

A Level OCR Biology

4 Nucleotides and nucleic acids – answers

Question	Answers	Extra information	Mark	AO Spec reference
1(a)	(A=) adenine ✓ (B=) ribose ✓ (C=) (inorganic) phosphates ✓	ACCEPT triphosphate	3	AO1 2.1.3c
1(b)	<i>similarities</i> pentose sugar ✓ (one) nitrogenous base ✓ <i>differences</i> ATP has three phosphates AND DNA nucleotide has one phosphate ✓ ATP has ribose AND DNA has deoxyribose ✓ ATP always has adenine AND DNA nucleotides can have different (named) bases ✓		Max 4	AO1 2.1.3a and c
1(c)	hydrolysis ✓		1	AO1 2.1.3b and c
1(d)	condensation (reaction) ✓ light-dependent stage of photosynthesis (in chloroplasts of plant cells) ✓ in mitochondria ✓ substrate-level phosphorylation ✓ oxidative phosphorylation / by ATP synthase ✓	ACCEPT photophosphorylation ACCEPT in glycolysis / in Krebs cycle	Max 4	AO1 2.1.3c, 5.2.1d, 5.2.2c, e, g, and h
2(a)(i)	(nitrogenous) bases ✓	ACCEPT named bases	1	AO2 2.1.3a
2(a)(ii)	<i>idea that</i> 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 ✓		Max 2	AO3 2.1.3e

A Level OCR Biology

4 Nucleotides and nucleic acids – answers

Question	Answers	Extra information	Mark	AO Spec reference												
2(a)(iii)	some DNA contains only ^{14}N ✓ which is low density ✓ <i>idea that</i> (when generation 1 replicated DNA) 50% of template strands were ^{14}N and 50% were ^{15}N ✓		Max 2	AO3 2.1.3e												
2(a)(iv)	50% high density ✓ 0% intermediate density AND 50% low density ✓		2	AO3 2.1.3e												
2(b)(i)	(DNA) helicase , unwinds / unzips / AW , DNA ✓ DNA polymerase , adds nucleotides to new DNA strand ✓ AVP ✓	e.g., DNA ligase catalyses the formation of phosphodiester bonds; DNA polymerase proofreads newly synthesised DNA	Max 2	AO1 2.1.3e												
2(b)(ii)	nucleotides ✓ ATP ✓		Max 1	AO2 2.1.3e												
3(a)(i)	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 ✓ RNA is shorter ora ✓		Max 3	AO1 2.1.3a												
3(a)(ii)	<table border="1"> <thead> <tr> <th>nitrogenous base</th> <th>Purine or pyrimidine?</th> <th>Complementary base</th> <th>Number of hydrogen bonds formed with complementary base</th> </tr> </thead> <tbody> <tr> <td>adenine</td> <td>purine</td> <td>T / thymine</td> <td>2</td> </tr> <tr> <td>cytosine</td> <td>pyrimidine</td> <td>G / guanine</td> <td>3</td> </tr> </tbody> </table>	nitrogenous base	Purine or pyrimidine?	Complementary base	Number of hydrogen bonds formed with complementary base	adenine	purine	T / thymine	2	cytosine	pyrimidine	G / guanine	3	One mark for column 2 One mark for column 3 One mark for two hydrogen bonds (column 4) One mark for three hydrogen bonds (column 4)	4	AO1 2.1.3a and di
nitrogenous base	Purine or pyrimidine?	Complementary base	Number of hydrogen bonds formed with complementary base													
adenine	purine	T / thymine	2													
cytosine	pyrimidine	G / guanine	3													

A Level OCR Biology

4 Nucleotides and nucleic acids – answers

Question	Answers	Extra information	Mark	AO Spec reference															
3(b)	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) three hydrogen bonds ✓		Max 3	AO2 2.1.3a and di															
4(a)(i)	walls ✓ detergent ✓ protease ✓		3	AO1 2.1.3dii															
4(a)(ii)	<table border="1"> <thead> <tr> <th>Step in DNA purification</th> <th>Why is it added?</th> </tr> </thead> <tbody> <tr> <td>addition of salt</td> <td>break hydrogen bonds (between DNA strands) / separate DNA polynucleotides</td> </tr> <tr> <td>addition of enzymes</td> <td>Break down, proteins / histones, surrounding DNA</td> </tr> <tr> <td>addition of alcohol</td> <td>Precipitate DNA</td> </tr> </tbody> </table>	Step in DNA purification	Why is it added?	addition of salt	break hydrogen bonds (between DNA strands) / separate DNA polynucleotides	addition of enzymes	Break down, proteins / histones, surrounding DNA	addition of alcohol	Precipitate DNA	One mark per correct row	3	AO1 2.1.3dii							
Step in DNA purification	Why is it added?																		
addition of salt	break hydrogen bonds (between DNA strands) / separate DNA polynucleotides																		
addition of enzymes	Break down, proteins / histones, surrounding DNA																		
addition of alcohol	Precipitate DNA																		
4(a)(iii)	pestle and mortar ✓		1	AO1 2.1.3dii															
5(a)	<table border="1"> <thead> <tr> <th>Process</th> <th>DNA replication</th> <th>transcription</th> </tr> </thead> <tbody> <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> </tbody> </table>	Process	DNA replication	transcription	Which sections of DNA need to be unzipped?	entire length of each chromosome / AW	the gene being transcribed	Enzyme that catalyses the formation of the polynucleotide product	DNA polymerase / ligase	RNA polymerase	Polynucleotide product	two (double-stranded) DNA molecules	mRNA	Letters of the four nitrogenous bases in the product	A, T, C, G	A, U, C, G	One mark per correct row	4	AO1 2.1.3e and g
Process	DNA replication	transcription																	
Which sections of DNA need to be unzipped?	entire length of each chromosome / AW	the gene being transcribed																	
Enzyme that catalyses the formation of the polynucleotide product	DNA polymerase / ligase	RNA polymerase																	
Polynucleotide product	two (double-stranded) DNA molecules	mRNA																	
Letters of the four nitrogenous bases in the product	A, T, C, G	A, U, C, G																	

A Level OCR Biology

4 Nucleotides and nucleic acids – answers

Question	Answers	Extra information	Mark	AO Spec reference
5(b)	<p>mRNA idea of carries genetic code from nucleus to ribosomes ✓</p> <p>rRNA idea of forms structure of ribosomes ✓</p> <p>tRNA idea of carries amino acid AND binds to (complementary bases on) mRNA ✓</p>		3	AO1 2.1.3g
6(a)(i)	AAU ACA UCG ✓		1	AO2 2.1.3di and f
6(a)(ii)	UUA UGU AGC ✓		1	AO2 2.1.3di, f, and g
6(b)(i)	degeneracy / degenerate ✓		1	AO1 2.1.3f
6(b)(ii)	<p>triplet / codon , changes ✓ (but) same amino acid is coded ✓ primary structure of polypeptide remains the same ✓</p>		Max 2	AO2 6.1.1a
6(c)	stop codon / determines length of mRNA / AW ✓		1	AO2 2.1.3f
7	<p>Level 3 (5–6 marks) Describes the roles of enzymes in replication and the uses of enzymes in genetic manipulations. <i>There is a well-developed line of reasoning, which is clear and logically-structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.</i></p> <p>Level 2 (3–4 marks) Describes a role of an enzyme in DNA replication and a use of an enzyme in genetic manipulations.</p>	<p>Indicative scientific points may include:</p> <p><i>DNA replication</i></p> <ul style="list-style-type: none"> • Helicase: unwinding the double helix; unzipping / breaking hydrogen bonds • DNA polymerase: catalyses synthesis of new DNA polynucleotide; proofreading 	6	AO1 2.1.3e 6.1.3d, e, and fii

A Level OCR Biology

4 Nucleotides and nucleic acids – answers

Question	Answers	Extra information	Mark	AO Spec reference
	<p><i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.</i></p> <p>Level 1 (1–2 marks) Describes a role of an enzyme in DNA replication or a use of an enzyme in genetic manipulations. <i>The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.</i></p> <p>0 marks No response or no response worthy of credit.</p>	<ul style="list-style-type: none"> DNA ligase: catalyses formation of phosphodiester bonds <p><i>genetic manipulations</i></p> <ul style="list-style-type: none"> Restriction enzymes: cuts DNA at specific sites; forms DNA fragments; uses in sequencing, electrophoresis, genetic engineering, DNA profiling. Taq DNA polymerase: stable at high temperatures; use in PCR. DNA ligase: use in genetic engineering to form recombinant DNA. 		
8	<p>Level 3 (5–6 marks) Describes DNA replication in detail, with no significant errors and explains the term ‘semi-conservative’. <i>There is a well-developed line of reasoning, which is clear and logically-structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.</i></p> <p>Level 2 (3–4 marks) Describes DNA replication, with few errors and explains the term ‘semi-conservative’. <i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.</i></p> <p>Level 1 (1–2 marks) Describes some aspects of DNA replication. <i>The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.</i></p>	<p>Indicative scientific points may include:</p> <p><i>DNA replication</i></p> <ul style="list-style-type: none"> Histone proteins removed DNA double helix unwound by helicase Hydrogen bonds between strands are broken by helicase Both strands are templates Activated mononucleotides form hydrogen bonds with bases on the template strands Complementary base pairing Sugar-phosphate backbone is formed in new strands 	6	AO1 2.1.3e

A Level OCR Biology

4 Nucleotides and nucleic acids – answers

Question	Answers	Extra information	Mark	AO Spec reference
	<p>0 marks No response or no response worthy of credit.</p>	<ul style="list-style-type: none"> • Phosphodiester bonds formed • Catalysed by DNA polymerase <p><i>Semi-conservative:</i></p> <ul style="list-style-type: none"> • In the two double-stranded DNA molecules, the template strand is conserved, but the other strand is newly synthesised. 		

Skills box answers

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