A Level OCR Biology

22 Patterns of inheritance – answers

Question	Answers	Extra information	Mark	AO Spec reference
1(a)(i)	(allele is located on) autosome ✓ *idea that* the syndrome affects men and women equally ✓ (allele is) dominant ✓ all affected individuals have an affected parent / an affected parent has a 50% (approximately) chance of having an affected offspring ✓	Accept not found on a sex chromosome / not sex-linked Accept five women and five men have the condition	4	AO3 6.1.2(b)(i)
1(a)(ii)	*discontinuous because* (the condition is caused by) one gene / allele ✓ *idea that* a person either has the condition or does not have it ✓	**ACCEPT** produces discrete data / there are no intermediate conditions	2	AO2 6.1.2(d)
2(a)(i)	(recessive) epistasis ✓		1	AO2 6.1.2(b)(ii)
2(a)(ii)	Any two from: allele C codes for pigment intermediate / precursor **OR** *idea that* allele C codes for enzyme needed at an earlier step in pigment production ✓ allele A / a codes for enzyme ✓ that converts product of C to pigment ✓		2 max	AO2 6.1.2(b)(ii)
2(a)(iii)	9 : 3 : 3 : 1 ✓ ✓ ✓	**AWARD 3 MARKS for the correct phenotypic ratio** (written in any order) Allow the use of any letters to represent the two genes (if the capital and lower case letters can be distinguished).	3	AO2 6.1.2(b)(i)

A Level OCR Biology

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		If the final answer is incorrect, award one mark for the correct offspring genotypes (e.g., shown in a Punnett square): e.g., AACC, AACc, AaCC, AaCc, AACc, AAcc, AaCc, Aacc, AaCC, AaCc, aaCC, aaCc, AaCc, Aacc, aaCc, aacc		
3(a)(i)	prediction is supported / null hypothesis is accepted ✓ 1.64 ✓ ✓ ✓	ALLOW two marks $(O–E)^2$ = 16, 25, 25, 16 $\frac{(O–E)^2}{E}$ = 0.32, 0.5, 0.5, 0.32 Accept no significant difference between the observed and expected data Allow errors carried forward	4	AO2 AO3 6.1.2(c)
3(a)(ii)	RrGg **AND** rrgg ✓		1	AO2 6.1.2(b)(i)
4(a)(i)	ratio 1 : 1 ✓ females with fragile X syndrome : healthy males ✓	Accept 50 : 50 ratio	2	AO2 6.1.2(b)(ii)
4(a)(ii)	females (usually) have one dominant allele and one recessive allele for fragile X ✓ *idea that* recessive allele reduces the severity of the syndrome ✓	Accept males lack a recessive allele for fragile X Accept no recessive allele to reduce the severity of the syndrome in males	2	AO2 6.1.2(b)(ii)
4(b)	Any three from: two genes located on the same chromosome / autosome ✓ linked alleles inherited together (as a single unit) ✓ expected offspring phenotypic ratios (based on independent assortment) are altered ✓ *idea of* crossing over can separate linked allele combinations ✓	Accept no independent assortment (of the two genes)	3 max	AO1 6.1.2(b)(ii)
5(a)	both alleles are expressed ✓ in a heterozygous genotype ✓		2	AO1 6.1.2(b)(i)

A Level OCR Biology

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Question	Answers	Extra information	Mark	AO Spec reference
5(b)(i)	(offspring will be blood group) A or B ✓ A:B ratio of 1:1 ✓	Accept 50:50 ratio of A:B	2	AO2 6.1.2(b)(i)
5(b)(ii)	$I^o I^o$ **AND** $I^A I^o$ / $I^B I^o$ ✓		1	AO2 6.1.2(b)(i)
5(b)(iii)	rough ER / ribosome ✓ Golgi apparatus ✓		2	AO2 2.1.1(g)
5(b)(iv)	B glycoproteins / red blood cells recognised as (foreign) antigens ✓ antibodies produced (against B antigens) ✓		2	AO2 4.1.1(h)
5(c)(i)	2 : 1 : 1 ✓ pink flowers : red flowers : white flowers ✓	Accept 50 : 25 : 25 ratio	2	AO2 6.1.2(b)(i)
5(c)(ii)	$C^W C^W$ **AND** $C^R C^R$ ✓		1	AO2 6.1.2(b)(i)
6(a)(i)	12% ✓ ✓ ✓ ✓	q = 0.063 245 553 (square root of 0.004) p = 0.936 754 447 (1 – q) ($2pq$ =) 0.118 49 (× 100 =) 11.849% The correct final answer scores 4 marks Allow errors carried forward	4	AO2 6.1.2(f)
6(a)(ii)	0.80% ✓ ✓ ✓ ✓	p = 0.995 99 (square root of 0.992) q = 0.004 01 (1 – p) ($2pq$ =) 0.007987 (× 100 =) 0.798% The correct final answer scores 4 marks Allow errors carried forward	4	AO2 6.1.2(f)

A Level OCR Biology

22 Patterns of inheritance – answers

Question	Answers	Extra information	Mark	AO Spec reference
6(a)(iii)	0.0016% ✓ ✓ ✓ ✓	p = 0.995 99 (square root of 0.992) q = 0.004 01 (1 – p) (q^2 =) 0.000 016 08 (× 100 =) 0.001 608% The correct final answer scores 3 marks Allow errors carried forward	3	AO2 6.1.2(f)
6(a)(iv)	Any two from: founder effect / genetic bottleneck ✓ genetic drift / random change in allele frequencies when new population was established ✓ reproduce within their population / lack of genetic mixing with other populations ✓		2 max	AO2 6.1.2(e)
7	**Level 3 (5–6 marks)** Describes **and** explains all or most of the relevant aspects of sexual reproduction. *There is a well-developed line of reasoning, which is clear and logically structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.* **Level 2 (3–4 marks)** Describes **and** explains some of the relevant aspects of sexual reproduction. *There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.*	**Indicative content**: *Crossing over* • Prophase 1 • Non-sister chromatids in homologous pairs of chromosomes exchange alleles • New allele combinations on chromosomes *Independent/random assortment* • Metaphase 1 (for homologous pairs of chromosomes) • Metaphase 2 (for chromatids) • Different combinations of alleles in gametes *Random mating / random fusion of gametes* • Different combinations of alleles brought together in different offspring	6	AO1 6.1.2(a)(ii)

A Level OCR Biology

22 Patterns of inheritance – answers

Question	Answers	Extra information	Mark	AO Spec reference
	Level 1 (1–2 marks) Describes some relevant aspects of sexual reproduction. *The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.* **0 marks** No response or no response worthy of credit.	*Credit references to non-disjunction, although this is not mentioned in the specification*		
8	**Level 3 (5–6 marks)** Compares the ethics **and** effectiveness of both processes in detail. *There is a well-developed line of reasoning, which is clear and logically structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.* **Level 2 (3–4 marks)** Compares some aspects of the ethics **and** effectiveness of both processes, with omissions or errors. *There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.* **Level 1 (1–2 marks)** Describes the ethics **or** effectiveness of artificial selection and/or genetic engineering. *The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.* **0 marks** No response or no response worthy of credit.	**Indicative content**: • Artificial selection is a longer process / takes generations • Artificial selection can cause inbreeding depression / cause animals to suffer or have health problems • Health problems can also be associated with GM animals (especially when cloning is used) • Artificial selection has a high degree of randomness / is less precise than genetic engineering (which targets specific genes) • Genetic engineering technology can be exploited (e.g., control of patents and the use of GM for potentially dangerous aims) • Genetic engineering may have unknown future consequences (whereas artificial selection has been conducted for millennia) Examples described (e.g., artificial selection of pets; GM for pharmaceuticals)	6	AO1 AO3 6.1.2(h) 6.1.3(f) 6.1.3(g)

A Level OCR Biology

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Skills box answers

<table>
<tr><th>Question</th><th>Answers</th></tr>
<tr><td>1</td><td>a homozygous recessive plant, in this case a plant with green wrinkled seeds, yyrr.</td></tr>
<tr><td>2</td><td>YyRr</td></tr>
<tr><td>3</td><td>
<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="4">Yellow round parent – YyRr</th></tr>
<tr><th>Gametes</th><th>YR</th><th>Yr</th><th>yR</th><th>yr</th></tr>
<tr><td rowspan="4">Green wrinkled parent – yyrr</td><td>yr</td><td>YyRr</td><td>Yyrr</td><td>yyRr</td><td>yyrr</td></tr>
<tr><td>yr</td><td>YyRr</td><td>Yyrr</td><td>yyRr</td><td>yyrr</td></tr>
<tr><td>yr</td><td>YyRr</td><td>Yyrr</td><td>yyRr</td><td>yyrr</td></tr>
<tr><td>yr</td><td>YyRr</td><td>Yyrr</td><td>yyRr</td><td>yyrr</td></tr>
</table>
YyRr – yellow round
yyRr – green round
yyrr – green wrinkled
Yyrr – yellow wrinkled
</td></tr>
<tr><td>4</td><td>
<table>
<tr><th>Class</th><th>Observed (O)</th><th>Expected (E)</th><th>$O - E$</th><th>$(O - E)^2$</th><th>$\frac{(O-E)^2}{E}$</th></tr>
<tr><td>green round</td><td>47</td><td>49</td><td>−2</td><td>4</td><td>0.08</td></tr>
<tr><td>green wrinkled</td><td>53</td><td>49</td><td>4</td><td>16</td><td>0.33</td></tr>
<tr><td>yellow round</td><td>51</td><td>49</td><td>2</td><td>4</td><td>0.08</td></tr>
<tr><td>yellow wrinkled</td><td>45</td><td>49</td><td>−4</td><td>16</td><td>0.33</td></tr>
</table>
$\chi^2 = 0.82$

Four classes, so 3 degrees of freedom. 0.82 falls between probability (p) of 0.99 and 0.75. Therefore the difference between the observed and expected results is not significant, so we cannot reject the null hypothesis.
</td></tr>
</table>