



Biology

Standard and Higher level

A1.2 Nucleic acids Paper 1A

19 August 2026

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

1 hour [Paper 1A]

Instructions to candidates

- Answer all questions.
- For each question, choose the answer you consider to be the best.
- A calculator is required for this paper.
- This paper generally presents questions in the same order the concepts are presented in the syllabus guide. The earlier questions are usually but not always easier than the later questions. Although most questions focus on this topic only, some are linked to other topics.
- This paper contains challenging IB-style problems. It is meant to enrich your learning and improve your mastery of the concepts presented in this topic after you have studied it.
- All of the questions here are original and written by me.
- **None of the questions are from past papers.**
- The maximum mark for paper 1A is **[40 marks]**.

1. What **correctly** describes the genetic material of living organisms and viruses?
 - A. Living organisms and viruses only use DNA
 - B. Living organisms only use DNA and viruses only use RNA
 - C. Living organisms only use RNA and viruses only use DNA
 - D. Living organisms only use DNA and viruses use DNA and RNA

2. Why are viruses considered non–living even if they have genetic material?
 - A. Their genetic material cannot be inherited because they are non-living
 - B. They are unable store their genetic material like living organisms
 - C. They cannot independently replicate their genetic material
 - D. Their genetic material can include ribose or deoxyribose

3. What is **correct** about the chemical connectivity of nucleotides?
 - A. 1' carbon of the pentose sugar is connected to the nitrogen base
 - B. 3' carbon of the pentose sugar is connected to the nitrogen base
 - C. 4' carbon of the pentose sugar is connected to the nitrogen base
 - D. 5' carbon of the pentose sugar is connected to the nitrogen base

4. Which chemical group is responsible for the acidity of DNA?
 - A. Pentose sugar
 - B. Phosphate group
 - C. Nitrogen base
 - D. Ester linkage

5. How is a strong backbone formed in DNA molecules?
 - A. Phosphodiester bonds form a continuous chain of hydrogen bonded atoms
 - B. Phosphodiester bonds form a continuous chain of covalently bonded atoms
 - C. Ester bonds form a continuous chain of hydrogen bonded atoms
 - D. Phosphate bonds form a continuous chain of covalently bonded atoms

6. What are phosphodiester bonds?
- A. The linkage of a phosphate group to two pentose sugars at different carbons
 - B. The linkage of a phosphate group to two pentose sugars at the same carbons
 - C. The linkage of a phosphate group to one pentose sugar at different carbons
 - D. The linkage of a phosphate group to one pentose sugar at the same carbons
7. How is information in genetic material stored?
- A. In DNA only
 - B. In DNA and RNA
 - C. In the order of DNA bases
 - D. In the DNA bases
8. Which nitrogenous base can thymine form hydrogen bonds with?
- I. Uracil
 - II. Cytosine
 - III. Adenine
- A. I only
 - B. III only
 - C. II and III only
 - D. I and III only
9. How is RNA formed?
- A. Hydrolysis of uracil nucleotides
 - B. Hydrolysis of RNA nucleotides
 - C. Condensation of uracil nucleotides
 - D. Condensation of RNA nucleotides

10. Which of the following describes a function of RNA polymers in cells?
- A. Addition of nucleotides during transcription
 - B. Growth of the nascent polypeptide chain during DNA replication
 - C. Increases the rate of protein synthesis
 - D. Energy storage as ATP

11. How are two strands of DNA joined together?
- A. Covalent bonding
 - B. Nitrogen bonding
 - C. Hydrogen bonding
 - D. Ionic bonding

12. A DNA strand with the following sequence is shown.

5' – AGGTTCAAGTC – 3'

What is the **correct** complementary nucleotide sequence?

- A. 3' – CTGAACTTGGA – 5'
 - B. 5' – CTGAACTTGGA – 3'
 - C. 5' – TCCAAGTTCAG – 3'
 - D. 3' – TCCAAGTTCAG – 5'
13. What **correctly** describes the antiparallel structure of DNA molecules?
- A. Bases face inwards and the sugar–phosphate backbone faces outwards
 - B. Bases face outwards and the sugar–phosphate backbone faces inwards
 - C. The 5' carbon faces the 3' carbon of the other strand at each end
 - D. The 5' carbon faces the 5' carbon of the other strand at each end

- 14.** What is a difference between DNA and RNA?
- A. The number of hydrogen bonds their bases can form
 - B. The structure of their pentose sugar
 - C. The reactions that form their polymers
 - D. The reactions that break down their polymers
- 15.** What similarity do DNA and RNA molecules share?
- A. Both of their polymers contain a sugar–phosphate backbone
 - B. Both of their polymers contain the same nitrogen bases
 - C. Both are typically double stranded
 - D. Both have stable and fixed functions
- 16.** What is the importance of complementary base pairing?
- I. It allows accurate expression of genetic information
 - II. It provides a mechanism for inheritance of genetic material
 - III. It supports the structural stability of DNA molecules
- A. I only
 - B. III only
 - C. I and II only
 - D. I, II and III
- 17.** How does the molecular structure of DNA explain the large biodiversity on Earth?
- A. Nucleotides are read in triplets which corresponds to the three domains of life
 - B. The length of DNA molecules is long to fit a lot of genetic information
 - C. The order of nucleotides in a DNA molecule is highly variable
 - D. The amount of genetic information that can be encoded by DNA is immense

18. How many possible nucleotide sequences exist for an RNA strand that is composed of 100 bases?
- A. 4^{100} because there are four DNA nucleotides
 - B. 100^4 because there are 100 bases which can be any of the four nucleotides
 - C. 3^{100} because nucleotides are read in codons
 - D. 5^{100} because there are five nucleotides in DNA and RNA
19. How is the genetic code universal?
- I. A specific sequence of three nucleotides codes for the same amino acid in all organisms
 - II. The same amino acid is specified by the same codon in all organisms
 - III. The same nucleotides are used in different organisms to store genetic information
- A. I and II only
 - B. II and III only
 - C. I and III only
 - D. I, II and III
20. What is evidence for universal common ancestry?
- A. Different organisms contain genes that code for similar functions
 - B. Amino acids are the building blocks of proteins in all organisms
 - C. Genes that produce similar phenotypes are found in different organisms
 - D. All organisms use the same codons during translation
21. **[AHL]** What is the role of directionality in DNA replication?
- A. DNA is replicated 3' to 5' relative to the template strand
 - B. DNA is replicated 5' to 3' relative to the template strand
 - C. DNA is replicated 5' to 3' relative to the antisense strand
 - D. DNA is replicated 3' to 5' relative to the new strand

- 22. [AHL]** What is the role of directionality in transcription?
- A. RNA is synthesized 5' to 3' relative to the template DNA strand
 - B. RNA is synthesized 5' to 3' relative to the coding DNA strand
 - C. RNA is synthesized 5' to 3' relative to the new RNA strand
 - D. RNA is synthesized 3' to 5' relative to the new RNA strand
- 23. [AHL]** What is the role of directionality in translation?
- A. Ribosomes bind near the 5' end of mRNA and synthesize 3' to 5'
 - B. Ribosomes bind near the 3' end of mRNA and read codons 5' to 3'
 - C. Ribosomes bind near the 3' end of mRNA and move toward the 5' end
 - D. Ribosomes bind near the 5' end of mRNA and move toward the 3' end
- 24. [AHL]** What is the difference between purines and pyrimidines?
- A. The number of hydrogen bonds
 - B. The number of carbon–nitrogen rings
 - C. The number of nitrogen rings
 - D. The number of carbon rings
- 25. [AHL]** Which of the following are purines?
- I. Adenine
 - II. Cytosine
 - III. Thymine
- A. I only
 - B. II only
 - C. II and III only
 - D. I and III only

26. **[AHL]** What is **correct** about histones?
- A. They contain many positively charged amino acids to attract DNA
 - B. They contain many positively charged amino acids to repel DNA
 - C. They contain many neutral amino acids to attract linker histones
 - D. They contain many negatively charged amino acids to attract DNA
27. **[AHL]** What **correctly** describes the histones in the nucleosome core?
- A. They are composed of eight histone proteins and linker histone
 - B. They are composed of a pair of four histone proteins
 - C. They are composed of four pairs of histone proteins
 - D. They are composed of eight pairs of histone proteins
28. **[AHL]** What is the role of linker DNA?
- A. It connects histones and DNA to each other
 - B. It connects DNA molecules to each other
 - C. It connects histones to each other
 - D. It connects nucleosomes to each other
29. **[AHL]** What is the role of nucleosomes?
- A. Condensation of DNA into larger molecules from nucleotides
 - B. Condensation of DNA into smaller fibers
 - C. Condensation of DNA into polymers
 - D. Condensation of DNA and histones into polymers
30. **[AHL]** How is the problem of induction addressed by the certainty of falsification?
- A. Repeated observations make a hypothesis more reliable
 - B. Falsification generalizes from specific examples to increase certainty
 - C. Observations that contradict hypotheses can falsify them
 - D. Induction is weaker logic than deduction so it is always falsified

31. **[AHL]** What is the tetranucleotide hypothesis?
- A. The hypothesis that DNA is composed of four nucleotides
 - B. The hypothesis that the genetic code is read in codons of four nucleotides
 - C. The hypothesis that DNA molecules repeat in sets of four nucleotides
 - D. The hypothesis that identical DNA molecules have equal nucleotide composition
32. **[AHL]** Which of the following observations would be sufficient to falsify the tetranucleotide hypothesis?
- A. A DNA sample in which $A = T$ and $G = C$
 - B. A DNA sample in which $A + G = T + C$
 - C. A DNA sample in which $G + T = A + C$
 - D. A DNA sample in which $A = T$ but $A \neq C$
33. **[AHL]** What is the percentage of adenine bases in a DNA sample if the percentage of cytosine bases is 22%?
- A. 22%
 - B. 28%
 - C. 26%
 - D. 25%
34. **[AHL]** What are radioisotopes?
- A. Isotopes that emit radiation when exposed to radio frequencies
 - B. Isotopes that lose different numbers of electrons with time
 - C. Isotopes that are radioactive and decay with time
 - D. Isotopes that release a lot of energy in living organisms

35. **[AHL]** Why were sulfur and phosphorus radioisotopes used in the Hershey–Chase experiment?

- A. DNA contains phosphorus but not sulfur
- B. Proteins contain phosphorus but not sulfur
- C. DNA contains sulfur and phosphorus
- D. Proteins contain sulfur and phosphorus

36. **[AHL]** Which option correctly shows the results of the Hershey–Chase experiment?

	Location of sulfur radioisotopes	Location of phosphorus radioisotopes
A.	Supernatant	Supernatant
B.	Supernatant	Pellet
C.	Pellet	Supernatant
D.	Pellet	Pellet

37. **[AHL]** How was viral DNA labeled in the Hershey–Chase experiment?

- A. Radioactive sulfur
- B. Radioactive phosphorus
- C. *E. coli* infection
- D. Centrifugation after blending

38. **[AHL]** What is the role of the centrifugation step in the Hershey–Chase experiment?

- A. To detach the viral protein coat from bacterial cells
- B. To separate sulfur and phosphorus radioisotopes according to weight
- C. To split bacterial and viral DNA according to differences in mass
- D. To separate bacterial cells from bacteriophage material outside of cells

39. **[AHL]** A student attempts to replicate the Hershey–Chase experiment and detects a small amount of S^{35} radioactivity in the pellet. What is a **correct** interpretation?
- A. This observation challenges the validity of the Hershey–Chase experiment
 - B. Viral protein enters cells since any radioactive sulfur originates from the virus
 - C. Protein is unlikely to be genetic material because only a small amount of S^{35} entered the pellet
 - D. An error likely occurred in the separation step of the experiment
40. **[AHL]** What is correct about two DNA molecules with the same amount of A, T, C, G bases?
- I. They encode the same genetic information
 - II. They are identical because they belong to the same organism
 - III. The possible arrangement of nucleotides along the molecules is diverse
- A. I only
 - B. III only
 - C. I and II only
 - D. I, II and III
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