

Centre For Excellence In Basic Sciences

Notations :

- 1.Options shown in **green** color and with  icon are correct.
- 2.Options shown in **red** color and with  icon are incorrect.

Question Paper Name :	NEST2022 18th June 2022 Shift 2
Subject Name :	NEST 2022
Creation Date :	2022-06-18 19:18:13
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
Show Reports :	No
Show Progress Bar :	No

NEST 2022

Group Number :	1
Group Id :	7332355
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

Biology

Section Id :	73323517
Section Number :	1
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 :	73323533
Question Shuffling Allowed :	Yes

Question Number : 1 Question Id : 733235273 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 path of transmission of electrical impulse in a nerve cell is:

Options :

7332351089. ✖ nerve ending $\Rightarrow$ cell body $\Rightarrow$ dendrite

7332351090. ✖ dendrite $\Rightarrow$ axon $\Rightarrow$ cell body $\Rightarrow$ nerve ending

7332351091. ✖ nerve ending $\Rightarrow$ axon $\Rightarrow$ cell body $\Rightarrow$ dendrite

7332351092. ✔ dendrite $\Rightarrow$ cell body $\Rightarrow$ axon $\Rightarrow$ nerve ending

Question Number : 2 Question Id : 733235274 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 two spherical cells **P** and **Q** with radii of 1 micrometer and 0.01 millimetre respectively. Choose the statement that is correct regarding these cells.

Options :

7332351093. ✖ Cell **P** has a surface area ten times greater than cell **Q**.

7332351094. ✔ The surface area to volume ratio of cell **P** is 10 times greater than that of cell **Q**.

7332351095. ✖ The volume of cell **Q** is 100 times larger than cell **P**.

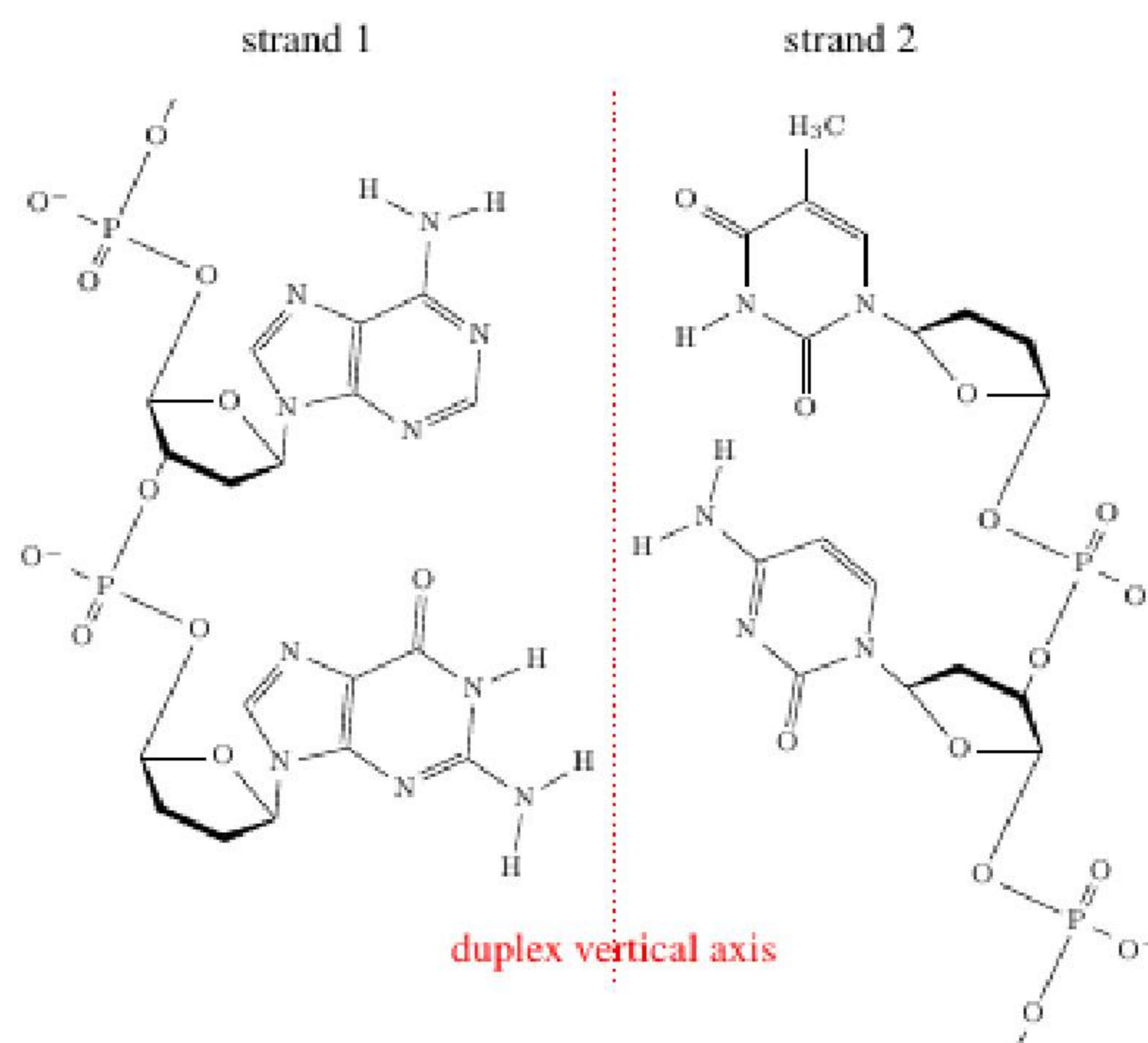
7332351096. ✖ If the radii of **P** and **Q** is doubled then the volume and surface area is also doubled.

Question Number : 3 Question Id : 733235275 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

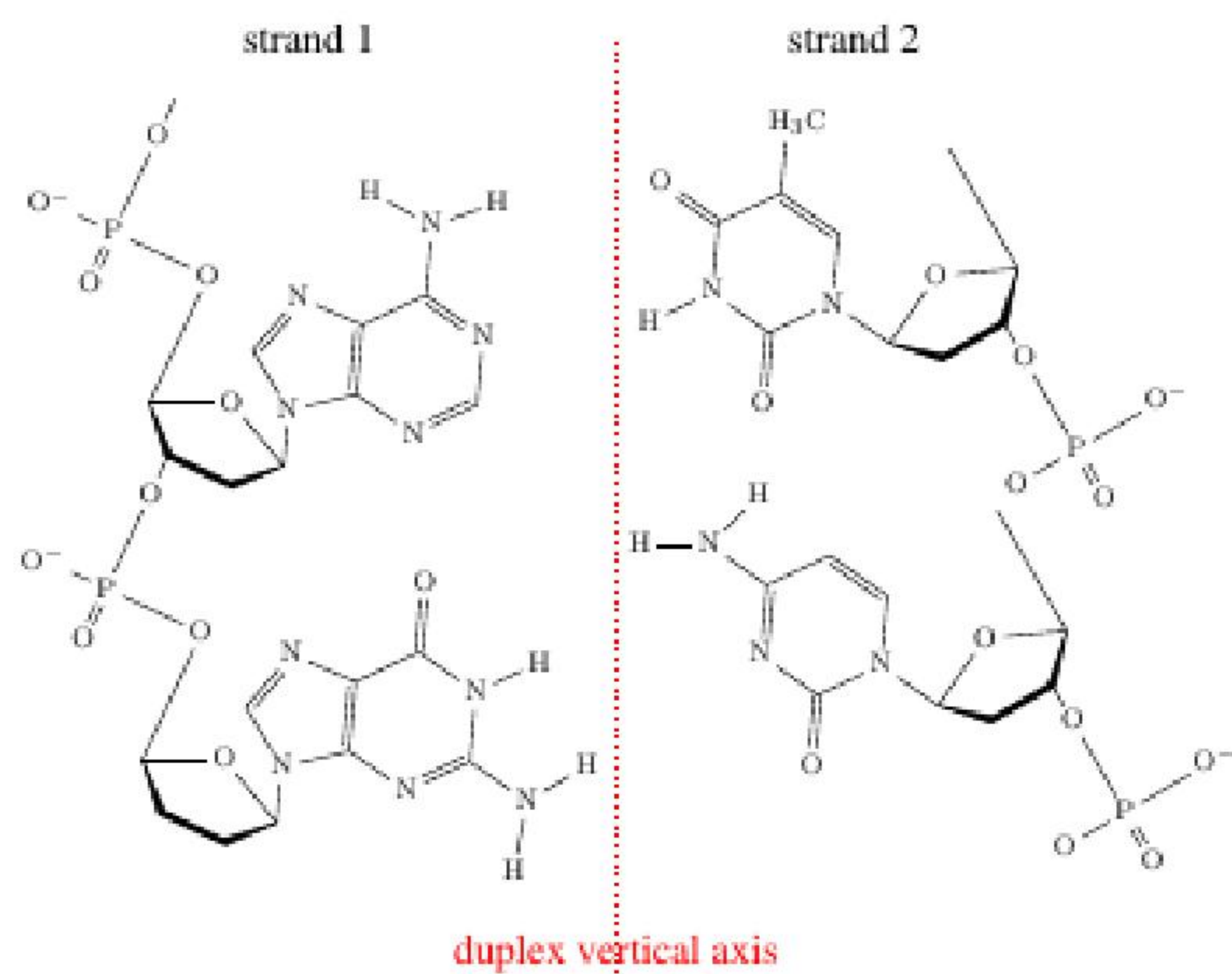
Correct Marks : 2.5 Wrong Marks : 1

Deoxyribonucleic acid (DNA) is a polymer composed of the nucleotides, deoxyadenosine triphosphate (dATP), deoxyguanosine triphosphate (dGTP), deoxythymidine triphosphate (dTTP) and deoxycytidine triphosphate (dCTP). Two such polymer strands are held together in a DNA duplex. From the following options, the correct representation of a typical Watson-Crick model of DNA duplex structure is:

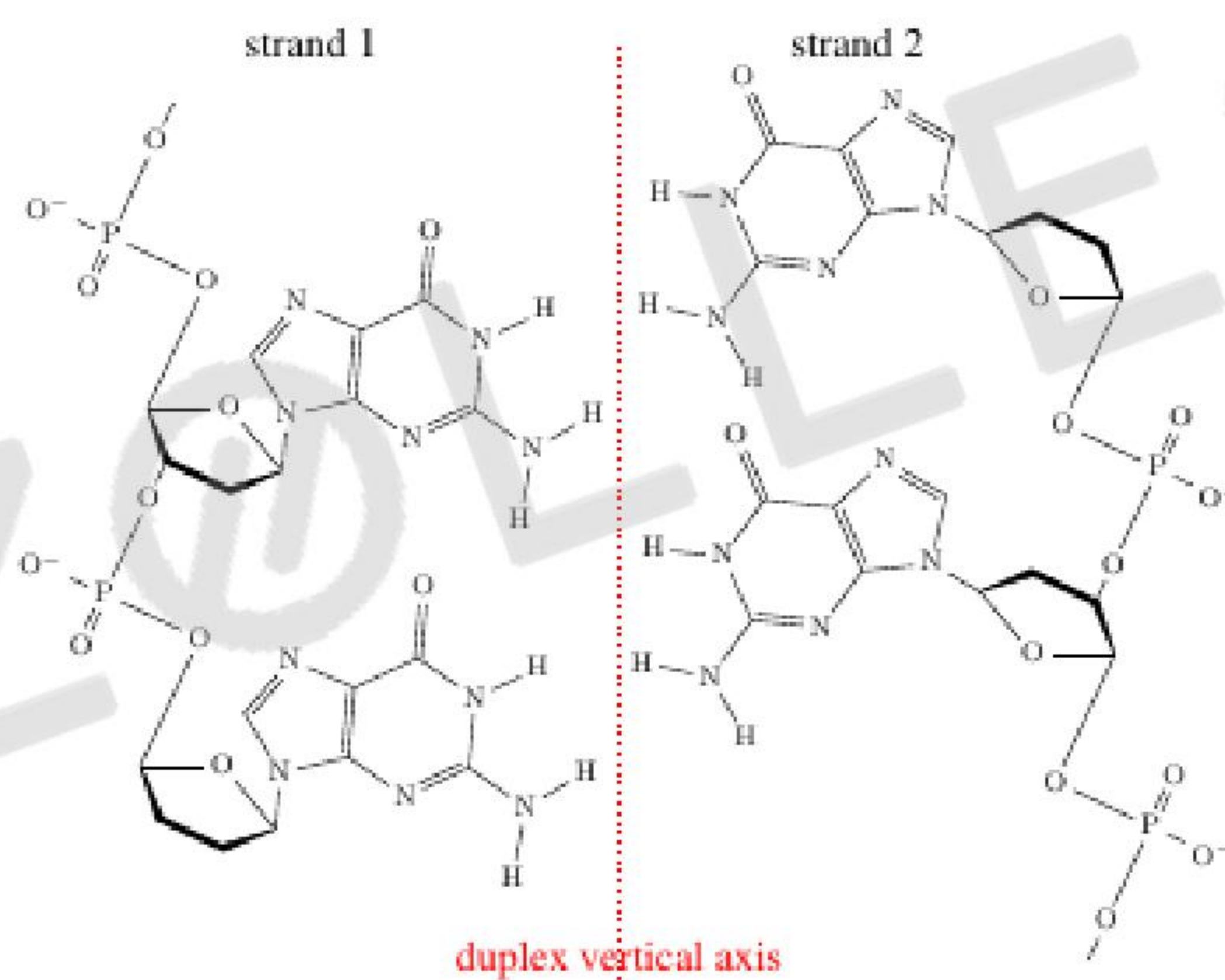
Options :



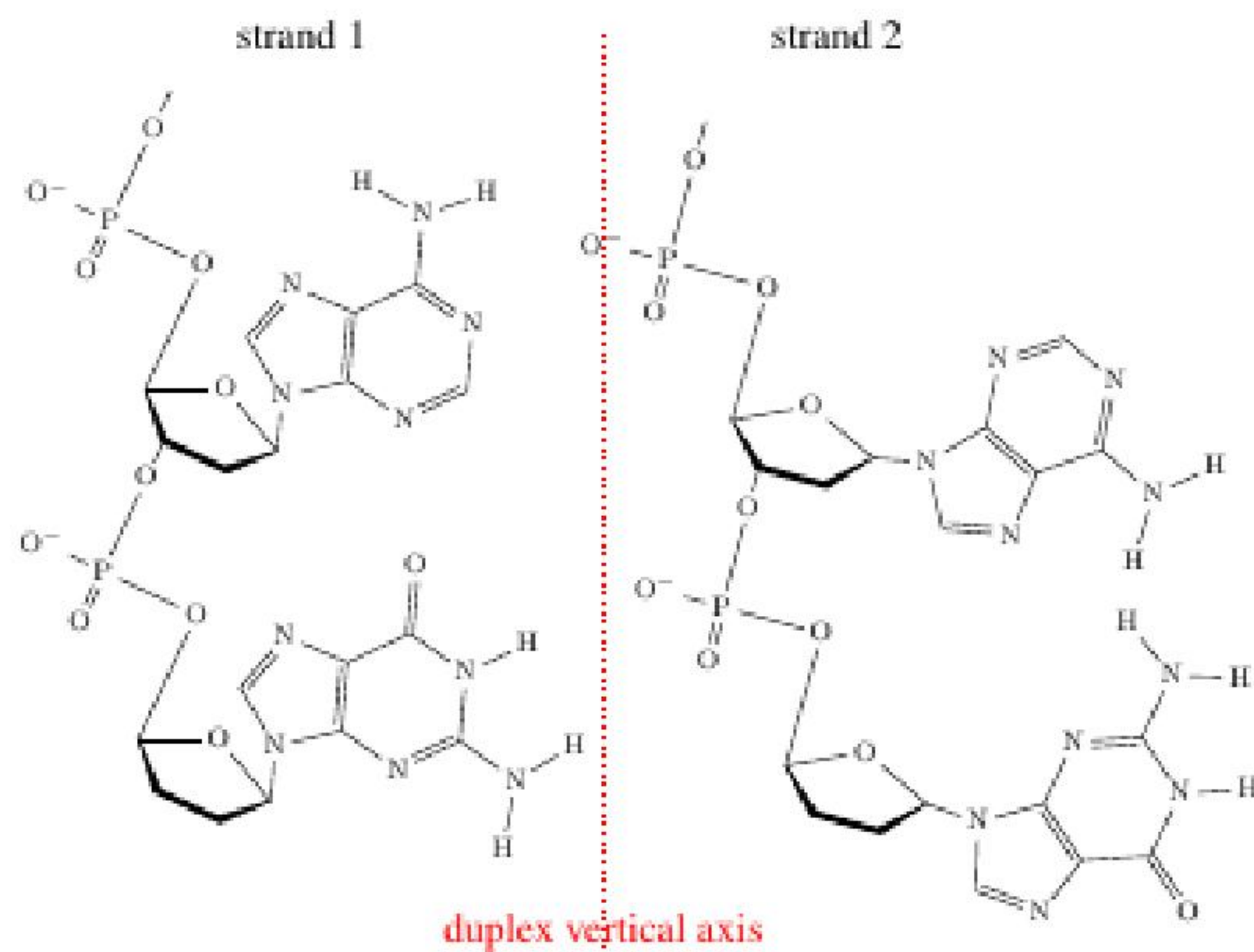
7332351097. ✔



7332351098. ✖



7332351099. ✖



7332351100. ✖

Question Number : 4 Question Id : 733235276 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 a family, the third child showed Down's syndrome but neither of the parents nor siblings of the affected child manifested symptoms of the syndrome. The possible reason for the Down's syndrome only in the affected child is:

Options :

7332351101. ✖ spontaneous mutations in the DNA of the child due to environmental factors.

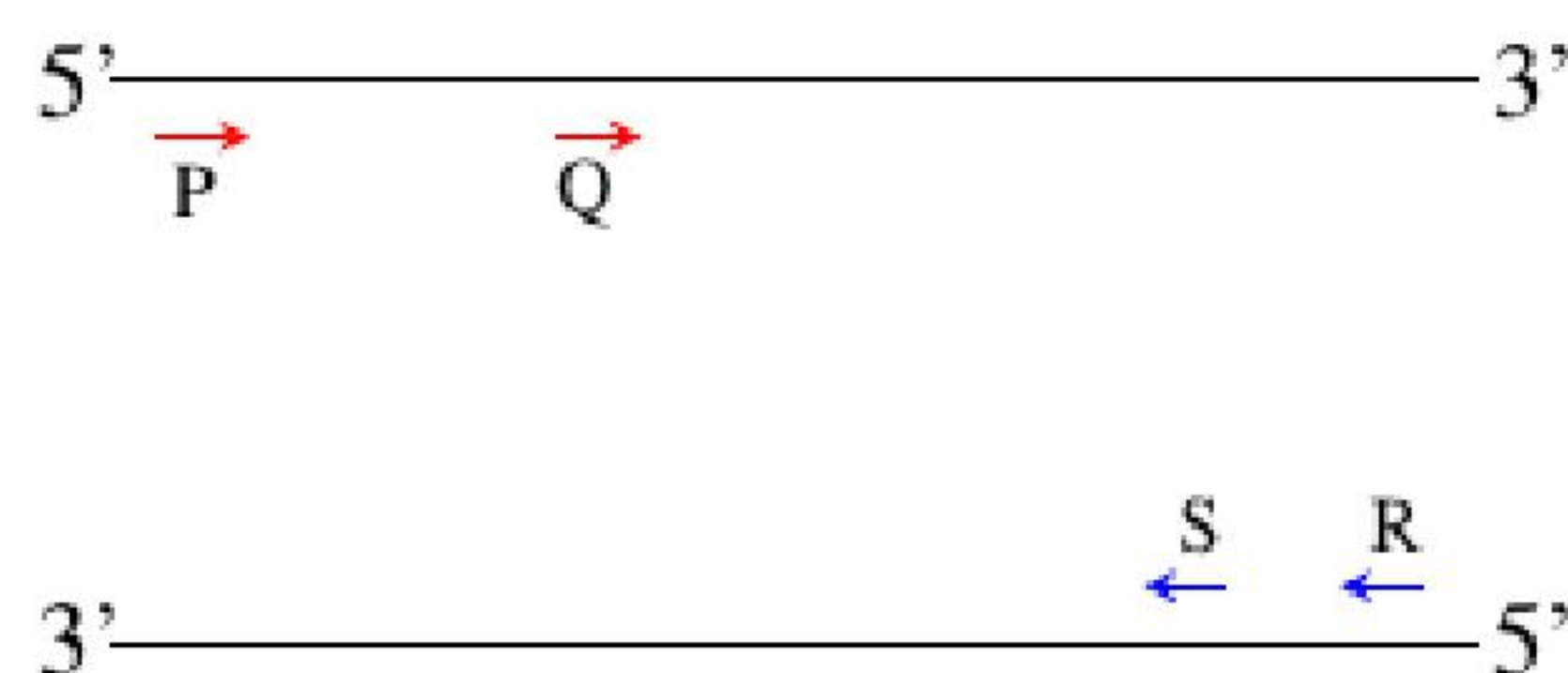
7332351102. ✔ chromosomal segregation defect during ovum development in the mother.

7332351103. ✖ chromosomal segregation defects in the cells of the uterine wall of the mother during foetus development.

7332351104. ✖ DNA replication defects in the child resulting in translocation of chromosomal arms.

Question Number : 5 Question Id : 733235277 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

Primers P, Q, R and S have binding sites on the template DNA as depicted in the figure below.



In a polymerase chain reaction (PCR) using all four primers together, the possible number of amplified products of different sizes is:

Options :

7332351105. ✖ 2

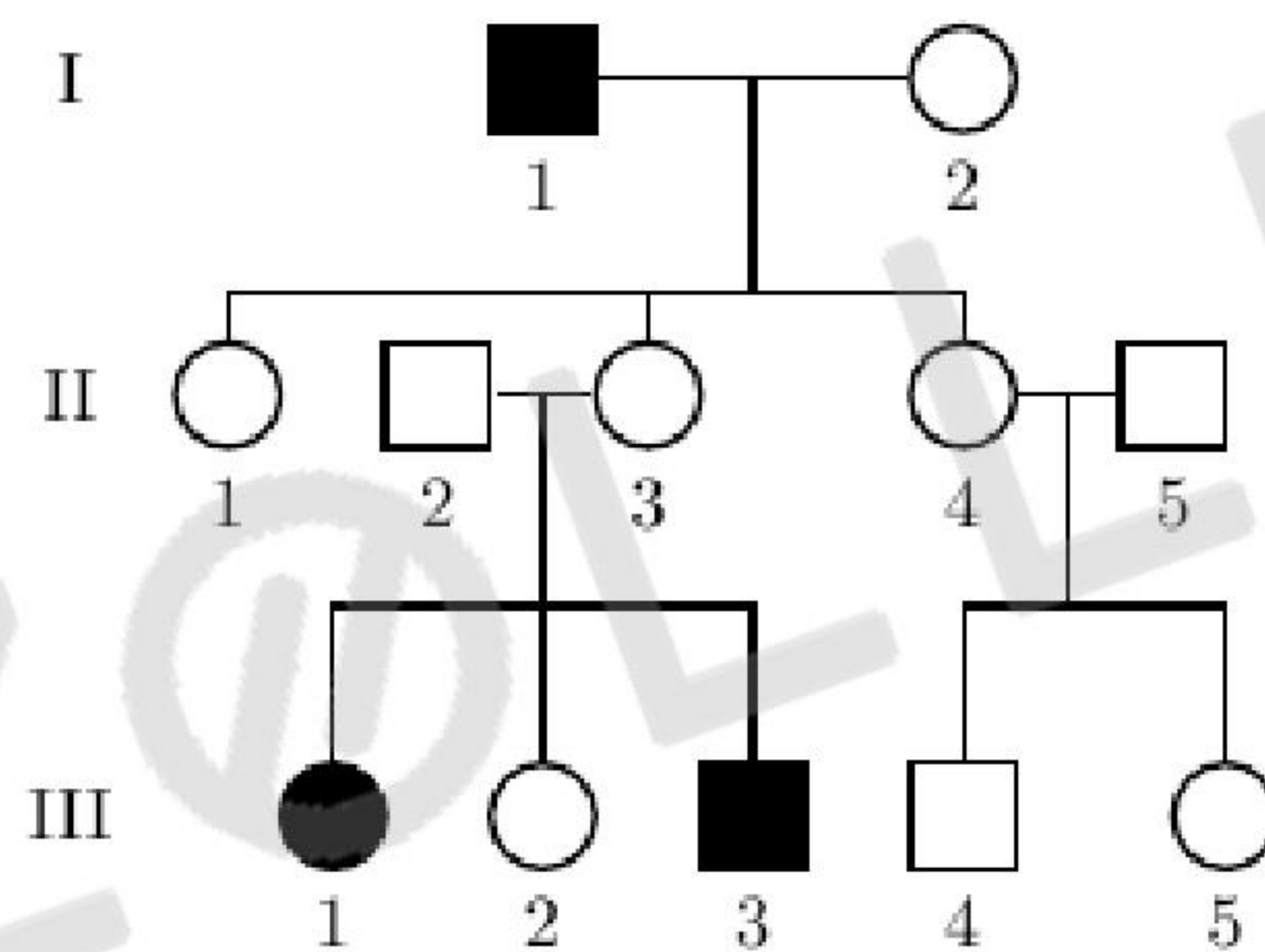
7332351106. ✔ 4

7332351107. ✖ 3

7332351108. ✖ 1

Question Number : 6 Question Id : 733235278 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 pedigree shown below represents the inheritance pattern of X-linked recessive color blindness trait (genotype X^c). In the pedigree, circles represent females and squares represent males. Filled shapes indicate affected individuals while unfilled shapes indicate unaffected individuals. Individual III-1 exhibits Turner syndrome and also manifests color blindness.



Genotypes of individual II-3 and III-5, respectively, would be:

Options :

7332351109. ✔ X^cX and X^cX/XX

7332351110. ✖ XX and X^cX/XX

7332351111. ✖ X^cO and X^cX^c

7332351112. ✖ X^cX and X^cX^c

Question Number : 7 Question Id : 733235279 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

Following are statements about different stages involved in plant development.

- (i) Conversion of root apical meristems to root cap cells.
- (ii) Conversion of leaf mesophyll tissue to callus tissue.
- (iii) Formation of xylem from vascular cambium.

Choose the option that correctly matches each statement with the respective process.

Options :

7332351113. ✓ i-differentiation; ii-dedifferentiation; iii-differentiation

7332351114. ✗ i-redifferentiation; ii-dedifferentiation; iii-differentiation

7332351115. ✗ i-dedifferentiation; ii-redifferentiation; iii-dedifferentiation

7332351116. ✗ i-dedifferentiation; ii-differentiation; iii-differentiation

Question Number : 8 Question Id : 733235280 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

Choose the correct set of molecules from the options below which are required along with water and CO_2 to drive photosynthesis in dark conditions in green plants to produce sugars.

Options :

7332351117. ✓ ATP and NADPH

7332351118. ✗ RuBisCo and phosphoenol pyruvate

7332351119. ✗ Oxaloacetic acid and Coenzyme A

7332351120. ✗ ADP and NADP

Question Number : 9 Question Id : 733235281 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 a population undergoing logistic growth where finite resources determine population growth ($\frac{dN}{dt}$), the growth is highest when the population size is:

Options :

7332351121. ✖ close to the carrying capacity (K).

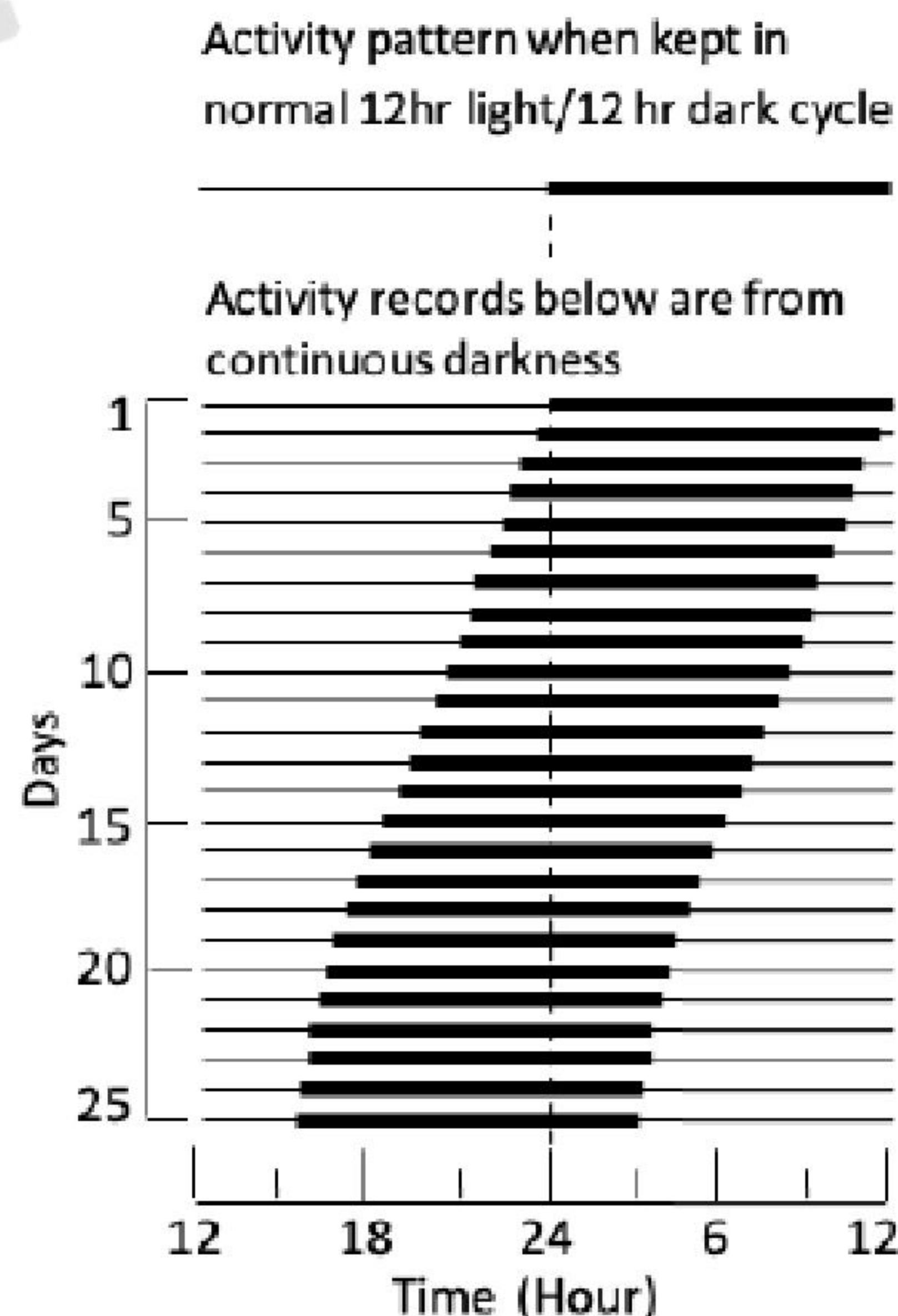
7332351122. ✔ half of the carrying capacity (K).

7332351123. ✖ at the start of the log phase.

7332351124. ✖ at equilibrium.

Question Number : 10 Question Id : 733235282 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 order to study the effect of external cues on circadian rhythm, the spontaneous wheel-running activity of flying squirrels in total darkness was recorded over 24 hours for several days. The results are shown below. Active periods appear as broad dark lines. Before these records were taken, the squirrels had been kept on a regular cycle of 12h light/12h dark, as indicated at the top of the figure.



Based on the results, the correct statement is:

Options :

7332351125. ✖ There is a slight delay in the period of activity each night as the experiment proceeds.

7332351126. ✖ The pattern and periodicity of the circadian rhythm in the squirrel is maintained throughout the experiment.

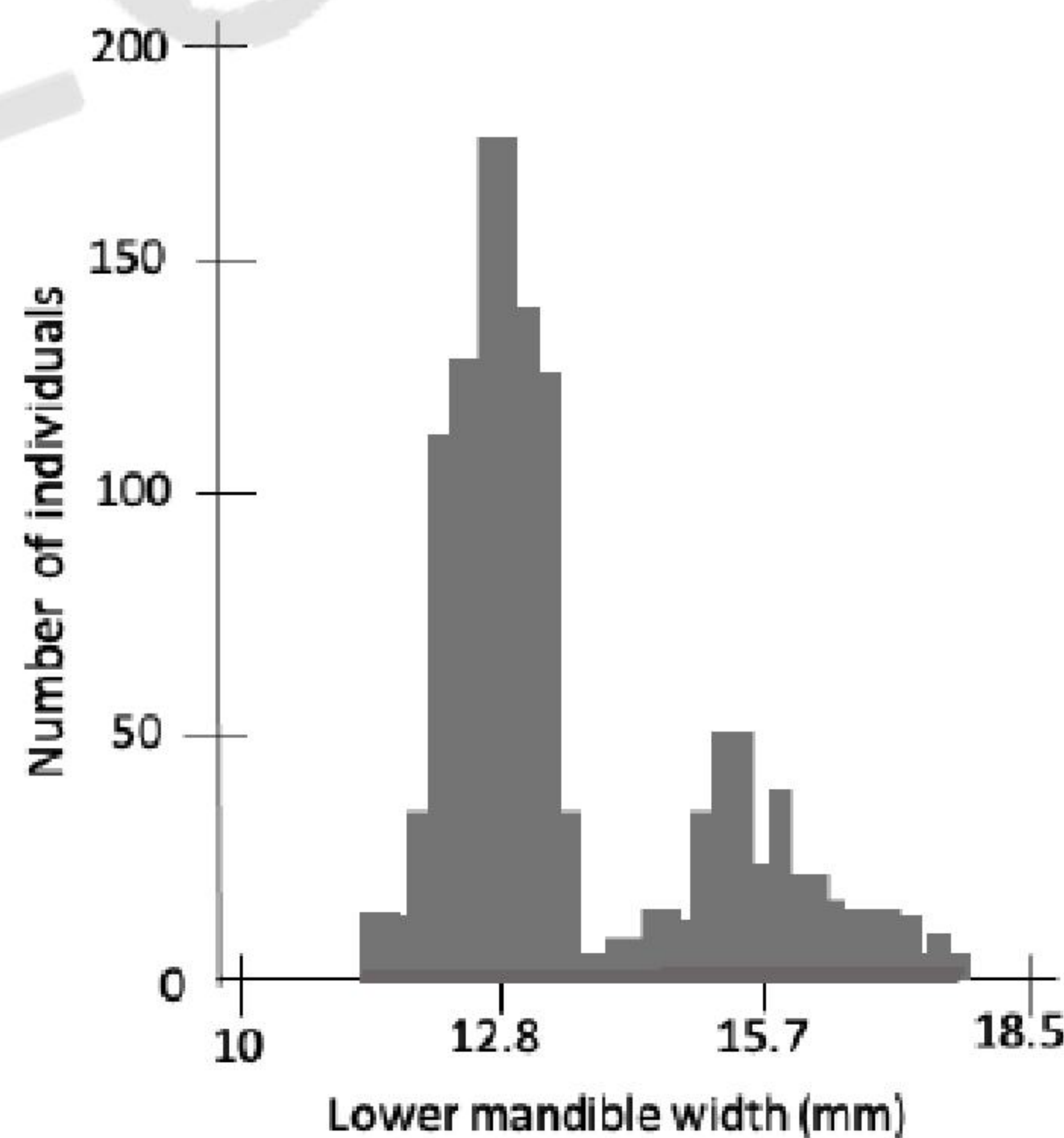
7332351127. ✖ The natural circadian rhythm of the squirrel is approximately 12 hours.

7332351128. ✔ On removal of external cues, the natural circadian rhythm is retained for the initial 24 hours.

Question Number : 11 Question Id : 733235283 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

On an island, black-bellied seed cracker birds feed primarily on seeds of two species of sedge plant. These seeds are similar in size but differ dramatically in their hardness. The distribution of bill size (as measured by the width of the lower section of the bill *i.e.* mandible) for an adult population of these birds is represented below.



This distribution is most likely a result of:

Options :

7332351129. ✖ stabilizing selection

7332351130. ✓ disruptive selection

7332351131. ✗ directional selection

7332351132. ✗ convergent evolution

Question Number : 12 Question Id : 733235284 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 a particular population of 107 individuals, which is under Hardy-Weinberg equilibrium, 94 people can perform somersaults while the remaining 13 people cannot. Assume that the ability to perform somersaults is a character that is genetically governed, rather than by the environment. If the non-performing 13 people represent the members of the population with the homozygous recessive condition, then the frequencies of the recessive allele, dominant allele and of the heterozygous individuals would respectively be:

Note: For this question, discrepancy is found in question/answer. So, this question is ignored for all candidates.

Options :

7332351133. 0.12, 0.65 and 0.44

7332351134. 0.13, 0.94 and 0.22

7332351135. 0.65, 0.12 and 0.44

7332351136. 0.12, 0.22 and 0.71

Sub-Section Number :

2

Sub-Section Id :

73323534

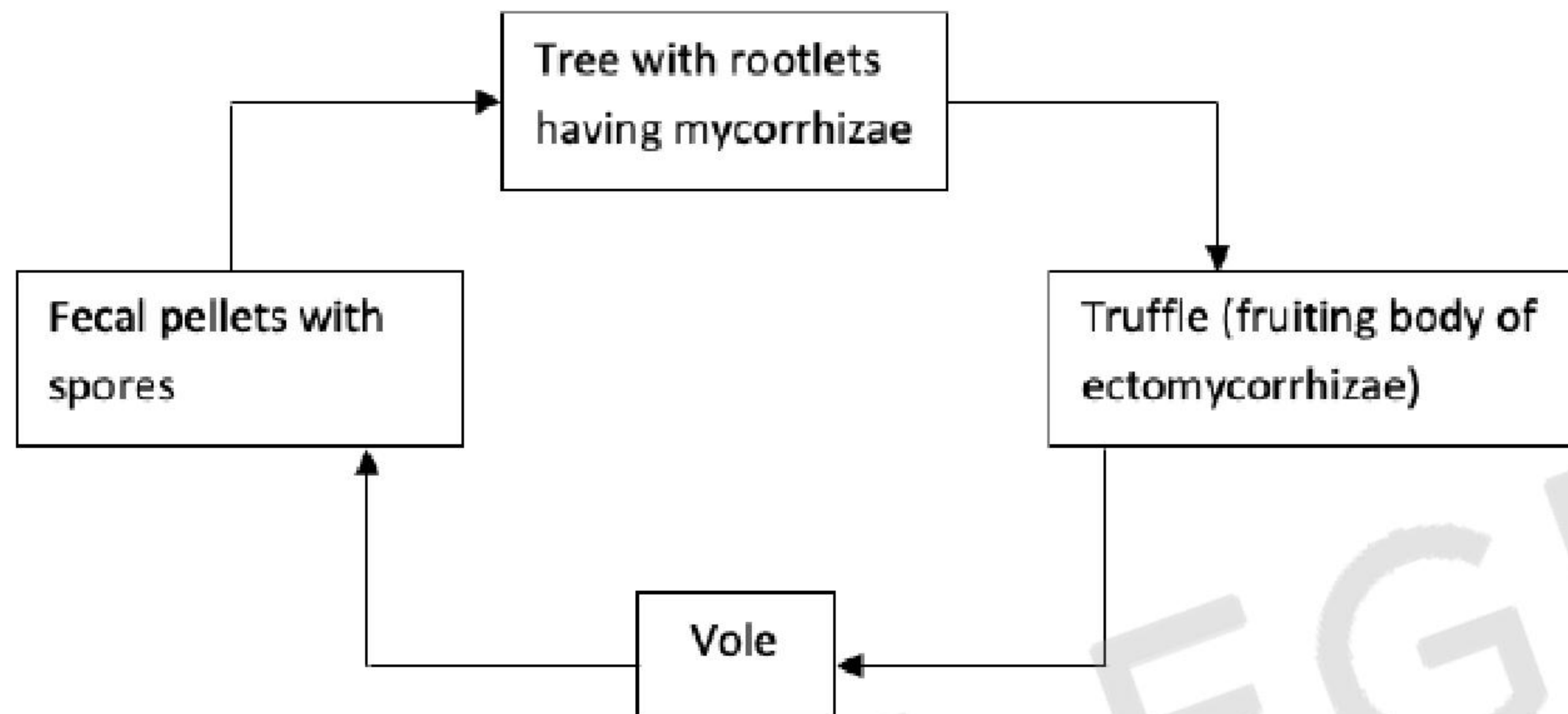
Question Shuffling Allowed :

Yes

Question Number : 13 Question Id : 733235285 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

In a nutrient-poor habitat under study, it was observed that pine trees depend on mycorrhizal fungi associated with the root system for nutrient acquisition from the soil. The mycorrhizae in turn depend on the pine trees for energy in the form of carbon. Voles (a kind of rodent) were found to be present in the habitat and their association with the pine trees and mycorrhizae is depicted in the schematic below.



Based on the given information, choose the correct statement(s).

Options :

7332351137. ✖ The three species involved are all in a direct obligate mutualistic relationship with each other.
7332351138. ✔ If the young pine trees invading the field fail to acquire mycorrhizal symbionts, the pine tree population could decrease over time.
7332351139. ✔ A marked decrease in the vole population would have a negative effect on the growth of new pine trees throughout the habitat.
7332351140. ✖ The mycorrhizae share a parasitic relationship with the trees.

Question Number : 14 Question Id : 733235286 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

A mutation in an autosomal gene, *Tum*, causes benign tumor in a dominant manner (*T* and *t* are two alleles of the gene). A mutation in another autosomal gene *Mat* (alleles are *M* and *m*) determines conversion of the benign tumours caused by the gene *Tum* to a metastatic one in a recessive manner. A couple, Mr. Y and Mrs. X, both heterozygous for the genes *Tum* and *Mat*, have a child together. Based on this information, choose the correct statement(s).

Options :

7332351141. ✖ The probability of the child not developing any type of tumor is $1/16$

7332351142. ✔ The probability of the child not developing any type of tumor is $1/4$

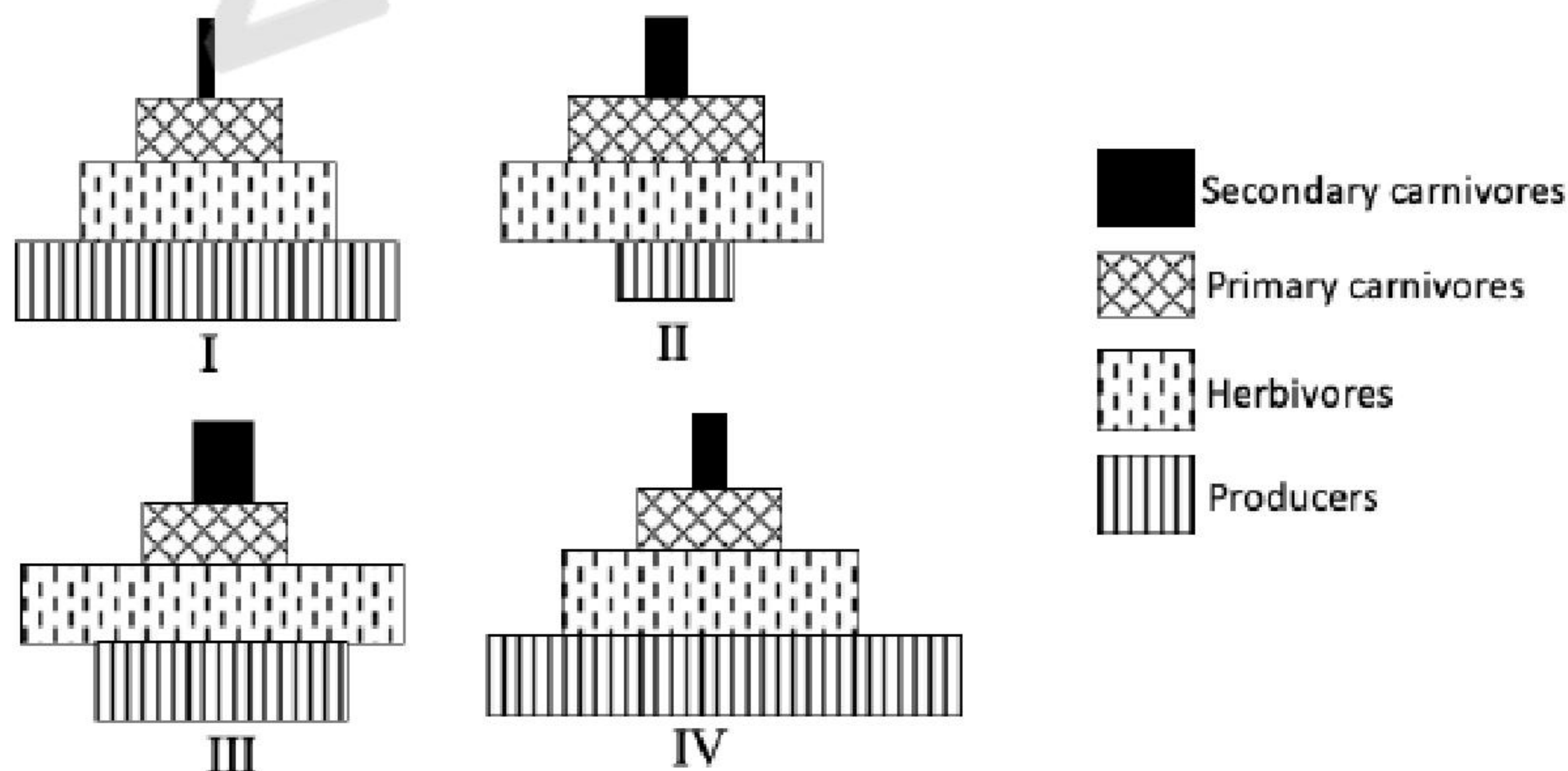
7332351143. ✔ The probability of the child developing only benign tumor is $9/16$

7332351144. ✖ The probability of the child developing only benign tumor is $3/4$

Question Number : 15 Question Id : 733235287 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

Four ecological pyramids (I to IV) are shown below.



The correct statement(s) about these pyramids is/are:

Options :

7332351145. ✖ II could be an energy pyramid for a temperate forest if secondary carnivores would have a greater value than primary carnivores.

7332351146. ✓ **III** represents a biomass pyramid while **I** represents an energy pyramid for an aquatic ecosystem.

7332351147. ✓ If **IV** represents a biomass pyramid for a terrestrial ecosystem and if the producers had a total of 75,000 kcal of energy then approximately 750 kcal energy would reach the secondary consumers.

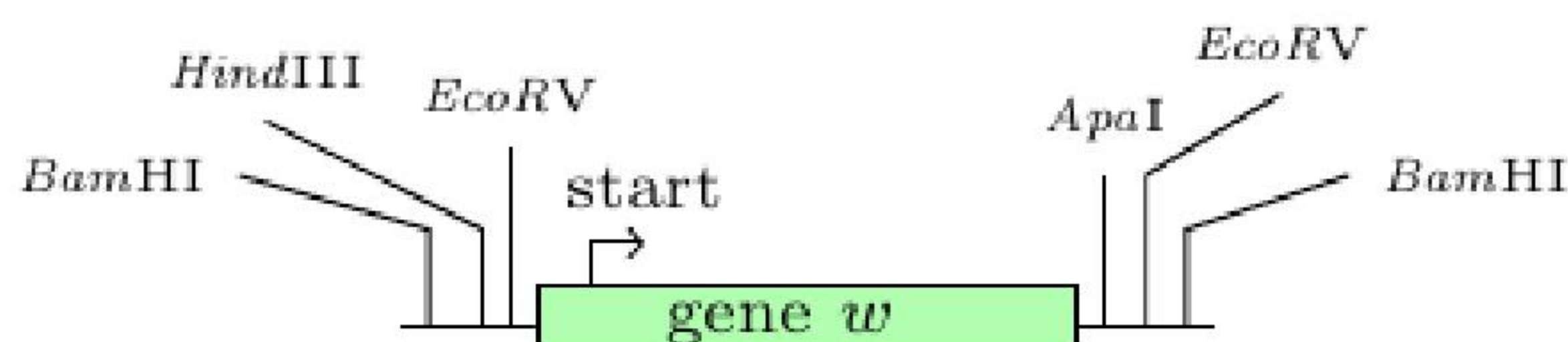
7332351148. ✓ **I** and **II** could represent number pyramids for a grassland ecosystem and a tree ecosystem respectively.

Question Number : 16 Question Id : 733235288 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

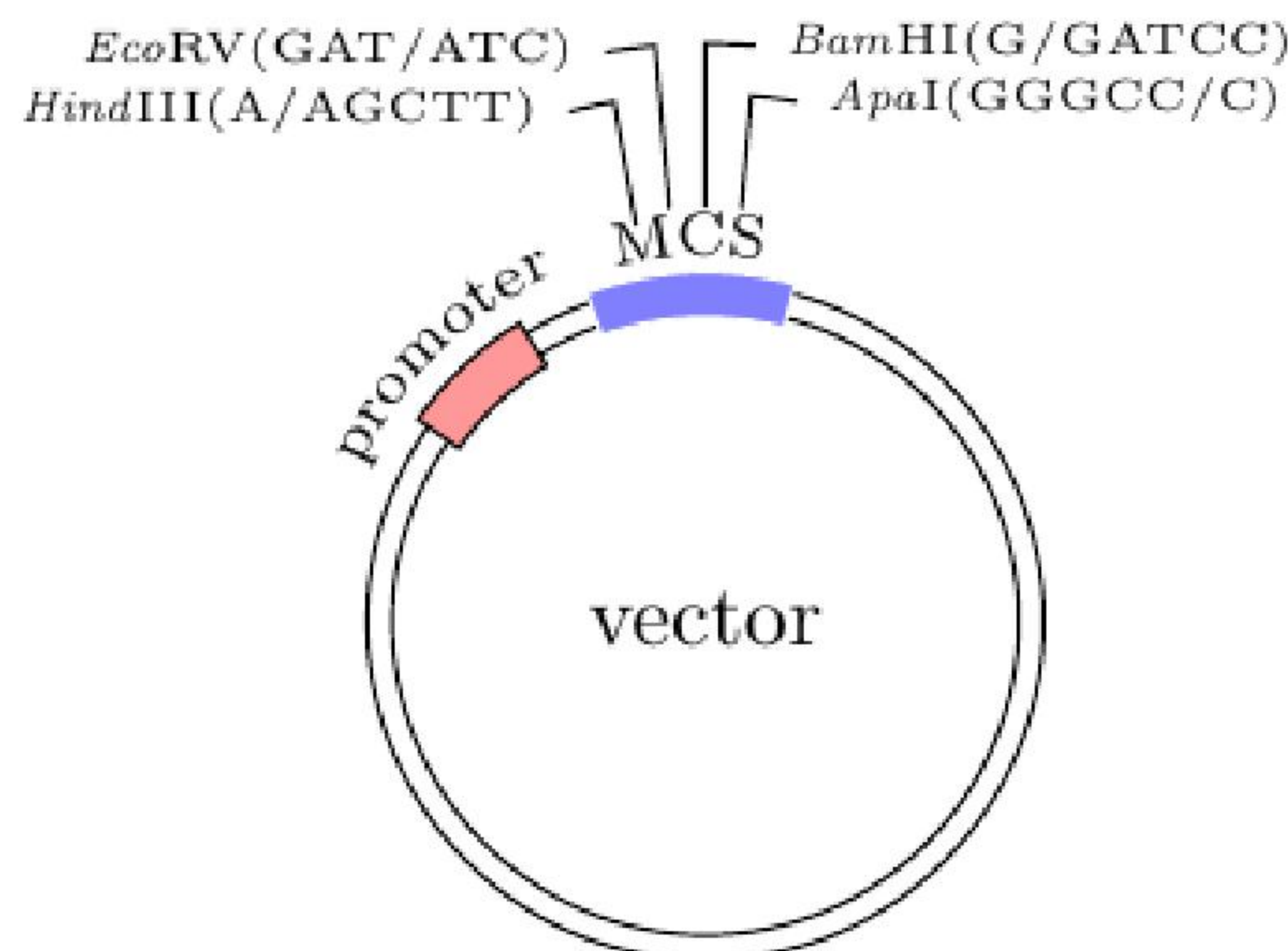
Correct Marks : 4 Wrong Marks : 0

Schematic **P** shows restriction enzyme site mapping on a DNA fragment containing gene *w* that codes for protein **W**. Schematic **Q** shows a plasmid-based vector map and restriction enzyme recognition site sequences in the multiple cloning site (MCS). The oblique lines in the sequences next to each restriction enzyme name show the cleavage sites of the respective restriction enzymes. If the goal of an experimenter is to clone the gene *w* into the vector to express the protein **W**, the correct restriction enzyme pair(s) from the options below that can be used to digest the DNA fragment as well as the vector is/are:

P



Q



Options :

7332351149. ✓ *HindIII* and *ApaI*

7332351150. ✗ *HindIII* and *EcoRV*

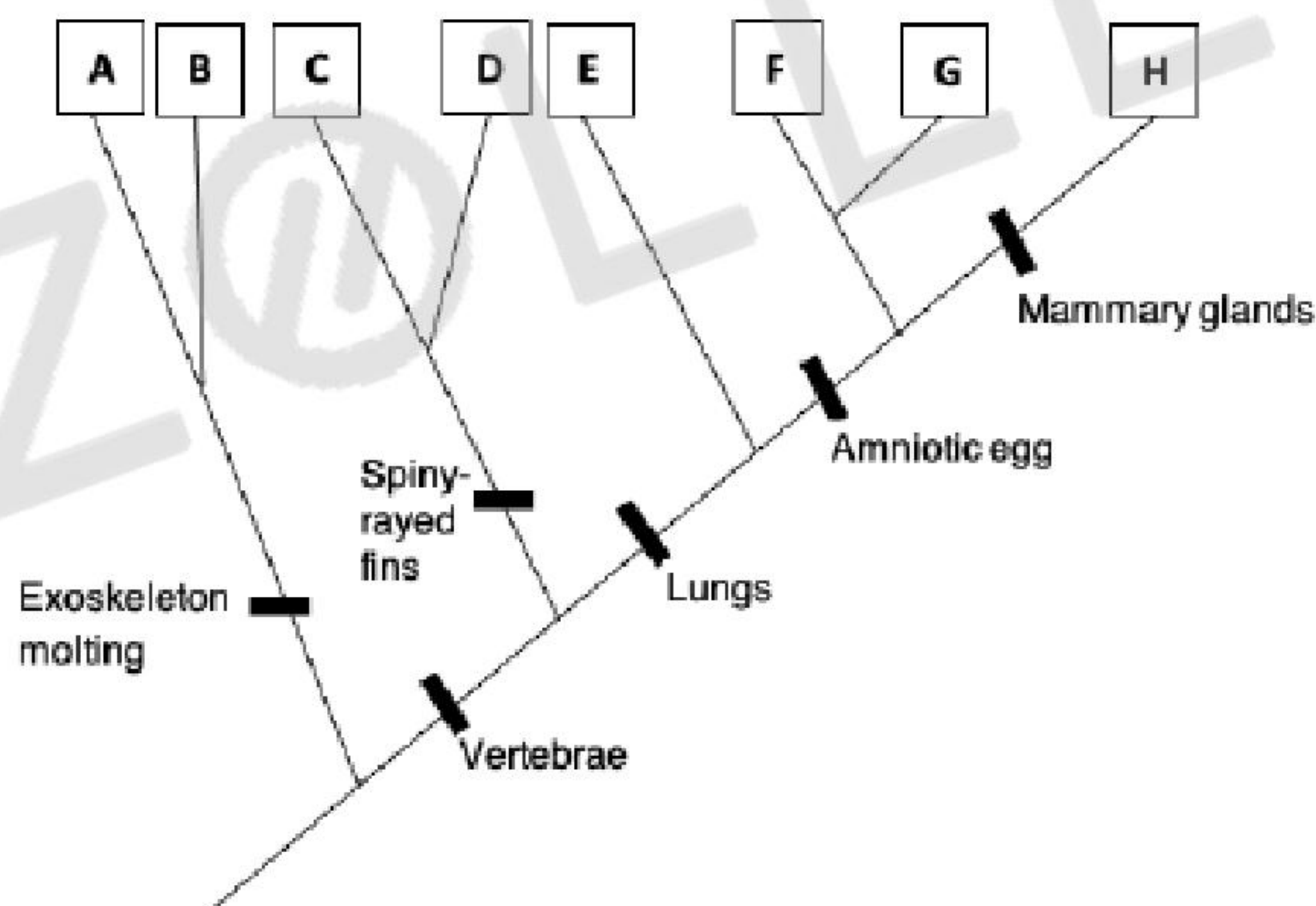
7332351151. ✓ *EcoRV* and *ApaI*

7332351152. ✗ *BamHI* and *EcoRV*

Question Number : 17 Question Id : 733235289 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

A tree depicting the evolutionary relationship between animals A to H is shown below.



With respect to the evolutionary tree, the correct statement(s) is/are:

Options :

7332351153. ✓ If **E** is lungfish, **G** and **H** could be birds and mammals respectively.

7332351154. ✗ **C** and **D** could be flounder fish and salamander respectively.

7332351155. ✓ **A** and **B** could be prawn and crab.

7332351156. ✗ **F** could be ants.

Chemistry

Section Id :	73323518
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 :	73323535
Question Shuffling Allowed :	Yes

Question Number : 18 Question Id : 733235290 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 following reaction



Options :

7332351157. ✖ Na (s) is oxidised and acts as an oxidising agent.

7332351158. ✖ Na (s) is reduced and acts as an oxidising agent.

7332351159. ✖ Cl₂ (g) is oxidised and acts as a reducing agent.

7332351160. ✔ Cl₂ (g) is reduced and acts as an oxidising agent.

Question Number : 19 Question Id : 733235291 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 a first order reaction, the concentrations of the reactant after 30 and 40 minutes are C₁ and C₂, respectively. The initial concentration C₀ (at t = 0) is

Options :

7332351161. ✖ $(C_1)^3/(C_2)^3$

7332351162. ✔ $(C_1)^4/(C_2)^3$

7332351163. ✖ $(C_1)^3/(C_2)^4$

7332351164. ✖ $(C_1)^4/(C_2)^4$

Question Number : 20 Question Id : 733235292 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 filling of two electrons in the p orbitals as shown in the following three figures

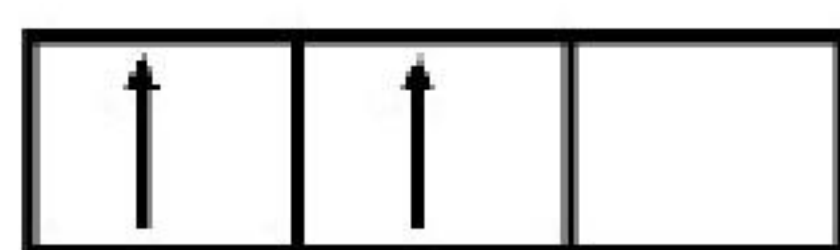


Figure 1

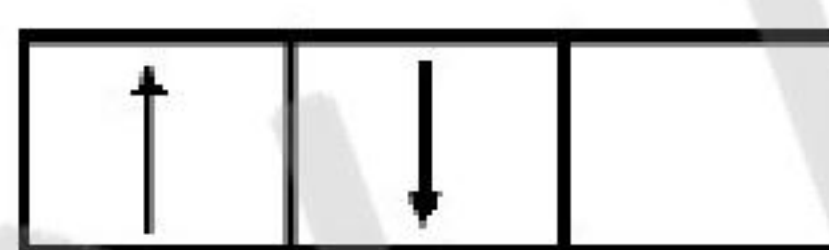


Figure 2



Figure 3

The correct statement is

Options :

7332351165. ✖ Energies of the electronic configurations shown in **Figures 1** and **2** are same, which are, however, lower than that of electrons in **Figure 3**.

7332351166. ✔ Energies of the above three different electronic configurations follow the order: $E(\text{Figure 1}) < E(\text{Figure 2}) < E(\text{Figure 3})$.

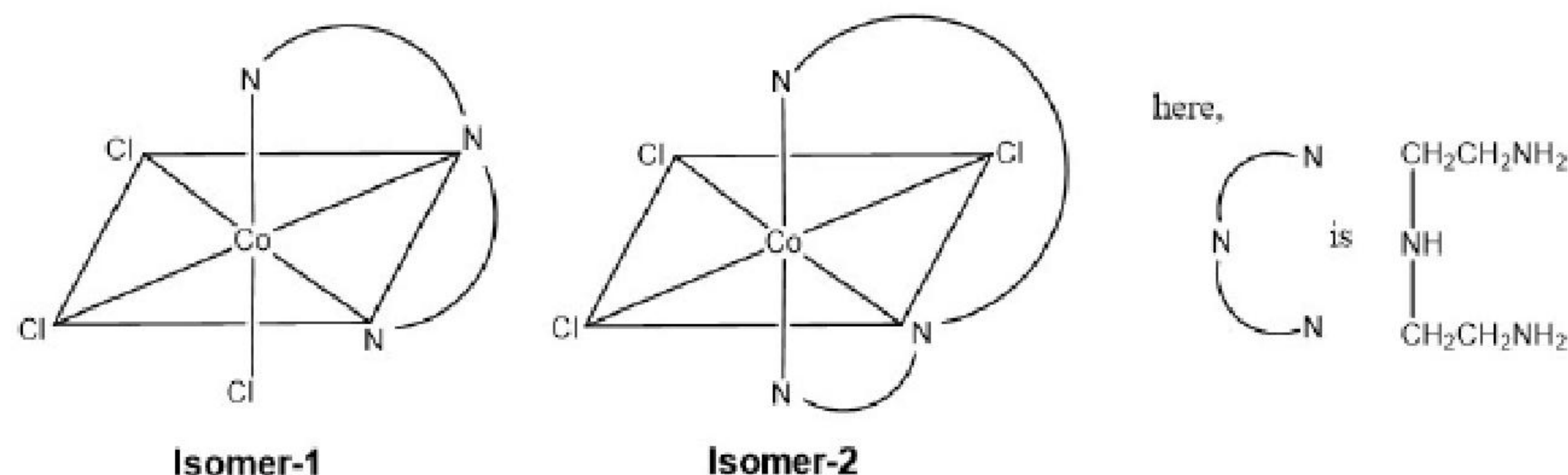
7332351167. ✖ The number of possible of electron exchanges in both **Figure 1** and **Figure 2** is one.

7332351168. ✖ Electronic configuration in **Figure 3** is the most stable.

Question Number : 21 Question Id : 733235293 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 isomers of $[\text{CoCl}_3(\text{NH}_2\text{CH}_2\text{CH}_2\text{NHCH}_2\text{CH}_2\text{NH}_2)]$ are shown below



The correct statement about Isomer-1 and Isomer-2 is

Options :

7332351169. ✓ Isomer-1 and Isomer-2 are *facial* and *meridional*, respectively.

7332351170. ✗ In Isomer-1 and Isomer-2, all Cl-Co-Cl and N-Co-N bond angles are 90° .

7332351171. ✗ Neutral aqueous solution of both these isomers will react with Ag^+ ion to give AgCl.

7332351172. ✗ In Isomer-2, two Cl-Co-Cl bond angles are 180° .

Question Number : 22 Question Id : 733235294 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 low solubility of LiF and CsI in water is due to

Options :

7332351173. ✗ high lattice enthalpy of LiF and CsI.

7332351174. ✗ high hydration enthalpy of LiF and CsI.

7332351175. ✓ high lattice enthalpy of LiF and low hydration enthalpy of CsI.

7332351176. ✗ high hydration enthalpy of LiF and low lattice enthalpy of CsI.

Question Number : 23 Question Id : 733235295 Question Type : MCQ Option Shuffling : Yes Is

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

Instruction Time : 0 Option Orientation : Vertical

Correct Marks : 2.5 Wrong Marks : 1

Hydrolysis of PCl_3 in the presence of moisture gives the compound **X** along with fumes of HCl . On heating, **X** disproportionates to give compound **Y** and phosphine. On heating, **Y** gives compound **Z** and water. The correct statement is

Options :

7332351177. ✖ The oxidation states of phosphorus in **X**, **Y** and **Z** are +3, +4 and +5, respectively

7332351178. ✔ The geometry around phosphorus in **X**, **Y** and **Z** is tetrahedral.

7332351179. ✖ Among **X**, **Y** and **Z**, the compounds **Y** and **Z** are reducing agents.

7332351180. ✖ The basicities of **X** and **Y** are same.

Question Number : 24 Question Id : 733235296 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

2-Propanamine can be synthesized by

Options :

7332351181. ✔ reaction of isobutyramide with Br_2/NaOH .

7332351182. ✖ reduction of isobutyronitrile with NaBH_4 .

7332351183. ✖ reaction of propanal with methanamine followed by reduction.

7332351184. ✖ ammonolysis of 1-chloro-2-methylpropane.

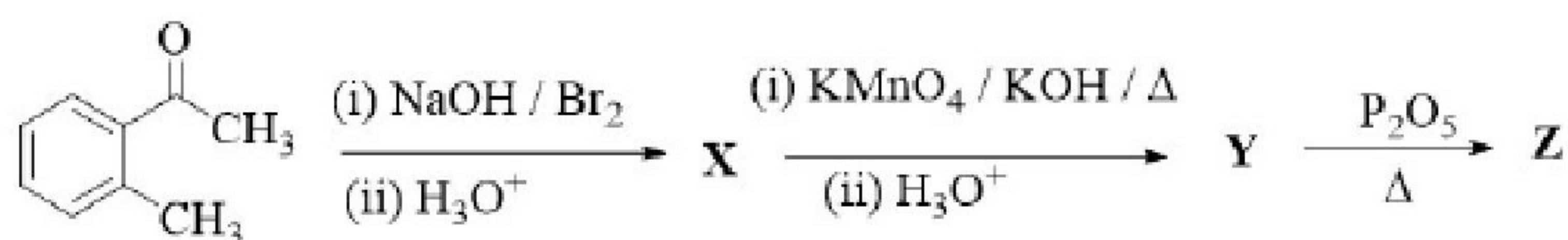
Question Number : 25 Question Id : 733235297 Question Type : MCQ Option Shuffling : Yes Is

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

Instruction Time : 0 Option Orientation : Vertical

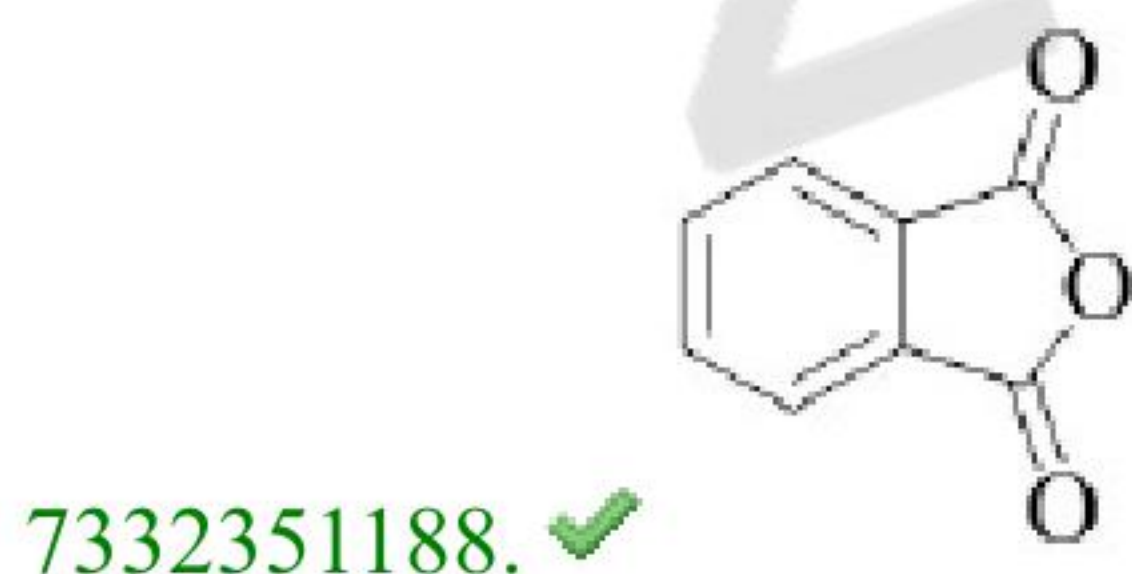
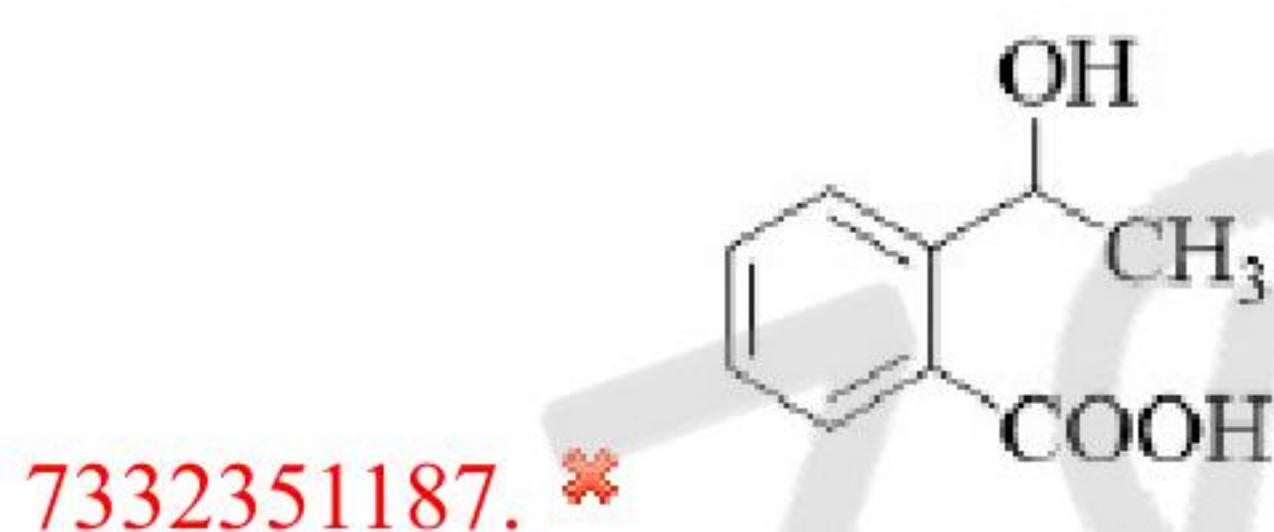
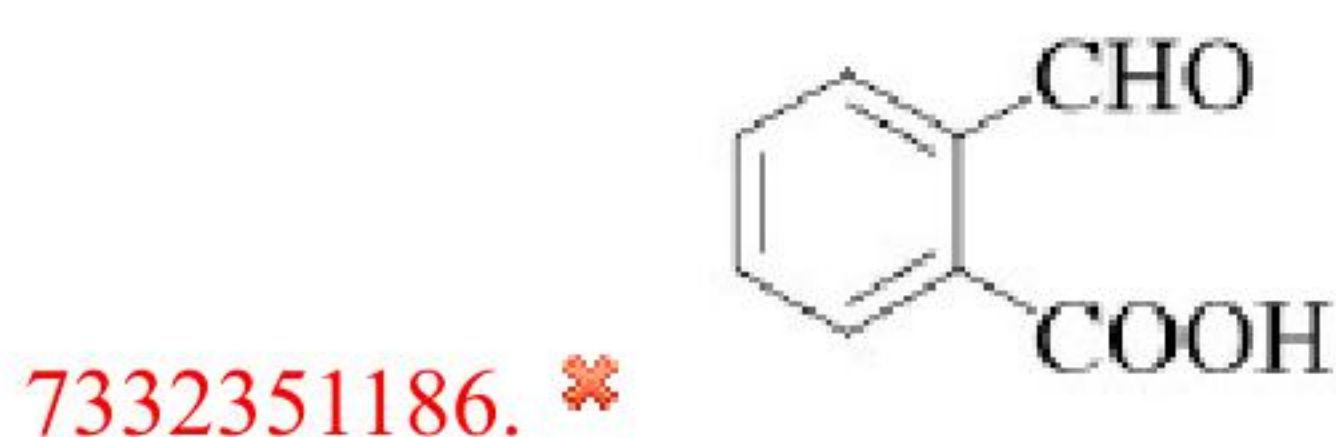
Correct Marks : 2.5 Wrong Marks : 1

Consider the following reaction sequence



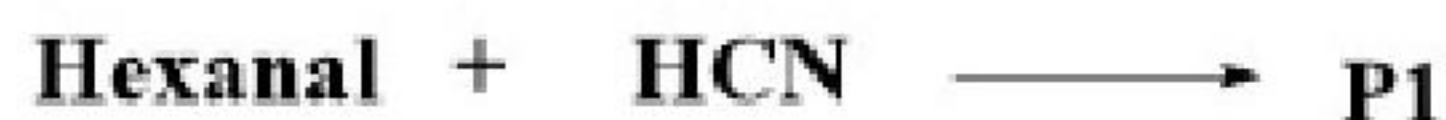
The product **Z** is

Options :



Question Number : 26 Question Id : 733235298 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 following reactions carried out under identical conditions.



The correct statement is

Options :

7332351189. ✖ These reactions involve nucleophilic substitution.

7332351190. ✖ Cyclohexanone is more reactive than hexanal.

7332351191. ✔ Both P1 and P3 are chiral.

7332351192. ✖ Hexanal is less reactive than benzaldehyde.

Question Number : 27 Question Id : 733235299 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

Among the following, the correct statement is

Options :

7332351193. ✖ For $\Psi(\mathbf{r})$ denoting the normalized wavefunction of a one-electron system, the value of $|\Psi(\mathbf{r})|^2$ at any point $\mathbf{r}$ cannot exceed one since the integral of $|\Psi(\mathbf{r})|^2$ over the whole space is one.

7332351194. ✖ The ionization potential of He atom is greater than that of He^+ ion.

7332351195. ✖ If the ionization potential of the hydrogen atom is 13.6 eV, the first excited state energy of the He^+ ion will be 13.6 eV.

7332351196. ✔ According to the prediction of simple molecular orbital theory, the bond orders of He_2^+ ion and H_2^+ ion are the same.

Question Number : 28 Question Id : 733235300 Question Type : MCQ Option

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 one mole of a real gas obeying the van der Waals equation. The correct statement regarding the variation of volume with the van der Waals constants a and b , at constant temperature and pressure, is

Options :

7332351197. ✖ The volume will increase with the increase in the value of a .

7332351198. ✖ The volume will decrease with the increase in the value of b .

7332351199. ✖ The volume will always increase with the increase in the values of both a and b .

7332351200. ✔ The volume will decrease if the value of a increases but the value of b decreases.

Question Number : 29 Question Id : 733235301 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 certain amount of an ideal gas is expanded against a constant external pressure of 1 atmosphere from an initial volume of 1 L to a final volume of 10 L at a constant temperature of 300 K till the pressure of the gas becomes equal to 1 atmosphere. The correct statement is

Options :

7332351201. ✖ The work done by the gas is 10 L atm.

7332351202. ✖ The work done by the gas is $(300 \times 2.303 \times 0.082)$ L atm.

7332351203. ✖ The entropy change in the process is (2.303×0.082) L atm K^{-1} .

7332351204. ✔ The entropy change in the process is $(2.303/30)$ L atm K^{-1} .

Sub-Section Number :

2

Sub-Section Id :

73323536

Question Shuffling Allowed :

Yes

Question Number : 30 Question Id : 733235302 Question Type : MSQ Option

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

The oxidation of sodium borohydride with iodine forms a colourless toxic gas **X** which catches fire spontaneously on exposure to air. **X** undergoes hydrolysis to yield a white crystalline solid **Y**. The correct statement(s) about **X** and **Y** is/are

Options :

7332351205. ✓ The oxidation state of the central atom in **X** and **Y** is +3.

7332351206. ✓ The compound **X** has both terminal and bridging hydrogens.

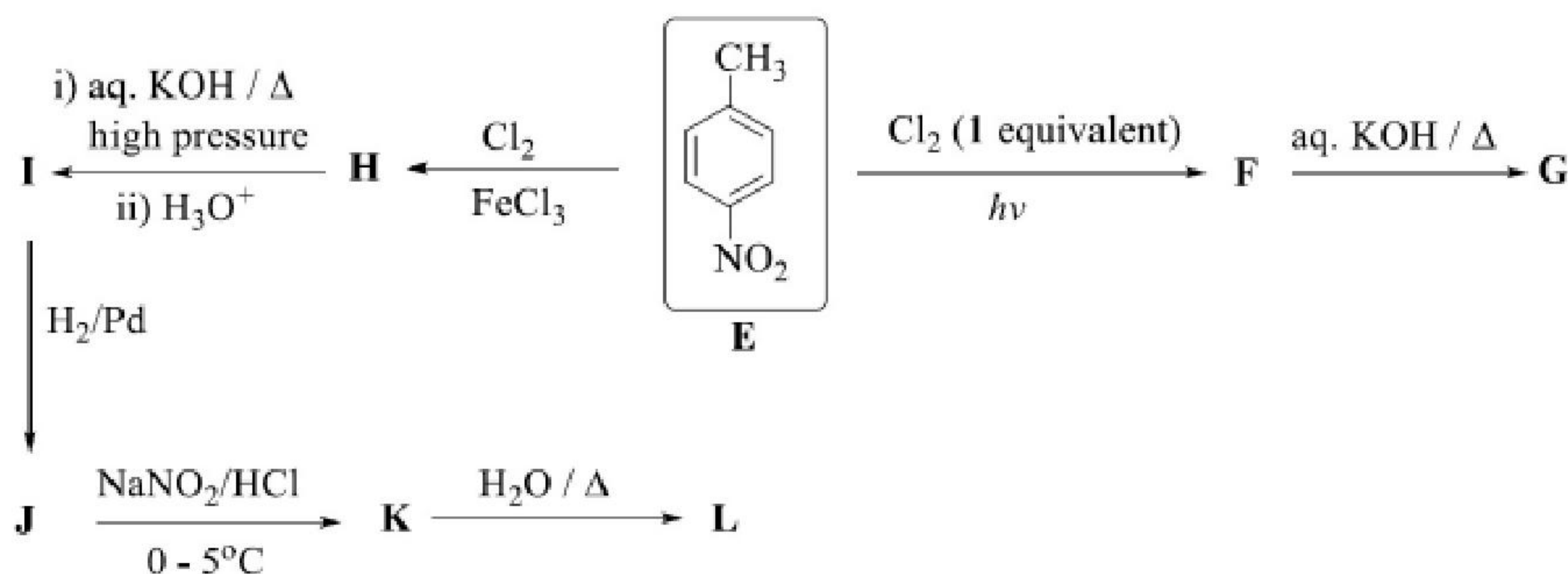
7332351207. ✓ The compound **Y** forms a layered type structure through hydrogen bonding interaction.

7332351208. ✗ The compound **X** reacts with ammonia to form benzene.

Question Number : 31 Question Id : 733235303 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

Consider the reaction sequences starting from compound **E**, shown below, and products formed therein,



The correct statement(s) is/are

Options :

7332351209. ✓ Compound **G** and compound **I** are structural isomers.

Electrophilic aromatic bromination of compound **L** can take place even in the absence of FeBr_3 .
7332351210. ✓

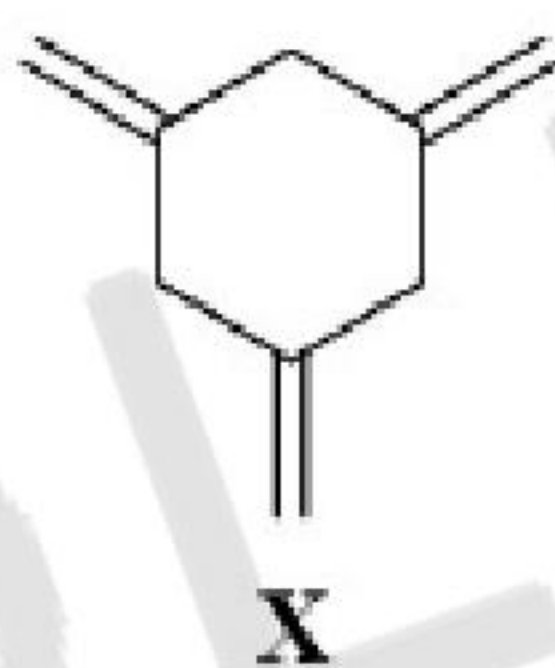
The presence of the $-\text{NO}_2$ group in compound **H** facilitates its conversion to compound **I**.
7332351211. ✗

Conversion of compound **J** to compound **K** involves nitration of **J**.
7332351212. ✗

Question Number : 32 Question Id : 733235304 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

The ozonolysis of the compound **X**, shown below, gives **P** and formaldehyde. **P** is in equilibrium with **Q**. In **Q**, all the carbon-carbon bond lengths are equal.



The correct statement(s) regarding **P** and **Q** is/are

Options :

7332351213. ✓ **Q** turns blue litmus paper red.

7332351214. ✗ **P** forms a silver mirror with Tollens' reagent.

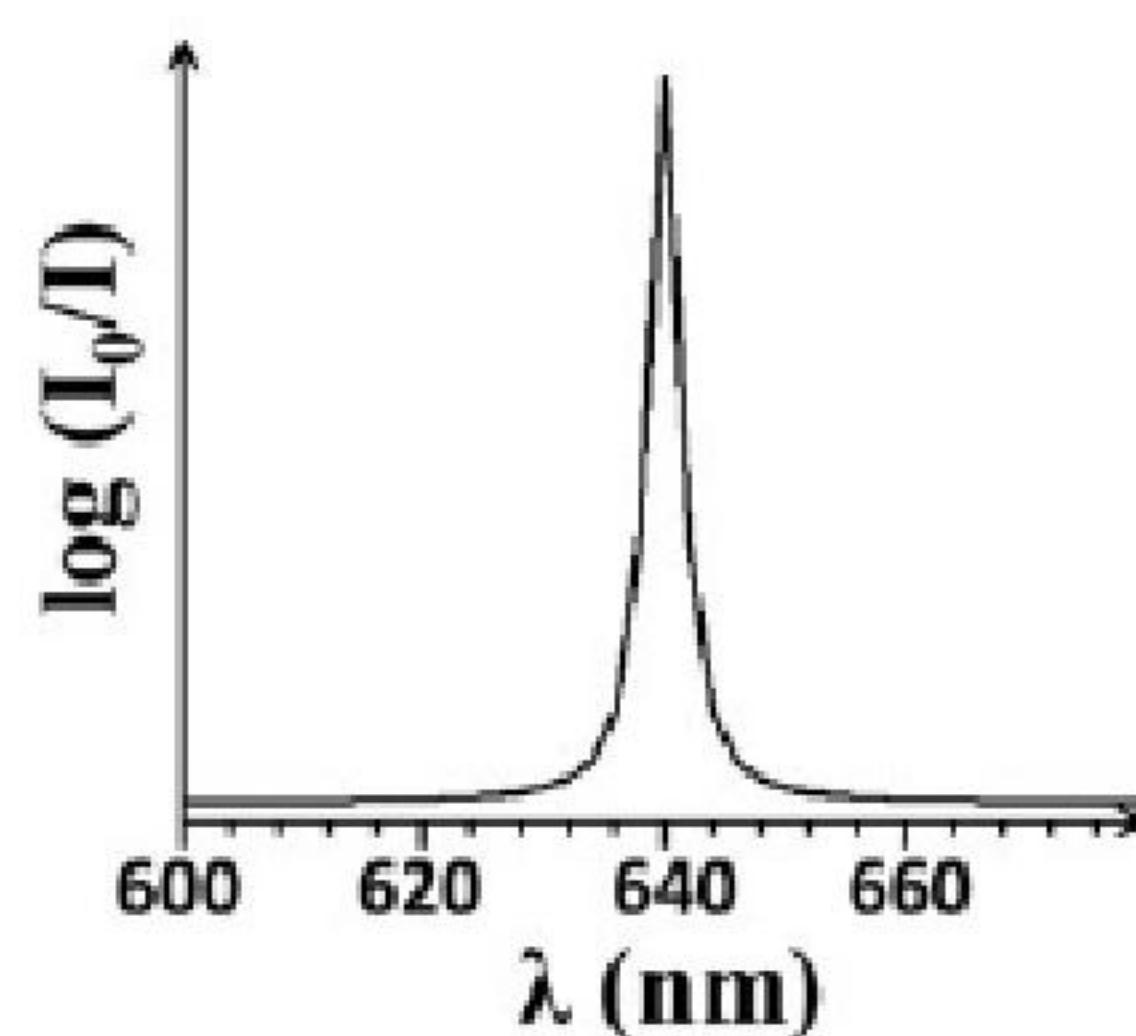
7332351215. ✓ **Q** is aromatic.

7332351216. ✗ **P** on reduction with $\text{NH}_2\text{-NH}_2/\text{KOH}$ yields 1,3,5-cyclohexanetriol.

Question Number : 33 Question Id : 733235305 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

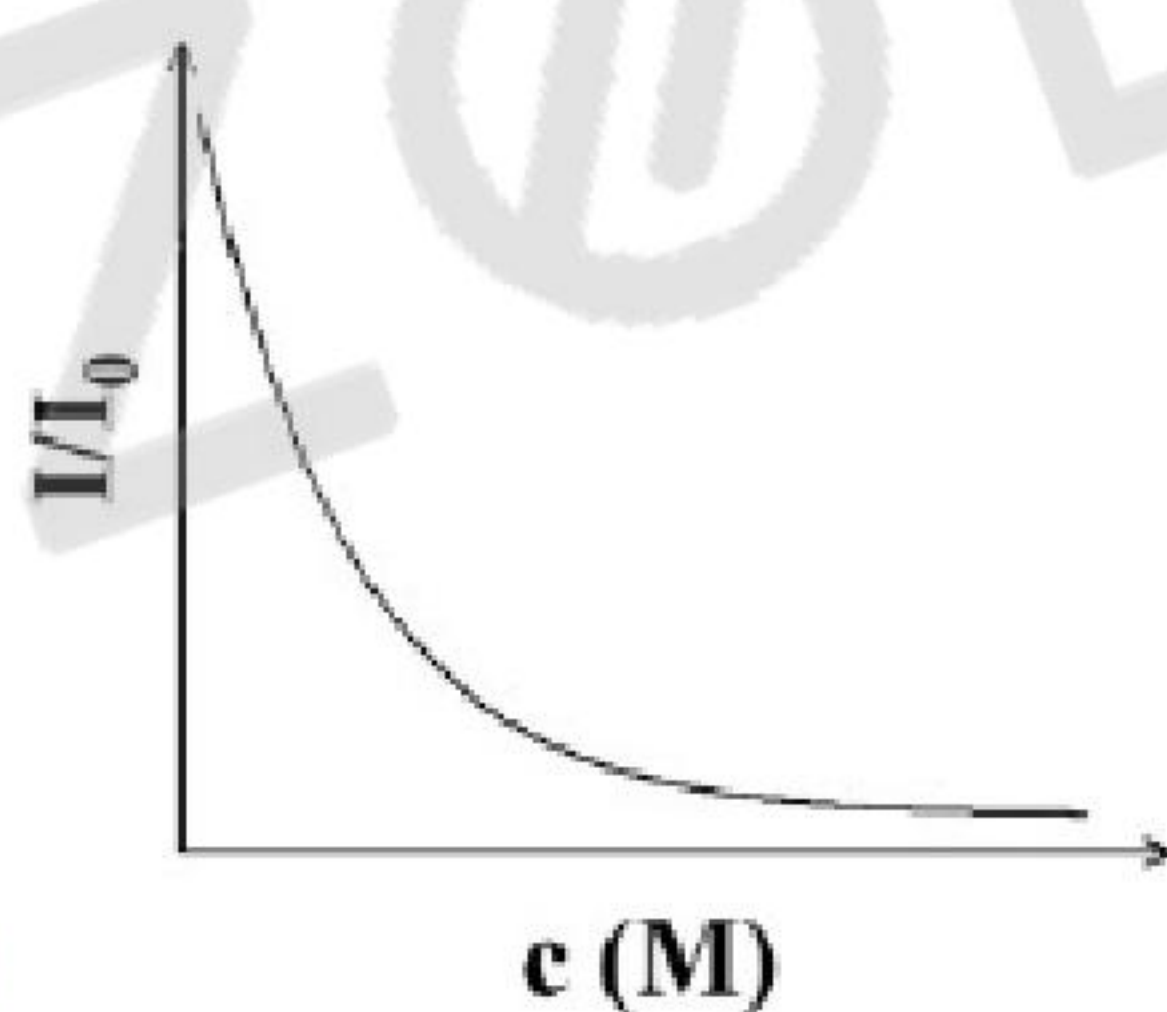
Correct Marks : 4 Wrong Marks : 0

Consider the UV-Visible light of intensity, I_0 , traversing through an aqueous solution of an organic compound placed in a cuvette of length d cm. The compound absorbs UV-Visible light, and hence the intensity of the light emerging out of the cuvette (also called as the transmitted light) reduces to I (with $I < I_0$). The magnitude of the reduction of the intensity of the transmitted light depends on the wavelength of the light (λ) and the concentration of the solution (c). The quantity $\log(I_0/I)$ is called absorbance, which is equal to ϵcd , where ϵ is the molar extinction coefficient. Absorbance depends on λ . A part of the plot of $\log(I_0/I)$ vs. λ for the compound is shown below.

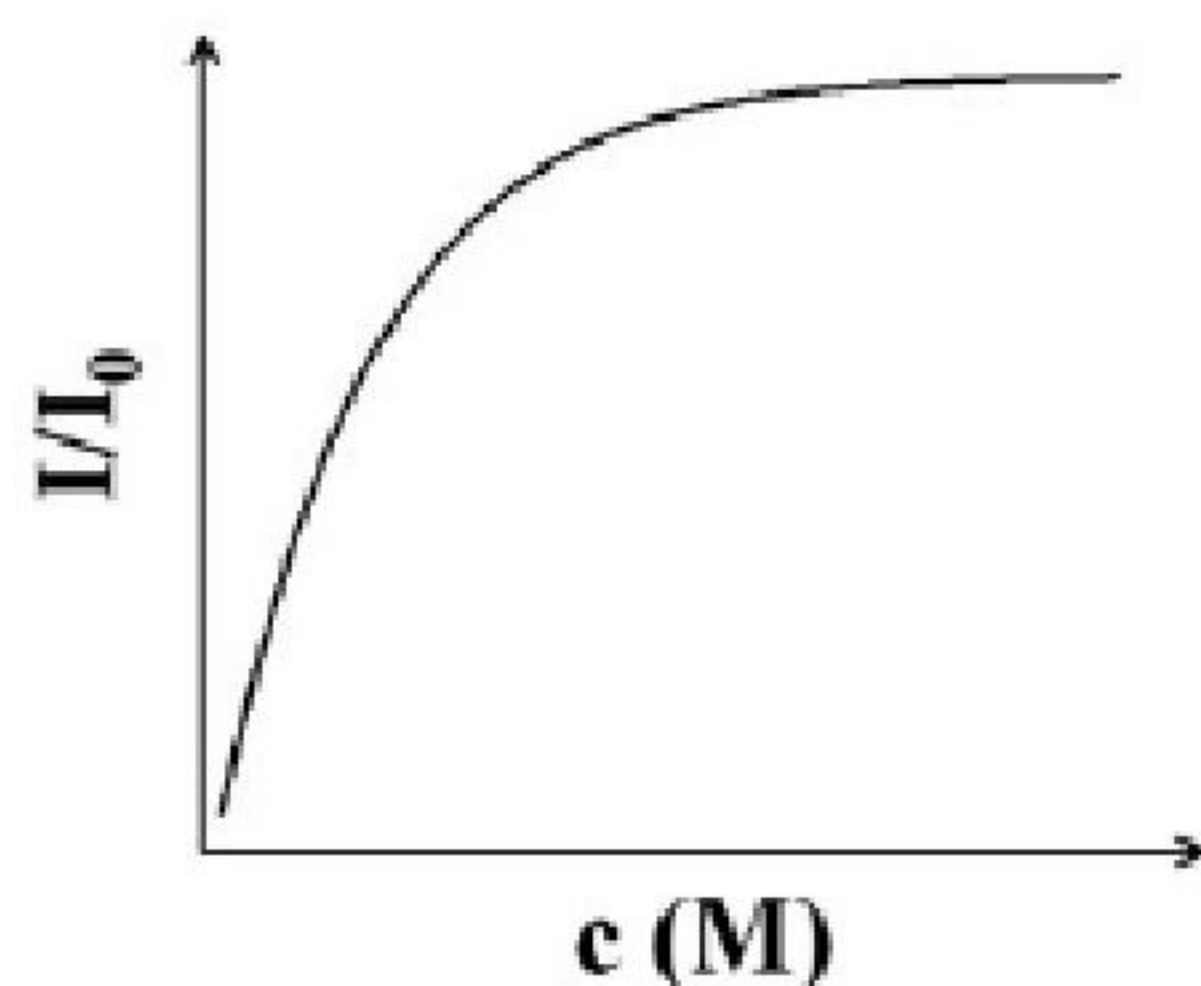


The correct plot(s) describing the phenomenon mentioned above is/are

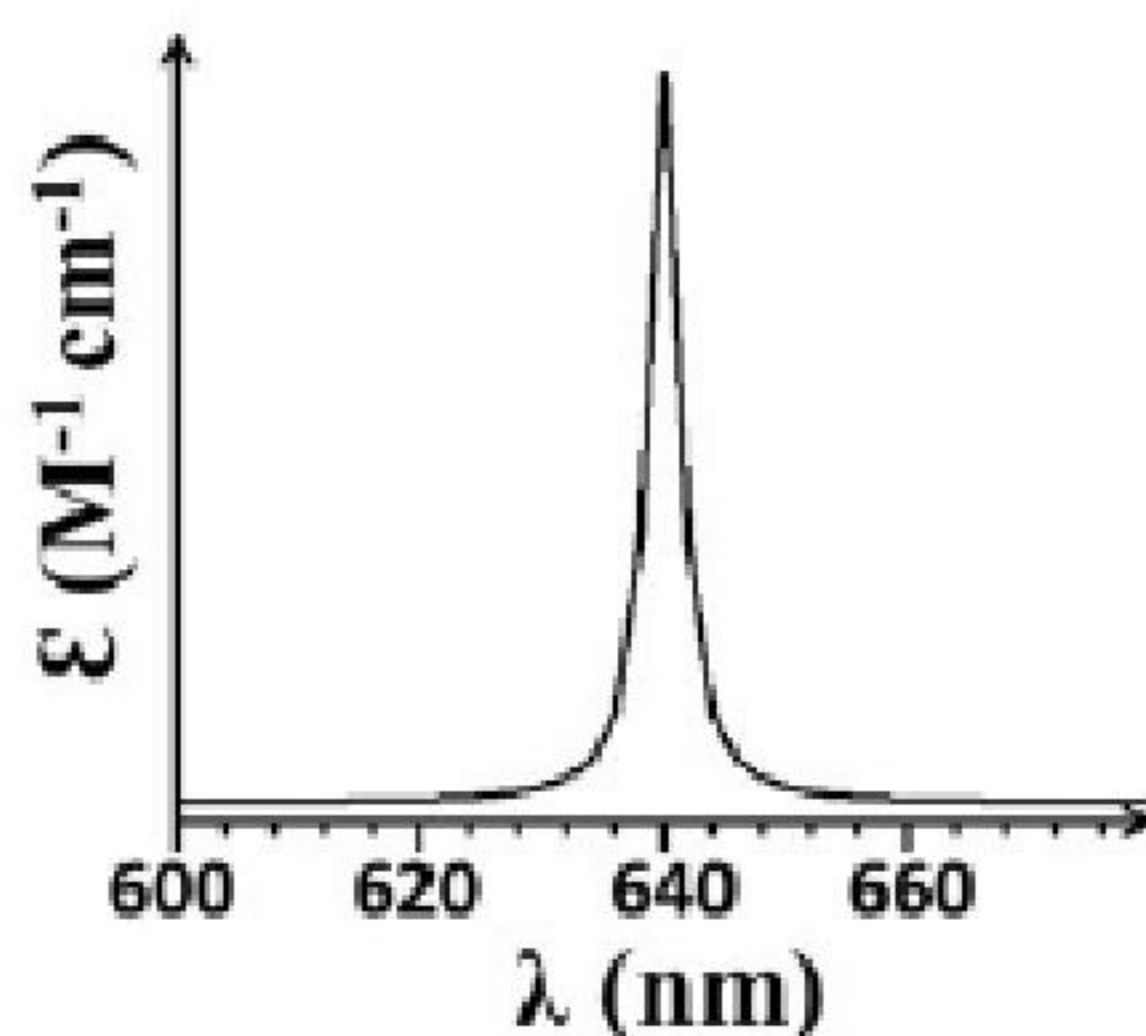
Options :



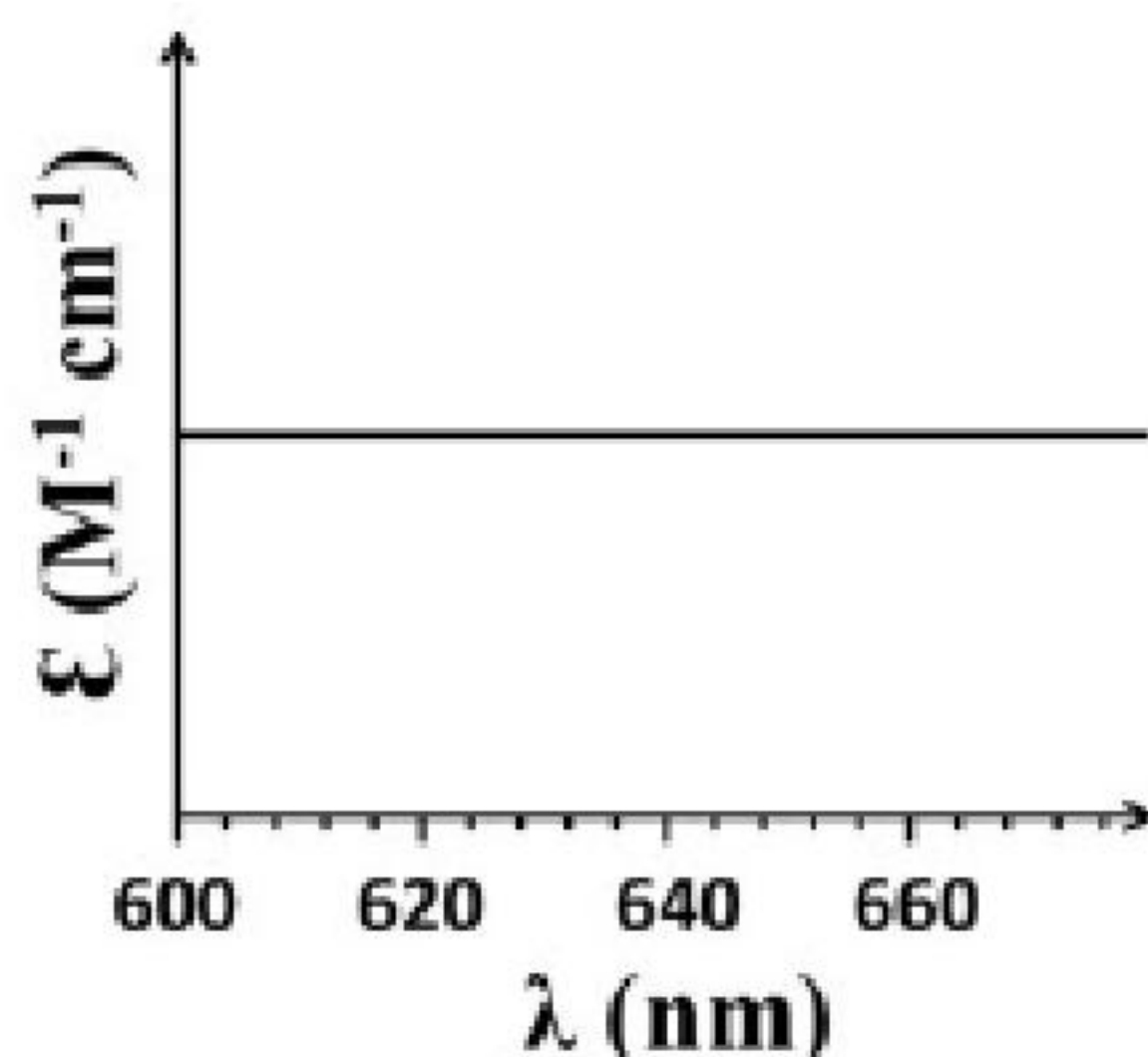
7332351217. ✓



7332351218. ✗



7332351219. ✓



7332351220. ✖

Question Number : 34 Question Id : 733235306 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

For a chemical reaction, between two species, with activation energy E_a and heat of reaction ΔH , the correct statement(s) is/are

Options :

7332351221. ✖ The minimum possible value of E_a is always zero, irrespective of the nature of the species.

7332351222. ✓ The minimum possible value of E_a is always ΔH for an endothermic reaction.

7332351223. ✖ Since E_a is a kinetic parameter, while ΔH is a thermodynamic parameter, the minimum possible value of E_a has no relation with ΔH .

7332351224. ✓ E_a is always zero for atom–atom reactions.

Section Id :	73323519
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 :	73323537
Question Shuffling Allowed :	Yes

Question Number : 35 Question Id : 733235307 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 C_1 and C_2 be two circles with positive radii such that the distance between their centers is equal to the sum of their radii. Then the number of tangents common to both the circles C_1 and C_2 is

Options :

7332351225. ✖ 2

7332351226. ✔ 3

7332351227. ✖ 4

7332351228. ✖ 1

Question Number : 36 Question Id : 733235308 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 $a_1, a_2, \dots, a_{2022}$ be positive integers such that $a_i + a_{i+1} = b + 1$ for $1 \leq i \leq 2021$, where b is a constant. If $a_{202} = 2$, then a_{22} is

Options :

7332351229. ✖ 1

7332351230. ✔ 2

7332351231. ✖ $b - 1$

7332351232. ✖ b

Question Number : 37 Question Id : 733235309 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 probabilities of getting a head for one coin is $\frac{1}{4}$ and for an another coin is $\frac{2}{3}$. If both the coins are tossed simultaneously, then the probability of getting a head and a tail is

Options :

7332351233. ✖ $\frac{1}{12}$

7332351234. ✔ $\frac{7}{12}$

7332351235. ✖ $\frac{1}{2}$

7332351236. ✖ $\frac{1}{6}$

Question Number : 38 Question Id : 733235310 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 α and β satisfy the equation $\sin \alpha + \sin \beta = \sqrt{3}(\cos \alpha - \cos \beta)$, then

Options :

7332351237. ✔ $\sin 3\alpha + \sin 3\beta = 0$.

7332351238. ✖ $\sin 3\alpha + \sin 3\beta = 1$.

7332351239. ✖ $\sin 3\alpha - \sin 3\beta = 0$.

7332351240. ✖ $\sin 3\alpha - \sin 3\beta = 1$.

Question Number : 39 Question Id : 733235311 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 $\lim_{n \rightarrow \infty} \int_0^1 (n+1) \sin \left(x^2 + \frac{\pi}{2} - 1 \right) x^n dx$ is

Options :

7332351241. ✓ 1

7332351242. ✗ 0

7332351243. ✗ $\sin \left(\frac{\pi}{2} - 1 \right)$

7332351244. ✗ ∞

Question Number : 40 Question Id : 733235312 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 $f : \mathbb{R} \rightarrow \mathbb{R}$ be defined by $f(x) = \min(x^3, x^2)$, where $\min(x^3, x^2)$ is the minimum of x^3 and x^2 . Then f is

Options :

7332351245. ✗ continuous everywhere except at $x = 1$.

7332351246. ✓ differentiable everywhere except at $x = 1$.

7332351247. ✗ differentiable everywhere.

7332351248. ✗ differentiable everywhere except at $x = 0, 1$.

Question Number : 41 Question Id : 733235313 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

Assume that the roots of $x^3 + 2x^2 + x + 1 = 0$ are α, β and γ . If $\alpha + \beta, \beta + \gamma, \gamma + \alpha$ are roots of $x^3 + ax^2 + bx + c = 0$ then the value of c is

Options :

7332351249. ✖ -1

7332351250. ✖ 0

7332351251. ✔ 1

7332351252. ✖ 2

Question Number : 42 Question Id : 733235314 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 a, b and c be real numbers such that $ab + bc + ca \neq 0$. Then the equation

$$\sin \theta = \frac{a^2 + b^2 + c^2}{ab + bc + ca}$$

has a solution for θ

Options :

7332351253. ✖ if $a + b + c = 0$.

7332351254. ✖ if and only if $a^2 + b^2 + c^2 < 1$.

7332351255. ✖ if and only if a, b and c all lie in the interval $(-1, 1)$.

7332351256. ✔ if and only if $a = b = c$.

Question Number : 43 Question Id : 733235315 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

$$a = 2^{202}, \quad b = 22^{20} \quad \text{and} \quad c = 20^{22}.$$

Then

Options :

7332351257. ✖ $a < b < c$

7332351258. ✖ $b < a < c$

7332351259. ✖ $c < b < a$

7332351260. ✔ $b < c < a$

Question Number : 44 Question Id : 733235316 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 $x \in \mathbb{R}$, let $\{x\} = x - [x]$ denote the fractional part of x . Suppose $\mathcal{R}$ is a relation defined on $\mathbb{N}$ by $(a, b) \in \mathcal{R}$ if and only if $\left\{\frac{a^2}{8}\right\} = \left\{\frac{b^2}{8}\right\}$. Then the number of equivalence classes of $\mathcal{R}$ is

Options :

7332351261. ✖ 1

7332351262. ✖ 2

7332351263. ✔ 3

7332351264. ✖ 8

Question Number : 45 Question Id : 733235317 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 set of lines in the plane at a unit distance from origin and intersecting both X -axis and Y -axis. Let S be the set of mid points of segments of these lines joining their point of intersection with X -axis and Y -axis. Then S is

Options :

7332351265. ✔ $\{(x, y) : \frac{1}{x^2} + \frac{1}{y^2} = 4\}$.

7332351266. ✖ $\{(x, y) : \frac{1}{x^2} - \frac{1}{y^2} = 4\}$.

7332351267. ✖ $\{(x, y) : x^2 + y^2 = 4\}$.

7332351268. ✖ $\{(x, y) : y^2 = 4x\}$.

Question Number : 46 Question Id : 733235318 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

Three people are to be selected for one post of principal and two posts of vice-principal from the 6 candidates called for an interview. All the 6 candidates are eligible for the post of vice-principals but only 2 of them are eligible for the post of principal. The number of possible ways to make the selection is

Options :

7332351269. ✖ 30

7332351270. ✖ 12

7332351271. ✖ 18

7332351272. ✔ 20

Sub-Section Number :

2

Sub-Section Id :

73323538

Question Shuffling Allowed :

Yes

Question Number : 47 Question Id : 733235319 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

Suppose a is a real number and f is defined as

$$f(x) = \begin{cases} |x|^a \sin(|x|^{-3}) & \text{if } x \neq 0, \\ 0 & \text{if } x = 0. \end{cases}$$

Then

Options :

7332351273. ✖ f is continuous everywhere.

7332351274. ✔ $f'(0)$ exists if and only if $a > 1$.

7332351275. ✖ if $a = 4$, then f' is continuous at 0.

7332351276. ✓ f' exists and is continuous on $\mathbb{R}$ if and only if $a > 4$.

Question Number : 48 Question Id : 733235320 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

Let P be a 3×3 matrix with real entries such that $P^2 = -P$. Then

Options :

7332351277. ✗ P is a diagonal matrix.

7332351278. ✗ the sum of the diagonal entries is 0 or -3 .

7332351279. ✓ if P^{-1} exists then $(P^{-1})^2 = -P^{-1}$.

7332351280. ✗ if P^{-1} does not exist then $P^k = 0$ for some natural number k .

Question Number : 49 Question Id : 733235321 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

Let $A_1, A_2, \dots$ be subsets of a set X such that $A_{j+1} \subset A_j$ for all j . If $A = \cap_{j=1}^{\infty} A_j$, then

Options :

7332351281. ✗ if all A_j 's are nonempty then A is nonempty.

7332351282. ✗ if all A_j 's are infinite then A is infinite.

7332351283. ✓ if there exists j_0 such that A_j 's are nonempty finite subsets for all $j \geq j_0$, then A is nonempty.

7332351284. ✗ if all A_j 's are infinite and A is nonempty then A is infinite.

Question Number : 50 Question Id : 733235322 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

Let $\vec{P}, \vec{Q}$ and $\vec{R}$ be three non-zero vectors in the three dimensional right handed rectangular coordinate system. Then

Options :

7332351285. ✖ if $\vec{P}, \vec{Q}$ and $\vec{P} + \vec{Q}$ are unit vectors then $|\vec{P} - \vec{Q}| = \frac{\sqrt{3}}{2}$.

7332351286. ✔ the vectors $\vec{P} \times (\vec{Q} \times \vec{R}), \vec{Q} \times (\vec{R} \times \vec{P})$ and $\vec{R} \times (\vec{P} \times \vec{Q})$ are coplanar.

7332351287. ✔ if $\vec{P} \times \vec{Q} = \vec{R}$ and $\vec{Q} \times \vec{R} = \vec{P}$ then $\vec{P}, \vec{Q}$ and $\vec{R}$ are orthogonal in pairs and $|\vec{P}| = |\vec{R}|$.

7332351288. ✖ if $\vec{P}, \vec{Q}$ and $\vec{R}$ are unit vectors then the angle between $\vec{P} + \vec{Q} + \vec{R}$ and any of $\vec{P}, \vec{Q}$ and $\vec{R}$ is the same.

Question Number : 51 Question Id : 733235323 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

For $n \in \mathbb{N}$, a complex number ω is called an n -th root of unity if $\omega^n = 1$. Then

Options :

7332351289. ✖ the product of all the distinct n -th roots of unity is $(-1)^n$.

if ω is a 10-th roots of unity different from 1 then

$$\sum_{j=0}^4 |z_1 + \omega^{2j} z_2|^2 = 5(|z_1|^2 + |z_2|^2) \quad \text{for any } z_1, z_2 \in \mathbb{C}.$$

7332351290. ✖

if $n \geq 5$ and ω is an n -th root of unity different from 1 then

$$\sum_{j=0}^{n-1} |z_1 + \omega^j z_2|^2 = n(|z_1|^2 + |z_2|^2) \quad \text{for any } z_1, z_2 \in \mathbb{C}.$$

7332351291. ✔

if $n \geq 5$ then the complex conjugate of an n -th roots of unity is an n -th root of unity.

7332351292. ✔

Physics

Section Id :	73323520
Section Number :	4
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 :	73323539
Question Shuffling Allowed :	Yes

Question Number : 52 Question Id : 733235324 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 natural units, the speed of light is set to unity, *i.e.* $c = 1$. In this unit the energy is measured in

Options :

7332351293. ✖ $\text{m} \cdot \text{s}^{-1}$

7332351294. ✖ $\text{kg} \cdot \text{s}^{-1}$

7332351295. ✖ $\text{kg} \cdot \text{m}^{-1}$

7332351296. ✔ kg

Question Number : 53 Question Id : 733235325 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 body of weight W is lifted through a height h by application of force F over a time Δt using a lever. Choose the correct option.

Options :

7332351297. ✖ When W is kept between the fulcrum and F , it needs a force greater than W to lift it by h .

If the fulcrum is between W and F , the mechanical advantage is always greater than when it is kept at any one end of the lever.

7332351298. ✖

If F is applied at a point on the lever between the fulcrum and W , then the body will be lifted by maximum distance.

7332351299. ✔

Irrespective of the position of the fulcrum, F must always be directed in the direction of the lift.

7332351300. ✖

Question Number : 54 Question Id : 733235326 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 maximum angle to the horizontal at which a stone is thrown, such that the distance between the stone and the point of projection is always increasing, is

Options :

7332351301. ✖ $\pi/4$

7332351302. ✔ $\sin^{-1}(2\sqrt{2}/3)$

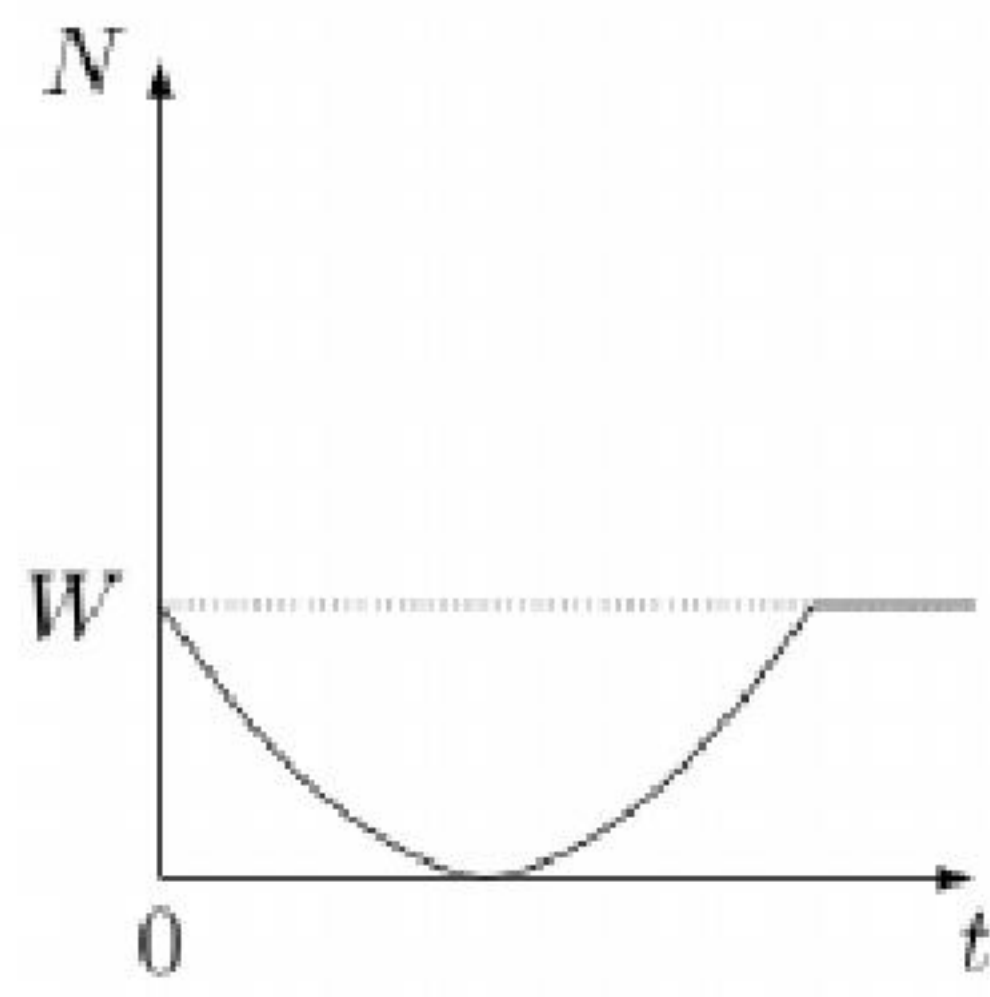
7332351303. ✖ $\sin^{-1}(\sqrt{2}/3)$

7332351304. ✖ $\sin^{-1}(2/3)$

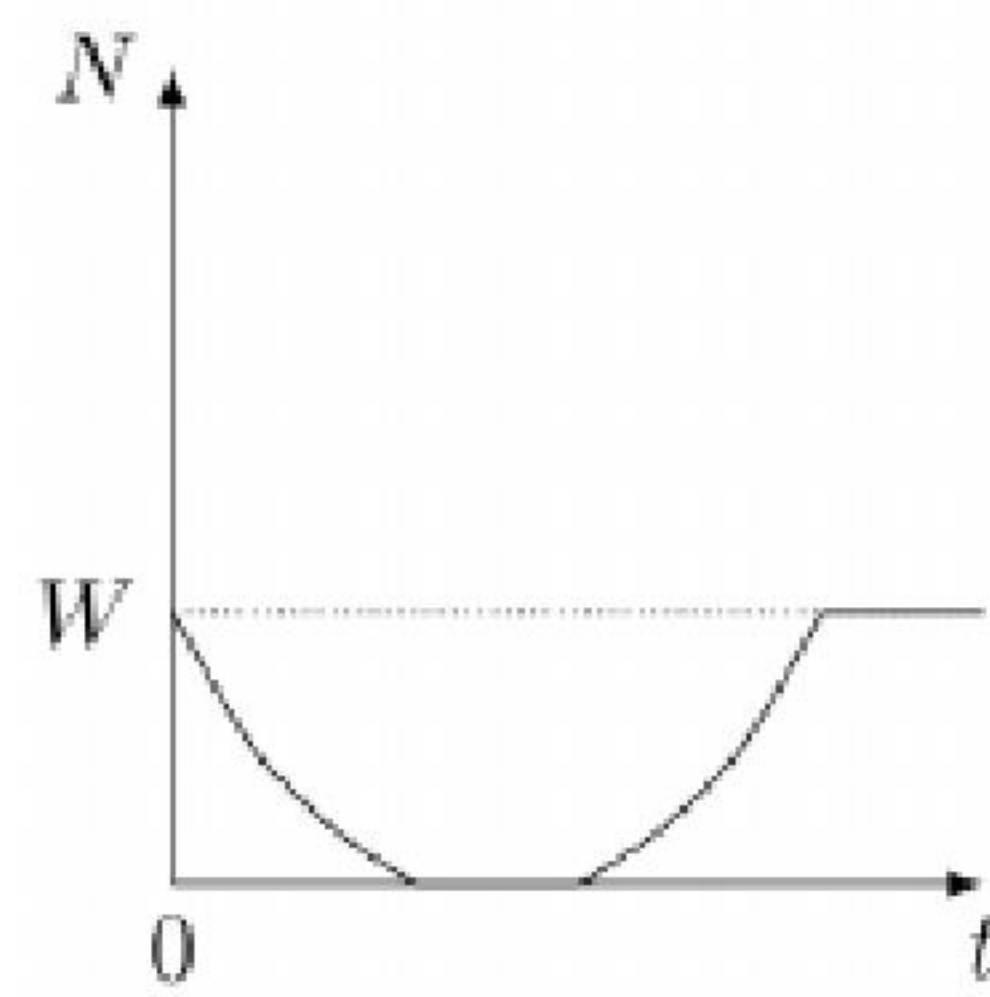
Question Number : 55 Question Id : 733235327 Question Type : MCQ Option Shuffling : Yes Is Question Mandatory : No Calculator : None Response Time : N.A Think Time : N.A Minimum Instruction Time : 0 Option Orientation : Vertical Correct Marks : 2.5 Wrong Marks : 1

A person of weight W is crouching on the ground, ready to jump. At $t = 0$, she starts to jump vertically up in the air. The normal reaction N of the ground as a function of time is best described by the plot

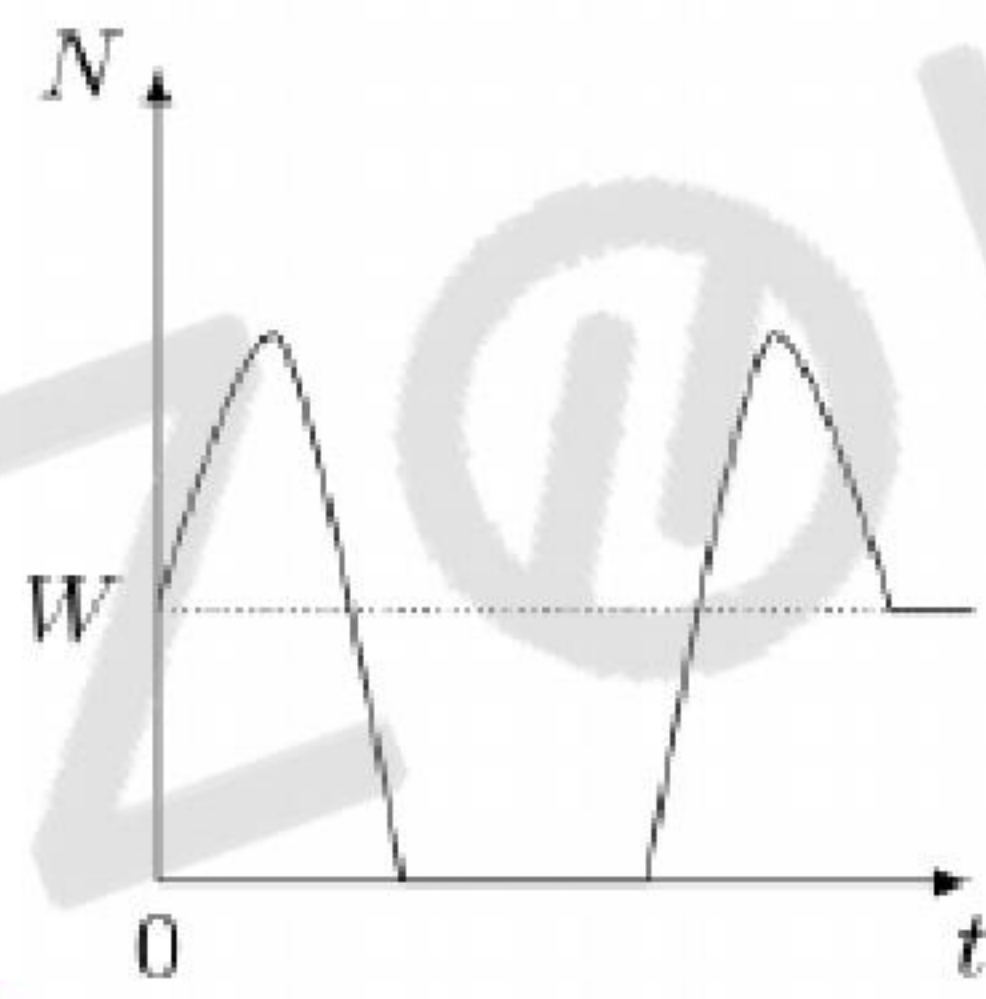
Options :



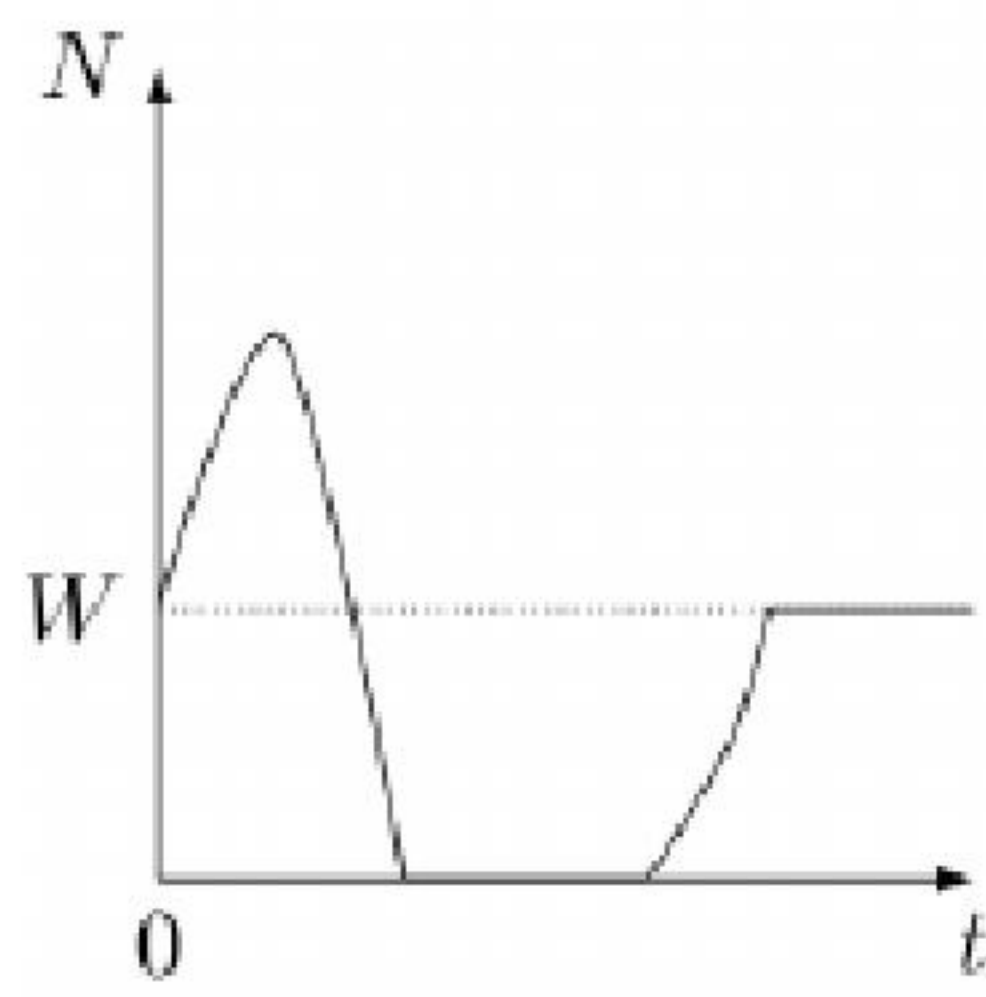
7332351305. ✖



7332351306. ✖



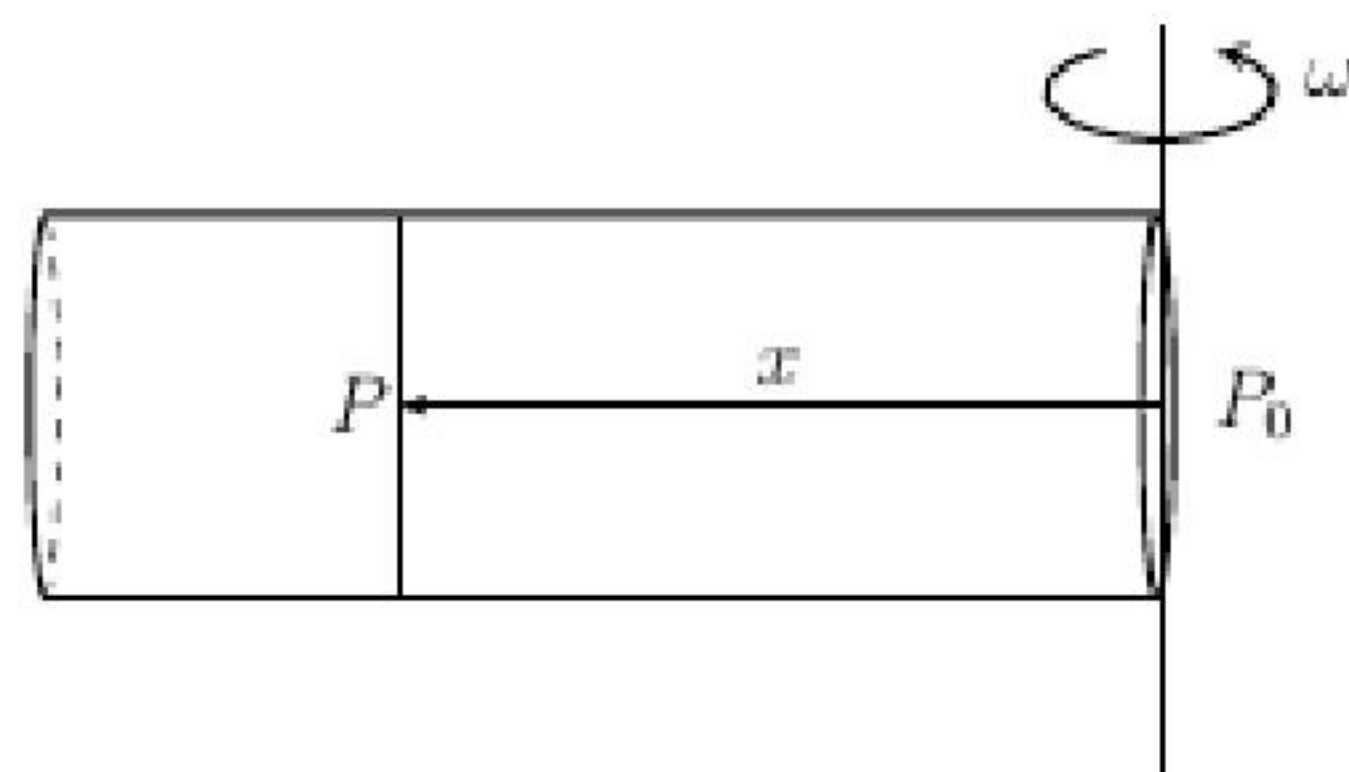
7332351307. ✔



7332351308. ✖

Question Number : 56 Question Id : 733235328 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 horizontal cylinder, closed at one end, is rotated with a constant angular velocity ω about a vertical axis passing through the open end of the cylinder as shown in the figure. The outside air pressure is P_0 , temperature is T and the molar mass of the air is μ . Assume air to be an ideal gas and the temperature T remaining constant everywhere. The air pressure inside the cylinder is best described by



Options :

7332351309. ✖ $P = P_0 \left[1 + \log \left(1 + \frac{\mu \omega^2 x^2}{2RT} \right) \right]$

7332351310. ✖ $P = P_0 \left(1 + \frac{\mu \omega^2 x^2}{2RT} \right)$

7332351311. ✖ $P = P_0 \left[1 + \exp \left(-\frac{2RT}{\mu \omega^2 x^2} \right) \right]$

7332351312. ✔ $P = P_0 \exp \left(\frac{\mu \omega^2 x^2}{2RT} \right)$

Question Number : 57 Question Id : 733235329 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 smaller soap bubble of radius r is inside a larger soap bubble of radius R . The smaller bubble bursts and the radius of the external bubble changes to Q . Assume the air inside the bubbles to be ideal gas and the process to be isothermal. If the external pressure is P , the surface tension of the soap solution is

Options :

7332351313. ✖ $\frac{PQ}{4}$

7332351314. ✖ $\frac{P(Q - R - r)}{12}$

7332351315. ✖ $\frac{P(Q^2 - R^2)}{4(R + r - Q)}$

7332351316. ✔ $\frac{P(Q^3 - R^3)}{4(R^2 + r^2 - Q^2)}$

Question Number : 58 Question Id : 733235330 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 identical drops of water are falling through air with a terminal velocity v . If the drops merge during the fall, then the terminal velocity of the combined drop is

Options :

7332351317. ✖ $2^{1/3} v$

7332351318. ✖ $\sqrt{2} v$

7332351319. ✔ $2^{2/3} v$

7332351320. ✖ $2 v$

Question Number : 59 Question Id : 733235331 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 oil drop experiment, negatively charged droplets of equal mass (2.93×10^{-15} kg) are studied as they fall through vacuum. An electric field of magnitude 5.92×10^4 N/C, pointing downwards, is present. It is observed that a droplet of charge Q_1 remains suspended while another with charge Q_2 falls through 0.125 m from rest in 0.25 s. The Q_1/Q_2 is closest to,

Options :

7332351321. ✔ 1.67

7332351322. ✖ 1.95

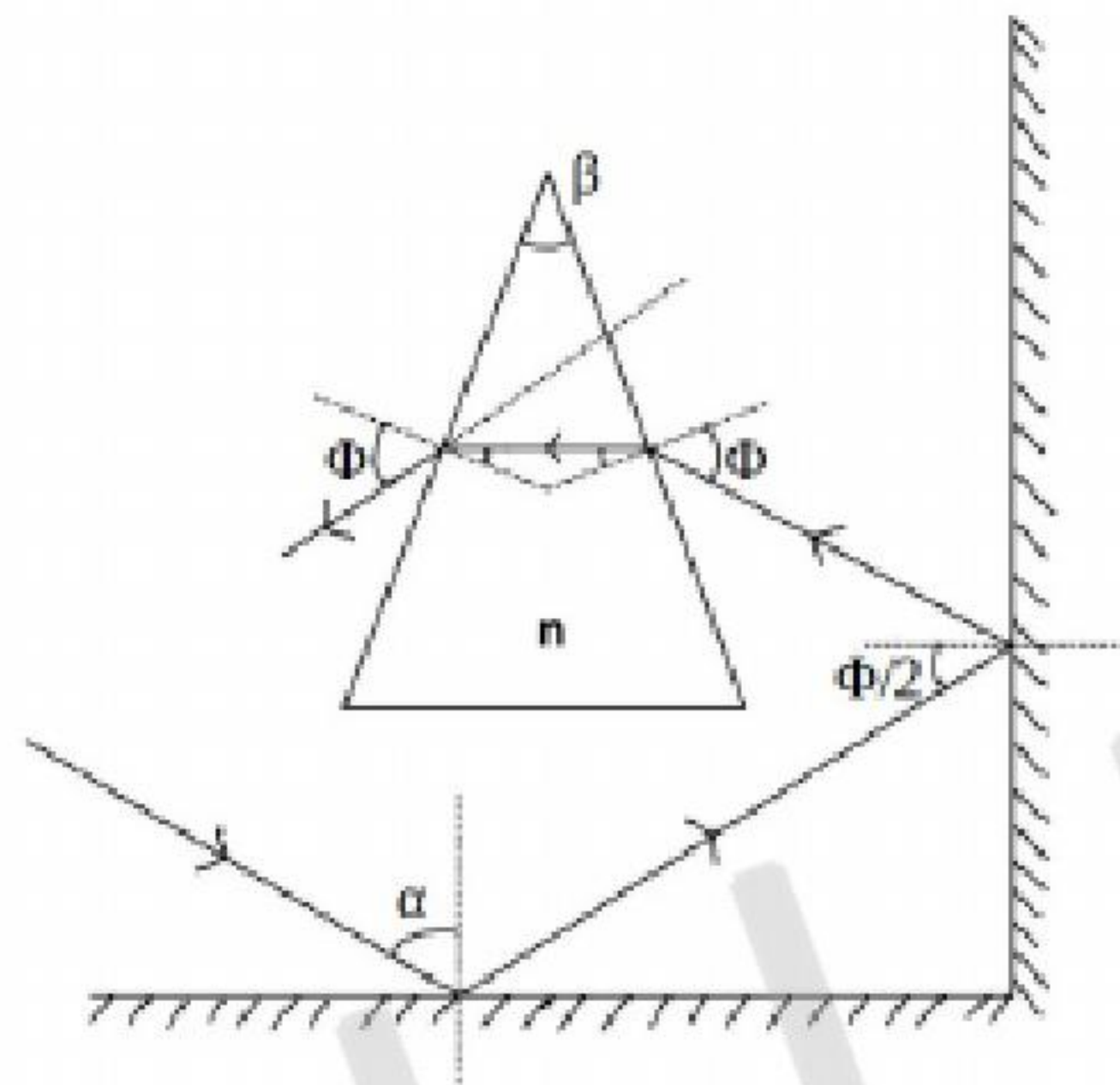
7332351323. ✖ 1.24

7332351324. ✖ 2.22

Question Number : 60 Question Id : 733235332 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 glass prism, of angle β , is placed in front of two mutually perpendicular mirrors, as shown in the figure below. The refractive index of the material of the prism is (taking $n_{\text{air}} = 1$),



Options :

7332351325. ✖ $\frac{\sin(\alpha)}{\sin(\beta/2)}$

7332351326. ✔ $\frac{\sin(2\alpha)}{\sin(\beta/2)}$

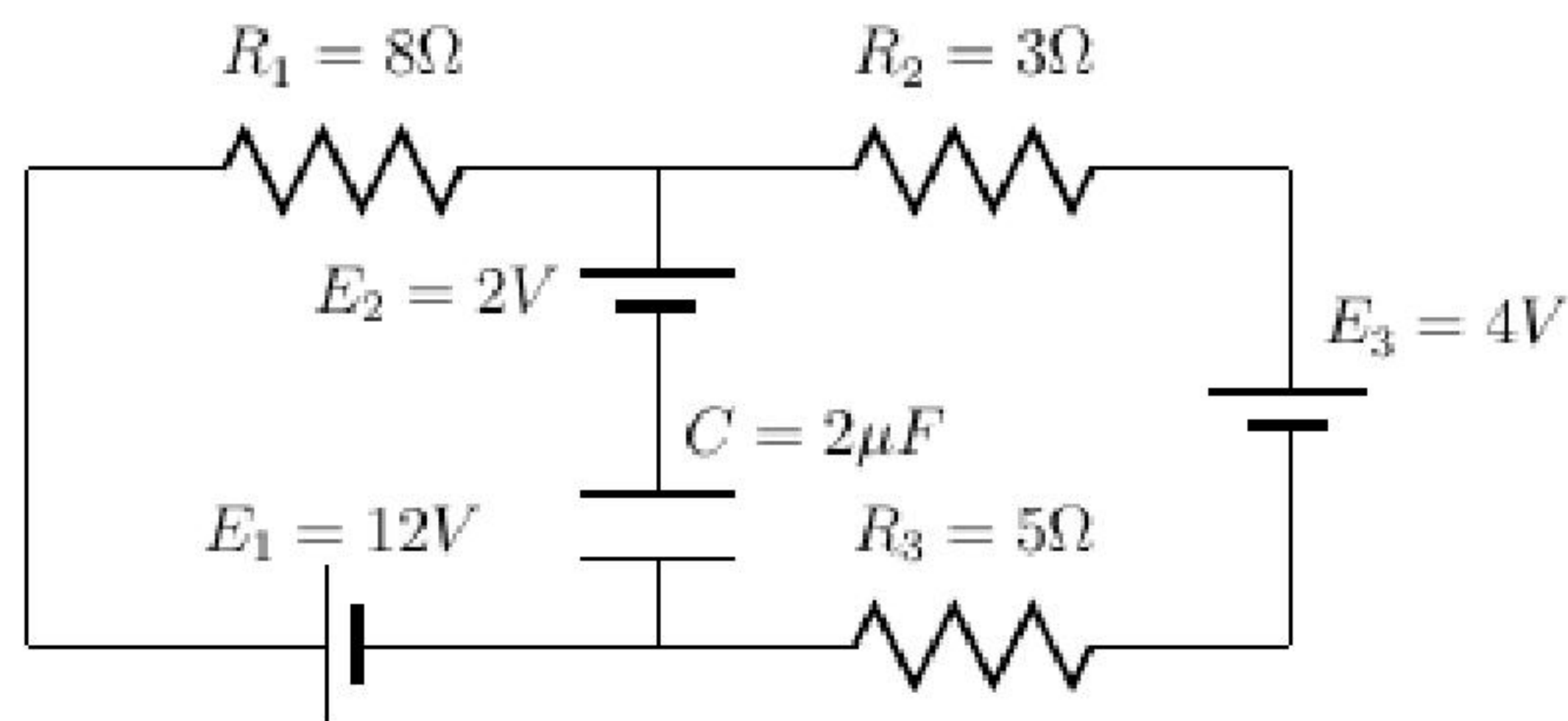
7332351327. ✖ $\frac{\sin(\alpha/2)}{\sin(\beta/2)}$

7332351328. ✖ $\frac{\sin\left(\frac{\alpha+\beta}{2}\right)}{\sin(\beta/2)}$

Question Number : 61 Question Id : 733235333 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 steady state, the charge (in micro Coulomb) stored in the capacitor $C = 2\mu F$ in the circuit below is



Options :

7332351329. ✖ 6

7332351330. ✔ 12

7332351331. ✖ 18

7332351332. ✖ 24

Question Number : 62 Question Id : 733235334 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 number of radioactive nuclei in a sample is halved every 69 sec. Then, on an average the number of nuclei decaying per second is approximately

Options :

7332351333. ✖ 1 in 70

7332351334. ✖ 1 in 140

7332351335. ✔ 1 in 100

7332351336. ✖ 1 in 35

Question Number : 63 Question Id : 733235335 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 hot metal block at temperature θ_H , kept in a room at lower temperature θ_R , cools as per Newton's law of cooling. In 22 minutes, the difference of temperature with the room reduces to $(\theta_H - \theta_R)/3$. Time taken in minutes to reduce the difference to $(\theta_H - \theta_R)/6$ is closest to

Options :

7332351337. ✖ 27

7332351338. ✖ 30

7332351339. ✖ 33

7332351340. ✔ 36

Sub-Section Number :

2

Sub-Section Id :

73323540

Question Shuffling Allowed :

Yes

Question Number : 64 Question Id : 733235336 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

A planet of mass M and radius R is surrounded by a thin layer of atmosphere of height H and of constant density ρ , having pressure P and temperature T . The atmosphere consists of ideal gas molecules of only one type, each of mass m with root-mean-square speed v_{rms} . Taking acceleration due to gravity to be constant within the atmosphere, at height $h < H$ from the surface

Options :

7332351341. ✔ $P = \frac{\rho G M h}{R^2}$

7332351342. ✔ $T = \frac{G M m h}{k_B R^2}$

7332351343. ✖ $\rho = \frac{3M}{4\pi R^3}$

7332351344. ✔ $v_{\text{rms}} = \frac{1}{R} \sqrt{3 G M h}$

Question Number : 65 Question Id : 733235337 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

A person is dropping identical tennis balls from rest at a rate of 1 ball per second. When the 6th ball is about to be dropped, the 1st ball has just reached the ground. At this instant,

Options :

7332351345. ✓ the center of mass of all 6 balls is in between the 2nd and 3rd ball from the ground.

7332351346. ✓ the difference between the velocities of any two consecutive balls is always constant.

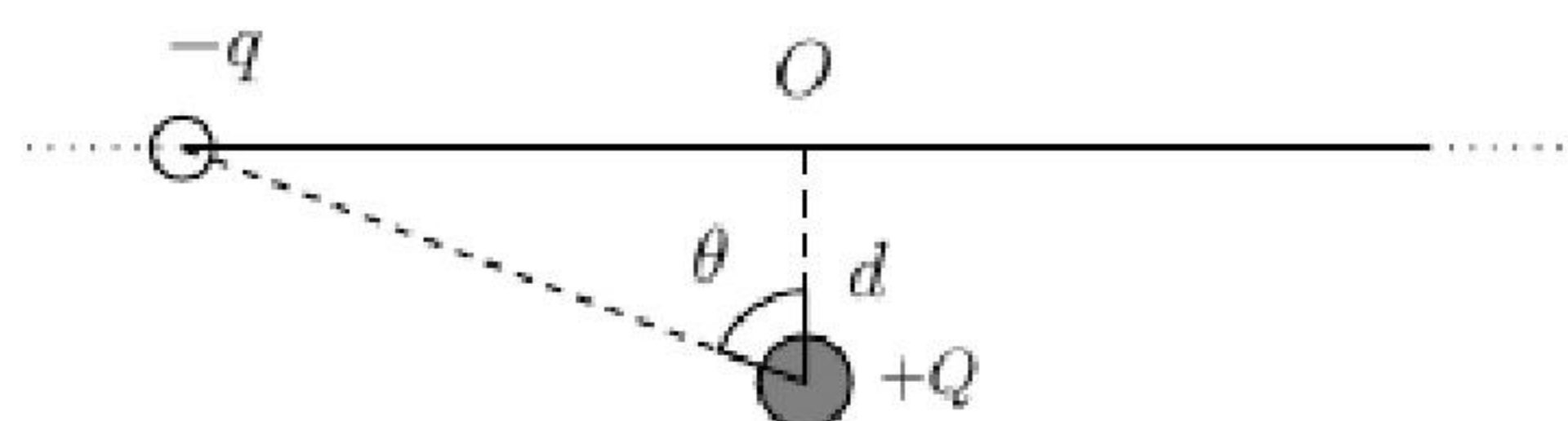
7332351347. ✗ the separations between three successive balls from the ground in the 4th second are in the ratio 5:3.

7332351348. ✓ the distance between two consecutive balls increases linearly every second.

Question Number : 66 Question Id : 733235338 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

A bead of mass m and charge $-q$ is constrained to move along a line. A charge of $+Q$ is kept at d distance away from the line as shown in the figure. The charged bead is released from rest at a point far away from O . Select the correct option(s).



Options :

7332351349. ✗ The component of the force on the bead due to $+Q$ along the line is proportional to $\sin \theta$.

7332351350. ✓ The maximum magnitude of acceleration occurs in the range $\pi/6 < \theta < \pi/4$.

7332351351. ✗ The bead will come to rest at O .

7332351352. ✓ Instead of far away point, if the bead is released from rest close to O , it will undergo simple harmonic motion.

Question Number : 67 Question Id : 733235339 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

Both the ends of a massless wire of length $2L$ and radius r are fixed to rigid supports such that the wire stays straight horizontally without any tension. A mass m is attached to the center of the wire and the center point is found to be lowered by distance l under the weight. Choose the correct statement(s).

Options :

7332351353. ✖ The wire makes an angle $\tan^{-1}(l/L)$ with the vertical.

7332351354. ✓ The Young's modulus of the wire is $\frac{mgL\sqrt{L^2 + l^2}}{2\pi r^2 l (\sqrt{L^2 + l^2} - L)}$.

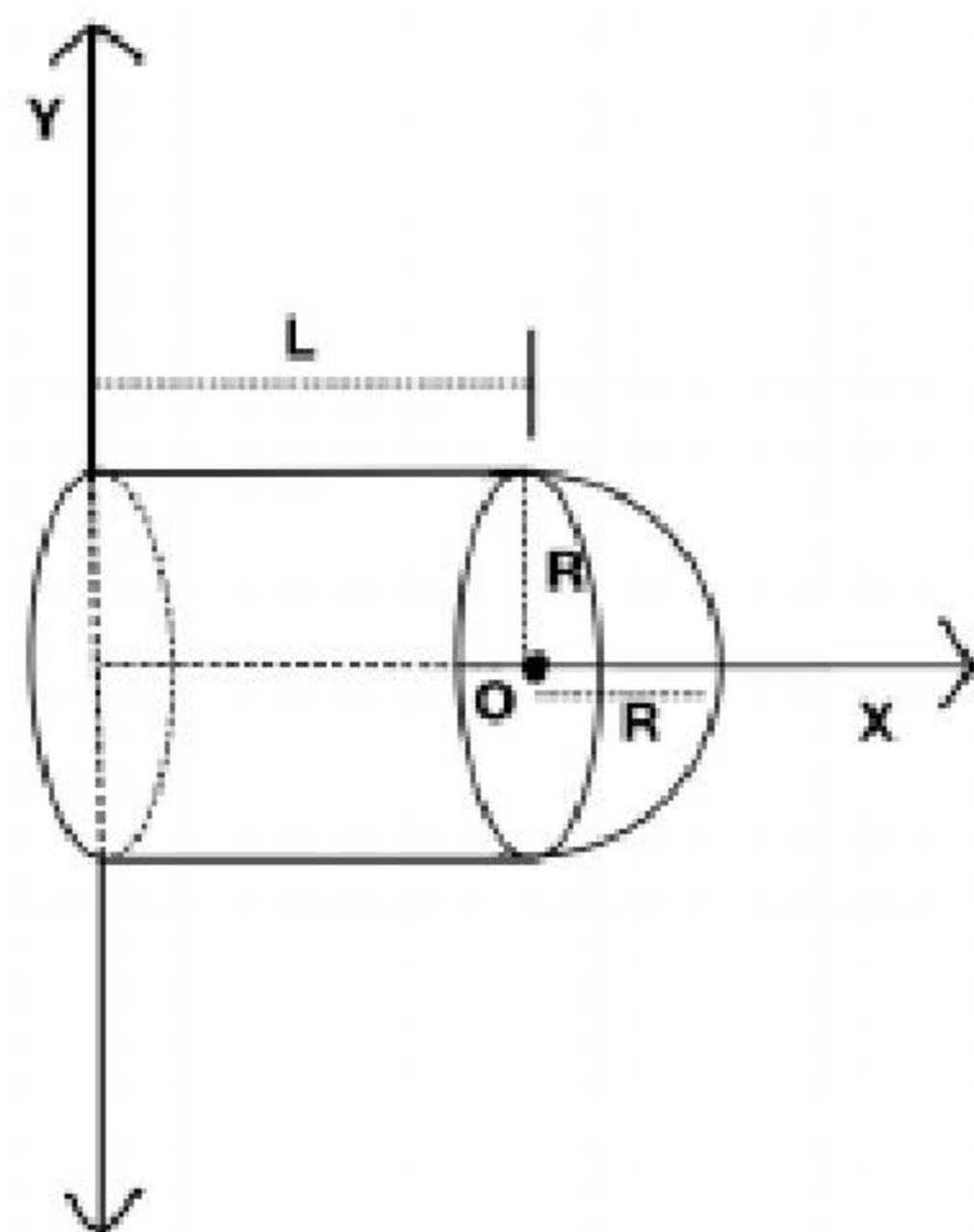
7332351355. ✖ The elongation in the wire can be removed by decreasing the temperature by $(\sqrt{L^2 + l^2} - L) / \alpha$, where α is the coefficient of thermal expansion.

7332351356. ✓ If the tension in the wire is equal to mg , then the wire makes an angle of $\pi/3$ with the vertical.

Question Number : 68 Question Id : 733235340 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

A hollow thin-walled glass tube of length L , is open at one end while the other end is closed by a hollow thin-walled glass hemisphere of radius R . The axis of the tube is along the x -axis with the open end at the origin, as shown in the figure. A net positive charge Q is distributed uniformly over the entire surface with surface charge density σ . The magnitude of the electric field at O due to the hemisphere is $\sigma/4\epsilon_0$. Choose the correct statement(s).



Options :

7332351357. ✓ If $L = R$, then the direction of electric field at O is $-\hat{i}$.

7332351358. ✗ The surface charge density $\sigma = \frac{Q}{2\pi R(L + 2R)}$

7332351359. ✓ At a point $x \gg L, R$, the magnitude of the electric field is proportional to $1/x^2$.

7332351360. ✓ When $L = \sqrt{3}R$, the electric field at O is zero.