InkBiology

ANSWER BOOK

Monohybrid inheritance: genetic diagrams that score

Inheritance and population genetics · Unit B16

AQA 3.7.1 · OCR A 6.1.2 · Edexcel A Topic 2.10–2.13 · CAIE 16.2

6 questions · 23 marks

NAVY EDITION

inkphysics.co.uk/biology/ · youtube.com/@InkPhysics

SECTION A · Short, 1 to 2 marks

A1 **B1** an allele is one of the alternative versions of a gene, found at the same locus on a chromosome. **B1** a carrier is an individual heterozygous for a recessive allele, so they do not show the condition but can pass the allele on. [2]

SECTION B · Standard, 3 to 5 marks

B1 **B1** the symbols are defined, for example R for the allele for red fruit and r for the allele for yellow fruit, using one letter for both alleles. **B1** parental genotypes given as Rr for the red-fruited plant and rr for the yellow-fruited plant. **B1** gametes shown as circled single alleles rather than pairs: R and r from the red-fruited parent, r and r from the yellow-fruited parent. **B1** offspring genotypes obtained from the gametes as Rr and rr, in equal numbers. **A1** offspring phenotypes and ratio given as 1 red-fruited : 1 yellow-fruited. [5]

B2 **B1** cross the tall plant with a homozygous recessive dwarf plant, which can only contribute a recessive allele to every offspring. **B1** if any offspring is dwarf, the tall parent must have supplied a recessive allele, so it is heterozygous. **B1** if a large number of offspring are all tall, the tall parent is very probably homozygous, because a heterozygote would be expected to give a 1 : 1 ratio. **A1** each fertilisation is independent, so a heterozygote can give a run of dominant offspring by chance: eight in a row happens about once in every 256 attempts. [4]

B3 **M1** both parents are heterozygous, so the cross is Ff × Ff and the offspring genotypes are 1 FF : 2 Ff : 1 ff. **A1** one of the four equally likely outcomes is homozygous recessive, so the probability is 1 in 4, or 0.25. **M1** the two fertilisations are independent events, so multiply the separate probabilities: 0.25 × 0.25. **A1** 1 in 16, or 0.0625. [4]

B4 **B1** a male is XY, and the Y chromosome is much smaller and carries no equivalent of the gene. **B1** a male therefore carries only one allele of the gene and expresses it whichever it is, because there is no second copy to mask it, so one recessive allele is enough. **B1** a female is XX and needs two copies of the recessive allele to show the condition; with one she is an unaffected carrier, and inheriting two is much less likely. **A1** a father passes his X to every daughter and his Y to every son, so his sons receive no allele of the gene from him at all and every daughter is at least a carrier. [4]

B5 **B1** the woman's genotype is I^AI^B, so every egg carries either I^A or I^B and never both. **B1** the man's genotype is I^OI^O, so every sperm carries I^O. **B1** every child is therefore I^AI^O or I^BI^O, giving blood group A or blood group B, because I^A and I^B are each dominant to I^O. **A1** group AB would need I^A and I^B together, which the father cannot supply, and group O would need two copies of I^O, which the mother cannot supply. [4]