Bases and the Structure of RNA

IB Biology - A1.2 Nucleic acids | Level: SL core | Suggested time: 40 minutes

Assessment pattern Multiple choice Short answer Data response Extended response	Total marks 28 Coverage SL focus with integrated application	Syllabus focus • A1.2.4 Nitrogenous bases in nucleic acids • A1.2.5 RNA as a polymer of nucleotide monomers • Single-stranded RNA structure

Instructions

- Answer all questions unless your teacher tells you otherwise.
- Show biological reasoning clearly in short-answer, data-response and extended-response items.

Section A - Multiple choice

Choose the best answer in each case.

1. Which nitrogenous base is found in RNA but not DNA? [1]

   A. Adenine

   B. Cytosine

   C. Uracil

   D. Thymine

2. How many different nitrogenous bases occur across DNA and RNA together? [1]

   A. 4

   B. 5

   C. 6

   D. 8

3. How many different nucleotide types exist in total across DNA and RNA? [1]

   A. 4

   B. 5

   C. 8

   D. 10

4. Which feature best identifies a diagram as RNA? [1]

   A. Double-stranded structure and thymine

   B. Single strand containing uracil

   C. Double helix and deoxyribose

   D. Presence of histones

5. All RNA nucleotides contain which sugar? [1]

   A. Glucose

B. Ribose

C. Deoxyribose

D. Cellulose

Section B - Short answer

6. Name the four nitrogenous bases found in RNA. [4]

7. Explain why a nucleotide containing adenine in RNA is not identical to a nucleotide containing adenine in DNA. [3]

8. An RNA molecule contains 322 nucleotides. State how many water molecules were produced when it formed and explain why. [3]

Section C - Data response / case study

9. Data response - Composition of RNA fragments [7]

Three RNA molecules were isolated from a cell and their nucleotide composition was measured.

Table 1. Nucleotide composition of three RNA fragments

RNA fragment	A	U	C	G	Total nucleotides
R1	8	6	4	2	20
R2	5	5	7	3	20
R3	10	8	6	6	30

9(a) Identify one piece of evidence from the table that these molecules are RNA. [2]

9(b) State which fragment is the longest and explain how you know. [2]

9(c) Explain why different RNA molecules can all belong to the same cell even though their base compositions differ. [3]

Section D - Extended response

10. Explain how the structure of RNA differs from DNA and how these differences relate to RNA's role in cells. [6]

Bases and the Structure of RNA - Answer key and marking guidance

IB Biology - A1.2 Nucleic acids | Level: SL core | Suggested time: 40 minutes | Accept equivalent biologically accurate wording where appropriate.

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General marking guidance

- Award credit for clear biological meaning even if wording differs from the model answer.
- Do not award more than the maximum marks shown for each question.
- For extended responses, reward linked explanation rather than isolated word lists.

Multiple choice answers

Q	Answer	Why it is correct
1	C	Uracil occurs in RNA; thymine occurs in DNA.
2	B	The five possible bases are adenine, thymine, cytosine, guanine and uracil.
3	C	There are four DNA nucleotides and four RNA nucleotides, giving eight in total.
4	B	RNA is usually single-stranded and contains uracil.
5	B	RNA contains ribose as its pentose sugar.

Short answer and data response guidance

6. Name the four nitrogenous bases found in RNA. [4]

- Adenine.
- Uracil.
- Cytosine.
- Guanine.

Marking guidance: Award 1 mark per correct base, max 4.

7. Explain why a nucleotide containing adenine in RNA is not identical to a nucleotide containing adenine in DNA. [3]

- The sugar differs: RNA has ribose and DNA has deoxyribose.
- They therefore are different nucleotides even though both include adenine.
- RNA and DNA are parts of different polymers with different overall structures/functions.

Marking guidance: Award up to 3 marks for a clear comparison.

8. An RNA molecule contains 322 nucleotides. State how many water molecules were produced when it formed and explain why. [3]

- 321 water molecules were produced.
- Each condensation reaction joining adjacent nucleotides releases one water molecule.
- A chain of 322 nucleotides contains 321 links.

Marking guidance: Award 1 mark for the correct value and up to 2 marks for explanation.

9(a). Identify one piece of evidence from the table that these molecules are RNA. [2]

- Uracil is present in the molecules.
- The molecules are recorded as single RNA fragments rather than paired DNA strands.

Marking guidance: Award 1 mark for a correct piece of evidence, max 2 if two distinct points are given.

9(b). State which fragment is the longest and explain how you know. [2]

- R3 is the longest fragment.
- It has the greatest total number of nucleotides (30).

Marking guidance: Award 1 mark for correct identification and 1 mark for explanation.

9(c). Explain why different RNA molecules can all belong to the same cell even though their base compositions differ. [3]

- RNA molecules are copied from different genes/regions.
- Different genes have different base sequences.
- Therefore RNA molecules can vary in length and composition while coming from the same cell.

Marking guidance: Award up to 3 marks for a linked explanation.

Extended response guidance

10. Explain how the structure of RNA differs from DNA and how these differences relate to RNA's role in cells. [6]

- RNA is usually single-stranded whereas DNA is double-stranded.
- RNA contains ribose instead of deoxyribose.
- RNA contains uracil instead of thymine.
- RNA can be copied from specific genes and used in protein synthesis.
- Its single-stranded structure allows a variety of RNA forms/functions.
- DNA remains the more permanent store of hereditary information.

Marking guidance: Award up to 6 marks for accurate linked contrasts between RNA and DNA tied to function.