RECOGNISING ACHIEVEMENT

JANUARY 2003

ADVANCED GCE UNIT

MARK SCHEME

MAXIMUM MARK: 90

Syllabus / Component: 2805/02

Options in Biology:
Applications of Genetics

Paper Set Date: 30/01/03

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 (½) 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
	( )	= words which are not essential to gain credit
	____	= (underlining) key words which **must** be used to gain credit
	ecf	= error carried forward
	AW	= alternative wording
	A	= accept
	R	= reject
	ora	= or reverse argument

Question **Expected Answers** **Marks**

1 (a) (i) AAII AAIi AaII AaIi ;;

minus 1 for each of first 2 mistakes or omissions –

A *A-I- for 1 mark* **2**

(ii) AAii Aaii ; **1**

(b) *parents* blue x white ;
gametes AI ai ;
F_1 AaIi blue ;

F_1 *x* F_1 *gametes* AI Ai aI ai x same ; **A** *off Punnett square*

F_2 *Punnett square* genotypes ;; *minus 1 for each of first 2 mistakes (see below)*
phenotypes ;;

Ratio 9 blue-flowered : 3 purple-flowered : 4 white-flowered ; **max 8**

gametes	AI	Ai	aI	ai
AI	AAII blue	AAIi blue	AaII blue	AaIi blue
Ai	AAIi blue	AAii purple	AaIi blue	Aaii purple
aI	AaII blue	AaIi blue	aaII white	aaIi white
ai	AaIi blue	Aaii purple	aaIi white	aaii white

(c) (i) gives one extra amino acid ;
shape of protein altered ;
ref. 1° structure and, folding/bonding ;
ref. 3D shape / 3° structure ; **max 2**

(ii) no longer accepts ion / ion does not fit / channel blocked ;
no longer accepts ATP / ATP does not fit ;
no longer changes shape ;
cannot embed in membrane; **max 2**

[Total: 15]

Question		Expected Answers	Marks
2	(a)	good taste / high yield / AVP ;;	2
	(b)	increase genetic contribution of popular variety / increase alleles for e.g. trait ; dilute genetic contribution of *O. longistaminata* ; background genes ; suitable for, climate / growing conditions ;	max 3
	(c)	to maintain genetic diversity / combat genetic erosion ; **A** *biodiversity* for, future / unknown / potential, use ; for changed environmental conditions ; e.g. of change ; **R** *'environment'* to counteract inbreeding ;	max 3
	(d)	idea shape and fit / allosteric effect ; changes shape of active site ; better fit / now fits substrate / AW ; **A** now catalyses reaction	max 2
	(e)	GE quick(er) / SB slow(er) / quick v. slow ; resistance in one generation v. many generations of SB ; single gene v. many ; rest of genome unaltered v. hybridisation ; background genes intact v. need for backcrossing ; different varieties engineered for different conditions ; no problem about whether different species can interbreed ; AVP ;	max 5
			[Total: 15]

Question		Expected Answers	Marks
3	(a)	diluted / ref. extender medium ; buffered / ref. citrate ; straws / thin tubes ; -196^{o}C / liquid nitrogen ;	**max 3**
	(b)	*acrosome* colourless ; *plasma membrane* colourless ; *mitochondria* green ;	**3**
	(c)	*advantages* **1** no cost of keeping male ; **2** avoids inbreeding due to having only one male available ; **3** choose high class sire ; **4** no, stress / cost, of travel ; **5** no stress of mating ; **6** avoids physical damage during mating ; **7** quickly available ; **8** available at any time ; **9** can be screened ; **10** speeds up progeny testing ; **11** pedigree stock increased quickly ; max 6 *disadvantages* **12** requires, technical skill / services of vet. ; **13** requires equipment ; **14** cost ; **15** if one sire overused can lead to, inbreeding / reduced gene pool ; **16** freezing may damage sperm ; **17** wide spread of disease ; **18** valid ethical disadvantage ; **R** *'playing God'*	**max 8**
		QWC - legible text with accurate spelling, punctuation and grammar;	**1**
			[Total: 15]

Question			Expected Answers	Marks
4	(a)		chance / random ; mutation ; changes DNA code / produces new allele ; **R** *gene* makes, different / new, enzyme / protein / pathway ; to break down *Bt* toxin ; natural selection / selective advantage ;	**max 3**
	(b)	(i)	caterpillars die ; less food for, 2^{o} consumers / carnivores ; fewer hosts for wasp larvae ; other herbivores unaffected by *Bt* ; superweeds qualified ; yield qualified ;	**max 3**
		(ii)	no / very little / uncertain, evidence ; ref. figures ; differences insignificant ;	**max 2**
	(c)		*benefits* commercially desirable trait ; insecticide resistance / herbicide resistance / disease resistance ; (potentially) reduces use of, herbicides / insecticides / etc. ; reduces cost of chemicals ; increases, yield / productivity ; improvement in quality of yield / ref. e.g. ; AVP ;	**max 2**
			hazards inserting gene may have unknown effect ; allergenic/toxic ; pass to organic crops damaging livelihood ; gene may pass to related species/ ref. method of gene transfer ; increased, invasiveness / weediness ; ref. increasing resistance problem ; AVP ;	**max 2**
				[Total: 12]

Question			Expected Answers	Marks
5	(a)		detection of, inherited disorder / genetic disease ; in a carrier ; in a fetus *in utero* ; in an IVF embryo ; by, DNA analysis /gene probe ; by karyotyping ;	**max 3**
	(b)		coding of each chromosome specific ; different genes on each chromosome ; ref. markers / other recognisable sequences ; single stranded ; ref. complementary / A-T / C-G, bonding ;	**max 3**
	(c)	(i)	trisomy 21 / 3 chromosomes 21 ; Down's syndrome ; female ;	**max 2**
		(ii)	normal / not Down's syndrome / no trisomy 21 / 2 chromosomes 21 ; male ; may be problem with, sex-linked condition / e.g.sex linked condition;	**max 2**
	(d)		genetic counsellor, provides information / explains options ; confidentially ; in light of, beliefs / culture ; about risks of screening ; about quality of life with condition ; about life expectancy ; about treatment of condition ; about termination ; about use of, donor / IVF with screening, on another occasion ; about chance of it occurring in future pregnancies / ref. pedigree diagram ;	**max 6**
				[Total: 16]

Question			Expected Answers	Marks
6	(a)		genetic tests for inherited diseases ; e.g. gene test ; susceptibility to disease can be assessed ; e.g. gene correlated with disease ; more accurate diagnosis / better treatment ; develop drugs with specific targets ; drugs with fewer side effects ; gene therapy ; AVP ; e.g. *insurance*	**max 4**
	(b)	**1**	HLA genes code for cell surface, (glyco) proteins / antigens ;	
		2	markers of, self / not self ;	
		3	immune response ;	
		4	detail immune response ;	
		5	<u>rejection</u> ;	
		6	pair 1 perfect match so no problem ;	
		7	pair 2 potential / slight / some, problem ;	
		8	pair 3 not suitable / major problem ;	
		9	description ref. figures of pair 2 or 3 ;	
		10	ref match at, some loci / B / DR, matter(s) more than others ;	
		11	ref. anti-rejection / immunosuppression, drugs necessary ;	
		12	match reduces need for anti-rejection drugs ; **R** *no need for a-r drugs*	
		13	AVP ;	**max 8**
			QWC - clear, well organised using specialist terms;	**1**
	(c)		loci, linked / on same chromosome ; tightly linked / crossing over rare ; <u>haplotype</u> ; offspring inherit one haplotype from each parent ; 50% DNA shared between, siblings/parents and offspring ; many HLA alleles (in population) ; many haplotypes / combinations of alleles, (in population) ; close relatives have many shared alleles / AW ; different alleles in, unrelated populations / populations with different, origins / ethnicities ;	**max 4**
				[Total: 17]