10.2 Inheritance

Mark Schemes

Course	DP IB Biology
Section	10. Genetics & Evolution (HL Only)
Topic	10.2 Inheritance
Difficulty	Medium

To be used by all students preparing for DP IB Biology HL
Students of other boards may also find this useful

1

The correct answer is **B**.

- Gene linkage is literally that; one gene is physically linked to the other by being part of the same DNA molecule. Linked genes can code for vastly different traits, but can't be at the same loci as each other, which explains why **A** is incorrect
- **C** refers to alleles which are versions of the same gene, so there is only one gene under consideration in **C**
- **D** is partly true for genes that are sex-linked but this question refers to all types of linkage (sex and autosomal)

2

The correct answer is **C**.

- **A** and **B** are strong features because they enable large numbers of offspring to be produced in a short experimental time period, leading to reliable crossing data
- **D** is important too so that biologists can identify/sort/count phenotypic variants easily in the various generations
- Whilst **C** is true, which makes them easy to rear in the laboratory, even if they were more selective eaters, this could be accommodated in the lab by providing their specific food needs

3

The correct answer is **C**.

Because the two pairs of alleles are unlinked, they will assort independently and follow the classic 9:3:3:1 ratio of phenotypes in the offspring, as predicted by Mendel. The proportion of flies with a combination of one dominant phenotype (red eyes) and one recessive phenotype (black body) is $^{3}/_{16}$, which works out to 30 flies.

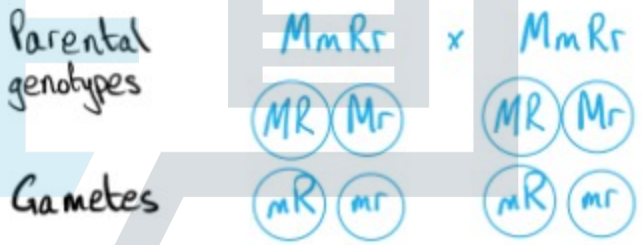
Fruit flies (*Drosophila melanogaster*) exhibit characteristics governed by the following pairs of alleles.

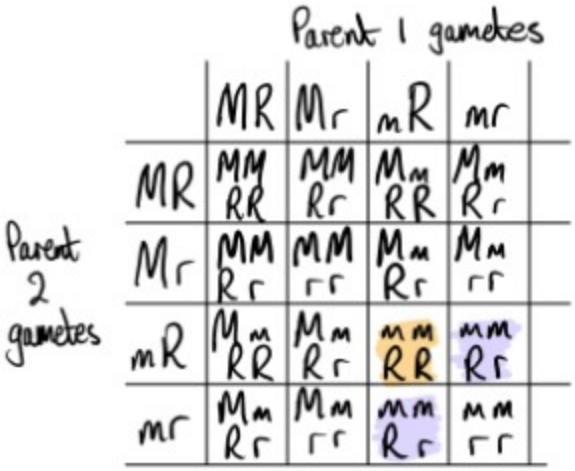
M = brown body, m = black body

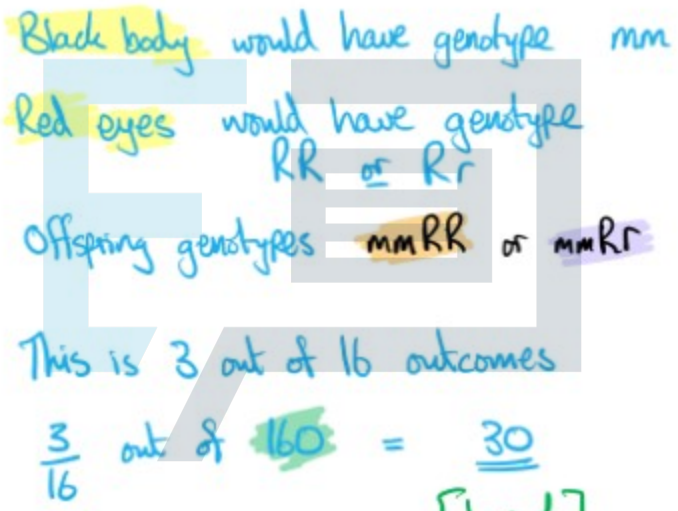
R = red eyes, r = white eyes

These pairs of alleles can be assumed to be unlinked.

If two double-heterozygous flies are crossed and produce 160 offspring, what is the likely number of offspring with red eyes and a black body?







4

The correct answer is **D**.

- **Statement A** is incorrect because sex linkage was later discovered by Thomas Hunt Morgan whilst investigating Bateson and Punnett's findings
- **Statement B** is incorrect because such alleles would appear by mutation so could hardly be called a discovery
- **Statement C** was part of Mendel's work although he never saw chromosomes; others discovered the link between chromosomes and heritability. Bateson and Punnett first observed non-Mendelian phenotype ratios but were not able to explain them

5

The correct answer is **C**.

Synapsis is the fusion of homologous chromosomes, without referencing their orientation relative to each other. **Cytokinesis** is the physical separation of one cell from its mother cell by forming a new cell membrane. **Assortment** occurs first, then the chromosomes separate (**segregate**) during anaphase I.

6

The correct answer is **D**.

- Both **B** and **C** are incorrect because they show two copies of the same gene on the same chromosome - a genetic impossibility
- Only **A** and **D** show a copy of each gene on each chromosome, which is the definition of linkage, and **A** is incorrect because the gene loci are wrong; G needs to be at the same locus as g, and H with h

7

The correct answer is **B**.

This value of χ^2 is lower than the critical value, so there is a high probability that the differences between the experimental and expected ratios are due to chance, which eliminates **C** and **D**. Because the low chi-squared suggests that there is not much difference between the experimental ratios and the expected ratios, then classical Mendelian (9:3:3:1) inheritance patterns are likely to have occurred. This indicates that the genes are **not linked** ie. on separate chromosomes and therefore assorted independently of each other, which eliminate **A**.

8

The correct answer is **D**. Continuously variable traits are usually **polygenic** and follow a **normal distribution** (bell-shaped curve).

Statement II is incorrect because that is a classic feature of discontinuous variation.

Statement IV is incorrect because continuously variable traits can be influenced by environmental factors eg. protein content of the diet on human height.

9

The correct answer is **A**. Because the genes are linked, they tend to be inherited together for the most part. However, on occasions, crossing over can result in gametes that carry non-parental combinations of the alleles, leading to non-parental genotypes and phenotypes in the offspring.

- Statement **B** is incorrect because we can assume that rigorous laboratory practice was followed in the original research and also in the many studies that have since corroborated their findings
- Statement **C** is incorrect because Morgan did not disprove independent assortment of chromosomes; only that it doesn't always happen on a gene-by-gene basis, as in the case for linked genes
- Statement **D** is incorrect on two counts; sweet peas (like many flowering plants) are not gendered, they are hermaphrodites ie. carry both male and female sex organs, pollinated by insects. Because the question specifically mentions **autosomal** linkage, the concept of sex linkage is not applicable in this question

10

The correct answer is **A**.

The key to this question is the recognition that the two alleles are **codominant** ie. both have an effect on the phenotype. This is evident in the family-tree diagram, where parental phenotypes appear in the offspring of both crosses. If both alleles are present, their effects 'merge' and create a moderately long-haired phenotype. Once codominance is apparent, you can conclude that H^LH^L homozygous is long hair and H^LH^S heterozygous is moderately-long-haired.