

2805/02 Applications of Genetics

January 2005

Mark Scheme

ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the **final** version of the Mark Scheme.
You are advised to destroy all draft versions.
2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks ($\frac{1}{2}$) should never be used.
3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.
 - x = incorrect response (errors may also be underlined)
 - ^ = omission mark
 - bod = benefit of the doubt (where professional judgement has been used)
 - ecf = error carried forward (in consequential marking)
 - con = contradiction (in cases where candidates contradict themselves in the same response)
 - sf = error in the number of significant figures
4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.
5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Examiners will be expected to use their professional judgment in marking answers that contain more than the number required. Advice about specific cases will be given at the standardisation meeting.
6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)
7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.
8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

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| Abbreviations, annotations and conventions used in the Mark Scheme | / = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit R = reject () = words which are not essential to gain credit <u> </u> = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording A = accept ora = or reverse argument |
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| Question | Expected Answers | Marks |
|-----------|--|-------|
| 1 (a) (i) | AaBB white ; aaBB black ; Aabb white ; aabb brown ; | 4 |
| | (ii) (dominant) epistasis ; | 1 |
| | (iii) codes for inhibitor ; protein ; blocks transcription (of allele coding for pigment) ; ref to, regulator / promoter ; blocks enzyme (producing pigment) ; AVP ; e.g. detail | max 3 |
| (b) (i) | AaBb x AaBb / AaBb x Aabb ; both must have A because they are white ; *both must, have a / not be homozygous AA, because some kittens coloured ; *both must have b to give brown kittens ; <ul style="list-style-type: none"> • <i>'must be heterozygous at both loci' = 1 only</i> at least one / one or both, must have B to give black kittens ; credit ref to Punnett square showing genotypes ; credit ref to Punnett square showing phenotypes ; | max 5 |
| (ii) | AaBb x AaBb 12 white : 3 black : 1 brown ;; AaBb x Aabb 6 white : 1 black : 1 brown ;; | max 2 |

[Total: 15]

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| Question | Expected Answers | Marks |
|-----------------|--|--------------|
| 2 (a) (i) | gradual process / AW ; to improve traits ; to achieve homozygosity / AW ; best in each generation interbred ; ref to artificial selection ; ref to several traits involved / may be, additive / polygenic ; | max 2 |
| (ii) | ref to mitosis ; chromosomes replicated ; failure of, spindle / cell division ; colchicine / other method ; | max 2 |
| (iii) | self-pollination prevented ; pollination by foreign pollen prevented ; pollen transfer ; practical detail ; | max 2 |
| (iv) | 3n ; meiosis fails ; ref to, synapsis / homologous pairs ; | max 2 |
| (b) (i) | sterile explant ; sterile nutrient medium ; ref to plant growth regulators ; <u>callus</u> ; subdivided ; medium with different plant growth regulators ; plantlets / embryoids ; hardening medium / sterile soil ; AVP ; e.g. appropriate plant growth regulators | max 5 |
| (ii) | callus can be divided ; large numbers of identical plants ; A clone in short time ; bulk up sterile hybrid ; bulk up master hybrid lines ; no need for making more 4n ; | max 2 |

[Total: 15]

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| Question | Expected Answers | Marks |
|-----------------|---|--------------|
| 3 (a) | gives value of individual's genotype (for selective breeding) ; male mated with different females ; trait measured in progeny of different matings ; average calculated ; especially for, sex-limited traits / traits that appear in one sex only ; | max 3 |
| (b) | A / 'marbling' ; scale 0 - 1 ; measure of genetic v. environmental contribution ; high value most easily selected for ; value <0.02 results in no selective breeding ; ease of selection = 'marbling'>growth rate>subcutaneous fat>'rib eye' ; all the traits / even 'rib eye', can be selected for ; | max 3 |
| (c) | <i>continuous v. discontinuous</i> 1 no discrete classes v. discrete classes / AW ; 2 vary between limits v. no intermediates ; 3 quantitative v. qualitative ; 4 plotted as normal distribution curve v. bar chart ; 5 3 or more genes v. one / few, genes ; 6 <u>polygenes</u> (v. not so) ; 7 many alleles v. few alleles ; A different alleles have small v. large effects ; 8 additive effects v. different effects ; 9 large v. small environmental effect ; 10 use of e.g. of continuous variation ; 11 use of e.g. of discontinuous variation ; 12 AVP ; | max 8 |
| | QWC - legible text with accurate spelling, punctuation and grammar ; | 1 |

[Total: 15]

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| Question | Expected Answers | Marks |
|--------------------|---|--------------|
| 4 (a) | embryos from endangered species can be implanted in surrogates ; different / related, species ; e.g. ; endangered species female can be superovulated ; many times ; not put at risk of pregnancy ; embryos may be cloned ; | max 4 |
| (b) (i) | <u>control</u> ; shows effect of, lipid removal but not freezing / lipid removal only ; | 2 |
| (ii) | allows development (to ball of cells) ; in 31 - 64% of embryos ; embryos with lipid, do not survive freeze-thawing / show no further development ; | max 2 |
| (iii) | increases percentage that develop (to ball of cells) ; 31% to 64% / doubles ; larger surface area : volume ratio ; freeze-thaw, quicker / more uniformly ; so less damage ; ref to size ice crystals ; AVP ; | max 4 |
| (c) | <i>three of following</i> ;;; seed bank sperm bank eggs / ovarian tissue tissue culture zoo botanical garden field gene bank / growing crop rare breed / landrace | max 3 |
| [Total: 15] | | |

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| Question | Expected Answers | Marks |
|-----------------|--|--------------------|
| 5 (a) | <p>increase in use of, GM crop / GE crop / Bt cotton ; no / less, insecticide needed ; reduced number of cases of pesticide poisoning ; ref to figures (e.g. by x 4.4) ; reduced cost (insecticide) ; ref to figures (e.g. by 0.62 US\$ kg⁻¹ / x 1.38) ; ref to limitations of survey ; AVP ;</p> <p>A reverse arguments</p> | max 4 |
| (b) | <p>mutation ; random / chance / pre-existing ; detail of mutation (gene / point / e.g.) ; e.g. of how resistance achieved ; <u>natural selection</u> ; toxin, is selective agent / exerts selective pressure ; resistants survive / susceptibles die ; resistants pass mutation to offspring ;</p> | max 5 |
| (c) | <p>wild sunflowers become resistant ; because hybridise readily (ref to 40%) ; become, weedier / more invasive ; spread quickly because (50%) more seeds produced ; pass resistance to other weeds ; increased Bt toxin resistance in insects ; ref to potential toxin (in seeds) ; ref to potential effect on food chain ; ref to potential effect on biodiversity ; danger to certified 'organic' crops ; ref to potential allergen in seeds ; credit example ; AVP ; e.g. kill beneficial insects</p> | max 6 |
| | | [Total: 15] |

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| Question | Expected Answers | Marks |
|----------|--|--------------------|
| 6 (a) | <ul style="list-style-type: none"> 1 MHC / HLA, system ; 2 6 loci / A,B,C,DP,DQ,DR ; A 4 loci A to D 3 tightly linked / rarely separated by crossing-over; 4 chromosome 6 ; 5 inherited as unit ; 6 <u>haplotype</u> ; 7 child inherits one haplotype from each parent ; 8 code for cell surface (glyco)proteins ; 9 = antigens ; 10 each, locus / gene, has many alleles ; 11 very large number of different combinations ; 12 much more likely to find match in family / ora ; 13 some antigens (B, DR) cause stronger reaction than others ; 14 match prevents rejection / ora ; 15 immune response ; 16 detail, rejection / immune response / immunosuppression ; 17 ref to ABO antigens and antibodies ; | max 8 |
| | QWC – clear well organised using specialist terms ; | 1 |
| | <p><i>award the QWC mark if the following are used in correct context</i></p> <p>MHC/HLA letters of loci haplotype antigen rejection linkage</p> | |
| (b) (i) | <ul style="list-style-type: none"> ref to, rDNA / recombinant DNA ; restriction enzyme(s) ; cut DNA at specific site(s) ; detail site(s) ; ref to viral DNA and, human DNA / DNA of gene ; ref to sticky ends ; complementary binding ; detail of binding ; A = T / C ≡ G / hydrogen bonds ligase to seal 'nicks' in (sugar-phosphate) backbone ; | max 4 |
| (ii) | <ul style="list-style-type: none"> has effect when added to genome ; not masked ; no need to, remove / inactivate, recessive / mutant, allele ; | max 2 |
| | | [Total: 15] |