

# GCE

## Biology

Advanced GCE

Unit **F215**: Control, Genomes and Environment

# Mark Scheme for June 2013

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.













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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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## 1. Annotations

Annotation	Meaning
	Correct answer
	Incorrect response
	Benefit of Doubt
	Not Benefit of Doubt
	Error Carried Forward
	Given mark
	Underline (for ambiguous/contradictory wording)
	Omission mark
	Ignore
	Correct response (for a QWC question)
	QWC* mark awarded
	First answer

\*Quality of Written Communication

Question		Answer	Marks	Guidance
1	(a)	reduce / slow, flow rate ; repeat process / run milk through again ; test for (named) sugars in milk ;	2	<b>ACCEPT</b> close tap for a time period <b>CREDIT</b> glucose, galactose, lactose, Benedict's test
	(b) (i)	<i>any two from</i>  hydrophobic / ionic bond, to (named), solid / support ;  covalent bond / cross-link to, (named) substance;  membrane separation ;  (en)trap / encapsulate / suspend, in (named), matrix ;	2	<b>Mark as prose.</b> <b>IGNORE</b> ref to cross-linking agents  <b>ACCEPT</b> 'insoluble material for solid. Suitable solids = clay, carbon, resin, glass, gold, ceramic beads. <b>CREDIT</b> <u>ad</u> sorption (but not absorption) <b>CREDIT</b> carrier bound.  <b>CREDIT</b> cross-link them together. Suitable substances = other enzymes, collagen, cellulose.  <b>ACCEPT</b> microcapsules  Suitable matrix materials = collagen, cellulose, silica gel, hydrogel, but <b>DO NOT CREDIT</b> entangled / alginate
	(ii)	1 (enzyme) can be re-used so reduces cost ; 2 product, pure(r) / uncontaminated ; 3 reduced downstream processing costs ; 4 (immobilised enzyme) works at high(er) temperature ;  5 (immobilised enzyme) works in changed pH ; 6 reaction, can be faster / have higher yield , because can be done at higher temperature ;	4	<b>2 ACCEPT</b> product not mixed with enzyme <b>3 ACCEPT</b> save money on purifying product <b>4 CREDIT</b> enzymes not denaturing at increased temperature <b>CREDIT</b> immobilised enzymes thermostable <b>5 CREDIT</b> enzymes not denaturing in changed pHs <b>6</b> This explanation scores mp 4 and mp 6 (unless mp 4 already awarded).
<b>Total</b>			<b>8</b>	

Question		Answer	Marks	Guidance
2	(a) (i)	C ;	1	<b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>
	(ii)	D ;	1	<b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>
	(iii)	B / E ;	1	<b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>
	(iv)	E ;	1	<b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>
	(b)	<p>1 muscles <u>contract</u>, in antagonistic (pairs) ;</p> <p>2 tendons, pull on bone / connect muscle to bone ;</p> <p>3 ligaments, hold bones together / prevent dislocation ;</p> <p>4 cartilage, reduces, friction / wear ;</p> <p>5 synovial membrane secretes fluid ;</p> <p>6 <u>synovial</u> fluid, is a lubricant / allows smooth movement ;</p>	3	<p><b>1 CREDIT</b> biceps and triceps <b>or</b> flexor and extensor contract</p> <p><b>IGNORE</b> context of direction of movement</p> <p><b>4 ACCEPT</b> 'prevents' for reduces</p> <p><b>5 ACCEPT</b> makes, produces but not 'releases'</p> <p><b>6 ACCEPT</b> prevents / reduces, friction</p>

Question	Answer	Marks	Guidance
(c)	<p><b>1</b> (two parts are) sympathetic <b>and</b> parasympathetic ;</p> <p><b>2</b> <b>S</b> has, short preganglionic neurone / long postganglionic neurone / ganglia near(er) spinal cord, <b>but P</b> has, long preganglionic neurone / short postganglionic neurone / ganglia near(er) organ ;</p> <p><b>3</b> <b>S</b> uses noradrenaline <b>but P</b> uses acetylcholine (at organ) ;</p> <p><b>4</b> <b>S</b>, fight / flight / stress, <b>but P</b>, rest / relaxation / calm ;</p> <p><b>5</b> <b>S</b> increases, heart rate / cardiac output / blood pressure, <b>but P</b> reduces this ;</p> <p><b>6</b> <b>S</b> increases , speed / rate / depth, of breathing, <b>but P</b> reduces this ;</p> <p><b>7</b> <b>S</b> increases airway diameter <b>but P</b> reduces it ;</p> <p><b>8</b> <b>S</b> increases blood flow to skeletal muscle <b>but P</b> increases blood flow to gut (smooth muscle) ;</p> <p><b>9</b> <b>S</b> for orgasm <b>but P</b> for sexual arousal ;</p> <p><b>10</b> <b>S</b> dilates pupils <b>but P</b> constricts pupils ;</p> <p><b>11</b> <b>S</b> makes liver release glucose, <b>but P</b> makes liver, store / take up, glucose ;</p> <p><b>12</b> <b>P</b> allows, <u>peristalsis</u> / digestion, <b>but S</b> reduces it ;</p>	7	<p><b>1</b> If BOTH names are wrong but begin with <b>S and P</b>, <b>DO NOT CREDIT</b> mp1 but allow ECF for mps 2-12</p> <p><b>2</b> <b>ACCEPT</b> tissue for organ</p> <p><b>3</b> <b>CREDIT</b> norepinephrine for noradrenaline but <b>IGNORE</b> noradrenaline from adrenal gland and <b>IGNORE</b> references to ganglion here</p> <p><b>6</b> <b>CREDIT</b> <b>S</b> increases ventilation rate and <b>P</b> slows it</p> <p><b>8</b> <b>CREDIT</b> voluntary or striated for skeletal <b>IGNORE</b> ORA</p> <p><b>11</b> <b>ACCEPT</b> correct reverse reasoning for glycogen <b>IGNORE</b> sugar 'liver' must be mentioned at least once</p> <p><b>12</b> <b>IGNORE</b> 'stops' for <b>S</b> but allow <b>S</b> inhibits</p>
	QWC ;	1	Award <b>QWC</b> if <b>1 mark</b> awarded for organisation mps <b>1-3</b> and <b>2 marks</b> awarded for functions mps <b>4-11</b>
	<b>Total</b>	<b>15</b>	

Question		Answer	Marks	Guidance
3	(a)	metaphase <b>I</b> and metaphase <b>II</b> ; prophase <b>I</b> ; anaphase <b>II</b> ; telophase <b>II</b> ; anaphase <b>I</b> ;	5	<b>Mark the first answer on each prompt line.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b>
	(b)	to, <b>halve</b> chromosome number / <b>reduce from 2n to n</b> ;  to separate homologous pairs (of chromosomes) <b>and</b> sister chromatids ;  because, DNA (previously) replicated / chromosomes are two chromatids at start ;	2	<b>IGNORE</b> all references to mitosis  <b>CREDIT</b> 'from diploid to haploid' <b>ACCEPT</b> 'from 46 to 23 chromosomes' <b>IGNORE</b> halve, genetic material / DNA  <b>ACCEPT</b> genetic, material / information
	(c) (i)	sequence / order, of bases / nucleotides ;	1	<b>CREDIT</b> base pairs <b>DO NOT CREDIT</b> amino acid sequence
	(ii)	different, primary / secondary / tertiary, structure ;  (protein ) shorter due to, deletion / stop codon <b>OR</b> longer due to, insertion / duplication ;  (protein) unchanged due to, silent mutation / non-coding DNA altered ;  (function is) lost / worse / better ;	3	<b>ACCEPT</b> different <u>sequence</u> or <u>order</u> of amino acids <b>ACCEPT</b> different 3D folding or 3D shape  for 'silent' <b>CREDIT</b> 'neutral' or a description of more than one triplet coding for one amino acid  <b>IGNORE</b> different / altered function <b>ACCEPT</b> idea that change is harmful
<b>Total</b>			<b>11</b>	

Question		Answer	Marks	Guidance																		
4	(a)	<table border="1"> <thead> <tr> <th>biological principle</th> <th>letter</th> </tr> </thead> <tbody> <tr> <td>artificial selection</td> <td><b>E</b></td> </tr> <tr> <td>predator-prey interaction</td> <td><b>G</b></td> </tr> <tr> <td>apical dominance</td> <td><b>B</b></td> </tr> <tr> <td>nitrogen fixation and nitrification</td> <td><b>D</b></td> </tr> <tr> <td>reproductive cloning</td> <td><b>A / F</b></td> </tr> <tr> <td>positive chemotaxis</td> <td><b>H</b></td> </tr> <tr> <td>decomposition</td> <td><b>C / D</b></td> </tr> <tr> <td>commercial use of plant hormones</td> <td><b>F</b></td> </tr> </tbody> </table>	biological principle	letter	artificial selection	<b>E</b>	predator-prey interaction	<b>G</b>	apical dominance	<b>B</b>	nitrogen fixation and nitrification	<b>D</b>	reproductive cloning	<b>A / F</b>	positive chemotaxis	<b>H</b>	decomposition	<b>C / D</b>	commercial use of plant hormones	<b>F</b>	8	<p><b>Award 1 mark per row.</b></p> <p><b>Mark the first answer in each box.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p>
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(b)	<p>respiration / decomposition / decay / ripening ;</p> <p><u>interspecific competition</u> ;</p> <p>(positive) <u>phototropism</u> ;</p> <p><u>succession</u> ;</p>	4	<p><b>Mark the first answer on each prompt line.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p> <p><b>ACCEPT</b> metabolism / metabolic reactions</p> <p><b>DO NOT CREDIT</b> negative phototropism  <b>DO NOT CREDIT</b> trophism (as ambiguous with trophic)</p>																			



Question		Answer	Marks	Guidance
	(c)	<p><i>animals = primary consumers</i></p> <p><b>1</b> keep animals, warm / indoors ;</p> <p><b>2</b> reduce animal movement ;</p> <p><b>3</b> feed animals high, protein / energy, food ;</p> <p><b>4</b> vaccination / (routine) antibiotics, for animals ;</p> <p><b>5</b> selective breeding / genetic engineering, for improved animals ;</p> <p><b>6</b> slaughter just before, mature / full size ;</p>	3	<p><b>2 ACCEPT</b> zero grazing idea</p> <p><b>3 ACCEPT</b> growth-enhancing food additives</p> <p><b>4 IGNORE</b> hormones</p> <p><b>5 ACCEPT</b> description of improvement, e.g. disease resistant, faster-growing, higher yielding</p>
<b>Total</b>			<b>15</b>	

Question			Answer	Marks	Guidance
5	(a)	(i)	<i>idea of tentative / uncertain / developing / advancing / improving / dynamic ;</i>	1	<b>IGNORE</b> change(s), changing, changeable (as given in question)
		(ii)	1 conservation / keep rare plants / save endangered plants ; 2 <u>gene bank</u> OR genetic resource / store of alleles ; 3 teaching / education ; 4 leisure / amenity / visitor attraction / aesthetic value ;	2	<b>Read as prose.</b> 1 <b>ACCEPT</b> prevent extinction / maintain biodiversity 3 <b>IGNORE</b> 'research' (as given in question)
	(b)	(i)	to, amplify / make (many) copies of, <u>DNA</u> ;  (range of) different lengths ;	2	<b>IGNORE</b> refs. to single stranded / coding strand / template strand  <b>CREDIT</b> idea of, chain terminating / dideoxy, nucleotides attaching at different points along sequence
		(ii)	to put DNA pieces in size order ;  to read, base sequence / order of bases ;	2	<b>IGNORE</b> speed or rate of movement, look for distance or position or pattern, e.g. shortest / lightest / smallest, lengths first or lighter move further and heavier move less far  <b>DO NOT CREDIT</b> 'put genome back in order'
		(iii)	to cut (genome DNA) into, small(er) / 750 bp, fragments ;  to cut, vectors / BACs / plasmids, (for gene library) ;	2	<b>ACCEPT</b> fragment size in range 500-1000 base pairs

Question		Answer	Marks	Guidance	
	(c)	genome, too big / very large ;  accuracy better / fewer errors (with small fragments) ;  divide job over, time / different labs ;	2	<b>ACCEPT ORA</b> only, small sections / 750bp, can be sequenced (at a time)  <b>CREDIT ORA</b> large sections sequenced less accurately  <b>ACCEPT</b> otherwise would take <u>too</u> long / be unmanageable / be impractical  <b>IGNORE</b> ref to efficiency	
	(d)	(i)	1 160 000 ; ;	2	<b>Correct answer = 2 marks (no units)</b>  <b>CREDIT</b> 1.16 <u>million</u> or $1.16 \times 10^6$  If answer incorrect, <b>award 1 mark</b> for $870 \text{ (million)} \div 750$  <b>AWARD</b> 1 max correct answer has inappropriate units (e.g. 1 160 000 Mbp = 1 mark)
		(ii)	(monkey flower) has, smaller genome / fewer Mbp DNA ;  fewer lab hours / fewer staff needed / quicker / cheaper ;	2	<b>Read as prose.</b>  <b>ACCEPT ORA</b> but must be comparative <b>IGNORE</b> refs to chromosome number  <b>ACCEPT ORA</b> but must be comparative
		(iii)	larger (in size) ;	1	<b>ACCEPT</b> bigger / plumper / juicier

Question		Answer	Marks	Guidance
	(e)	<p><i>phylogenetic approach</i></p> <p>no need to test for interbreeding ;</p> <p>ref. common ancestor / <u>monophyletic</u> groups ;</p> <p>can apply to organisms that reproduce asexually ;</p> <p>can apply to, extinct organisms / fossils ;</p>	2	<p><b>ORA</b> for biological species concept – (importance of members of same species) (inter)breeding to give fertile offspring</p> <p><b>IGNORE</b> clades</p> <p><b>ORA</b> for biological species concept – doesn't apply to asexually reproducing organisms</p> <p><b>ORA</b> for biological species concept – doesn't apply to, extinct organisms / fossils</p>
<b>Total</b>			<b>18</b>	

Question			Answer	Marks	Guidance								
6	(a)	(i)	<table border="1"> <tr> <td></td> <td>Discontinuous</td> <td>Continuous</td> </tr> <tr> <td>Species identified by letter</td> <td>S and T ;</td> <td>R ;</td> </tr> </table>		Discontinuous	Continuous	Species identified by letter	S and T ;	R ;	2			
	Discontinuous	Continuous											
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		(ii)	<p>statement 1 in S and T only ; statement 8 in S and T only ;</p> <p>statements 2 and 3 in R only ; statement 5 in R only ;</p> <p>statements 4 and 7 in T only ; statement 6 in S only ;</p>	6	<table border="1"> <thead> <tr> <th>Species</th> <th>Statement number(s)</th> </tr> </thead> <tbody> <tr> <td>R</td> <td>2 3 5</td> </tr> <tr> <td>S</td> <td>1 6 8</td> </tr> <tr> <td>T</td> <td>1 4 7 8</td> </tr> </tbody> </table>	Species	Statement number(s)	R	2 3 5	S	1 6 8	T	1 4 7 8
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Question	Answer	Marks	Guidance
(b)	<p><i>collection</i></p> <ol style="list-style-type: none"> <li>1. named equipment for collecting from, dogs / fields ;</li> <li>2. get, large number / over 100 (fleas) ;</li> <li>3. use several, dogs / fields ;</li> <li>4. <i>idea of random sampling</i> (dogs / field) ;</li> </ol> <p><i>testing</i></p> <ol style="list-style-type: none"> <li>5. (named) container ;</li> <li>6. correct dose / range (of concentrations), tested ;</li> <li>7. control without flea killer ;</li> <li>8. delivery method described ;</li> </ol> <p><i>processing</i></p> <ol style="list-style-type: none"> <li>9. leave for set time ;</li> <li>10. count number of, dead / live, fleas (after testing) ;</li> <li>11. calculate percentage (frequency) of, alive / dead / resistant / non-resistant ;</li> </ol>	6	<p><b>1 CREDIT</b> pooter, forceps, tweezers, pipette, (flea) comb, sweep net, sticky traps, light traps (in correct context)</p> <p><b>5 CREDIT</b> tank, jam jar, boiling tube, petri dish.</p> <p><b>6 ACCEPT</b> 'dose according to manufacturer's instructions' <b>IGNORE</b> same, volume / concentration</p> <p><b>8</b> e.g. flea-killer sprayed / left to evaporate from cotton wool / fed in blood or food</p> <p><b>9 ACCEPT</b> leave for same amount of time</p> <p><b>10 IGNORE</b> how many were left, how many were resistant <b>IGNORE</b> identify – must be counting number</p>
	QWC ;	1	<p>Award if the <b>first mark point awarded in each section is <u>in the correct section order.</u></b></p> <p>collection <b>1 to 4</b> <b>then</b> testing <b>5 to 8</b> <b>then</b> obtaining and processing results <b>9 to 11</b></p> <p><i>e.g. if the first mark of each section is awarded in the wrong order (such as mp 1, then mp 10, with nothing from the testing section inbetween) <b>then do not award QWC</b></i></p>
	<b>Total</b>	<b>15</b>	

Question			Answer	Marks	Guidance
7	(a)	(i)	<p>(both) to, avoid / counter, (abiotic) stress ;</p> <p>(both) to avoid, being eaten / predation ;</p> <p>(both) to access resources ;</p>	2	<p><b>Mark the first 2 reasons</b></p> <p><b>CREDIT</b> to avoid named stressors e.g. cold, heat, dryness, humidity or unfavourable conditions  <b>only CREDIT</b> descriptions relevant to both animals (avoiding a stressor) <b>and</b> to plants (closing stomata, wintering underground, etc).  <b>IGNORE</b> survival and dangers unqualified</p> <p><b>only CREDIT</b> descriptions relevant to both animals (being consumed, being preyed upon) <b>and</b> to plants (being grazed, herbivory).</p> <p><b>only CREDIT</b> descriptions relevant to both animals (get food) <b>and</b> plants (obtain light, minerals, water)</p>
		(ii)	<p><i>all points must show a clear comparison between mammals (M) and plants (P)</i></p> <p><b>1 (M)</b> made in <u>endocrine</u> glands <b>versus</b>                      (P) made in many plant tissues ;</p> <p><b>2 (M)</b> move in blood <b>versus</b>                      (P) move, in xylem / in phloem / from cell to cell ;</p> <p><b>3 (M)</b> act on, a few / specific / target, tissues <b>versus</b>                      (P) act on most tissues / can act in cells where produced ;</p> <p><b>4 (M)</b> act <u>more</u> rapidly ; <b>ORA</b></p>	3	<p><b>2(P) ACCEPT</b> diffusion / through plasmodesmata, for 'from cell to cell'.  <b>ACCEPT</b> by translocation / in transpiration stream  <b>IGNORE</b> mass flow</p> <p><b>4</b> must be comparative e.g. respond faster in mammals</p>
	(b)	(i)	<p>inherited / passed to offspring /                      passed (down) from parents ;</p> <p>(caused by) <u>mutation</u> / <u>allele</u> ;</p>	2	<p><b>ACCEPT</b> in context of condition or gene</p>

Question		Answer	Marks	Guidance
	(ii)	<p><u>gene</u> / <u>allele</u> ;</p> <p>(DNA) <u>ligase</u> ;</p> <p>transgenic / transformed ;</p> <p>antibiotic(s) ;</p> <p>(gene / DNA / fluorescent / radioactive) <u>probe</u> ;</p>	5	<p><b>Mark the first answer on each prompt line.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p> <p><b>ACCEPT</b> recombinant / GE / GM</p> <p><b>CREDIT</b> named antibiotic e.g. ampicillin, tetracycline</p>
	(c)	<p>fat soluble / non-polar / uncharged / hydrophobic ;</p> <p>(so can move directly through) phospholipid bilayer ;</p>	2	<p><b>ACCEPT</b> through phospholipids / through phospholipid membrane</p> <p><b>DO NOT CREDIT</b> through pores</p>



Question	Answer	Marks	Guidance
(d)	<p><b>EITHER</b></p> <p>1 (<i>lac</i>) <u>repressor protein</u> ;</p> <p>2 (repressor protein) changes shape when bound to lactose ;</p> <p>3 (with lactose) lifts off <u>operator</u> allowing, transcription / gene expression / binding of RNA polymerase to promoter ; <b>ORA</b></p> <p>4 <math>\beta</math>-galactosidase / enzyme(s) / structural gene(s) ;</p> <p><b>OR</b></p> <p>5 homeotic / homeobox / hox (genes) ;</p> <p>6 gene product / protein / transcription factor, binds to DNA ;</p> <p>7 gene product / protein, starts transcription / is a transcription factor ;</p> <p>8 many genes affected / controls body plan ;</p>	4	<p><b>Mark the first example.</b></p> <p><b>3 ORA</b> without lactose the protein binds to the <u>operator</u> stopping, transcription / gene expression / binding of RNA polymerase to promoter <b>DO NOT CREDIT</b> mp 3 if ref. made to DNA polymerase or DNA replication</p> <p><b>4 CREDIT</b> lactose permease</p> <p><b>6 CREDIT</b> homeobox domain / homeodomain, binds to DNA</p> <p><b>7 ACCEPT</b> controls / regulates / stops, transcription</p> <p><b>8 CREDIT</b> controls, development / segmentation</p>
	<b>Total</b>	<b>18</b>	

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