HL Paper 1

Which of the following conclusions did Mendel make from his experiments?

A. Dominant genes are more frequent than recessive genes.
B. Genes are composed of DNA.
C. Traits are inherited in discrete units, one from each parent.
D. Segregation occurs through meiosis.

Markscheme

C

Examiners report

This question was deemed to be unfair, as it tested information required by the previous syllabus and was therefore discounted.

What causes variation in **both** sexually and asexually reproducing organisms?

A. Mutations
B. Polygenic inheritance
C. Crossing over
D. Independent assortment

Markscheme

A

Examiners report

Question 34 was based on assessment statements 2.5.6 and 5.4.6. More candidates than expected chose crossing over and independent assortment as the cause of variation in both sexual and asexual reproduction. Mutation was the expected answer.

What can lead to reproductive isolation after just one generation?

A. Polyploidy

B. Increased mutation rate

C. Changed allele frequencies

D. Independent assortment of chromosomes

Markscheme

A

Examiners report

[N/A]

In humans, wavy hair is dominant to straight hair and free ear lobes are dominant to fixed ear lobes. A man and a woman are heterozygous for both characteristics. What is the probability that their first child will have straight hair and fixed ear lobes?

A. 0
B. 1/16
C. 3/16
D. 9/16

Markscheme

B

Examiners report

N/A

Which of the following processes result in the production of recombinants?

I. Crossing over between linked genes
II. Reassortment of non-linked genes
III. Mutation

A. I only
B. I and II only
C. I and III only
D. I, II and III

Markscheme

B

Examiners report

Many candidates confused the production of recombinants with the source of variety. This question did not discriminate well.

At which stage of meiosis does a pair of sister chromatids separate?

A. Metaphase I

B. Anaphase I

C. Metaphase II

D. Anaphase II

Markscheme

D

Examiners report

[N/A]

In a plant, dark leaves are dominant to pale leaves and yellow seeds are dominant to white seeds.

A heterozygous dark-leaved plant with yellow seeds was crossed with a pale-leaved plant with white seeds. A large number of offspring were produced. They were either dark-leaved with yellow seeds or pale-leaved with white seeds in equal number.

What is the **most** likely cause of this pattern?

A. Crossing over has occurred.

B. The two genes are linked.

C. The traits are polygenic.

D. The genes are codominant.

Markscheme

B

Examiners report

[N/A]

A test cross of **linked** genes was performed with fruit flies (*Drosophila melanogaster*).

Wild type body (B) is dominant to black body (b)
Normal wings (W) is dominant to vestigial wings (w)

BbWw crossed with bbww

The resulting offspring were
952 wild type body, normal wings
948 black body, vestigial wings
200 wild type body, vestigial wings
198 black body, normal wings

What is the most likely explanation for these results not fitting the expected ratio?

A. Crossing-over
B. Non-disjunction
C. Gene mutation
D. Random variation

Markscheme

A

Examiners report

N/A

When do chiasmata form in meiosis?

A. During prophase I
B. During metaphase I
C. During anaphase I
D. During prophase II

Markscheme

A

Examiners report

N/A

Skin colour is a trait controlled by polygenic inheritance. Which statement is correct?

A. Skin colour shows discontinuous variation

B. Individuals show a wide range of phenotypes for skin colour

C. No two people have the same skin colour

D. Children always have the same skin colour as one of their parents

Markscheme

B

Examiners report

[N/A]

Fossil records show that black bears increased in size during the Ice Age and decreased in size with warmer temperatures. What type of selection do these changes in size represent?

A. Allopatric
B. Directional
C. Disruptive
D. Stabilizing

Markscheme

B

Examiners report

[N/A]

Why do humans inherit continuous variation with regard to height?

A. The trait for tallness is dominant.
B. The height phenotype is polygenic.
C. This is a case of multiple alleles.
D. Height in humans is polyclonal with multiple alleles.

Markscheme

B

Examiners report

N/A

Which is a statement of Mendel's law of independent assortment?

A. Allele pairs separate during gamete formation and recombine during fertilization.
B. Allele pairs for different genes separate independently during gamete formation.
C. Unlinked alleles are assorted with a 9 : 3 : 3 : 1 ratio in a dihybrid cross.
D. Allele pairs for the same gene are assorted independently during gamete formation.

Markscheme

B

Examiners report

Many candidates were tricked to answer that alleles from the same gene are assorted independently. While the alleles migrate to each pole, it is the collection of different genes that are assorted independently.

Some of the ratios that Morgan investigated in genetic crosses did not correspond with expected Mendelian ratios. What was the cause?

A. The genetic crosses used insects rather than plants.
B. The results were counted more reliably than Mendel's.
C. The genes in the genetic crosses were linked.
D. *Drosophila* has more genes than plants.

Markscheme

C

Examiners report

[N/A]

How does meiosis cause Mendel's law of independent assortment?

A. Linked genes are randomly separated.
B. The chromosome number is divided twice.
C. Crossing-over occurs in Anaphase I.
D. Alleles that are not in the same linkage group are segregated.

Markscheme

D

Examiners report

N/A

In which situation are alleles exchanged?

A. During the separation of sister chromatids
B. In the transmission of linked genes
C. During fertilization when sperm and egg chromosomes pair up
D. When chiasmata are formed between non-sister chromatids

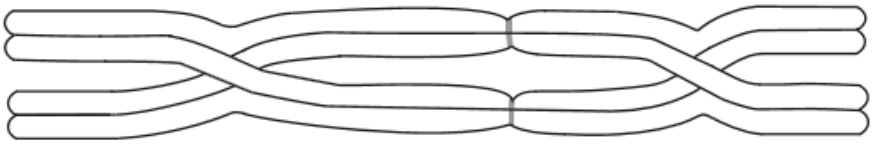
Markscheme

D

Examiners report

These were all very good discriminators.

The diagram below shows chromosomes during meiosis.



How many chromosomes and chiasmata are visible?

	Chromosomes	Chiasmata
A.	4	4
B.	2	4
C.	2	2
D.	4	2

Markscheme

C

Examiners report

There were some G2 comments on the chromosome diagram in this question. While it is not conventional, it is correct.

A test cross resulted in these recombinants:

$$\frac{tB}{tb} \qquad \frac{Tb}{tb}$$

Which of the following was the parental test cross?

A. $\frac{TB}{tb} \times \frac{tb}{tb}$

B. $\frac{TB}{tB} \times \frac{tb}{Tb}$

C. $\frac{Tb}{tB} \times \frac{tb}{tb}$

D. $\frac{TB}{tb} \times \frac{TB}{tb}$

Markscheme

A

Examiners report

Candidates are still finding it hard to identify recombinants.

Human skin colour shows continuous variation. What does this indicate about the pattern of inheritance of human skin colour?

A. It is dominant.
B. It is sex-linked.
C. It is recessive.
D. It is polygenic.

Markscheme

D

Examiners report

N/A

Which are the possible recombinants in a dihybrid test cross involving the linked genes JQ/jq?

A. JQ/jq and JJ/Qq

B. Jq/Qq and Qq/JJ

C. Jq/jq and jQ/jq

D. JQ/jq and Jq/jQ

Markscheme

C

Examiners report

This also contained an error as the linked genes had not been shown using the notation that is specified in AS 10.2.5 and AS 10.2.6. Nevertheless, it was possible for candidates to do some working and convert the information into that form. The question then had one clearly correct answer. Perhaps because of the unfamiliar notation, this proved to be the second most difficult on the exam, but it discriminated relatively well.

Maize (*Zea mays*) contains 20 chromosomes in a diploid cell. How many chromosomes will be in each cell after the first and second division of meiosis?

	After first meiotic division	After second meiotic division
A.	10	10
B.	20	10
C.	40	20
D.	10	5

Markscheme

A

Examiners report

Question 33 was the one that candidates found hardest on the whole paper, with fewer than 25% answering it correctly; below the expected level if candidates had all guessed the answer! The most popular choice was B, which was incorrect because it implies that the chromosome number is halved in the second division of meiosis not the first. The stage of meiosis in which the chromosome number is halved is not specified in any of the assessment statements, probably because it was thought to be obvious. The first division of meiosis is the reduction division. In humans for example, it results in the formation of two nuclei, each with 23 chromosomes consisting of two chromatids. The second division of meiosis results in four nuclei, each with 23 chromosomes consisting of a single chromatid.

In fruit flies (*Drosophila melanogaster*) grey body is dominant to black body and normal wings are dominant to vestigial wings.

If a heterozygous grey fruit fly is mated with a black-bodied fruit fly, what proportion of the offspring would be black?

A. 0 %

B. 25 %

C. 50 %

D. 100 %

Markscheme

C

Examiners report

N/A

In fruit flies (*Drosophila melanogaster*) grey body is dominant to black body and long wings are dominant to vestigial wings. Two flies heterozygous for both genes were crossed. What proportion of the offspring would be expected to have black bodies and long wings?

A. 1/2
B. 3/16
C. 1/4
D. 1/16

Markscheme

B

Examiners report

N/A

In a fruit fly experiment, grey body, normal winged (homozygous dominant) fruit flies were mated with black body, short winged (homozygous recessive) fruit flies. The F_1 dihybrid females were then used in a test cross. If the genes are always linked and no crossing over occurs, what would be the predicted ratio in the F_2 generation?

A. 9 : 3 : 3 : 1

B. 1 : 1 : 1 : 1

C. 3 : 1

D. 1 : 1

Markscheme

D

Examiners report

This question proved to be too difficult for many candidates and was a poor discriminator. Many candidates just guessed the answer.

How do the concepts of gradualism and punctuated equilibrium differ?

A. The timing of evolution

B. The mechanism causing evolution

C. The sequence of evolutionary events

D. The reality of evolution

Markscheme

A

Examiners report

[N/A]

In a variety of tulips, V is the allele for variegated colour and C is the allele for compound flower. Which cross will give a 1:1:1:1 ratio of phenotypes in the offspring?

A. VvCc × VvCc

B. VVcc × vvCC

C. VvCc × vvCc

D. Vvcc × vvCc

Markscheme

D

Examiners report

Fewer than half gave the correct answer of D.

When does an unequal division of cytoplasm occur?

A. During meiosis in the apical meristem
B. During the division of Sertoli cells into spermatozoa
C. During binary fission of eukaryotic cells
D. During meiosis in the human ovary

Markscheme

D

Examiners report

N/A

The genetic determination of dogs' coats can be quite complex, with many different genes acting at the same time.

• The dominant allele **E** gives brown tones. The recessive allele **e** results in red tones.
• The colour intensity is due to another gene. The dominant allele **B** gives a dark colour, whereas the recessive allele **b** results in a light colour.

What would be the genotype of a light brown dog produced from a cross between a dark brown dog and a light red dog?

A. EEbb

B. EeBb

C. eeBb

D. Eebb

Markscheme

D

Examiners report

[N/A]

How many autosomes are there in a human sperm?

A. 1

B. 22

C. 23

D. 46

Markscheme

B

Examiners report

[N/A]

What is polygenic inheritance?

A. A character that is controlled by two or more genes

B. A character that is controlled by more than two copies of a gene

C. Inheriting more than two alleles of a gene

D. Inheriting a linked group of genes

Markscheme

A

Examiners report

[N/A]

What is a suspected heterozygous individual crossed with in a test cross?

A. Homozygous dominant
B. Homozygous recessive
C. Heterozygous dominant
D. Heterozygous recessive

Markscheme

B

Examiners report

N/A

This is the cross that led to the discovery of non-Mendelian ratios in Morgan's experiments with *Drosophila*.

Grey body – Normal wings $\frac{b^+ \quad vg^+}{b \quad vg}$ × Black body – Vestigial wings $\frac{b \quad vg}{b \quad vg}$

Which is a recombinant genotype?

A. $\frac{b^+ \quad vg^+}{b \quad vg}$

B. $\frac{b \quad vg}{b \quad vg^+}$

C. $\frac{b^+ \quad vg^+}{b^+ \quad vg^+}$

D. $\frac{b \quad vg}{b \quad vg}$

Markscheme

B

Examiners report

This question was a very good discriminator. Many candidates were able to recognize the recombinants.

In fruit flies (*Drosophila melanogaster*) grey body is dominant to black body and normal wings are dominant to vestigial wings.

Male flies, heterozygous for both grey body and normal wings, were mated with black-bodied, vestigial-winged females. 2000 offspring were counted. The resulting percentage of each type of offspring is shown in the table below.

Resulting offspring	Frequency
Grey body, normal wings	40 %
Black body, vestigial wings	40 %
Grey body, vestigial wings	10 %
Black body, normal wings	10 %

What conclusion can be drawn from the information given above?

A. The genes assort independently.
B. A mistake has been made.
C. The genes are linked.
D. The genes are on separate chromosomes.

Markscheme

C

Examiners report

N/A

What causes genetic variety in the formation of gametes during meiosis?

A. Crossing over in prophase I and random orientation of homologous chromosomes in metaphase I
B. Crossing over in metaphase I and random orientation of homologous chromosomes in metaphase II
C. Linkage of genes in prophase I and crossing over in metaphase I
D. Linkage of genes in metaphase I and random orientation of homologous chromosomes in metaphase II

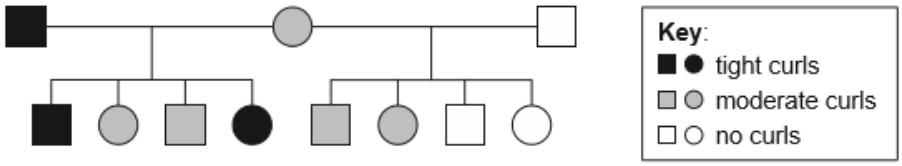
Markscheme

A

Examiners report

N/A

The curly hair of the coat of Selkirk Rex cats is due to the presence of the allele SC. These cats can either have tight curls or be moderately curly, whereas the coat of other cats is usually made of straight hair with no curls because of the allele SS. Circles indicate female cats and squares indicate males.



What are the phenotypes of cats with these genotypes?

	$S^S S^S$	$S^S S^C$
A.	no curls	moderate curls
B.	tight curls	no curls
C.	tight curls	moderate curls
D.	no curls	tight curls

Markscheme

A

Examiners report

Although this question looked difficult, it was the easiest question on the paper.

The statement is about the genetic control of cat coat colour.

> Many genes control cat coat colour. Tabby cats have a coat with stripes. Two of their genes are the tabby gene Mm and the agouti gene Aa.
> - The dominant allele **M** codes for straight stripes, whereas the recessive allele **m** codes for blotches and whorls instead of stripes.
> - The dominant allele **A** produces two-toned hair, to reveal coat patterns, whereas the recessive allele **a** causes all coat hair to be black and so hides any pattern.

In a cross between two double heterozygous tabby cats, what would the expected proportion of black offspring be?

A. 1 out of 16
B. 3 out of 16
C. 4 out of 16
D. 9 out of 16

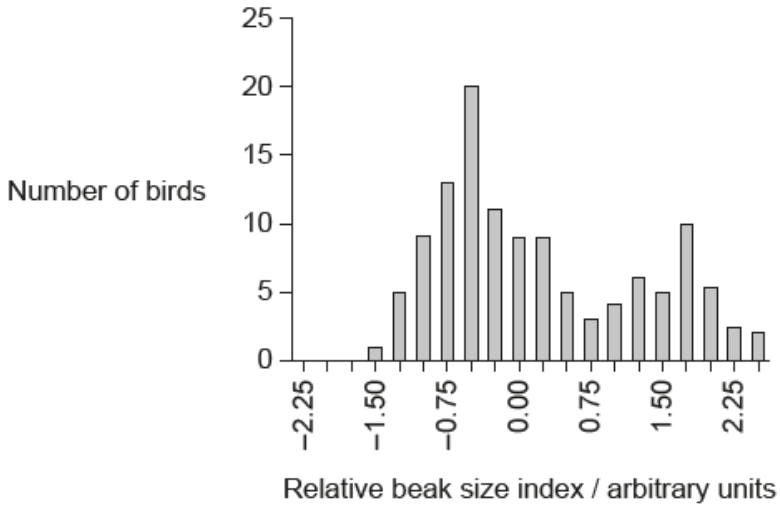
Markscheme

C

Examiners report

N/A

The graph shows variations in beak size for the bird *Geospiza fortis* on an island in the Galápagos archipelago.



[Source: adapted from A P Hendry et al. (2006) *Proceedings of the Royal Society B*, 273, page 1890, by permission of the Royal Society.]

What evidence from the graph indicates that disruptive selection is occurring?

A. An intermediate beak size is less common.

B. Median beak size is the most common.

C. Smaller beaks are favoured.

D. Larger beaks are favoured.

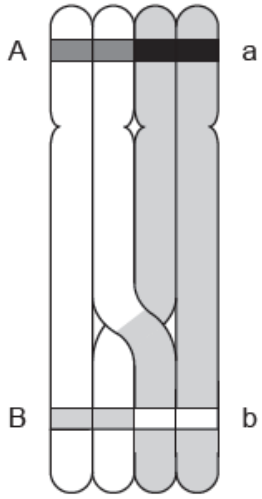
Markscheme

A

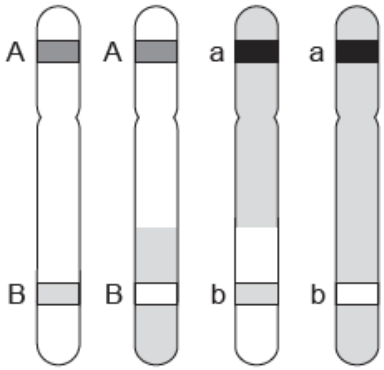
Examiners report

[N/A]

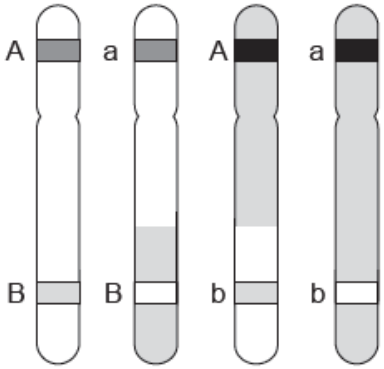
Which gametes can result from the following crossover?



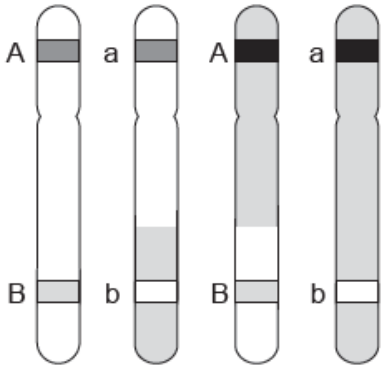
A.



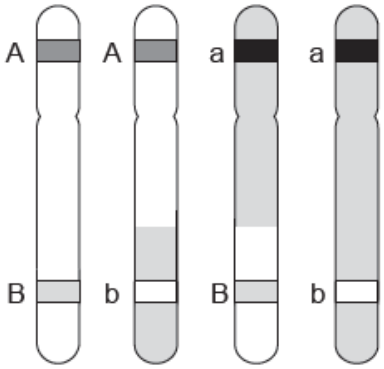
B.



C.



D.



[Source: www.ib.bioninja.com.au]

Markscheme

D

Examiners report

[N/A]