OCR
RECOGNISING ACHIEVEMENT

GCE

Biology

Advanced GCE **F215**

Control, Genomes and Environment

Mark Scheme for June 2010

Oxford Cambridge and RSA Examinations

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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Question			Expected Answer	Mark	Additional Guidance
1	(a)	(i)	microbes **/** (living) organisms **/** cells **/** enzymes **;** (make) product **/** for human benefit / (carry out) conversion / reaction / industrial process **;**	**2**	**CREDIT** microorganisms / bacteria / prokaryotes / fungi **CREDIT** living things **CREDIT** cell components / parts of cells **CREDIT** example such as (named) food or medicine BUT **IGNORE** cheese (as stated in question) **IGNORE** process unqualified
1	(a)	(ii)	microbes **/ AW ,** killed / removed / not present **;** enzymes <u>denatured</u> **;** (so no) competitors **/** unwanted reactions **/** (human) health risk **;**	**2 max**	**Mark the first two suggestions** **IGNORE** contamination / sterile **IGNORE** idea of preserving milk **AW** for microbes as in **(a)(i)** plus **ACCEPT** organisms **DO NOT CREDIT** microbes denatured **CREDIT** (no) competition **CREDIT** (no) food spoilage / change of flavour / loss of quality **CREDIT** (no) pathogens / harmful microbes / TB "Kills harmful microbes" or "Kills pathogens" scores 2 marks (mps 1 & 3)

Question			Expected Answer	Mark	Additional Guidance
1	(b)	(i)			**Award mp 1 plus 2 max from the other mark points**
		1	enzyme **;**		***1*** **ACCEPT** globular / tertiary / catalyst / catalytic (protein)
			plus any 2 of the following	**1**	
		2	(enzyme) not, changed / used up **; ora**		***2*** **ora** = can be used again / re-used **IGNORE** enzyme recycled
		3	*idea of* ESC (forms) / substrate and enzyme (bind) **;**		***3*** ESC = enzyme-substrate complex **ACCEPT** substrate entering active site
		4	products (and enzyme) released at end **;**		
				max 2	
1	(b)	(ii)			**Mark the FIRST suggestion on each numbered line** **IGNORE** **'**cheaper' without qualification
		1	(enzyme can be removed to be) used again **;**		
		2	(enzyme can) to leave pure(r) product **; ora**		***2*** **ACCEPT** cheaper / easier, downstream processing
		3	(enzyme) more stable / more efficient / works better **;**		***3*** **CREDIT** less susceptible to, pH / temperature, change / extremes "enzymes work at high temperatures" = 0 "enzymes work at higher temperatures" = 1 (because comparative statement made)
				2	

Question			Expected Answer	Mark	Additional Guidance
1	(c)		***This is a QWC question***		
			Section I - Obtaining the gene		
		1	use restriction, enzyme / endonuclease **;**		***1*** **CREDIT** named example e.g. *Eco* R1, *Bam* H1, *Hin* dIII
		2	to, cut out / get / isolate, (rennin) gene / DNA coding for rennin ***or*** to, fragment / digest, DNA **;**		***2*** **DO NOT CREDIT** 'cut gene' **IGNORE** 'break up DNA'
		3	gene probe **;**		
			OR		
		4	obtain rennin mRNA **;**		***NOTE***
		5	(use) reverse transcriptase **;**		***1-9*** **CREDIT** whichever of the three alternative "obtaining the gene" protocols yields most marks, **either award marking points 1-3 or 4-6 or 7-9**
		6	to make cDNA **;**		
			OR		
		7	sequence, rennin (protein) **;**		
		8	work out base code **;**		
		9	make this DNA sequence **;**		
		10	sticky ends **;**		***10*** can be awarded, once only, in Sections I or II
			Section II - Vector		
		11	cut (open), plasmid / phage **;**		***11*** **DO NOT CREDIT** 'cut out plasmid' **DO NOT CREDIT** 'ring of DNA' unless it is clear that plasmid is being referred to
		12	using same restriction enzyme **;**		***12*** **CREDIT** same named enzyme (re. mp1)
		13	annealing / base pairing of sticky ends **;**		***13*** **CREDIT** idea of sticky end bases hydrogen bonding
		14	join sugar-phosphate backbones **;**		***14*** **CREDIT** formation of phosphodiester bonds
		15	(using DNA) ligase **;**		
		16	recombinant, vector / plasmid / phage / DNA **;**		
			Section III - Introduction into host cell		
		17	mix with bacteria **;**		
		18	detail of conditions **;**		***18*** e.g. Ca^{2+} ions added / heatshock (freeze then inc to $40^{o}C$)
		19	transformation (plasmid) / transduction (phage) **;**	**max 7**	***19*** **CREDIT** transform / transformed / transduce / transduced **IGNORE** transgenic
			QWC – sequencing of steps – at least 1 mark point scored from each of the three sections, in the correct order ;	**1**	I. obtaining gene (mp **1 – 9**) followed by II. vector (mp **13 – 16**) followed by III. introduction to host cell (mp **17 – 19**)
			TOTAL	**17**	

Question			Expected Answers	Marks	Additional Guidance
2	(a)	(i)	red ; vermillion ; cinnabar ;	3	
2	(a)	(ii)	(recessive) epistasis / epistatic ;	1	**ACCEPT** complementary epistasis **DO NOT CREDIT** dominant epistasis
2	(a)	(iii)			
		1	gene products are enzymes ;		
		2	multi-enzyme / multi-step, pathway ;		***2*** needs to be a clear generalised statement (and not implied - e.g. by awarding mp 3) **IGNORE** 'metabolic' pathway (as given in question)
		3	3, steps / enzymes, change tryptophan to red pigment ;		***3*** **ACCEPT** V, C and B are responsible for the change of tryptophan to red
		4	product of one reaction / intermediate compound, is, substrate / starting point, for next ;		
		5	dominant allele gives, functional / wild-type / AW, enzyme ;		
		6	recessive allele gives, non-functional / different / AW, enzyme ;	max 3	
2	(b)	(i)	*if (red-eyed parent) was heterozygous*		**IGNORE** ref to sex linkage
		1	there would be no difference between, sexes / males and females ;		
		2	red-eyed males **and** white-eyed females would occur ;		***2*** **ACCEPT** "because there are no red-eyed males **and** white-eyed females (in results)" "*all* 4 phenotypes would, occur / be represented"
		3	1:1:1:1 ratio **or** 1:1 ratio in both sexes ;	max 2	**DO NOT** infer phenotype(s) from genotype(s) ***3*** If 4 phenotypes stated / listed *together with the ratio*, then award mp 2 as well

<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional Guidance</th></tr>
<tr><td>2</td><td>(b)</td><td>(ii)</td><td>parental genotypes XrXr XRY- ;
gametes Xr XR and Y- ;
F1 genotypes XRXr XrY- ;</td><td>3</td><td>ACCEPT alternative letters only if a KEY is given. Must have capital letter for dominant allele and small (same) letter for recessive allele.

CREDIT GAMETES either on the correct line or in correct place on Punnett square, whichever is correct. They do not need to be in circles.

ACCEPT ecf once only if Y wrongly shown as carrying ‘r’ allele
ACCEPT ecf once only if X and Y missing

DO NOT CREDIT F1 genotypes written in blank space if F1 phenotypes put on bottom lines instead</td></tr>
<tr><td>2</td><td>(b)</td><td>(iii)</td><td>
<table>
<tr><th>phenotype of fly</th><th>O</th><th>E</th><th>O - E</th><th>$(O - E)^2$</th><th>$\frac{(O - E)^2}{E}$</th></tr>
<tr><td>red-eyed female</td><td>27</td><td>25</td><td>2</td><td>4</td><td>0.16</td></tr>
<tr><td>white-eyed male</td><td>23</td><td>25</td><td>-2</td><td>4</td><td>0.16</td></tr>
</table>
; ;
$\chi^2 = 0.32$;
no significant difference (at 95% confidence level) ;</td><td>4</td><td>One mark per row

ACCEPT fractions in last column (4/25)

ACCEPT not significant
IGNORE ref to happening by chance

ACCEPT ecf for last two points
IGNORE arguments referring to null hypothesis</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>16</td><td></td></tr>
</table>

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)			
		1	similar / same, cells / metabolism ;		*1* **ACCEPT** they are all eukaryotic cells
		2	similar / same / share, genes **or** have genes in common ;		
		3	similar / same, (embryonic) development ;		
		4	shared, ancestry / ancestor **or** all related by evolution ;	max 2	*4* **CREDIT** due to phylogeny **ACCEPT** all same kingdom **IGNORE** 'they are all animals'
3	(a)	(ii)			**Mark the FIRST answer on each numbered line**
		1	small ;		
		2	short life cycle ;		*2* **ACCEPT** fast development / mature quickly / fast reproductive rate / short generation time
		3	easy to, keep / breed / AW ;		*3* **ACCEPT** produce many offspring
		4	cheap (to buy / keep) ;		
		5	readily available / common / not rare ;		
		6	large cells ;		
		7	previously well-studied / many known mutants ;	max 2	*7* **ACCEPT** genome has been, mapped / sequenced
3	(b)	(i)	scanning ; electron (microscope) ;	2	**CREDIT** SEM = 2 marks **ACCEPT** transmission electron / TEM = 1 mark **IGNORE** micrograph
3	(b)	(ii)	description of legs in place of antennae in, mutant / 3.2 / AW ;	1	**ACCEPT** projections on head / antennae / feelers, longer (in Fig. 3.2) **DO NOT CREDIT** antennae / projections vs. none **DO NOT CREDIT** mandibles / fangs **DO NOT CREDIT** incorrect statement e.g. legs on mouth
3	(b)	(iii)	homeotic / homeobox / hox ;	1	

Question			Expected Answers	Marks	Additional Guidance
3	(c)	1	*synthesis*		**MAX 6** marks for synthesis
		2	DNA, copied into / →, mRNA **or** described **;**		**MAX 6** marks for roles
		3	transcription / transcribed **;**		
			one strand copied **;**		***1*** **DO NOT CREDIT** descriptions that contain errors
		4			
		5	complementary base-pairing **;**		***3*** **ACCEPT** coding / sense / non-sense / template, strand (implying one only)
		6	triplet code / code read in threes / codon is 3 bases **;**		***4*** **CREDIT** description of base pairing as correct to context
		7	base sequence determines amino acid sequence **;**		
		8	translation **;**		
		9	ribosomes **;**		
			role of tRNA described **;** **(max 6)**		***9*** e.g. "tRNA brings amino acid" or "tRNA anticodon binds to mRNA codon"
		10	*roles of polypeptides*		
		11	(named) structural protein **;**		
			enzymes / catalyse reactions / control metabolism **;**		***10*** e.g. actin / myosin / collagen / keratin
		12			
		13	hormones / growth factors **;**		
		14	receptor proteins **;**		
			adenyl cyclase / cAMP **;**		***12*** **CREDIT** growth hormone / GH / somatotrophin / FSH
		15			
			idea of switching genes, on / off **;**		***14*** most likely to be expressed in context of mp 12
		16			
			homeotic / homeobox, genes		***15*** **CREDIT** transcription factors / regulatory proteins / repressor proteins
		17	**or** homeodomain proteins **;**		
			idea of master switch gene / one gene turns on/off whole set of other genes / cascades of gene switching **;**		
		18			
			apoptosis **;** **(max 6)**		
				7 max	
			QWC – balanced account ;	**1**	At least 2 marks from points 1 - 9 **and** at least 2 marks from points 10 – 18
			Total	**16**	

<table>
<tr><th colspan="3">Question</th><th>Expected Answers</th><th>Marks</th><th>Additional Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td>
<table>
<tr><th></th><th>similarity</th><th>difference</th></tr>
<tr><td>structure</td><td>mitochondria
or
vesicles
or
postsynaptic receptors ;</td><td>NMJ membrane(s), wavy / AW * ora
or
receptors different (shape)
or
enzymes in different places ;</td></tr>
<tr><td>function</td><td>(neuro)transmitter, released / crosses gap
or
changes potential difference / AW **
or
enzymes break down (neuro)transmitter ;</td><td>different neurotransmitters / ACh vs. dopamine
or
muscle contraction vs. nerve impulse
or
different enzymes ;</td></tr>
</table>
</td><td>4</td><td>One mark per box

difference
NMJ is neuromuscular junction
* AW ACCEPT wiggly / bumpy / not smooth / rough / larger SA / any suitable description but IGNORE microvilli

difference
ACh is acetylcholine

similarity
** AW CREDIT depolarises / -70 mV → +40 mV but IGNORE pass on action potential</td></tr>
<tr><td>4</td><td>(b)</td><td>(i)
1

2
3

4</td><td>phenelzine ;

no ecf from incorrect drug
idea that does not bind to (dopamine) receptor ; ora
idea that binds to, MAO / enzyme ;

allosteric site / non-competitive inhibitor ;</td><td>1

max 1</td><td>Award mp1 and, if correct, any 1 from the remaining points

2 CREDIT other two do bind to dopamine receptor
3 IGNORE inhibits, MAO / enzyme (as given in the question)
4 ACCEPT “not a competitive inhibitor”</td></tr>
<tr><td>4</td><td>(b)</td><td>(ii)</td><td>(drug) occupies / blocks / binds to, (dopamine) receptors ;
without causing, action potential / response ;
reduces effect of dopamine / is a dopamine antagonist ;</td><td>2</td><td>CREDIT “without causing depolarisation” / AW
DO NOT CREDIT “inhibits dopamine” or “reduces dopamine levels</td></tr>
</table>

Question			Expected Answers	Marks	Additional Guidance
4	(c)	(i)	humans are, diploid / 2n ; chromosomes, are in pairs / homologous ; one, (copy / gene / allele), from each parent / on each chromosome of pair ;	2 max	**DO NOT CREDIT** ref to bivalents
4	(c)	(ii)	(gel) <u>electrophoresis</u> ;	1	
4	(d)	1	13 b-p deletion (has most serious consequences) ;		
		2	frameshift / alter reading frame ;		
		3	genetic code is triplet / read in groups of 3 bases ;		
		4	alters all amino acids (coded for) after the mutation ;		
		5	21 b-p deletion causes 7 amino acids to be lost ;		
		6	substitution changes, one / no, amino acids ;	3 max	***6*** **CREDIT** could be a silent mutation / 1 b-p substitution may not have an effect
4	(e)	1	<u>natural selection</u> ;		
		2	<u>selective advantage</u> ;		
		3	(allele / behaviour) increases, survival / breeding / AW ;		***3*** **CREDIT** increases reproductive success / AW
		4	(because) helped, find food / find new resources / make new tools / get mates ;		***4*** **ACCEPT** more promiscuous / AW
		5	<u>allele</u> passed on (to next generation) ;		
		6	(allele / behaviour) increased in frequency over, generations / time ;	4 max	***6*** **MUST HAVE** time element
			Total	18	

Question			Expected Answers	Marks	Additional Guidance
5	(a)		ecosystem ; producers / autotrophs ; primary ; trophic level(s) ; biotic / living ; minerals / elements ;	6	**DO NOT CREDIT** plants **DO NOT CREDIT** tropic **CREDIT** named, element / ion, e.g. nitrogen, nitrate **ACCEPT** symbol e.g. N / NO_3^- **ACCEPT** nutrient **DO NOT CREDIT** energy / waste products
5	(b)	(i)		max 4	
		1	limiting / density-dependent, factors ;		
		2	carrying capacity ;		
		3	intraspecific competition ;		***3*** **ACCEPT** description e.g. ● "competition with other members of the same species" ● "competition with other (small) squirrels"
		4	for, food / nesting sites ;		***4*** **ACCEPT** they run out of food
		5	interspecific competition ;		***5*** **ACCEPT** description e.g. "competition with other species"
		6	with, deer / tree shrew / giant squirrel ;		
			larger squirrel populations		
		7	attract more predators ;		***7*** **DO NOT CREDIT** predation alone, must be linked to larger squirrel population
		8	parasites / diseases, spread more easily ;		***8*** **DO NOT CREDIT** disease alone, must be linked to larger squirrel population

Question			Expected Answers	Marks	Additional Guidance
5	(b)	(ii)	species richness & evenness decrease **; ora** (richness) 29 → 26 (species) **;** (evenness) large numbers of, 2 / some, species, but, low numbers / none, of other species **;**	**max 2**	**ACCEPT** they both, decrease / decline / fall **or** they were higher at start **ACCEPT** 6 → 4 **or** 2 fewer (from table) **or** 3 fewer (from text) **CREDIT** suitable named e.g.s from table
5	(c)	(i)	rare initially / AW **;** prey, numbers have reduced / have become extinct / have left the area **;** idea of slower reproductive rate / AW **;**	**max 1**	**ACCEPT** that there weren't very many at start **DO NOT CREDIT** 'lack of food' unless has indicated that food is an animal **ACCEPT** don't breed as fast / don't have as many offspring
5	(c)	(ii)			**Mark the FIRST suggestion on each numbered line**
		1	aesthetic / amenity / recreational, value **;**		***1*** **ACCEPT** description, e.g. beautiful / so people will visit / so people will use it for leisure
		2	(eco)tourism **;**		***2*** **ACCEPT** description, e.g. raise money from visitors
		3	to, preserve biodiversity / preserve genetic diversity / stop extinction **;**		***3*** **ACCEPT** description, e.g. keep more species
		4	ref. interactions between species / need to preserve whole habitat **;**		***4*** **ACCEPT** description, e.g. if habitat destroyed there will be a knock-on effect on many species
		5	(rainforest species / preserve gene pool as) could be useful, in future / as potential, for, medicine / genetic engineering / AW **;**		***5*** **ACCEPT** for drugs, pharmaceuticals, GM or GM e.g. (like crop improvement)
		6	to support indigenous peoples / AW **;**		***6*** **ACCEPT** let native people continue to live in forest income for indigenous people
		7	to stop effect of deforestation on, atmosphere / climate / soil **;**		***7*** **ACCEPT** to stop, CO_2 % rising / global warming / erosion **or** forest acts as C, sink / store
		8	AVP **;**	**max 3**	***8*** e.g. ● habitat for pollinators ● habitat for predators of pests **DO NOT CREDIT** 'right to life'

Question			Expected Answers	Marks	Additional Guidance
5	(d)		*management practices*		**LOOK FOR** key ideas expressed in different ways
		M1	coppicing / pollarding / description ;		***M1*** **CREDIT** coppicing with standards / rotational coppicing
		M2	selective felling / description ;		***M2*** **ACCEPT** only some trees cut down
		M3	rotational felling / description ;		***M3*** **ACCEPT** cycle of felling different areas
		M4	strip felling ;		
		M5	replant after felling ; **(max 2)**		
			explanation of benefits re. sustainability		
		B1	preserves / prevents disruption to, habitat / ecosystems / nesting sites ;		
		B2	maintains / increases, species diversity / biodiversity ;		
		B3	prevents, soil erosion / leaching ;		
		B4	less disturbance by machinery ;		
		B5	AVP ; **(max 2)**		***B5*** **CREDIT** specific benefits linked to a practice e.g. ● faster recovery due to seeding from untouched areas nearby (M3) ● pollarding so deer can't eat shoots (M1)
				max 4	
			Total	**20**	

Question			Expected Answers	Marks	Additional Guidance
6	(a)	1	to cope with changing conditions / AW ;		***1*** Looking for a general statement **DO NOT CREDIT** "adapt to change"
		2	avoid <u>abiotic</u> stress ;		
		3	to maximise photosynthesis **or** to obtain more, light / water / minerals **; ora**		***3*** **CREDIT** named elements / ions **IGNORE** nutrients
		4	avoid, herbivory / grazing ;		***4*** methods of preventing grazing could include producing more toxins / more spines / encouraging stinging ants **IGNORE** predation
		5	to ensure, germination in suitable conditions / pollination / seed set / seed dispersal ;	**max 2**	***5*** **DO NOT CREDIT** 'maximise reproduction' without further qualification
6	(b)	(i)			
		1	in water / in **A** / with no abscisic acid, germination increases as conc. GA increases ;		
		2	when abscisic acid present / in **B**, no germination ;		***2*** **DO NOT CREDIT** 'inhibits germination' (as this is a conclusion not a description)
		3	maximum germination 90% with 5 mol dm^{-3} GA, in water / without abscisic acid ;		***3*** **ACCEPT** 91% (± 2%) for 90%
		4	2 comparative figures (x and y refs. plus units) ;		***4*** EITHER compare **A** and **B** at the same GA conc OR two points on same line **with units for both**
		5	GA concentration increases, logarithmically / by a factor of 10, on x axis ;		
		6	10 times more GA gives, 3 (conc 0.05 to 0.5) / 0.5 (conc 0.5 to 5), times more germination ;	**4 max**	

GA conc (mol dm^3)	A (%)	B (%)
0	10 ± 2	0
0.05	22 ± 2	0
0.5	66 ± 2	0
5	91 ± 2	0

Question			Expected Answers	Marks	Additional Guidance
6	(b)	(ii)			
		1	so temperature doesn't affect results / so only desired variable(s) changed / to show just the effect of plant hormones ;		*1* **ACCEPT** fair test **IGNORE** to control temperature / temperature is a limiting factor / temperature is a controlled variable
		2	since temperature affects enzyme activity ;		*2* **CREDIT** "optimum temperature for enzyme activity" or "this is the temperature when enzymes work best"
		3	suitable / optimum, temperature for (lettuce) germination ;	2 max	*3* **ACCEPT** 'these' seeds
6	(b)	(iii)			**Mark the FIRST suggestion on each numbered line** **DO NOT CREDIT** conc, GA / giberrellin (as this is the independent variable) **IGNORE** number of seeds (as given in the question)
		1	<u>volumes</u> of liquid(s) ;		*1* **DO NOT CREDIT** amounts / levels **CREDIT** volume of, water / GA / ABA
		2	ABA concentration ;		
		3	oxygen availability ;		*3* **IGNORE** carbon dioxide
		4	age of seeds ;		
		5	previous storage of seeds / viability idea ;		
		6	genotype / variety, of seeds ;		*6* **CREDIT "**from same batch of seeds" or "seeds from same plant"
		7	size / type of, petri dish / filter paper ;		
		8	length of time experiment left for (before recording results) ;		
		9	space between seeds ;		
		10	AVP ;		*10* e.g. ● light qualified (duration / intensity / wavelength) ● use of distilled water ● all lids, off / on
				3 max	

Question			Expected Answers	Marks	Additional Guidance
6	(c)				**Mark the FIRST TWO suggestions** **IGNORE** the names of plant growth regulators
		1	seedless, fruits / grapes **;**		
		2	weedkillers **;**		
		3	rooting powder / to grow cuttings / used in tissue culture **;**		
		4	control fruit ripening **;**		***4*** could be used to speed up or slow down
		5	controls fruit drop **;**		
		6	restrict hedge growth **;**		
		7	preserve, cut flowers / green vegetables **;**		
		8	specific example of improved fruit quality **;**		***8*** e.g. ● longer stalks on grapes ● longer apples
		9	producing malt / in brewing **;**		
		10	AVP **;**		***10 & 11*** e.g. ● promoting sexual maturity in conifers ● promoting latex flow in rubber plants ● promoting sexual maturity in female cucumber plants ● longer nodes in sugar cane ● restricting growth in, chrysanthemums / other e.g.
		11	AVP **;**	**2 max**	
			Total	**13**	

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