RECOGNISING ACHIEVEMENT

GCE

Biology

Advanced GCE

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

Mark Scheme for January 2011

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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)	**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 **,** DNA / base(s) / nucleotide(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 gene **,** controls / affects **,** the expression of structural gene **;**	**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**	

<table>
<tr><th colspan="3">Question</th><th>Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td></td><td>
<table>
<tr><th></th><th>voluntary (skeletal)</th><th>involuntary (smooth)</th><th>cardiac</th></tr>
<tr><td>cellular structure</td><td>*striated / bands of actin & myosin
or
cylindrical cells

or
multinucleate ;</td><td>*unstriated / *non striated

or
spindle-shaped cells
or
uninucleate ;</td><td>*striated

or
branched cells
or
uninucleate
or
interlocking / junctions / intercalated discs ;</td></tr>
<tr><td>function</td><td>to move , bones / skeleton / joints / (named) limbs ;</td><td>idea of **controlling diameter of , arteries / arterioles / bronchi / bronchioles
or
peristalsis
or
uterine contraction
or
control pupil size ;</td><td>to pump blood / AW ;</td></tr>
</table>
</td><td>6</td><td>
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
</td></tr>
</table>

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

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