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GCE AS / A LEVEL – BIOLOGY UNIT 1 QUESTION PACK

1071-01 (Legacy BY1) · New spec Unit 1 Topic 6 · AS unit, first sat 2016, 80 marks, 1h 30min paper

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BIOLOGY – UNIT 1 · NUCLEIC ACIDS

BY1.5 Nucleic acids – DNA / RNA structure and replication

Nucleotide structure, the Watson-Crick double helix, complementary base pairing, semi-conservative replication, plus contrasts with RNA. (Legacy BY1 has no questions on transcription/translation – protein synthesis is reserved for a future BY2 pack once those papers are added.)

LEGACY 2008 SPECIFICATION

Estimated time for entire question pack: ~1 h 20 min

Derived from the legacy BY1 paper's pace of ~1.1 min/mark, padded for long-prose answers (50 marks over 7 questions).

*You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **comprehensive practice question pack**, not a single mock paper. It contains every question from the legacy WJEC BY1 papers (2008 modular spec, 2011–2017) that maps onto new-spec AS Unit 1 Topic 6 (1.5). Questions are ordered by source paper date.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working – quality of written communication will affect marks. A calculator is allowed. Diagrams included in answers must be fully annotated.

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Q	Source	Max	Mark	Q	Source	Max	Mark
1	Jan 14 Q1	5		5	Jan 13 Q2	5	
2	Jan 12 Q5	4		6	Jun 14 Q4	10	
3	Jun 12 Q3	10		7	Jun 17 Q7	10	
4	Jun 15 Q2	6		Total			
				50			

Nucleic Acids – what the new spec asks

WJEC GCE AS / A Level Biology (from 2015) · Unit 1: Basic Biochemistry & Cell Organisation · Topic 1.5.

Nucleotide structure

- Pentose sugar + phosphate + nitrogenous base.
- Purines: adenine, guanine (double-ring).
- Pyrimidines: cytosine, thymine, uracil (single-ring).
- Nucleotides join via phosphodiester bonds (sugar-phosphate backbone).

DNA structure

- Double helix; two antiparallel polynucleotide strands.
- Complementary base pairing: A-T (2 H-bonds), C-G (3 H-bonds).
- 0.34 nm between bases; full turn every 3.4 nm (10 bp).
- Chargaff: %A = %T and %C = %G.

DNA replication

- Semi-conservative: each daughter has one parent + one new strand.
- DNA helicase unwinds; DNA polymerase adds free nucleotides.
- Meselson & Stahl – ^{15}N / ^{14}N density gradient experiment.

RNA & comparison

- Single-stranded; ribose instead of deoxyribose; uracil instead of thymine.
- mRNA, tRNA, rRNA – roles in protein synthesis.
- (BY1 papers contain DNA-structure questions; transcription/translation tested in legacy BY2/BY4.)

Nucleic Acids in one page

Quick-reference notes – revisit before each question.

Nucleotide

Pentose sugar + phosphate + base.
Base classes: purines (A, G) double-ring; pyrimidines (C, T, U) single-ring.
Phosphodiester bonds form sugar-phosphate backbone.

DNA structure

Double helix; antiparallel strands.
Base pairs A-T (2 H-bonds), G-C (3 H-bonds).
10 bp per turn; 3.4 nm per turn; 0.34 nm between bases.

Replication

Semi-conservative.
Helicase unwinds; polymerase adds nucleotides 5'→3'.
Meselson & Stahl: ^{15}N parents → hybrid → hybrid + light.

RNA vs DNA

RNA single-stranded; ribose; uracil replaces thymine.
mRNA carries code; tRNA carries amino acids; rRNA in ribosomes.

Chargaff & base ratios

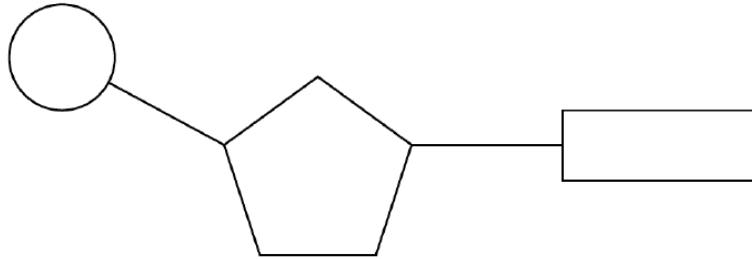
$\%A = \%T$; $\%G = \%C$.
 $(\%A + \%G) = (\%T + \%C) = 50\%$ (in dsDNA).
Useful for calculating composition from one strand.

Corpus note

The legacy BY1 papers test DNA *structure* & replication, but not transcription / translation – those appeared in BY2/BY4.
A future protein-synthesis pack will draw from those papers once added.

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1. The diagram below shows a simple nucleotide.



- (a) On the diagram above, draw a circle around the component that contains nitrogen. [1]
- (b) Describe **two** differences between a DNA nucleotide and an RNA nucleotide. [2]

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An experiment was carried out to determine the relative percentages of the bases in DNA from various organisms. The results are shown in the table below.

Source of DNA	Relative percentage of base in sample			
	Adenine	Guanine	Thymine	Cytosine
human	30.9	19.9	29.4	19.8
sea urchin	32.8	17.7	32.1	17.3
wheat	27.3	22.7	27.1	22.8

(c) DNA is a double stranded molecule. Explain how the data in the table supports the concept of complementary base pairing. [2]

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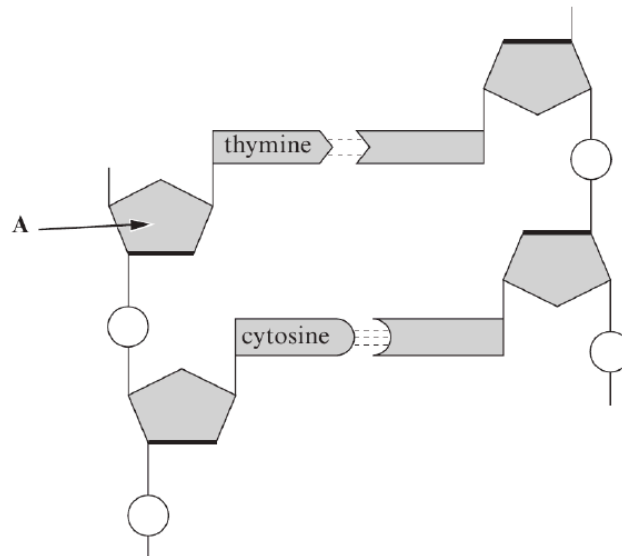
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5. The diagram represents the molecular structure of part of a DNA molecule.



(a) Name part A. [1]

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(b) Part of a DNA molecule has the following sequence of bases.

T-A-T-C-G

(i) In the table below write the letters for the sequence of bases of the complementary portion of DNA. [1]

DNA molecule	T	A	T	C	G
complementary DNA					

(ii) Biochemical analysis of a sample of DNA showed that 30% of the bases were guanine. Calculate the percentage of the bases in the sample which would be adenine. Show your working. [2]

Answer

(Total 4 marks)



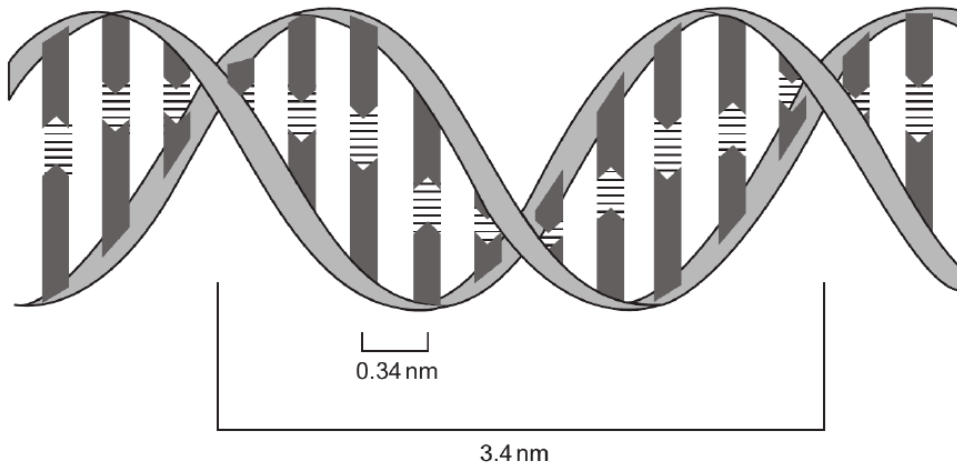


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2. The diagram below shows the DNA structure proposed by Watson and Crick in 1953.

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(a) If the double helix takes 3.4 nm to make one complete turn and base pairs are 0.34 nm apart, how many base pairs would you expect to find in five complete turns? Show your working. [2]

Answer =

(b) Give a reason why the diagram **shown** above must be DNA rather than RNA. [1]

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(c) The table below shows the bases guanine and cytosine as percentages of the total nucleotides present in three different micro-organisms.

Micro-organism	Base composition (%)	
	G	C
yeast	18.7	17.1
bacteria	36.0	35.7
virus	42.0	13.9

(i) Suggest which type of nucleic acid is present in the virus shown in the table. Explain your answer. [2]

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(ii) State the type of base to which cytosine belongs. [1]

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2. There are 2 types of nucleic acid: DNA and RNA.

(a) Complete the table below to describe **three** differences between the structure of DNA and RNA. [3]

DNA	RNA

(b) A sample of DNA was analysed, 23% of the nucleotides contained guanine. Calculate the percentage of nucleotides which contained adenine. Show your working. [2]

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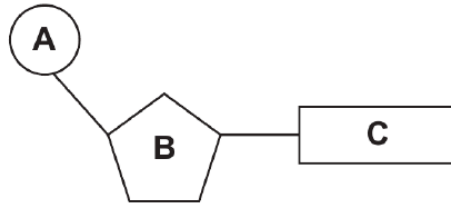
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(Total 5 marks)

4. The diagram below shows a component of DNA.

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(a) Name the parts **A**, **B** and **C**.

[3]

- A**
- B**
- C**

(b) Describe how a polymer of DNA would be different from a polymer of RNA.

[2]

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(c) (i) Name the stage in the cell cycle where DNA replication occurs. [1]
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(ii) Vincristine is a drug which prevents the spindle fibres from shortening. Name the stage in the cell cycle which would be affected. [1]
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(iii) State **three** differences between daughter cells produced by the process of mitosis and those produced by meiosis. [3]
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END OF QUESTION PACK

7 questions · 50 marks · ~1 h 20 min

Source: WJEC BY1 (2008 modular spec, 2011–2017)

Curated for WJEC Biology 2015 spec AS Unit 1 – Topic 6 (1.5)

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