



Inheritance: practice questions

8 questions • 26 marks • mark scheme at the back

For IB Diploma Biology, Standard Level and Higher Level (first assessment 2025). **HL only** is additional higher level content, for HL students only.

Name

Total / 26

1 PAPER 1A STYLE

[1 mark]

Pink-flowered four o'clock plants (*Mirabilis jalapa*) are self-pollinated. Which ratio of offspring phenotypes is expected?

- A. ☐ 3 red : 1 white
- B. ☐ 1 red : 2 pink : 1 white
- C. ☐ All pink
- D. ☐ 9 red : 3 pink : 3 white : 1 other

2 PAPER 1A STYLE

[1 mark]

A woman who is a carrier of haemophilia has children with a man who does not have haemophilia. What is the probability that their first child is a son with haemophilia?

- A. ☐ 0
- B. ☐ 0.25
- C. ☐ 0.5
- D. ☐ 1.0

[3 marks]

The table describes part of a family pedigree for a rare genetic condition. Deduce, with reasons, whether the allele causing the condition is dominant or recessive, and whether it is autosomal or sex-linked.

Individuals in the pedigree			
Individual	Sex	Affected?	Parents
I-1	Male	No	Not shown
I-2	Female	No	Not shown
II-1	Female	Yes	I-1 and I-2
II-2	Male	No	I-1 and I-2
II-3	Male	Yes	I-1 and I-2

[illegible]

[5 marks]

Students measured the heights of two groups of 16-year-olds. The table summarises the results (data for practice). (a) Calculate the interquartile range for group X. [1] (b) Determine whether a student of 188 cm in group X would be an outlier. Show your working. [2] (c) Compare the two groups. [1] (d) Suggest why height shows continuous variation. [1]

Height (cm)					
Group	Minimum	Q1	Median	Q3	Maximum
X	151	162	168	172	188
Y	149	155	160	166	176

Answer =

[illegible]

HL only

In a plant, purple flowers (P) are dominant to white (p) and tall stems (T) are dominant to short (t). Two PpTt plants were crossed. The table shows the offspring. The critical value of χ^2 at $p = 0.05$ with 3 degrees of freedom is 7.815. (a) State a null hypothesis for this cross. [1] (b) Calculate the expected number of purple tall offspring. [1] (c) The χ^2 value for these data is 14.0. Evaluate what this shows about the two genes. [3]

F2 offspring	
Phenotype	Observed number
Purple tall	194
Purple short	48
White tall	46
White short	32

Answer =

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HL only

In maize, coloured seed (C) is dominant to colourless (c) and full seed (F) is dominant to shrunken (f). A plant with genotype CF/cf was crossed with a cf/cf plant. (a) Using vertical lines for chromosomes, show the genotype of the CF/cf parent. [1] (b) Explain why the four offspring phenotypes were not in a 1:1:1:1 ratio. [2] (c) Identify the recombinant phenotypes. [1]

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Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

B B [1]

2. [1]

B B [1]

3. [3]

- recessive because II-1 / II-3 is affected but neither parent (I-1, I-2) is [1]
- so both parents must be carriers / heterozygous [1]
- autosomal because a daughter (II-1) is affected while her father (I-1) is not [1]
- if X-linked recessive, an affected daughter's father would have to be affected [1]
- [max 3]

4. [5]

- (a) $172 - 162 = 10$ cm [1]
- (b) $1.5 \times 10 = 15$; $172 + 15 = 187$ cm (ECF) [1]
- (b) $188 > 187$ so it is an outlier [1]
- (c) group X has a higher median (168 vs 160 cm) OR group Y has a larger IQR / spread (11 vs 10 cm) [1]
- (d) polygenic / controlled by many genes [1]
- (d) and environmental factors such as nutrition [1]
- [max 5]

5. [6]

- PKU is caused by a recessive allele [1]
- of an autosomal gene / gene not on a sex chromosome [1]
- gene codes for the enzyme that converts phenylalanine to tyrosine [1]
- affected individuals are homozygous recessive / pp [1]
- two carrier / heterozygous parents have a 0.25 / 1 in 4 chance of an affected child [1]
- shown with a Punnett grid: Pp $\times$ Pp gives PP, Pp, Pp, pp [1]
- heterozygote has one dominant allele coding for functional enzyme [1]
- one allele produces enough enzyme to convert phenylalanine [1]
- so heterozygote has the same phenotype as homozygous dominant / is a carrier [1]
- phenylalanine builds up in affected individuals damaging the brain unless a low-phenylalanine diet is followed [1]
- [max 6]

6. [1] **HL only**

B B [1]

7. [5] HL only

- (a) no significant difference between observed and expected (9:3:3:1) results / genes assort independently / genes unlinked [1]
- (b) $9/16 \times 320 = 180$ [1]
- (c) $14.0 > 7.815$ [1]
- (c) difference is statistically significant / unlikely to be due to chance ($p < 0.05$) [1]
- (c) reject the null hypothesis [1]
- (c) genes are probably linked / on the same chromosome [1]
- (c) parental types (purple tall, white short) more frequent than expected [1]
- [max 5]

8. [4] HL only

- (a) C and F on one vertical line, c and f on the other (alleles shown alongside the lines) [1]
- (b) genes are linked / loci close together on the same chromosome [1]
- (b) alleles on one chromosome tend to be inherited together / do not assort independently [1]
- (b) only crossing over between the loci separates them, which is infrequent [1]
- (c) coloured shrunken and colourless full [1]
- [max 4]