RECOGNISING ACHIEVEMENT

GCE

Biology

Advanced GCE

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

Mark Scheme for January 2011

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of pupils of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, OCR Nationals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

It is also responsible for developing new specifications to meet national requirements and the needs of students and teachers. OCR is a not-for-profit organisation; any surplus made is invested back into the establishment to help towards the development of qualifications and support which keep pace with the changing needs of today's society.

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.

Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

Question			Expected Answer	Mark	Additional Guidance
1	(a)	(i)	**1** *idea that* (produces) large **,** yield / volume / amount**,** of milk **;** **2** *idea of* long lactation period **;** **3** *idea of* high milk quality **;** **4** large udders / correct udder shape (for milking machine) **;** **5** resistance to **,** (named) disease / mastitis / pathogens **or** effective immune system **;** **6** *idea of* calm temperament **;** **7** AVP **;**	**3 max**	**Mark the first suggestion on each line** ***1*** **DO NOT CREDIT** milk yield unqualified ***2*** ***3*** **DO NOT CREDIT** milk quality unqualified or ref. meat ***4*** ***5*** **DO NOT CREDIT** disease free ***6*** **CREDIT** docile / placid ***7*** eg • walk / stand **,** comfortably without need for hoof-trimming • *idea that* converts food to milk efficiently
1	(a)	(ii)	normal shaped curve **;** shifted to the right of original **;**	**2**	Position of curve must meet the following conditions: • **curve must end** to right of original end • **must not start** to left of original • **may start** at same point as original or to right of original

Question			Expected Answer	Mark	Additional Guidance
1	(a)	(iii)	**1** artificial insemination / AI **;** **2** in vitro fertilisation / IVF **;** **3** *idea of* progeny testing **;** **4** embryo transplantation / use of surrogate mother **;** **5** cloning **;** **6** genetic screening / use of gene probes **;** **7** AVP **;** **8** AVP **;**	**2 max**	**Mark the first suggestion on each line** ***1*** **IGNORE** performance testing ***2*** ***3*** ***4*** **CREDIT** embryo splitting ***5*** ***6*** **ACCEPT** genetic engineering ***7*** eg ● sex selection technique / screening X and Y sperm ***8*** eg ● portmanteau animals
1	(b)	(i)	*idea of* change to **,** <u>DNA</u> / <u>base</u>(s) / <u>nucleotide</u>(s) **;**	**1**	
1	(b)	(ii)	natural / directional **,** selection **;**	**1**	**ACCEPT** evolution **DO NOT CREDIT** genetic drift
1	(c)	(i)	*regulatory* *idea that* makes **,** repressor protein / transcription factor **or** *idea that* product switches (structural / another) gene **,** on / off **;** *structural* *idea that* makes **,** enzyme / polypeptide / protein **;** *relationship between the 2* *idea that* regulatory <u>gene</u> **,** controls / affects **,** the expression of structural <u>gene</u> **;**	**2 max**	**ACCEPT** 'makes regulatory protein' **ACCEPT** 'switching on / off' for idea of control **IGNORE** explanation involving repetition of word "regulates"

Question			Expected Answer		Mark	Additional Guidance
1	(c)	(ii)	lactose has been **,** removed / digested / respired / broken down (by bacteria) **;** to **,** lactic acid / lactate / other sugars **;** yogurt still a good source of **,** calcium / vitamins **;**		**2 max**	**DO NOT CREDIT** if context wrong (eg heat) eg ● glucose (and galactose)
1	(d)		**1** lactose binds to repressor protein **;** **2** changes **,** shape / structure (of protein) **;** **3** removes it from / stops it binding to **,** operator **;** **4** RNA polymerase binds to promoter **;** **5** *idea that* (so that Z and Y) are **,** transcribed / mRNA made **;**		**3 max**	***1*** **DO NOT CREDIT** regulator substance ***2*** **IGNORE** ref. to active site ***3*** ***4*** **DO NOT CREDIT** DNA polymerase ***5*** **CREDIT** lactose permease and β-galactosidase for Z and Y **IGNORE** gene **,** switched on / expressed
				Total	**16**	

Question			Expected Answer	Mark	Additional Guidance
2	(a)			6	**For each box, mark the first answer that will result in a mark being awarded.** If an additional answer is given that is incorrect or contradictory then **= 0 marks** **IGNORE** information in second or third boxes across row that is identical to 1st or 2nd box – each box should be different (as Q asks for differences between the types) eg striated(✓) unstriated(✓) striated = **2** multinucleate(✓) uninucleate(✓) uninucleate = **2** striated(✓) unstriated(✓) striated multinucleate uninucleate uninucleate(✓) = **3** **CREDIT** drawings if feature such as striated / multinucleate / uninucleate**,** are clearly shown *** ACCEPT** description of striated / non striated (eg stripey) **** ACCEPT** control **,** blood pressure / diameter of blood vessels / diameter of airways **** CREDIT** vasoconstriction / vasodilation **,** for controlling diameter of blood vessels

	voluntary (skeletal)	involuntary (smooth)	cardiac
cellular structure	*striated / bands of actin & myosin **or** cylindrical cells **or** multinucleate **;**	*unstriated / *non striated **or** spindle-shaped cells **or** uninucleate **;**	*striated **or** branched cells **or** uninucleate **or** interlocking / junctions / intercalated discs **;**
function	to move **,** bones / skeleton / joints / (named) limbs **;**	*idea of* **controlling diameter of **,** arteries / arterioles / bronchi / bronchioles **or** peristalsis **or** uterine contraction **or** control pupil size **;**	to pump blood / AW **;**

Question			Expected Answer		Mark	Additional Guidance	
2	(b)		*voluntary* intercostal / diaphragm **;** *involuntary* bronchi / bronchioles / arteries / arterioles / aorta / oesophagus **;** *cardiac* heart **;**		**3**	**CREDIT** trapezius / deltoid / pectorals / latissimus dorsi / rotator cuff muscles **ACCEPT** 'between the ribs' for intercostal **DO NOT CREDIT** named artery not found in thorax **IGNORE** gut unqualified **ACCEPT** walls of **,** atria / ventricle(s)	
2	(c)		(cardiac) **D ;** (clapping) **B ;** (bicycle) **C ;**		**3**		
2	(d)			*monkeys rather than rats* **1** *idea that* (humans & monkeys) closely related / share more genes / share a common ancestor **;** **2** (humans & monkeys) both <u>primates</u> **;** **3** *idea that* brain / body **,** structure / physiology / behaviour **,** similar (to humans) **;** **4** monkey brain bigger (than rat) **;** ***max 2*** *comment* **5** argument in favour **;** **6** argument against **;** ***max 2***	**3 max**	**MAXIMUM 2 marks from either section** ***1*** **DO NOT CREDIT** 'monkeys are closest ancestors to humans' ***2*** ***3*** **ACCEPT** having a similar response to treatment ***4*** ***5*** eg ● to alleviate human suffering / can save lives ***6*** eg ● causes **,** pain / distress / stress **,** to monkeys **DO NOT CREDIT** 'cruel to monkeys' unqualified 'right to life of monkeys' / monkeys killed

Question			Expected Answer	Mark	Additional Guidance
2	(e)		*appropriate parts of nervous / endocrine systems*		**ACCEPT** phonetic spelling throughout
			1 sympathetic (motor neurones) stimulated **;**		***1***
			2 noradrenaline / norepinephrine **;**		***2***
			3 neurotransmitter released at **,** neuromuscular junction / organs **;**		***3*** May be awarded in the context of acetylcholine
			4 adrenaline (secreted / released into blood) **;**		***4***
			5 from adrenal **,** glands / medulla **;**		***5***
			6 *idea of* adrenaline / noradrenaline **,** binding to receptors (on target tissue) **;**		***6***
			7 AVP **;**		***7*** eg ● correct ref to corticosteroids ● correct ref to medulla oblongata
			effect on structures containing 3 types of muscle		**C** = cardiac
			C8 *idea of* heart beats faster **;**		***C8***
			C9 *idea of* heart beats more forcefully **;**		***C9***
					S = smooth
			S10 alter blood flow / increase blood pressure **;**		***S10*** eg ● contriction / dilation **,** of arterioles
			S11 less blood flow to **,** gut / skin **;**		***S11***
			S12 reducing gut secretions / making skin pale **;**		***S12***
			S13 smooth muscle in gut relaxes / peristalsis slows down **;**		***S13*** **ACCEPT** involuntary for smooth
			S14 smooth muscle in airways relaxes / airways wider **;**		***S14*** **ACCEPT** involuntary for smooth
			S15 iris radial muscle contracts / pupil dilates **;**		***S15***
					V = voluntary
			V16 *idea of* breathing / intercostals contracting / diaphragm contracting **,** faster **;**		***V16***
			V17 more blood flow to (skeletal) muscles **;**		***V17***
			V18 *idea of* (named skeletal) muscles being primed for action **;**		***V18*** **ACCEPT** 'leg muscles' as named eg **CREDIT** glycogenolysis in muscle for priming
			19 AVP **;**	**8 max**	***19*** eg ● erector pili muscles raise hairs
			QWC – linking structure to response **;**	**1**	**Award if** **2** different mps from mps **1 – 7** correctly linked to **2** different mps from mps **C7 – V17**
			Total	**24**	

<table>
<tr><th colspan="3">Question</th><th colspan="2">Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td></td><td>climate - tropical versus temperate
tropical has …

1 higher temperature / hotter ;
2 more (sun)light / days longer ;
3 photosynthesis faster ;

4 idea that
more storage of , organic molecules / biomass / energy
or
more formation of , organic molecules / biomass ;

5 AVP ;

vegetation - woodland or rainforest versus grassland(s)
woodland or forest has …

6 idea of greater complexity / greater biodiversity / more niches ;
7 competition for space less limiting ;

8 AVP ;</td><td>4 max</td><td>CREDIT reverse arguments for temperate

<table><tr><td></td><td>tropical</td><td>temperate</td></tr><tr><td>temperature</td><td>higher</td><td>lower</td></tr><tr><td>light intensity</td><td>more</td><td>less</td></tr><tr><td>photosynthesis</td><td>more</td><td>less</td></tr><tr><td>biomass made</td><td>more</td><td>less</td></tr></table>
eg ● less seasonal change
● faster , mineral cycling / decomposition

CREDIT reverse arguments for grassland

<table><tr><td></td><td>wood</td><td>grassland</td></tr><tr><td>complexity</td><td>more</td><td>less</td></tr><tr><td>competition</td><td>less</td><td>more</td></tr></table>
eg ● greater , humidity / shelter</td></tr>
<tr><td>3</td><td>(b)</td><td></td><td colspan="2">(bomb) calorimeter ;

detail of technique ;

detail of , measurement / analysis ;</td><td>2 max</td><td>

eg ● known / dry , mass of (organic material)
● (material) burnt in oxygen

eg ● temperature rise of water measured
● known volume of water
● calculation described / converted to kJ</td></tr>
</table>

Question			Expected Answer	Mark	Additional Guidance
3	(c)	(i)	(perch) 22 ; (cow) 1 ;	2	
3	(c)	(ii)	**1** higher in bobcat / lower in cow ; *for bobcat* **2** more (energy) absorbed ; **ora** **3** less (energy / waste) egested ; **ora** **4** correct comparative figs. quoted from table ; **5** meat more digestible ; **ora** **6** mainly protein and fat ; **7** contains no <u>cellulose</u> ; **ora**	3 max	***1*** **DO NOT CREDIT** figs alone **IGNORE** refs to grasshopper and perch **ALLOW** ecf if cow calculated as > 6 in **(i)** ***2*** ***3*** ***4*** bobcat 83(%) <u>and</u> cow 40(%) (absorbed) **or** bobcat 17(%) <u>and</u> cow 60(%) (egested) ***5*** ***6*** ***7***
3	(c)	(iii)	**1** <u>grasshopper</u> ; **2** *idea of* high conversion to biomass figure ; **3** *idea of* herbivore / primary consumer / low(er) trophic level than perch ; **4** *idea of* more food available ; **5** *idea of* one stage of energy loss in food chain not two / more energy passes through food chain (to humans) ;	3 max	If perch is suggested, candidate can only access mp 2 **= max 1** If bobcat or cow suggested, then **= 0** ***1*** ***2*** **ACCEPT** ref to more energy accumulated in body **ACCEPT** mp2 in context of perch for max 1 ***3*** ***4*** ***5***
			Total	**14**	

Question			Expected Answer	Mark	Additional Guidance
4	(a)	(i)			**max 2 for description and max 2 for explanation** If bacteria mentioned, penalise once and then apply ecf. If incorrect units used, penalise the mark point and then apply ecf for subsequent mark points.
			description		
			1 lactose decreases and qualified **;**		***1*** eg ● single **figure quote** **either** at start (96 / 97 (a.u.)) **or** levelling-off point (45 - 60 h) **or** end (65 -70 h)
			2 ammonia decreases and qualified **;**		***2*** eg ● single **figure quote** **either** at start (34 (a.u.)) **or** levelling-off point (40 - 55 h)
			3 ammonia **,** plateaus / constant **,** at c. 2 (a.u.) (between 55 -140 h) **;** ***max 2***		***3***
			explanation		
			4 *idea that* lactose / ammonia **,** used **,** for growth / to make biomass **;**		***4***
			5 lactose / ammonia **,** used to make penicillin **;**		***5***
			6 lactose broken down to glucose (and galactose) **;**		***6***
			7 lactose / glucose **,** used for **,** respiration / energy **;**		***7*** **IGNORE** ammonia
			8 ammonia used to make named N-containing molecule **;** ***max 2***	**4 max**	***8*** eg ● amino acids / protein / nucleotides / nucleic acids / chitin / glycoprotein

Question			Expected Answer	Mark	Additional Guidance
4	(a)	(ii)	lactose **and** ammonia levels **,** stay high / oscillate **;** biomass **,** continues to rise / does not level off **;**	**2**	If bacteria mentioned, penalise once and then apply ecf. **IGNORE** incorrect ref to stationary phase **DO NOT CREDIT** 'remains constant' without the idea of more being added **ACCEPT** 'biomass **,** rises and falls / levels off**'** only if reference made to harvesting / removal
4	(a)	(iii)	*idea that* most penicillin produced after main growth phase **;** after 24 h / when nutrients declining **;** not needed for growth **;** (however evidence not entirely clear as) production begins during biomass log phase **;**	**2 max**	If bacteria mentioned, penalise once and then apply ecf. **IGNORE** incorrect ref to stationary phase
4	(b)	(i)	**1** to avoid unwanted microbe **,** entry / presence **;** **2** so no competition for nutrients **;** **3** so conditions remain unchanged **;** **4** so no decrease in yield **;** **5** so no contamination of **,** batch / product / penicillin **or** batch is unusable **;** **6** to prevent escape of **,** microbes / fungus / *Penicillium* / spores **;**	**3 max**	If bacteria mentioned, penalise once and then apply ecf. ***1*** **IGNORE** pathogens ***2*** ***3*** ***4*** ***5*** **DO NOT CREDIT** contamination unqualified ***6***

Question			Expected Answer	Mark	Additional Guidance
4	(b)	(ii)	temperature - as it affects enzymes **;** pH - as it affects enzymes **;** oxygen content – ref. respiration **;** AVP **;**	**3 max**	If bacteria mentioned, penalise once and then apply ecf. **DO NOT CREDIT** air eg ● salt concentration – affects osmosis / water potential / enzymes ● removal of waste gases (CO_2) – reduce pressure / prevents explosion of fermenter ● speed of stirrer – ensure even **,** mixing / temperature
			Total	**14**	

Question			Expected Answer	Mark	Additional Guidance
5	(a)		**A** DNA polymerase / Taq polymerase **;** **B** restriction endonuclease **;** **C** (DNA) ligase **;** **D** plasmid(s) **;** **E** reverse transcriptase **;**	**5**	**Mark the first answer on each prompt line.** If an additional answer is given that is incorrect or contradicts the correct answer, then **= 0 marks** ***B*** **ACCEPT** restriction enzyme or named example **DO NOT ACCEPT** restriction endonucleus
5	(b)		*hospital* **1** WBCs **,** easy to obtain / obtained from blood sample **;** **2** WBCs good source of DNA **;** **3** mutant gene's location unknown / need to look in whole genome **;** *biotechnology company* **4** *idea that* insulin made in pancreas **;** **5** many mRNA copies there / mRNA easier to find **;** **6** AVP **;**	**4 max**	***1*** **ACCEPT** *idea that* these cells less **,** painful / expensive / dangerous **,** to obtain ***2*** ***3*** ***4*** ***5*** ***6*** eg ● introns already removed in mRNA

Question			Expected Answer		Mark	Additional Guidance
5	(c)					**For A marks** points must be comparative - need to **either** match the 2 processes and state the advantage (eg PCR is quick and in vivo is slow) **or** use a comparative adjective (------er**,** less**,** more**,** least**,** most**,** better**,** best etc) as shown in the mark scheme. **For the related E mark,** accept any explanation that is true of **one** of the processes *and relates to the advantage described*. (Note that in some cases a statement could be considered as an advantage or as an explanation.)
				advantages of PCR		
			A1	PCR quick**er ;**		***A1***
			E1	explanation **;**		***E1*** eg ● few hours versus weeks ● 30 cycles ● no bacterial growth or screening stages
			A2	PCR uses **less** equipment **;**		***A2***
			E2	explanation **;**		***E2*** eg ● tube and heat block for PCR ● multiple test tubes or agar plates for in vivo
			A3	PCR uses **less** space **;**		***A3***
			E3	explanation **;**		***E3*** eg ● DNA and enzyme more compact than whole cells ● no growth medium required ● in vivo requires many plates to be **,** stored / incubated / refrigerated
			A4	PCR **less** labour-intensive / easi**er** / (some parts of process) **less** costly **;**		***A4***
			E4	explanation **;**		***E4*** eg ● PCR set to run and left ● in PCR gene is identified & cloned in one stage ● in vivo requires work to pick out and transfer colonies ● in vivo requires more purification of DNA at end
			A5	PCR combines selection of gene and amplification **but** in vivo requires separate steps **;**		***A5***
			E5	explanation **;**		***E5*** eg ● primer selects only correct gene to be copied ● in vivo needs probe to identify correct gene
		contd				

Question			Expected Answer		Mark	Additional Guidance
5	(c)	*contd*	**A6** **E6**	PCR saf**er ;** explanation **;**		***A6*** ***E6*** eg ● PCR uses DNA and enzymes ● PCR does not use whole cells which could cause contamination
			A7 **E7**	PCR can use low**er** quality DNA **;** explanation **;**		***A7*** ***E7*** eg ● can use **,** old / prehistoric / forensic **,** DNA
				advantages of in vivo		
			A8 **E8**	in vivo **less** prone to mutation **;** explanation **;**		***A8*** ***E8*** eg ● Taq polymerase occasionally inserts wrong base ● early mutation reproduced many times in PCR ● exact correct sequence needed for making therapeutic proteins
			A9 **E9**	in vivo **less** expensive **;** explanation **;**		***A9*** ***E9*** eg ● materials for growing bacteria cheap ● PCR chemicals / primers / Taq polymerase / high temperatures **,** expensive
			A10 **E10**	in vivo **less** technically complex **;** explanation **;**		***A10*** eg ● conditions not so critical ***E10*** ● optimising PCR takes time
			A11 **E11**	in vivo useful **,** when gene **less** well known / as longer piece of DNA can be cloned **;** explanation **;**	**7 max**	***A11*** ***E11*** eg ● searching for new gene ● obtains complete gene ● PCR has limited size (for cloning)
			QWC – clearly stated advantage linked to correct explanation **;**		**1**	2 pairs of A & E marks awarded. (eg A1 & E1 **and** A5 & E5 A9 & E9 **and** A4 & E4 etc)
				Total	**17**	

Question			Expected Answer	Mark	Additional Guidance
6	(a)				**Mark the first answer on each prompt line for all parts of (a).** If an additional answer is given that is incorrect or contradicts the correct answer, then **= 0** **ACCEPT** phonetic spelling
6	(a)	(i)	tropism(s) **;**	**1**	**IGNORE** named tropism eg phototropism
6	(a)	(ii)	(plant) hormone / growth substance / growth regulator / pgr **;**	**1**	
6	(a)	(iii)	deciduous **;**	**1**	
6	(a)	(iv)	conservation **;**	**1**	**DO NOT CREDIT** preservation
6	(a)	(v)	decomposer(s) **;**	**1**	**ACCEPT** saprotroph / saprophyte / saprobiont **IGNORE** fungi / bacteria **DO NOT CREDIT** detritivore
6	(a)	(vi)	nitrogen fixation **;**	**1**	**ACCEPT** nitrogen fixing **DO NOT CREDIT** nitrogen fixing bacteria
6	(b)	(i)	stimulus identified **;** organism named **and** normal response described **;** response **,** stops / lessens **,** after repeated stimulation / over time **;**	**3**	eg ● touch eg ● sea anemone withdrawing tentacles 'learning to ignore' is not quite enough
6	(b)	(ii)	organism named **and** voluntary behaviour described **;** reinforcer / reward / punishment **,** identified **;** behaviour **,** increases (for reward) / decreases (for punishment) **,** in frequency **;**	**3**	eg ● dog begging eg ● food reward / treat

Question			Expected Answer	Mark	Additional Guidance
6	(b)	(iii)			Marks can be awarded in general context of social interaction instead of a specific piece of behaviour described.
			primate species identified **;**		**CREDIT** English names eg chimpanzee**,** gorilla**,** orang-utan**,** (named) monkey**,** lemur or ape **IGNORE** humans
			behaviour described **;**		eg ● include dominance hierarchy interactions (play**,** aggressive**,** affiliative) ● allogrooming ● communication behaviours (vocal**,** facial**,** postural) ● passing on of **,** cultural / tool-using**,** knowledge ● *idea of* prolonged / frequent **,** mother-infant interactions
			purpose / importance **,** stated **;**	3	**CREDIT** answers relating to benefit to group or to individual eg ● with respect to access to food**,** resources or mates eg ● reducing **,** disease / parasites
			Total	**15**	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

14 – 19 Qualifications (General)
Telephone: 01223 553998
Facsimile: 01223 552627
Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored

Oxford Cambridge and RSA Examinations
is a Company Limited by Guarantee
Registered in England
Registered Office; 1 Hills Road, Cambridge, CB1 2EU
Registered Company Number: 3484466
OCR is an exempt Charity

OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553