Nucleotides and Nucleic Acids (2.1.3): OCR A Level Biology Exam Questi

17 questions · 39 marks · about 47 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · AS Paper 1 · June 2018 · Q24(a)(i) · 1 mark

24 Fig. 24 shows a DNA nucleotide.

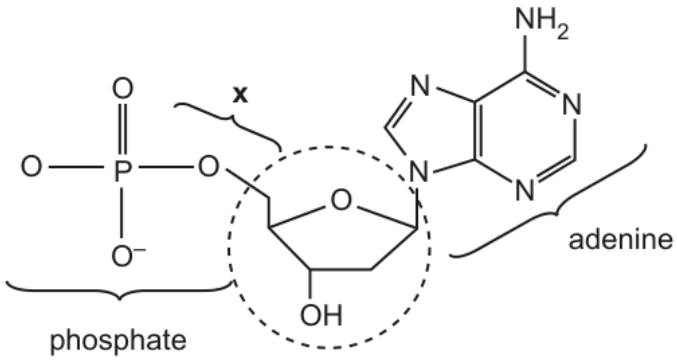


Fig. 24

(a) (i) Name the circled component in Fig. 24.

..... **[1]**

Question 2 · AS Paper 1 · June 2018 · Q24(a)(ii) · 1 mark

(ii) Name the bond labelled **x** in Fig. 24.

..... **[1]**

Question 3 · AS Paper 1 · June 2025 · Q22(a) · 3 marks

22

(a) DNA is a molecule found in the nucleus of eukaryotic cells.

The passage below is about the structure and properties of DNA.

Complete the sentences using the most appropriate term(s).

A molecule of DNA is made from two polynucleotides twisted around each other in a shape known as a ..... . The two polynucleotides are held together by ..... between nitrogenous bases. Cytosine and guanine are more strongly bonded than adenine and thymine, as there are ..... bonds holding them together.

[3]

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Question 4 · A level Paper 3 · June 2023 · Q7(b) · 2 marks

(b) State the roles of DNA polymerase and helicase in cells.

DNA polymerase .....

.....

Helicase .....

.....

[2]

Question 5 · AS Paper 2 · June 2018 · Q1(b)(i) · 2 marks

(b) Pepsin is a protease enzyme with a polypeptide chain containing 327 amino acids.

Titin is the largest known protein. It has a polypeptide chain containing at least 92 times more amino acids than pepsin.

(i) DNA sequences in genes code for polypeptide molecules such as pepsin and titin.

Explain why a process known as transcription is necessary for polypeptide synthesis.

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.....

.....

..... **[2]**

Question 6 · A level Paper 3 · June 2025 · Q4(a) · 2 marks

4 RNA and DNA are polynucleotides.

(a) Two types of RNA are messenger RNA and transfer RNA.

The table shows some properties of these two types of RNA.

Place ticks (✓) in the correct boxes to indicate which properties are true for each type of RNA.

Property	Messenger RNA	Transfer RNA
Anticodons are present.		
The nucleotide base sequence codes for a polypeptide.		
Uracil is bonded to adenine by hydrogen bonds within the molecule.		

[2]

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Question 7 · information from earlier in the question

24 Fig. 24 shows a DNA nucleotide.

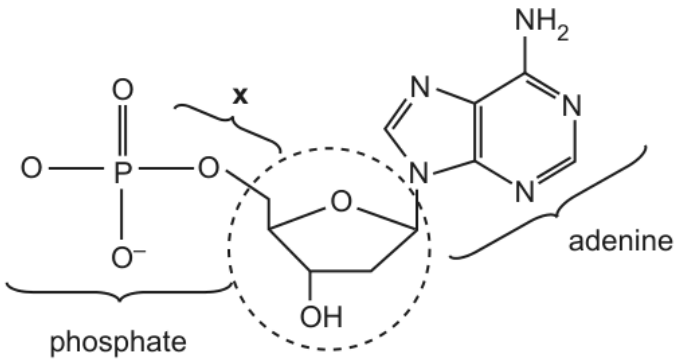


Fig. 24

(a) (i) Name the circled component in Fig. 24.

..... **[1]**

Question 7 · AS Paper 1 · June 2018 · Q24(b) · 4 marks

(b) Identify two similarities and two differences between the DNA nucleotide shown in Fig. 24 and a molecule of ATP.

Similarities .....

.....

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.....

Differences .....

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[4]

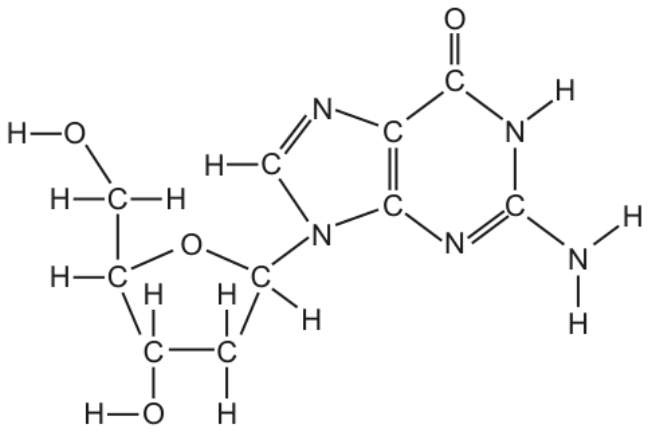
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Question 8 · A level Paper 3 · June 2024 · Q4(a) · 2 marks

4 Respiration allows cells to carry out processes such as DNA replication.

(a) Phosphodiester bonds are formed during DNA replication.

The diagram shows a molecule of deoxyguanosine, which consists of deoxyribose bonded to guanine.



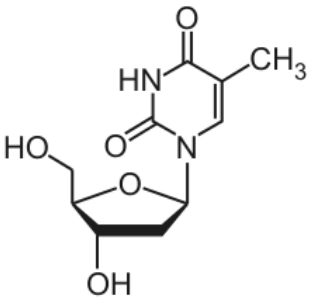
Draw **two** circles **on the diagram** around the two parts of the molecule that bond to phosphate when phosphodiester bonds form in DNA. **[2]**

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Question 9 · A level Paper 3 · June 2023 · Q2(b) · 2 marks

(b) Vitamin B_9 is needed for the synthesis of molecule **D**, shown in **Fig. 2.2**.

Fig. 2.2



Molecule **D**

Molecule **D** is a component in the structure of DNA.

A deficiency of vitamin B_9 in the diet can cause interphase to stop in some cells.

Use **Fig. 2.2** to explain why a deficiency of vitamin B_9 can cause interphase to stop.

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..... **[2]**

Question 10 · information from earlier in the question

(b) Pepsin is a protease enzyme with a polypeptide chain containing 327 amino acids.

Titin is the largest known protein. It has a polypeptide chain containing at least 92 times more amino acids than pepsin.

(i) DNA sequences in genes code for polypeptide molecules such as pepsin and titin.

Explain why a process known as transcription is necessary for polypeptide synthesis.

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.....

..... **[2]**

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Question 10 · AS Paper 2 · June 2018 · Q1(b)(ii) · 2 marks

(ii) Calculate the minimum length of the DNA base sequence required to code for titin.

Show your working.

Answer ..... **[2]**

Turn over

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(b) Sickle cell disease is a genetic disease that results from a substitution mutation in one of the genes that code for haemoglobin.

Fig. 16.2 below shows part of the mRNA sequence that codes for normal haemoglobin and the corresponding sequence of amino acids.

mRNA	ACU	CCU	GAG	GAG	AAG
Amino acids	1	2	glutamic acid	glutamic acid	lysine

Fig. 16.2

Fig. 16.3 is a representation of the genetic code.

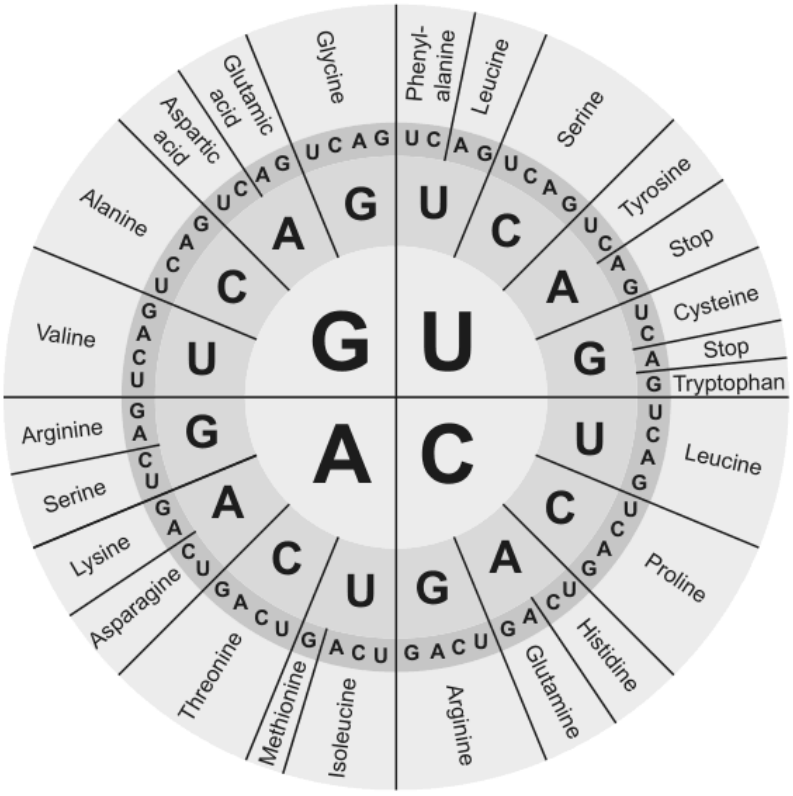


Fig. 16.3

(i) Use **Fig. 16.3** to identify the missing amino acids 1 and 2 in **Fig. 16.2**.

1 .....

2 .....

[2]

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Question 12 · A level Paper 2 · June 2022 · Q16(b)(ii) · 2 marks

(ii) Outline the role of RNA polymerase in the production of the mRNA sequence in **Fig. 16.2**.

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..... **[2]**

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(c) Insulin is a hormone that regulates blood glucose concentration. People with type 1 diabetes need to inject insulin, to reduce their blood glucose concentration, as they are unable to produce their own insulin.

Diabetics need to inject insulin before every meal as insulin has a short half-life. Enzymes in the liver cells break down insulin, which removes it from the blood.

Insulin glargine is a modified version of human insulin that lasts much longer in the blood.

Fig. 21.3 shows the sequence of amino acids in one molecule of human glargine with the modifications in **bold**.

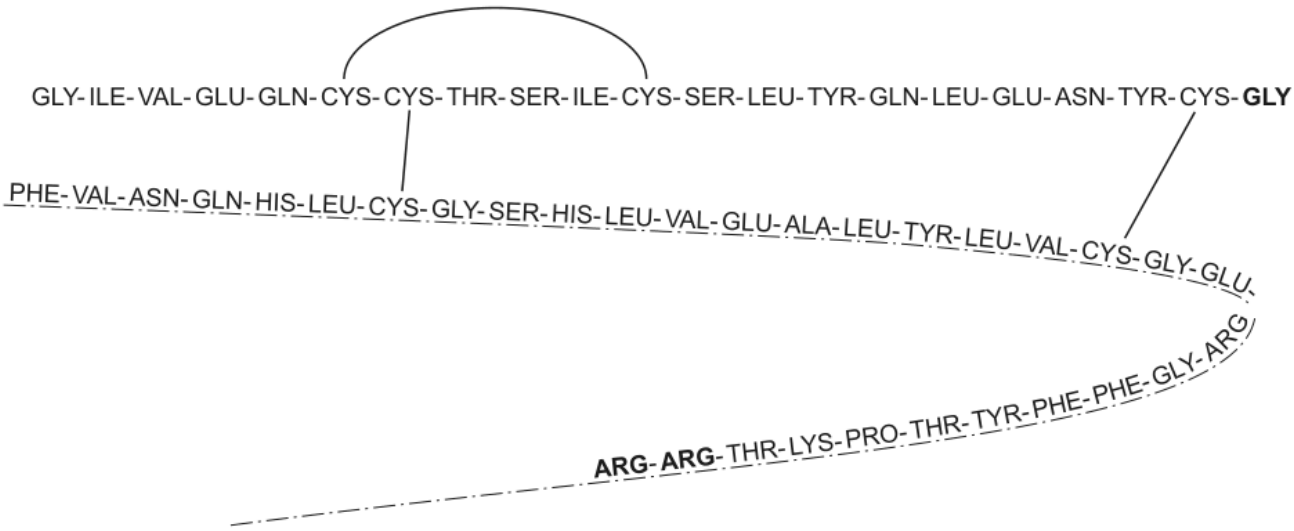


Fig. 21.3

(i) Suggest why insulin glargine is long-lasting.

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..... **[1]**

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Question 13 · AS Paper 1 · June 2022 · Q21(c)(ii) · 2 marks

The table shows some of the DNA triplet codes for amino acids.

1st base of DNA triplet	2nd base of DNA triplet								3rd base of DNA triplet
	T		C		A		G		
A	ATT	(ILE) Isoleucine	ACT	(THR) Threonine	AAT	(ASN) Asparagine	AGT	(SER) Serine	T
	ATC		ACC		AAC		AGC		C
	ATA		ACA		AAA	(LYS) Lysine	AGA	(ARG) Arginine	A
	ATG	(MET) Methionine	ACG		AAG		AGG		G
G	GTT	(VAL) Valine	GCT	(ALA) Alanine	GAT	(ASP) Aspartic acid	GGT	(GLY) Glycine	T
	GTC		GCC		GAC		GGC		C
	GTA		GCA		GAA	(GLU) Glutamic acid	GGA		A
	GTG		GCG		GAG		GGG		G

In order to produce insulin glargine, the human insulin gene is modified by genetic engineering. This is a process which can change the genetic code of the gene. The genetic code of DNA triplet 21 is changed so that the amino acid it codes for is glycine instead of asparagine.

(ii) With reference to the table, predict how the genetic code of DNA triplet 21 is changed so that it codes for the amino acid glycine instead of the amino acid asparagine.

.....

..... **[2]**

Questions, mark schemes and examiners' report extracts © OCR.

Question 14 · AS Paper 1 · June 2022 · Q21(c)(iii) · 4 marks

(iii) The modified polypeptides that form insulin glargine are made inside cells.

The process of making the modified polypeptides that form insulin glargine involves several steps. The process starts with the modified gene for insulin glargine.

Outline the steps involved in the process of making the modified polypeptides that form insulin glargine, starting with the gene for insulin glargine until when the modified polypeptides are made.

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..... **[4]**

Turn over

Questions, mark schemes and examiners' report extracts © OCR.

Question 15 · A level Paper 3 · June 2022 · Q5(a) · 3 marks

5 DNA must be extracted from cells before it can be analysed.

(a) The sentences describe how DNA is extracted from a sample of tissue.

Complete the sentences using the most appropriate words or phrases.

Detergent is used to break down ..... . Proteins, such as histones, surrounding DNA can be hydrolysed by the addition of ..... . The DNA is precipitated from solution by adding ..... .

[3]

Question 16 · A level Paper 2 · June 2019 · Q17(a)(i) · 1 mark

17 DNA can be obtained from a variety of plant and animal cells.

(a) A group of students tried to purify some DNA from leek cells using the following method. They decided that exact volumes were not necessary.

1. Grind a leek leaf to a fine pulp using a pestle and mortar.
2. Add salt and cold water and mix again for at least 10 s.
3. Add protease enzyme and mix again for at least 10 s.
4. Filter the liquid into a test tube and stand for at least 10 min.
5. Tilt the test tube and gently pour in ice-cold ethanol.
6. A white layer of DNA forms between the sample and the ethanol.
7. Extract the white layer carefully using a glass rod.

(i) State the purpose of step **1**.

.....

..... **[1]**

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Question 17 · AS Paper 1 · June 2024 · Q23(d) · 4 marks

(d) Students use this method to extract DNA from the fruit of a strawberry plant:

- Take a fruit from a strawberry plant and crush it using a mortar and pestle.
- Add salt to the crushed strawberry fruit mixture.
- Add an enzyme to the mixture.
- Add ethanol to the mixture.

Evaluate whether the method used by the students would successfully extract DNA.

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..... **[4]**

Turn over

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Mark schemes

Question 1 · AS Paper 1 · June 2018 · Q24(a)(i) · 1 mark

24	(a)	(i)	deoxyribose ✓	1

Question 2 · AS Paper 1 · June 2018 · Q24(a)(ii) · 1 mark

(ii)	phosphodiester ✓	1

Question 3 · AS Paper 1 · June 2025 · Q22(a) · 3 marks

22	(a)		double helix ✓	3	1.1	
			hydrogen / H , bond (s) ✓			**DO NOT ALLOW** H_2 bonds
			three / 3 (hydrogen) ✓			**ALLOW** more / triple

Question 4 · A level Paper 3 · June 2023 · Q7(b) · 2 marks

7	(b)	(DNA polymerase) (catalyses) formation of phosphodiester bonds (between nucleotides / in DNA strand) ✓ (helicase) unwinds / separates / unzips, (DNA) double helix / (DNA) strands ✓	2	1.1

ALLOW proofreading of new DNA strand
ALLOW adds nucleotides to new DNA strand
ALLOW construction of new sugar phosphate backbone (between nucleotides / in DNA strand)

ALLOW breaks the H bonds between, base pairs / (DNA) strands / nucleotides

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Question 5 · AS Paper 2 · June 2018 · Q1(b)(i) · 2 marks

1(b)(i)	**1** gene / DNA, copied / transcribed, to (m)RNA ✓ **2** (*idea that* RNA goes to / translation is at) ribosome(s) / RER ✓ **3** DNA, is too large to / cannot / is not able to, leave nucleus / cross nuclear envelope / fit through nuclear pores ✓

2 max	**Read all and mark as prose** **ALLOW** used as a template to create / AW, for 'copied to' **ALLOW** RNA, copies / takes a copy of, gene / DNA **DO NOT ALLOW** replicated for 'copied' **ALLOW ORA** 'RNA, is small enough to / can / is able to' or just 'RNA leaves nucleus' **ALLOW** nuclear membrane for 'nuclear envelope' **DO NOT ALLOW** leave the cell for 'leave nucleus'

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Question 6 · A level Paper 3 · June 2025 · Q4(a) · 2 marks

4	(a)	Property	Messenger RNA	Transfer RNA
		Anticodons are present		✓
		The nucleotide base sequence codes for a protein	✓	
		Uracil is bonded to adenine by hydrogen bonds within the molecule	(✓)	✓
			✓	✓

2	1.1 1.2	**One mark per correct column** **ALLOW** 'yes' for '✓' **DO NOT ALLOW** hybrid ticks

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(b)		*both have:* a pentose (sugar) ✓ adenine (base) ✓ phosphodiester bond (between sugar and phosphate) ✓ an OH group on carbon 3 of the sugar ✓ phosphate (group) ✓ *ATP has:* two additional phosphates ✓ deoxyribose replaced by ribose ✓ an OH group on carbon 2 of the, sugar / ribose	4 max

Question	Answer	Mark

Guidance

Mark first two similarities and first two differences

IGNORE both have N, C, H, O, NO_3^-

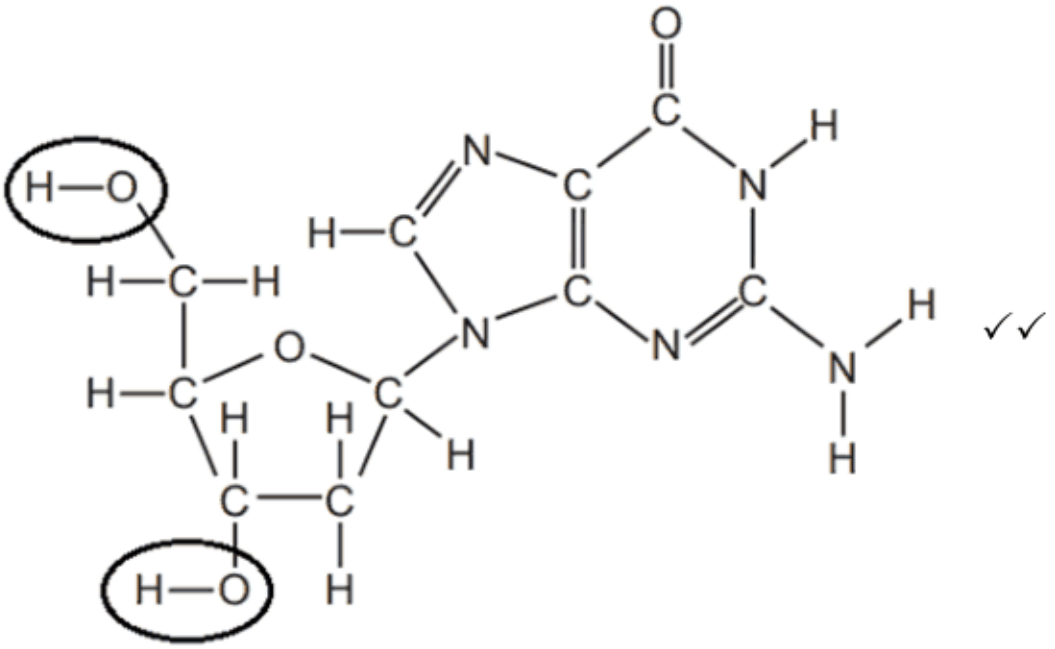
DO NOT ALLOW phosphate ion / molecule (but penalise only once)

ALLOW ORA for DNA nucleotide

DO NOT ALLOW 'ATP has ribose' without comparison

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4	(a)	2



✓✓

One mark per correct circle

ALLOW circles around OH or H alone
ALLOW clear, unambiguous mark other than a circle
DO NOT ALLOW if circle encloses other parts of molecule e.g. CH_2 or O alone

If more than 2 circles drawn, -1 mark for each incorrect circle

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Question 9 · A level Paper 3 · June 2023 · Q2(b) · 2 marks

2	**(b)**	D is, pyrimidine (base) / thymine, and, pentose sugar / deoxyribose ✓ (*B_9 deficiency causes*) fewer, nucleotides / pyrimidines / bases (available) ✓ DNA synthesis / DNA replication / S phase , slows / stops / incomplete ✓ (due to) less complementary base pairing with, purines / adenine (on template strand) ✓ does not pass G2 checkpoint / AW ✓	**2 max**	2.5

ALLOW D is thymidine
IGNORE cytosine

ALLOW 'less D available'
DO NOT ALLOW 'no D available'

IGNORE guanine

e.g. 'due to G2 checkpoint identifying the error'

Question 10 · AS Paper 2 · June 2018 · Q1(b)(ii) · 2 marks

1(b)(ii)	90 252 **or** 90 255 **or** 90 258 ✓ ✓	2

Question	Answer	Mark

Correct final answer gets 2 marks, even if no working is shown.
Wrong final answer (which may include a 90 252 stage in the working) = **ALLOW 1 mark for seeing any of these:**
327 x 92 x 3 **OR** 30 084 **OR** 981

Guidance

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Question 11 · A level Paper 2 · June 2022 · Q16(b)(i) · 2 marks

(b)	**(i)**	1 = threonine ✓ 2 = proline ✓	**2**	2.1

Question 12 · A level Paper 2 · June 2022 · Q16(b)(ii) · 2 marks

(ii)	joins / adds , (RNA) nucleotides ✓ forms phosphodiester bonds (between nucleotides) ✓	**2**	1.2

IGNORE bases

ALLOW forms sugar–phosphate backbone
IGNORE covalent bonds

Question 13 · AS Paper 1 · June 2022 · Q21(c)(ii) · 2 marks

21	**(c)**	**(ii)**	AAT / AAC ✓ is replaced by, GGT / GGC / GGA / GGG ✓	2

For two marks:
ALLOW 1st A and 2nd A replaced by GG.
ALLOW A replaced by G twice
ALLOW 2 A's replaced by 2 G's
For one mark:
ALLOW A replaced by G

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Question 14 · AS Paper 1 · June 2022 · Q21(c)(iii) · 4 marks

21	(c)	(iii)	1. (modified gene undergoes) transcription (in nucleus)✓ 2. production of (modified) mRNA / described ✓ 3. mRNA, leaves nucleus / goes to ribosomes ✓ 4. translation at ribosome(s) ✓ 5. tRNA with specific amino acid binds its anticodon (to codon of mRNA) ✓ 6. (formation of) peptide bonds between amino acids ✓	Max 4

Question	Answer	Ma

ırk	Guidance

Question 15 · A level Paper 3 · June 2022 · Q5(a) · 3 marks

5	(a)	(cell / nuclear / mitochondrial / chloroplast) membrane(s) ✓ protease ✓ alcohol / ethanol ✓

3	1.2	**Mark the first answer in each space** **ALLOW** nuclear envelope **ALLOW** named protease e.g. pepsin / trypsin

Question 16 · A level Paper 2 · June 2019 · Q17(a)(i) · 1 mark

17	(a)	(i)	break / AW , cell walls ✓	1	**IGNORE** membranes

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Question 17 · AS Paper 1 · June 2024 · Q23(d) · 4 marks

	(d)		*Yes because…* 1. crushing, breaks down / opens, cell walls ✓ 2. salt, breaks hydrogen bonds between the DNA and water (molecules) / makes DNA less soluble in water ✓ 3. ethanol added to cause precipitation of DNA ✓ 4. ethanol would break down/disrupt the, plasma / cell surface / nuclear, membrane ✓ *No because…* 5. detergent not added to break down, plasma / cell surface / nuclear, membrane ✓ 6. enzyme not specified as a protease / enzyme must be a protease, to digest, (histone) proteins ✓
			7. ethanol is not (ice) cold so enzyme activity not reduced ✓
			Total

4 max	**DO NOT ALLOW** cell membrane **and** cell wall **IGNORE** ref to precipitation/clumping **ALLOW** DNA won't stay dissolved in ethanol / will clump the DNA together / DNA becomes visible
	DO NOT ALLOW ref to denaturing enzymes
11	

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