RECOGNISING ACHIEVEMENT

2805/02 Applications of Genetics

June 2003

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 (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
	R	=	reject
	( )	=	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
	ora	=	or reverse argument

Question			Expected Answers	Marks
1	(a)		emasculation / AW / male sterility gene ; anthers removed before, opening / maturity (of recipient plant) ; (recipient) flower, isolated / bagged / insects excluded ; **A** isolated before / after, pollination ; pollen transferred by hand ;	**max 3**
	(b)	(i)	-37 1369 27.38 ; -33 1089 21.78 ; χ^2 = 98.32 ;	**3**
		(ii)	3 ;	**1**
		(iii)	less than (<) 0.001 ; ecf	**1**
		(iv)	difference from expectation is, significant / below critical value (0.05) ; result not due to chance ; hypothesis *re* expectation should be rejected / prediction incorrect ;	**max 2**
	(c)		loci / genes, are, linked / on the same chromosome ; no, independent / random, assortment ; large numbers of, parental types / specified ; **A** gametes or genotypes small numbers of, recombinants / specified ; from crossing over ; in, meiosis I / prophase I ; between non-sister chromatids of homologous chromosomes / AW / credit diagram ; number recombinants depends on how close together the, loci / genes ; c. 15 map units apart / cov = 15 ;	**max 5**
				[Total: 15]

Question		Expected Answers	Marks
2	(a)	inbreeding depression ; loss of, viability / fertility / yield / fitness / vigour ; deleterious recessive alleles, expressed / homozygous / accumulate ; reduced genetic, variation / diversity ; increased homozygosity / decreased heterozygosity ; genetic erosion / loss of alleles / reduced gene pool ;	**max 3**
	(b)	deleterious alleles removed / ora ; by (natural) selection ; no artificial selection ; now, natural inbreeders / tolerant of inbreeding ; sites sampled not genes but 'junk' having no effect on viability ; AVP; length reign of α male / length time to maturity means fathers do not mate with daughters	**max 2**
	(c)	source of genetic variation ; alleles ; for future use ; in changed circumstances ; e.g. changed circumstance ; climate / disease / etc.	**max 3**
	(d)	**1** donor female treated with, hormone / named hormone ; **2** to superovulate ; **3** surrogate treated with, hormone / named hormone ; **4** to, synchronise cycle / prepare uterus ; **5** donor female, inseminated / mated ; **6** embryos washed from, uterus / female ; **7** oocytes removed from donor female ; **8** IVF ; **9** embryos, subdivided / cloned ; **10** embryos, sexed / genetically tested ; **11** inserted into surrogate via, catheter / syringe ; **12** may not be same breed ; **13** may not be same species / use of portmanteau ;	**max 6**
		QWC – clear, well organised using specialist terms;	**1**
			[Total: 15]

Question			Expected Answers	Marks
3	(a)	(i)	DNA from two different, sources / organisms ;	1
		(ii)	cut, DNA / plasmid / chromosome ; at, specific / target, sites ; detail of site ; e.g. 4 - 6 base pairs / palindromic allows joining of different DNAs ; may give sticky ends / AW ; may give blunt ends / AW ; in which case sticky ends added ; allows, isolation / identification, of gene ;	max 4
		(iii)	ref. homeostasis ; negative feedback ; synthetic insulin only made when blood glucose is high ; reduces blood glucose, concentration / level ; restores, normality / set point ; detail of action ; no injection / produced on site ;	max 2
	(b)	(i)	*glucose* pattern similar ; peak slightly higher in, experimental / diabetic, rats ; **A** figures drop after peak slightly delayed in, experimental / diabetic rats ; diabetic rats lower from 2 - 7 h than, normal rats / set point / 100 mg dm^{-3} ; diabetic rats returned to normal at, 7 / 8, h ; max 3 *hormone* peak in, experimental / diabetic, rats higher than normal rats ; **A** figures much later / 4 h v. 30 min. ; (high concentration) lasts much longer / 5(6) h v. 90 min. ; max 2	max 4
		(ii)	blood glucose concentration effectively controlled ; treatment / cure for diabetes ; removes need for, daily / frequent, insulin ; persistence of hormone in blood ; leads to drop in blood glucose below normality ; ref. results may not be long-term ; ref. insulin derived from other animals; ref. rejection ; ref. problem viral vector ; unforeseen effects of gene therapy;	max 4

[Total: 15]

Question			Expected Answers	Marks
4	(a)		explant / meristem / cambium / undifferentiated / totipotent / pluripotent, tissue ; nutrient medium ; ref. sterile, tissue / medium; PGS / AW / cytokinin, to stimulate mitosis ; callus ; subdivided / cloned ; PGS / AW / auxin / GA, to stimulate differentiation ; embryoids / plantlets ; hardening medium / sterile soil ;	**max 4**
	(b)		analysis of medium ; in which non-*Bt* maize grown ; in same, conditions / temperatures / time intervals ;	**max 2**
	(c)	**(i)**	bacteria / fungi / microorganisms ; broke down *Bt* toxin ; because containers left open ; AVP ;	**max 2**
		(ii)	results show that *Bt* toxin lost by seedlings to surroundings ; can kill (susceptible), insects / larvae ; could encourage evolution of resistance to *Bt* toxin ; but effect only seen in sterile conditions ; bacteria / fungi / microorganisms, not killed ; break down toxin ; within 5 days of arrival ; in soil (microbes) present all the time ; no evidence involving soil / effect only seen in soil-free medium ; adsorption onto soil particles could alter results ; ref. water / run-off / leaching, in soil ;	**max 5**

[Total: 13]

Question			Expected Answers	Marks
5	(a)	1	random / chance ;	
		2	mutation ;	
		3	selection ; **R** artificial selection	
		4	natural selection ;	
		5	fenthion / insecticide, selective agent ;	
		6	selective advantage ;	
		7	susceptibles die / resistants survive ;	
		8	pass on allele to offspring ;	
		9	rapid spread because short generation time ;	
		10	because large numbers of offspring ;	
		11	because lots of breeding sites ;	**max 6**
			QWC – legible text with accurate spelling, punctuation and grammar;	**1**
	(b)		more sites for transcription ; more mRNA ; more translation ; more, enzyme / esterase ; more insecticide broken down ;	**max 3**
	(c)		via, DNA / gene, probe ; specific to (part of) coding / DNA / genome, of parasite ; method of detection of marker ; e.g. fluorescence / radioactivity ref. single stranded ; complementary ; ref. A - T / C - G, bonding ;	**max 3**
	(d)	**(i)**	parasite DNA / infection, falls with increased esterase (activity) ; high resistance = low level of infection / ora ; no resistant females produce parasite larvae ; most / 76%, susceptible females produce parasite larvae ; low level of infection = low infectivity / ora ;	**max 3**
		(ii)	no / not / lower risk ; although resistance may result in more mosquitoes ; resistant mosquitoes are less likely to transmit filariasis ; increased, esterase / enzyme / gene amplification, stops, development of parasite / infection ;	**max 3**
				[Total: 19]

Question			Expected Answers	Marks
6	(a)	(i)	change in, triplet code / base sequence, of DNA ; substitution / addition / deletion / frame shift ; may code for a different, amino acid sequence / protein ; may introduce a stop, triplet / code ; transcription stops at that point ; different mRNA sequence ; shortened / abbreviated, mRNA ; no mRNA if mutation in gene regulator ; splicing failure ;	**max 3**
		(ii)	cancer result of mutation(s) and more likelihood of mutations in rapidly dividing cells ;	**1**
		(iii)	mutation speeds up mitosis ; ref. protein which, prevents / slows, mitosis ; ref. enzyme repairing DNA ;	**max 1**
	(b)	(i)	dominant allele ; mutation does not skip generations ; approx. expected 1 in 2 chance of passing on allele ; inherited from affected female ; or from male who cannot show condition ;	**max 2**
		(ii)	(0.5 x 0.5) = 0.25 ;	**1**
	(c)		C does not carry mutation ; risk of, breast / ovarian, cancer that of unmutated female / AW ; risk not zero ; D carries mutation ; advised to have (frequent) screening ; detail screening ; precautionary surgery / lifestyle change to prevent expression ; screening / genetic testing, of any children of D ; screening of embryos ; gamete / embryo, donation ;	**max 5**
				[Total: 13]