

BIOLOGY



EXAM QUESTION PACK

TOPIC 8: ORIGINS OF GENETIC VARIATION ORIGINS OF GENETIC VARIATION

SCORE

/16

PERCENTAGE

%

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Q1.

The diagram shows four varieties of rabbit.



Fur colour in rabbits is controlled by four different alleles:

- the allele for brown fur, C , is dominant to all other alleles
- the allele for chinchilla fur, c^{ch} , is dominant to the alleles for Himalayan and albino
- the allele for Himalayan fur, c^h , is dominant to the allele for albino
- the allele for albino fur, c , is recessive to all other alleles

(i) Describe how new combinations of alleles are produced in meiosis.

(2)

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(ii) State all the possible genotypes of a rabbit with brown fur.

(1)

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(iii) Two parent rabbits with brown fur were mated. Two of the F_1 offspring had chinchilla fur.

The F_1 rabbit offspring with chinchilla fur were mated.

The F_2 generation consisted of some rabbits with chinchilla fur and the rest having Himalayan fur.

Use genetic crosses to deduce the genotypes of the two parent rabbits with brown fur.

(3)

Answer

(Total for question = 6 marks)

Q2.

The photograph shows a maize cob with smooth, wrinkled and different coloured grains.



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The shape and colour of maize grains are controlled by two unlinked genes.

The allele for smooth seeds (A) is dominant to the allele for wrinkled seeds (a).

The allele for purple seeds (B) is dominant to the allele for yellow seeds (b).

A student cross-pollinated a maize plant grown from a smooth, purple grain (heterozygous for both pairs of alleles) with a maize plant grown from a wrinkled, yellow grain.

Using a genetic diagram, determine the probability that this cross will produce grains that are wrinkled and purple.

(4)

Answer

(Total for question = 4 marks)

Q3.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

The photograph shows a maize cob with smooth, wrinkled and different coloured grains.



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The shape and colour of maize grains are controlled by two unlinked genes.

The allele for smooth seeds (A) is dominant to the allele for wrinkled seeds (a).

The allele for purple seeds (B) is dominant to the allele for yellow seeds (b).

Two maize plants, grown from grains that were both wrinkled and purple, were cross-pollinated.

In the F₁ generation, some grains were wrinkled and purple and some were wrinkled and yellow.

Which of the following shows the genotypes of the parent plants?

(1)

- ☐ **A** AaBb × AaBb
- ☐ **B** aaBB × aaBB
- ☐ **C** AABb × AABb
- ☐ **D** aaBb × aaBb

(Total for question = 1 mark)

Q4.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☐ and then mark your new answer with a cross ☐.

(i) The table shows the chromosome number and chromatid number of some of the cells formed during oogenesis in humans.

Cell type	Chromosome number	Chromatid number
ovum	23	23
primary oocyte	46	92
secondary oocyte	23	46

Which of the cells are haploid?

(1)

- ☐ A ovum and primary oocyte
- ☐ B ovum and secondary oocyte
- ☐ C primary oocyte and secondary oocyte
- ☐ D ovum alone

(ii) Explain how meiosis produces new combinations of alleles in gametes.

(4)

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(Total for question = 5 marks)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to the following: {independent / random} assortment of chromosomes (1) {crossing over / recombination / chiasmata formation} between homologous chromosomes (1)	Accept correct descriptions of crossing over between homologous chromosomes	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: CC, Cc^{ch}, Cc^h, Cc (1)	Accept alleles in different order e.g. c ^h C	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to the following: - parents identified as Cc^h, Cc^{ch} (1) - F₁ that are crossed identified as c^{ch}c^h × c^{ch}c^h (1) - F₂ identified as c^{ch}c^{ch}, c^{ch}c^h, (c^{ch}c^h), c^hc^h (1)	Accept all mps from Punnett squares Accept any clear indication that c^{ch}c^h × c^{ch}c^h are crossed	(3)

Q2.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: - parent genotypes are AaBb and aabb (1) - gametes are AB, Ab, aB, ab and ab (1) - F₁ genotypes are AaBb, Aabb, aaBb and aabb (1) - probability 0.25 / ¼ / 25% (1)	ACCEPT correct answers from Punnett square	4

Q3.

Question Number	Answer	Mark
	The only correct answer is D aaBb x aaBb <i>A is incorrect because the parents would be round and yellow</i> <i>B is incorrect because no yellow seeds could be produced</i> <i>C is incorrect because no yellow seeds could be produced</i>	1

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	B ovum and secondary oocyte A is incorrect because secondary oocyte is diploid C is incorrect because the secondary oocyte is diploid D is incorrect because the primary oocyte is diploid		1
(ii)	<i>An explanation that makes reference to:</i> • crossing over (1) • which swaps {alleles / DNA / genes} between {homologous chromosomes} (1) • independent / random assortment (1) • because it is random movement of homologous chromosomes to poles (1)	Allow random movement of paternal and maternal chromosomes / random combinations of paternal and maternal chromosomes	4