Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5586196771

BIOLOGY **9700/41**

Paper 4 A Level Structured Questions **October/November 2020**

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Section A: answer **all** questions.
- Section B: answer **one** question.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **28** pages. Blank pages are indicated.

© UCLES 2020

BLANK PAGE

© UCLES 2020

Section A

Answer **all** questions.

1 Fig. 1.1 is a transverse section through a leaf from the maize plant, *Zea mays*.

Maize is a **C4** plant.

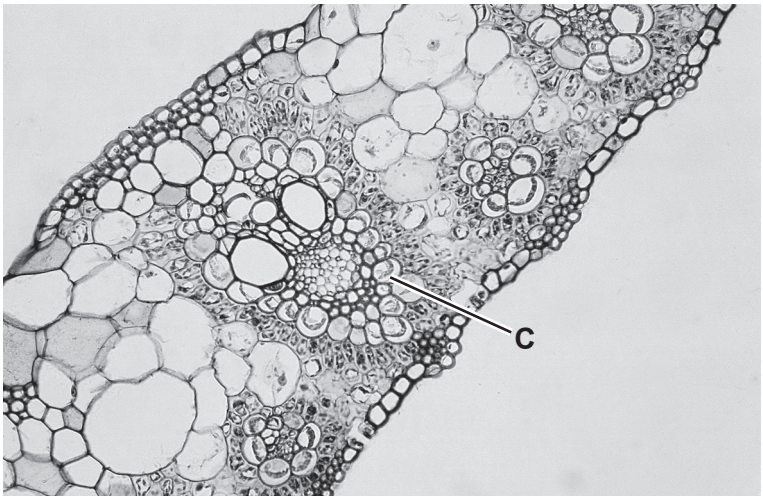


Fig. 1.1

(a) On Fig. 1.1, use label lines and letters to show:

A – a cell in the epidermal layer

B – a cell that contains PEP carboxylase.

[2]

(b) (i) Identify the cell type labelled **C** in Fig. 1.1.

C ..... [1]

(ii) Explain how the leaf anatomy shown in Fig. 1.1 adapts the C4 plant to maintain a high rate of photosynthesis at high temperatures.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(c) Fig. 1.2 shows the results of an experiment comparing the rate of carbon dioxide uptake in a C3 plant (*Chenopodium album*) and a C4 plant (*Amaranthus retroflexus*) in high and low carbon dioxide (CO_2) conditions.

The rate of CO_2 uptake is used to measure the rate of photosynthesis.

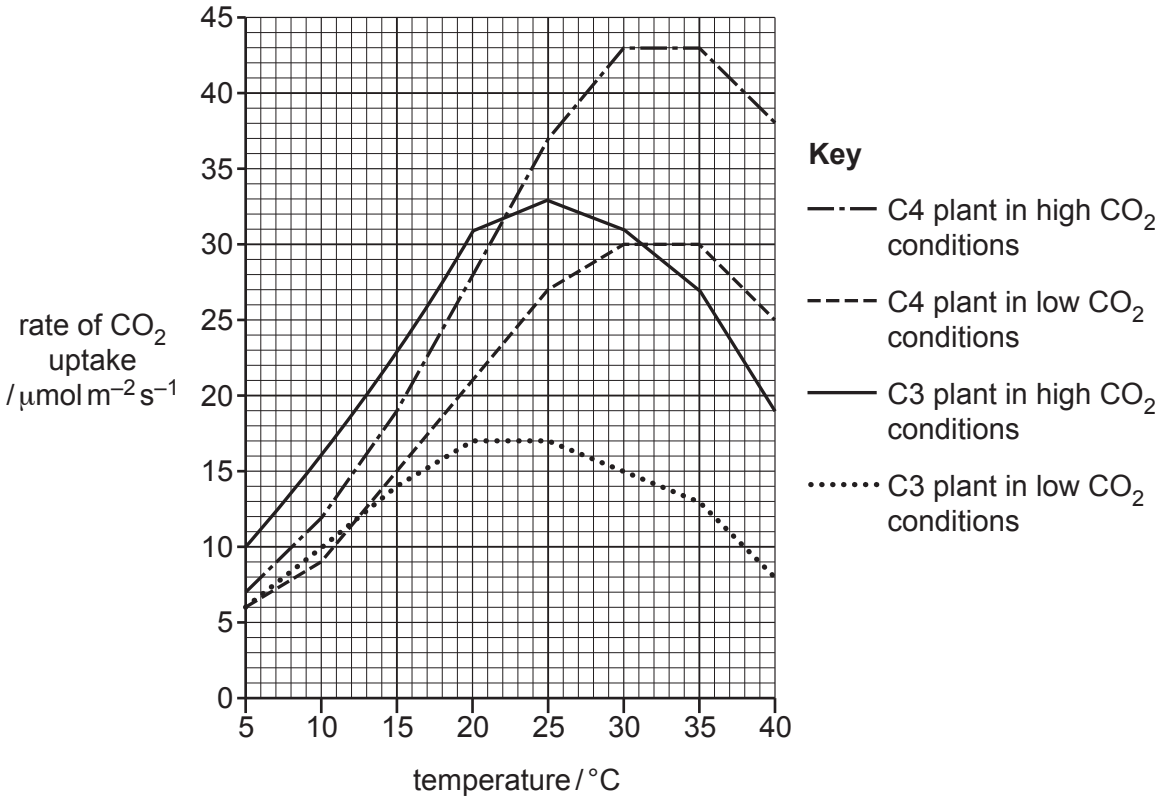


Fig. 1.2

(i) Using Fig. 1.2, compare the rates of photosynthesis in **high** CO_2 conditions in the C3 and C4 plants.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) Using Fig. 1.2, compare the rates of photosynthesis in low and high CO_2 conditions in the C4 plant between 30 °C and 35 °C **and** suggest an explanation for this difference.

.....

.....

.....

.....

.....

..... [2]

[Total: 13]

2 Domestic goats are small, herbivorous animals that provide milk for human use. Goats' milk is an important source of food for people living in rural China. Xinong Saanen and Guanzhong are the names of two varieties (breeds) of goat common in China.

In these breeds, there is genetic variation at nucleotide position 5752 of a gene coding for a growth factor. At this position there is either a cytosine (C) or a guanine (G) nucleotide. Some individuals are homozygous for the allele containing C at this position (**CC**), some are homozygous for the allele containing G at this position (**GG**) and some are heterozygous (**CG**).

Table 2.1 compares the mean milk yield of the first milk-producing period (first lactation) and the next milk-producing period (second lactation) for Xinong Saanen goats of each genotype.

Table 2.1

genotype at position 5752	mean milk yield / kg	
	first lactation	second lactation
CC	679	940
CG	622	858
GG	616	834

(a) (i) Variation in a phenotypic characteristic such as milk yield is caused by a combination of genetic and environmental factors.

Goats also show variation in milk yield between the first lactation and second lactation.

Suggest, with reasons, whether the variation in milk yield between the first lactation and second lactation, as shown in Table 2.1, is genetic or environmental.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(ii) The variation at position 5752 of the gene coding for a growth factor is due to a substitution mutation from **G** to **C**.

With reference to Table 2.1, describe the importance of the substitution from **G** to **C**.

.....

.....

.....

.....

.....

.....

..... [3]

(b) In a population of 268 Xinong Saanen goats:
- the frequency of the **C** allele (q) is 0.30
- the frequency of the **G** allele (p) is 0.70.

The Hardy-Weinberg principle can be used to predict the number of goats with **CC**, **CG** and **GG** genotypes in the population, using the equation:

$p^2 + 2pq + q^2 = 1$

For example, the number of goats with genotype **GG** can be predicted to be 131.

(i) Use the Hardy-Weinberg principle to predict the number of goats with genotypes **CC** and **CG** in this population of Xinong Saanen goats.

number of goats with genotype **CC** .....

number of goats with genotype **CG** .....

[2]

Table 2.2 shows the **actual** number of goats with each genotype in a population of Xinong Saanen goats and in a population of Guanzhong goats.

Table 2.2

population	total number of goats	number of goats of each genotype			allele frequency	
		CC	CG	GG	*p*	*q*
Xinong Saanen	268	22	116	130	0.70	0.30
Guanzhong	440	47	69	324	0.81	0.19

(ii) A close match between your predicted figures in **(b)(i)** and the actual numbers in Table 2.2 would mean that the Xinong Saanen population is in Hardy-Weinberg equilibrium.

State the name of a statistical test that could be used to find out whether or not the Xinong Saanen population is in Hardy-Weinberg equilibrium.

..... [1]

(iii) The **predicted** numbers of goats with each genotype in the Guanzhong population according to the Hardy-Weinberg principle are:

- **CC** = 16
- **CG** = 135
- **GG** = 289.

These figures are significantly different from the actual figures in Table 2.2.

With reference to Table 2.2, describe the evidence that shows that the Guanzhong population is **not** in Hardy-Weinberg equilibrium **and** suggest reasons for this.

.....

.....

.....

.....

.....

.....

..... [3]

© UCLES 2020

(c) Goats can be genetically modified to produce human proteins in their milk.

In 2009, an anti-clotting protein produced in this way was approved for use as a drug in people who lack the protein.

State **one** ethical advantage and **one** ethical problem of producing medicinal drugs from the milk of genetically modified goats.

advantage .....

.....

.....

problem .....

.....

.....

[2]

[Total: 14]

3 DNA barcoding is used in species identification.

To create a DNA barcode, a specific region of DNA is sequenced so that it can be compared to an online database of reference DNA. One region of DNA that is commonly used is 648 base pairs long within a mitochondrial gene, coding for the enzyme cytochrome c oxidase I.

(a) The solitary sandpiper, *Tringa solitaria*, is a migratory bird.

DNA barcoding has shown that approximately 2.5 million years ago *T. solitaria* evolved into two subspecies, *Tringa solitaria solitaria* and *Tringa solitaria cinnamomea*.

A subspecies is a genetically distinct population of a species that has some phenotypic differences but is not yet reproductively isolated.

T. s. solitaria breed in eastern North America whereas *T. s. cinnamomea* breed in western North America.

Suggest **and** explain how the two subspecies *T. s. solitaria* and *T. s. cinnamomea* could have evolved from the original *T. solitaria* population.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) Fig. 3.1 shows an American oystercatcher, *Haematopus palliatus*.



Fig. 3.1

The black oystercatcher, *Haematopus bachmani*, has all black feathers.

DNA barcoding analysis suggests that the American oystercatcher and the black oystercatcher are **not** separate species.

Suggest how DNA barcoding evidence could indicate that the American oystercatcher and black oystercatcher are **not** separate species.

.....

.....

.....

.....

..... [2]

(c) Customs officers at airports can use a hand-held DNA barcoding device to identify biological specimens entering or leaving a country.

Suggest how this helps protect endangered species.

.....

.....

.....

.....

..... [2]

[Total: 8]

4 There are a number of mutations affecting the production of fetal haemoglobin, HbF, and normal adult haemoglobin, HbA.

- The Hb^A allele codes for the normal β-globin polypeptide of haemoglobin.
- The Hb^S allele, caused by a base substitution mutation, codes for an abnormal β-globin polypeptide.
- The base substitution results in the amino acid glutamine, which has a polar R group, to be replaced by valine, which has a non-polar R group, in the polypeptide.

The abnormal haemoglobin molecules (HbS) form fibres in low partial pressures of oxygen (pO_2). The fibres cause red blood cells to become sickle shaped and the cells can block blood capillaries.

Individuals with adult haemoglobin molecules that are all abnormal (HbS) have sickle cell anaemia. This is a painful chronic condition that can be life-threatening.

(a) Explain why this mutation causes the HbS to form fibres.

.....

.....

.....

..... [2]

(b) Fetal haemoglobin, HbF, is produced by the fetus until just before birth, when adult haemoglobin begins to be made.

By the age of six months, adult haemoglobin has replaced most of the HbF. This change occurs when the genes coding for HbF are switched off and the genes coding for adult haemoglobin are switched on.

- A base substitution, British-198, causes fetal haemoglobin to continue to be produced.
- Normally by the age of six months, the concentration of HbF reduces to less than 1% of total haemoglobin.
- With the British-198 mutation, the concentration of HbF may be as high as 20% of total haemoglobin in an adult.
- HbF has a higher affinity for oxygen at low pO_2 than adult haemoglobin.

Individuals who have both sickle cell anaemia and British-198 mutation have reduced symptoms of sickle cell anaemia.

(i) Suggest why having the British-198 mutation reduces the symptoms of sickle cell anaemia.

.....

.....

.....

.....

..... [2]

© UCLES 2020

(ii) In adults with the British-198 mutation, the gene coding for a fetal haemoglobin polypeptide remains switched on. This is due to the presence of a protein that controls gene expression.

State the term that is used to describe a protein that controls gene expression.

..... [1]

(c) Gel electrophoresis can be carried out to test individuals for the different versions of haemoglobin: HbA, HbS and HbF.

- A buffer with alkaline pH is used to make all haemoglobin molecules negatively charged.
- HbS molecules have an additional positive charge compared to HbA.

(i) Describe **and** explain how gel electrophoresis is used to diagnose sickle cell anaemia.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) Four individuals had their haemoglobin analysed by gel electrophoresis. One of the individuals was heterozygous for the Hb^A and Hb^S alleles and had a condition known as sickle cell trait (SCT).

Some of the results are shown in Fig. 4.1. In Fig. 4.1, lane 1 and lane 5 are complete.

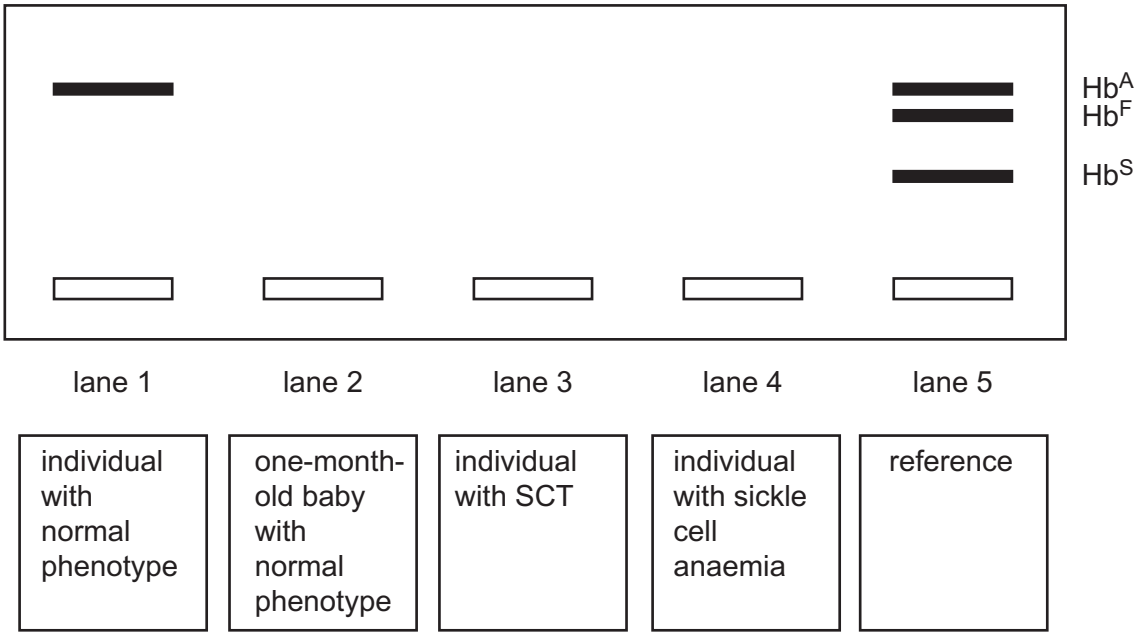


Fig. 4.1

Predict the results for the individuals analysed, by adding bands to lanes 2, 3 and 4 on Fig. 4.1. [2]

[Total: 11]

© UCLES 2020

5 Fig. 5.1 shows a cat displaying the recessive phenotype for two unlinked genes.

- **H/h** controls hair length. The allele for short hair is dominant to the allele for long hair.
- **R/r** controls coat pattern. The allele for 'full colour', with pigment on all parts of the body, is dominant to the allele for 'pointed', where the pigment is restricted to the ears, face, paws and tail.



Fig. 5.1

(a) Draw a genetic diagram to predict the offspring genotypes and phenotypes when the cat in Fig. 5.1 is crossed with a cat that is heterozygous for the hair length gene and heterozygous for the coat pattern gene.

parent phenotypes:

parent genotypes:

gametes:

F1 genotypes:

F1 phenotypes:

[5]

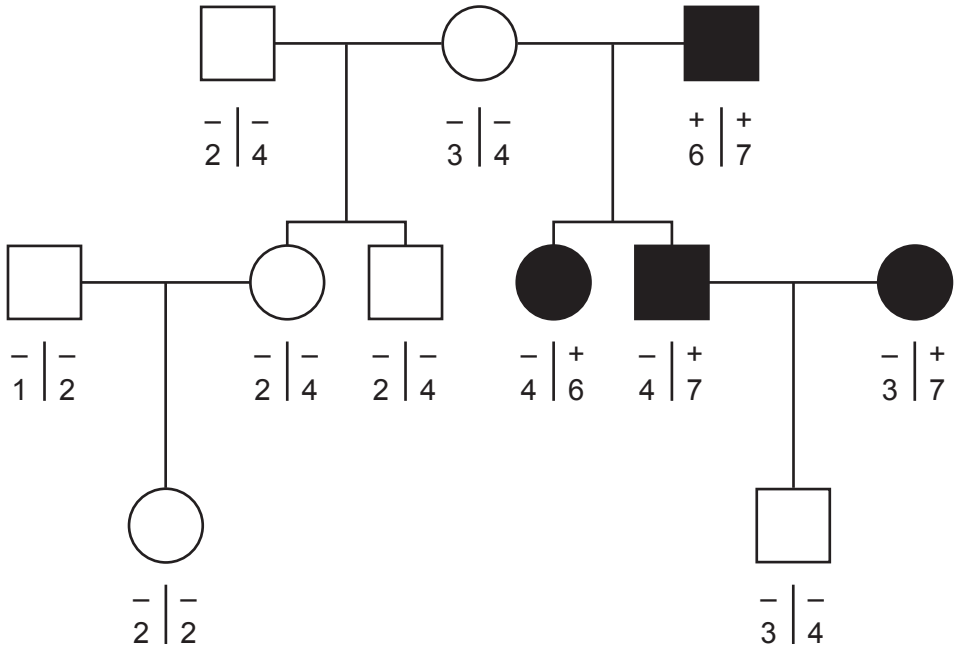
(b) Scientists isolated two sections of DNA thought to correspond with the allele for full colour (**R**) and the allele for pointed (**r**).

Sequencing these two DNA sections showed that the DNA sequence for full colour, **R**, had a restriction site for the restriction enzyme *Hpa*II. This restriction site did **not** occur in the DNA sequence **r** because of a single nucleotide substitution.

The scientists then carried out an analysis of three generations of cats. Each cat was assessed for three features:

- coat pattern, full colour or pointed
- the presence or absence of the *Hpa*II restriction site
- the pair of alleles present at a variable marker locus thought to lie close to the **R/r** locus. The marker locus (gene) has seven different alleles designated as 1, 2, 3, 4, 5, 6 and 7.

Fig. 5.2 shows the relationships of these cats and the results of the assessment.



Key

–	*Hpa*II restriction site absent
+	*Hpa*II restriction site present
1–7	are alleles at the marker locus

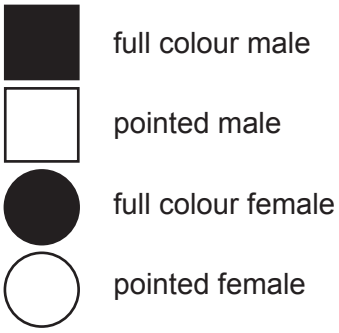


Fig. 5.2

© UCLES 2020

Identify evidence from Fig. 5.2 to support these statements:

(i) the pointed phenotype is due to a recessive allele

.....

.....

..... [1]

(ii) the **R/r** gene is located on an autosome

.....

.....

.....

.....

..... [2]

(iii) the marker locus and **R/r** are closely linked.

.....

.....

.....

.....

..... [2]

[Total: 10]

6 **(a)** **(i)** Identify the precise location in a cholinergic synapse that is described in each of the statements.

A region that contains many mitochondria.

.....

A region where exocytosis of ACh occurs.

.....

A region that contains voltage-gated channel proteins.

.....

A region that contains ligand-gated channel proteins.

.....
[4]

(ii) Outline the roles of synapses in the nervous system.

.....

.....

.....

..... [2]

(b) Some insecticides contain compounds called organophosphates. Organophosphates can act as enzyme inhibitors in neuromuscular junctions.

People who use organophosphates and do not follow safety guidelines are at risk of organophosphate poisoning, which affects muscle function.

Suggest how organophosphates could affect muscle function in humans.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(c) Outline the role of the sarcoplasmic reticulum in the contraction of striated muscle.

.....

.....

.....

.....

..... [2]

[Total: 12]

7 **(a)** Structures and compounds involved in respiration in anaerobic conditions include:

A – pyruvate

B – reduced NAD

C – ethanol

D – carbon dioxide

E – cytoplasm

F – NAD

G – ethanal

H – lactate

I – oxygen

J – mitochondrion

Complete Table 7.1 by matching each description with **one** letter chosen from **A** to **J** to show the correct structure or compound.

You may use each letter once, more than once or not at all.

Table 7.1

description	letter
end product of glycolysis	
cellular location of respiration in anaerobic conditions	
end product of respiration in anaerobic conditions in yeast cells	
compound used to reduce pyruvate	
end product of respiration in anaerobic conditions in muscle cells	
gas released during alcoholic fermentation	

[6]

(b) Respiration in anaerobic conditions in muscle cells during vigorous exercise can create an oxygen debt. Extra oxygen is breathed in after exercise to pay back the oxygen debt.

Explain **two** ways in which the mammalian body uses this **extra** oxygen.

.....

.....

.....

..... [2]

[Total: 8]

© UCLES 2020

8 Palm oil is a vegetable oil that is used very widely in food products. The oil is extracted from the fruit of the oil palm tree.

(a) Oil palm trees have a higher oil yield than that of other oil-producing plants.

Fig. 8.1 shows the oil yield of four crop plants.

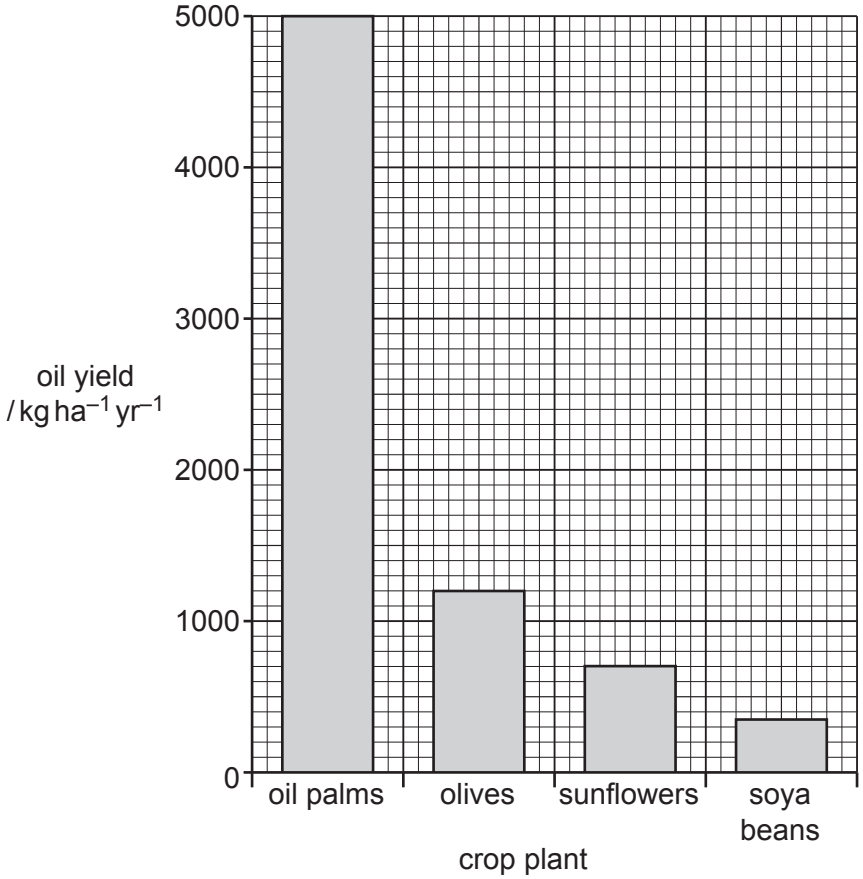


Fig. 8.1

Calculate how many hectares of soya bean plants would be needed to produce the **same** yield of oil as one hectare of oil palm trees.

Show your working and write your answer to **one** decimal place.

answer ..... hectares [2]

(b) Oil palm plantations in Malaysia and Indonesia have been created by cutting down rainforests. This reduces biodiversity.

Outline reasons why it is important to maintain biodiversity.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(c) Palm oil companies are now being asked to produce palm oil in a sustainable way. This means that no more deforestation should take place.

Suggest ways in which individual consumers can encourage manufacturers to use palm oil from sustainable sources.

.....

.....

.....

.....

.....

..... [2]

[Total: 9]

Section B

Answer **one** question.

9 **(a)** Describe **and** explain the properties of plasmids that allow them to be used in gene cloning. [7]

(b) Explain the roles of restriction endonucleases, ligases and reverse transcriptase in genetic engineering. [8]

[Total: 15]

10 **(a)** Describe how adrenaline can stimulate liver cells to convert glycogen to glucose. [7]

(b) Describe the role of abscisic acid (ABA) in the closure of stomata during times of drought. [8]

[Total: 15]

© UCLES 2020

© UCLES 2020

© UCLES 2020

[Turn over

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

9915660275

BIOLOGY **9700/42**

Paper 4 A Level Structured Questions **October/November 2020**

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Section A: answer **all** questions.
- Section B: answer **one** question.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **24** pages. Blank pages are indicated.

DC (CJ/SW) 185658/3
© UCLES 2020

PapaCambridge

Section A

Answer **all** questions.

1 Fig. 1.1 shows a transmission electron micrograph of a chloroplast.

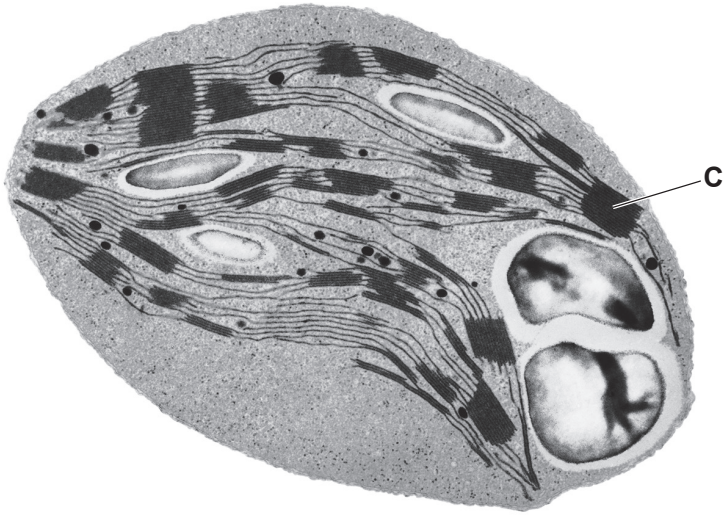


Fig. 1.1

(a) On Fig. 1.1, use label lines and letters to label:

A – the storage site of the carbohydrate product of photosynthesis

B – the site of the light independent stage.

[2]

© UCLES 2020

PapaCambridge

(b) (i) Name the structure labelled **C** in Fig. 1.1.

C ..... [1]

(ii) Explain how the structure of **C** is linked to its function.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(c) (i) The anatomy of C4 plants is adapted to allow the rate of photosynthesis to remain high at high temperatures.

C3 plants do not have these adaptations and an additional reaction occurs at high temperatures that reduces the rate of photosynthesis.

Explain why the reaction that takes place at high temperatures in **C3** plants reduces the rate of photosynthesis.

.....

.....

.....

..... [2]

© UCLES 2020

[Turn over

PapaCambridge

(ii) C4 plants have higher rates of photosynthesis than C3 plants when the ratio of atmospheric oxygen to atmospheric carbon dioxide is high.

Fig. 1.2 shows the atmospheric carbon dioxide concentration in the last 50 million years.

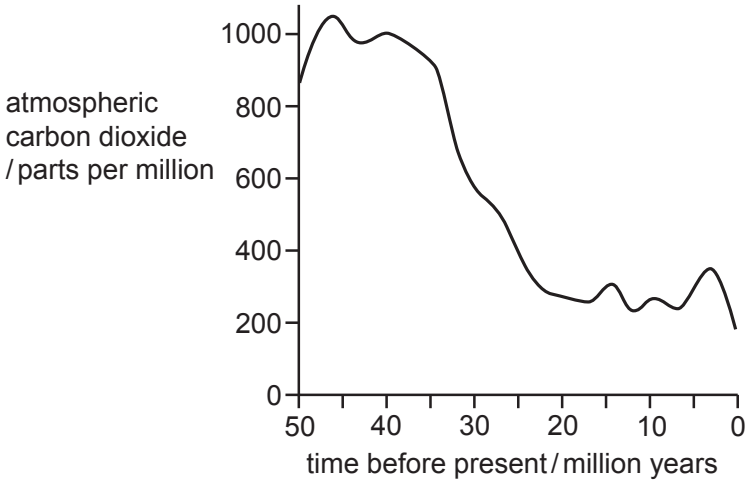


Fig. 1.2

There is evidence that C4 plants first appeared 30 million years ago.

With reference to Fig. 1.2, suggest why C4 plants first appeared 30 million years ago.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 12]

PapaCambridge

BLANK PAGE

© UCLES 2020

[Turn over

PapaCambridge

2 Domestic goats are small, herbivorous animals that provide milk for human use. This is an important source of food for people in rural South Africa.

Three Northern European goat varieties (breeds) have been imported to South Africa because they have higher milk yields than the native South African goats.

Table 2.1 compares the mean daily milk yields of these three breeds of Northern European goat in three locations, Northern Europe, Barbados and South Africa.

Table 2.1

goat breed	mean daily milk yield / kg in different locations		
	Northern Europe	Barbados	South Africa
British Alpine	4.09	2.55	0.75
Saanen	5.17	1.73	1.45
Toggenburg	4.54	3.46	0.56

(a) Native South African goats have a mean daily milk yield of 0.25 kg.

Calculate how many times greater the mean daily milk yield will be if a native South African goat is replaced by the Northern European goat breed that gives maximum yield.

Show your working and write your answer to **two** significant figures.

answer ..... [2]

(b) (i) Explain how the data in Table 2.1 support the claim that some of the variation in mean daily milk yield in goats is due to **genetic** causes.

.....

.....

.....

.....

.....

..... [2]

© UCLES 2020

PapaCambridge

(ii) The climate, vegetation and availability of veterinary care for goats in Northern Europe, Barbados and South Africa are different.

Explain how Table 2.1 shows that **environmental** factors can cause variation in mean daily milk yield in goats.

.....

.....

.....

.....

..... [2]

(c) Native South African goats are better adapted to the local conditions in South Africa than a Northern European breed, such as the Saanen. However Saanen goats have the potential for very high milk yield.

Outline a programme of selective breeding that could produce a goat with a high milk yield that is adapted to the local conditions in South Africa.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

© UCLES 2020

[Turn over

PapaCambridge

(d) Children in developing countries may drink unpasteurised goats' milk. Some may develop diarrhoea caused by live bacteria ingested in the milk.

Scientists have used genetic engineering to develop goats that produce human lysozyme in their milk. Lysozyme is an enzyme that kills bacteria and so reduces the number of bacteria in the milk.

State a social advantage **and** a social disadvantage of making these GM goats available in developing countries.

advantage .....

.....

disadvantage .....

.....

[2]

[Total: 13]

© UCLES 2020

PapaCambridge

3 A subspecies is a genetically distinct population of a species that has some phenotypic differences but is not yet reproductively isolated.

500 000 years ago, the European house mouse, *Mus musculus*, evolved into two subspecies, *Mus musculus domesticus* and *Mus musculus musculus*.

(a) Suggest **and** explain how the two subspecies *M. m. domesticus* and *M. m. musculus* could have evolved from the original *M. musculus* population.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

PapaCambridge

(b) Today, *M. m. domesticus* populations are separated from *M. m. musculus* populations by a large hybrid zone. The hybrid zone formed 5000–1000 years ago when populations of the two subspecies overlapped and interbreeding occurred between the two subspecies, resulting in hybrids.

Researchers investigated the populations in the hybrid zone.

It was observed that:

- hybrid mice were infected by more intestinal worms than *M. m. domesticus* and *M. m. musculus*
- *M. m. domesticus* and *M. m. musculus* individuals frequently mate together
- hybrid male mice had a very low fertility score based on testis weight and total sperm production, whereas *M. m. domesticus* and *M. m. musculus* males had a very high fertility score
- some female hybrids were sterile
- crosses between a fertile female hybrid and a male from either subspecies produced a very low number of offspring.

M. m. domesticus and *M. m. musculus* usually have the same diploid number ($2n = 40$). Some individuals of *M. m. domesticus* have a different diploid number ($2n = 34$).

Discuss the extent to which pre-zygotic and post-zygotic isolating mechanisms maintain *M. m. domesticus* and *M. m. musculus* as two separate subspecies within the hybrid zone.

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 7]

© UCLES 2020

PapaCambridge

4 Sickle cell anaemia is a non-infectious chronic disease. If not treated, sickle cell anaemia can be painful and life-threatening.

Sickle cell anaemia is caused by a base substitution mutation in the gene coding for the β-globin polypeptide of haemoglobin. This leads to a change in the primary structure of the polypeptide, as valine is present instead of glutamine. This results in abnormal sickle-shaped red blood cells, which stick together in blood vessels.

Symptoms of sickle cell anaemia include painful attacks when red blood cells block capillaries in tissues and organs.

(a) Suggest the consequences to cells when sickle-shaped red blood cells block capillaries in tissues and organs.

.....

.....

.....

..... [2]

(b) Sickle cell anaemia is an autosomal recessive inherited disorder:

- allele Hb^A codes for the normal β-globin polypeptide
- allele Hb^S codes for the sickle-cell polypeptide.

People who are heterozygous (Hb^A Hb^S) have sickle cell trait (SCT). For a child to inherit sickle cell anaemia (Hb^S Hb^S), both parents must have SCT.

A genetic screening program is available for sickle cell anaemia and SCT:

- when a mother is screened and found to have SCT, the father is then screened
- if the mother becomes pregnant, the fetus is screened for both sickle cell anaemia and for SCT
- the test is done either by amniocentesis or by chorionic villus sampling, both of which carry a small risk of the pregnancy failing.

(i) Outline **two** advantages of genetic screening for sickle cell anaemia and SCT.

.....

.....

.....

.....

.....

..... [2]

PapaCambridge

(ii) To test for the presence of Hb^S, DNA is extracted and the polymerase chain reaction (PCR) is carried out with two specific primers.

One mutation to produce Hb^S is a base substitution in the sixth codon of the β-globin gene. The normal codon GAG changes to GTG. The normal-specific primer detects GAG whereas the mutant-specific primer detects GTG.

Explain:
- why primers are used in PCR
- how the use of two specific primers allows the amplification of the normal, sickle cell anaemia and SCT genotypes.

.....

.....

.....

.....

.....

.....

..... [3]

(iii) Gel electrophoresis is carried out on the products of the PCRs.

Fig. 4.1 includes the results for two individuals, **A** and **B**, tested for the sickle cell allele.

- Each lane has an 860 base pair (bp) band to indicate the test is valid.
- Lane 1 is a control lane with a 207bp band for an individual with known normal phenotype.
- Lane 2 is a control lane with a 207bp band for an individual with known sickle cell anaemia phenotype.
- Lanes 1, 3 and 5 contain DNA from the PCR that used normal-specific primer.
- Lanes 2, 4 and 6 contain DNA from the PCR that used mutant-specific primer.

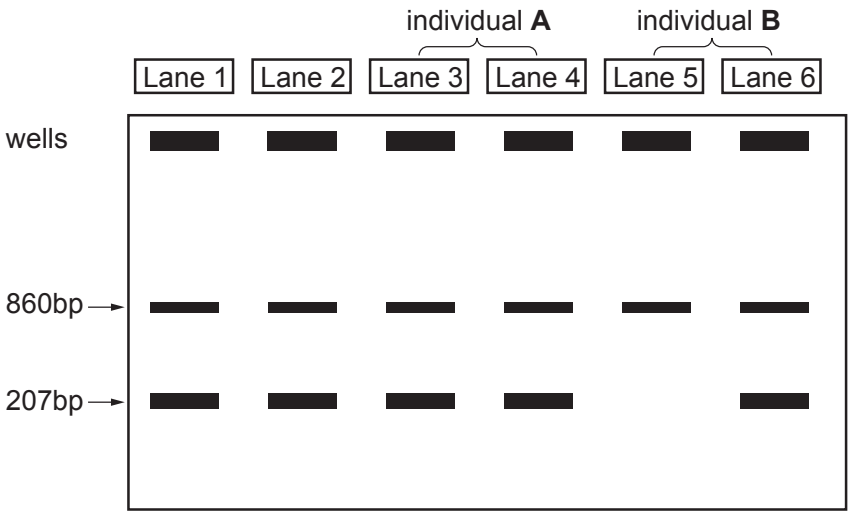


Fig. 4.1

PapaCambridge

Deduce the genotypes and phenotypes of individuals **A** and **B** in Fig. 4.1.

A .....

B .....
[2]

(c) The number of cases of sickle cell anaemia is highest in sub-Saharan Africa, the Middle East and India. These areas also have a high incidence of malaria.

People with SCT (heterozygotes) are either unaffected or may have mild symptoms of sickle cell anaemia. One advantage of SCT is an increased resistance to malaria.

(i) Explain how natural selection operates to maintain the presence of the sickle cell allele in populations in areas with malaria.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) Parents who use IVF to produce embryos may decide to have embryos genetically screened by a test known as pre-implantation genetic diagnosis (PGD). Only embryos that do not have sickle cell alleles are transferred to the woman's uterus.

Discuss **two** ethical reasons why parents using IVF may choose **not** to have PGD.

.....

.....

.....

.....

..... [2]

[Total: 15]

© UCLES 2020

[Turn over

PapaCambridge

5 Tyrosinase is an enzyme found in mammals. It is involved in the synthesis of melanin pigment. Mutations in the tyrosinase gene affect a mammal's hair colour.

Table 5.1 compares DNA sequences for codons 974–985 of:
- the normal tyrosinase gene of humans (human)
- the normal tyrosinase gene of cats that have pigmented hair (normal cat)
- the tyrosinase gene of cats that show an albino phenotype (albino cat).

The corresponding amino acid sequences of each tyrosinase are shown in the shaded rows.

Table 5.1

	974	**975**	**976**	**977**	**978**	**979**	**980**	**981**	**982**	**983**	**984**	**985**
human	CTC	CCC	TCT	TCA	GCT	GAT	GTG	GAA	TTT	TGC	CTA	AGT
normal cat	CTC	CCC	TCC	TCT	GCT	GAT	GTG	GAA	TTT	TGC	CTA	AGT
albino cat	CTC	CCT	CCT	CTG	CTG	ATG	TGG	AAT	TTT	GCC	TAA	GTC
human	Leu	Pro	Ser	Ser	Ala	Asp	Val	Glu	Phe	Cys	Leu	Ser
normal cat	Leu	Pro	Ser	Ser	Ala	Asp	Val	Glu	Phe	Cys	Leu	Ser
albino cat	Leu	Pro	Pro	Leu	Leu	Met	Trp	Asn	Phe	Ala	STOP	–

(a) (i) A silent mutation involves a base substitution that does not result in an amino acid change.

Use Table 5.1 to identify, with reasons, a silent mutation distinguishing humans from normal cats with pigmented hair.

.....

.....

.....

.....

.....

.....

..... [2]

PapaCambridge

(ii) State the changes that resulted in the premature STOP codon in the albino cat DNA sequence.

.....

.....

.....

.....

..... [2]

(iii) Explain why albino cats, homozygous for the mutation that resulted in the premature STOP codon, do **not** produce melanin.

.....

.....

.....

.....

..... [2]

(iv) Bioinformatics was used to compare the whole sequence of the tyrosinase genes of humans and cats.

Explain why bioinformatics was used to compare these gene sequences **and** suggest a conclusion that could be made from the percentage similarity data obtained.

.....

.....

.....

.....

.....

..... [2]

© UCLES 2020

[Turn over

PapaCambridge

(b) Siamese cats have a temperature-sensitive tyrosinase that only functions in the cooler areas of the skin. This means they only produce a small quantity of melanin pigment. Melanin is mainly on their ears, face, paws and tail.

Fig. 5.1 shows a Siamese cat.



Fig. 5.1

The Siamese allele of tyrosinase ($\mathbf{t^s}$) is recessive to the normal allele that causes full pigmentation all over the body (**T**) but is dominant to the albino allele ($\mathbf{t^a}$).

Draw a genetic diagram to show how a cross between an albino cat and a fully pigmented cat can result in offspring that include kittens with Siamese colouring.

parent phenotypes: albino × fully pigmented

parent genotypes:

gametes:

F1 genotypes:

F1 phenotypes:

ratio:

[3]

[Total: 11]

© UCLES 2020

PapaCambridge

6 **(a)** A person who has a wound to their skin may experience pain. Opioid drugs can be taken to relieve the pain.

Opioid receptors are located in the presynaptic membrane of a cholinergic synapse.

Fig. 6.1 shows the action of an opioid drug on the presynaptic membrane.

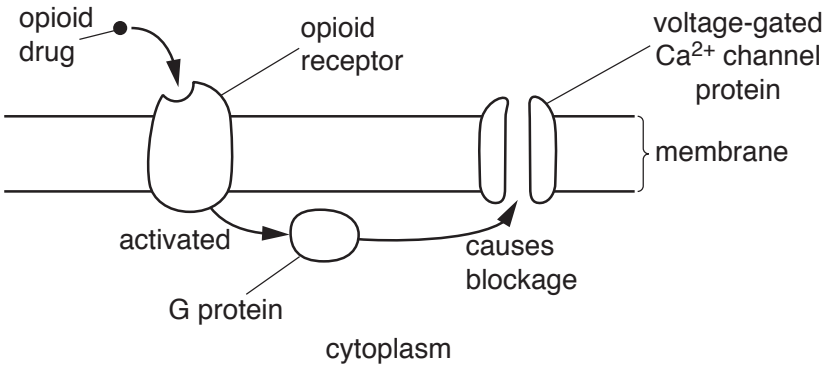


Fig. 6.1

Explain how the action of an opioid drug on the presynaptic membrane can prevent the generation of pain impulses in the postsynaptic neurone.

.....

.....

.....

.....

.....

.....

.....

..... [5]

PapaCambridge

(b) Spinal reflexes help the body to respond very quickly to potentially dangerous situations that could cause injury.

(i) State **two** features of a spinal reflex, **other than** being fast.

.....

.....

.....

..... [2]

(ii) Sensory and motor neurones are involved in a spinal reflex.

State the location of the cell body of a sensory neurone **and** a motor neurone.

sensory neurone .....

motor neurone .....

[2]

(iii) Describe the function in a spinal reflex of a sensory neurone **and** a motor neurone.

sensory neurone .....

.....

.....

.....

motor neurone .....

.....

.....

.....

[4]

[Total: 13]

© UCLES 2020

PapaCambridge

7 Insulin is transported around the body in the blood. The cells of the liver, muscle tissue and adipose (fat) tissue have receptors for insulin.

(a) State:
- the precise cellular location of the insulin receptors
- the type of biological molecule that forms an insulin receptor.

location .....

type of biological molecule .....
[2]

(b) Insulin stimulates the activity of the enzyme glycogen synthetase in liver cells.

Fig. 7.1 shows the activity of glycogen synthetase in liver cells for 210 seconds after glucose has been injected into the bloodstream.

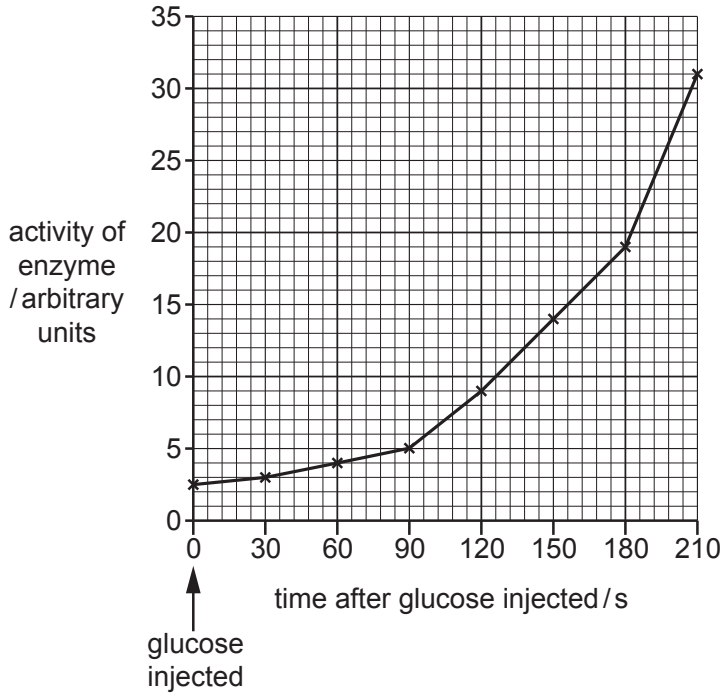


Fig. 7.1

(i) Calculate the percentage increase in glycogen synthetase activity between 90 s and 180 s after glucose was injected into the blood.

Show your working and write your answer to the nearest whole number.

answer .....% [2]

(ii) Suggest the role of glycogen synthetase in the regulation of blood glucose concentration.

.....

..... [1]

[Total: 5]

PapaCambridge

8 **(a)** Describe a method that could be used to estimate the population size of a mobile animal, such as a brown rat.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(b) The soft rush plant, *Juncus effusus*, grows in many habitats in Northern Europe. An investigation was carried out to assess whether there was a relationship between the height of soft rush plants and the altitude at which they grow on exposed hillsides.

The mean height of 10 soft rush plants was calculated at each of eight different altitudes.

The results are shown in Table 8.1.

Table 8.1

altitude / m	mean height of soft rush plants / cm
100	85
150	86
200	83
250	79
300	72
350	74
400	68
450	63

© UCLES 2020

PapaCambridge

The statistical test, Spearman's rank correlation (r_s), was applied to find out if there was a relationship between the altitude and the mean height of the soft rush plants.

(i) The formula for calculating Spearman's rank correlation is:

$$r_s = 1 - \left(\frac{6 \times \Sigma D^2}{n^3 - n}\right)$$

- ΣD^2 is the sum of the differences between the ranks of the two samples
- n is the number of samples.

In this investigation the value of ΣD^2 is 164.

Calculate the value of r_s.

Show your working and write your answer to **two** decimal places.

r_s = ... [2]

(ii) Use your value for r_s to evaluate the relationship between the altitude and the mean height of the soft rush plants.

.....

.....

.....

..... [2]

[Total: 9]

PapaCambridge

Section B

Answer **one** question.

9 **(a)** Using named examples, describe the differences between structural and regulatory genes **and** the differences between repressible and inducible enzymes. [9]

(b) Explain the function of transcription factors in gene expression in eukaryotes. [6]

[Total: 15]

10 **(a)** Describe how a molecule of glucose is converted to pyruvate and then to acetyl CoA. [9]

(b) Explain how ATP is formed during oxidative phosphorylation. [6]

[Total: 15]

© UCLES 2020

PapaCambridge

PapaCambridge

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.

© UCLES 2020

PapaCambridge

Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

9431237737

BIOLOGY **9700/43**

Paper 4 A Level Structured Questions **October/November 2020**

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Section A: answer **all** questions.
- Section B: answer **one** question.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **28** pages. Blank pages are indicated.

© UCLES 2020

BLANK PAGE

© UCLES 2020

Section A

Answer **all** questions.

1 Fig. 1.1 is a transverse section through a leaf from the maize plant, *Zea mays*.

Maize is a **C4** plant.

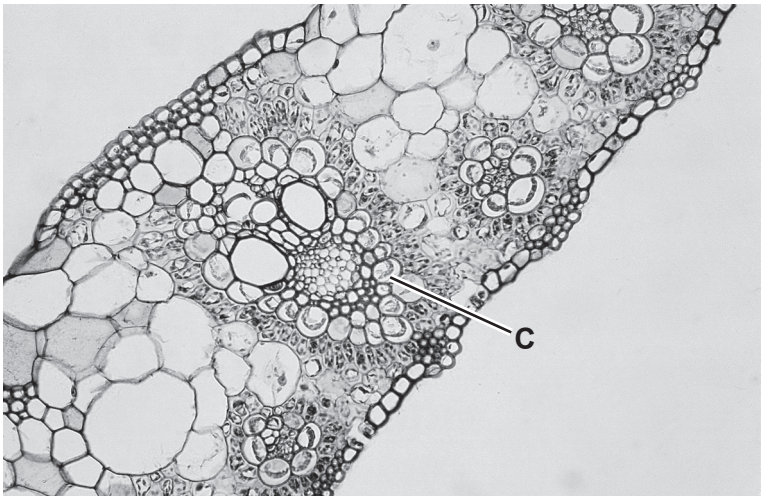


Fig. 1.1

(a) On Fig. 1.1, use label lines and letters to show:

A – a cell in the epidermal layer

B – a cell that contains PEP carboxylase.

[2]

(b) (i) Identify the cell type labelled **C** in Fig. 1.1.

C ..... [1]

(ii) Explain how the leaf anatomy shown in Fig. 1.1 adapts the C4 plant to maintain a high rate of photosynthesis at high temperatures.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(c) Fig. 1.2 shows the results of an experiment comparing the rate of carbon dioxide uptake in a C3 plant (*Chenopodium album*) and a C4 plant (*Amaranthus retroflexus*) in high and low carbon dioxide (CO_2) conditions.

The rate of CO_2 uptake is used to measure the rate of photosynthesis.

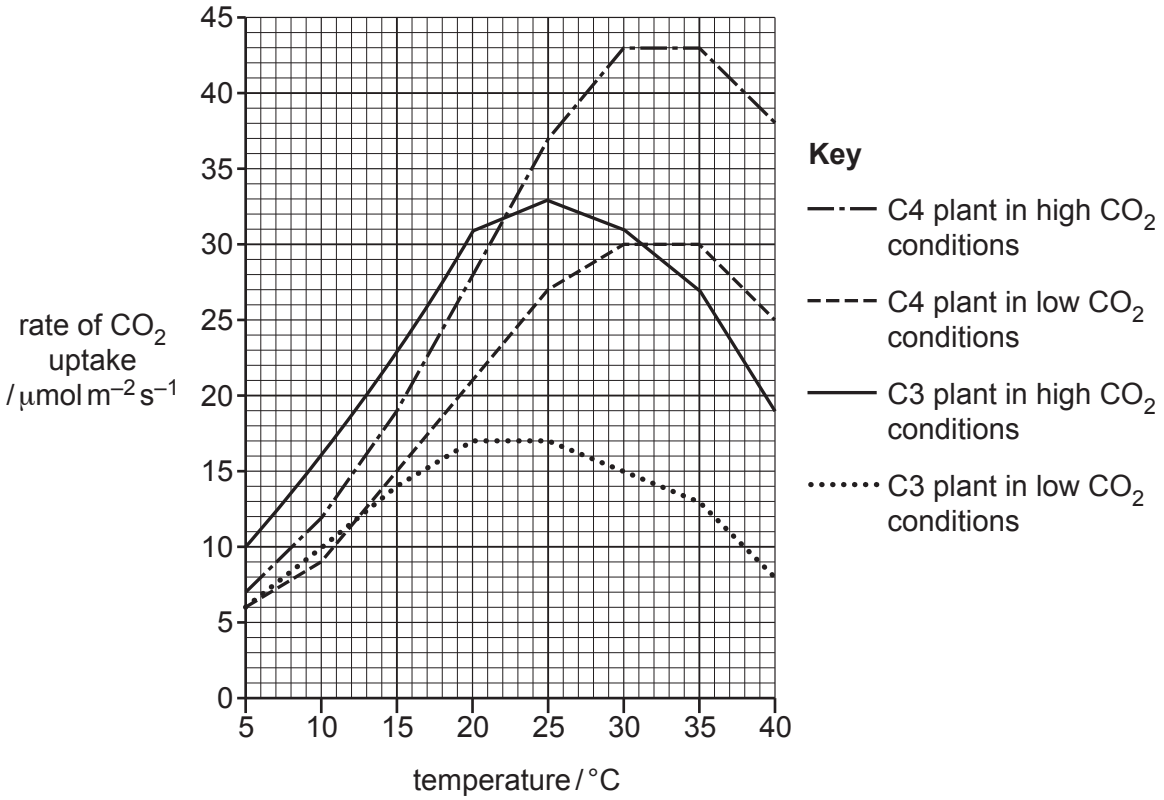


Fig. 1.2

(i) Using Fig. 1.2, compare the rates of photosynthesis in **high** CO_2 conditions in the C3 and C4 plants.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) Using Fig. 1.2, compare the rates of photosynthesis in low and high CO_2 conditions in the C4 plant between 30 °C and 35 °C **and** suggest an explanation for this difference.

.....

.....

.....

.....

.....

..... [2]

[Total: 13]

2 Domestic goats are small, herbivorous animals that provide milk for human use. Goats' milk is an important source of food for people living in rural China. Xinong Saanen and Guanzhong are the names of two varieties (breeds) of goat common in China.

In these breeds, there is genetic variation at nucleotide position 5752 of a gene coding for a growth factor. At this position there is either a cytosine (C) or a guanine (G) nucleotide. Some individuals are homozygous for the allele containing C at this position (**CC**), some are homozygous for the allele containing G at this position (**GG**) and some are heterozygous (**CG**).

Table 2.1 compares the mean milk yield of the first milk-producing period (first lactation) and the next milk-producing period (second lactation) for Xinong Saanen goats of each genotype.

Table 2.1

genotype at position 5752	mean milk yield / kg	
	first lactation	second lactation
CC	679	940
CG	622	858
GG	616	834

(a) (i) Variation in a phenotypic characteristic such as milk yield is caused by a combination of genetic and environmental factors.

Goats also show variation in milk yield between the first lactation and second lactation.

Suggest, with reasons, whether the variation in milk yield between the first lactation and second lactation, as shown in Table 2.1, is genetic or environmental.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(ii) The variation at position 5752 of the gene coding for a growth factor is due to a substitution mutation from **G** to **C**.

With reference to Table 2.1, describe the importance of the substitution from **G** to **C**.

.....

.....

.....

.....

.....

.....

..... [3]

(b) In a population of 268 Xinong Saanen goats:
- the frequency of the **C** allele (q) is 0.30
- the frequency of the **G** allele (p) is 0.70.

The Hardy-Weinberg principle can be used to predict the number of goats with **CC**, **CG** and **GG** genotypes in the population, using the equation:

$p^2 + 2pq + q^2 = 1$

For example, the number of goats with genotype **GG** can be predicted to be 131.

(i) Use the Hardy-Weinberg principle to predict the number of goats with genotypes **CC** and **CG** in this population of Xinong Saanen goats.

number of goats with genotype **CC** .....

number of goats with genotype **CG** .....

[2]

Table 2.2 shows the **actual** number of goats with each genotype in a population of Xinong Saanen goats and in a population of Guanzhong goats.

Table 2.2

population	total number of goats	number of goats of each genotype			allele frequency	
		CC	CG	GG	*p*	*q*
Xinong Saanen	268	22	116	130	0.70	0.30
Guanzhong	440	47	69	324	0.81	0.19

(ii) A close match between your predicted figures in **(b)(i)** and the actual numbers in Table 2.2 would mean that the Xinong Saanen population is in Hardy-Weinberg equilibrium.

State the name of a statistical test that could be used to find out whether or not the Xinong Saanen population is in Hardy-Weinberg equilibrium.

..... [1]

(iii) The **predicted** numbers of goats with each genotype in the Guanzhong population according to the Hardy-Weinberg principle are:

- **CC** = 16
- **CG** = 135
- **GG** = 289.

These figures are significantly different from the actual figures in Table 2.2.

With reference to Table 2.2, describe the evidence that shows that the Guanzhong population is **not** in Hardy-Weinberg equilibrium **and** suggest reasons for this.

.....

.....

.....

.....

.....

.....

..... [3]

© UCLES 2020

(c) Goats can be genetically modified to produce human proteins in their milk.

In 2009, an anti-clotting protein produced in this way was approved for use as a drug in people who lack the protein.

State **one** ethical advantage and **one** ethical problem of producing medicinal drugs from the milk of genetically modified goats.

advantage .....

.....

.....

problem .....

.....

.....

[2]

[Total: 14]

3 DNA barcoding is used in species identification.

To create a DNA barcode, a specific region of DNA is sequenced so that it can be compared to an online database of reference DNA. One region of DNA that is commonly used is 648 base pairs long within a mitochondrial gene, coding for the enzyme cytochrome c oxidase I.

(a) The solitary sandpiper, *Tringa solitaria*, is a migratory bird.

DNA barcoding has shown that approximately 2.5 million years ago *T. solitaria* evolved into two subspecies, *Tringa solitaria solitaria* and *Tringa solitaria cinnamomea*.

A subspecies is a genetically distinct population of a species that has some phenotypic differences but is not yet reproductively isolated.

T. s. solitaria breed in eastern North America whereas *T. s. cinnamomea* breed in western North America.

Suggest **and** explain how the two subspecies *T. s. solitaria* and *T. s. cinnamomea* could have evolved from the original *T. solitaria* population.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) Fig. 3.1 shows an American oystercatcher, *Haematopus palliatus*.



Fig. 3.1

The black oystercatcher, *Haematopus bachmani*, has all black feathers.

DNA barcoding analysis suggests that the American oystercatcher and the black oystercatcher are **not** separate species.

Suggest how DNA barcoding evidence could indicate that the American oystercatcher and black oystercatcher are **not** separate species.

.....

.....

.....

.....

..... [2]

(c) Customs officers at airports can use a hand-held DNA barcoding device to identify biological specimens entering or leaving a country.

Suggest how this helps protect endangered species.

.....

.....

.....

.....

..... [2]

[Total: 8]

4 There are a number of mutations affecting the production of fetal haemoglobin, HbF, and normal adult haemoglobin, HbA.

- The Hb^A allele codes for the normal β-globin polypeptide of haemoglobin.
- The Hb^S allele, caused by a base substitution mutation, codes for an abnormal β-globin polypeptide.
- The base substitution results in the amino acid glutamine, which has a polar R group, to be replaced by valine, which has a non-polar R group, in the polypeptide.

The abnormal haemoglobin molecules (HbS) form fibres in low partial pressures of oxygen (pO_2). The fibres cause red blood cells to become sickle shaped and the cells can block blood capillaries.

Individuals with adult haemoglobin molecules that are all abnormal (HbS) have sickle cell anaemia. This is a painful chronic condition that can be life-threatening.

(a) Explain why this mutation causes the HbS to form fibres.

.....

.....

.....

..... [2]

(b) Fetal haemoglobin, HbF, is produced by the fetus until just before birth, when adult haemoglobin begins to be made.

By the age of six months, adult haemoglobin has replaced most of the HbF. This change occurs when the genes coding for HbF are switched off and the genes coding for adult haemoglobin are switched on.

- A base substitution, British-198, causes fetal haemoglobin to continue to be produced.
- Normally by the age of six months, the concentration of HbF reduces to less than 1% of total haemoglobin.
- With the British-198 mutation, the concentration of HbF may be as high as 20% of total haemoglobin in an adult.
- HbF has a higher affinity for oxygen at low pO_2 than adult haemoglobin.

Individuals who have both sickle cell anaemia and British-198 mutation have reduced symptoms of sickle cell anaemia.

(i) Suggest why having the British-198 mutation reduces the symptoms of sickle cell anaemia.

.....

.....

.....

.....

..... [2]

© UCLES 2020

(ii) In adults with the British-198 mutation, the gene coding for a fetal haemoglobin polypeptide remains switched on. This is due to the presence of a protein that controls gene expression.

State the term that is used to describe a protein that controls gene expression.

..... [1]

(c) Gel electrophoresis can be carried out to test individuals for the different versions of haemoglobin: HbA, HbS and HbF.

- A buffer with alkaline pH is used to make all haemoglobin molecules negatively charged.
- HbS molecules have an additional positive charge compared to HbA.

(i) Describe **and** explain how gel electrophoresis is used to diagnose sickle cell anaemia.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(ii) Four individuals had their haemoglobin analysed by gel electrophoresis. One of the individuals was heterozygous for the Hb^A and Hb^S alleles and had a condition known as sickle cell trait (SCT).

Some of the results are shown in Fig. 4.1. In Fig. 4.1, lane 1 and lane 5 are complete.

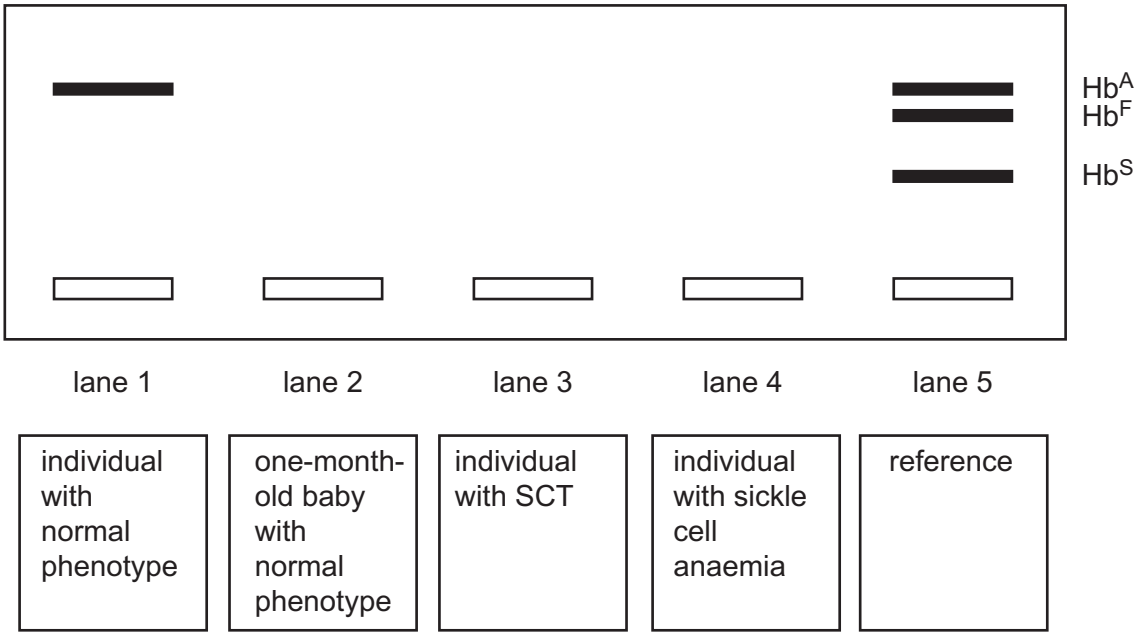


Fig. 4.1

Predict the results for the individuals analysed, by adding bands to lanes 2, 3 and 4 on Fig. 4.1. [2]

[Total: 11]

© UCLES 2020

5 Fig. 5.1 shows a cat displaying the recessive phenotype for two unlinked genes.

- **H/h** controls hair length. The allele for short hair is dominant to the allele for long hair.
- **R/r** controls coat pattern. The allele for 'full colour', with pigment on all parts of the body, is dominant to the allele for 'pointed', where the pigment is restricted to the ears, face, paws and tail.



Fig. 5.1

(a) Draw a genetic diagram to predict the offspring genotypes and phenotypes when the cat in Fig. 5.1 is crossed with a cat that is heterozygous for the hair length gene and heterozygous for the coat pattern gene.

parent phenotypes:

parent genotypes:

gametes:

F1 genotypes:

F1 phenotypes:

[5]

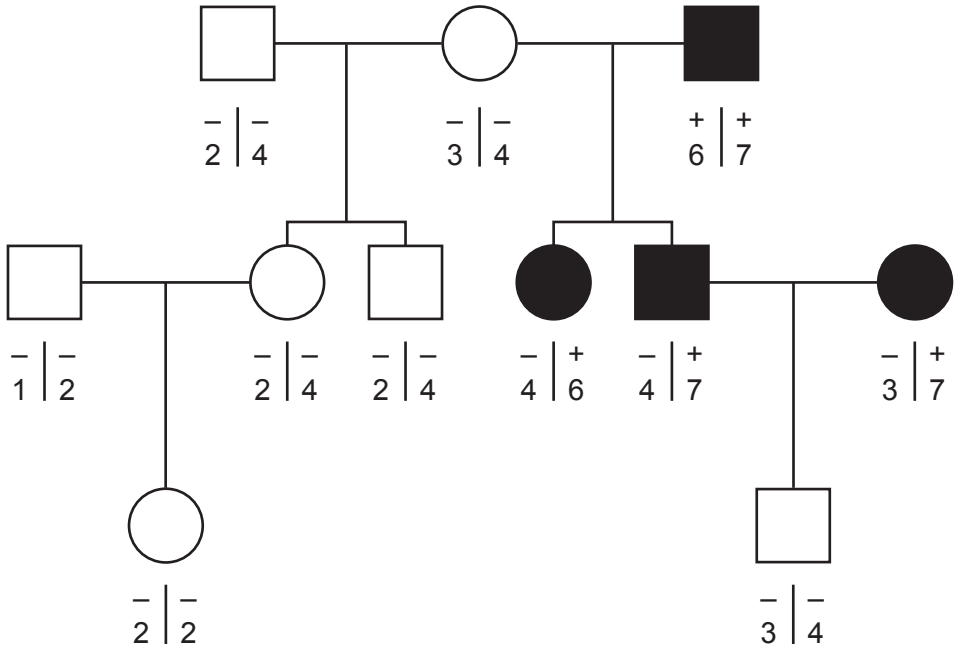
(b) Scientists isolated two sections of DNA thought to correspond with the allele for full colour (**R**) and the allele for pointed (**r**).

Sequencing these two DNA sections showed that the DNA sequence for full colour, **R**, had a restriction site for the restriction enzyme *Hpa*II. This restriction site did **not** occur in the DNA sequence **r** because of a single nucleotide substitution.

The scientists then carried out an analysis of three generations of cats. Each cat was assessed for three features:

- coat pattern, full colour or pointed
- the presence or absence of the *Hpa*II restriction site
- the pair of alleles present at a variable marker locus thought to lie close to the **R/r** locus. The marker locus (gene) has seven different alleles designated as 1, 2, 3, 4, 5, 6 and 7.

Fig. 5.2 shows the relationships of these cats and the results of the assessment.



Key

–	*Hpa*II restriction site absent
+	*Hpa*II restriction site present
1–7	are alleles at the marker locus

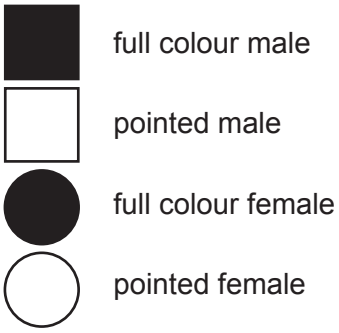


Fig. 5.2

© UCLES 2020

Identify evidence from Fig. 5.2 to support these statements:

(i) the pointed phenotype is due to a recessive allele

.....

.....

..... [1]

(ii) the **R/r** gene is located on an autosome

.....

.....

.....

.....

..... [2]

(iii) the marker locus and **R/r** are closely linked.

.....

.....

.....

.....

..... [2]

[Total: 10]

6 **(a)** **(i)** Identify the precise location in a cholinergic synapse that is described in each of the statements.

A region that contains many mitochondria.

.....

A region where exocytosis of ACh occurs.

.....

A region that contains voltage-gated channel proteins.

.....

A region that contains ligand-gated channel proteins.

.....
[4]

(ii) Outline the roles of synapses in the nervous system.

.....

.....

.....

..... [2]

(b) Some insecticides contain compounds called organophosphates. Organophosphates can act as enzyme inhibitors in neuromuscular junctions.

People who use organophosphates and do not follow safety guidelines are at risk of organophosphate poisoning, which affects muscle function.

Suggest how organophosphates could affect muscle function in humans.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(c) Outline the role of the sarcoplasmic reticulum in the contraction of striated muscle.

.....

.....

.....

.....

..... [2]

[Total: 12]

7 **(a)** Structures and compounds involved in respiration in anaerobic conditions include:

A – pyruvate

B – reduced NAD

C – ethanol

D – carbon dioxide

E – cytoplasm

F – NAD

G – ethanal

H – lactate

I – oxygen

J – mitochondrion

Complete Table 7.1 by matching each description with **one** letter chosen from **A** to **J** to show the correct structure or compound.

You may use each letter once, more than once or not at all.

Table 7.1

description	letter
end product of glycolysis	
cellular location of respiration in anaerobic conditions	
end product of respiration in anaerobic conditions in yeast cells	
compound used to reduce pyruvate	
end product of respiration in anaerobic conditions in muscle cells	
gas released during alcoholic fermentation	

[6]

(b) Respiration in anaerobic conditions in muscle cells during vigorous exercise can create an oxygen debt. Extra oxygen is breathed in after exercise to pay back the oxygen debt.

Explain **two** ways in which the mammalian body uses this **extra** oxygen.

.....

.....

.....

..... [2]

[Total: 8]

© UCLES 2020

8 Palm oil is a vegetable oil that is used very widely in food products. The oil is extracted from the fruit of the oil palm tree.

(a) Oil palm trees have a higher oil yield than that of other oil-producing plants.

Fig. 8.1 shows the oil yield of four crop plants.

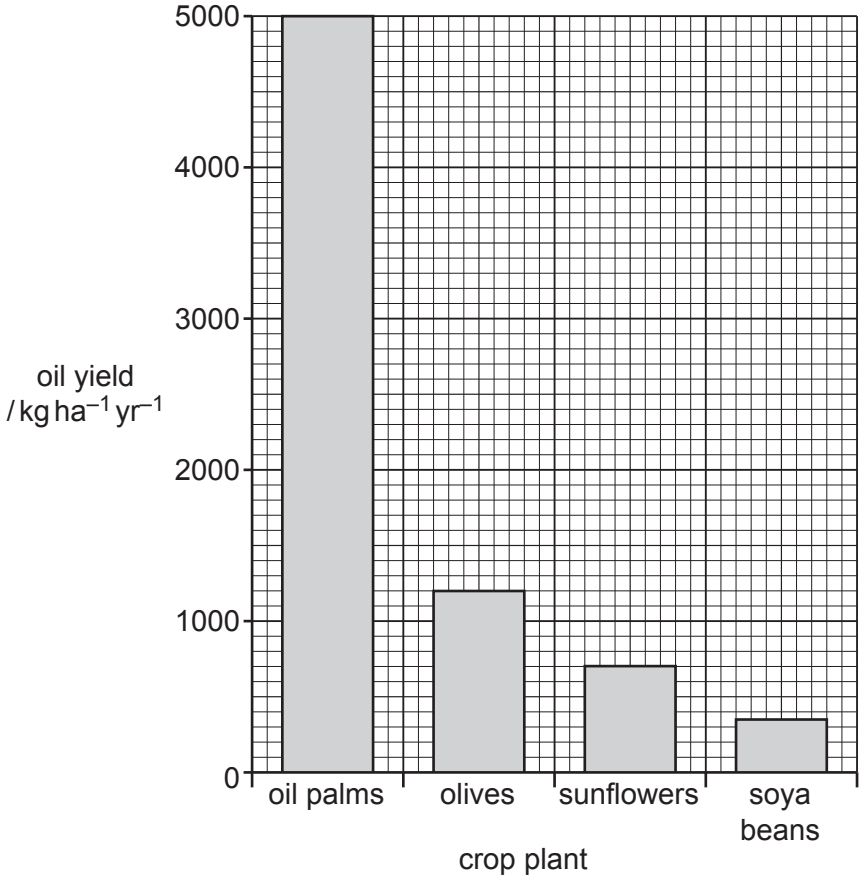


Fig. 8.1

Calculate how many hectares of soya bean plants would be needed to produce the **same** yield of oil as one hectare of oil palm trees.

Show your working and write your answer to **one** decimal place.

answer ..... hectares [2]

(b) Oil palm plantations in Malaysia and Indonesia have been created by cutting down rainforests. This reduces biodiversity.

Outline reasons why it is important to maintain biodiversity.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(c) Palm oil companies are now being asked to produce palm oil in a sustainable way. This means that no more deforestation should take place.

Suggest ways in which individual consumers can encourage manufacturers to use palm oil from sustainable sources.

.....

.....

.....

.....

.....

..... [2]

[Total: 9]

© UCLES 2020

Section B

Answer **one** question.

9 **(a)** Describe **and** explain the properties of plasmids that allow them to be used in gene cloning. [7]

(b) Explain the roles of restriction endonucleases, ligases and reverse transcriptase in genetic engineering. [8]

[Total: 15]

10 **(a)** Describe how adrenaline can stimulate liver cells to convert glycogen to glucose. [7]

(b) Describe the role of abscisic acid (ABA) in the closure of stomata during times of drought. [8]

[Total: 15]

© UCLES 2020

© UCLES 2020

[Turn over

© UCLES 2020

© UCLES 2020

[Turn over

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.