bio letters

Biology
Higher level
Paper 1A

11 May 2025

Zone A afternoon | **Zone B** morning | **Zone C** afternoon

2 hours [Paper 1A and Paper 1B]

Instructions to candidates

- **This paper is meant to be more challenging than typical IB exams.**
- Do not open this mock examination paper until instructed to do so.
- Answer all questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- A calculator is required for this paper.
- The maximum mark for paper 1A is **[40 marks]**.
- The maximum mark for paper 1A and paper 1B is **[75 marks]**.

1105–2026

1. Why do scientists use Goldilocks zone in the search for extraterrestrial life?

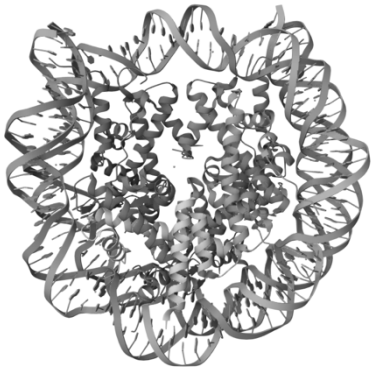
A. It identifies planets with strong gravitational fields that can retain water

B. It identifies planets with solar radiation that is sufficient for metabolic activity

C. It identifies planets with enough oxygen concentrations for respiration

D. It identifies planets with surface temperatures that allow for liquid water

2. The image shows the molecular structure of one nucleosome from the Protein Data Bank, a molecular visualization software.



What is **not** shown in the image?

A. Core DNA

B. 8 histone proteins

C. Additional histone proteins attached to linker DNA

D. Histone secondary structure

3. What is the role of water in hydrolysis reactions?

A. It acts as a catalyst to break down polymers

B. It is formed by combining –H and –OH groups

C. It splits into –H and –OH groups

D. It hydrogen bonds with polymers to disrupt their structures

4. AlphaFold is an AI database that predicts the three-dimensional conformation of a protein given its amino acid sequence. Which of the following biological features of protein structure allows for such predictions by AI to be reasonably accurate?

A. The primary structure contains all the necessary information needed for folding

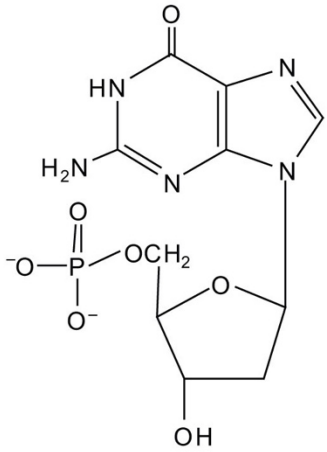
B. The secondary structure is stabilized by hydrogen bonding for higher folding

C. The tertiary structure is composed of noncovalent bonding for complex folding

D. The quaternary structure is composed of polypeptide chains that determine folding

5. AZT is an antiviral drug that competitively inhibits reverse transcriptase activity, an enzyme that synthesizes DNA from an RNA template, in HIV. Which of the following molecules would AZT be most similar to?

A.



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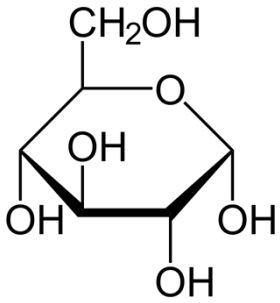

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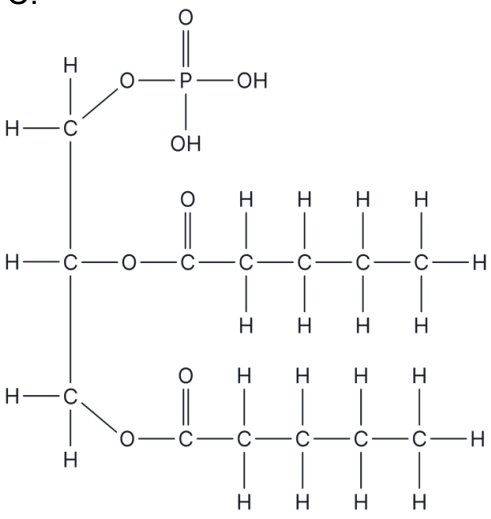
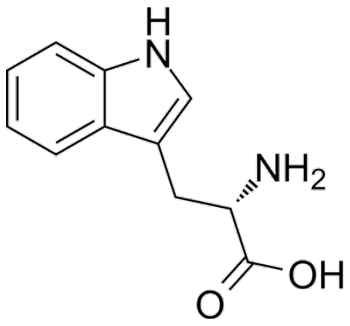


D.



6. A dysfunction in the insertion of ATP synthase in the mitochondrial inner membrane results in a reversal of its orientation within the membrane. What is most likely to occur?

A. The electron transport chain will stop functioning and no ATP will be produced

B. The electron transport chain will function but no ATP is produced

C. The proton gradient is destroyed and no ATP will be produced

D. The proton gradient will be reinforced which disrupts the electron transport chain

7. Which statement about photosynthesis is **correct**?

A. Only photosystem I is involved in cyclic photophosphorylation

B. Only photosystem II is involved in cyclic photophosphorylation

C. Only photosystem I is involved in non-cyclic photophosphorylation

D. Only photosystem II is involved in non-cyclic photophosphorylation

8. How does knowledge of DNA replication enable applications in biotechnology?

I. The denaturation phase of PCR unwinds the DNA double helix

II. The annealing phase of PCR requires DNA primers

III. The synthesis phase of PCR requires nucleotides

A. I only

B. I and II only

C. II and III only

D. I, II, and III

9. What is the difference between proteasomal and lysosomal protein degradation?

A. Only lysosomal degradation depends on enzymes

B. Only proteasomal degradation depends on enzymes

C. Only proteasomal degradation functions at low pH

D. Only lysosomal degradation functions at low pH

10. Why is the location of a mutation in a gene important?

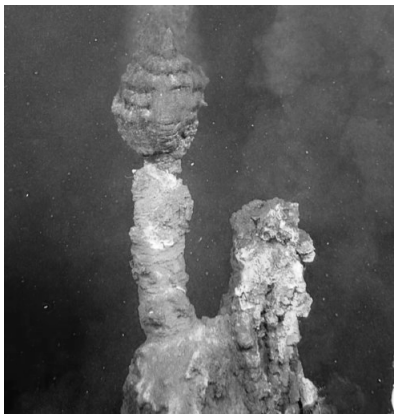
A. It can determine whether the mutation will be an insertion or deletion

B. It can determine whether the mutation will be sense or missense

C. It can determine how harmful the mutation will be

D. It can determine how the protein unfolds at high temperatures

11. The image shows a hydrothermal vent.



How have hydrothermal vents provided evidence for the evolution of the Last Universal Common Ancestor (LUCA)?

A. Fossils were genetically analyzed and showed very high genetic diversity

B. Fossils were genetically analyzed and showed highly conserved sequences

C. Currently alive organisms are genetically analyzed and show conserved sequences in some genes

D. Their highly oxidized environment supports the evolution of metabolism

12. The length of an eyepiece graticule from 0 to 100 is 1 mm on the stage micrometer. What is the actual length of a cell that measures 12 units on the graticule?

A. 1.2 mm

B. 0.12 mm

C. 0.012 mm

D. 0.0012 mm

13. Which of the following can be used by scientists to add new genes to a bacterium?

I. Infection with a virus that undergoes a lysogenic cycle

II. Using a CRISPR-Cas9 system

III. Hypermutation by UV radiation

A. I only

B. I and II only

C. II and III only

D. I, II and III

14. Cell-adhesion molecules (CAMs) in nephron tubule cells prevent the passage of molecules between cells. How will mutations that reduce CAM function affect the activity of sodium-dependent glucose cotransporters in the nephron?

A. Cotransporter activity will be unchanged

B. Cotransporter activity will increase

C. Cotransporter activity will decrease

D. Cotransporter activity will depend on the amount of ingested glucose

15. In chloroplasts, protons are pumped from the stroma into the thylakoid lumen, whereas in mitochondria protons are pumped from the matrix into the intermembrane space. How does the proton gradient compare in each organelle?

A. The proton gradient is larger in chloroplasts due to photolysis

B. The proton gradient is larger in chloroplasts due to thylakoid size

C. The proton gradient is larger in mitochondria due to the electron transport chain

D. The proton gradient is larger in mitochondria due to cristae inner folding

16. What changes during stem cell differentiation?

I. Genome

II. Epigenome

III. Transcriptome

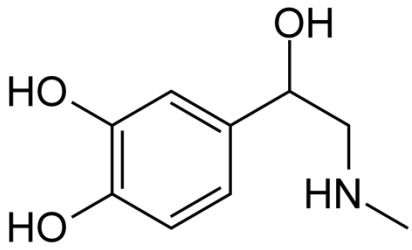
A. I only

B. I and II only

C. II and III only

D. I, II and III

17. The structure of epinephrine (adrenaline) is shown.



What type of receptors does epinephrine (adrenaline) bind to?

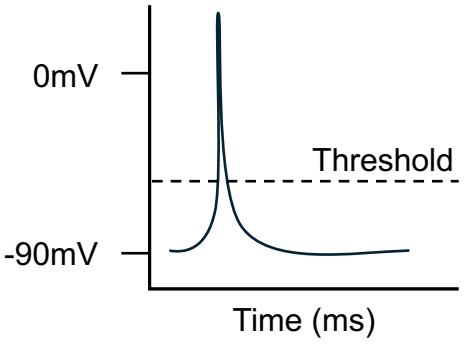
A. Enzyme coupled receptors

B. Ion channel coupled receptors

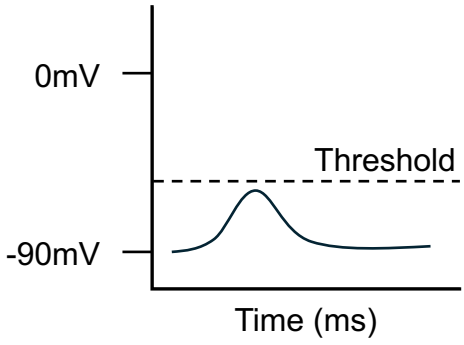
C. G-protein coupled receptors

D. Cholesterol coupled receptors

18. The graphs show oscilloscope traces of a presynaptic and a postsynaptic neuron.



Presynaptic neuron



Postsynaptic neuron

What is the type of potential in the postsynaptic neuron?

A. Inhibitory postsynaptic potential

B. Excitatory postsynaptic potential

C. Threshold potential

D. Action potential

19. How can mutations in genes regulating the cell cycle lead to cancer?

I. Loss of function mutations in tumor suppressor genes

II. Loss of function mutations in protooncogenes

III. Gain of function mutations in protooncogenes

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

20. What is the difference between promoters and enhancers?

A. Only promoters are required for transcription initiation

B. Only enhancers are required for transcription initiation

C. Only promoters interact with transcription factors

D. Only enhancers interact with transcription factors

21. What molecule crosses through a semi-permeable membrane during osmosis?

A. Proteins

B. Glucose

C. Salt

D. Water

22. Which of the following species are difficult to classify according to the biological species concept?

I. Bacteria that undergo vertical gene transfer

II. Bacteria that undergo horizontal gene transfer

III. Asexually reproducing organisms

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

23. The table shows the relative genetic distance between species 1–5.

Species	**1**	**2**	**3**	**4**
2	0.065			
3	0.170	0.215		
4	0.150	0.280	0.045	
5	0.270	0.280	0.180	0.230

Which species can be grouped together?

I. Species 1 and 2

II. Species 1 and 5

III. Species 3 and 4

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

24. How are lungs and leaves both adapted for gas exchange?

A. They both have substances that increase water loss and surface tension

B. They both rely on active transport to move gases across cell membranes

C. They both maximize diffusion distance for gas exchange

D. They both maximize surface area for gas exchange

25. What is a consequence of the absence of a central pump (like the human heart) in xylem transport?

A. Constant active transport is needed

B. Hydrostatic pressure is needed by sucrose loading

C. Transpiration pull drives fluid movement

D. Diffusion is the main mechanism of transport

26. Which row correctly matches the role of each structure in the synovial joint?

	Synovial fluid	**Tendons**	**Ligaments**
A.	Reduces friction	Muscle to bone connections	Bone to bone connections
B.	Reduces friction	Bone to bone connections	Muscle to bone connections
C.	Muscle to bone connections	Reduces friction	Bone to bone connections
D.	Bone to bone connections	Muscle to bone connections	Reduces friction

27. What part of the brain is responsible for regulating heart rate?

A. Hypothalamus

B. Cerebellum

C. Superchiasmatic nucleus

D. Medulla oblongata

28. Why is everyone encouraged to vaccinate?

A. Herd immunity

B. Cross immunity

C. Lower medical costs

D. Reduced pathogen resistance

29. What is the role of GnRH in humans?

A. Stimulate FSH and LH in males only

B. Stimulate FSH and LH in females only

C. Stimulate FSH and LH in males and females

D. Stimulate FSH and LH only during puberty in males and females

30. Which amino acid accumulates in phenylketonuria?

A. Methionine

B. Tyrosine

C. Ketone

D. Phenylalanine

31. Why is water reabsorption in the proximal convoluted tubule proportional to solute reabsorption?

A. Helps to regulate the osmolarity of the blood

B. Maintains isotonicity between filtrate and blood

C. There are equal numbers of aquaporins and sodium ion channels

D. Water reabsorption is a natural consequence of solute reabsorption

32. Which statement is **correct** regarding allopatric and sympatric speciation?

A. Only sympatric speciation requires geographic isolation

B. Only allopatric speciation requires reproductive isolation

C. Only sympatric speciation requires reproductive isolation

D. Only allopatric speciation requires geographic isolation

33. Which of the following is/are considered a method of ex situ conservation?

I. Seed storage
II. Captive breeding programs
III. Reclamation of degraded ecosystems

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

34. If two species are able to exist in the same habitat, what must be **true**?

A. They evolved different traits

B. They evolved different niches

C. They evolved different modes of nutrition

D. They evolved different behaviors

35. How much of an animal population at carrying capacity (K) should be hunted to maximize its growth rate afterward?

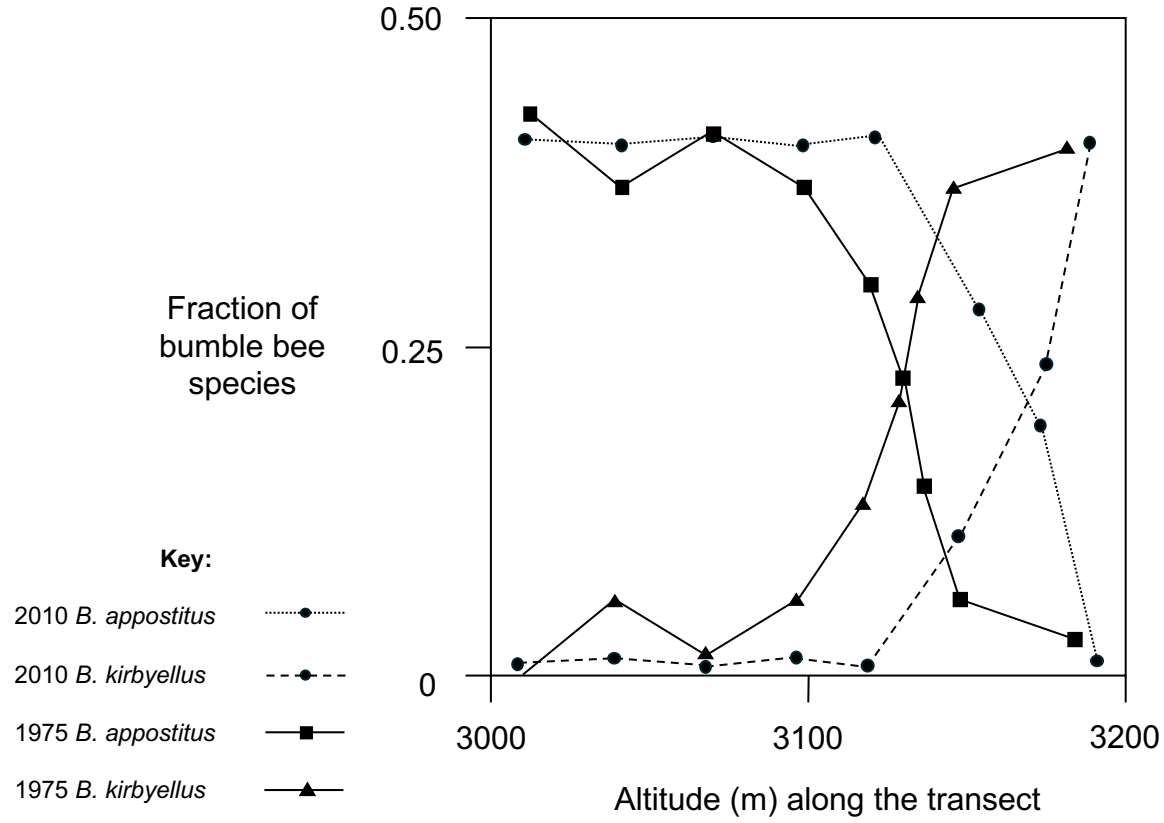
A. 0.80K

B. 0.70K

C. 0.60K

D. 0.50K

36. A transect study was done to investigate the effects of climate change on the geographic range distribution of two species of bumble bee, *B. appostitus* and *B. kirbyellus*. The graph shows bumble bee distribution across various altitudes in 1975 and 2010.



What can be concluded from the data?

A. The two species responded differently because they each have unique tolerance ranges

B. *B. appostitus* shifted towards lower elevation whereas *B. kirbyellus* shifted towards higher elevation to synchronize with earlier flowering times in plants they pollinate

C. Both species shifted towards higher elevation to remain within their tolerance ranges

D. Both species shifted towards higher elevation due to a rapid evolutionary response to rising annual temperatures

37. Which of the following is **not** conclusive evidence that anthropogenic CO_2 emissions have altered the carbon cycle?

A. A sustained rise in atmospheric CO_2 after industrialization

B. Isotopic carbon in CO_2 indicating a fossil fuel source

C. A decline in global carbon fixation rates

D. Strong correlations between industrialization and CO_2 levels

38. Which of the following examples will violate Hardy-Weinberg equilibrium?

I. Female birds preferring bright-colored males

II. Individuals in small populations often mate with relatives

III. Migrants do not mate with the population they moved to

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

39. Which of the following features of an ecosystem most likely indicates cyclical succession?

A. Colonization after a rare volcanic eruption

B. Seasonal natural disasters

C. Forest regrowth after a wildfire

D. Gradual growth of a forest in a grassland biome

40. Which species are affected by the melting of landfast ice?

A. Black-throated loon (*Gavia arctica*)

B. Arctic mouse-ear chickweed (*Cerastium arcticum*)

C. Migrating reindeer (*Rangifer tarandus*)

D. Emperor penguin (*Aptenodytes forsteri*)

References:

2. Protein Data Bank.
11. National Oceanic and Atmospheric Administration.
23. https://saylordotorg.github.io/LegacyExams/BIO/BIO312/BIO312-FinalExam-Answers.html
34. Pyke G. H., J. D. Thomson, D. W. Inouye, and T. J. Miller. 2016. Effects of climate change on phenologies and distributions of bumble bees and the plants they visit. Ecosphere 7(3):e01267. 10.1002/ecs2.126.
Images: Chemical structures of molecules were taken from Google Images.