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DUNMAN HIGH SCHOOL

Preliminary Examination

Year 6

H2 BIOLOGY

9744/01

Paper 1 Multiple Choice Questions

26 September 2025

Additional Materials: Multiple Choice Answer Sheet

1 hour

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your centre number, index number, name and class at the top of this page.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

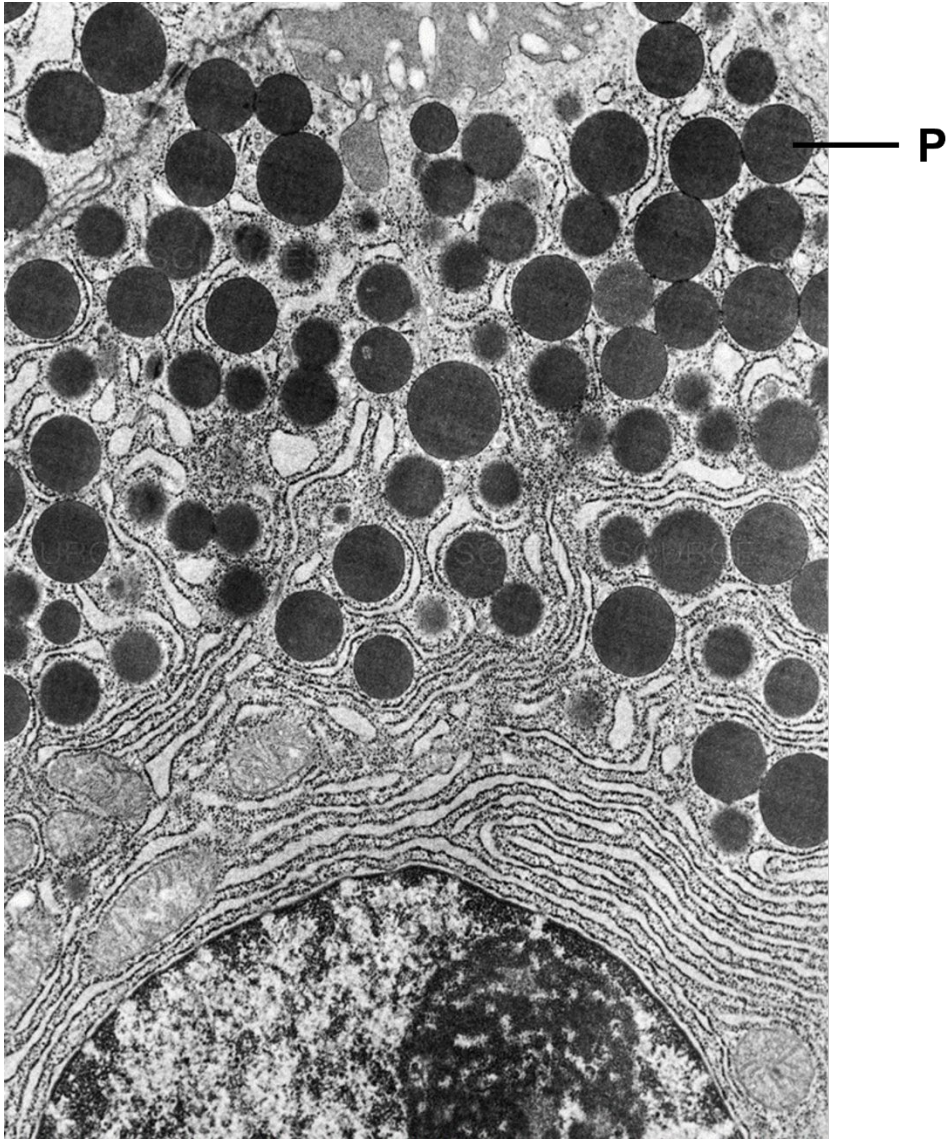
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

This document consists of **24** printed pages.

- 1 The electron micrograph shows a part of a cell found in the pancreas.



Identify organelle **P** and its related function in the pancreatic cell.

	Organelle P	Function
A	Golgi vesicle	Packaging of misfolded proteins for degradation
B	Transport vesicle	Transporting synthesized lipids to the rough ER
C	Secretory vesicle	Storing and secreting digestive enzymes or hormones
D	Ribosome	Initiating protein synthesis after attachment

- 2** A researcher is studying the properties of a toxin produced by a plant. When cellular contents are exposed to the toxin, the cell will die.

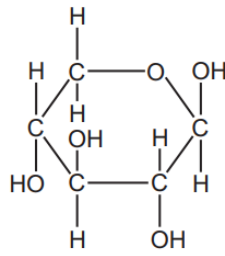
The table shows the relative percentages of various organelles, in cells that are not actively producing the toxin and cells that are actively producing the toxin.

cell structure	description	relative percentage of cell / %	
		non-toxin producing cell	toxin producing cell
V	double membrane bound organelle with cristae	12	15
W	sheet-like, single membrane bound organelle with continuous lumen	15	20
X	single membrane bound organelle arranged in tubules	14	3
Y	large, dense, and contains rRNA	3	10
Z	single membrane bound organelle that does not contain phospholipids in the lumen	35	46

Which statement is consistent with the data provided?

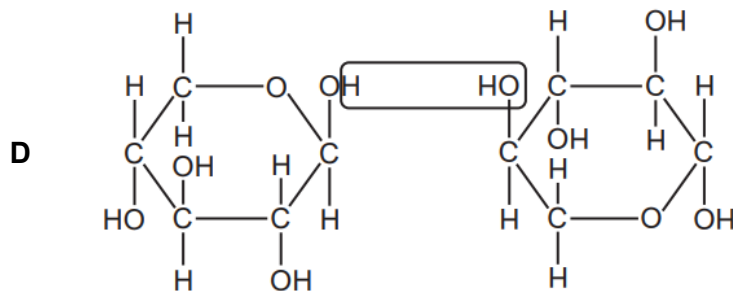
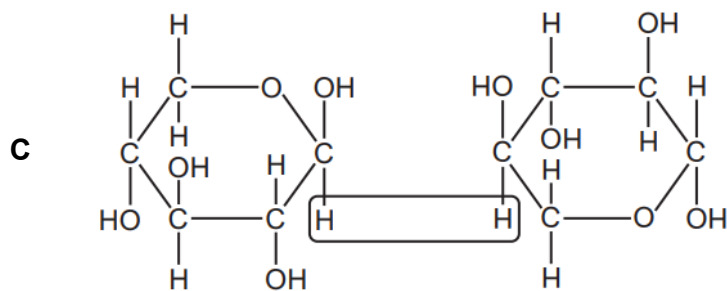
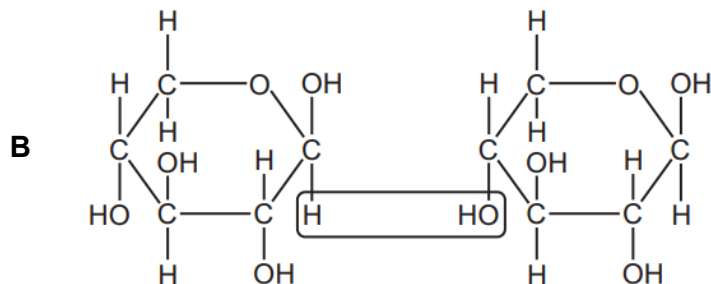
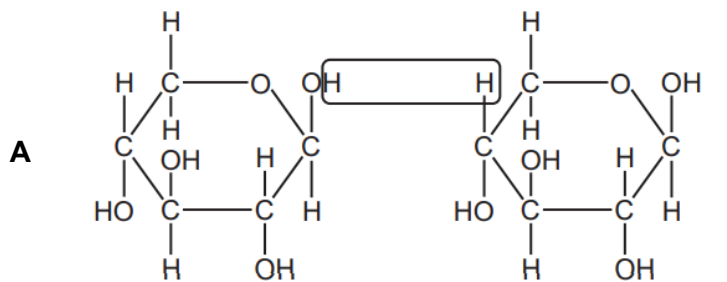
- A** Toxin production in structure V is energy-intensive, suggesting that the toxin is lipid-soluble.
- B** Protein synthesis is upregulated in structure W, implying that the toxin is protein-based and lipid-soluble.
- C** Increased ribosome production in structure Y suggests the toxin is RNA-based and water-soluble.
- D** Structure Z stores the water-soluble toxin.

- 3 The diagram shows the monosaccharide xylose.

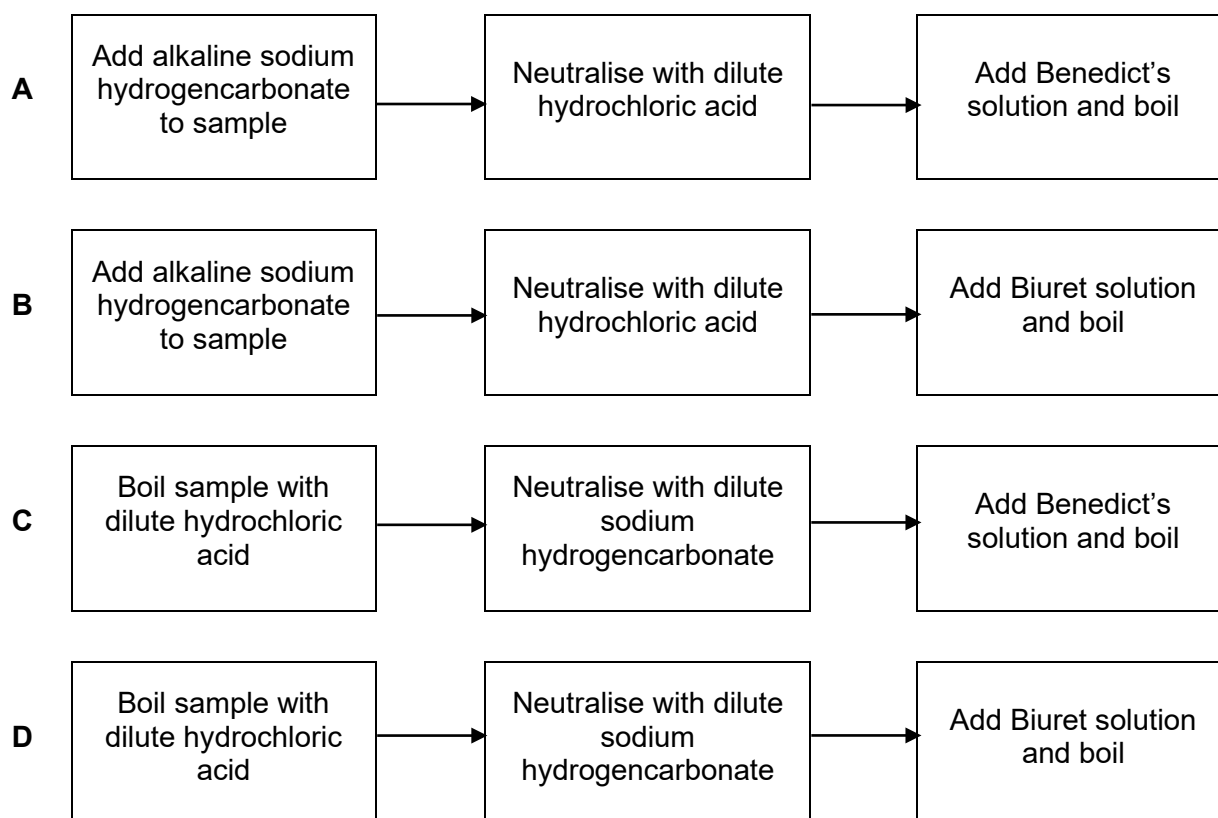


Xylan is a structural polysaccharide made from mainly xylose residues and is found in cell walls of many flowering plants and grasses. It has a similar structure to cellulose.

Which diagram shows the formation of a glycosidic bond between two xylose monomers in xylan?



4 Which flow chart outlining the test for non-reducing sugars is correct?



5 In an experiment, fluorescent dyes were attached to proteins on the outer surface of cell surface membranes. Fluorescent dyes of one colour were attached to proteins of a living human cell and fluorescent dyes of a different colour were attached to proteins of a living mouse cell.

The human cell and the mouse cell were then fused to form a hybrid cell.

At first, the proteins attached to different fluorescent dyes remained separate, but after 40 minutes the proteins were distributed randomly across the hybrid cell surface membrane.

A student made four conclusions based on the result of this experiment. How many conclusions are correct?

- Proteins are found only on the outer surface of cell surface membranes.
- Proteins in the outer layer of a bilayer do not penetrate into the inner layer.
- Proteins move freely in the phospholipids of a bilayer.
- The cell surface membranes of the two cells are bilayers.

A 1

B 2

C 3

D 4

- 6 Which statement best describes a structural similarity between collagen and cellulose that contributes to their function?
- A Both rely on covalent cross-links within their monomers to resist tensile forces and provide rigidity.
 - B Both collagen and cellulose have parallel, linear chains held together by extensive hydrogen bonding, forming strong fibrils that give them high tensile strength.
 - C Both are largely insoluble due to hydrophobic interactions, ensuring structural durability.
 - D Both consist of polypeptide chains forming hydrogen bonds between adjacent molecules.
- 7 During lung infections, phagocytes move from the blood to the epithelial lining of the alveoli. Phagocytes release the enzyme elastase (a protease) which digests a pathway through the alveolar wall. A glycoprotein, alpha 1-antitrypsin (AAT), is often produced in the lung to inhibit elastase and hence prevent widespread breakdown of the alveoli.

An investigation was conducted to study the effect of AAT on trypsin activity. The experiment measured the rate of protein digestion by trypsin under different conditions. The results are shown in the table below.

Condition	Relative Rate of Protein Digestion by Trypsin (%)
Trypsin alone	100
Trypsin + excess substrate	100
Trypsin + AAT	20
Trypsin + AAT + Excess substrate	95

Based on the information, which conclusion best explains how AAT inhibits trypsin?

- A AAT binds to the substrate, preventing it from interacting with the active site of trypsin.
- B AAT binds irreversibly to the active site of trypsin, permanently inactivating the enzyme.
- C AAT has a similar charge and shape to the substrate, allowing it to compete for binding at the active site of trypsin.
- D AAT alters the shape of trypsin's active site through allosteric regulation, preventing substrate binding.

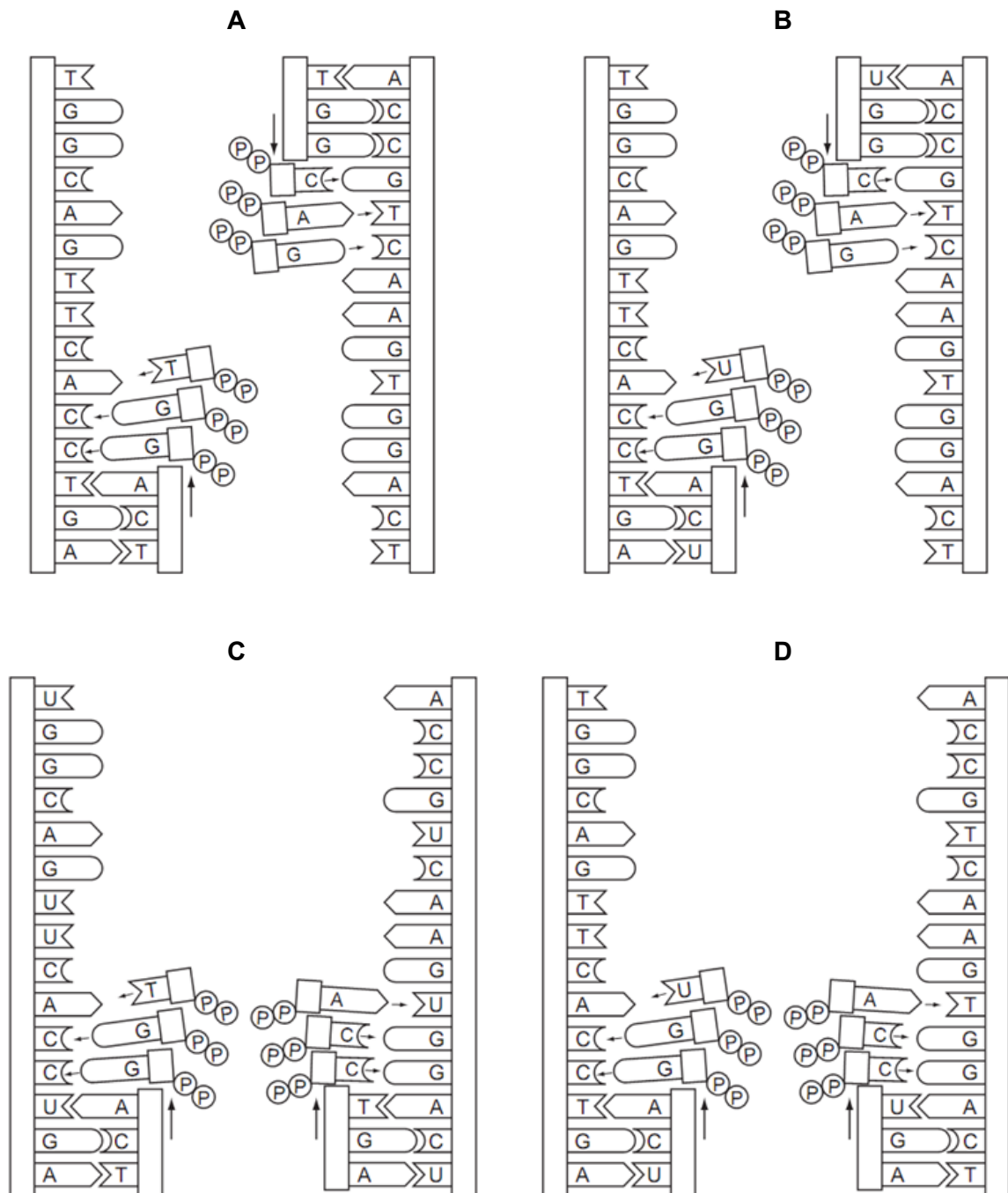
- 8 Cells can regulate their membrane composition to maintain appropriate fluidity under different environmental conditions. In an investigation on membrane fluidity in bacterial cells, three variables influencing membrane fluidity were measured under different temperature conditions.

Variable	Condition A	Condition B
Percentage of saturated fatty acids	18.2	12.5
Average number of double bonds per lipid molecule	4.2	4.8
Cholesterol to phospholipid ratio	2.5	1.8

Which statement correctly identifies Condition A and provides the appropriate explanation?

- A** Hot temperatures; a higher proportion of unsaturated fatty acids reduces excessive membrane fluidity at elevated temperatures.
- B** Cold temperatures; a higher cholesterol-to-phospholipid ratio helps maintain membrane integrity by preventing excessive solidification.
- C** Hot temperatures; an increased number of double bonds allows for tighter phospholipid packing at high temperatures.
- D** Cold temperatures; a higher proportion of saturated fatty acids prevents phospholipids from packing too tightly.

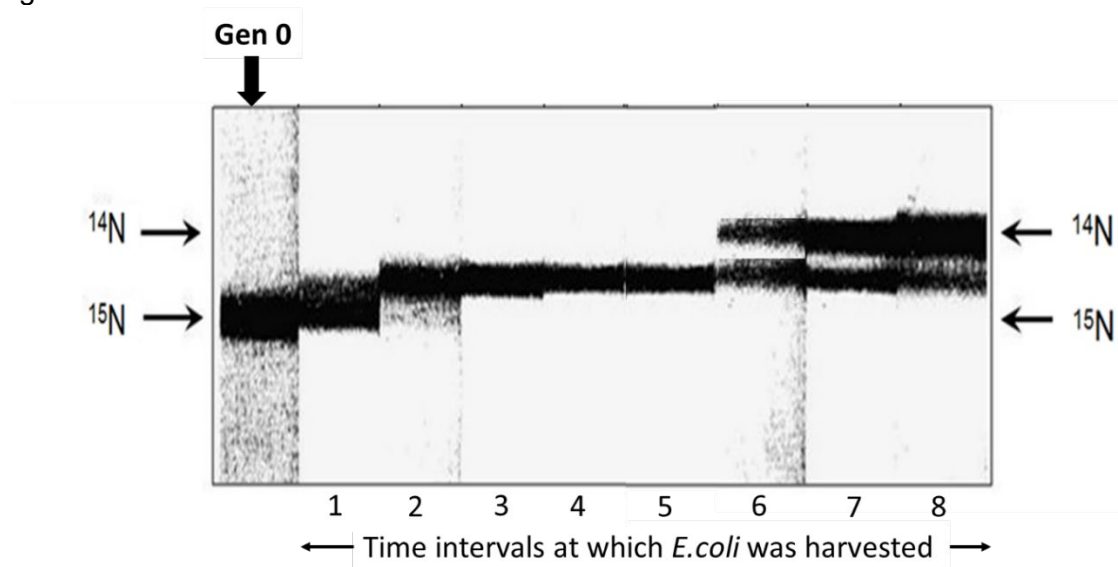
9 Which diagram shows the semi-conservative replication of a section of a molecule of DNA?



- 10 In an investigation to study DNA replication, *Escherichia coli* cells were first grown in a medium containing heavy nitrogen (^{15}N) until all the DNA was labelled. This was generation 0 (Gen 0).

These were then transferred to a medium with light nitrogen (^{14}N) and were allowed to multiply. The DNA was extracted at various time points and analysed using density gradient centrifugation.

The results are shown in the image, where DNA bands correspond to the different isotopes of nitrogen.



Which statements are consistent with the results observed?

- 1 The *E.coli* cells were allowed to multiply for 3 generations.
- 2 The generation time for *E.coli* is about 20 minutes.
- 3 In generation 1, only hybrid DNA ($^{14}\text{N}/^{15}\text{N}$) was produced.
- 4 In generation 3, 75% of DNA was hybrid ($^{14}\text{N}/^{15}\text{N}$) and 25% was light ($^{14}\text{N}/^{14}\text{N}$).
- 5 In generation 4, only light DNA ($^{14}\text{N}/^{14}\text{N}$) would be produced.

- A** 1 and 3
- B** 2 and 4
- C** 1, 2 and 5
- D** 1, 3 and 4

- 11 The DNA sequence TTGCGAATAGAGGCTGGA was transcribed and translated to produce the polypeptide chain leu-arg-tyr-glu-ala-gly.

A mutation in this sequence resulted in a polypeptide chain that was truncated after only two amino acids.

Which mutations could have led to the observed outcome?

- 1 A single base substitution from A to T.
- 2 A single base substitution from A to C.
- 3 Insertion of a base pair at the 4th codon in the mRNA sequence.

- A** 1 and 2
- B** 1 and 3
- C** 2 and 3
- D** 1, 2 and 3

- 12 A hypothetical operon has a sequence of sites, Q, R, S, T and U, in the regulatory region. The exact location of the operator and promoter consensus sequences have not been identified.

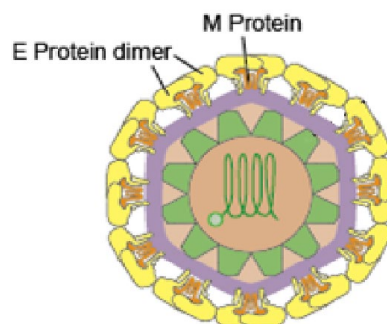
Various deletions of this control region are isolated and mapped. Locations with “/” represent a deleted region. Deletions 3 and 4 result in the operon being constantly switched on, while deletion 1 results in the operon being constantly switched off.

deletion	sequence of sites				
	Q	R	S	T	U
1	////////				
2		////////			
3			////////		
4			////////////////////		
5					////////

Which row is correct?

	location of operator	location of promoter
A	R, S	Q
B	S, T	Q
C	T, U	R
D	Q, U	R

- 13** Which molecules are found in both the cytoplasm and the nucleus of a typical eukaryotic cell?
- 1 Deoxyribonucleotides
 - 2 DNA polymerase
 - 3 Ribonucleotides
 - 4 RNA polymerase
- A** 1 and 3
- B** 2 and 4
- C** 2, 3 and 4
- D** 1, 2, 3 and 4
- 14** The image shows the structure of a dengue virus which contains a positive-sense RNA. Unlike DNA viruses, RNA viruses use unique strategies for replication.



Which statement best describes the replication process of the dengue virus?

- A** The viral RNA must first be transcribed into DNA before replication can occur.
- B** The viral RNA acts directly as mRNA, allowing immediate translation into viral proteins.
- C** The viral RNA is transcribed into complementary RNA before translation can occur.
- D** The viral RNA is packaged into a capsid and remains inactive until the next infection cycle.

- 15** In May 2011, an outbreak of foodborne illness in Germany was traced to a strain of *Escherichia coli* that caused severe haemorrhagic diarrhoea and kidney failure. Unlike the harmless strains of *E. coli* commonly found in the human gut, this strain produced Shiga toxin, a potent bacterial toxin.

Subsequent genomic analysis revealed that the Shiga toxin gene was carried on DNA sequences of a lysogenic bacteriophage integrated into the bacterial chromosome, rather than on a plasmid.

These are some explanations a student use to explain how this *E. coli* strain became pathogenic.

- The *E. coli* strain acquired the Shiga toxin gene from dead bacterial cells in the environment through transformation.
- The *E. coli* strain obtained the toxin gene from a neighbouring bacterium through conjugation, using a sex pilus to transfer a toxin-encoding plasmid.
- The *E. coli* strain was exposed to antibiotics, which induced mutations leading to spontaneous development of the Shiga toxin gene.
- A bacteriophage previously infected another Shiga-toxin-producing bacterium, incorporated the toxin gene, and later transferred it to the non-pathogenic *E. coli* strain via transduction.

Given this information, how many statements could explain how this *E. coli* strain became pathogenic?

A 1

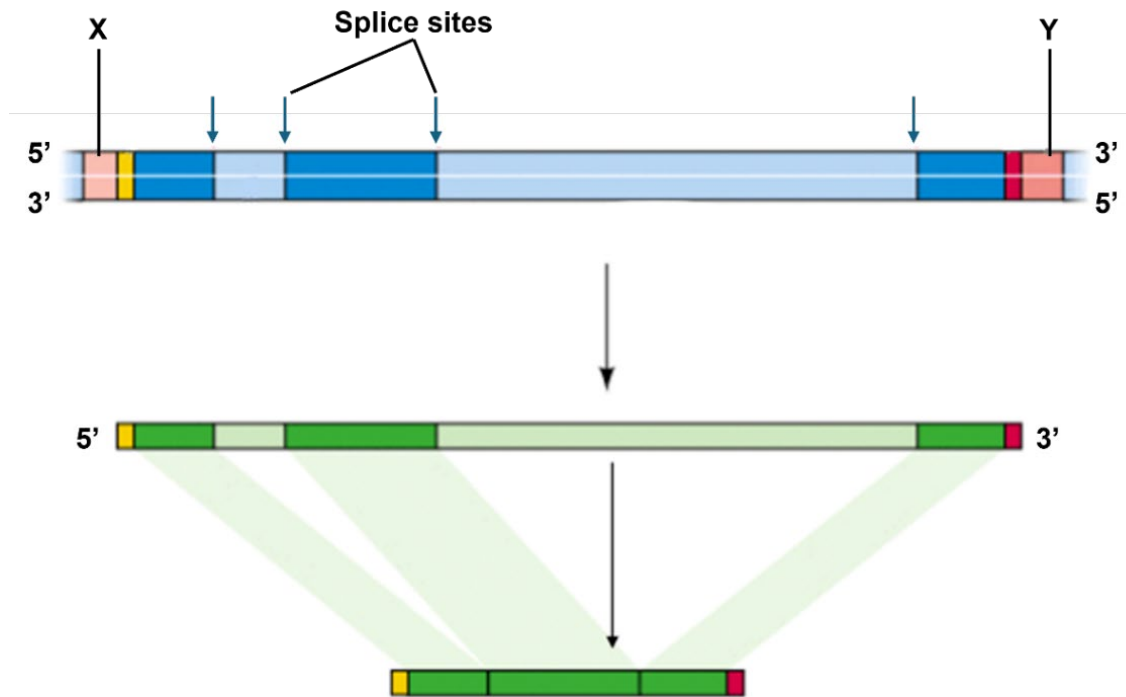
B 2

C 3

D 4

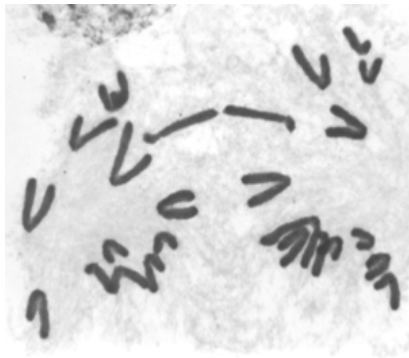
16 The diagram shows the process of transcription and pre-mRNA processing.

Identify the regions X and Y in the diagram and count the number of introns and exons found in the gene.

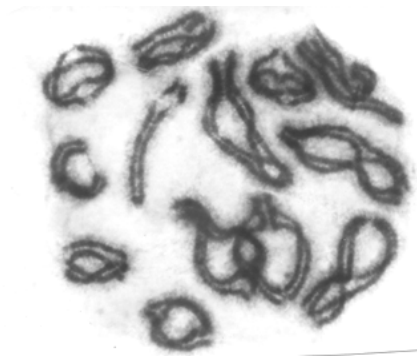


	Region X	Region Y	introns	exons
A	Terminator	Promoter	3	2
B	Enhancer	Silencer	3	2
C	Enhancer	Silencer	2	3
D	Promoter	Terminator	2	3

17 The photographs R and S show different stages of meiosis in a plant cell.



R



S

How many statements correctly distinguish stage R from stage S?

- Stage R represents Anaphase II, where chromatids separate, while Stage S represents Prophase I, where homologous chromosomes undergo crossing over.
- In Stage R, homologous chromosomes align in pairs, while in Stage S, centromeres split and chromatids move apart.
- In Stage S, chiasmata are visible, indicating genetic recombination, while in Stage R, chromosomes are in a V-shape as they move to opposite poles.
- Stage R occurs in Meiosis I, whereas Stage S occurs in Meiosis II.

A 1

B 2

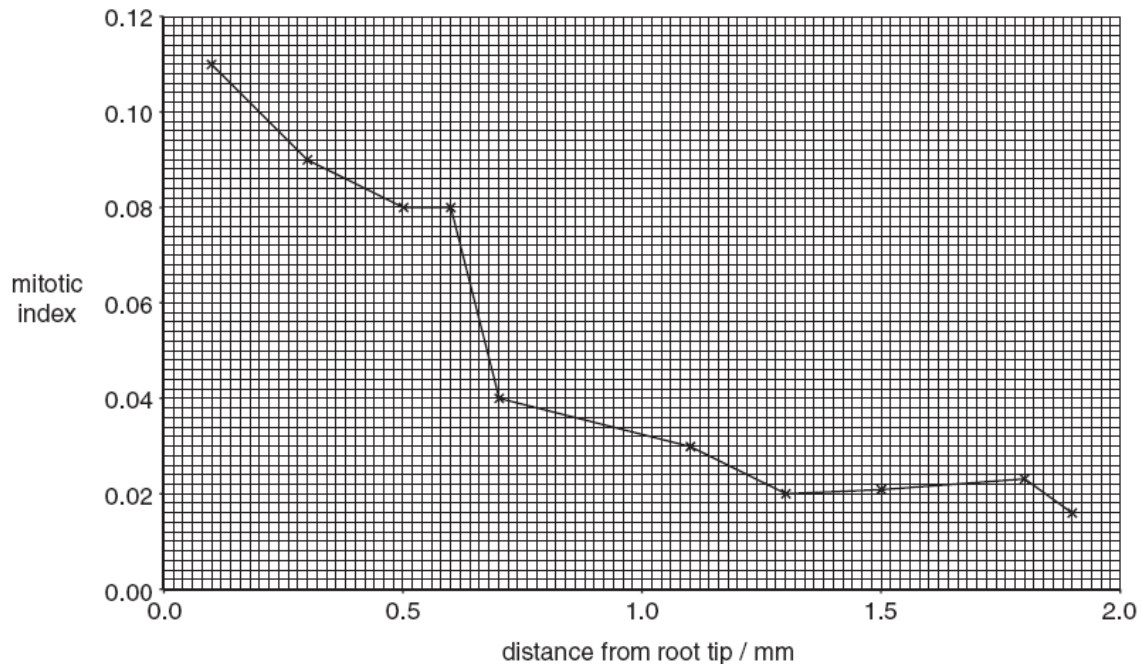
C 3

D 4

- 18 A study was conducted to analyze the mitotic index in different sections of a root tip. The mitotic index was determined by counting the number of cells in mitosis and expressing it as a proportion of the total number of cells in each section. This is calculated as follows:

$$\text{mitotic index} = \frac{\text{number of cells in mitosis}}{\text{total number of cells}}$$

The results are plotted in the graph below.



Based on the data, which conclusions are correct?

- 1 The lowest mitotic index values are observed in regions furthest from the root tip.
- 2 The mitotic index remains constant along the length of the root.
- 3 There is a steep decrease in the mitotic index between 0.6 mm and 0.7 mm from the tip.
- 4 The mitotic index increases significantly beyond 1.3 mm from the tip due to increased cell division.
- 5 The highest mitotic activity occurs near the root tip.

- A** 1 and 3
- B** 2 and 4
- C** 1, 3 and 5
- D** 1, 2, 3 and 4

- 19 Burkitt's lymphoma is associated with the development of aggressive B-cell cancer. This cancer is linked to:

- A chromosomal translocation between chromosome 8 and chromosome 2, 14, or 22.
- The *MYC* gene being relocated near an immunoglobulin gene promoter.
- Overexpression of *MYC* gene leading to uncontrolled cell division.

When the *MYC* gene is overexpressed, it promotes rapid cell proliferation.

Which statements **cannot** be concluded with the information above?

- 1 The *MYC* gene is a proto-oncogene as its product stimulates cell division.
- 2 Multiple copies of the *MYC* gene result in the development of cancer.
- 3 Burkitt's lymphoma is an example of gene amplification.

- A** 1 and 2
- B** 1 and 3
- C** 2 and 3
- D** 1, 2 and 3

- 20 Which statements correctly describe features of stem cells that are essential for their role in cell replacement and tissue repair?

- 1 After mitosis of stem cells, the daughter cells can either remain as stem cells or follow a developmental pathway that leads to the formation of specialised cells.
- 2 Stem cells are different from all other body cells because they retain all the genetic information in their DNA throughout the life of the organism.
- 3 A small population of stem cells is retained in the body of adults throughout their lifetime.
- 4 Stem cells have more telomeres than other body cells and this allows them to undergo unlimited number of mitotic divisions.

- A** 1 and 3
- B** 1 and 4
- C** 2, 3 and 4
- D** 1, 2, 3 and 4

21 DNA mutations can be classified into transition and transversion mutations.

- Transition: A mutation where a purine is replaced by another purine, or a pyrimidine is replaced by another pyrimidine.
- Transversion: A mutation where a purine is swapped for a pyrimidine, or vice versa.

Below is a DNA sequence:

G A T A C C A
C T A T G G T

Which mutated sequence only contain transversions?

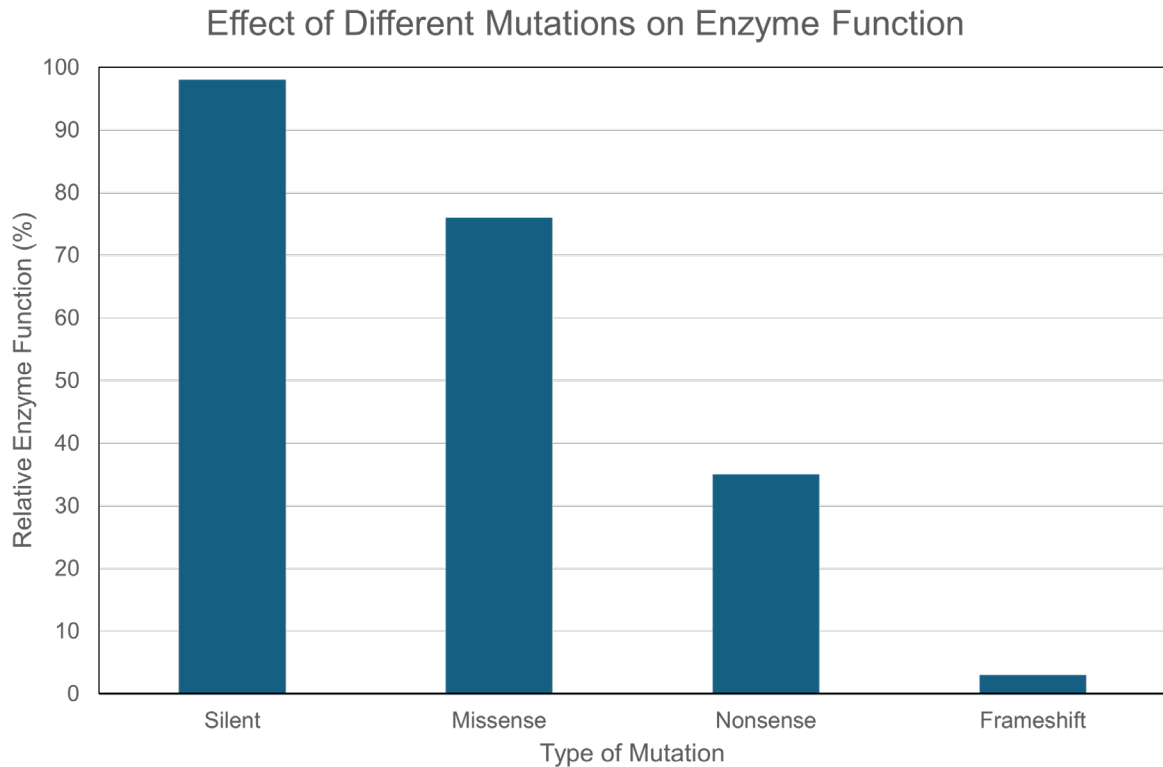
A G A T A T A C
 C T A T A G T

B G A A A C A A
 C T T T G T T

C A A T A C C A
 T T A T G G T

D G T T A T C A
 C A A T A G T

- 22** The graph shows collated information on the effect of different mutations on digestive enzyme's function.



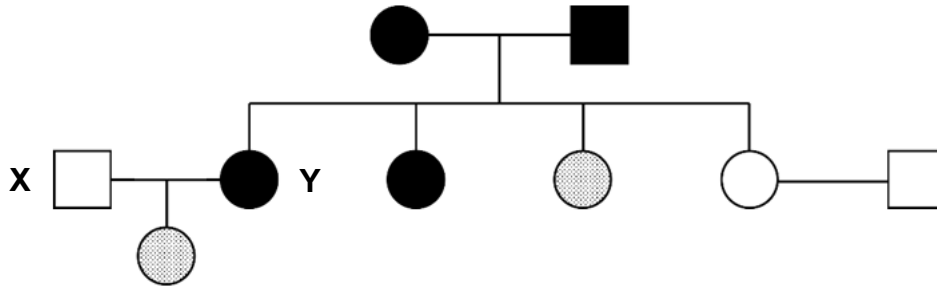
Which statement explains why a frameshift mutation can lead to the greatest loss of function?

- A** It only changes one amino acid but preserves the enzyme's shape.
- B** It introduces a premature stop codon, preventing full translation of binding site.
- C** It alters the entire reading frame, thus leading to loss of active site.
- D** Codon changes will lead to decreased affinity of catalytic site.

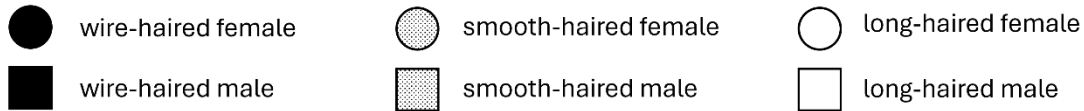
Use the following information for the questions 23 and 24.

Dachshunds have three basic coat types: wire-haired, smooth-haired or long-haired. These are affected by two genes, **H/h** and **G/g**. The presence of **H** always results in wire hair. When long-haired dogs are crossed amongst themselves, they always produce long-haired puppies.

Below is the pedigree for inheritance of coat type in Dachshunds. **X** and **Y** were crossed and they had one offspring at the time of observation. Based on a separate experiment, it was found that **Y** is heterozygous for gene **G/g**.



Key:



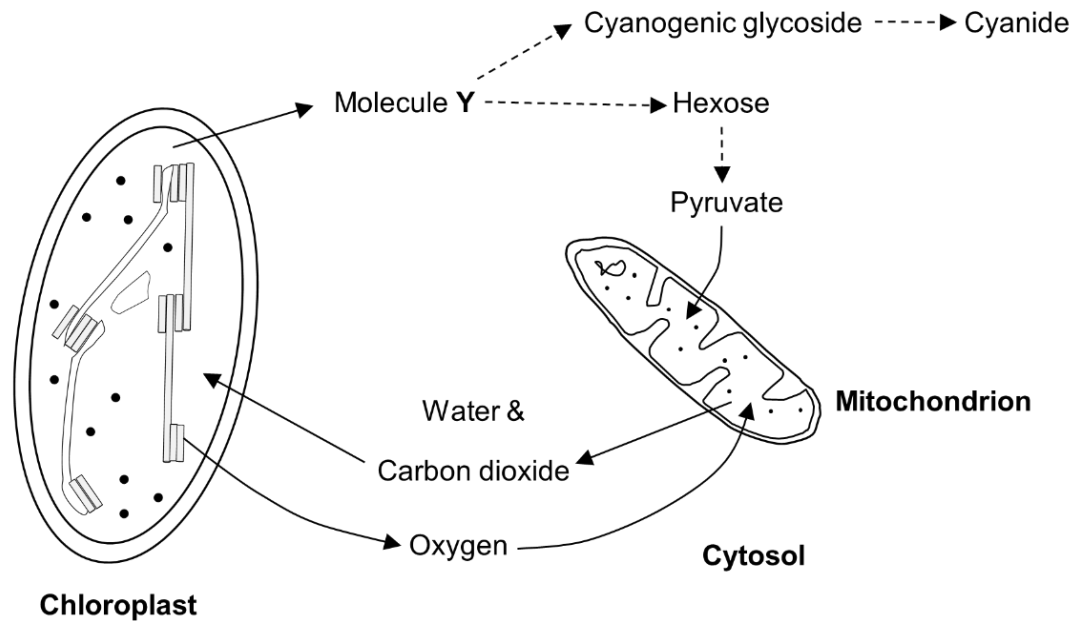
23 Which row represents the expected phenotypic ratio of the offspring of **X** and **Y**?

	Ratio	Phenotypes
A	9:3:4	wire-haired : smooth-haired : long-haired
B	12:3:1	wire-haired : smooth-haired : long-haired
C	2:1:1	wire-haired : smooth-haired : long-haired
D	1:1:1	wire-haired : smooth-haired : long-haired

24 If a male Dachshund with wire-haired has a long-haired female offspring, what is the genotype of the male parent?

- A HHGG
- B hhGg
- C HhGG
- D HhGg

- 25** The diagram shows the exchange of substances between a chloroplast and a mitochondrion in a leaf cell of cassava (local name: tapioca), an important crop in Africa.



Molecule **Y** is a product of light-independent reaction of photosynthesis.

Which statements correctly describe the formation of **Y**?

- 1 RuBP combines with oxygen during photorespiration to produce G3P.
 - 2 Carbon dioxide from the mitochondrion is fixed to RuBP by the enzyme RuBisCO.
 - 3 ATP and NADPH produced from the light-dependent reaction are required to convert 3-phosphoglycerate to G3P.
 - 4 Pyruvate from the mitochondrion is directly used in the Calvin cycle to form G3P.
- A** 1 and 2
B 2 and 3
C 1, 3 and 4
D 2, 3 and 4

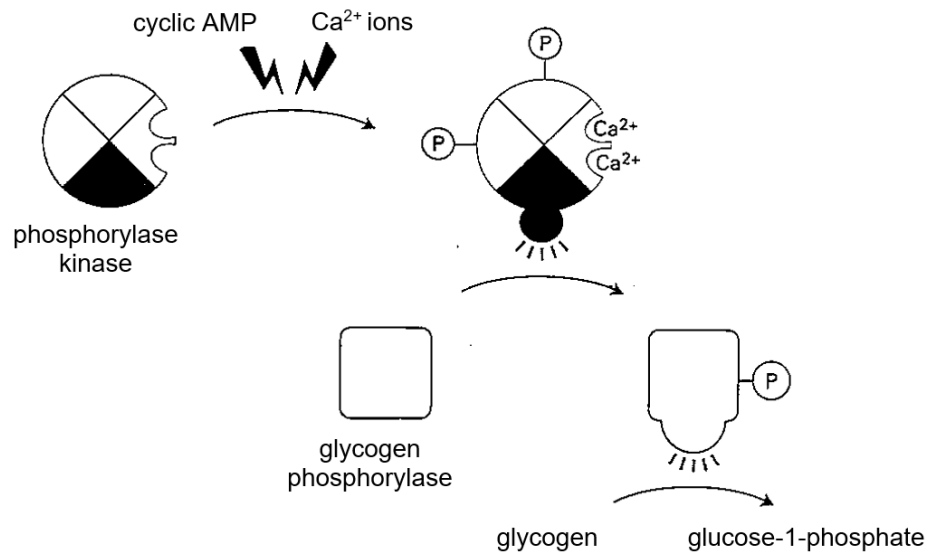
- 26** Cyanide inhibits cytochrome c oxidase, the terminal complex of eukaryotic oxidative phosphorylation.

What are the downstream effects of this inhibition?

- 1 NADH and FADH₂ remain in their reduced states, preventing further oxidation and recycling of NAD⁺ and FAD.
- 2 The proton gradient across the inner mitochondrial membrane collapses, stopping ATP synthesis by chemiosmosis.
- 3 ATP can still be produced via Krebs cycle.
- 4 Cells may switch to anaerobic respiration, leading to an accumulation of lactic acid in muscle cells or ethanol in yeast.

- A** 1 and 2
- B** 2 and 3
- C** 1, 2 and 4
- D** 1, 3 and 4

- 27 Phosphorylase kinase integrates signals from cyclic AMP (cAMP)-dependent and Ca^{2+} -dependent pathways to regulate glycogen metabolism. Similar signal transduction pathways control other metabolic processes, such as insulin signaling and MAP kinase cascades.



The following statements describe the series of reactions that occur to control glycogen breakdown in liver and muscle cells.

- 1 Phosphorylase kinase is composed of four subunits.
- 2 One subunit is the protein kinase that catalyses the addition of phosphate to the glycogen phosphorylase to activate it for glycogen breakdown.
- 3 The other three subunits are regulatory proteins that control the activity of the catalytic subunits. Two of these three subunits contain sites for phosphorylation by PKA, which is activated by cyclic AMP.
- 4 The remaining subunit is calmodulin, which binds Ca^{2+} ions when its cytosolic concentration rises.
- 5 The regulatory subunits control the equilibrium between active and inactive conformations of the catalytic subunit.

Which statement is a correct deduction?

- A Phosphorylase kinase has a tertiary level of protein structure.
- B Binding of Ca^{2+} ions to calmodulin activates calmodulin to produce a cellular response.
- C Glycogen phosphorylase is broken down and releases glycogen from glucose-1-phosphate molecules.
- D Phosphorylase kinase adds a phosphate group to glycogen phosphorylase, inhibiting the latter.

- 28** The Isthmus of Panama formed approximately 3 million years ago, separating a population of snapping shrimps into two groups, one on the Caribbean side and one on the North Pacific side. Over time, these groups evolved into separate species.



What type of isolation and speciation best describes this process?

	Isolating mechanism	Type of speciation
A	Temporal	Sympatric
B	Behavioural	Sympatric
C	Mechanical	Allopatric
D	Geographical	Allopatric

- 29** Antibiotic-resistant strains of *Mycobacterium tuberculosis* are a major problem when treating TB. A new antibiotic, teixobactin, could be very effective at killing *M. tuberculosis* with only a small risk that the bacteria will evolve teixobactin resistance.

Penicillin and similar antibiotics bind to a single protein, but teixobactin binds to two lipids that are needed for the formation of the bacterial cell wall. Teixobactin binds to regions of the two lipids that do not vary across many different species of bacteria.

Which statements help to explain why the use of teixobactin is thought to be less likely to lead to the evolution of antibiotic resistance than the use of many other antibiotics, such as penicillin?

- 1 A single mutation can result in bacteria that are resistant to penicillin and similar antibiotics but at least two mutations are required to produce teixobactin-resistant bacteria.
- 2 Mutations can affect the structure of proteins but cannot affect the structure of lipids because only proteins are made of amino acids.
- 3 The lack of variation across many species of bacteria in the two lipids that bind to teixobactin suggest that the particular structure of these lipids is essential for successful bacterial cell wall formation.

- A** 1, 2, and 3
- B** 1 and 2
- C** 2 and 3
- D** 1 and 3

- 30** There are many interconnected atmospheric processes that contribute to global warming. The statements below explain the greenhouse effect and its contribution to global warming.

- 1 Long-wave radiation emitted by Earth's surface is absorbed by greenhouse gases.
- 2 Short-wave radiation from the Sun passes through the atmosphere and warms the Earth's surface.
- 3 Greenhouse gases re-emit the absorbed radiation back to the Earth's surface.
- 4 The concentration of greenhouse gases increases in the atmosphere.

Which is the correct sequential order of these steps?

- A** 2, 1, 3, 4
- B** 4, 2, 1, 3
- C** 2, 3, 1, 4
- D** 1, 2, 3, 4

Answers

Paper 1: Multiple Choice Question need to check again.

1	C	11	A	21	B		
2	D	12	B	22	C		
3	D	13	D	23	C		
4	C	14	B	24	D		
5	A	15	A	25	B		
6	B	16	D	26	C		
7	C	17	B	27	B	A	7
8	B	18	C	28	D	B	8
9	A	19	C	29	D	C	8
10	A	20	A	30	A	D	7

Q	Explanation
1	Organelle P shows a vesicle, which may be Golgi, transport or secretory. A. Incorrect as function of Golgi vesicle is to package and transport proteins and lipids that have been processed. It should not be misfolded / for degradation. B. Incorrect as function of transport vesicle should be transporting substances from RER to GA. C. Correct as the function of pancreas is to secrete digestive enzymes or hormones D. Incorrect as the structure is clearly not a ribosome, which should be much smaller than the RER.
2	V – mitochondrion W – RER X – SER Y – nucleolus Z – vesicles that do not contain phospholipids A. Incorrect, unable to conclude that toxin is lipid soluble. B. Incorrect, unable to conclude that toxin is protein-based since there are more structure Y too. C. Incorrect, unable to conclude that toxins are RNA-based since there are more structure W too. D. Correct, structure Z does not contain phospholipids in the lumen, and we can conclude that toxin within the organelle is water-soluble.
3	Only C and D shows the monomers alternating 180°. During condensation, a water molecule is formed hence 2H and 1O should be involved. But C only shows 2H.
4	This is an acid hydrolysis. A. Alkaline. B. Alkaline. C. After acid hydrolysis, Benedict's test for reducing sugar. D. Biuret tests for presence of peptide bond.

5	To explain the observations, recall that membrane is a fluid mosaic model. Hence, there are only 1 correct statement that can be concluded from the context. 1. Incorrect, proteins can be found on either surface of membrane / it may be an integral protein + unable to conclude from the experiment. 2. Incorrect, some proteins may be integral proteins + unable to conclude from the experiment. 3. Correct based on fluid mosaic model + can be concluded from experiment. 4. Unable to conclude from the experiment, even though the statement is theoretically correct.
6	A. Cellulose no cross links. B. True. C. There is no hydrophobic interactions. Both are insoluble because they are macromolecules made up numerous chains joined by hydrogen bonds. D. Cellulose is not consisting of polypeptide chains.
7	A. Q says, "AAT is often produced in the lung to inhibit elastase". So, ATT should not bind to substrate. B. This statement is true for non-competitive inhibitor. But 4th condition shows that excess substrate increases rate, so AAT should be a competitive inhibitor. C. 4th condition shows that excess substrate increases rate, so AAT should be a competitive inhibitor. D. No information suggests this is allosteric regulation.
8	A. Incorrect, unsaturated fatty acids increase fluidity, and do not reduce it. B. Correct. C. Incorrect, there is a lower proportion of C=C in condition A. D. Incorrect, saturated fatty acids increase packing and do not prevent it.
9	A. Correct. B. Incorrect, the newly added deoxyribonucleotides should not include uracil. C. D. Incorrect as replication should be antiparallel.
10	First Gen - $^{15}\text{N}^{14}\text{N}$ Second Gen - $^{15}\text{N}^{14}\text{N}$ $^{14}\text{N}^{14}\text{N}$ Third Gen - $^{15}\text{N}^{14}\text{N}$ $^{14}\text{N}^{14}\text{N}$ $^{14}\text{N}^{14}\text{N}$ $^{14}\text{N}^{14}\text{N}$ 1. Correct, as time point 1 shows first gen. Time points 2-5 show second gen. Time points 6-8 is showing third gen. 2. Incorrect, x-axis shows time intervals, and the exact duration is not specified. 3. Correct, see working above. 4. Incorrect, 75% is light and 25% hybrid. 5. Incorrect, not shown in experiment and theoretically incorrect.
11	The third triplet code is ATA thus the mRNA codon is UAU. 1. Correct, ATT triplet code results in UAA stop codon. 2. Correct, ATC triplet code results in UAG stop codon. 3. Incorrect, mutation to 4th codon is irrelevant since the truncated product only has 2 amino acids.

12	Q says, "Deletions 3 and 4 result in the operon being constantly switched on". If operator is deleted, transcription will proceed. So, Deletions 3 and 4 are likely from operator. Q says, "deletion 1 results in the operon being constantly switched off." This means there is no transcription. So, Deletions 1 is likely from promoter.
13	1. Deoxyribonucleotides are made in the cytoplasm and imported into the nucleus for DNA repair and replication. 2. DNA polymerase is an enzyme. Proteins are synthesized in the cytoplasm too and transported into the nucleus for DNA replication. 3. Similar to 1, but for transcription. 4. Similar to 2, but for transcription.
14	A. Only retrovirus need to first be transcribed into DNA. B. True C. Q says viral RNA is positive-sense RNA. This can be used for translation directly. D. Not replication process.
15	Q says, "Subsequent genomic analysis revealed that the Shiga toxin gene was carried on DNA sequences of a lysogenic bacteriophage integrated into the bacterial chromosome, rather than on a plasmid." So, you need to look out for statements implying transduction. 1. Transformation. 2. Conjugation. 3. "exposed to antibiotics" and "induced mutations" are not horizontal gene transfer. 4. Transduction.
16	Darker shade is exon. 3 exons 2 introns Terminator is at the end of the gene., so shown by Y. Enhancer and silencer may be upstream, within or even downstream of gene.
17	1. correct. 2. wrong. 3. correct. 4. wrong.
18	1. Correct based on graph. 2. Incorrect, mitotic index decreases. 3. Correct based on graph. 4. Incorrect, mitotic index only increased slightly. 5. Correct based on graph.
19	Third point in Q says, "Overexpression of MYC leading to uncontrolled cell division." This indicates that statement 1 can be concluded.

	State 2 and 3 implies gene amplification. But nothing in the Q indicates gene amplification. So statement 2 and 3 cannot be concluded.									
20	1. Correct based on content knowledge. 2. Incorrect, all body cells and stem cells retain all genetic information. But they express different genes. 3. Correct based on content knowledge. 4. Incorrect, the number of telomeres remains the same in all cells. 1 chromosome has 2 telomeres.									
21	A. Incorrect, C (pyrimidine) changed to T (pyrimidine) and A (purine). B. Correct, T (pyrimidine) changed to A (purine). C. Incorrect, G (purine) changed to A (purine). D. Incorrect, A (purine) and C (pyrimidine) changed to T (pyrimidine)									
22	A. Incorrect, frameshift mutation changes many amino acids. B. Incorrect, frameshift mutation may not always lead to a truncated protein. C. Correct based on content knowledge. D. Incorrect as it doesn't explain why frameshift mutations lead to the greatest loss of function. This applies to missense and nonsense mutation too.									
23	Dachshunds have three basic coat types: wire-haired, smooth-haired or long-haired. These are affected by two genes, H/h and G/g. The presence of H always results in wire hair. When long-haired dogs are crossed amongst themselves, they always produce long-haired puppies. Based on the Q, "These are affected by two genes", implies this is epistasis. "The presence of H always results in wire hair.", implies this is dominant epistasis. "When long-haired dogs are crossed amongst themselves, they always produce long-haired puppies", implies long-haired is homozygous recessive. The genotype is hhgg. Based on the Q: <table><tr><td>X</td><td>x</td><td>Y</td></tr><tr><td>Long-haired</td><td>x</td><td>wire-haired</td></tr><tr><td>hhgg</td><td>x</td><td>HhGg</td></tr></table> hg x HG Hg hG hg Current offspring is smooth-haired, possibly hhGg. X and Y is a test cross, so, should see a genotypic ratio of 1:1:1:1. There are four possible offspring genotypes, HhGg, Hhgg, hhGg and hhgg. Since a H allele results in wire-haired, the phenotypic ratio is 2:1:1. This is represented by row C.	X	x	Y	Long-haired	x	wire-haired	hhgg	x	HhGg
X	x	Y								
Long-haired	x	wire-haired								
hhgg	x	HhGg								
24	male Dachshund with wire-haired is either HH or Hh a long-haired female offspring is hhgg This male need to be Hh in order for offspring to have a chance to be hh. This male also needs to have at least one g allele.									

	You can now eliminate A and B.
25	Y is produced by chloroplast and goes through a series of reaction to become hexose, which is likely glucose since it goes through glycolysis to become pyruvate. 1. False. RuBP reacting with oxygen does not directly produce G3P. 2. True. Carbon dioxide from the mitochondrion is taken in by chloroplast, which is then fixed to RuBP by the enzyme RuBisCO. 3. True. In the Reduction phase. 4. False. Pyruvate is taken into mitochondrion for link reaction.
26	You should deduce from the context that cyanide will block the electron flow. 1. True. Since electron flow is disrupted, there is no way NADH and FADH₂ can donate their electrons. 2. True. Without electron flow, proton is not pumped from matrix into intermembrane space, so, proton gradient across the inner mitochondrial membrane collapses, stopping ATP synthesis by chemiosmosis. 3. False. Without the regeneration of NAD⁺ and FAD⁺, Krebs cycle is disrupted too. 4. True.
27	A. It has 4 subunits. B. True. Activating the catalytic subunits. C. Glycogen phosphorylase is enzyme. It is not broken down. D. glycogen phosphorylase become activated.
28	Separated by land: Geographical isolation. Speciation that occurs when a population of the same species becomes geographically separated by a physical barrier such as: Allopatric Speciation.
29	1. True. From Para 2, "Penicillin and similar antibiotics bind to a single protein, but teixobactin binds to two lipids that are needed for the formation of the bacterial cell wall." DNA codes for the enzymes that make these lipids. 2. Factual statement. BUT this statement does not help to explain why the use of teixobactin is thought to be less likely to lead to the evolution of antibiotic resistance than the use of many other antibiotics, such as penicillin. 3. True. If the particular structure of these lipids is essential for successful bacterial cell wall formation, then the use of teixobactin is less likely to lead to the evolution of antibiotic resistance because otherwise, successful bacterial cell wall formation would become a problem.
30	Step 2: The process begins when short-wave radiation from the Sun enters the Earth's atmosphere and warms the surface. This happens first. Step 1: The Earth's surface, after absorbing solar energy, re-emits it as long-wave infrared radiation. This is then absorbed by greenhouse gases in the atmosphere. Step 3: The greenhouse gases re-radiate the energy, some back to space but importantly also back to the Earth's surface, further warming it. This is the greenhouse effect. Step 4: Over time, due to human activities (burning fossil fuels, deforestation, etc.), the concentration of greenhouse gases increases, which strengthens this warming effect, contributing to global warming. Hence,

	A. Correct. B. (4 → 2 → 1 → 3) puts greenhouse gas increase first, but the physical sequence of energy transfer (sun → Earth → longwave radiation → absorption/re-emission) is independent of concentration changes. C. (2 → 3 → 1 → 4): suggests re-emission happens before absorption, which is impossible. D. (1 → 2 → 3 → 4): suggests longwave absorption happens before sunlight reaches Earth, which is not correct.
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