>Sub-Section Id :</b>                                             | 414664176 |
| <b>Question Shuffling Allowed :</b>                                 | Yes       |
| <b>Is Section Default? :</b>                                        | null      |

**Question Number : 1 Question Id : 4146641271 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

An example of multiple alleles is seen at a locus that determines the feather pattern of mallard ducks. One allele  $M$  produces the wild-type mallard pattern. A second allele  $M^R$  produces a different pattern called restricted, and a third allele,  $m^d$ , produces a pattern termed dusky. In this allelic series, the dominance pattern is  $M^R > M > m^d$ . In a cross between restricted and mallard ducks it was found that only dusky ducks were absent in the F1 generation. This indicates that the genotypes of the parents most likely could be

**Options :**

4146645009. ✖  $(M^R M \times M m^d)$  and  $(M^R m^d \times M m^d)$

4146645010. ✖  $(M^R M^R \times M M)$  and  $(M^R m^d \times M m^d)$

4146645011. ✔  $(M^R M \times M m^d)$  and  $(M^R m^d \times M M)$

$(M^R M^R \times MM)$  only

4146645012. ✖

**Question Number : 2 Question Id : 4146641272 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

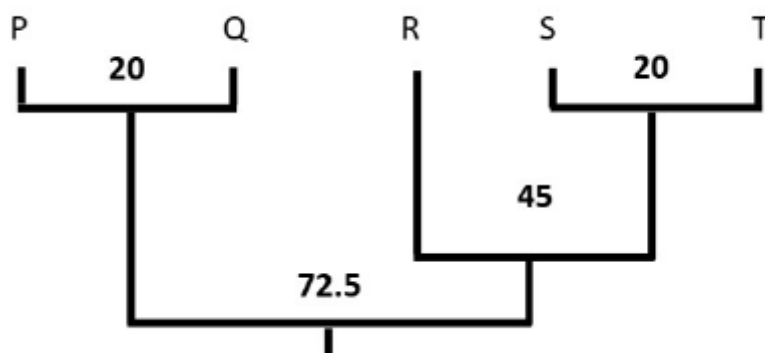
**Correct Marks : 2.5 Wrong Marks : 1**

UPGMA is a method of constructing phylogenetic trees using distance matrices between organisms. The following matrix depicts distance (measured as the difference in characters) between five organisms. The distance between a pair of organisms (say, P and Q) and a third organism (R) is calculated as an average of their individual distances from the third organism (example: New average distance between PQ and R is  $R \text{ to } PQ = (60 + 50) / 2 = 55$ ).

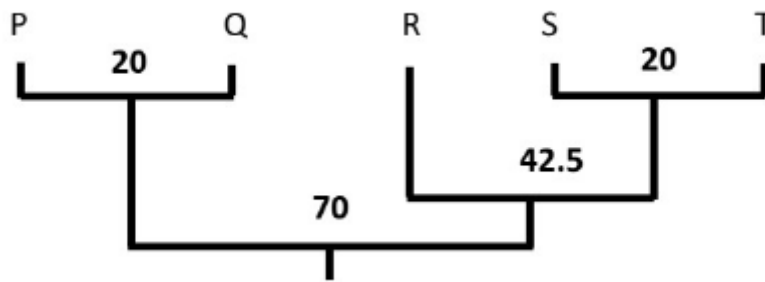
|   | P   | Q  | R  | S  | T |
|---|-----|----|----|----|---|
| P | 0   |    |    |    |   |
| Q | 20  | 0  |    |    |   |
| R | 60  | 50 | 0  |    |   |
| S | 100 | 90 | 40 | 0  |   |
| T | 90  | 80 | 50 | 20 | 0 |

Based on the distance matrix, the correct phylogenetic tree is

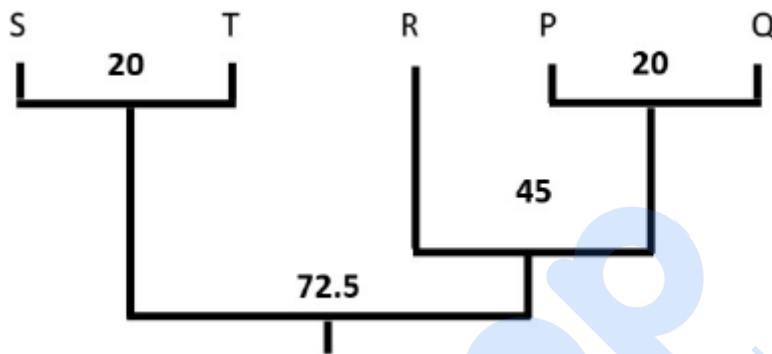
**Options :**



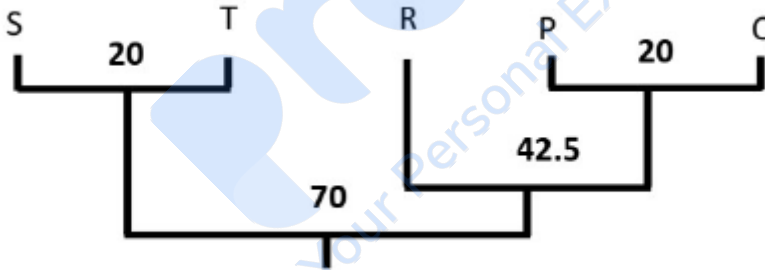
4146645013. ✔



4146645014. ✖



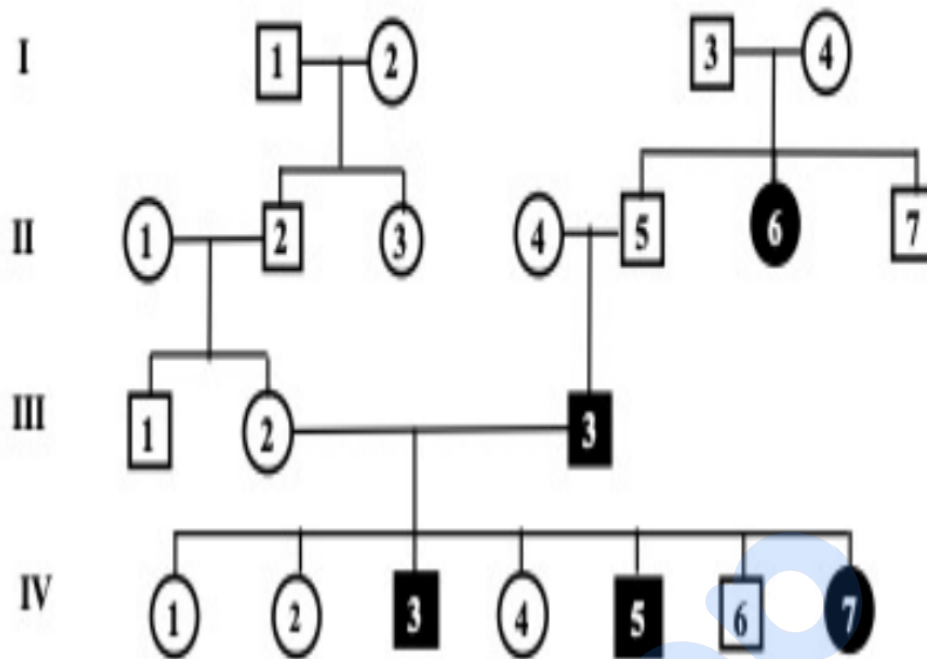
4146645015. ✖



4146645016. ✖

Question Number : 3 Question Id : 4146641273 Question Type : MCQ Option Shuffling : Yes Is  
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum  
Instruction Time : 0 Option Orientation : Vertical  
Correct Marks : 2.5 Wrong Marks : 1

In the given pedigree, circles represent females and squares represent males. Filled shapes indicate affected individuals while unfilled shapes indicate unaffected individuals. Based on the pedigree information provided below, identify the inheritance pattern.



**Options :**

4146645017. ✖ Autosomal dominant

4146645018. ✔ Autosomal recessive

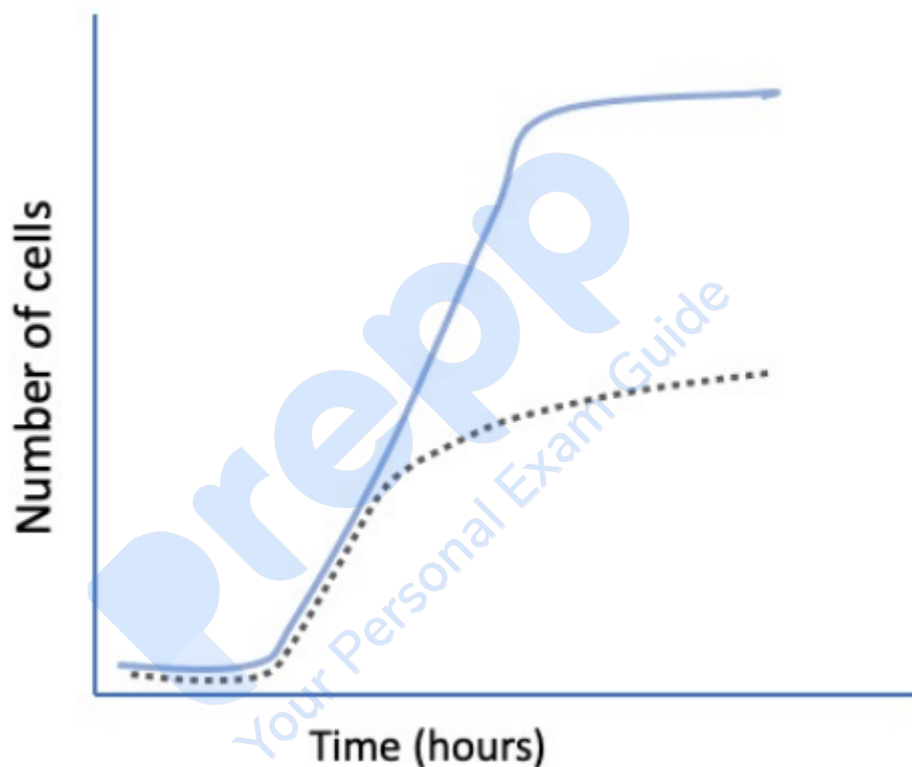
4146645019. ✖ X-linked dominant

4146645020. ✖ X-linked recessive

**Question Number : 4 Question Id : 4146641274 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical Correct Marks : 2.5 Wrong Marks : 1**

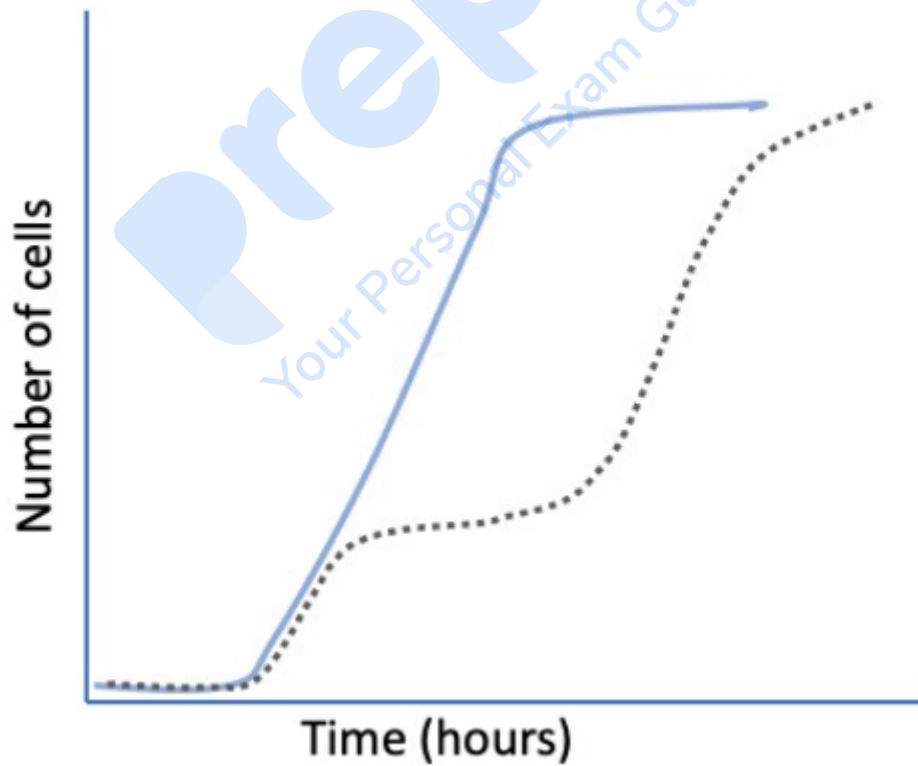
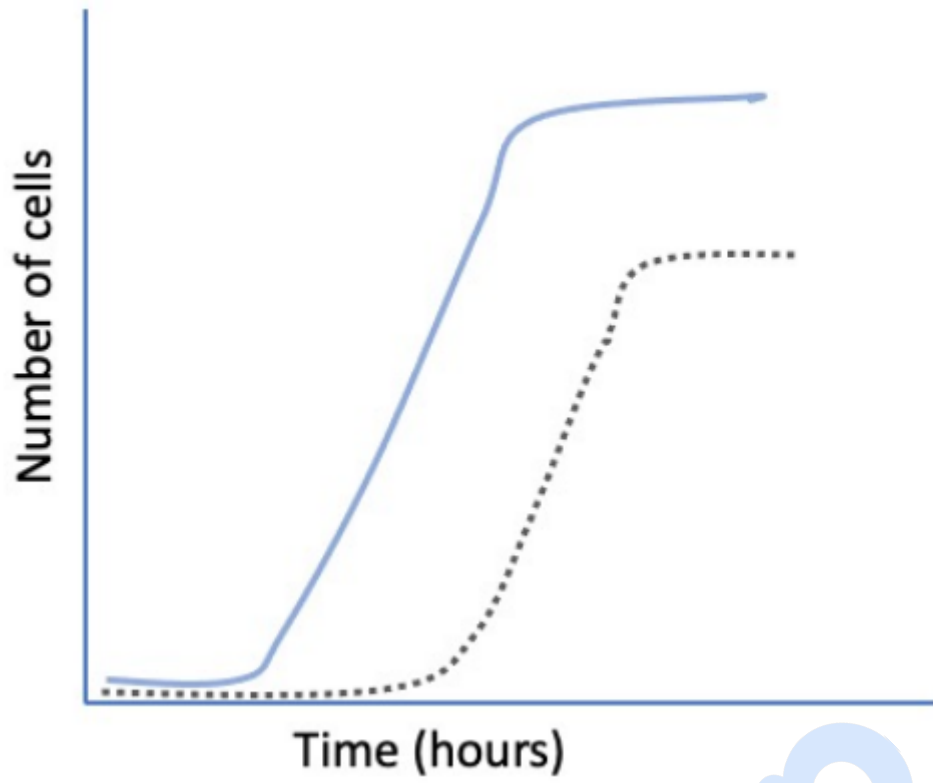
In an experiment with a facultative aerobic bacterial species, identical number of cells were inoculated in two 500 ml jars (**M** and **N**) with 250 ml volume of media in each. Both the jars contained the same concentration of glucose as the only energy source. Jar **M** was incubated in airtight conditions while **N** was maintained in aerobic conditions. Both the jars were kept in a sterile chamber and all other conditions of incubation were kept the same. The correct plot that depicts the growth patterns of these bacterial cultures in **M** (grey dotted line) and **N** (blue solid line) is

**Options :**



4146645021. ✓

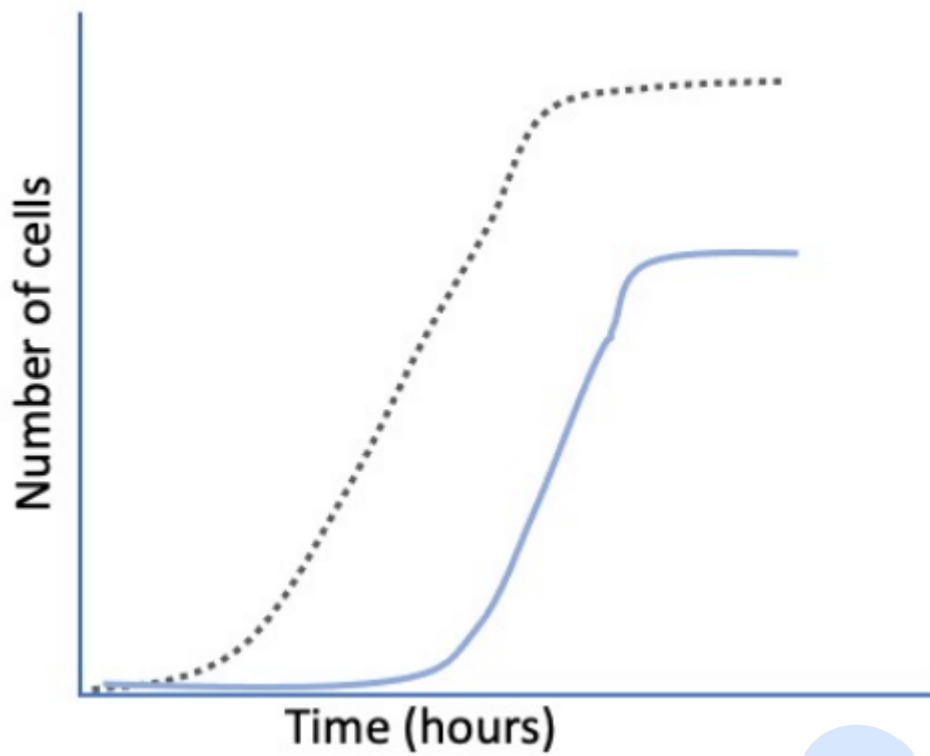
4146645022. ✗



4146645023. ✖

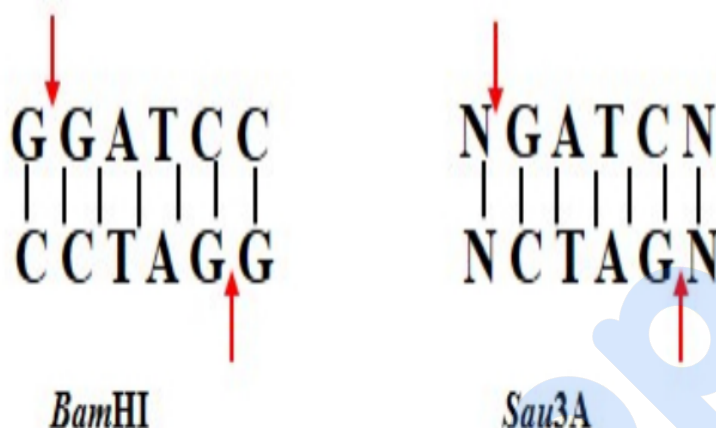
4146645024. ✖





Question Number : 5 Question Id : 4146641275 Question Type : MCQ Option Shuffling : Yes Is  
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum  
Instruction Time : 0 Option Orientation : Vertical  
Correct Marks : 2.5 Wrong Marks : 1

Restriction enzymes recognize certain sequences within the DNA and cleave them. If a DNA fragment is cleaved with *Bam*HI restriction enzyme, it generates sticky ends. If the same DNA fragment is cleaved with *Sau*3A restriction enzyme, it generates sticky ends. The cleaved fragments can be joined using DNA ligase. The recognition and cleavage site (red arrows) for *Bam*HI and *Sau*3A are given below. N represents any of the nucleotides.



Based on this information and assuming there is only a single cleavage site, choose the correct option.

**Options :**

4146645025. ✓ If a *Sau*3A cleaved end is ligated to a *Bam*HI cleaved end, the ligated fragment can be further digested using *Sau*3A irrespective of the neighbouring sequence.

4146645026. ✗ If a *Bam*HI cleaved end is ligated to a *Sau*3A cleaved end, the ligated fragment can be further digested using *Bam*HI irrespective of the neighbouring sequence.

4146645027. ✗ If both the recognition sequences are reverse complemented then it cannot be cleaved using either *Bam*HI or *Sau*3A.

If a *Bam*HI cleaved end is ligated to a *Sau*3A cleaved end and reverse complemented then the ligated fragment can be digested using *Bam*HI irrespective of the neighbouring sequence.

4146645028. ✖

**Question Number : 6 Question Id : 4146641276 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

A mutant bacterial strain having a shorter glycolytic pathway was discovered. If the mutant bacteria are grown aerobically, the net ATP yield was lowered to 28 (compared to the net ATP yield of 34 from Kreb's cycle for wild type bacteria). Except for the reaction that is bypassed in the mutant, assume that the other reactions of the pathway remain unaffected. The step that is most likely bypassed is

**Options :**

4146645029. ✖ phosphoenolpyruvate to pyruvate.

4146645030. ✔ glyceraldehyde-3-phosphate to 1,3-bisphosphoglycerate.

4146645031. ✖ fructose 6-phosphate to Fructose 1,6-bisphosphate.

4146645032. ✖ 1,3-bisphosphoglycerate to 3-phosphoglycerate.

**Question Number : 7 Question Id : 4146641277 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

The table below presents the kinetic data obtained for an enzyme in the absence and presence of two different inhibitors **P** and **Q**, each at a concentration of 10.0 mM.

| Substrate<br>(1/S)<br>(mM) <sup>-1</sup> | Without Inhibitor<br>(1/V <sub>0</sub> )<br>(μmol/mL.s) <sup>-1</sup> | With Inhibitor <b>P</b><br>(1/V <sub>0</sub> )<br>(μmol/mL.s) <sup>-1</sup> | With Inhibitor <b>Q</b><br>(1/V <sub>0</sub> )<br>(μmol/mL.s) <sup>-1</sup> |
|------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1.000                                    | 0.28                                                                  | 0.31                                                                        | 0.39                                                                        |
| 0.500                                    | 0.16                                                                  | 0.19                                                                        | 0.22                                                                        |
| 0.250                                    | 0.10                                                                  | 0.13                                                                        | 0.14                                                                        |
| 0.125                                    | 0.07                                                                  | 0.09                                                                        | 0.09                                                                        |
| 0.083                                    | 0.06                                                                  | 0.08                                                                        | 0.08                                                                        |

Consider that the total enzyme concentration  $[E]_T$  is the same for all the experimental conditions. **P** and **Q** respectively, are

**Options :**

competitive and non-competitive inhibitors.

4146645033. ✖

uncompetitive and competitive inhibitors.

4146645034. ✖

uncompetitive and non-competitive inhibitors.

4146645035. ✔

competitive and uncompetitive inhibitors.

4146645036. ✖

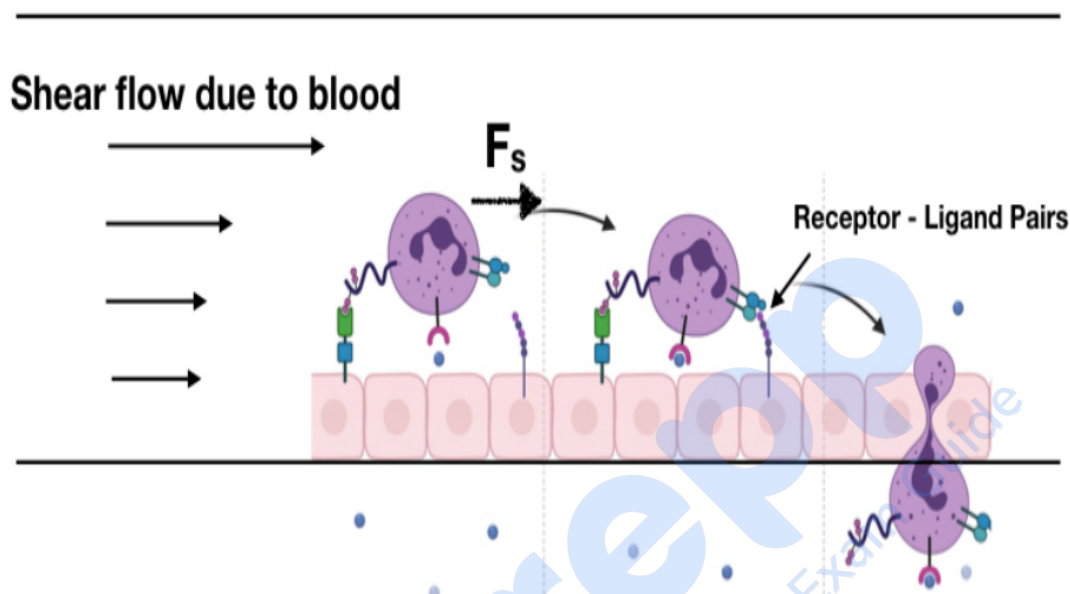
**Question Number : 8 Question Id : 4146641278 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

**Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

Tissue damage alters the surface-adhesive behaviour of leukocytes resulting in leukocyte rolling. This involves several cycles of attachment and detachment of leukocytes on the surface of endothelial cells. Given that the typical rupture force for a ligand–receptor pair is 25 pN, multiple bonds must be formed at the same time to provide the necessary counterbalance to the shear force exerted by the flowing blood. The general schematic is depicted below.



Consider the effective cross-sectional area of the cell that experiences the shear and the following parameters.

|                                                |                    |
|------------------------------------------------|--------------------|
| Leukocyte radius (approximated to be a sphere) | $5 \mu\text{m}$    |
| Rolling velocity                               | $10 \mu\text{m/s}$ |
| Shear Stress due to blood flow                 | $1 \text{ N/m}^2$  |

Among the given options, the minimum number of ligand-receptor pairs (bonds) that need to form at the same time to provide the counterforce against the shear force to stop the leukocyte rolling is

**Options :**

15 ligand-receptor pair

4146645037. ✖

10 ligand-receptor pair

4146645038. ✖

4146645039. ✖ 2 ligand-receptor pair

4146645040. ✔ 5 ligand-receptor pair

**Question Number : 9 Question Id : 4146641279 Question Type : MCQ Option Shuffling : Yes Is**

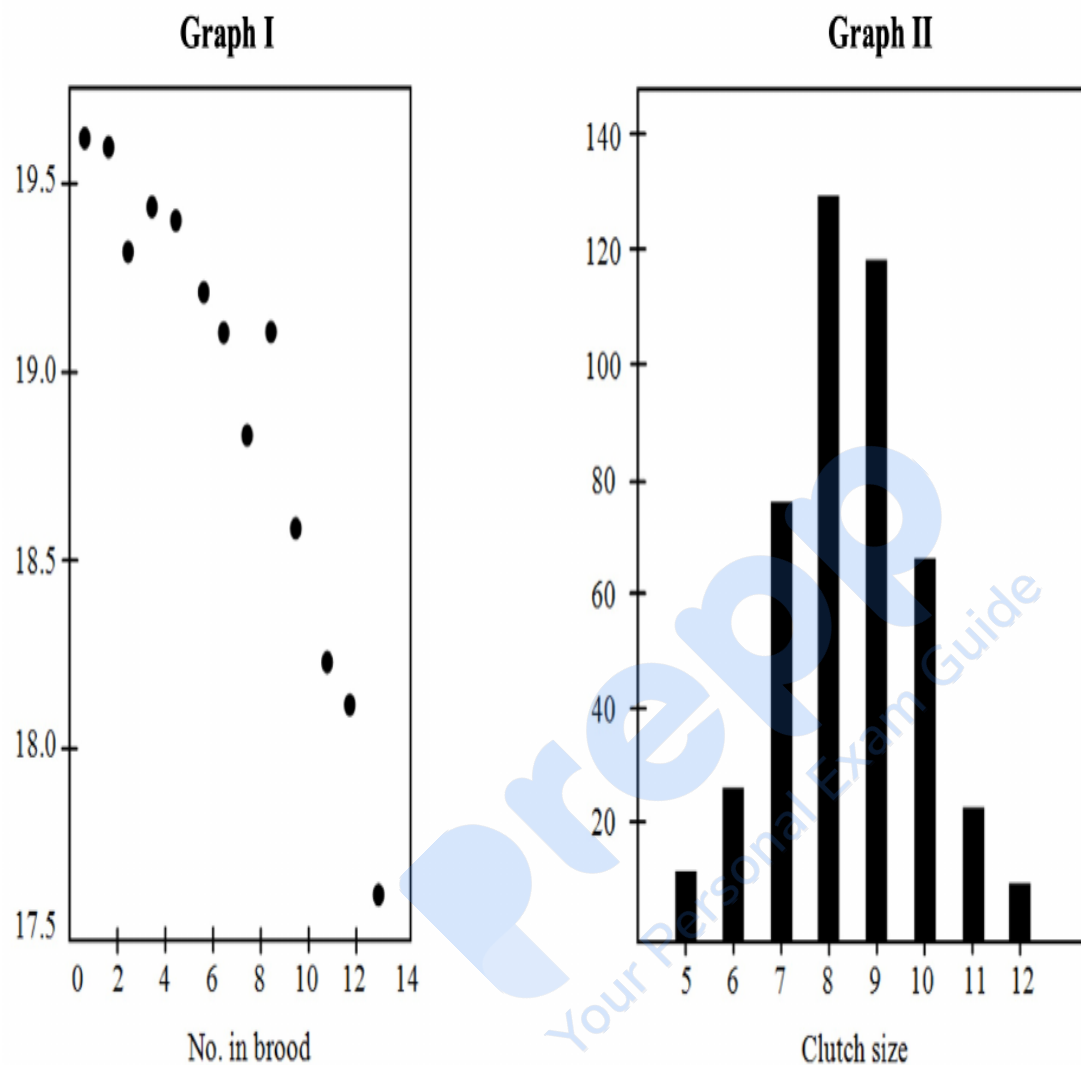
**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

**Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**



Clutch size in birds refers to the number of eggs laid in a single nesting attempt by a nesting pair of birds while number in brood refers to the number of young hatched. The graphs below represent the relationship between these parameters (clutch size and number in brood) and fitness in bird populations of the Great tit.



The Y-axes for graphs I and II could respectively be

**Options :**

Average nest dimension; Average weight of young

4146645041. ✖

Average number of clutches; Average adult survival

4146645042. ✖

4146645043. ✖



Average adult survival; Average nest dimension

4146645044. ✓ Average weight of young; Average number of clutches

**Question Number : 10 Question Id : 4146641280 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

A population has three genotypes,  $XX$ ,  $XY$  and  $YY$ , where  $X$  is dominant over the  $Y$  allele. The number of each genotype in the population is as follows,  $XX = 1185$ ,  $XY = 3045$  and  $YY = 1300$  individuals. Consider that there is random mating, no gene flow, no mutation and selection, and the population size is sufficiently large. The correct statement is

**Options :**

4146645045. ✗ The population is in Hardy-Weinberg equilibrium and will remain the same if random mating is allowed for one generation.

4146645046. ✓ The population is not in Hardy-Weinberg equilibrium but will come to equilibrium if random mating is allowed for one generation.

4146645047. ✗ The population is in Hardy-Weinberg equilibrium and will deviate from equilibrium if selection is acting against any one genotype.

4146645048. ✗ The population is not in Hardy-Weinberg equilibrium and will come to equilibrium if selection is acting against the dominant genotype.



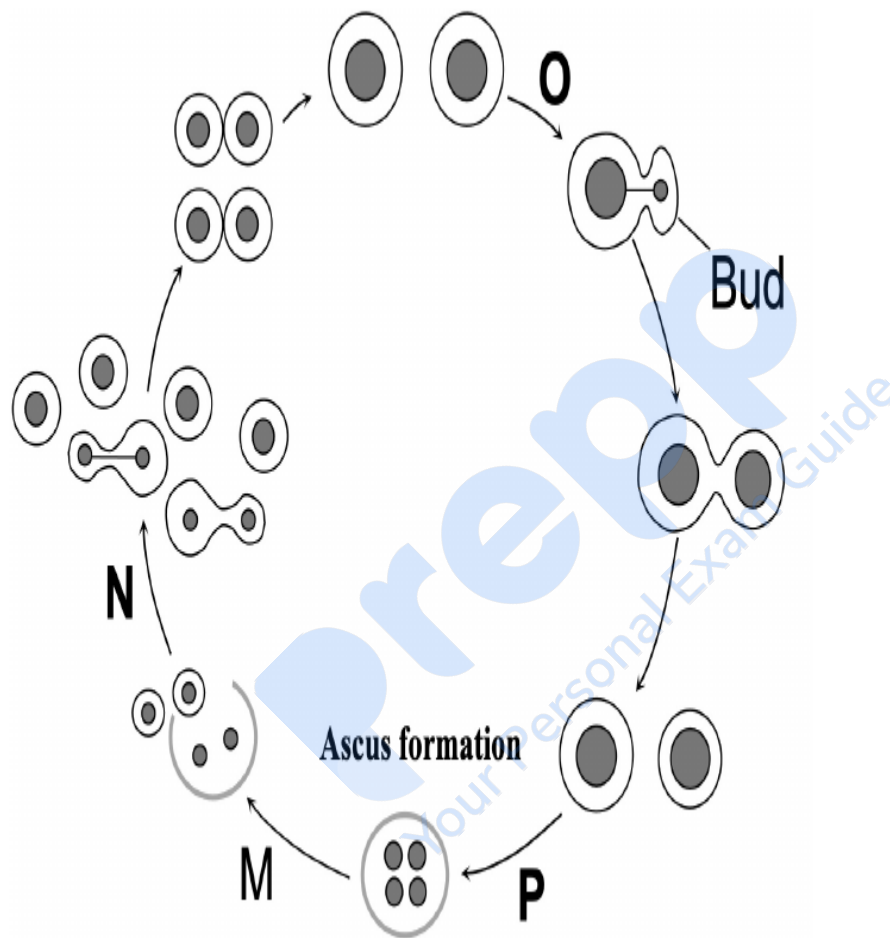
**Question Number : 11 Question Id : 4146641281 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

**Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

The life cycle of yeast *Saccharomyces cerevisiae* which reproduces both sexually as well as asexually is depicted below.



M, N, O and P represent

**Options :**

M - Germination; N - Vegetative growth of haploid cells; O - Vegetative growth of diploid cells; P - Starvation

4146645049. ✓

4146645050. ✗

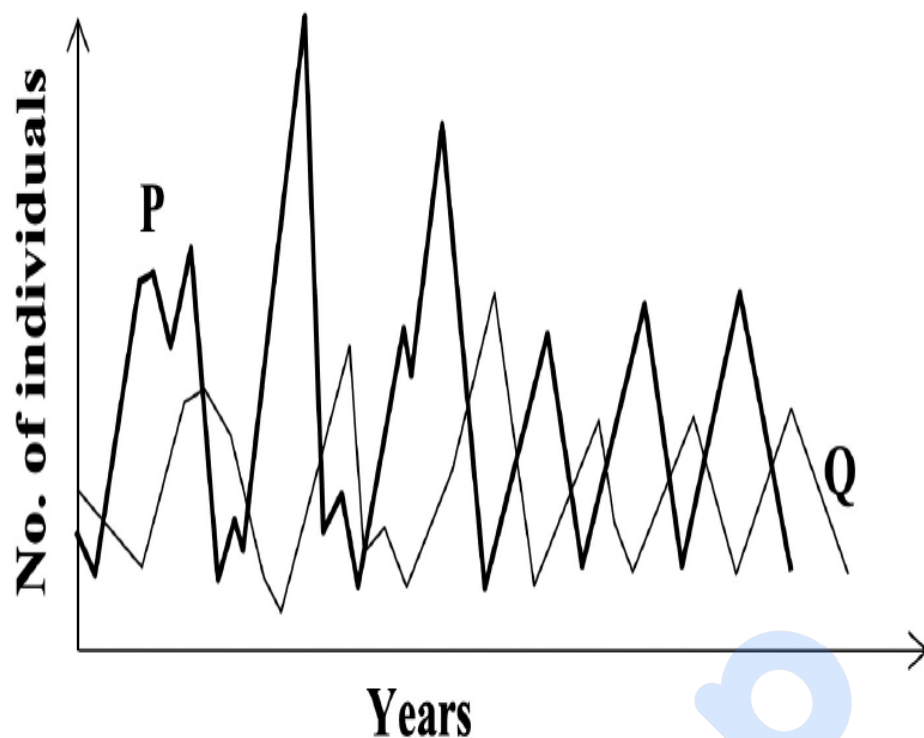
M - Vegetative growth of haploid cells; N - Starvation; O - Germination;  
P - Vegetative growth of diploid cells

4146645051. ✖ M - Germination; N - Vegetative growth of diploid cells; O - Vegetative growth  
of haploid cells; P - Starvation

4146645052. ✖ M - Vegetative growth of diploid cells; N - Starvation; O - Germination;  
P - Vegetative growth of haploid cells

**Question Number : 12 Question Id : 4146641282 Question Type : MCQ Option Shuffling : Yes Is**  
**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**  
**Instruction Time : 0 Option Orientation : Vertical**  
**Correct Marks : 2.5 Wrong Marks : 1**

The population sizes of two organisms P and Q growing in a given habitat is shown.



If P and Q share ecological relationship, then they most likely represent

**Options :**

**P: Predator; Q: Prey**

4146645053. ✖

**P: Parasite; Q: Host**

4146645054. ✖

**P: Herbivore; Q: Carnivore**

4146645055. ✔

**P: Competitor of Q; Q: Competitor of P**

4146645056. ✖

**Sub-Section Number :**

2

**Sub-Section Id :**

414664177

**Question Number : 13 Question Id : 4146641283 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

Female beetles are known to prefer males with bigger mandibles. In an experiment, a population of these beetles were picked and divided into two groups. For one group, only those males who had larger than average mandible size were allowed to mate to produce next-generation offspring (group 1). For the other group, the males and females were allowed to mate randomly (group 2). These populations were maintained using this regime for 50 generations. After this, it was found that the male mandible size in group 1 was significantly larger than that of group 2. However, the females in group 1 produced fewer offspring than females in group 2. Possible explanation(s) of this observation is(are)

**Options :**

In the experiment, as selection on female reproduction was not imposed in group 1, female reproductive capability declined over time.

4146645057. ✖

Group 1 males produced offspring with larger thorax (to support larger mandible) and hence smaller abdomen, which influenced the egg-carrying capacity in female offspring leading to a decline in female reproductive ability.

4146645058. ✔

Under unlimited food condition, males with larger mandibles in group 1, preferred females with lesser reproductive ability as that allowed dominant individual males to have more resources for themselves.

4146645059. ✖

4146645060. ✔

Under limited food condition, females producing fitter offspring after mating with males with larger mandibles started producing fewer offspring to nourish them better.

**Question Number : 14 Question Id : 4146641284 Question Type : MSQ Option Shuffling : Yes Is**

**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

**Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**



Autoradiography of a green leaf of summer squash (upper panel) showed import of  $^{14}\text{C}$  carbon from the source over a period of time. A similar experiment was carried out with an albino tobacco leaf (lower panel) which do not photosynthesize. Shaded portions denote  $^{14}\text{C}$  labelling.



Based on these observations the correct option(s) is(are)

**Options :**

4146645061. ✖ In the early stages of development, the leaf acts as a source.

4146645062. ✔ Mature leaf gains the ability to load and export sugar.

4146645063. ✓ The import to export transition is dependent on the developmental stage of leaves irrespective of photosynthesis.

4146645064. ✓ Import cessation and export initiation are two separate events.

**Question Number : 15 Question Id : 4146641285 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

In a true-breeding homozygous lines of snapdragon, *Antirrhinum majus*, white coloured flower of personate shape was crossed with red coloured flower with peloric shape. The F1 flowers were pink and personate-shaped. Assuming that both these genes segregate independently, choose the correct option(s).

**Options :**

4146645065. ✓ F2 progeny will have  $\frac{1}{4}$  probability of showing the parental phenotype.

4146645066. ✓ 50% of the progeny in the F2 generation will be pink in colour.

4146645067. ✓ In F2 progeny, peloric-shaped flowers with pink colour are expected to be in  $\frac{1}{8}$  ratio.

4146645068. ✗ In F2 progeny, the ratio of red-coloured personate-shaped flowers would be  $\frac{1}{4}$ .

**Question Number : 16 Question Id : 4146641286 Question Type : MSQ Option Shuffling : Yes Is**

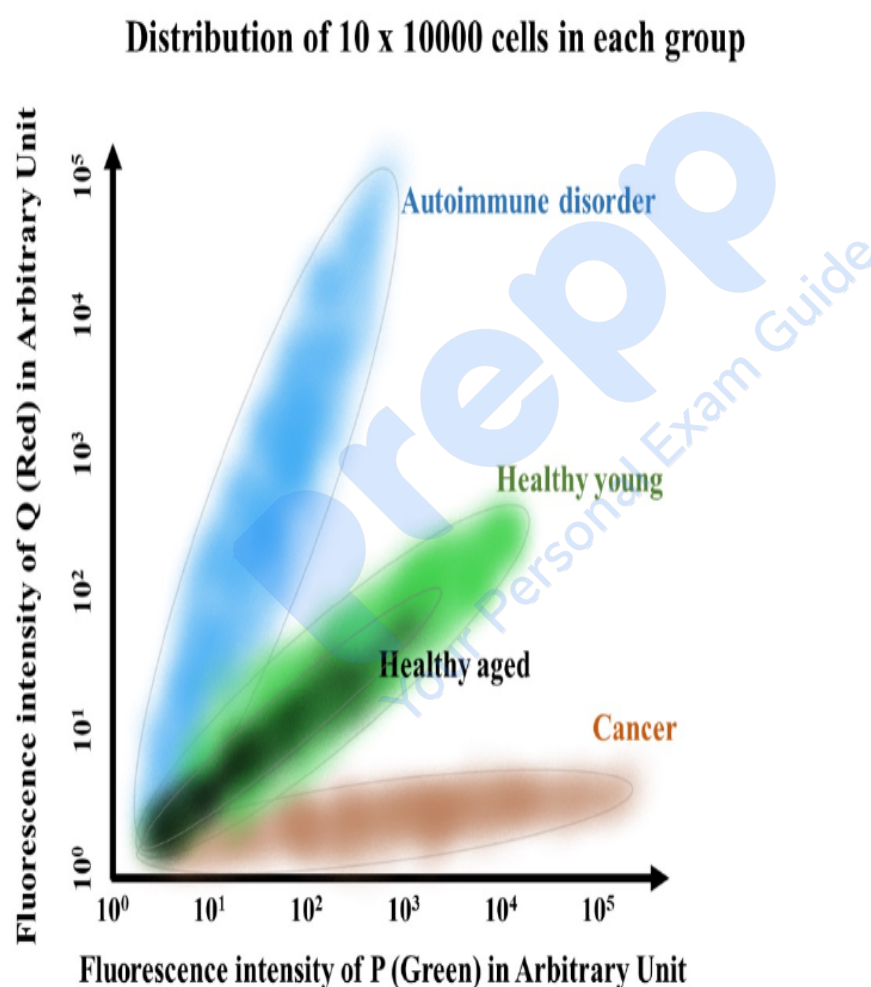


**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

**Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

Specific fluorescence probes are used to label proteins present on the surface of specific immune cell type. A scientist labelled protein **P** with a green probe and protein **Q** with a red probe. A machine can provide quantitative information about the amount of these two proteins present on the surface of each cell by quantifying 10000 cells. This experiment is repeated for cells present in blood of multiple individuals who are healthy young, healthy aged, with cancer, and with auto-immune disorder. The data of 10 individuals per group is provided below.



If there are no other confounding factors, then based on this data, the correct inference(s) is(are)

**Options :**

In healthy aged individuals, the expression of **P** reduces drastically as compared to **Q**.



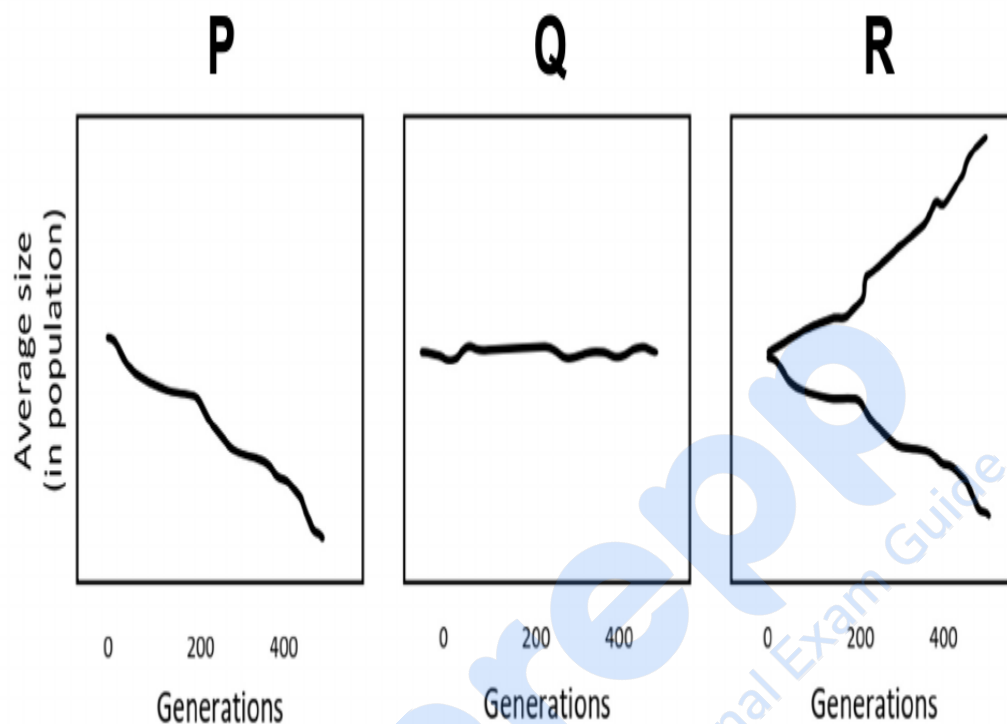
4146645070. ✓ Reduction of Q protein can be correlated with the development of cancer.

4146645071. ✓ Increased expression of Q protein can be correlated with the autoimmune disorder.

4146645072. ✗ In comparison to healthy individuals, the expression of Q in autoimmune condition is negatively regulated by expression of P.

**Question Number : 17 Question Id : 4146641287 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

The following graphs depict three different scenarios where the average body size of a population (assuming a normal distribution with a single mean) of a study organism has been plotted over several generations. If body size is heritable and there is no genetic drift present in the population, the correct option(s) that can give rise to the observed patterns would be



**Options :**

4146645073. ✓ **P** - Directional selection, **Q** - Stabilizing selection

4146645074. ✓ **Q** - No selection, **R** - Disruptive selection

4146645075. ✗ **P** - No selection, **R** - Disruptive selection

4146645076. ✗ **P** - No selection, **Q** - Directional selection

## Chemistry

|                                                              |           |
|--------------------------------------------------------------|-----------|
| Section Id :                                                 | 41466487  |
| Section Number :                                             | 2         |
| Section type :                                               | Online    |
| Mandatory or Optional :                                      | Mandatory |
| Number of Questions :                                        | 17        |
| Number of Questions to be attempted :                        | 17        |
| Section Marks :                                              | 50        |
| Enable Mark as Answered Mark for Review and Clear Response : | Yes       |
| Maximum Instruction Time :                                   | 0         |
| Sub-Section Number :                                         | 1         |
| Sub-Section Id :                                             | 414664178 |
| Question Shuffling Allowed :                                 | Yes       |
| Is Section Default? :                                        | null      |

Question Number : 18 Question Id : 4146641288 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The correct statement regarding the halides and monoxides of the alkaline earth metals is:

Options :

4146645077. ✖ All the oxides and halides are ionic in nature.

4146645078. ✖ All the halides are always monomeric.

4146645079. ✖

Hydrated chlorides of all the alkaline earth metals give dehydrated products at high temperature.

4146645080. ✓ Beryllium monoxide reacts with water to give beryllium hydroxide which further reacts with an alkali metal hydroxide to give  $[\text{Be}(\text{OH})_4]^{2-}$ .

**Question Number : 19 Question Id : 4146641289 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

The reaction of methyl chloride with silicon at 573 K in the presence of copper as a catalyst produces substituted chlorosilanes. Hydrolysis of chlorosilanes produces silanols. The silanols with appropriate substitution, thus formed, are used to make silicone polymers. The correct statement in this context is:

**Options :**

4146645081. ✗ Only two different chlorosilanes are produced in the reaction of methyl chloride with silicon.

4146645082. ✗ A silicate is formed on condensation polymerization of silanols.

4146645083. ✓ The chain length of the silicone polymer can be controlled by adding trimethylchlorosilane.

4146645084. ✗ Trimethylsilanol upon condensation yields a straight chain polymer.

**Question Number : 20 Question Id : 4146641290 Question Type : MCQ Option Shuffling : Yes Is**

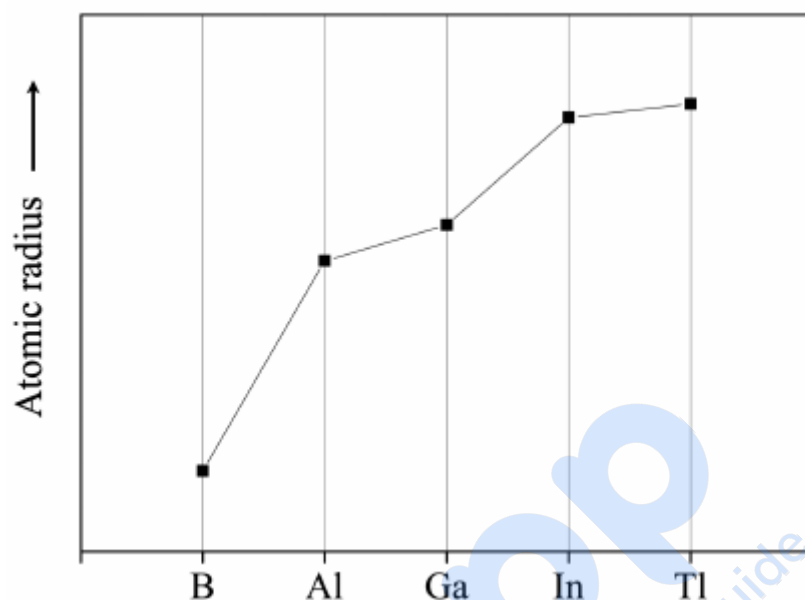
**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

**Instruction Time : 0 Option Orientation : Vertical**

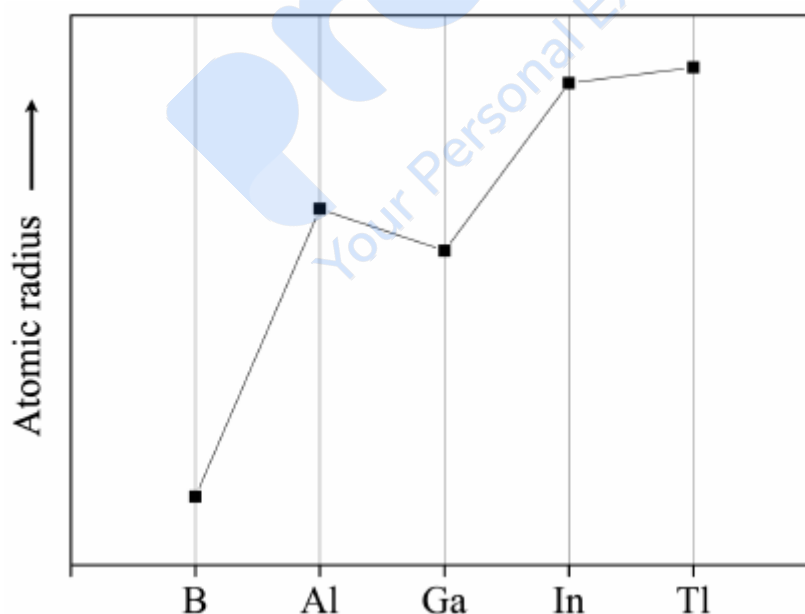
**Correct Marks : 2.5 Wrong Marks : 1**

The correct graph representing the trend in the atomic radius of the boron family is

**Options :**

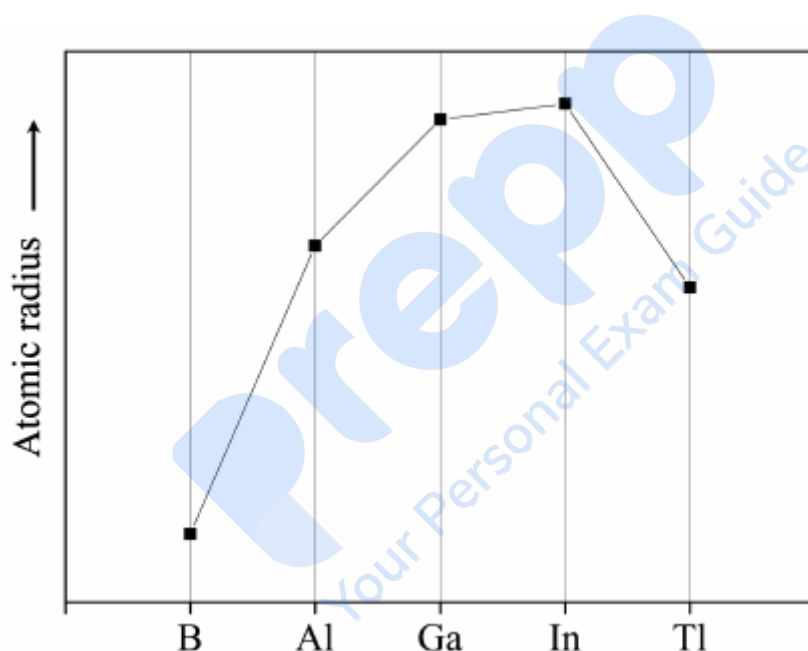
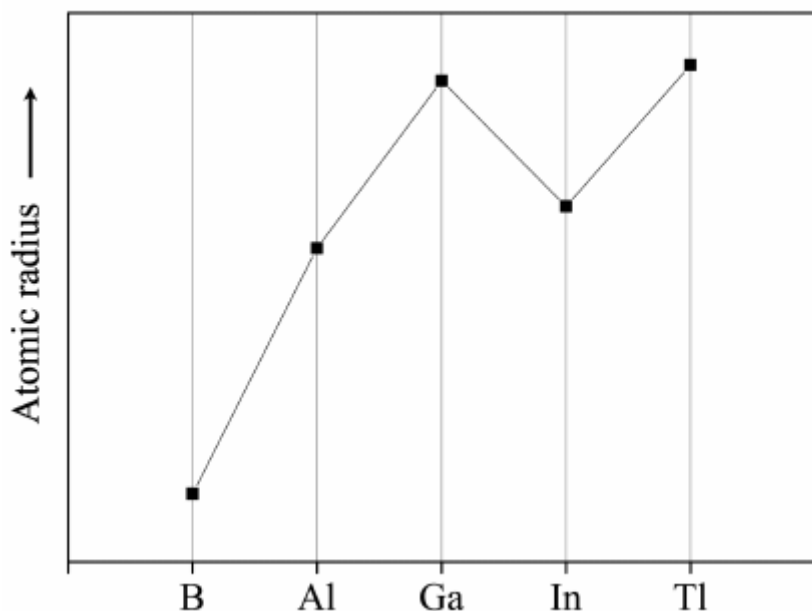


4146645085. ✖



4146645086. ✔

4146645087. ✖



4146645088. ✖

Question Number : 21 Question Id : 4146641291 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The largest crystal field stabilization energy is for

Options :

4146645089. ✔  $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$

4146645090. ✖  $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$

4146645091. ✖  $[\text{V}(\text{H}_2\text{O})_6]^{3+}$

4146645092. ✖  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$

**Question Number : 22 Question Id : 4146641292 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

**Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

The equation appropriate for the exact calculation of pH of an aqueous solution of HCl at a concentration ( $c_{\text{HCl}}$ ), close to  $10^{-6}$  M, is given by

**Options :**

4146645093. ✖  $[\text{H}^+] = c_{\text{HCl}}$

4146645094. ✔  $[\text{H}^+] = c_{\text{HCl}} + K_w / [\text{H}^+]$

4146645095. ✖  $[\text{H}^+] = c_{\text{HCl}} + \sqrt{K_w}$

4146645096. ✖  $[\text{H}^+] = c_{\text{HCl}} + K_w / (2c_{\text{HCl}})$

**Question Number : 23 Question Id : 4146641293 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

**Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

Consider a hypothetical one-electron atom, where the nucleus and the electron interact with a force  $F = -kr$ . Here,  $r$  is the distance between the electron and the nucleus, and  $k$  is a constant. If this atom is studied using the Bohr model, the electron is assumed to move around the nucleus in selected stable orbits of fixed radii, characterized by quantum number  $n$ . The radius of the orbiting electron (of mass  $m_e$ ) is

**Options :**

4146645097. ✓  $\left( \frac{n^2 h^2}{4\pi^2 k m_e} \right)^{1/4}$

4146645098. ✗  $\left( \frac{n^2 h^2}{4\pi^2 k m_e} \right)$

4146645099. ✗  $\left( \frac{n^2 h^2}{4\pi^2 k m_e} \right)^{1/3}$

4146645100. ✗  $\left( \frac{n^2 h^2}{4\pi^2 k m_e} \right)^{1/2}$

**Question Number : 24 Question Id : 4146641294 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

**Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**



Biological standard potential ( $E^*$ ) is defined as the potential measured at pH = 7.0. The species nicotinamide adenine dinucleotide (NADH) and its oxidised form  $\text{NAD}^+$  play an important role in respiratory process. Given, the standard potential  $E^0 = -0.099 \text{ V}$  for the reaction  $\text{NAD}^+(\text{aq}) + \text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{NADH}(\text{aq})$ , the value of  $E^*$  for the conversion of  $\text{NAD}^+(\text{aq})$  to NADH (aq) in 1.0 M  $\text{NAD}^+$  solution, at room temperature ( $25^\circ \text{C}$ ), is

**Options :**

4146645101. ✓  $-0.31 \text{ V}$

4146645102. ✗  $-0.99 \text{ V}$

4146645103. ✗  $-0.51 \text{ V}$

4146645104. ✗  $-0.41 \text{ V}$

**Question Number : 25 Question Id : 4146641295 Question Type : MCQ Option Shuffling : Yes Is**

**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

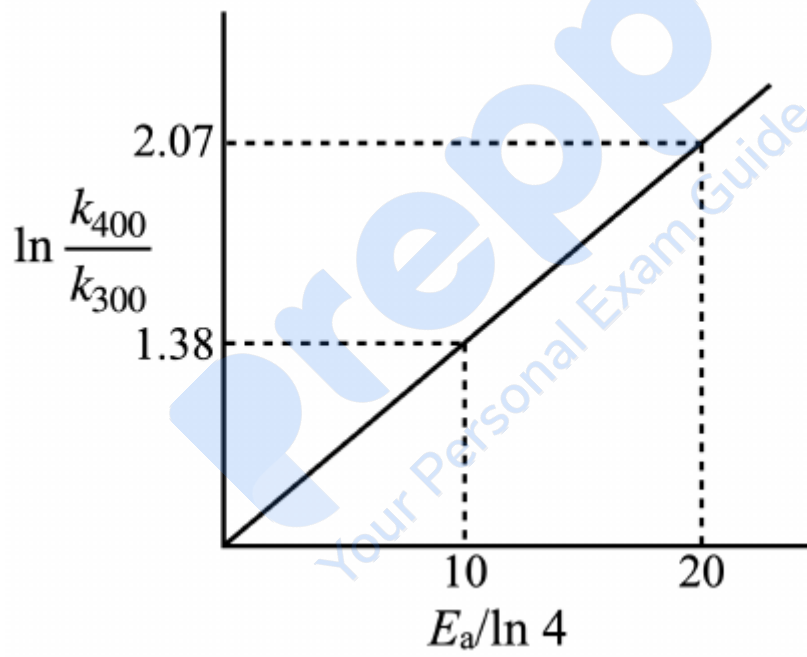
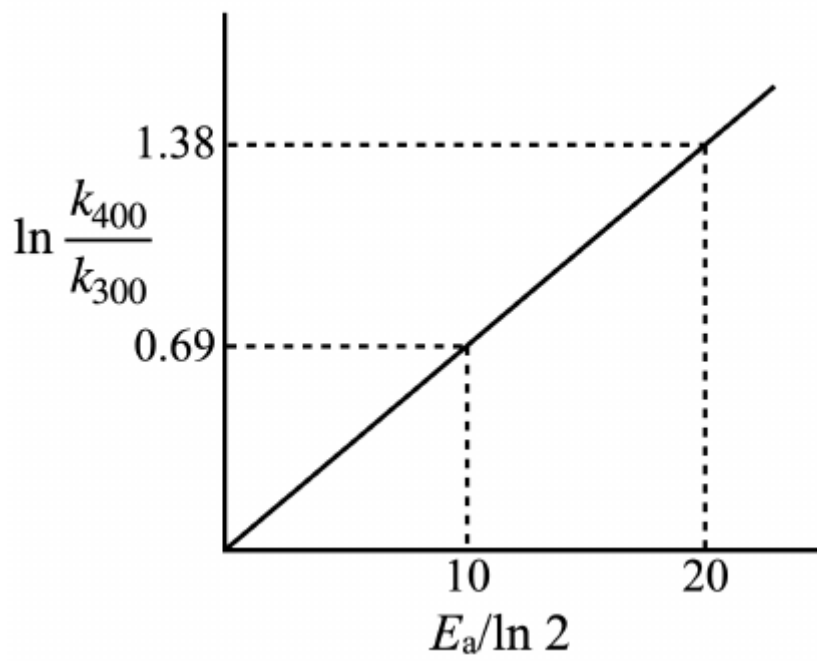
**Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

The temperature dependence of the rate constants ( $k$ ) of a chemical reaction can be expressed in terms of Arrhenius equation, which contains the corresponding activation energy ( $E_a$ ) term. The correct plot of the ratio of the rate constants (not drawn to scale) of different chemical reactions, at two temperatures 300 K and 400 K, as a function of their  $E_a$  values (in  $\text{kJ mol}^{-1}$ ) is

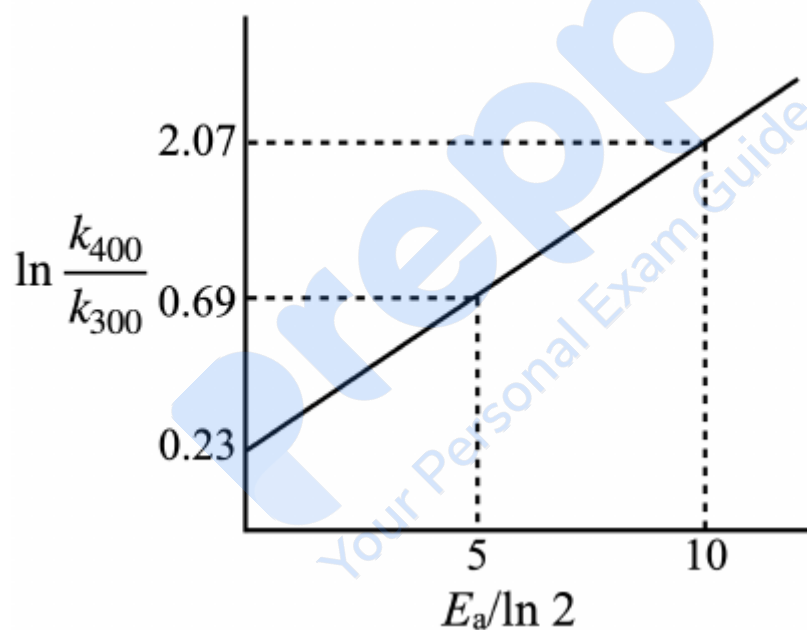
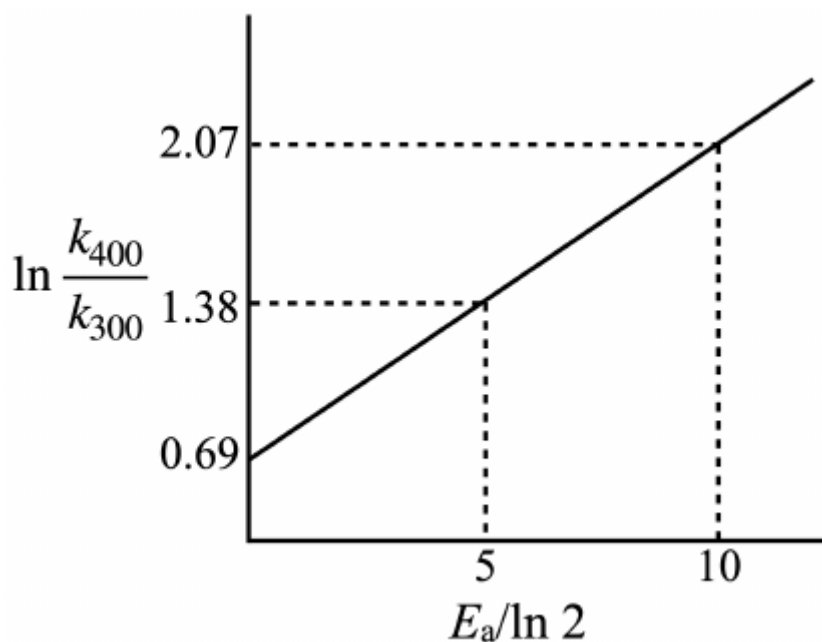
**Options :**

4146645105. ✓



4146645106. ✖

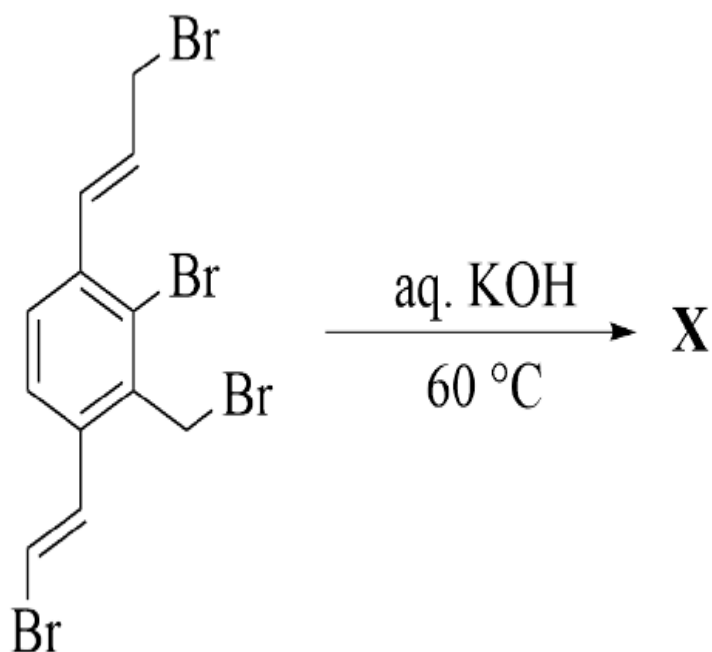
4146645107. ✖



4146645108. ✖

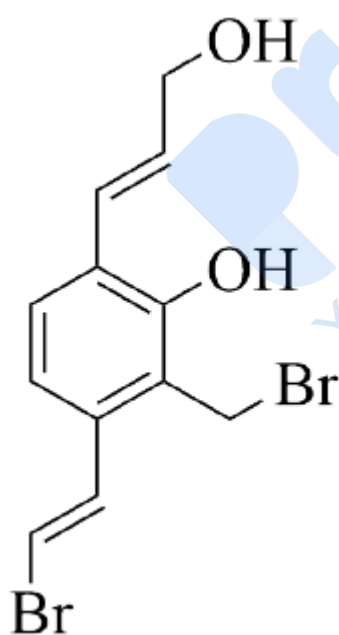
Question Number : 26 Question Id : 4146641296 Question Type : MCQ Option Shuffling : Yes Is  
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum  
Instruction Time : 0 Option Orientation : Vertical  
Correct Marks : 2.5 Wrong Marks : 1

In the reaction shown below,



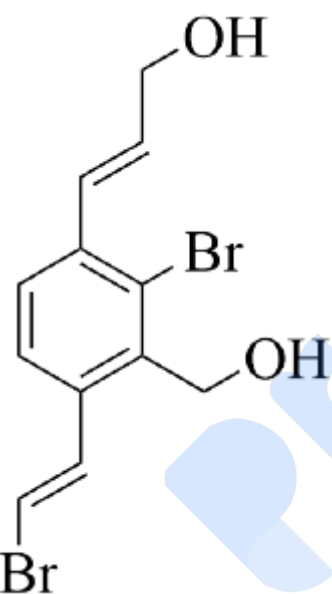
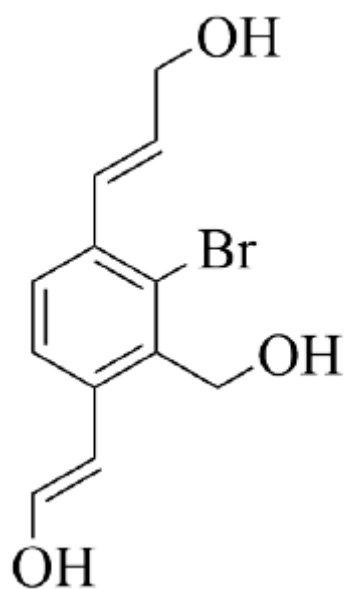
the major product X is

Options :

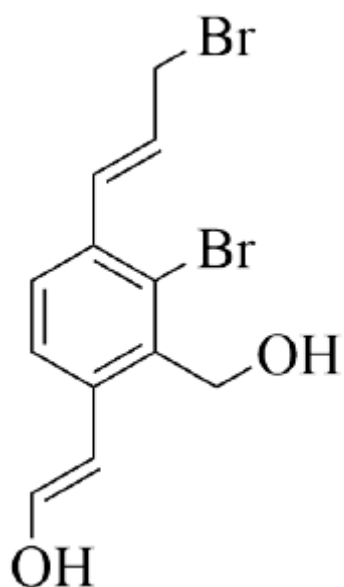


4146645109. ✖

4146645110. ✖



4146645111. ✓

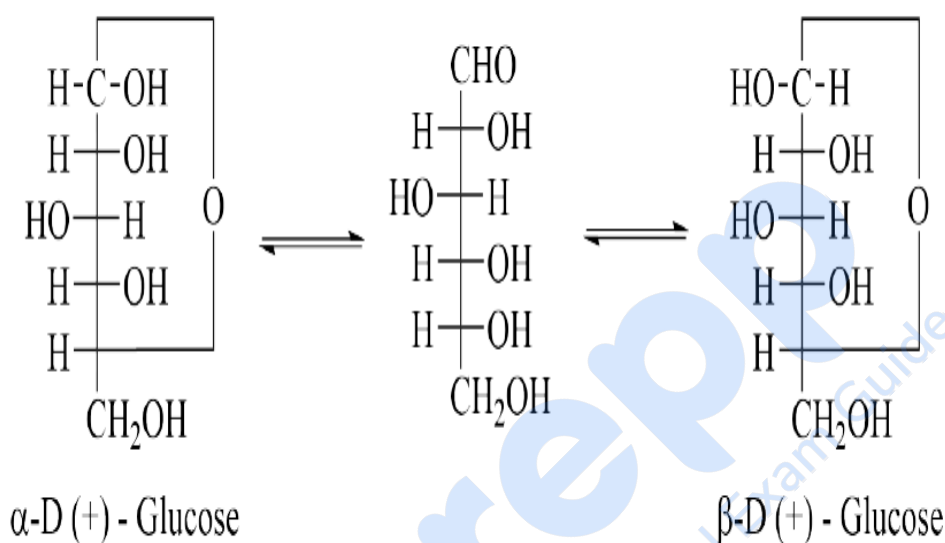


4146645112. ✗

**Question Number : 27 Question Id : 4146641297 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

In an aqueous solution, glucose exists in cyclic and open-chain forms, in equilibrium, as shown below. Glucose solution does not give positive Schiff test.



The correct statement is:

**Options :**

4146645113. ✖  $\alpha$ -D(+)-glucose and  $\beta$ -D(+)-glucose are enantiomers.

4146645114. ✔  $\alpha$ -D(+)-glucose and  $\beta$ -D(+)-glucose are anomers.

4146645115. ✖ In solution, the open-chain form predominates over the cyclic forms.

4146645116. ✖ Glucose reacts with sodium bisulphite to form an addition product.

Question Number : 28 Question Id : 4146641298 Question Type : MCQ Option Shuffling : Yes Is

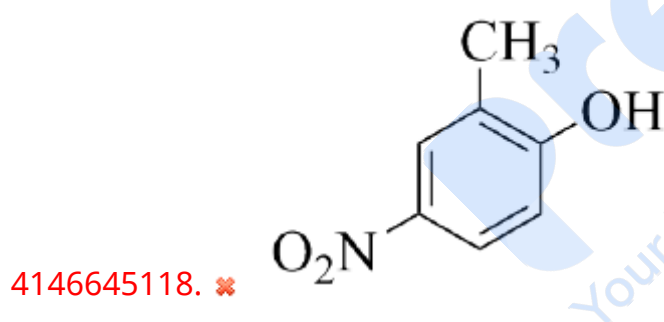
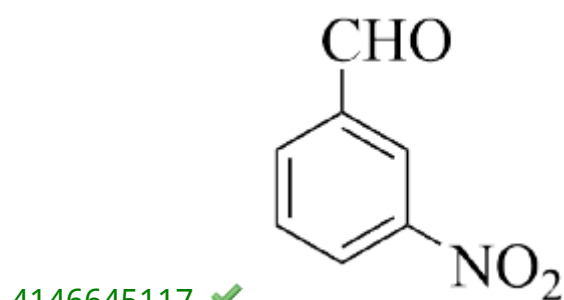
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum

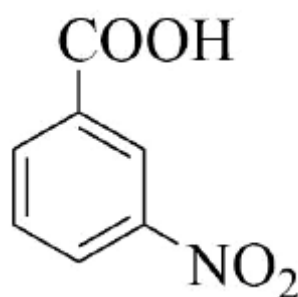
Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

One mole of toluene on reaction with 2 moles of  $\text{Cl}_2$  in the presence of light gives **X**, which on hydrolysis at  $100^\circ\text{C}$  gives **Y**. **Y** on reaction with conc. $\text{HNO}_3/\text{H}_2\text{SO}_4$  at  $0-10^\circ\text{C}$  provides **Z** as the major product. The compound **Z** is

Options :

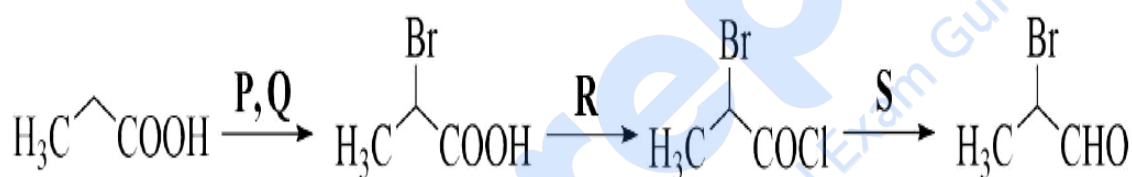




Question Number : 29 Question Id : 4146641299 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Consider the following sequence of reactions.



The correct reagents (P, Q, R and S) required are:

Options :

4146645121. ✓ **P** = Br<sub>2</sub>/red phosphorous; **Q** = H<sub>2</sub>O; **R** = SOCl<sub>2</sub>; **S** = H<sub>2</sub>, Pd-BaSO<sub>4</sub>

4146645122. ✗ **P** = Br<sub>2</sub>/red phosphorous; **Q** = H<sub>3</sub>O<sup>+</sup>; **R** = SOCl<sub>2</sub>; **S** = LiAlH<sub>4</sub>

4146645123. ✗ **P** = Br<sub>2</sub>/NaOH; **Q** = H<sub>2</sub>O; **R** = PCl<sub>3</sub>; **S** = DIBAL-H

4146645124. ✗ **P** = PBr<sub>3</sub>; **Q** = H<sub>3</sub>O<sup>+</sup>; **R** = Cl<sub>2</sub>/FeCl<sub>3</sub>; **S** = Pd-BaSO<sub>4</sub>



Sub-Section Number :

2

Sub-Section Id :

414664179

Question Shuffling Allowed :

Yes

Is Section Default? :

null

Question Number : 30 Question Id : 4146641300 Question Type : MSQ Option Shuffling : Yes Is  
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum  
Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0

Ammonium sulfate on reaction with sodium hydroxide produces compounds **Q** and **R** along with water. Catalytic oxidation of **Q** by atmospheric oxygen yields **T** (an oxide of nitrogen) and water. **T** reacts with oxygen to produce compound **X**, which dissolves in water giving **Y** and **T**. The correct statement(s) is(are):

Options :

4146645125. ✓ The geometry of compound **X** is bent.

4146645126. ✓ Compound **T** on reaction with hexaaqua iron(II) complex gives brown color.

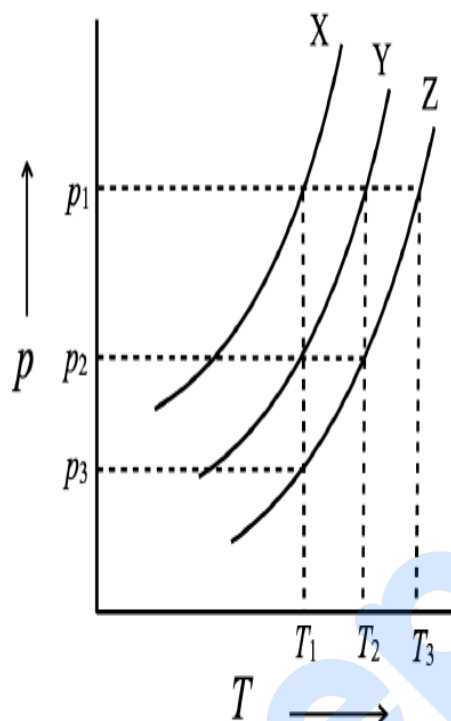
4146645127. ✗ The conversion of **X** to **Y** is a reduction process.

4146645128. ✓ Compound **Y** on reaction with carbon yields compound **X**,  $\text{CO}_2$  and water.

Question Number : 31 Question Id : 4146641301 Question Type : MSQ Option Shuffling : Yes Is  
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum  
Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0

Consider three liquids: water, dilute aqueous solution of glucose, and dilute aqueous solution of NaCl. The aqueous solutions of glucose and NaCl are of the same molal concentrations. The vapour pressures ( $p$ ) of the three liquids are plotted (not drawn to scale) as a function of temperature ( $T$ ) in the figure below.



The three values of pressure,  $p_1$  ( $= 1 \text{ atm}$ ),  $p_2$  and  $p_3$  and three temperatures  $T_1$ ,  $T_2$  and  $T_3$  are indicated in the figure. The correct statement(s) is (are):

**Options :**

Curves X , Y and Z correspond to pure water, glucose solution and NaCl solution respectively.

4146645129. ✓

The temperatures  $T_1$ ,  $T_2$  and  $T_3$  represent the boiling points of the solutions corresponding to the curves X, Y and Z, respectively.

4146645130. ✓

The pressures,  $p_1$ ,  $p_2$  and  $p_3$  are related as  $2p_2 = p_1 + p_3$ .

4146645131. ✓

4146645132. ✗

The temperatures,  $T_1$ ,  $T_2$  and  $T_3$  are related as  $3T_2 = 2T_1 + T_3$ .

**Question Number : 32 Question Id : 4146641302 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

Consider the three electrodes  $\text{Fe}/\text{Fe}^{2+}$ ,  $\text{Fe}/\text{Fe}^{3+}$ , and  $\text{Fe}^{2+}/\text{Fe}^{3+}$ , for which the standard electrode (oxidation) potentials are:  $E_1^0, E_2^0$ , and  $E_3^0$ , respectively. The standard EMF of the cell,  $\text{Fe}/\text{Fe}^{2+}||\text{Fe}^{3+}/\text{Fe}$ , is  $E_4^0$ . The correct expression(s) is (are):

**Options :**

4146645133. ✓  $E_3^0 = (3E_2^0 - 2E_1^0)$

4146645134. ✗  $E_3^0 = (E_2^0 - E_1^0)$

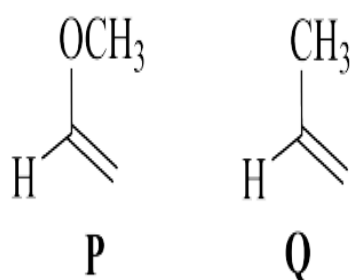
4146645135. ✗  $E_4^0 = (2E_1^0 - 3E_2^0)$

4146645136. ✓  $E_4^0 = (E_1^0 - E_2^0)$

**Question Number : 33 Question Id : 4146641303 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

In an electrophilic addition reaction of olefins, the stability of carbocations plays a crucial role. Consider the compounds **P** and **Q** that can undergo such reactions with different reagents.



With reference to the above reactions, the correct statement(s) is(are):

**Options :**

4146645137. ✖ In the HBr addition, the rate of the reaction is faster for **Q** than for **P**.

4146645138. ✔ HBr addition to **P** gives an equal mixture of enantiomers as a major product.

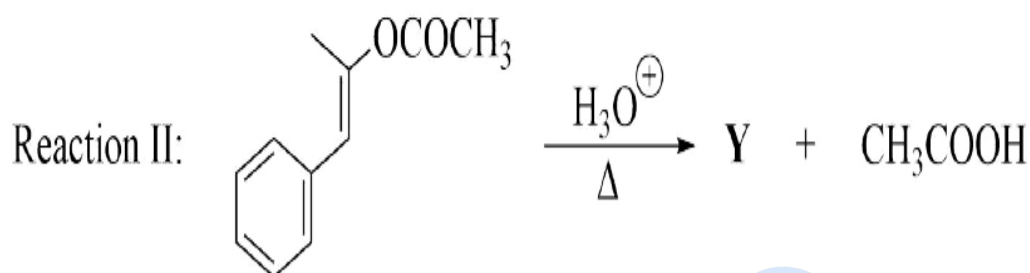
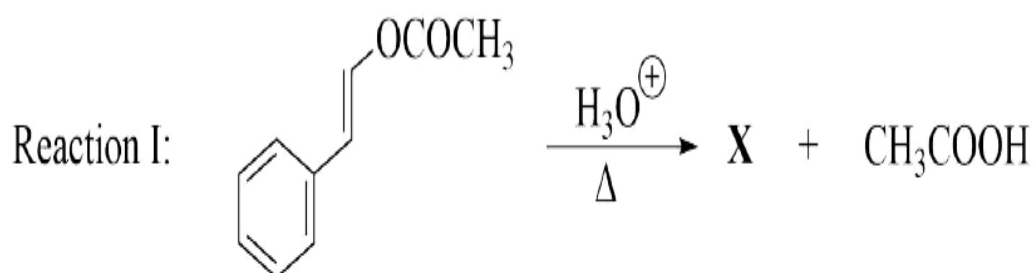
4146645139. ✖ **P** reacts with diborane followed by oxidation with  $\text{H}_2\text{O}_2/\text{NaOH}$  gives racemic alcohol as a major product.

4146645140. ✔ Reaction of **P** with  $\text{O}_3$  followed by treatment with  $\text{Zn}/\text{H}_2\text{O}$  gives methyl formate and formaldehyde.

**Question Number : 34 Question Id : 4146641304 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

Consider the following acid hydrolysis of esters.



The correct statement(s) about **X** and **Y** is(are):

**Options :**

Both **X** and **Y** on reaction with Lucas reagent ( $\text{ZnCl}_2 + \text{conc. HCl}$ ) give turbid solutions.

4146645141. ✖

**Y** on reaction with  $\text{Br}_2/\text{NaOH}$  gives sodium salt of phenyl acetic acid.

4146645142. ✔

**X** forms silver mirror with ammonical silver nitrate solution.

4146645143. ✔

The reaction of **Y** with  $\text{NH}_2\text{NH}_2$  followed by heating with  $\text{KOH}$  in ethylene glycol gives n-propylbenzene.

4146645144. ✔

|                                                              |           |
|--------------------------------------------------------------|-----------|
| Section Id :                                                 | 41466488  |
| Section Number :                                             | 3         |
| Section type :                                               | Online    |
| Mandatory or Optional :                                      | Mandatory |
| Number of Questions :                                        | 17        |
| Number of Questions to be attempted :                        | 17        |
| Section Marks :                                              | 50        |
| Enable Mark as Answered Mark for Review and Clear Response : | Yes       |
| Maximum Instruction Time :                                   | 0         |
| Sub-Section Number :                                         | 1         |
| Sub-Section Id :                                             | 414664180 |
| Question Shuffling Allowed :                                 | Yes       |
| Is Section Default? :                                        | null      |

Question Number : 35 Question Id : 4146641305 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Let  $f$  be the function on  $\mathbb{R}$  defined by  $f(x) = x^3 - 3x^2 + ax - 1$ , where  $a \in \mathbb{R}$ .  
Then the set of all possible values of  $a$  for which  $f$  is strictly increasing is

Options :

4146645145. ✓  $[3, \infty)$

4146645146. ✗  $(-\infty, 3]$

4146645147. ✗  $[-3, 0]$

4146645148. ✖  $[0, 3]$ 

Question Number : 36 Question Id : 4146641306 Question Type : MCQ Option Shuffling : Yes Is  
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum  
Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

If  $\frac{1}{(1+i)^{2023}} = te^{i\theta}$ , where  $t \in \mathbb{R}$  and  $0 \leq \theta < 2\pi$ , then the value of  $\theta$  is

Options :

4146645149. ✔  $\frac{\pi}{4}$ 4146645150. ✖  $\frac{3\pi}{4}$ 4146645151. ✖  $\frac{5\pi}{4}$ 4146645152. ✖  $\frac{7\pi}{4}$ 

Question Number : 37 Question Id : 4146641307 Question Type : MCQ Option Shuffling : Yes Is  
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum  
Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Let  $S$  be the set of all 4-digit natural numbers with the following properties:

- (i) every digit of any element of  $S$  belongs to the set  $\{0, 1, 3, 5, 7, 9\}$ ,
- (ii) every element of  $S$  is divisible by 5, and
- (iii) no element of  $S$  is divisible by 2.

Then the number of elements in  $S$  is

**Options :**

4146645153. ✓ 180

4146645154. ✗ 216

4146645155. ✗ 360

4146645156. ✗ 250

**Question Number : 38 Question Id : 4146641308 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

If a teacher assigns homework on the  $n$ th day, the probability that she will assign homework on the  $(n + 1)$ th day is  $\frac{1}{3}$ . If she does not assign homework on the  $n$ th day, the probability that she will assign homework on the  $(n + 1)$ th day is  $\frac{2}{3}$ . If she assigned homework on a Monday then the probability that she will assign homework on the Thursday of the week is

**Options :**

4146645157. ✗



$$\frac{1}{3}$$

4146645158. ✖  $\frac{7}{27}$

4146645159. ✔  $\frac{13}{27}$

4146645160. ✖  $\frac{2}{3}$

Question Number : 39 Question Id : 4146641309 Question Type : MCQ Option Shuffling : Yes Is  
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum  
Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

The value of  $\sin \frac{2\pi}{23} + \sin \frac{4\pi}{23} + \dots + \sin \frac{42\pi}{23} + \sin \frac{44\pi}{23}$  is

Options :

4146645161. ✖  $-1$

4146645162. ✔  $0$

4146645163. ✖  $1$

4146645164. ✖

**Question Number : 40 Question Id : 4146641310 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

Let  $P = (a, b)$  be a point in the Euclidean plane, with  $a$  and  $b$  nonzero. For any point  $S$  on the  $x$ -axis, let  $T$  be the point of intersection of the line  $PS$  with the  $y$ -axis. Let  $M$  be the midpoint of the segment  $ST$ . Then the locus of  $M$ , as  $S$  varies on the  $x$ -axis, is given by

**Options :**

4146645165. ✖  $xy = ab$

4146645166. ✖  $xy = \frac{ab}{4}$

4146645167. ✖  $xy = ay + bx$

4146645168. ✔  $2xy = ay + bx$

**Question Number : 41 Question Id : 4146641311 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

Let  $f$  be a differentiable function on  $\mathbb{R}$  satisfying the conditions

(i)  $f(x) = \int_0^x (f(t))^{\frac{1}{3}} dt$  for all  $x \in \mathbb{R}$ , and

(ii)  $f(x) > 0$  for all  $x > 0$ .

Then the value of  $f(3)$  is

**Options :**

4146645169. ✓  $2\sqrt{2}$

4146645170. ✗  $3\sqrt{3}$

4146645171. ✗  $\frac{1}{2}$

4146645172. ✗  $\frac{1}{3}$

**Question Number : 42 Question Id : 4146641312 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

Let  $f(x) = \ln x - 2023x + 2023$  for all  $x \in (0, \infty)$ . Then the number of points at which the graph of  $f$  cuts the  $x$  axis is

**Options :**

4146645173. ✗  $0$

4146645174. ✓ 2

4146645175. ✗ 3

4146645176. ✗ 1

**Question Number : 43 Question Id : 4146641313 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

Let  $N$  be the number of integers  $n$  such that

- (i)  $n = 2^a 3^b 5^c$  where  $a, b, c$  are non-negative integers  $\leq 10$ , and
- (ii)  $n$  is neither a square nor a cube of a natural number.

Then  $N$  is equal to

**Options :**

4146645177. ✗ 848

4146645178. ✗ 849

4146645179. ✗ 1051

4146645180. ✓ 1059

Question Number : 44 Question Id : 4146641314 Question Type : MCQ Option Shuffling : Yes

Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum

Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Let  $ABC$  be a triangle and let  $a$ ,  $b$  and  $c$  denote the lengths of the sides  $BC$ ,  $CA$  and  $AB$  respectively. Let  $\alpha$  and  $\beta$  be positive real numbers such that

$$\alpha(\angle A) + \beta(\angle B) = (\alpha + \beta)(\angle C).$$

Then

Options :

4146645181. ✖  $\alpha a + \beta b = (\alpha + \beta)c$

4146645182. ✔  $\alpha a + \beta b = (\alpha + \beta)c$  implies  $a = b$

4146645183. ✖  $\alpha a + \beta b > (\alpha + \beta)c$

4146645184. ✖  $\alpha a + \beta b = (\alpha + \beta)c$  implies  $\alpha a = \beta b$

Question Number : 45 Question Id : 4146641315 Question Type : MCQ Option Shuffling : Yes Is

Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum

Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

For  $a, b \in \mathbb{R}$ , with  $a > 0$ , let  $N(a, b)$  denote the number of elements in the set  $\{x \in \mathbb{R} \mid x + a \sin x = b\}$ . Then

Options :

4146645185. ✖  $N(a, b) = 1$  for all  $a, b$ .

4146645186. ✖ there does not exist any  $a$  such that  $N(a, b) = 1$  for all  $b$ .

4146645187. ✔  $N(a, b)$  is finite for all  $a, b$ .

4146645188. ✖ there exist  $a, b$  such that  $N(a, b)$  is infinite.

**Question Number : 46 Question Id : 4146641316 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

Let  $N$  be the number of solutions of the equation

$$x_0 + 2x_1 + 2x_2 + 2x_3 + 2x_4 + x_5 = 6,$$

with  $x_0, x_1, x_2, x_3, x_4$  and  $x_5$  taking non-negative integer values. Then

**Options :**

4146645189. ✖  $N < 50$

4146645190. ✔  $50 \leq N < 100$

4146645191. ✖  $100 \leq N < 1000$

4146645192. ✖  $1000 \leq N$

Question Number : 47 Question Id : 4146641317 Question Type : MSQ Option Shuffling : Yes Is  
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum  
Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0

For  $a, b > 0$  let  $F(a, b) = \int_a^b |\sin 2\pi x| dx$ . Then

Options :

4146645193. ✓  $F(10, 11) = 2F(0, \frac{1}{2})$

4146645194. ✗  $F(\frac{41}{4}, \frac{43}{4}) = \frac{1}{2}F(\frac{1}{2}, 1)$

4146645195. ✗  $F(\frac{1}{8}, \frac{1}{4}) = F(1, 2)$

4146645196. ✓  $F(\frac{41}{4}, \frac{43}{4}) = \frac{2}{3}F(0, \frac{3}{4})$

Question Number : 48 Question Id : 4146641318 Question Type : MSQ Option Shuffling : Yes Is  
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum  
Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0

Let  $S = \{x, y, z\}$  and  $f : S \rightarrow \mathbb{N}$  be a function. Let  $A$  be a subset of  $\mathbb{N}$  such that the following conditions are satisfied:

- (i) if  $f(x) \in A$  then  $f(y) \in A$ , and
- (ii) if  $f(z) \notin A$  then  $f(y) \notin A$ .

Then it follows that

**Options :**

4146645197. ✓ whenever  $f(x) \in A$ ,  $f(z) \in A$ .

4146645198. ✗ whenever  $f(x) \notin A$ ,  $f(z) \notin A$ .

4146645199. ✗ whenever  $f(z) \in A$ ,  $f(x) \in A$ .

4146645200. ✓ whenever  $f(z) \notin A$ ,  $f(x) \notin A$ .

**Question Number : 49 Question Id : 4146641319 Question Type : MSQ Option Shuffling : Yes Is**

**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

**Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

Let  $\mathbf{a}$  and  $\mathbf{b}$  be non-zero vectors. Let  $S$  be the set of vectors  $\mathbf{v}$  such that  $\mathbf{a} \times \mathbf{v} = \mathbf{b}$ . Then

**Options :**

4146645201. ✗ there exists a positive real number  $r$  such that  $\|\mathbf{v}\| < r$  for all  $\mathbf{v} \in S$ .



4146645202. ✓  $S$  is non-empty if and only if  $\mathbf{a} \cdot \mathbf{b} = 0$ .

4146645203. ✓  $S$  is contained in a plane.

4146645204. ✓ if  $\mathbf{v}_1$  and  $\mathbf{v}_2$  are in  $S$ , then there exists  $\lambda \in \mathbb{R}$  such that  $\mathbf{v}_1 - \mathbf{v}_2 = \lambda \mathbf{a}$ .

**Question Number : 50 Question Id : 4146641320 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

Let  $C_1, C_2$  and  $C_3$ , be three circles having the same radius  $r$ , which touch each other externally. Then

**Options :**

4146645205. ✗ for any circle  $C$  which is touched internally by  $C_1$  and  $C_2$ ,  $C_3$  lies within  $C$ .

4146645206. ✗ there is no circle  $C$  touched internally by  $C_1, C_2$  and  $C_3$ .

4146645207. ✓ a circle  $C$  touched internally by  $C_1, C_2$  and  $C_3$  has radius  $\left(1 + \frac{2}{\sqrt{3}}\right)r$ .

4146645208. ✓ the radius of any circle  $C$  touched internally by  $C_1$  and  $C_2$  is at least  $2r$ .

**Question Number : 51 Question Id : 4146641321 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

**Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

Let  $S = \{(a, b) \mid a, b \in \mathbb{Z}\}$ . Let  $R$  be the equivalence relation on  $S$  defined by  $(a, b)R(c, d)$  if  $a^2 + b^2 = c^2 + d^2$ . For  $(a, b) \in S$  let  $F(a, b)$  denote the equivalence class  $\{(c, d) \in S \mid (a, b)R(c, d)\}$  of  $(a, b)$ . Then

**Options :**

4146645209. ✓ there exists  $(a, b) \in S$  such that  $F(a, b)$  has only one element.

4146645210. ✓ there exists  $(a, b) \in S$  such that  $F(a, b)$  has exactly 4 elements.

4146645211. ✗ there exists  $(a, b) \in S$  such that  $F(a, b)$  has exactly 6 elements.

4146645212. ✗ there exists  $(a, b) \in S$  such that  $F(a, b)$  has infinitely many elements.

## Physics

|                                                                     |           |
|---------------------------------------------------------------------|-----------|
| <b>Section Id :</b>                                                 | 41466489  |
| <b>Section Number :</b>                                             | 4         |
| <b>Section type :</b>                                               | Online    |
| <b>Mandatory or Optional :</b>                                      | Mandatory |
| <b>Number of Questions :</b>                                        | 17        |
| <b>Number of Questions to be attempted :</b>                        | 17        |
| <b>Section Marks :</b>                                              | 50        |
| <b>Enable Mark as Answered Mark for Review and Clear Response :</b> | Yes       |
| <b>Maximum Instruction Time :</b>                                   | 0         |

Question Number : 52 Question Id : 4146641322 Question Type : MCQ Option Shuffling : Yes Is

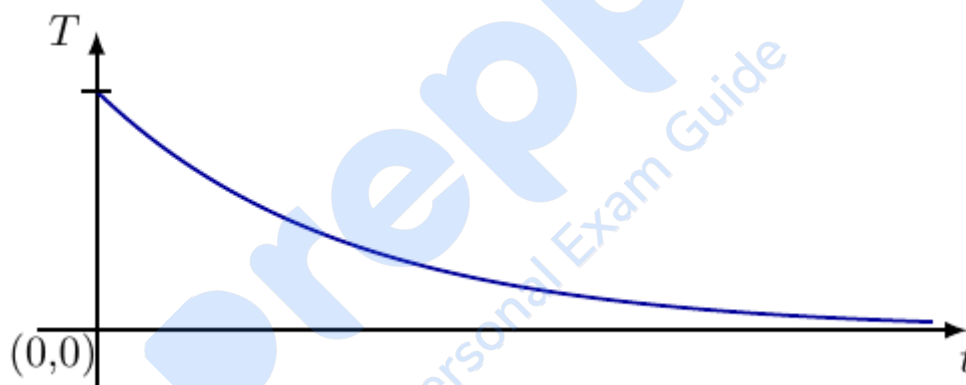
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum

Instruction Time : 0 Option Orientation : Vertical

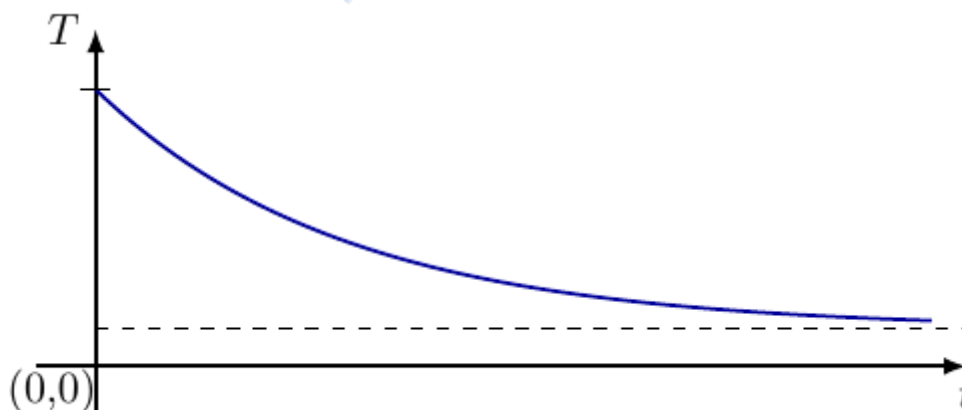
Correct Marks : 2.5 Wrong Marks : 1

An arrow is released from a rigid bow at time  $t = 0$ . The magnitude of the tension ( $T$ ) in the bowstring as a function of time is best described by

Options :

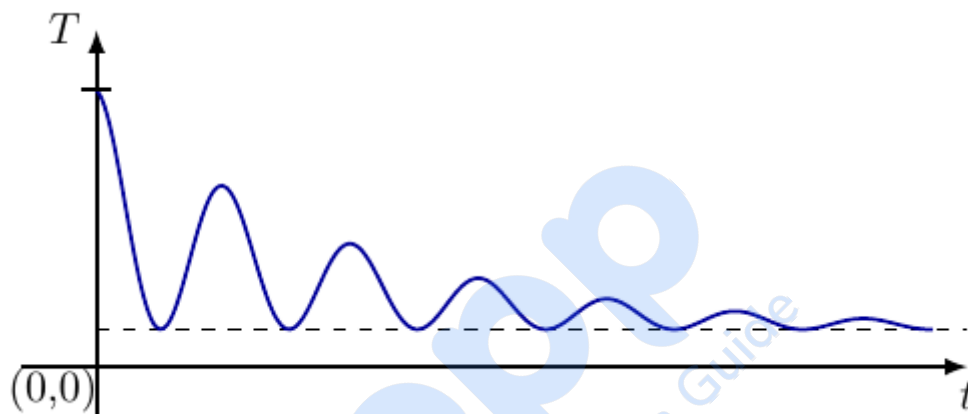
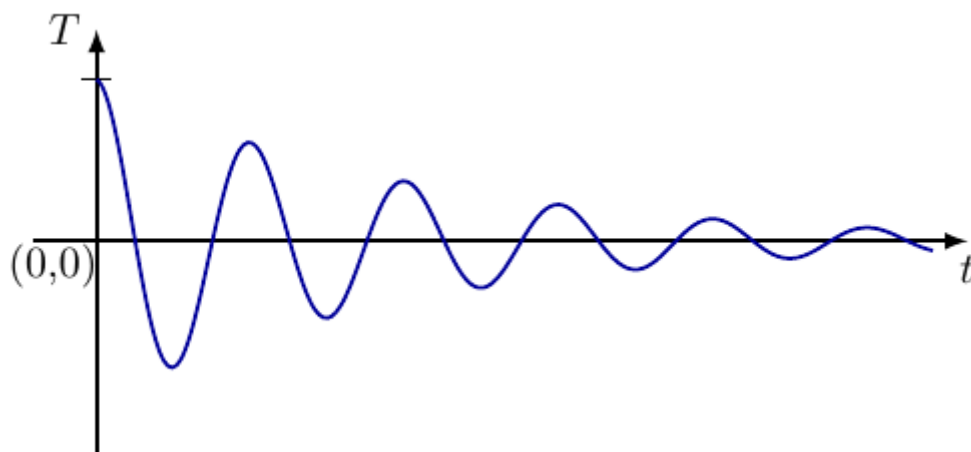


4146645213. ✖



4146645214. ✖

4146645215. ✖



4146645216. ✓

**Question Number : 53 Question Id : 4146641323 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

Two air bubbles of equal initial volume rise from the bottom of a lake to the surface. One bubble ascends and expands adiabatically while the other bubble ascends and expands isothermally. Let  $V_A$  and  $V_T$  be the final volumes of the bubbles with adiabatic and isothermal expansions, respectively. Consider an ideal gas behaviour and note that  $\gamma$  is the adiabatic constant. Then,

**Options :**

4146645217. ✗  $V_A > V_T$

4146645218.

✓  $V_A < V_T$

4146645219. ✗  $V_A = V_T$

4146645220. ✗  $V_A = \gamma V_T$

**Question Number : 54 Question Id : 4146641324 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

A current  $I$  flows through a regular hexagonal loop of side length  $l$ . The magnitude of the magnetic field at the centre is

**Options :**

4146645221. ✗  $\frac{\mu_0 I}{3\pi l}$

4146645222. ✗  $\frac{\mu_0 I}{2\sqrt{3}\pi l}$

4146645223. ✓  $\frac{\sqrt{3}\mu_0 I}{\pi l}$

4146645224. ✗  $\frac{3\mu_0 I}{\pi l}$

**Question Number : 55 Question Id : 4146641325 Question Type : MCQ Option Shuffling : Yes****Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum****Instruction Time : 0 Option Orientation : Vertical****Correct Marks : 2.5 Wrong Marks : 1**

A planet of mass  $m$  is orbiting around a non-rotating star of mass  $\alpha m$  ( $\alpha \gg 1$ ) with an orbital radius  $r$ . The star ejects mass  $\lambda m$  ( $\lambda \ll 1$ ) radially outwards in a spherically symmetric fashion. Neglecting any impact of ejected mass on the planet, the radius of new circular orbit of the planet is

**Options :**

4146645225. ✖  $(1 + \frac{\lambda}{\alpha})^{-1}r$

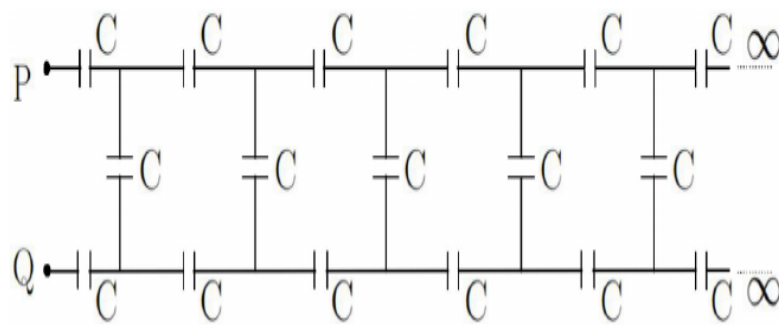
4146645226. ✖  $(1 - \lambda\alpha)^{-1}r$

4146645227. ✖  $(1 + \lambda\alpha)r$

4146645228. ✔  $(1 - \frac{\lambda}{\alpha})^{-1}r$

**Question Number : 56 Question Id : 4146641326 Question Type : MCQ Option Shuffling : Yes Is****Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum****Instruction Time : 0 Option Orientation : Vertical****Correct Marks : 2.5 Wrong Marks : 1**

The equivalent capacitance between P and Q for the infinite series of capacitors shown in the figure is



Options :

4146645229. ✖  $\frac{C}{2}(\sqrt{3} + 1)$

4146645230. ✖  $\frac{C}{3}$

4146645231. ✖  $3C$

4146645232. ✔  $\frac{C}{2}(\sqrt{3} - 1)$

**Question Number : 57 Question Id : 4146641327 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

The temperature and pressure at the summit of Mt. Everest is  $-30^{\circ}\text{C}$  and  $0.27 \times 10^5 \text{ N.m}^{-2}$ , respectively. The corresponding values at sea-level are  $27^{\circ}\text{C}$  and  $1 \times 10^5 \text{ N.m}^{-2}$ . Considering air to be an ideal gas, the ratio between the molecular number density at the summit of Mt. Everest to that at sea level is closest to

Options :

4146645233. ✖ 1:30

4146645234. ✖ 81:100

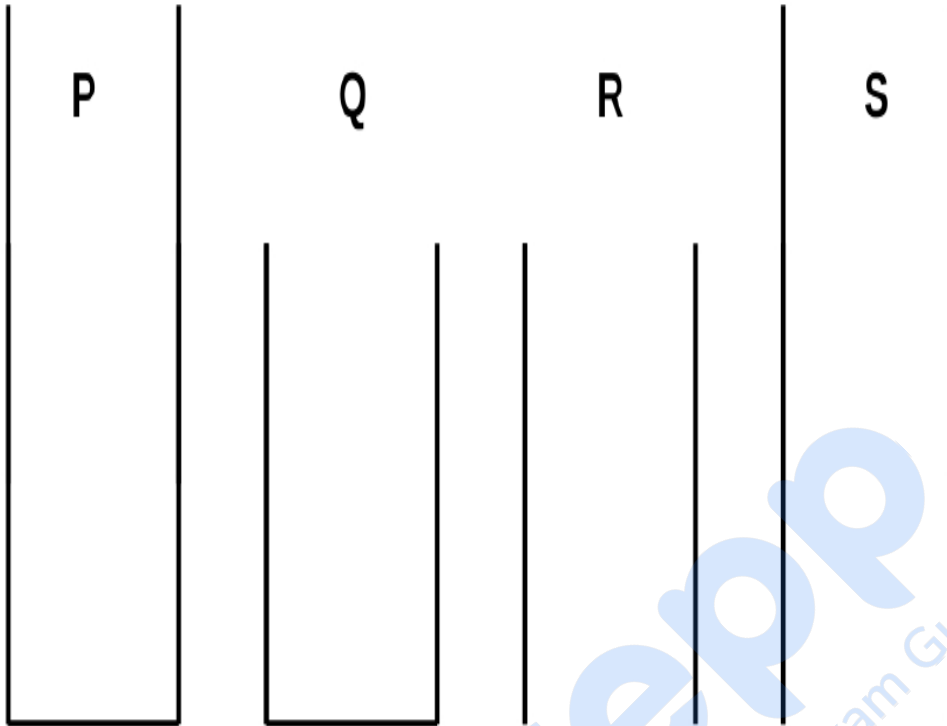
4146645235. ✖ 27:100

4146645236. ✔ 1:3

**Question Number : 58 Question Id : 4146641328 Question Type : MCQ Option Shuffling : Yes Is  
Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum  
Instruction Time : 0 Option Orientation : Vertical  
Correct Marks : 2.5 Wrong Marks : 1**



Consider the following four cylindrical tubes (P,Q,R,S) all of equal radii. The tubes Q and R are of length  $l$ . The tubes P and S are of length  $1.5l$ . If the fundamental frequencies are  $\nu_P, \nu_Q, \nu_R$  and  $\nu_S$ , respectively, then the correct option is



Options :

4146645237. ✖  $\nu_R > \nu_S > \nu_P > \nu_Q$

4146645238. ✔  $\nu_R > \nu_S > \nu_Q > \nu_P$

4146645239. ✖  $\nu_S > \nu_R > \nu_Q > \nu_P$

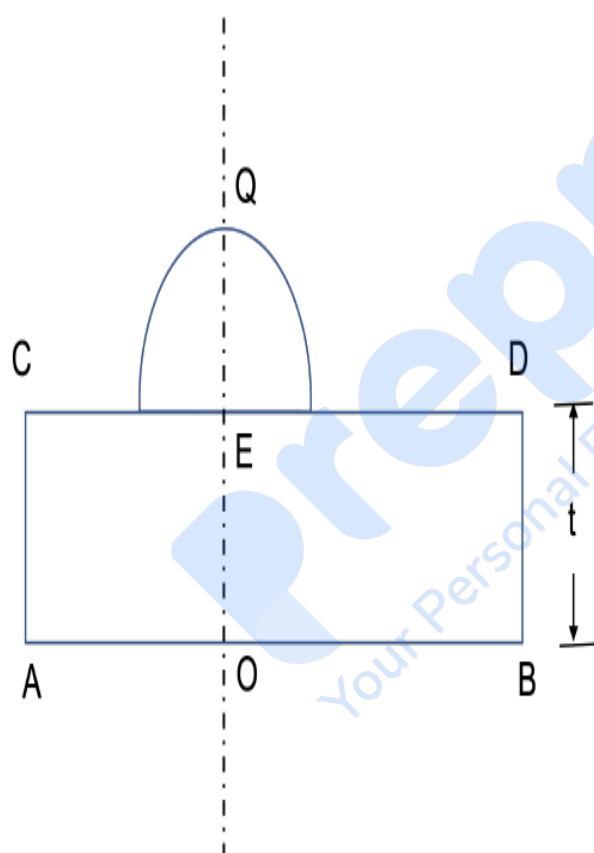
4146645240. ✖  $\nu_R > \nu_P > \nu_S > \nu_Q$

**Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum**

**Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

A transparent glass slab of thickness  $t = 0.50$  cm is placed with its face  $AB$  on a horizontal table. A hemispherical water drop of radius  $R = 0.33$  cm condenses on the glass slab as shown in figure. The refractive indices of the slab and the water drop are respectively 1.50 and 1.33. The image of the object at  $O$  on the face  $AB$  is viewed after refraction from the drop. Taking  $OEQ$  as the optical axis, the distance (cm) of the image from the point  $Q$  is



**Options :**

4146645241. ✓ 1.40

4146645242. ✗ 0.60

4146645243. ✗ 0.72

4146645244. ✖ 2.00

**Question Number : 60 Question Id : 4146641330 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

A beam of monochromatic light is incident on one face of a prism of angle  $75^\circ$ . If the angle of incidence is  $60^\circ$  and the refractive index of the prism is  $\sqrt{3}$ , then the correct option about the emergence of the beam from the opposite face is

**Options :**

4146645245. ✔ no emergence.

4146645246. ✖ grazing emergence.

4146645247. ✖ emergence with an angle of  $60^\circ$  from the normal.

4146645248. ✖ emergence with an angle of  $30^\circ$  from the normal.

**Question Number : 61 Question Id : 4146641331 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

In an isobaric process involving an ideal gas the mean distance between the molecules is quadrupled (four times). Then, the ratio of final to initial sound speeds is

**Options :**

4146645249. ✖ 1

4146645250. ✖ 2

4146645251. ✔ 8

4146645252. ✖ 4

**Question Number : 62 Question Id : 4146641332 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 2.5 Wrong Marks : 1**

Two radioactive samples  $X$  and  $Y$  have the same number of atoms initially  $[N_X(t = 0) = N_Y(t = 0)]$ . The half life  $\tau_{1/2}^x$  of  $X$  is half the mean life of  $Y$ . Then the ratio  $N_Y(t)/N_X(t)$  when  $t = \tau_{1/2}^x$  is close to

**Options :**

4146645253. ✖ 0.8

4146645254. ✖ 1.0

4146645255. ✔ 1.2

4146645256. ✖ 1.4

**Question Number : 63 Question Id : 4146641333 Question Type : MCQ Option Shuffling : Yes****Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum****Instruction Time : 0 Option Orientation : Vertical****Correct Marks : 2.5 Wrong Marks : 1**

Consider the Bohr model of the hydrogen atom. Suppose that the charge of the proton were  $1.1e$  while the electron charge continued to be  $-e$  but the masses for both remained unchanged. Then, the angular frequency of revolution  $\omega_B$  of the electron would have

**Options :**

4146645257. ✖ remain unchanged.

4146645258. ✖ change to  $\sqrt{1.1}\omega_B$ .4146645259. ✖ change to  $1.1 \omega_B$ .4146645260. ✔ change to  $1.21 \omega_B$ .**Sub-Section Number :**

2

**Sub-Section Id :**

414664183

**Question Shuffling Allowed :**

Yes

**Is Section Default? :**

null

**Question Number : 64 Question Id : 4146641334 Question Type : MSQ Option Shuffling : Yes Is****Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum****Instruction Time : 0 Option Orientation : Vertical****Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

A heavy disc of radius  $R$  and mass  $M$  is placed horizontally. A small coin of mass  $m$  placed at a radial distance  $R/2$  from the centre. The disc is now ( $t = 0$ ) given a constant angular acceleration of magnitude  $\alpha \text{ rad} \cdot \text{s}^{-2}$  about a vertical axis passing through its centre. If  $\mu_s$  and  $\mu_d$  are the coefficients of static and dynamic friction, respectively, between the coin and the rotating disc, then

**Options :**

4146645261. ✓ at  $t > 0$ , the force due to static friction acts radially inwards.

4146645262. ✗ at  $t > 0$ , the magnitude of force due to static friction is always  $F_s = \mu_s mg$ .

4146645263. ✓ the coin starts sliding at time  $t = \frac{1}{\alpha} \sqrt{\frac{2\mu_s g}{R}}$ .

4146645264. ✗ the coin reaches the edge of the disc at time  $t = \frac{2}{\alpha} \sqrt{\frac{(\mu_d - \mu_s)g}{R}}$ .

**Question Number : 65 Question Id : 4146641335 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

An electromagnetic wave, travelling in vacuum, is represented by  $\vec{E} = E_0 \cos(kz - wt) \hat{y}$  where  $E_0$  is the amplitude of the electric field. A square loop of side  $a$  ( $a \ll 2\pi/k$ ) is placed in its path. Then, the correct option(s) is (are)

**Options :**

4146645265. ✓  $\vec{B} = B_0 \cos(kz - wt) \hat{x}$  where  $B_0 = -E_0/c$

4146645266. ✖ The wave is travelling in the  $y$ -direction.

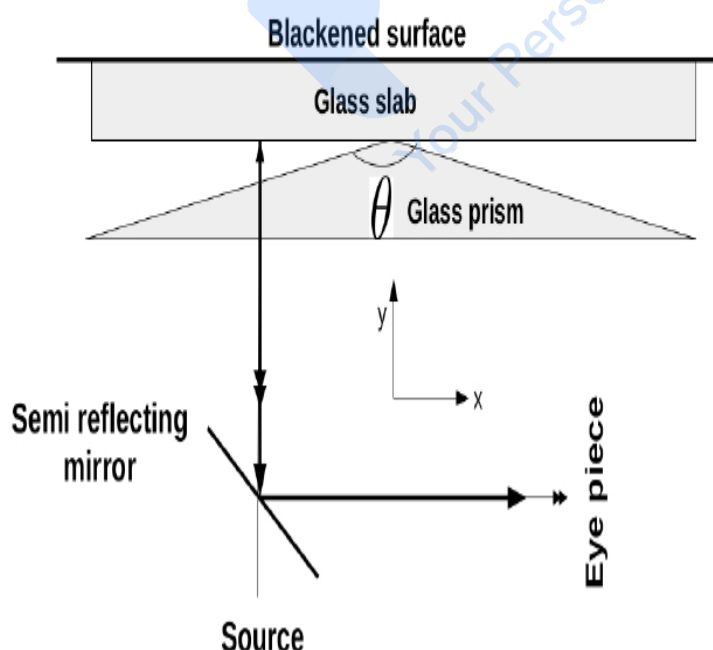
4146645267. ✔ The induced emf is zero if the loop lies in the  $xz$  plane.

4146645268. ✔ The induced emf is finite if the loop lies in the  $yz$  plane.

**Question Number : 66 Question Id : 4146641336 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

Consider the experimental set-up shown in the figure to observe the interference pattern. Note that the prism angle  $\theta$  is close to  $\pi$ . The correct option(s) regarding this experiment is (are)



**Options :**

4146645269. ✔ fringe width will increase with increasing angle  $\theta$ .

4146645270. ✖ fringe width will decrease with the refractive index of the lens.

4146645271. ✖ fringe width will increase if the glass slab is lifted along y direction.

4146645272. ✔ fringes will alternate between dark and bright if glass slab is lifted along y direction.

**Question Number : 67 Question Id : 4146641337 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

A current  $I$  is passing flowing through a thin copper slab placed on a diamond slab. The bottom surface of the diamond slab is maintained at  $0^\circ \text{C}$  and the remaining arrangement is thermally insulated from the surroundings. Note that diamond is an excellent thermal conductor but a poor electrical conductor. Then, the correct option(s) is(are)

**Options :**

4146645273. ✔ the steady-state temperature of the copper slab is directly proportional to the thickness of the diamond slab.

4146645274. ✖ the steady-state temperature of the copper slab depends upon the specific heat of the copper.

4146645275. ✔ if the current is supplied from a constant voltage source, the steady-state temperature of the copper slab will double when the its thickness is doubled.



4146645276. ✓ if the current is held constant, the steady-state temperature of the copper slab will be halved if its thickness is doubled.

**Question Number : 68 Question Id : 4146641338 Question Type : MSQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical**

**Correct Marks : 4 Wrong Marks : 0 Max. Selectable Options : 0**

The pair(s) with same dimensions is(are)

**Options :**

4146645277. ✓ Pressure and Young's modulus

4146645278. ✗ Power and energy flux

4146645279. ✓ Gravitational potential and latent heat

4146645280. ✓ Rotational impulse and Planck's constant