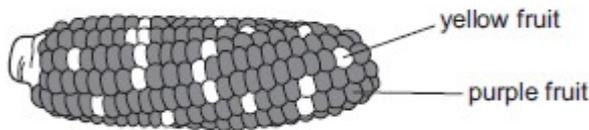PPQ Units 17 and 18 – Genetics and Natural Selection

1 The diagram shows a maize (corn) cob with purple and yellow fruits. Purple (P) is dominant to yellow (p).

What are the genotypes of the parent maize plants?
A PP × Pp
B PP × pp
C Pp × Pp
D pp × Pp

2 What is a mutation?
A a change in a gene or chromosome
B a condition caused by a recessive allele
C a process used in genetic engineering
D a type of discontinuous variation

3 In cats, the allele for short hair is dominant to the allele for long hair.
A short-haired cat and a long-haired cat had several families of offspring (kittens). All their kittens were short-haired.
One of these kittens matured and mated with a long-haired cat.
What would be the expected phenotypes of their offspring?
A 1 : 1 short to long
B 3 : 1 short to long
C all long-haired
D all short-haired

4 A man who was blood group A and a woman who was blood group B had four children, each with a different blood group A, B, AB and O.
Which type of variation does this demonstrate?
A continuous, environmental and genetic
B continuous and genetic only
C discontinuous, environmental and genetic
D discontinuous and genetic only

5 The colour of a mouse's fur is controlled by a single pair of alleles.
 A mouse with black fur was crossed with a mouse with white fur. All the offspring had black fur.
 What would be the most likely ratio in several litters of offspring if two of these black offspring were crossed?

	black fur	white fur
A	1	3
B	2	2
C	3	1
D	4	0

6 What is always found in female gametes and may be found in male gametes?
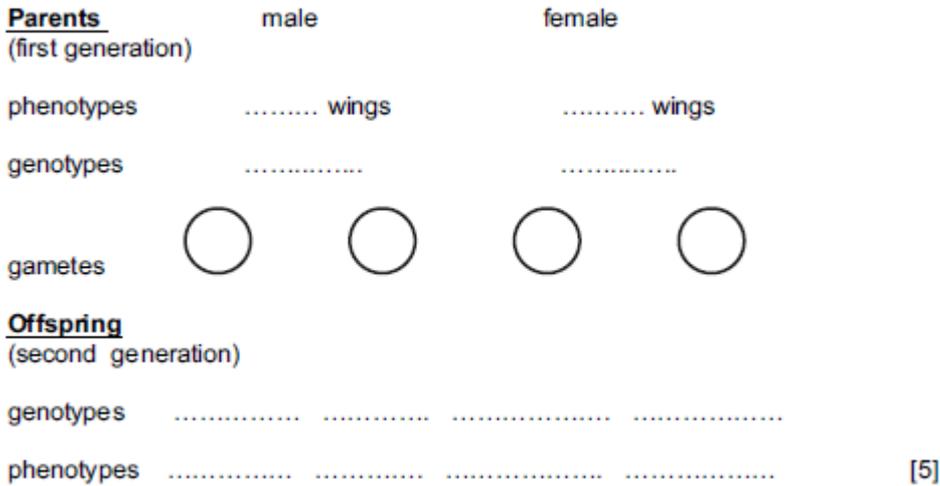A one X chromosome

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B one Y chromosome
C two X chromosomes
D one X chromosome and one Y chromosome

7 (a) In Drosophila, the fruit fly, wing length is controlled by a single gene.
Wing length can be long or short. A long winged male fruit fly was crossed with a short winged female. All of their offspring, the second generation, had long wings. When the second generation flies were interbred, to produce a third generation, some of the offspring had long wings and some had short wings.
(i) Which wing length is controlled by the recessive allele?[1]
(ii) Complete the genetic diagram, using the symbols R and r to represent the alleles.
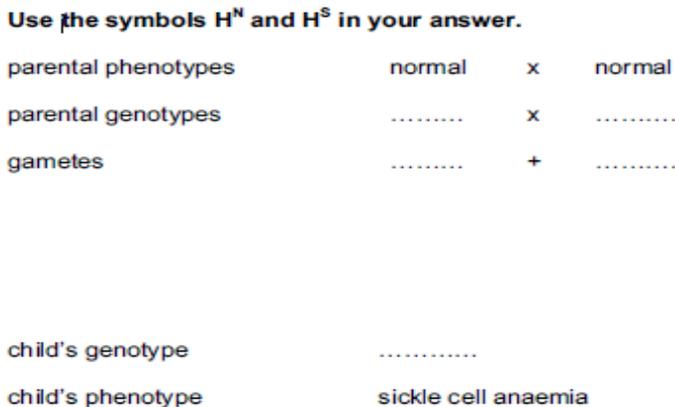
Parents   male   female
(first generation)

phenotypes   ……… wings   ………. wings

genotypes   ……………   ……..…..

gametes   ( )   ( )   ( )   ( )

Offspring
(second generation)

genotypes   …………… ………… ………………… ………………

phenotypes …………… ………… ………………… ………………   [5]

(iii) If the third generation consisted of 464 offspring how many would be expected to have short wings?
Show your working.[2]
(b) The female parent fruit fly was crossed with one of her male offspring from the second generation.
Draw a genetic diagram to show this cross and state the ratio of the offspring phenotypes. [4]
[Total: 12]

8 (a) Define the term gene.[1]
The medical condition sickle cell anaemia is widely distributed in Africa, parts of Asia and the Americas. People with sickle cell anaemia have red blood cells with an abnormal form of haemoglobin.
The gene for haemoglobin exists in two forms:
HN = allele for normal haemoglobin HS = allele for abnormal haemoglobin
(b) Complete the genetic diagram below to show how two people who are heterozygous for this gene may have a child who has sickle cell anaemia.

Use the symbols H^N and H^S in your answer.

parental phenotypes   normal   x   normal

parental genotypes   ………   x   ……….

gametes   ………   +   ……….

child's genotype   …………

child's phenotype   sickle cell anaemia

(c) Describe the effects of sickle cell anaemia on the body.[4]
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(d) Fig. 5.1 is a map that shows the distribution of the allele for the abnormal form of haemoglobin (HS) and malaria in Africa.
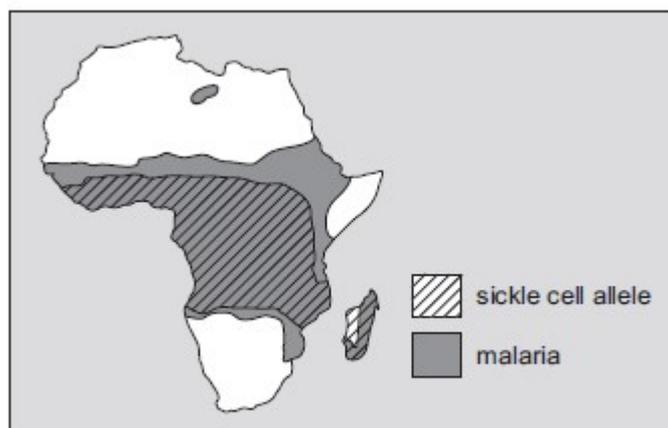

Fig. 5.1

Explain how natural selection is responsible for the distribution of the allele for the abnormal form of haemoglobin (HS). [5]

(e) Sickle cell anaemia is an example of the variation that exists in the human population.

It is a form of discontinuous variation.

Explain why sickle cell anaemia is a form of discontinuous variation.[3]

[Total: 16]

9 (b) A couple who have blood groups A and B have four children. Each child has a different blood group.

Use the space below to draw a genetic diagram to show how this is possible. Use the symbols, I^A , I^B and I^o, for the alleles.

parental blood groups   A   ×   B

parental genotypes   ....   ×   ....

gamete genotypes   ....

children's genotypes   ....

children's blood groups ....

[4]

(c) Explain what is meant by codominance. You may refer to the genetic diagram in (b) to help you with your answer. [3]
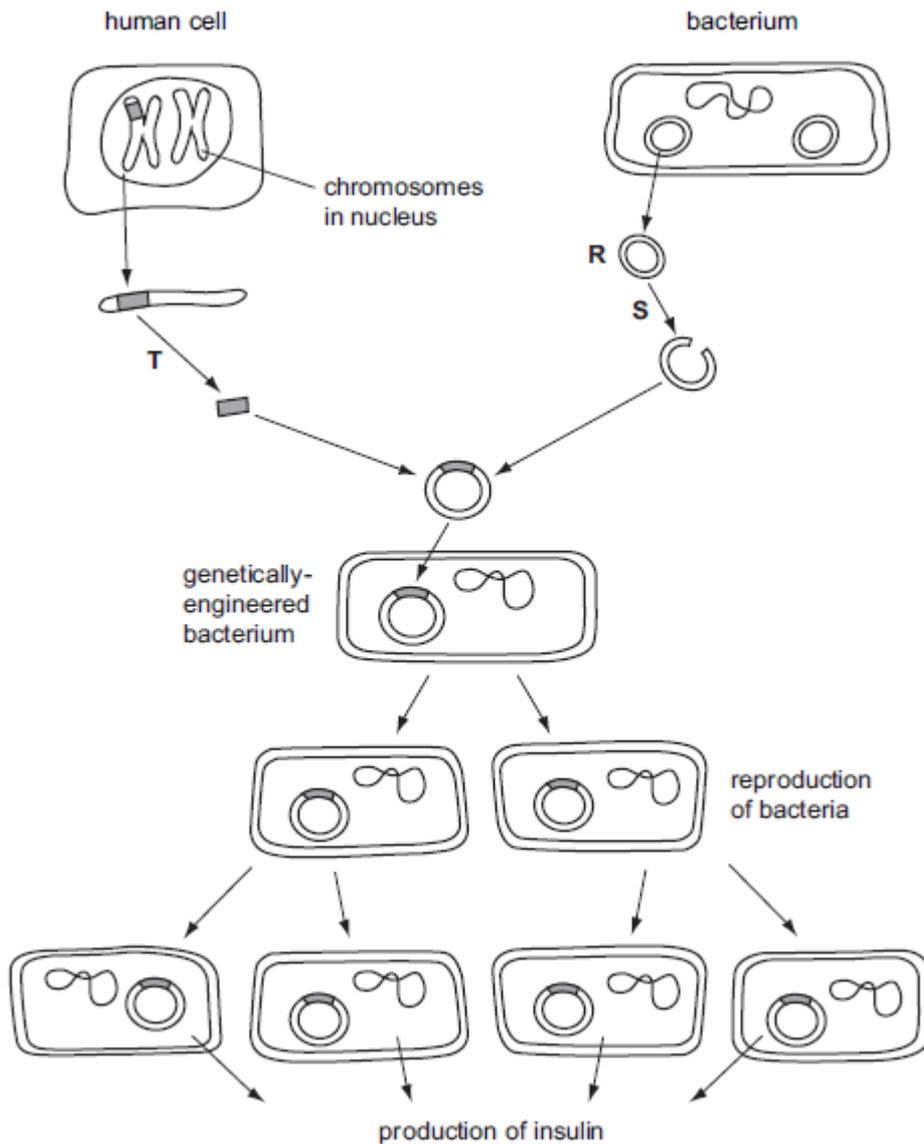

(d) Insulin produced by genetically engineered bacteria first became available in 1982.

Before 1982, insulin had been prepared from dead animal tissues.

Explain the advantages of using insulin produced by genetically engineered bacteria rather than insulin from dead animal tissues. [3]

(e) Fig. 5.1 shows some of the steps involved in the genetic engineering of bacteria.

human cell

bacterium

chromosomes in nucleus

R

S

T

genetically-engineered bacterium

reproduction of bacteria

production of insulin

(i) Name structure R and state what it is made from.[2]

(ii) State what is added at stages S and T.[1]

[Total: 17]

10 Reed warblers are small birds that migrate over long distances between western Africa and northern Europe.
Fig. 5.1 shows a reed warbler, Acrocephalus scirpaceus.

Fig. 5.1

(a) State three characteristic features of birds that are visible in Fig. 5.1.

PPQ Units 17 and 18 – Genetics and Natural Selection

1
2
3 [3]

A study was carried out in Sweden into the effects of natural selection on wing length in reed warblers.

The wings of young reed warblers reach their maximum length a few days after leaving the nest.

At this age the wing length in millimetres of each bird was recorded. Each bird was identified by putting a small ring around one of its legs.

When the birds were caught in net traps as adults, the information on the rings was used to identify specific birds and their ages.

The length of time between ringing and trapping was recorded for each bird that was identified before it was released.

The mean age at trapping was calculated for birds with each wing length.

The results are shown in Table 5.1.

Table 5.1

wing length at ringing / mm	number of birds trapped	mean age at trapping / days
63 or less	24	253
64	72	256
65	130	297
66	183	346
67	167	349
68	106	270
69	66	237
70 or more	23	199
	total = 771	

(b) (i) Explain why wing length is an example of continuous variation. [2]

  (ii) Suggest a feature of reed warblers, other than wing length, that shows continuous variation.   [1]

  (c) The researchers concluded that reed warblers with a wing length of 66-67mm had the best chance of survival.

   (i) Describe the evidence from Table 5.1 that supports this conclusion.   [4]

   (ii) The researchers also suggested that more evidence was needed to make this conclusion.

   Suggest what other evidence would show that birds with wings 66-67mm in length have the best chance of survival. [3]

  (d) Scientists have discovered that genes are responsible for wing length in reed warblers.

The most common length of wing has been 66-67 mm for many generations of these birds.

   Explain how natural selection may be responsible for maintaining the mean wing length of reed warblers at 66-67mm.   [4]

   [Total: 17]

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