RECOGNISING ACHIEVEMENT

2805/02 Applications of Genetics

June 2004

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)		red ; orange ; yellow ; pale / lemon, yellow ;	**4**
	(b)		red x pale / lemon, yellow ; AB x ab ; AaBb red ; AB Ab aB ab x same ; **A** *from Punnett square* Punnett square genotypes ;; *minus 1 for each of first two mistakes* Punnett square phenotypes ;; ratio of 9 red : 3 orange : 3 yellow : 1 pale / lemon, yellow ;	**max 8**
	(c)	(i)	expression of (hypostatic) gene not completely blocked ; allows other genotypes to show through slightly ; bb must be homozygous to have effect ;	**max 2**
		(ii)	gene switching / gene control / blocks transcription ; codes for inhibitor ;	**max 1**
				[Total: 15]

Question		Expected Answers	Marks
2	(a)	superovulation ; ref. hormone / FSH / named preparation ; *either* eggs harvested ; *or* fertilisation / AI ; IVF / description ; embryos harvested ; recipient uterus hormonally prepared ; **A** oestrus synchronised more than one embryo ; inserted via catheter ;	**max 5**
	(b) (i)	(667/5420 x 100) = 12.3% ;	**1**
	(ii)	yes slightly / not significant / very similar ; donated embryos most successful / woman's and partner's own gametes least successful ; ref. comparative figures re success ; *minimum two from 11.7% (12%) v 15.4% v 13.0% v 19.8% (20%)* ref. relatively small numbers involving donation ;	**max 3**
	(c) (i)	embryos stored because, eggs / oocytes, do not freeze well / ora ; treatment cycle / superovulation, expensive / unpleasant / unsuccessful, so excess stored ; now recommended that only, 2 / 3, embryos implanted so excess stored ; embryos produced while, mother / eggs / oocytes, young and stored for later use ; embryos produced before parent made infertile ; for future use in research ; for future use for, infertile relative / embryo donation ; AVP ;	**max 3**
	(ii)	infertility of either partner ; avoid passing on inherited condition ; problem aging eggs / oocytes ; elderly / postmenopausal, female ; no male partner ; AVP ;	**max 3**
			[Total: 15]

Question		Expected Answers	Marks
3	(a)	**1** random / chance ; **2** mutation ; **3** detail mutation ; **4** ref. (R) plasmid ; **5** <u>natural selection</u> ; **6** antibiotic, = selective agent / exerts selective pressure ; **7** resistants survive / susceptibles die ; **8** selective advantage ; **9** e.g. breakdown of antibiotic / alternative metabolic pathway / method of expelling antibiotic ; **10** offspring inherit mutation / vertical transmission ; **11** horizontal transmission / named method of horizontal transmission; **12** detail of horizontal transmission ; **13** AVP ; e.g. ref. multiple resistance	**max 7**
		QWC - clear, well-organised answer using specialist terms	**1**
	(b) **(i)**	use from 1 - 7 days, not significantly different / very slightly different, from no use ; ref. comparative figures ; percentage of resistant colonies increases with length of time of antibiotic use ; ref. comparative figures ;	**max 2**
	(ii)	exposure before experimental period ; passed from other people ; who had used a β-lactam ; multiple resistance ; so selected by use of other antibiotic ; mutation occurs ; previously existing normal level of resistance in population / AW ;	**max 3**
	(c)	*two of* use antibiotic only when necessary ; use only when appropriate (not for viruses) ; prescription only ; avoid wide-spectrum / use only specific ; ensure patients complete course ; take out of use (v. doubtful effect!) ; use different antibiotic ; stop use as growth promoter for livestock ; international agreement / reduce black market ; **A** do not use for more than 7 days, in a year / at a time ;	**max 2**
			[Total: 15]

Question		Expected Answers	Marks
4	(a)	**1** named organism modified ; **2** reason for / advantage of, modification ; **3** detail of, reason/advantage ; **4** source of gene ; **5** effect of gene ; **6** detail of effect of gene ; **7** vector / other method of introduction ; **8** detail of introduction ; **9** how GM organism multiplied ; **10** hazard / disadvantage ; **11** detail of, hazard / disadvantage ;	**max 8**
		QWC - legible text with accurate spelling, punctuation and grammar	**1**
	(b)	**(i)** idea of control ; *mark once only* to show not part of normal maize genome ; *once only* seeds from museum, date from before genetic engineering possible / show must have been recent introduction ; blue maize from Peru, remote from transgenic crops / should be unaffected ;	**max 2**
		(ii) via pollen / cross-pollination ; (pollen) blown by wind ; hybrid / offspring, carries promoter ; carried by, virus / vector ; ref. transduction ;	**max 2**
		(iii) hybrids survive and mate ; escaped transgenic plants as source of pollen ; ban on transgenic crops not obeyed ; windblown pollen from other countries where there is no ban ; AVP ; e.g. possible selective advantage	**max 2**
			[Total: 15]

Question		Expected Answers	Marks
5	(a)	code for cell surface (glyco)proteins ; self / not self, markers ; not self / foreign, rejected ; ref. immune system ; 4 / 6, genes / loci ; A, B, C and D / A, B, C, DP, DQ and DR ; many alleles ; some loci / B / DR, more important in rejection than others ; match more likely in family than from outside ; ref. linkage / haplotype ;	**max 5**
	(b) **(i)**	*one mark for χ^2 and max 4 for working* O 61 39 ; E 50 50 ; O-E 11 -11 ; $(O-E)^2$ 121 121 ; $(O-E)^2 / E$ 2.42 2.42 ; $\chi^2 =$ 4.84 ;	**max 5**
	(ii)	1 ;	**1**
	(iii)	between 0.05 and 0.02 / < 0.05 / > 0.02 ; *ecf*	**1**
	(iv)	the difference from expectation is significant ; *ecf* just / ref. to *p* of 0.05 ; expected by chance in fewer than 1 in 20 / not due to chance ; null hypothesis can be rejected ; HLA D4 associated with Type 1 diabetes ;	**max 3**
			[Total: 15]

Question		Expected Answers	Marks
6	(a)	autosomal / chromosome 4 ; dominant allele ; stutter / triplet repeat / CAG repeat ; sufferers have, >37 / 37 -100, repeats ; longer stutter earlier onset ; sufferer has 1 in 2 chance of passing on allele ; stutter increases with generations ; inheritance from male and female different ; gene instability ; not truly Mendelian ;	**max 4**
	(b)	chorea / involuntary muscle movement / shaking ; mental deterioration / e.g., mental deterioration ; progressive / degenerative ; brain cells lost ; brain ventricles enlarge ;	**max 3**
	(c)	sequence of glutamines responsible for binding ; bound enzyme inactive / ora ; transcription needed for cell to survive / ora ; clumps of huntingtin alone do not kill cell ;	**max 3**
	(d) (i)	reduces the number ; by more than half ; from groups of 7 to average, 3 / 3.1 ; **A** 3 - 4 lost per group	**max 2**
	(ii)	chemical reduces effect of mutant HD allele ; more neurones survive ; groups of 7 reduced to average 4.9 / 5.0 (instead of 3) ; **A** 1 - 2 lost	**max 2**
	(e)	lack of transcription ; having huntingtin attached to AT, blocks active site / makes it insoluble / denatures it / AW ;	**max 1**
			[Total: 15]