



Rewarding Learning

ADVANCED

General Certificate of Education

2019

Centre Number

--	--	--	--	--

Candidate Number

--	--	--	--

Life and Health Sciences

Assessment Unit A2 5

assessing

Genetics, Stem Cell Research and Cloning



AZ051

[AZ051]

THURSDAY 6 JUNE, AFTERNOON

TIME

1 hour 45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Write your answers in the spaces provided in this question paper.

Answer **all nine** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is **100**.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

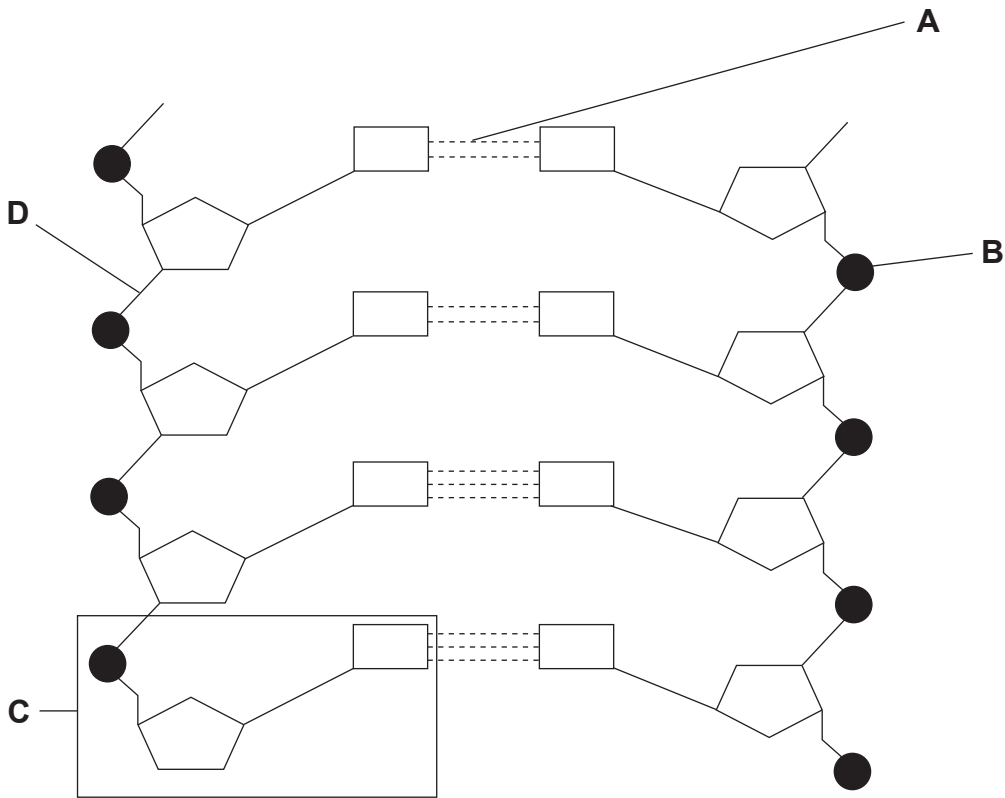
Quality of written communication will be assessed in Question **5(b)**.

For Examiner's use only

Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	

Total Marks	
-------------	--

1 The diagram below represents the structure of DNA.



© AS Biology for CCEA AS Level, Dr James Napier, Colourpoint Creative Ltd (2015) ISBN: 9781780730097.
Used with permission

(a) Scientists Watson and Crick described the structure of DNA as a double helix.

(i) Name **one** other scientist who added to our understanding of the structure of DNA.
Describe the contribution of this scientist.

Name _____

Description of contribution _____

_____ [2]

(ii) Name the parts of the diagram labelled **A**, **B**, **C** and **D**.

A _____

B _____

C _____

D _____ [4]

Examiner Only	
Marks	Remark

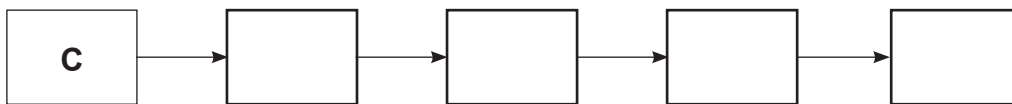
2 The steps **A** to **E** below describe how DNA replication occurs.

They are **not** in the correct order.

- A** Each strand now acts as a template.
- B** DNA polymerase joins adjacent nucleotides on the new strands.
- C** The enzyme DNA helicase unwinds the two strands of DNA.
- D** Free DNA nucleotides enter opposite their complementary bases.
- E** Hydrogen bonds between complementary bases are broken.

(a) Use the letters to put the steps in the correct order in the boxes below.

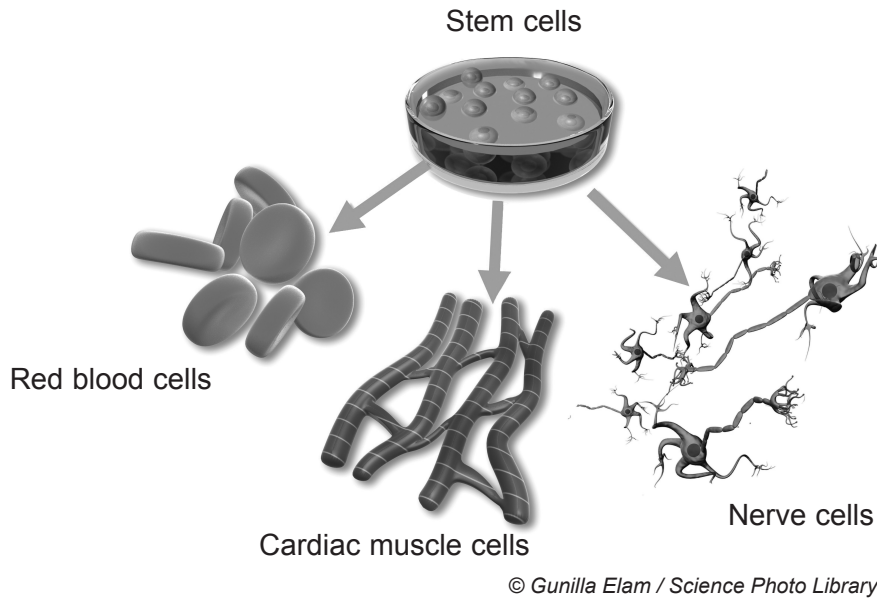
The first step is given.



[3]

Examiner Only	
Marks	Remark

3 The diagram below shows stem cells and the cells that they can form.



(a) (i) Using your knowledge and the diagram above, describe **two** key features of stem cells.

1. _____

 2. _____

- [2]

(ii) State **two differences** between embryonic and adult stem cells.

1. _____

 2. _____

- [2]

Examiner Only	
Marks	Remark

Scientists are investigating the use of embryonic stem cells in the treatment of patients with diabetes.

Patients with diabetes cannot regulate their blood glucose levels.

(b) (i) Suggest the type of cell the embryonic stem cell could become in a patient with diabetes.

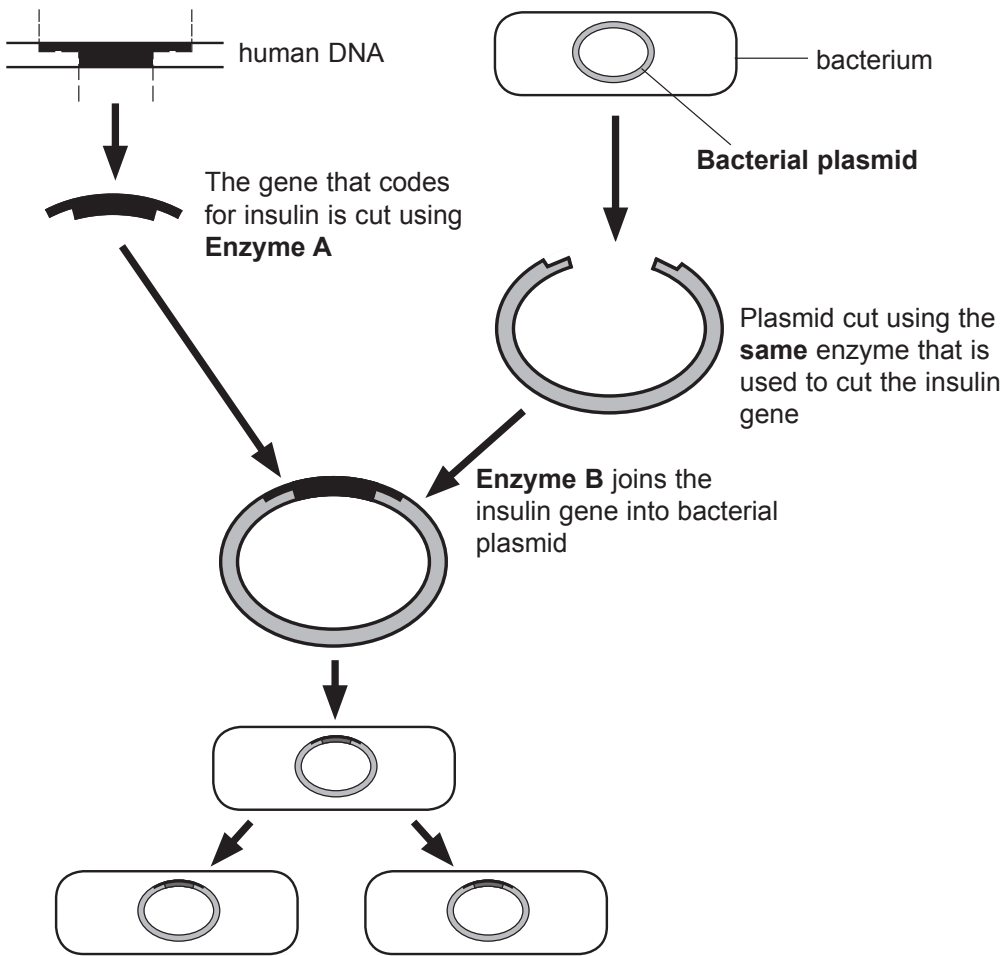
_____ [1]

(ii) Suggest how these cells are of benefit to a person with diabetes.

_____ [1]

Examiner Only	
Marks	Remark

5 (a) The diagram below shows how insulin can be made using genetically modified bacteria.



© Barking Dog Art

(i) Give the names of Enzyme A and Enzyme B.

Enzyme A _____

Enzyme B _____ [2]

(ii) The **same** enzyme (Enzyme A) is used to cut the insulin gene and the bacterial plasmid. Explain why.

 _____ [2]

(iii) Name one other medical substance that is produced by genetic engineering.

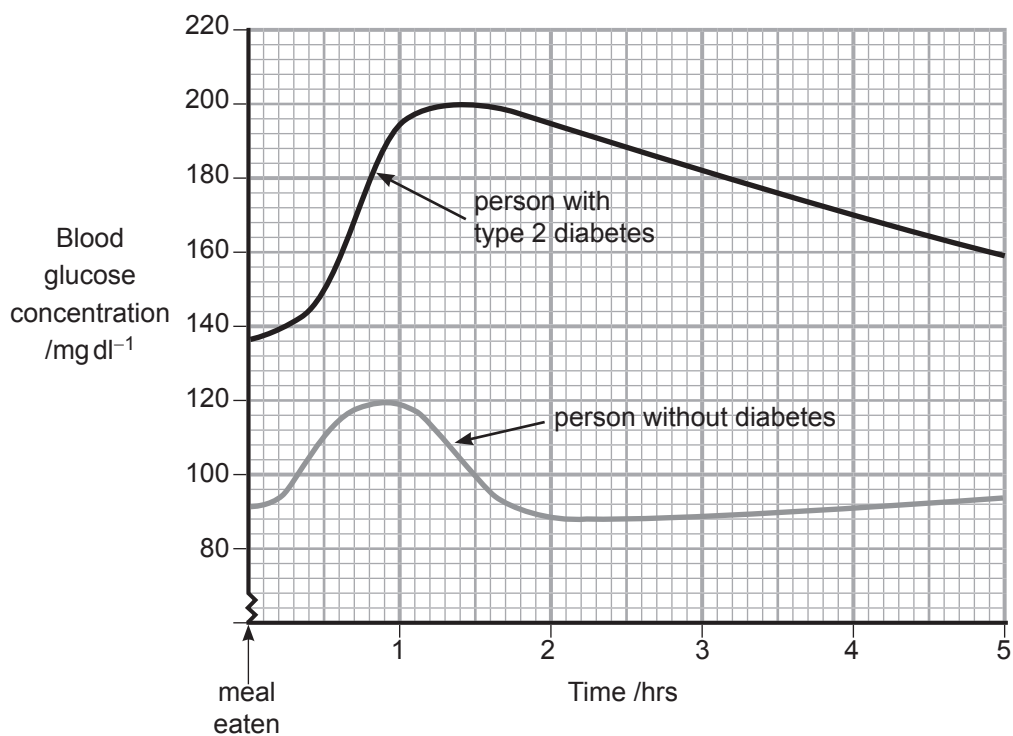
_____ [1]

Examiner Only	
Marks	Remark

BLANK PAGE

(Questions continue overleaf)

(b) The graph below shows the blood glucose concentration of a person without diabetes and a person with type 2 diabetes.



© Michael W. King PhD, The Medical Biochemistry page

Use the graph and your knowledge to:

- describe and explain the changes in blood glucose concentration in a person without diabetes between one and two hours after eating a meal.
- state and describe the difference in blood glucose concentration of a person without diabetes compared to a person with type 2 diabetes over the five hours.

Use data to support your answer.

You will be assessed on the quality of written communication in this question.

- 6 In squash plants, fruit colour is determined by the interaction of two genes, **W/w** and **G/g**.

The **W** allele suppresses the action of the **G/g** gene so the fruit are white.

When the genotype is **ww**, the **G/g** gene is expressed, the dominant **G** allele determines yellow fruit colour, whilst the recessive **g** allele determines green fruit colour.

- (a) (i) Define the term 'gene'.

_____ [2]

- (ii) What term is used to describe the interaction between the genes **W/w** and **G/g**?

_____ [1]

Examiner Only	
Marks	Remark

- 7 Rennet obtained from calves has traditionally been used in cheese-making to coagulate milk. Due to increased demand for this enzyme, several other sources of rennet are being used.

These sources include a rennet enzyme extracted from the fungus *Rhizomucor miehei*.

- (a) Scientists carried out an investigation into the effect of temperature and pH on the average milk coagulation time when the rennet of *Rhizomucor miehei* was used.

The results obtained by the scientists are shown in the table below.

Temperature/°C	Average milk coagulation time/s	
	pH 5.0	pH 6.0
30	37	50
35	27	37
40	22	20
45	22	24
50	19	19
55	16	18
60	18	100

© Asian Journal of Chemistry, 2009 Vol. 21, No.3 (1754-1758). Creative Commons License: <https://creativecommons.org/licenses/by-nc/4.0/>

- (i) Using the information provided, draw a graph showing the effect of temperature and pH on the average milk coagulation time of *Rhizomucor miehei* rennet. [5]

- (ii) Determine the **optimum** temperature and pH of *Rhizomucor miehei* rennet in the coagulation of milk.

Temperature _____ °C

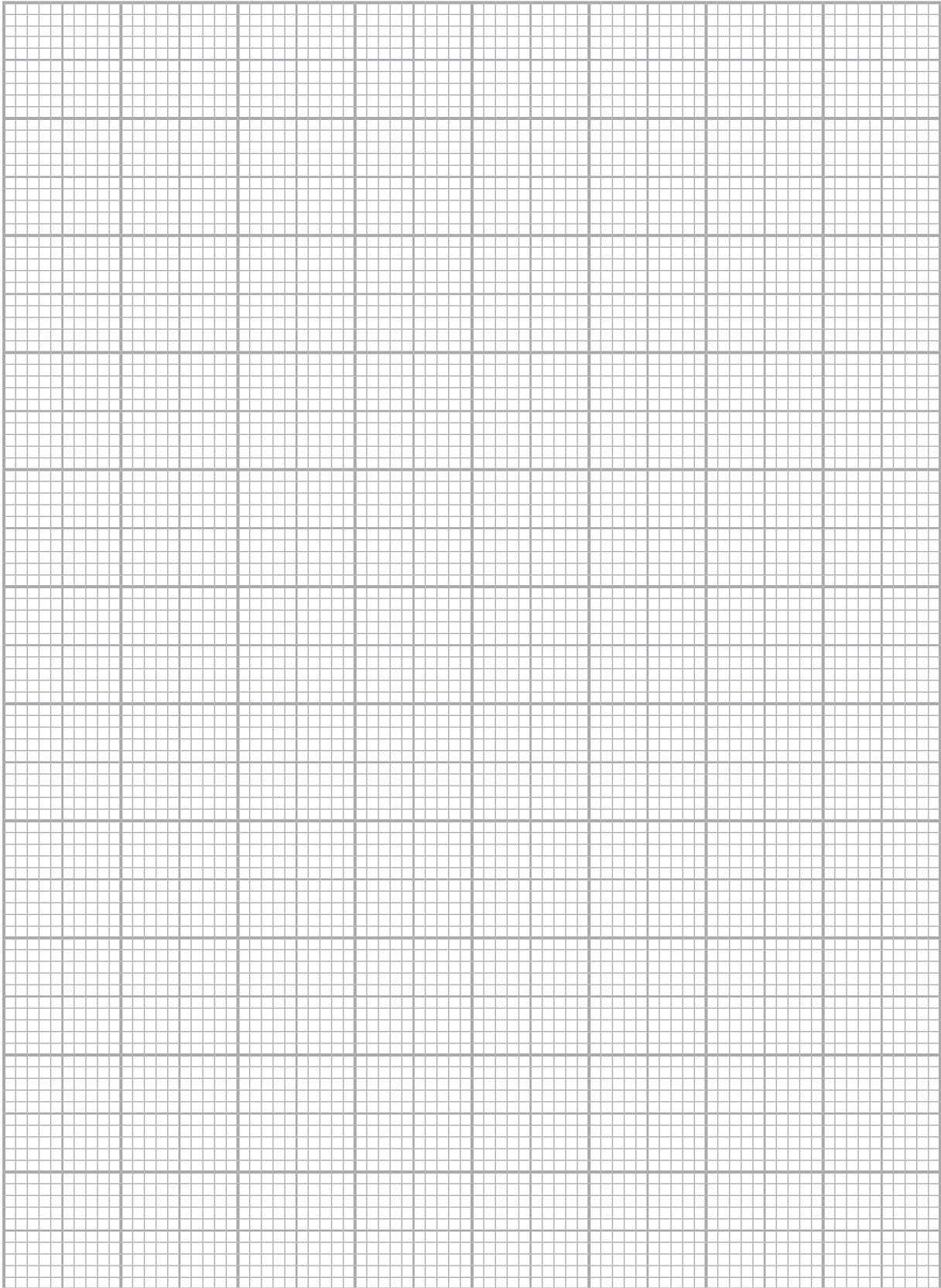
pH _____ [2]

- (iii) Which temperature shows the greatest difference in milk clotting time between pH 5.0 and 6.0?

_____ °C [1]

Examiner Only

Marks Remark



(iv) Suggest **two** variables the scientists controlled to ensure the results were valid.

1. _____

2. _____ [2]

(v) Scientists measured the average milk coagulation time at intervals of 5°C.

How could scientists improve their method to obtain a more exact value for the optimum temperature of milk coagulation?

_____ [2]

Chymosin is an alternative to rennet used in the cheese-making industry to coagulate milk.

(b) Give **two** advantages of using chymosin as an alternative to rennet.

1. _____

2. _____ [2]

Examiner Only

Marks

Remark

(b) In a study, the genotype of **500** children living in an African village was recorded:

- 110 are homozygous and do not suffer from sickle cell anaemia
- 279 are heterozygous for sickle cell anaemia
- 111 suffer from sickle cell anaemia

The chi-squared test can be used to check if these results statistically fit an expected ratio of **1:2:1**.

The formula for the chi-squared test is:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

where O = observed frequency

E = expected frequency

Σ = sum of.

(i) Complete the table below and then calculate the χ^2 value for these results.

Category	Observed (O)	Expected (E)	(O - E)	(O - E) ²	$\frac{(O - E)^2}{E}$
Homozygous and do not suffer from sickle cell anaemia	110				
Heterozygous for sickle cell anaemia	279				
Suffer from sickle cell anaemia	111				

Calculated χ^2 value _____ [5]

Examiner Only

Marks

Remark

The table below gives probability values for use in a χ^2 test with $n - 1$ degrees of freedom (d.f.) where n is the number of categories.

χ^2 values

d.f.	probability = 0.900	0.500	0.100	0.050	0.010	0.001
1	0.016	0.455	2.71	3.84	6.63	10.83
2	0.211	1.39	4.61	5.99	9.21	13.82
3	0.584	2.37	6.25	7.81	11.34	16.27
4	1.06	3.36	7.78	9.49	13.28	18.47
5	1.61	4.35	9.24	11.07	15.09	20.52
6	2.20	5.35	10.64	12.59	16.81	22.46
7	2.83	6.35	12.02	14.07	18.48	24.32
8	3.49	7.34	13.36	15.51	20.09	26.13
9	4.17	8.34	14.68	16.92	21.67	27.88

Source: CCEA

(ii) What is the number of degrees of freedom (d.f.) for this test?

_____ [1]

(iii) Between what **range of probabilities** does your χ^2 value fit?

Use the table above to assist you.

Between _____ and _____ [1]

(iv) Explain fully the outcome of your statistical test.

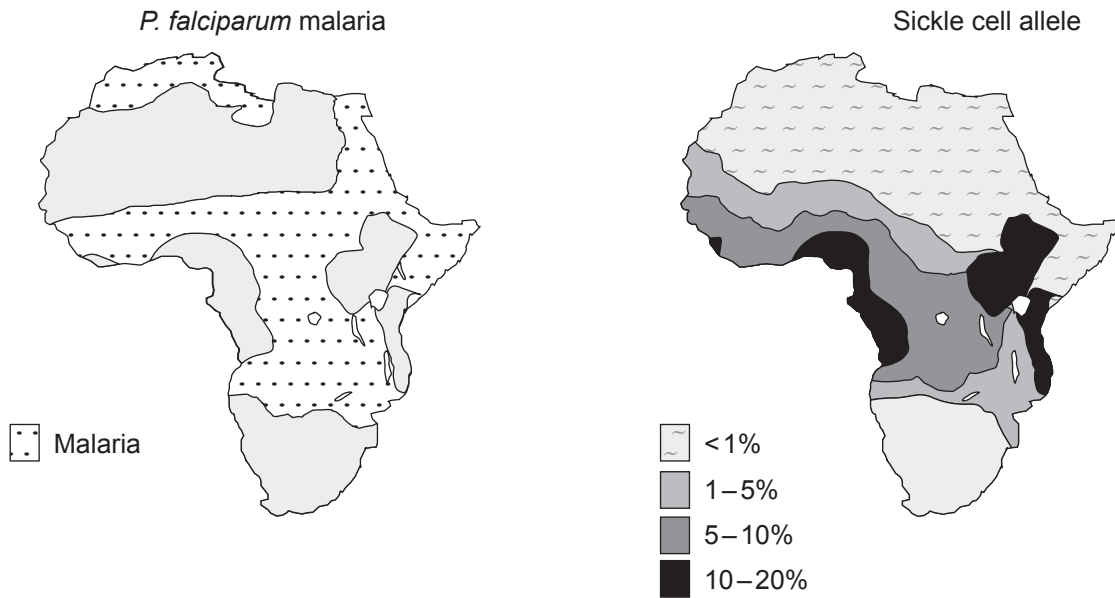
 _____ [2]

Examiner Only	
Marks	Remark

(c) Malaria is a disease caused by the parasite *Plasmodium falciparum* which is carried by the female mosquito.

The malaria parasite is less able to complete its life cycle in sickle shaped red blood cells.

The diagram below shows the distribution of *P. falciparum* malaria and sickle cell anaemia in Africa.



Source: Principal Examiner

(i) Compare the distribution of malaria to that of sickle cell allele in Africa.

[2]

(ii) Suggest why there is < 1% incidence of sickle cell anaemia in Southern Africa.

[1]

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

Permission to reproduce all copyright material has been applied for.
In some cases, efforts to contact copyright holders may have been unsuccessful and CCEA
will be happy to rectify any omissions of acknowledgement in future if notified.