Candidate evidence

This document contains marking instructions and examples of candidate responses to various questions in the 2019 Higher Biology Paper 2. Teachers and lecturers can work through the examples, allocating marks to each candidate response.

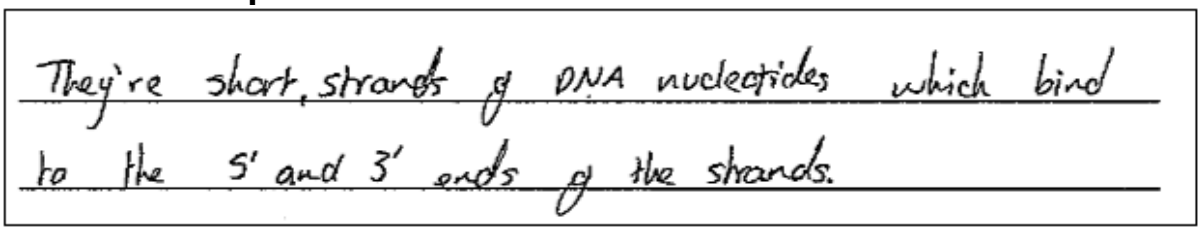
Teachers and lecturers should apply the general marking principles for Higher Biology, using them in conjunction with the detailed marking instructions provided for each example.

The associated commentaries illustrate the required marking standard.

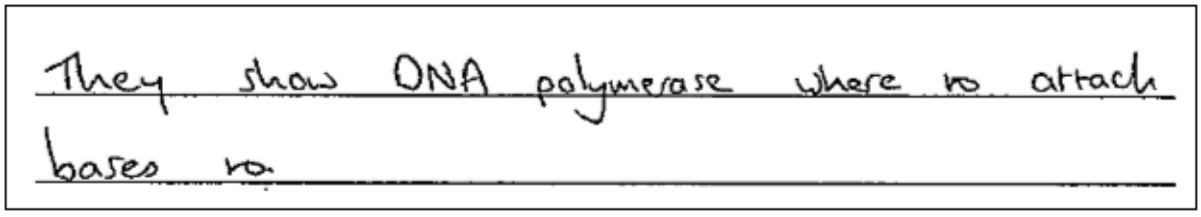
Question 1(b) and Marking Instructions

Question 1(b)		
Explain why primers are necessary for DNA replication.		
Expected response	**Max mark**	**Additional guidance**
So DNA polymerase can add nucleotides to the 3′ end of the new strand. **OR** To give DNA polymerase a start point for replication.	**1**	Do not accept - to start/initiate replication alone.

Candidate response 1



Candidate response 2



Question 1(d) and Marking Instructions

Question 1(d)			
Describe how DNA is organised in prokaryotes.			
Expected response		**Max mark**	**Additional guidance**
Circular chromosomes Plasmids	**(1)** **(1)**	**2**	If neither of these responses are given a maximum of 1 mark can be awarded for: Circular (DNA).

Candidate response 1

prokaryotes do not contain a nucleus, and the DNA is contained in circular DNA fragments ~~loops~~ and also plasmids

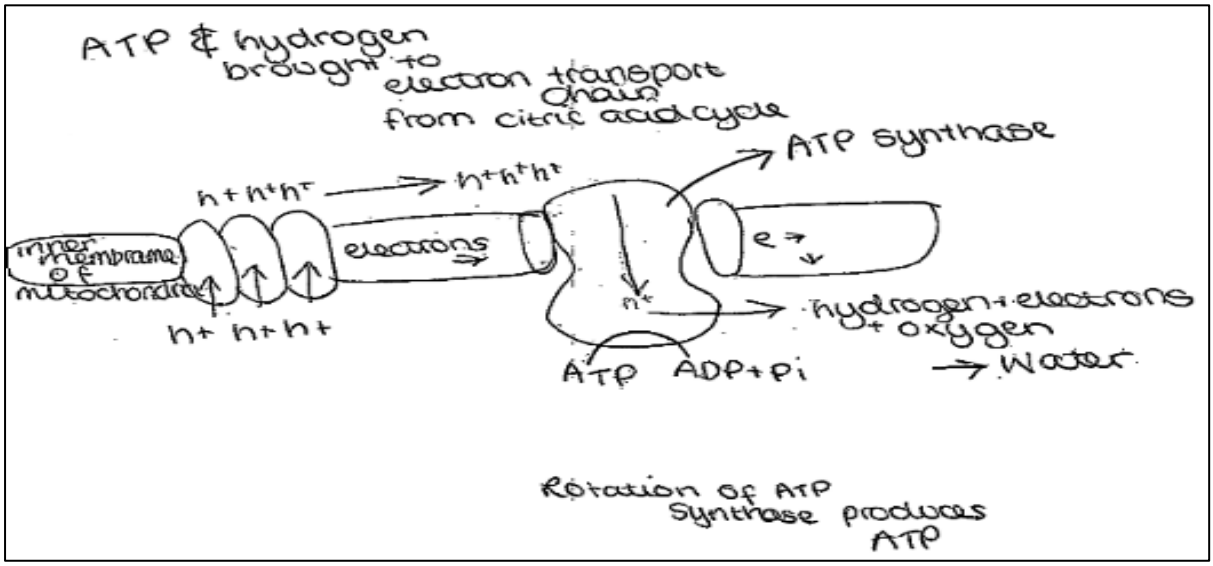
Candidate response 2

prokaryotes are organisms with cells that lack nucleus. Their DNA is circular in mitochondria or chloroplasts or plasmids

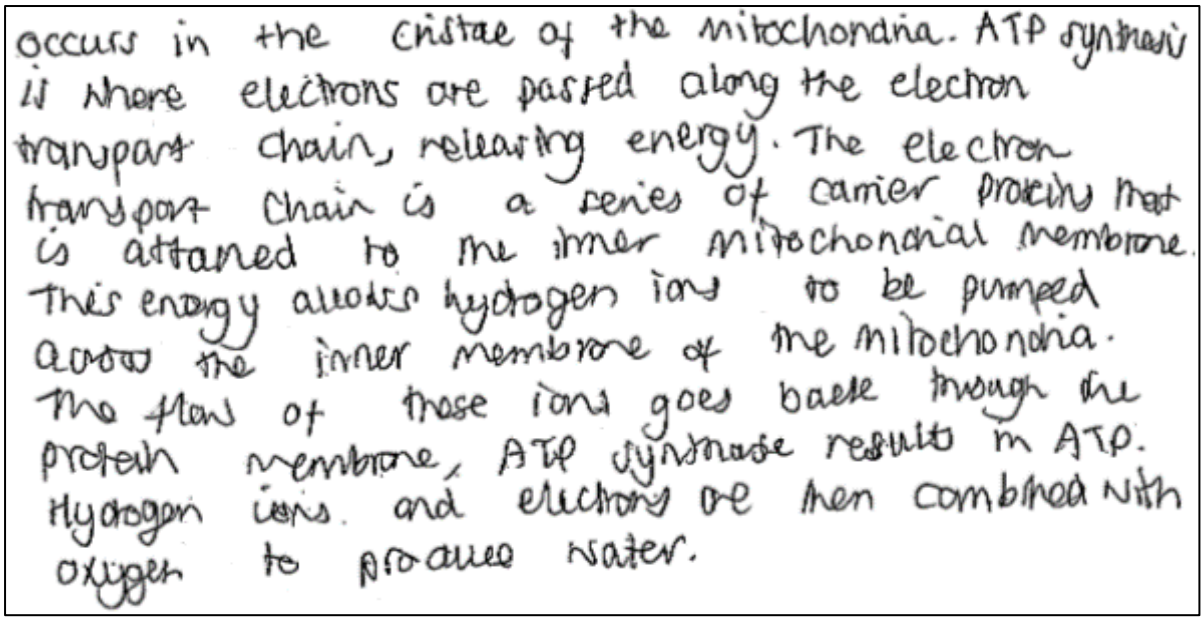
Question 3A and Marking Instructions

Question 3A		
Write an account of ATP synthesis in the electron transport chain during cellular respiration.		
Expected response	**Max mark**	**Additional guidance**
1. On inner membrane/cristae of mitochondrion 2. NAD/NADH passes/carries electrons and hydrogen ions to inner mitochondrial membrane or electron transport chain 3. Electrons are passed along the electron transport chain/ proteins/series of carriers 4. Energy pumps/passes hydrogen ions across the inner mitochondrial membrane 5. Hydrogen ions flow back through ATP synthase 6. ATP synthase produces ATP **Any 4**	4	

Candidate response 1



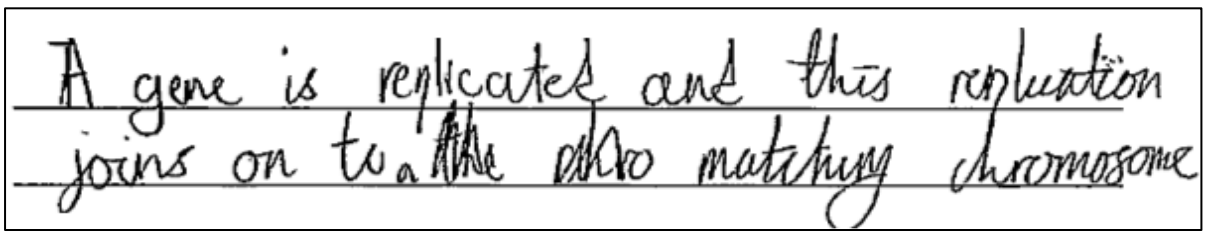
Candidate response 2



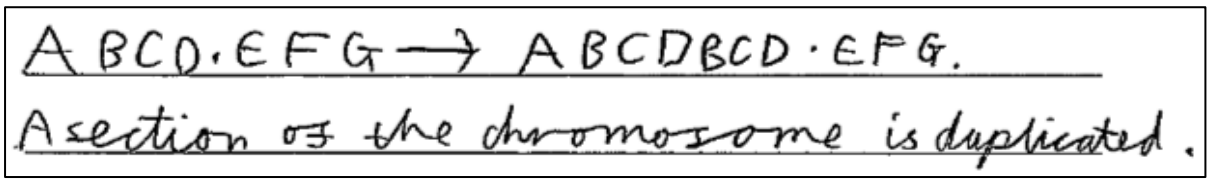
Question 4(b)(i) and Marking Instructions

Question 4(b)(i)		
The multiple copies of alpha and beta globin genes are the result of duplication mutations. Describe how a duplication mutation occurs.		
Expected response	**Max mark**	**Additional guidance**
Section of a chromosome/gene(s) is added to its homologous partner. **OR** A gene moves from a chromosome to its homologous partner.	**1**	

Candidate response 1



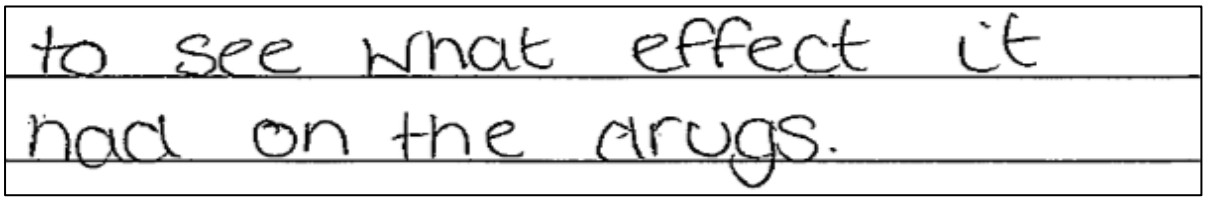
Candidate Response 2



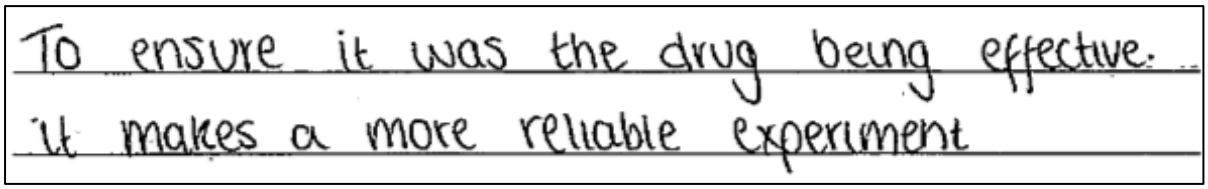
Question 6(a) and Marking Instructions

Question 6(a)		
State the purpose of including a control group in this investigation.		
Expected response	**Max mark**	**Additional guidance**
To show the effect of the mutations. **OR** To show the effect of the drugs/ each drug. **OR** To prove the drugs affect/increase chloride transport. **OR** To compare with and without drugs.	**1**	Do not accept - to compare alone.

Candidate response 1



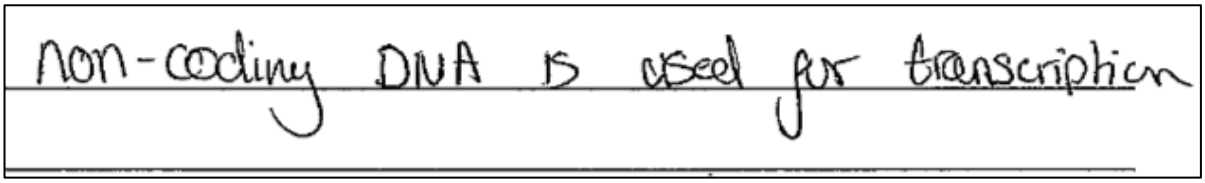
Candidate response 2



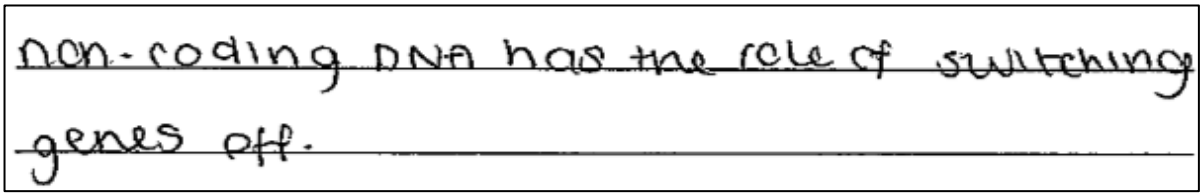
Question 7(c) and Marking Instructions

Question 7(c)		
Give **one** role of the non-coding DNA in the genome.		
Expected response	**Max mark**	**Additional guidance**
Regulates transcription **OR** Transcribed to tRNA/rRNA	**1**	Do not accept – transcribed but not translated alone

Candidate response 1



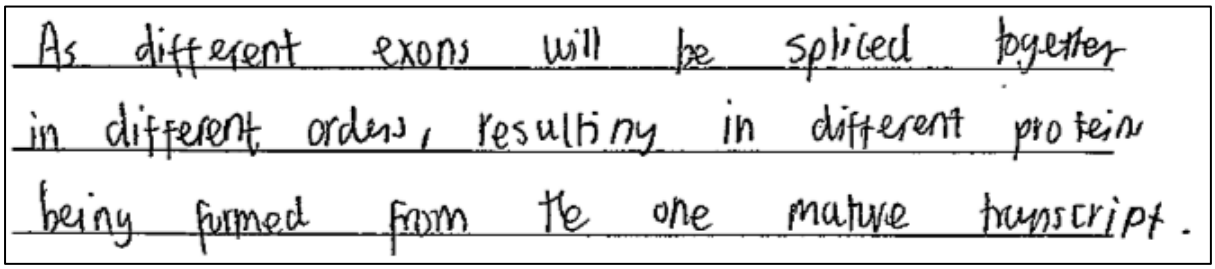
Candidate response 2



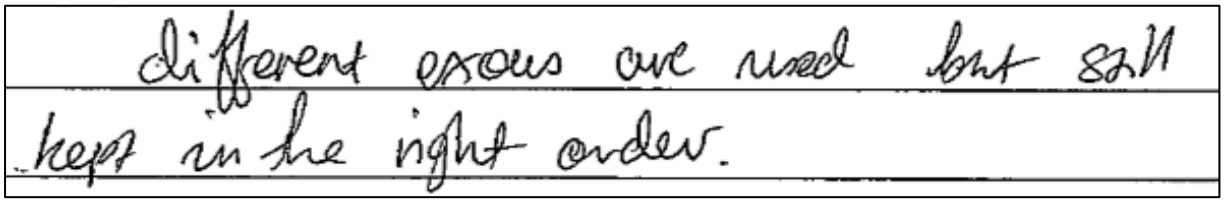
Question 7(d) and Marking Instructions

Question 7(d)		
In eukaryotes, alternative RNA splicing occurs. Explain how this results in different proteins being expressed from a single gene.		
Expected response	**Max mark**	**Additional guidance**
There are different combinations of exons in the mature transcript. **OR** Different exons are removed from the primary transcript.	**1**	Do not accept any reference to a change in sequence of exons: eg different order of exons. Do not accept - depends on which exons are treated as introns.

Candidate response 1



Candidate response 2



Question 8(a) and Marking Instructions

Question 8(a)

Using values from the table, describe changes in the concentration of lactose over the 180 minutes of the experiment.

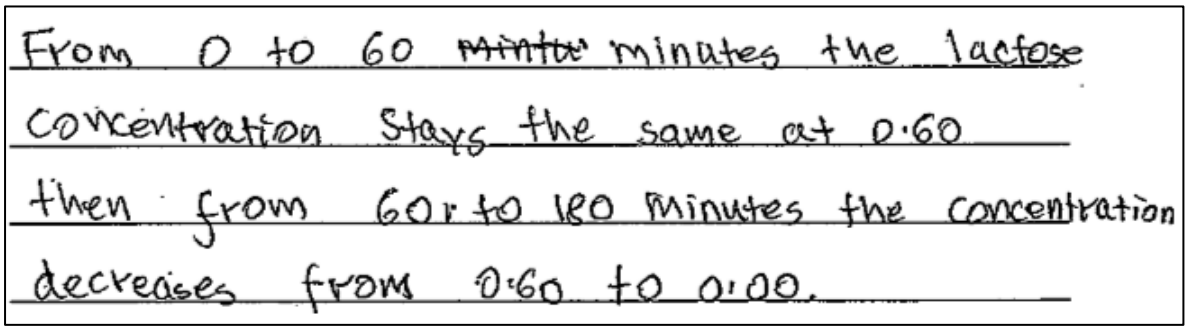
Time (minutes)	Glucose concentration (mM)	Lactose concentration (mM)
0	0·60	0·60
20	0·50	0·60
40	0·38	0·60
60	0·09	0·60
80	0·00	0·55
100	0·00	0·44
120	0·00	0·32
140	0·00	0·15
160	0·00	0·04
180	0·00	0·00

Expected response	Max mark	Additional guidance
From 0 to 60 minutes lactose concentration stays at 0·6 mM. **(1)** From 60 to 180 minutes lactose concentration falls to 0mM. **(1)** (unit must be given at least once)	**2**	Award 1 mark for correct description and values with no units.

Candidate 1 response

At ϕ minutes - 60 minutes the lactose concentration stayed constant at 0.60 mM. At 180 minutes the lactose conc ~~being~~ begins to decrease to 0.55mM all the way to 0.00 mM at 180 minutes.

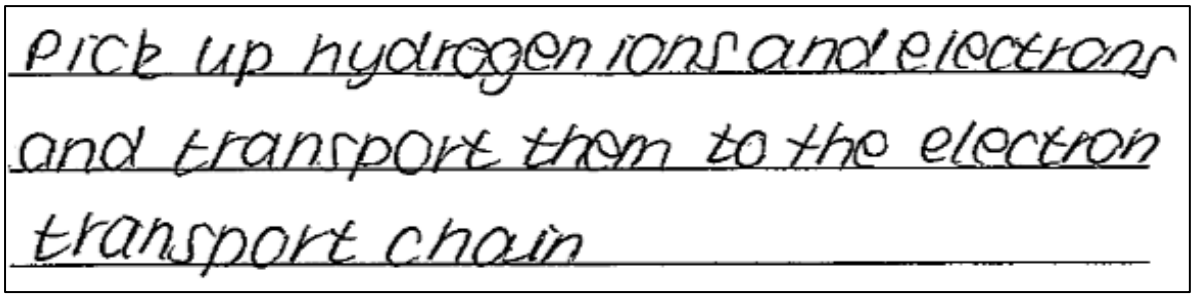
Candidate 2 response



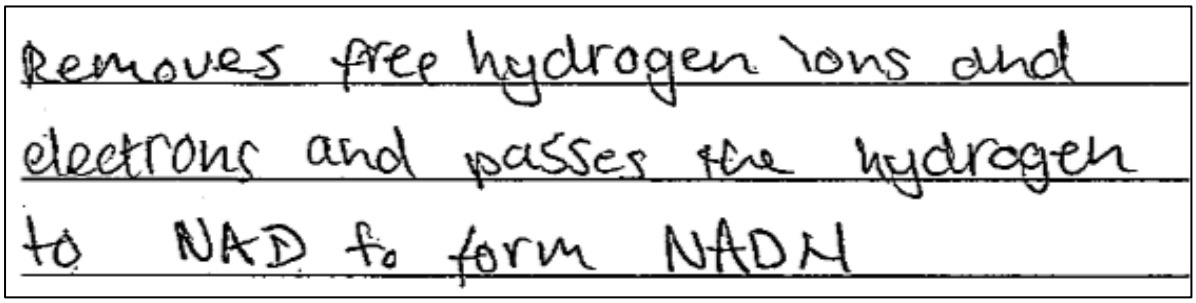
Question 9(b)(iii) and Marking Instructions

Question 9(b)(iii)		
Describe the role of dehydrogenase enzymes in the conversion of intermediates to pyruvate.		
Expected response	**Max mark**	**Additional guidance**
Removes hydrogen/ions **and** electrons **(1)** Passes them to (coenzyme) NAD **OR** Turns NAD to NADH **(1)**	**2**	Do not accept - passes hydrogen ions and electrons to electron transport chain.

Candidate response 1



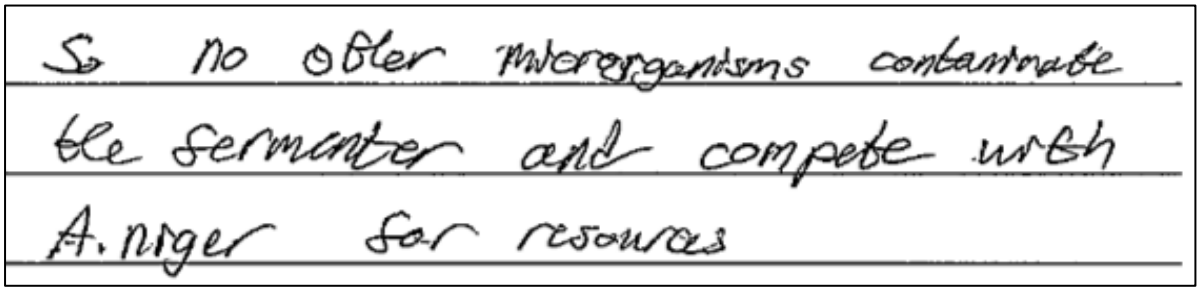
Candidate response 2



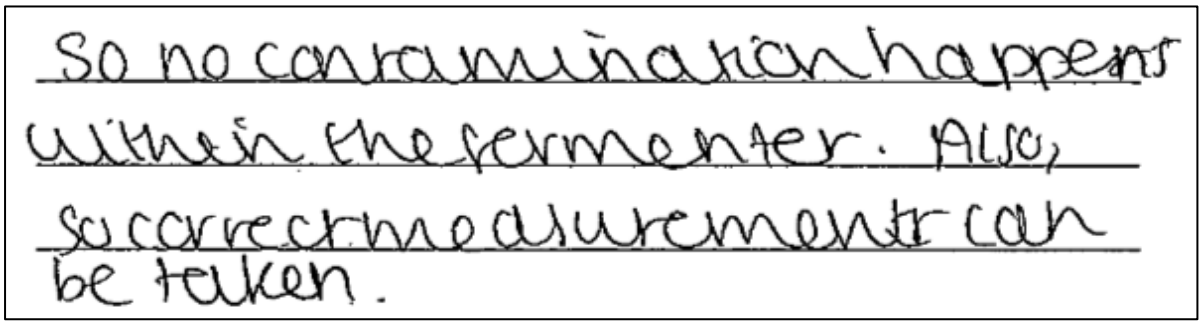
Question 10(c)(iv) and Marking Instructions

Question 10(c)(iv)		
Explain why it was necessary to sterilise the fermenter before *A.niger* was added.		
Expected response	**Max mark**	**Additional guidance**
To kill any (other) microorganisms/ bacteria/fungi **OR** To ensure (other) microorganisms/ bacteria/fungi were not present **(1)** Which would compete with *A.niger* **OR** Which would spoil/contaminate end product/citric acid **(1)**	**2**	Do not accept – organisms

Candidate response 1



Candidate response 2

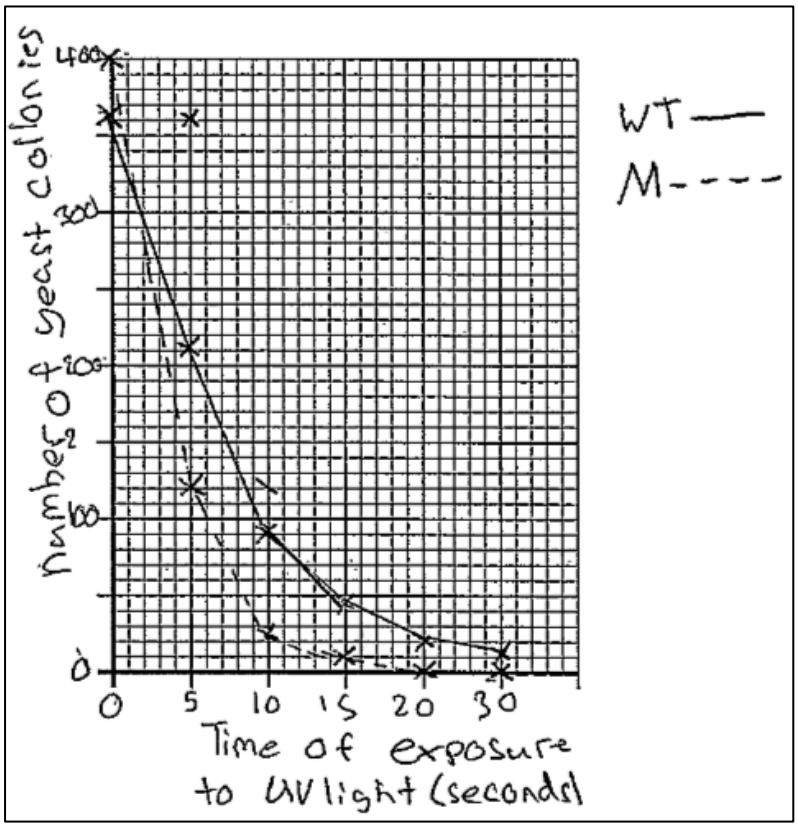


Question 12(b) and Marking Instructions

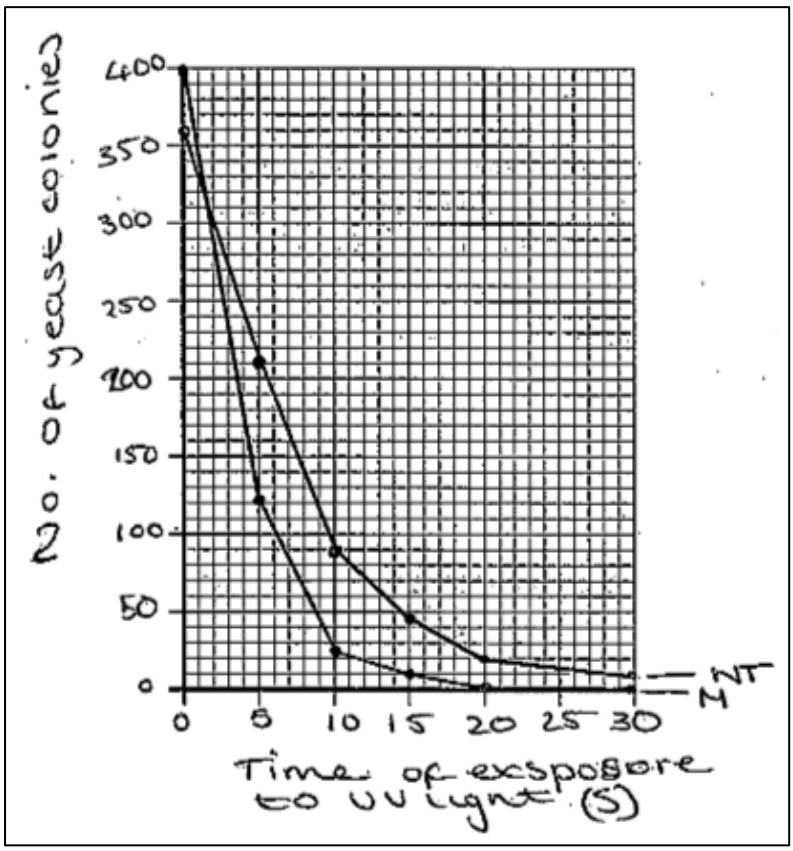
Question 12(b)		
Draw a line graph using the results in the table for both WT yeast and M yeast.		
Expected response	**Max mark**	**Additional guidance**
Axes have correct scales and labels. **(1)** Points correctly plotted and lines joined. **(1)** Lines labelled or key. **(1)** If a key is given but lines cannot be distinguished, assume the candidate has used different colours and award the mark.	**3**	Any 3 values to establish a linear scale. A number at the origin is not essential. Data can be plotted outwith the numbered scale. Scale breaks are not acceptable. If the axes are transposed the candidate loses the scale mark. Lines must go through all points.

Time of exposure to UV light (seconds)	Number of yeast colonies	
	WT	M
0	360	400
5	210	120
10	90	25
15	45	10
20	20	0
30	10	0

Candidate response 1



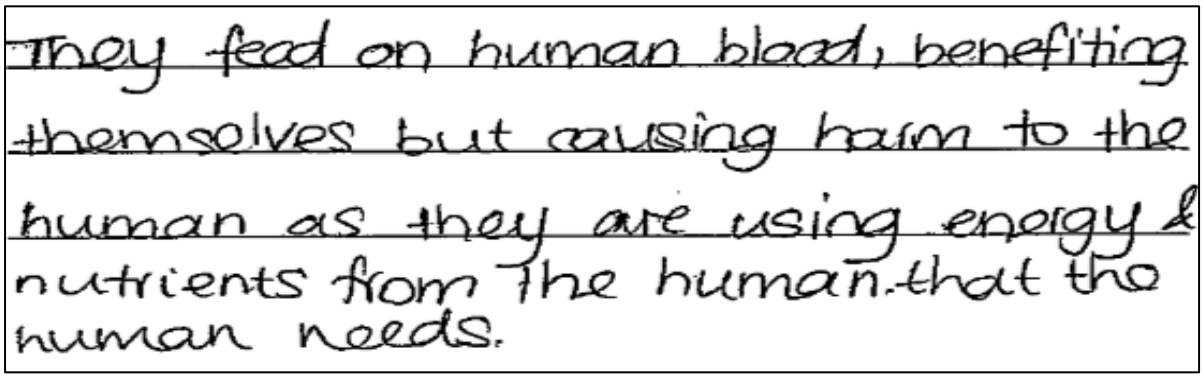
Candidate response 2



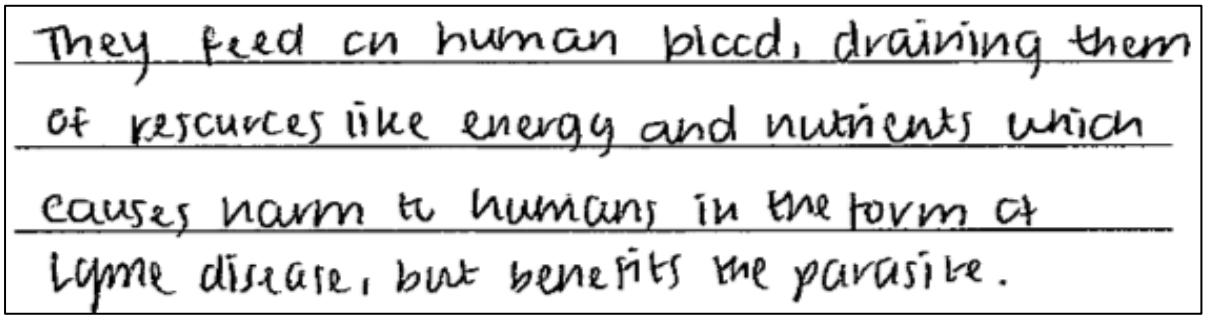
Question 14(a)(ii) and Marking Instructions

Question 14(a)(ii)		
Use the information given to suggest why ticks can be described as parasites.		
Expected response	**Max mark**	**Additional guidance**
Take blood/food/energy/nutrients from humans who are harmed by this.	1	Do not award the mark if there is any reference to the harm being caused by disease/bacteria.

Candidate response 1



Candidate response 2



Question 16A and Marking instructions

Question 16 A		
Write notes on photosynthesis under the following headings. (i) Use of energy absorbed by photosynthetic pigments (ii) Carbon fixation		
Expected response	**Max mark**	**Additional guidance**
Part (i) 1. Energy absorbed by carotenoids is passed to chlorophyll (1) 2. Electrons in the pigment molecules become excited (1) 3. Electrons pass along electron transport chain releasing energy (1) 4. This energy is used by ATP synthase to produce ATP (1) 5. Energy is also used for photolysis (to split water) (1) **(Max 3 marks from points 1-5)**	**3**	Do not award point 5 if stated that ATP/energy from ATP is used to split water.
Part (ii) a. ATP and hydrogen/NADPH from the first stage are used in carbon fixation/Calvin cycle (1) b. Carbon dioxide is joined to RuBP to form 3PG (1) c. By RuBisCO (1) d. 3PG is phosphorylated by ATP to form G3P (1) e. Hydrogen/NADPH is required for this step (1) f. G3P is used to make glucose (1) g. G3P is used to make/regenerate RuBP (1) **(Max 4 marks from points a-g)**	**4**	Accept full names. RuBP – ribulose bisphosphate 3PG – 3-phosphoglycerate G3P – glyceraldehyde-3-phosphate Diagrams must be correctly labelled, and arrows must show direction of reactions

Candidate 1 response (i)

(i) absorbed energy excites electrons in the pigment molecule
this energy can be used to bring about the synthesis of ATP by ATP synthase in the transport electron chain.
this ATP can be used for photolysis where water is broken down into oxygen, which is released, and hydrogen which is passed onto NADP which is then taken to the carbon fixation stage.

Candidate 2 response (i)

(i)
- light energy absorbed by chlorophyll which raises electrons to a high energy state.
- electrons ~~state~~ recieved by a primary electron accepter and transported along the chain.
- this pumps hydrogen ions into the grana and releases ~~the~~ energy used by ATP synthase to make ATP and and in photolysis to split water into hydrogen and oxygen.
- hydrogen picked up by NADP to make NADPH.
- oxygen diffuses out of the cell.

Candidate 1 response (ii)

(ii)
- occurs in the stroma.
- CO_2 attaches to RUBP which is controlled by enzyme ~~RUBISCO~~ RUBISCO.
- CO_2 and RUBP combine to make ~~3-phosphoglycerate~~ 3-phosphoglycerate.
- 3-phosphoglycerate combines to the hydrogen from NADPH and becomes phosphorylated to make glyceraldehyde-3-phosphate.
- glyceraldehyde-3-phosphate is used to regenerate RUBP and the rest is used to synthesise sugars as starch and cellulose.

Candidate 2 response (ii)