OCR
Oxford Cambridge and RSA

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.

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

Annotation	Meaning
BOD	Benefit of Doubt
CON	Contradiction
	Cross
ECF	Error Carried Forward
GM	Given Mark
	Extendable horizontal wavy line
I	Ignore
	Large dot (Key point attempted)
NBOD	Benefit of the doubt not given
QWC+	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)	**1** succession **;** **2** migration / <u>species</u> introduction / extinction **;** **3** named human activity **;** **4** population size (fluctuation) **;** **5** natural selection / genetic drift / evolution / speciation **;** **6** variation in named abiotic factor **;** **7** named natural disaster **;**	**2 max**	**CREDIT** new, pathogen / disease **CREDIT** farming / hunting / building / deforestation / artificial selection / named form of pollution **ACCEPT** directional / disruptive, selection **ACCEPT** desertification, climate change e.g. volcanic eruption, flooding
		(ii)	**1** collect **,** grass / plants / producers (from,1 m^2 / quadrat) **;** **2** wash / remove, soil / organisms **;** **3** dry mass / dry in oven / heat to evaporate water **;** **4** ref. constant mass / oven at 105°C **;** **5** ref. (bomb) <u>calorimeter</u> **;** **6** energy (in kJ) = <u>temperature rise x mass of water x 4.2</u> (plant dry mass)	**5 max**	**DO NOT ACCEPT** collect grassland **IGNORE** take a sample (of the plant) **ACCEPT** dry in microwave **ACCEPT** 101-110°C **DO NOT ACCEPT** colorimeter **CREDIT** ΔH for temperature rise / change **CREDIT** volume for mass of water **CREDIT** specific heat capacity / 4.18 for 4.2 J g^{-1} $^{\circ}C^{-1}$
	(b)	(i)	<u>geographic</u>(al) **;**	**1**	**IGNORE** allopatric
		(ii)	DNA / nucleotide / base / gene**,** sequence (data) **;** protein / amino acid**,** sequence (data) **;**	**2**	**IGNORE** genome / mapping / cladistics **IGNORE** genotype sequencing **IGNORE** genetic fingerprinting / DNA profiling **ACCEPT** named e.g. cytochrome c, haemoglobin
		(iii)	they can produce fertile offspring **;**	**1**	**IGNORE** viable

Question			Answer	Mark	Guidance
	(c)		*giant tortoises (accept ORA for mammal throughout)* **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 days* 51100 000 / 51 240 000 / 51 135 000 **,** kg (year $^{-1}$) **; ;**	**2**	correct with units = 2 missing or incorrect units = 1 **CREDIT** 5.11 x 10^7 kg, etc OR 51 100 tonnes, etc **ACCEPT** kg / year **DO NOT ACCEPT** kJ If answer is incorrect, then allow 1 mark for : 4000 x 35 (1 day) **or** 35 x 365 (1 tortoise) **or** 35 x 366 **or** 35 x 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) phototropism ;	1	**DO NOT ACCEPT** phototrop**H**ism / phototaxis
2	(b)	(i)	***control experiments*** **E1** *control* intact / AW, seedling / shoot, (without tip removed) ; *explanation of purpose* to, show / compare, normal height of intact seedling ; **E2** *control* seedling / shoot, with tip removed ; *explanation of purpose* to show, height without auxin / that elongation depends on, tip / auxin ; **E3** *control* seedling / shoot, with tip removed **and** replaced with agar block (that does not contain auxin) ; *explanation of purpose* to show that agar does not cause elongation ; **E4** *control* seedling / shoot, plus barrier plus agar with auxin ; *explanation of purpose* to show that auxin moves downwards / AW ; ***control variables*** **V1** *variable* temperature ; *explanation / purpose* ref. enzyme activity / limiting factor on Calvin cycle ; **V2** *variable* carbon dioxide concentration ; *explanation / purpose* rate of / limiting factor on, Calvin cycle ;		**CREDIT** growth for height / elongation throughout **ACCEPT** limiting factor on light independent reaction **IGNORE** dark reaction **ACCEPT** light independent reaction **IGNORE** dark reaction

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

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

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>or 17 410 or 52 230 ÷ 3</td></tr>
<tr><td></td><td>(d)</td><td>(ii)</td><td>
<table>
<tr><th>Statement</th><th>mRNA</th><th>rRNA</th><th>tRNA</th></tr>
<tr><td>binds to amino acid by condensation</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></tr>
<tr><td>found in the nucleus</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>present in the ribosome</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>structural component of organelle</td><td></td><td>✓</td><td></td></tr>
</table>
;
;
;
;
;
</td><td>5</td><td>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</td></tr>
</table>

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

Question			Answer	Mark	Guidance
3	(a)	H1	*habituation:* (innate / instinctive), response decreases after repeated, exposure / stimulus **;**		
		C1	*classical:* two stimuli occur together so **reflex** triggered by, new / conditioned, stimulus **;**		**ACCEPT** innate / instinctive / automatic / involuntary, response for reflex
		O1	*operant: (*chance / voluntary) action is, reinforced by reward / deterred by punishment **;**		**ACCEPT** strengthened / idea of training or learning
		H2	decreased response to beef is not due to repeated (beef) stimulus / nausea response to chemical does not decrease **;**		**ACCEPT** response is to a second stimulus (chemical) **OR** lions do not stop having upset stomach response after eating treated beef
		C2	lions learn to <u>associate</u> beef and, chemical (stimuli) **;**		**ACCEPT** pain / stomach upset, for chemical
		C3	sickness reflex to chemical now due to beef, alone / instead **;**		**ACCEPT** lions' instinct to eat beef stops so **not** classical
		O2	lions <u>associate</u> eating beef with, pain / stomach upset **;**		**ACCEPT** lions learn that beef causes them pain
		O3	eating beef + chemical is, negatively reinforced / punished **;**		**ACCEPT** poisoned / tainted / contaminated, beef for beef plus chemical
		O4	ref. trial and error learning **;**	**5 max**	**ACCEPT** causes a bad outcome
	(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)	**1** myelin / Schwann cells **;** **2** increased speed (of, transmission / impulse) **;** **3** <u>saltatory conduction</u> **;** **4** depolarisation / action potential / ion movement, **only** at nodes (of Ranvier) **;** **5** longer <u>local circuits</u> **;**	**3**	**ACCEPT** fast**er**, quick**er**, speeded up **DO NOT ACCEPT** an action potential is faster **ACCEPT** depolarisation / action potential / impulse, jumps from node to node **ACCEPT** only at gaps, between Schwann cells / in myelin sheath
	(c)	**(i)**	biceps **and** triceps **;** to bend / flex, biceps contracts **and** triceps relaxes **or** to straighten / extend, biceps relaxes **and** triceps contracts **;**	**2**	**ACCEPT** bicep and tricep e.g. 'to bend, biceps contracts and triceps relaxes' **= 2 marks** (mps 1 & 2)
		(ii)	(Pi from) creatine phosphate / phosphocreatine **;**	**1**	
	(d)		**B** and **E** occur together (in either order) **;** **C** and **D** **or** **C** and **H,** occur together (in either order) **;** **F** and **G** occur together (in any order) **;** **F B A** appear in this order in cycle (any start point) **;**	**4**	**ACCEPT** letters at start and end as together (cycle) **IGNORE** intervening letters **ACCEPT B A F / A F B**
			Total	**17**	

Question			Answer	Mark	Guidance
4	(a)		overgrazing / eating many, plants **;** interspecific competition 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**	**Correct answer = 2 marks** even if no working shown **1 mark if no units.** **1 mark for working if final answer incorrect:** $\frac{500 - 40}{500} \times 100$ **or** $\frac{460}{500} \times 100$ **ACCEPT** $\frac{40}{500} \times 100 = 8\%$ **ACCEPT** working with 6 extra zeros on figs, or figs x 10^6
		(iii)	live in **,** warrens / (large) groups **;** low herd immunity **;**	**1 max**	**IGNORE** high density / density-dependent **IGNORE** not resistant

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

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Mark</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>(iii)</td><td>substitution ;
<u>adenine</u> changed to <u>guanine</u> ;

at , base / nucleotide / position , 3 242 ;</td><td>2 max</td><td>DO NOT CREDIT insertion / deletion / frameshift
CREDIT adenine is substituted by guanine (2 marks)
DO NOT CREDIT adenine is substituted for guanine</td></tr>
<tr><td></td><td></td><td>(iv)</td><td>number / proportion, of mitochondria with mutation ;</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>amino acid sequence / primary structure / tertiary structure, different ;</td><td>1</td><td>IGNORE base / nucleotide sequence</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>
<table>
<tr><th>Plasmid feature</th><th>Importance</th><th></th></tr>
<tr><td>Small size</td><td>taken up / AW, by bacteria</td><td>;</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><td>;</td></tr>
<tr><td>Contains at least one active promoter</td><td>switch on / transcribe, gene OR allows RNA polymerase to bind</td><td>;</td></tr>
<tr><td>Can be cut by different enzymes in different places</td><td>insert new gene</td><td>;</td></tr>
</table>
</td><td>4</td><td>Award 1 mark for each correct row

ACCEPT taken up by E. coli

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</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>14</td><td></td></tr>
</table>

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

Question			Answer	Mark	Guidance
7	(a)	(i)	DNA replication **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)	mutation (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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