

GCE

Biology

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

Advanced GCE

Mark Scheme for June 2017

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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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These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation	Meaning
	Benefit of Doubt
	Contradiction
	Cross
	Error Carried Forward
	Given Mark
	Extendable horizontal wavy line
	Ignore
	Large dot (Key point attempted)
	Benefit of the doubt not given
	additional QWC credit given
	Tick
	Tick 1
	Tick 2
	Omission Mark

Subject specific instructions

Unless otherwise stated, accept phonetic spelling throughout unless there is clear ambiguity with another term.

For each correct mark point awarded the tick annotation should be used.

Ensure that the answers to all part questions are acknowledged with a suitable annotation – e.g.

an omission mark or NBOD if the answer is incomplete or not good enough

a wavy line if some information is inaccurate

CON if a potential mark point is contradicted

a cross if the answer is completely wrong.

Use BOD with care and only if you are certain that the answer is close enough to the required information for the mark.

Question			Answer	Mark	Guidance
1	(a)	(i)	<p>1 succession ;</p> <p>2 migration / <u>species</u> introduction / extinction ;</p> <p>3 named human activity ;</p> <p>4 population size (fluctuation) ;</p> <p>5 natural selection / genetic drift / evolution / speciation ;</p> <p>6 variation in named abiotic factor ;</p> <p>7 named natural disaster ;</p>	2 max	<p>CREDIT new, pathogen / disease</p> <p>CREDIT farming / hunting / building / deforestation / artificial selection / named form of pollution</p> <p>ACCEPT directional / disruptive, selection</p> <p>ACCEPT desertification, climate change</p> <p>e.g. volcanic eruption, flooding</p>
		(ii)	<p>1 collect , grass / plants / producers (from, 1 m² / quadrat) ;</p> <p>2 wash / remove, soil / organisms ;</p> <p>3 dry mass / dry in oven / heat to evaporate water ;</p> <p>4 ref. constant mass / oven at 105°C ;</p> <p>5 ref. (bomb) <u>calorimeter</u> ;</p> <p>6 energy (in kJ) = $\frac{\text{temperature rise} \times \text{mass of water} \times 4.2}{\text{(plant dry mass)}}$</p>	5 max	<p>DO NOT ACCEPT collect grassland</p> <p>IGNORE take a sample (of the plant)</p> <p>ACCEPT dry in microwave</p> <p>ACCEPT 101-110°C</p> <p>DO NOT ACCEPT calorimeter</p> <p>CREDIT ΔH for temperature rise / change</p> <p>CREDIT volume for mass of water</p> <p>CREDIT specific heat capacity / 4.18 for 4.2 J g⁻¹ °C⁻¹</p>
	(b)	(i)	<u>geographic</u> (al) ;	1	IGNORE allopatric
		(ii)	<p>DNA / nucleotide / base / gene, sequence (data) ;</p> <p>protein / amino acid, sequence (data) ;</p>	2	<p>IGNORE genome / mapping / cladistics</p> <p>IGNORE genotype sequencing</p> <p>IGNORE genetic fingerprinting / DNA profiling</p> <p>ACCEPT named e.g. cytochrome c, haemoglobin</p>
		(iii)	they can produce fertile offspring ;	1	IGNORE viable

Question			Answer	Mark	Guidance
	(c)		<i>giant tortoises (accept ORA for mammal throughout)</i> 1 ectotherm(ic) / control temperature by behaviour / do not use much energy to regulate temperature ; 2 low, BMR / metabolism / rate of respiration ; 3 moves, less / slowly ;	2 max	IGNORE don't need to eat ACCEPT poikilothermic DO NOT ACCEPT cold-blooded ACCEPT slow, BMR / metabolism ACCEPT less active / less energy lost in movement
	(d)	(i)	$year = 365 / 366 / 365.25 \text{ days}$ $51100\ 000 / 51\ 240\ 000 / 51\ 135\ 000, \text{ kg (year}^{-1}\text{)} ; ;$	2	correct with units = 2 missing or incorrect units = 1 CREDIT $5.11 \times 10^7 \text{ kg}$, etc OR 51 100 tonnes, etc ACCEPT kg / year DO NOT ACCEPT kJ If answer is incorrect, then allow 1 mark for : $4000 \times 35 \text{ (1 day) or}$ $35 \times 365 \text{ (1 tortoise) or } 35 \times 366 \text{ or } 35 \times 365.25$
		(ii)	less (interspecific) competition (for food) ;	1	DO NOT ACCEPT intraspecific competition
	(e)		(increases), employment / jobs / income / profit / revenue, from, (eco)tourism / scientific research / grants ;	1	
			Total	17	

Question			Answer	Mark	Guidance
2	(a)		(positive) <u>phototropism</u> ;	1	DO NOT ACCEPT phototropHism / phototaxis
2	(b)	(i)	<p>control experiments</p> <p>E1 <i>control</i> intact / AW, seedling / shoot, (without tip removed) ; <i>explanation of purpose</i> to, show / compare, normal height of intact seedling ;</p> <p>E2 <i>control</i> seedling / shoot, with tip removed ; <i>explanation of purpose</i> to show, height without auxin / that elongation depends on, tip / auxin ;</p> <p>E3 <i>control</i> seedling / shoot, with tip removed and replaced with agar block (that does not contain auxin) ; <i>explanation of purpose</i> to show that agar does not cause elongation ;</p> <p>E4 <i>control</i> seedling / shoot, plus barrier plus agar with auxin ; <i>explanation of purpose</i> to show that auxin moves downwards / AW ;</p> <p>control variables</p> <p>V1 <i>variable</i> temperature ; <i>explanation / purpose</i> ref. <u>enzyme</u> activity / limiting factor on Calvin cycle ;</p> <p>V2 <i>variable</i> carbon dioxide <u>concentration</u> ; <i>explanation / purpose</i> rate of / limiting factor on, Calvin cycle ;</p>		<p>CREDIT growth for height / elongation throughout</p> <p>ACCEPT limiting factor on light independent reaction IGNORE dark reaction</p> <p>ACCEPT light independent reaction IGNORE dark reaction</p>

Question			Answer	Mark	Guidance
			<p>V3 <i>variable</i> light intensity ; <i>explanation / purpose</i> rate of / limiting factor on, light dependent reaction;</p> <p>V4 <i>variable</i> light wavelength ; <i>explanation / purpose</i> rate of / limiting factor on, light dependent reaction ;</p> <p>V5 <i>variable</i> water availability ; <i>explanation / purpose</i> ref. osmosis / turgor / cell elongation ;</p> <p>V6 <i>variable</i> variety / species of barley ; <i>explanation / purpose</i> ref. genetic potential for growth ;</p> <p>V7 <i>variable</i> age of seedling ; <i>explanation / purpose</i> different, initial heights / growth rates ;</p> <p>V8 <i>variable</i> size of agar block ; <i>explanation / purpose</i> ref. diffusion / concentration, of auxin ;</p> <p>V9 <i>variable</i> length of time, tip is on agar / agar is on seedling ; <i>explanation / purpose</i> ref. diffusion / concentration, of auxin ;</p> <p>V10 <i>variable</i></p>		<p>ACCEPT photolysis / photophosphorylation IGNORE light reaction</p> <p>ACCEPT photolysis / photophosphorylation IGNORE light reaction</p> <p>IGNORE transpiration</p> <p>ACCEPT different responses to auxin</p>

Question			Answer	Mark	Guidance						
			length / mass, of shoot tip removed ; <i>explanation / purpose</i> ref. concentration, of auxin ;	4 max							
		(ii)	temperature ; carbon dioxide concentration ; water availability ; variety / species, of barley ; age of seedling ; size of agar block ; length of time, tip is on agar / agar is on seedling ; length / mass, of shoot tip removed ;	2 max	Mark first two responses only. DO NOT ACCEPT repeat variable from (i)						
	(c)	(i)	<table><tr><th><i>Plant hormone</i></th><th><i>Change in levels (e.g. increase, decrease or stays the same)</i></th></tr><tr><td><i>auxin</i></td><td>decrease</td></tr><tr><td><i>ethene</i></td><td>and increase ;</td></tr></table>	<i>Plant hormone</i>	<i>Change in levels (e.g. increase, decrease or stays the same)</i>	<i>auxin</i>	decrease	<i>ethene</i>	and increase ;	1	Both rows need to be correct for the mark to be awarded
<i>Plant hormone</i>	<i>Change in levels (e.g. increase, decrease or stays the same)</i>										
<i>auxin</i>	decrease										
<i>ethene</i>	and increase ;										
		(ii)	(increase) competition ; insect / mollusc, herbivory / attack ; (bacterial / viral / fungal) pathogen / disease ;	1 max	ACCEPT allelopathy DO NOT ACCEPT herbivory / grazing unqualified						
	(d)	(i)	8 704 or 17 409 ; ;	2	Correct answer = 2 marks If answer is incorrect, allow 1 mark for 8 705 or 52 230 ÷ 2 ÷ 3						

Question			Answer	Mark	Guidance																														
					or 17 410 or 52 230 ÷ 3																														
	(d)	(ii)	<table><tr><th>Statement</th><th>mRNA</th><th>rRNA</th><th>tRNA</th><td></td></tr><tr><td>binds to amino acid by condensation</td><td></td><td></td><td>✓</td><td>;</td></tr><tr><td>carries a DNA transcript from nucleus to cytoplasm</td><td>✓</td><td></td><td></td><td>;</td></tr><tr><td>found in the nucleus</td><td>✓</td><td>✓</td><td>✓</td><td>;</td></tr><tr><td>present in the ribosome</td><td>✓</td><td>✓</td><td>✓</td><td>;</td></tr><tr><td>structural component of organelle</td><td></td><td>✓</td><td></td><td>;</td></tr></table>	Statement	mRNA	rRNA	tRNA		binds to amino acid by condensation			✓	;	carries a DNA transcript from nucleus to cytoplasm	✓			;	found in the nucleus	✓	✓	✓	;	present in the ribosome	✓	✓	✓	;	structural component of organelle		✓		;	5	<p>Award 1 mark for each correct row DO NOT CREDIT if additional tick(s) in a row DO NOT ACCEPT hybrid ticks ACCEPT crosses in blank squares</p>
Statement	mRNA	rRNA	tRNA																																
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present in the ribosome	✓	✓	✓	;																															
structural component of organelle		✓		;																															

Question			Answer	Mark	Guidance
	(d)	(iii)	<p>1 take (named) explants from (GM), lavender / plant ;</p> <p>2 sterilise with, bleach / sodium hypochlorite / ethanol ;</p> <p>3 ref. growth / nutrient / culture, medium OR agar ;</p> <p>4 ref. callus formation or mass of , undifferentiated / totipotent , cells ;</p> <p>5 auxin and cytokinin promote, mitosis / cell division ;</p> <p>6 subdivide callus / sub-culturing ;</p> <p>7 (high / increase), cytokinin (: auxin ratio) for shoots ;</p> <p>8 (high / increase), auxin (: cytokinin ratio) for roots ;</p> <p>9 transfer to , greenhouse / soil / non-sterile environment ;</p> <p>QWC – link the roles of named plant hormones to steps in process ;</p>	<p>4 max</p> <p>1</p>	<p>1 e.g. pieces of, leaf / stem / root / bud / meristem / apex DO NOT CREDIT a single cutting or cells</p> <p>3 CREDIT linked to mps 7 / 8 also</p> <p>7 CREDIT cytokinin : auxin ratio = 4 : 1 for shoots 8 CREDIT auxin : cytokinin ratio = 100 : 1 for roots ECF for mp 8 from incorrect mp 7</p> <p>IGNORE gibberellins / other plant hormones and other effects of auxin such as lateral inhibition / phototropism / stem elongation</p> <p>Answer includes two of mps 5, 7 and 8 linked to correct sequence of steps in process.</p>
			Total	21	

Question			Answer	Mark	Guidance
3	(a)	H1	<i>habituation</i> : (innate / instinctive), response decreases after repeated, exposure / stimulus ;	5 max	<p>ACCEPT innate / instinctive / automatic / involuntary, response for reflex</p> <p>ACCEPT strengthened / idea of training or learning</p> <p>ACCEPT response is to a second stimulus (chemical) OR lions do not stop having upset stomach response after eating treated beef</p> <p>ACCEPT pain / stomach upset, for chemical</p> <p>ACCEPT lions' instinct to eat beef stops so not classical</p> <p>ACCEPT lions learn that beef causes them pain</p> <p>ACCEPT poisoned / tainted / contaminated, beef for beef plus chemical</p> <p>ACCEPT causes a bad outcome</p>
		C1	<i>classical</i> : two stimuli occur together so reflex triggered by, new / conditioned, stimulus ;		
		O1	<i>operant</i> : (chance / voluntary) action is, reinforced by reward / deterred by punishment ;		
		H2	decreased response to beef is not due to repeated (beef) stimulus / nausea response to chemical does not decrease ;		
		C2	lions learn to <u>associate</u> beef and, chemical (stimuli) ;		
		C3	sickness reflex to chemical now due to beef, alone / instead ;		
		O2	lions <u>associate</u> eating beef with, pain / stomach upset ;		
		O3	eating beef + chemical is, negatively reinforced / punished ;		
		O4	ref. trial and error learning ;		
	(b)	(i)	memory ; speech ;	2	If additional cells are ticked, max 1 for 1 extra tick and 0 marks if 2 or more extra ticks

Question			Answer	Mark	Guidance
		(ii)	<p>1 myelin / Schwann cells ;</p> <p>2 increased speed (of, transmission / impulse) ;</p> <p>3 <u>saltatory conduction</u> ;</p> <p>4 depolarisation / action potential / ion movement, only at nodes (of Ranvier) ;</p> <p>5 longer <u>local circuits</u> ;</p>	3	<p>ACCEPT faster, quicker, speeded up</p> <p>DO NOT ACCEPT an action potential is faster</p> <p>ACCEPT depolarisation / action potential / impulse, jumps from node to node</p> <p>ACCEPT only at gaps, between Schwann cells / in myelin sheath</p>
	(c)	(i)	<p>biceps and triceps ;</p> <p>to bend / flex, biceps contracts and triceps relaxes</p> <p>or</p> <p>to straighten / extend, biceps relaxes and triceps contracts ;</p>	2	<p>ACCEPT bicep and tricep</p> <p>e.g. 'to bend, biceps contracts and triceps relaxes' = 2 marks (mps 1 & 2)</p>
		(ii)	(Pi from) creatine phosphate / phosphocreatine ;	1	
	(d)		<p>B and E occur together (in either order) ;</p> <p>C and D or C and H, occur together (in either order) ;</p> <p>F and G occur together (in any order) ;</p> <p>F B A appear in this order in cycle (any start point) ;</p>	4	<p>ACCEPT letters at start and end as together (cycle)</p> <p>IGNORE intervening letters ACCEPT B A F / A F B</p>
			Total	17	

Question			Answer	Mark	Guidance
4	(a)		overgrazing / eating many, plants ; <u>interspecific competition</u> with (native) animals; burrows / warrens, kill / decrease, plants ; destroy habitats for (native), animals / plants ;	2 max	DO NOT ACCEPT competing with plants
	(b)	(i)	use (living) organisms to , control / decrease, population ;	1	ACCEPT microorganisms / pathogens
		(ii)	(–) 92 % ; ;	2	<p>Correct answer = 2 marks even if no working shown 1 mark if no units. 1 mark for working if final answer incorrect:</p> $\frac{500 - 40}{500} \times 100 \quad \text{or} \quad \frac{460}{500} \times 100$ <p>ACCEPT $\frac{40}{500} \times 100 = 8\%$</p> <p>ACCEPT working with 6 extra zeros on figs, or figs x 10^6</p>
		(iii)	live in , warrens / (large) groups ; low <u>herd immunity</u> ;	1 max	<p>IGNORE high density / density-dependent IGNORE not resistant</p>

Question			Answer	Mark	Guidance
		(iv)	(genetic) <u>resistance</u> , developed / evolved ; <u>immunity</u> increased / more rabbits were <u>immune</u> ; more rabbits were born than died ; carrying capacity not reached / named factor not yet limiting ;	2 max	DO NOT ACCEPT mp2 if linked to natural selection or mutation.
		(v)	fleas , are vectors / transmit virus ; fleas are parasitic and weaken , host / rabbit ;	1 max	ACCEPT spread / carry, the virus
		(vi)	foxes eats , new / other, prey / species ;	1	ACCEPT rabbits not foxes', only / main, prey
	(c)	(i)	DNA ; polymerase chain reaction / PCR ;	2	IGNORE RNA / genetic material / genes
		(ii)	3 ; 4 ;	2	CREDIT in either order
		(iii)	antibodies / immunoglobulins ;	1	ACCEPT IgG / IgA
			Total	15	

Question			Answer	Mark	Guidance
5	(a)	(i)	<p>A3242G / gene, contained in (DNA of) <u>mitochondria</u> ;</p> <p><u>mitochondria</u>, are in ovum cytoplasm / come from mother</p> <p>OR</p> <p><u>mitochondria</u> do not come from, sperm / father ;</p> <p>(only) mother can / father cannot, pass on, A3242G / gene ;</p>	3	<p>ACCEPT mutation / mutated gene / mutant gene / allele throughout.</p> <p>ACCEPT A3242G / gene, contained in mitochondrial DNA</p> <p>ACCEPT mitochondrial DNA for mitochondria</p> <p>CREDIT 100% inheritance / all offspring inherit, (dominant) gene / MIMD, from affected mother OR all offspring are affected if mother is affected OR no offspring of affected father inherit, gene / MIMD</p>
		(ii)	<p>males, are XY / have one copy of, gene / allele ; ora for ♀ one copy gives, affected male / carrier female ;</p> <p>affected / (a) mother will have sons that are (all) affected ;</p> <p>affected / (a), mother will have daughters that are carriers ;</p> <p>affected / (b), father will have unaffected sons ;</p> <p>affected / (b), father will have daughters that are carriers ;</p>	3 max	<p>ACCEPT sons / fathers / boys / men, for ♂ throughout and daughters / mothers / girls / women, for ♀ throughout</p> <p>CREDIT affected males are hemizygous / affected females are homozygous</p> <p>ACCEPT have (named sex-linked recessive) condition for affected</p>

Question			Answer	Mark	Guidance										
		(iii)	substitution ; <u>adenine</u> changed to <u>guanine</u> ; at , base / nucleotide / position , 3 242 ;	2 max	DO NOT CREDIT insertion / deletion / frameshift CREDIT adenine is substituted by guanine (2 marks) DO NOT CREDIT adenine is substituted for guanine										
		(iv)	number / proportion, of mitochondria with mutation ;	1											
	(b)	(i)	amino acid sequence / primary structure / tertiary structure, different ;	1	IGNORE base / nucleotide sequence										
		(ii)	<table><tr><th>Plasmid feature</th><th>Importance</th></tr><tr><td>Small size</td><td>taken up / AW, by bacteria ;</td></tr><tr><td>Plasmid passes to both daughter cells in binary fission</td><td><u>all</u> offspring GM / <u>all</u> cells produce insulin / product ;</td></tr><tr><td>Contains at least one active promoter</td><td>switch on / transcribe, gene OR allows RNA polymerase to bind ;</td></tr><tr><td>Can be cut by different enzymes in different places</td><td>insert new gene ;</td></tr></table>	Plasmid feature	Importance	Small size	taken up / AW, by bacteria ;	Plasmid passes to both daughter cells in binary fission	<u>all</u> offspring GM / <u>all</u> cells produce insulin / product ;	Contains at least one active promoter	switch on / transcribe, gene OR allows RNA polymerase to bind ;	Can be cut by different enzymes in different places	insert new gene ;	4	Award 1 mark for each correct row ACCEPT taken up by <i>E. coli</i> CREDIT transgenic / have new gene, for GM CREDIT produces GM clone IGNORE switching off, translat(ion), activated CREDIT control gene expression DO NOT CREDIT swap or replace genes IGNORE accept gene CREDIT section of (new / foreign) DNA for gene
Plasmid feature	Importance														
Small size	taken up / AW, by bacteria ;														
Plasmid passes to both daughter cells in binary fission	<u>all</u> offspring GM / <u>all</u> cells produce insulin / product ;														
Contains at least one active promoter	switch on / transcribe, gene OR allows RNA polymerase to bind ;														
Can be cut by different enzymes in different places	insert new gene ;														
			Total	14											

Question			Answer	Mark	Guidance
6	(a)		<p><i>both:</i></p> <p>S1 use a, fermenter / bioreactor ;</p> <p>S2 are on a, large / industrial, scale ;</p> <p>S3 control, pH / temperature ;</p> <p>S4 maintain / require, aseptic conditions ;</p> <p>D1 <i>continuous:</i> nutrients added and products removed, constantly / at intervals OR <i>batch:</i> nutrients added, once / at start / in fixed amount, and products removed, once / at end ;</p> <p>D2 <i>continuous:</i> exponential / log, phase maintained OR <i>batch:</i> stationary / death, phase(s) occur ;</p> <p>D3 <i>continuous:</i> used to make (only) primary metabolite OR <i>batch:</i> used to make secondary metabolite ;</p> <p>D4 <i>continuous:</i> more problems from contamination OR <i>batch:</i> contamination affects one batch only ;</p>	4 max	<p>IGNORE fermentator</p> <p>CREDIT both require optimum temperature / pH</p> <p>CREDIT named nutrient e.g. glucose, amino acids, minerals, ammonia.</p> <p>IGNORE waste (products)</p> <p>IGNORE primary metabolites also made in batch culture</p> <p>ACCEPT more chance of contamination</p> <p>IGNORE disease</p>
			QWC ;	1	Award for 2 S marks plus 2 D marks
	(b)		<p>nitrates and sulfates / NO_3^- and SO_4^{2-}, for protein / polypeptides ;</p> <p>nitrates and phosphates / NO_3^- and PO_4^{3-}, for , DNA / RNA / nucleic acids ;</p>	2	<p>DO NOT CREDIT if phosphates stated also</p> <p>DO NOT CREDIT if sulfates stated also</p>
Total				7	

Question			Answer	Mark	Guidance
7	(a)	(i)	<u>DNA replication</u> OR pairs of chromatids / sister chromatids, formed ; condensation / supercoiling / tight packing, (of DNA) ;	2	IGNORE doubling DO NOT ACCEPT sister chromatids pair up IGNORE become visible
		(ii)	3 ; 1 and 3 and 5 ; ;	3	IGNORE 1 All 3 correct = 2 marks 2 correct = 1 mark 1 or 0 correct = 0 marks
		(iii)	<u>mutation</u> (during replication) ;	1	DO NOT CREDIT if additional answers are given that are incorrect, e.g. independent assortment / crossing over
	(b)	(i)	happens, in asexual reproduction / naturally / in nature plus example ;	1	e.g. (root) suckers / basal sprouts / runners / bulbs / tubers / fragmentation / budding / binary fission / formation of identical twins IGNORE vegetative propagation
		(ii)	environmental effects ; detail ; e.g. nutrition / light / pathogens / temperature imprinting / epigenetics ; (somatic) mutation ; copies of, parent / mother, not each other ;	2 max	CREDIT random X inactivation
			Total	9	

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