



RECOGNISING ACHIEVEMENT

JUNE 2002

ADVANCED GCE UNIT

MARKING SCHEME

MAXIMUM MARK: 90

Syllabus / Component: 2805/02

**Options in Biology:
Applications of Genetics**

Paper Set Date: 20/06/02

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. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.
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.

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 _____ = (underlining) key words which must be used to gain credit ecf = error carried forward A = accept AW = alternative wording ora = or reverse argument
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1 (a) interaction between two, genes / loci ;
 one gene affects expression of other ;
 (may be) inhibition ;
 epistatic gene qualified ;
 hypostatic gene qualified ; max 2

(b) $Ab \times aB$;

$AaBb$;
 yellow (-flowered) ;

$AaBb \times AaBb$;

$AB \ Ab \ aB \ ab \times$ same ;; [*may be taken from sides of Punnett square*]

genotypes in Punnett square ;; [*minus 1 for each of first three mistakes*]

gametes	AB	Ab	aB	ab
AB	AABB yellow	AABb yellow	AaBB yellow	AaBb yellow
Ab	AABb yellow	AAbb magenta	AaBb yellow	Aabb magenta
aB	AaBB yellow	AaBb yellow	aaBB yellow	aaBb yellow
ab	AaBb yellow	Aabb magenta	aaBb yellow	aabb yellow

phenotypes shown ;; [*yellow A-B- and aa-- ; magenta A-bb ;*]

ratio ; [*13 yellow-flowered: 3 magenta-flowered*] max 10

(c) $aaBb / AaBb / AABb / --Bb$; 1

(d) code for protein ;
 which binds to, DNA / enzyme ;
 prevents transcription / inhibits enzyme ;
 prevents, RNA polymerase binding to DNA / synthesis of pigment ;
 AVP ;
 detail of AVP ; max 2

[Total: 15]

- 2 (a) 1.9% ;
24.3% ; 2
- (b) (i) greater chance of pregnancy ;
when more embryos transferred ;
ref. figures ; [*any comparison within sequence 9.0 - 23.0 - 26.0% (or totals)*] max 2
- (ii) to reduce number of multiple pregnancies ;
with small effect (3%) on number of pregnancies ;
multiple pregnancies undesirable ;
more multiple pregnancies with 3 transferred ;
ref. figures ; [*any comparison within sequence 1.9 - 24.3 - 34.7% including ecf*]
AVP ; [*ref. litigation*] max 2
- (c) 1. superovulation ;
2. hormone / gonadotrophin / FSH, treatment ;
3. oocytes harvested ;
4. then IVF ;
5. detail harvesting / IVF ;
6. or fertilisation / AI ;
7. then embryos washed from uterus ;
8. detail, AI / washing ;
9. cloning ;
10. detail of cloning ; [*separation of cells/subdivision of, blastocyst/morula/ball of cells; totipotent/pluripotent cells*]
11. in process (cell) may be tested for, sex / mutation / genetic disease ;
12. surrogate(s) ;
13. uterus prepared hormonally / cycle synchronised hormonally ;
14. embryos placed in uterus ;
15. embryos may be stored frozen ;
16. embryos may be temporarily incubated in one animal and then transferred to second ;
17. embryos may be transported in small mammal and then transferred to own species ;
18. = portmanteau animal ;
19. surrogate may be different species ; [*A example of placing in different species*]
20. ref. use in breeding, valuable animals / rare / endangered, species ;
- max 9
- QWC - legible text with accurate spelling, punctuation and grammar;** 1

[Total: 16]

- 3 (a) loss alleles ;
loss genetic, variation / diversity ; [A reduction of gene pool]
increased homozygosity / decreased heterozygosity ;
ref. deleterious recessive alleles ;
increased, expression / accumulation . frequency ; max 3
- (b) fewer features of *M. micranthus* affected than *M.guttatus* / AW ;
M. micranthus is natural inbreeder / tolerant of inbreeding ;
[A converse argument for *M. guttatus*]
fewer deleterious recessives left in population ;
removed by selection ;
M. guttatus still has deleterious recessives ;
which are expressed when homozygous / AW ; max 4
- (c) *four of*
whole organism ;
rare breed ;
landrace / wild type ;
zoo ;
field gene bank ;
botanic garden ;
tissue culture ;
seed bank ;
sperm bank ;
(frozen), embryos / oocytes / tissue ;
AVP ; max 4
- (d) store of genetic variation / maintaining gene pool ;
store of alleles ;
for future use ;
in, selective breeding ;
maintaining, endangered species / rare breeds ;
to counteract, inbreeding / genetic erosion ;
for resistance to, 'new' / mutated, pathogen / named pathogen ;
for tolerance to, changed environment / example of change ;
of presently unfashionable traits ;
of alleles as yet, undetected / unknown ; max 3

[Total: 14]

- 4 (a) recessive slower / dominant faster ;
recessive must be homozygous to show resistance ;
and be selected for ;
recessive phenotype may skip generation(s) / AW ;
if dominant, heterozygote shows resistance ;
both homozygote dominant and heterozygote selected for ;
ref. irrelevant in, bacteria / haploid organisms ; max 3
- (b) moths in refuges not subject to selection ;
resistance no longer an advantage ;
low / reduced, frequency resistance allele ;
interbreed with those on *Bt* cotton ;
maintain frequency of, dominant / susceptible, allele;
mask presence of, recessive / resistant, allele; max 3
- (c) (i) both very similar / no significant differences ;
peak at 22 days ;
ref. %s at peak ;
range similar ;
earliest, after 10 days / same day ;
latest after 41 / 42 days ; max 3
- (ii) peaks different days ;
22 days v. 28 days / 6 days apart ;
ref. %s at peaks ;
susceptibles emerge earlier ;
after 10 days v. after 18 days / c. 8 days earlier ;
few resistants later than susceptibles ; max 3
- (d) *two of*
most of each population cannot interbreed ;
peak emergence times a week different ;
few / some, can interbreed ;
poor / limited / some, success of refuges ;
moths may not move to different field to mate ; max 2

[Total: 14]

- 5 (a) (i) DNA from two different sources ;
combined / joined / AW ;
may be from different taxon ; [*A egs of taxa*] max 2
- (ii) bind at specific sequences ;
both DNAs cut ;
with the same enzyme ;
complementary sticky ends / complementary ends shown ;
H bond ;
C with G / C ≡ G / A with T / A=T ;
cut to give blunt ends ;
prior to adding sticky ends ; max 4
- (b) 1. named organism modified ;
2. source of gene ; [*other organism or antisense gene from same organism*]
3. effect of gene ; [*how it alters phenotype*]
4. detail of effect ;
5. detail of effect ;
6. vector / other method of insertion ;
 [*virus / plasmid / liposome / electroporation / gene gun / etc.*]
7. detail of vector or method ;
8. how GM organism multiplied ; [*cloning / tissue culture / asexual or sexual reproduction*]
9. benefit / advantage, of modification stated ;
10. detail of benefit / advantage ;
11. hazard of modification stated ; [*to health, other organism or ecosystem*]
12. detail of hazard ;
- max 8
- QWC - clear, well-organised answer using specialist terms** 1

[Total: 15]

- 6 (a) chorea / involuntary muscle movement / AW ;
mental deterioration / AW ;
progressive ;
brain cells / tissue, lost /deteriorate(s) ;
brain ventricles enlarge ;
late onset ;
dominant allele ;
autosomal / chromosome 4 ;
not truly Mendelian ;
inheritance from male and female different ;
unstable gene ;
stutter / triplet repeat / CAG repeat ;
sufferers have, 37-100 / >37, repeats ;
stutter size increases with generations ;
age of onset inversely \propto length of repeat ;
heterozygotes suffer ;
1 in 2 chance of passing to offspring ; max 8
- (b) no normal mice fail test ;
failure of HD mice reduced in environmentally enriched cages ;
only 14% environmentally enriched HD mice fail test ;
at 15 weeks ;
plateau to end ;
increasing numbers of HD mice fail test with time ;
100% at, 19 / 20, weeks ; max 4
- (c) suggests, physiotherapy / stimulation / activity / AW ;
may, delay onset / reduce effects ; 2
- (d) advantage ;
[young man can avoid having children / use AID / test embryo after IVF / delay onset via activity / AVP]
- disadvantage ;
[foreknowledge of incurable disease / insurance problems / if young man positive then so must be father / AVP] 2

[Total: 16]