A Level AQA Biology

3 Nucleotides and nucleic acids – answers

Question	Answers	Extra information	Mark	AO Spec reference
01.1	(nitrogenous) bases;	Accept named bases	1	AO2 3.1.5.1
01.2	all (double-stranded) DNA molecules contain 50% ^{14}N and 50% ^{15}N; template strand contains (only) ^{15}N; new strand contains (only) ^{14}N;		2 max	AO3 3.1.5.2
01.3	some DNA contains only ^{14}N; which is low density; idea that (when generation 1 replicated DNA); 50% of template strands were ^{14}N and 50% were ^{15}N;		2 max	AO3 3.1.5.2
01.4	50% high density; 0% intermediate density **AND** 50% low density;		2	AO3 3.1.5.2
01.5	(DNA) helicase , unwinds / unzips DNA; DNA polymerase , adds nucleotides to new DNA strand;	Accept all other suitable answers e.g., DNA ligase catalyses the formation of phosphodiester bonds; DNA polymerase proofreads newly synthesised DNA	2 max	AO1 3.1.5.2
01.6	nucleotides; ATP;		1 max	AO2 3.1.5.2
02.1	RNA contains ribose **AND** DNA contains deoxyribose; RNA contains , U / uracil **AND** DNA contains , T / thymine; RNA is single-stranded **AND** DNA is double-stranded ✓	Accept 'amino' for 'amine' and 'carboxylic acid' for 'carboxyl group'.	3	AO1 3.1.5.1

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<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO
Spec reference</th></tr>
<tr><td>02.2</td><td>
<table>
<tr><th>Nitrogenous base</th><th>Complementary base</th><th>Number of hydrogen bonds formed with complementary base</th></tr>
<tr><td>adenine</td><td>T / thymine</td><td>2</td></tr>
<tr><td>cytosine</td><td>G / guanine</td><td>3</td></tr>
</table>
</td><td>One mark for column 2
One mark for 2 hydrogen bonds (column 3)
One mark for 3 hydrogen bonds (column 3)</td><td>3</td><td>AO1
3.1.5.1</td></tr>
<tr><td>02.3</td><td>P = guanine AND Z = cytosine;
Plus any two from:
P , has two rings / is a purine;
Z , has one ring / is a pyrimidine;
(they are bonded by) 3 hydrogen bonds;</td><td></td><td>3 max</td><td>AO2
3.1.5.1</td></tr>
<tr><td>03.1</td><td>
<table>
<tr><th>Step in DNA purification</th><th>Why is this step required?</th></tr>
<tr><td>grinding of plant tissue</td><td>break down cell walls</td></tr>
<tr><td>addition of detergent</td><td>break down cell membranes</td></tr>
<tr><td>addition of protease enzymes</td><td>break down , proteins / histones , surrounding DNA</td></tr>
<tr><td>addition of alcohol</td><td>precipitate DNA</td></tr>
</table>
</td><td>One mark per correct row</td><td>4</td><td>AO3
3.1.5.1</td></tr>
<tr><td>03.2</td><td>use of restriction enzymes/endonucleases;
use of buffer (for electrophoresis gel);
place DNA (fragments) in sample wells/at cathode/at negative electrode;
idea that shorter fragments move (towards cathode) faster (when electric current is applied);
method of visualisation described;</td><td>e.g., fluorescence under UV light or autoradiography</td><td>3 max</td><td>AO1
3.1.5.1
ATg</td></tr>
</table>

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<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO
Spec reference</th></tr>
<tr><td>04.1</td><td>
<table>
<tr><td>Process</td><td>DNA replication</td><td>Transcription</td></tr>
<tr><td>Which sections of DNA need to be unzipped?</td><td>entire length of each chromosome / AW</td><td>the gene being transcribed</td></tr>
<tr><td>Enzyme that catalyses the formation of the polynucleotide product</td><td>DNA polymerase / ligase</td><td>RNA polymerase</td></tr>
<tr><td>Polynucleotide product</td><td>two (double-stranded) DNA molecules</td><td>mRNA</td></tr>
<tr><td>Letters of the four nitrogenous bases in the product</td><td>A , T, C, G</td><td>A, U, C, G</td></tr>
</table>
</td><td>One mark per correct row</td><td>4</td><td>AO1
3.1.5.1
3.1.5.2
3.4.1
3.4.2</td></tr>
<tr><td>04.2</td><td>mRNA
idea of carries genetic code from nucleus to ribosomes;
rRNA
idea of forms structure of ribosomes;
tRNA
idea of carries amino acid AND binds to (complementary base on) mRNA;</td><td></td><td>3</td><td>AO1
3.1.5.1
3.4.2</td></tr>
</table>

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Spec reference</th></tr>
<tr><td>05.1</td><td>
<table>
<tr><th>Location of bond</th><th>Name of bond</th><th>Explanation of the importance of this bonding</th></tr>
<tr><td>between deoxyribose and phosphate</td><td>phosphodiester (bond)</td><td>forms sugar-phosphate backbone / forms structure of single DNA polynucleotide strand</td></tr>
<tr><td>between nitrogenous bases</td><td>hydrogen (bond)</td><td>forms double-stranded DNA molecule / complementary base pairing</td></tr>
</table>
</td><td>One mark per correct box</td><td>4</td><td>AO1
3.1.5.1</td></tr>
<tr><td>05.2</td><td>(it is) single-stranded;</td><td></td><td>1</td><td>AO1
3.1.5.1</td></tr>
<tr><td>05.3</td><td>(mRNA is relatively) shorter / smaller (than DNA);</td><td>Or reverse argument</td><td>1</td><td>AO2
3.1.5.1</td></tr>
<tr><td>05.4</td><td>(formed from) (r)RNA and proteins;</td><td></td><td>1</td><td>AO1
3.1.5.1</td></tr>
<tr><td>06.1</td><td>AAU ACA UCG;</td><td></td><td>1</td><td>AO2
2.1.3di and f</td></tr>
<tr><td>06.2</td><td>UUA UGU AGC;</td><td></td><td>1</td><td>AO2</td></tr>
<tr><td>06.3</td><td>degeneracy / redundancy;</td><td></td><td>1</td><td>AO1</td></tr>
<tr><td>06.4</td><td>triplet / codon changes;
(but) same amino acid is coded;
primary structure of polypeptide remains the same;</td><td></td><td>2 max</td><td>AO2</td></tr>
<tr><td>06.5</td><td>stop codon / determines length of mRNA;</td><td>Accept alternative wording</td><td>1</td><td>AO2</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO
Spec reference</th></tr>
<tr><td>07</td><td>The following are suitable topic areas from the specification that could be used to describe the use of pentose and hexose sugars in biochemical reactions and the formation of other molecules within cells.

In order to fully address the question and reach the highest mark bands students must also include at least five topics in their answer, to demonstrate a synoptic approach to the essay.

<table>
<tr><th>Specification reference</th><th>Topic area</th></tr>
<tr><td>3.1.1</td><td>Monomers and polymers</td></tr>
<tr><td>3.1.2</td><td>Carbohydrates</td></tr>
<tr><td>3.1.4.1</td><td>General properties of proteins</td></tr>
<tr><td>3.1.4.2</td><td>Many proteins are enzymes</td></tr>
<tr><td>3.1.5.1</td><td>Structure of DNA and RNA</td></tr>
<tr><td>3.1.5.2</td><td>DNA replication</td></tr>
<tr><td>3.4.2</td><td>DNA and protein synthesis</td></tr>
</table>

Students may be able to show the relevance of other topics from the specification.

Note: other topics from beyond the specification can be used, providing they relate to the title and contain factually correct material of at least an A-level standard. Credit should not be given for topics beyond the specification which are below A-level standard.</td><td></td><td>25</td><td>AO1
3.1.2
3.1.5.1
3.1.5.2
3.1.6
3.4.1
3.5.1
3.5.2</td></tr>
</table>

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Skills box answers

Question	Answer
1	C = 32% T = 18%
2	A = 19%
3	G and C = 17% A and U = 33%

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