

GCE

Human Biology

Unit **F225**: Genetics, Control and Ageing

Advanced GCE

Mark Scheme for June 2016

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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.

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

Annotation	Meaning of Annotation
	correct response
	incorrect response
	benefit of the doubt
	benefit of the doubt not given
	error carried forward
	information omitted
	ignore
	reject

Question		Answer	Mark	Guidance
1	(a)	urea / creatinine / uric acid ;	1	DO NOT CREDIT urine or creatine or ammonia
	(b)	(i) 120 μm ;;	2	Correct answer with units = 2 marks Correct answer without units or unrounded = 1 mark If answer is incorrect look for 36 000 \div 300 OR 36 \div 300 OR 3.6 \div 300 AWARD 1 MARK for an error carried forward from an incorrect measurement / : Answer must be a whole number have units e.g. 117 μm = 1 mark (from 35 mm measurement)
		(ii) <i>idea that</i> collecting ducts are, combining / merging OR so volume of, urine / filtrate / fluid, will be larger ;	1	IGNORE ref to water
	(c)	(i) ADH / Antidiuretic hormone and (posterior) pituitary ;	1	Both parts correct for 1 mark ACCEPT phonetic spelling
		(ii) (membrane) would have, microvilli / brush border / AW ;	1	ACCEPT idea that it would be more folded. DO NOT CREDIT basal membrane more folded
	(d)	(i) carbonic anhydrase ;	1	
		(ii) (mitochondria) for <u>synthesis of</u> / AW, <u>ATP</u> , for active transport / transport of <u>ions</u> ;	1	CREDIT hydrogen ions / H^+ / protons / chloride ions / Cl^- / hydrogen carbonate ions / HCO_3^- IGNORE mitochondria providing energy

Question		Answer	Mark	Guidance
	(iii)	gas exchange (system) ;	1	<p>Mark the first answer</p> <p>IGNORE 'lungs' or 'brain' or a region of the brain since these are not organ systems</p> <p>CREDIT 'respiratory' system CREDIT nervous system</p>
(e)	(i)	<i>Diabetes insipidus</i> - no glucose present ;	1	<p>CREDIT glucose present for Diabetes mellitus</p> <p>IGNORE references to concentration, solute concentration and volume</p>
	(ii)	<i>idea that</i> levels of dehydration can be monitored (quickly) ;	1	CREDIT idea of monitoring (overall) water loss
	(iii)	(urine) volume ;	1	<p>Mark the first answer</p> <p>IGNORE pH , glucose, erythrocytes</p>
	(iv)	<p><i>Diabetes insipidus - patient 1 (no mark - green dot)</i></p> <p><i>explanation</i> (patient 1) urine, stays dilute / does not become concentrated, (as person dehydrates) ;</p> <p>(because) no ADH (secreted) in, diabetes insipidus/patient 1</p> <p>OR ADH secreted , normally / in patient 2 ;</p> <p>(idea that) water reabsorbed (more) with ADH / water not / less reabsorbed, in without ADH ;</p>	3	<p>ACCEPT 'always more water in urine' (for patient 1) 'solute concentration is less throughout'</p> <p>ACCEPT more water reabsorbed by patient 2 / less water reabsorbed by patient 1</p>
			Total 15	

Question			Answer	Mark	Guidance
2	(a)	(i)	somatic (motor neurone) ;	1	ACCEPT voluntary DO NOT CREDIT sympathetic
	(b)	(i)	57 / 58 mms^{-1} ;;	2	Correct answer = 2 marks If answer is incorrect, look for 200 / 3.5 OR 20/3.5 = 1 mark 6 = 1 mark (they have calculated (5.7) correctly but not converted cm to mm) CREDIT 1 mark for an error carried forward for $200 \div x$ (any number) if answer is correct and a whole number
		(ii)	<ol style="list-style-type: none"> 1. (voltage gated) sodium (ion) channels open ; 2. sodium ions / diffuse in / rush in ; 3. (membrane becomes) depolarised / AW ; 4. <i>idea of</i> local circuits, ahead (and behind) the active zone ; 5. (circuit due to) sideways movement of sodium ions; 6. Ref to (circuit / sodium ion movement) depolarisation / AW, of next region / node ; 7. Ref to hyperpolarisation of, previous region / previous node ; 8. ref to saltatory conduction / described ; 9. ion movement (only) at nodes of Ranvier / myelin sheath insulates between nodes ; 	6 max	<ol style="list-style-type: none"> 1. DO NOT CREDIT in context of acetylcholine CREDIT Na^+ enters down a concentration gradient ACCEPT influx of sodium ions 3. CREDIT a description e.g. + 40mv IGNORE 'neurone' or 'cell' in this context 4. ACCEPT alternative wording e.g. local currents 7. CREDIT ref to refractory period in previous region
			QWC ;	1	AWARD any two mark points from 4, 5, 6 or 7

Question			Answer	Mark	Guidance
2	(b)	(iii)	<p><i>idea that</i> myelin sheath is not present at birth OR myelin sheath takes time to develop ;</p> <p>AVP ;</p>	1	<p>DO NOT CREDIT reference to nervous system not being fully developed</p> <p>IGNORE reference to shorter axons / neurones e.g. ref to neurones having a smaller diameter</p>
	(c)	(i)	<p><i>Idea that</i> higher temperatures would give faster, conduction / impulses / diffusion OR lower temperatures would give slower, conduction / impulses / diffusion of ions ;</p> <p>(not 37°C) <i>idea that</i> peripheral/skin temperature will be lower than 37°C OR 37°C is the, core body temperature / AW OR AVP ;</p>	2	<p>IGNORE reference to controlling a variable as this is given in the question</p> <p>IGNORE reference to high temperatures denaturing proteins (in this context)</p> <p>e.g. 37°C could cause sweating (which could interfere with the readings)</p>
		(ii)	<p><i>idea that</i> diabetes / high blood glucose leads to damaged neurones /nerves ;</p> <p>AVP ;</p>	1	<p>CREDIT <i>idea of</i> damage to receptors e.g. reduced sensitivity CREDIT idea of damage to Schwann cells or myelin sheath or reduction in myelination</p> <p>e.g. medication taken could interfere with the results OR low blood sugar / hypoglycaemia slows impulses</p>
		(iii)	<p><i>idea that</i> Conduction velocity slows, (significantly) / AW (over 5 years) ;</p>	2	<p>CREDIT answers in either order</p> <p>ACCEPT reference to age slowing transmission in neurones (without further qualification).</p> <p>DO NOT CREDIT references to either nerve being faster or</p>

Question			Answer	Mark	Guidance
			<i>idea that</i> (means) not all neurones change at the same rate OR (confidence limits) changes within the same nerve varies within populations ;		slower (since the data is about change in velocity) ACCEPT nerve 1 changes more than nerve 2
				Total 16	

Question			Answer	Mark	Guidance
3	(a)		1. polypeptide / protein/ glycoprotein ; 2. antigen ; 3. loci ; 4. cross(ing) over ; 5. meiosis ; 6. codominant ;	6	2. ACCEPT receptor 3. ACCEPT 'locus or locuses' 4. CREDIT 'chiasma/chiasmata'

Question		Answer	Mark	Guidance																																				
(b)	(i)	Individual 1 and 2 correct ; Individuals 3 and 4 correct ; Individuals 5 to 8 all correct ;	3	<p>Individuals 1 and 2</p> <table border="1"> <tr> <td>A16 - A20</td> <td>A9- A21</td> </tr> <tr> <td>B31-B26</td> <td>B29-B30</td> </tr> <tr> <td>DR14-DR12</td> <td>DR7-DR17</td> </tr> </table> <p>CREDIT new haplotype in either column</p> <table border="1"> <tr> <td>A21 - A14</td> <td>A15- A17</td> </tr> <tr> <td>B9-B35</td> <td>B25-B22</td> </tr> <tr> <td>DR23-DR6</td> <td>DR19-DR10</td> </tr> </table> <p>CREDIT new haplotype in either column</p> <p>CREDIT correct combinations in any order.</p> <table border="1"> <tr> <td>A20</td> <td>A14</td> </tr> <tr> <td>B26</td> <td>B35</td> </tr> <tr> <td>DR12</td> <td>DR6</td> </tr> </table> <table border="1"> <tr> <td>A20</td> <td>A17</td> </tr> <tr> <td>B26</td> <td>B22</td> </tr> <tr> <td>DR12</td> <td>DR10</td> </tr> </table> <table border="1"> <tr> <td>A21</td> <td>A14</td> </tr> <tr> <td>B30</td> <td>B35</td> </tr> <tr> <td>DR17</td> <td>DR6</td> </tr> </table> <table border="1"> <tr> <td>A21</td> <td>A17</td> </tr> <tr> <td>B30</td> <td>B22</td> </tr> <tr> <td>DR17</td> <td>DR10</td> </tr> </table>	A16 - A20	A9- A21	B31-B26	B29-B30	DR14-DR12	DR7-DR17	A21 - A14	A15- A17	B9-B35	B25-B22	DR23-DR6	DR19-DR10	A20	A14	B26	B35	DR12	DR6	A20	A17	B26	B22	DR12	DR10	A21	A14	B30	B35	DR17	DR6	A21	A17	B30	B22	DR17	DR10
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	(b) (ii)	<p><i>idea that</i> there is less chance that there will be a similar, haplotype / alleles at all (with grand parents)</p> <p>OR</p> <p><i>idea that</i> parents will always have (1) haplotype / (3) alleles the same ;</p> <p><i>idea of</i> organ form grandparent being (much) older (so increases possibility of organ functioning less well) ;</p>	2	IGNORE references to blood type
	(c)	<ol style="list-style-type: none"> 1. ref to MHC genes and ABO genes being, unlinked / on separate chromosomes / on chromosomes 6 and 9 ; 2. ref to independent assortment (of chromosomes 6 and 9) in meiosis ; 3. <i>idea that</i> gametes(s) contain same copy of chromosome 6 / different copies of chromosome 9; 4. children could be blood group O or A ; 5 ref to 25% probability that a child could have, blood group O OR (only) 75% probability of, blood group A OR children could be ii / I^oI^o, I^AI^A, or I^A i 6. ref to 25% chance of having same haplotype ; 	3 max	5. CREDIT this mark point on a genetic diagram

Question		Answer	Mark	Guidance																																																																			
(d)	(i)	<p>1. <i>Evidence for:</i> Idea that countries / named country with the high(est) number of donors all have opt out policies;</p> <p>2. Data quoted correctly in support with correct units ;</p> <p>3. <i>Evidence against</i> Same rates in some countries where policy is different ;</p> <p>4. Data quoted correctly in support with correct units ;</p> <p>5. <i>Idea that countries / named countries with the lowest number of donors all have opt out policies</i> OR Idea that countries / named country with opt in policy has more donors than, countries / named country with opt out policy ;</p> <p>6. Data quoted correctly in support with correct units ;</p>	<p>4 max</p>	<table border="1"> <thead> <tr> <th>OPT IN COUNTRY</th> <th>DONORS PER MILLION PEOPLE</th> <th>OPT OUT COUNTRY</th> <th>DONORS PER MILLION PEOPLE</th> </tr> </thead> <tbody> <tr> <td>IRELAND</td> <td>21</td> <td>SPAIN</td> <td>34</td> </tr> <tr> <td>SLOVENIA</td> <td>18</td> <td>LATVIA</td> <td>24</td> </tr> <tr> <td>ENGLAND</td> <td>13</td> <td>AUSTRIA</td> <td>24</td> </tr> <tr> <td>NETHERLANDS</td> <td>13</td> <td>PORTUGAL</td> <td>22</td> </tr> <tr> <td>GERMANY</td> <td>12</td> <td>BELGIUM</td> <td>22</td> </tr> <tr> <td></td> <td></td> <td>FRANCE</td> <td>20</td> </tr> <tr> <td></td> <td></td> <td>ITALY</td> <td>18</td> </tr> <tr> <td></td> <td></td> <td>HUNGARY</td> <td>17</td> </tr> <tr> <td></td> <td></td> <td>NORWAY</td> <td>14</td> </tr> <tr> <td></td> <td></td> <td>DENMARK</td> <td>13</td> </tr> <tr> <td></td> <td></td> <td>POLAND</td> <td>13</td> </tr> <tr> <td></td> <td></td> <td>SWEDEN</td> <td>11</td> </tr> <tr> <td></td> <td></td> <td>GREECE</td> <td>6</td> </tr> <tr> <td></td> <td></td> <td>BULGARIA</td> <td>1</td> </tr> <tr> <td>Mean</td> <td>15</td> <td></td> <td>17</td> </tr> </tbody> </table> <p>CREDIT data quotes using calculated differences</p> <p>IGNORE data quotes using total donors</p> <p>IGNORE references to more countries having opt out policies as this is a sample</p>				OPT IN COUNTRY	DONORS PER MILLION PEOPLE	OPT OUT COUNTRY	DONORS PER MILLION PEOPLE	IRELAND	21	SPAIN	34	SLOVENIA	18	LATVIA	24	ENGLAND	13	AUSTRIA	24	NETHERLANDS	13	PORTUGAL	22	GERMANY	12	BELGIUM	22			FRANCE	20			ITALY	18			HUNGARY	17			NORWAY	14			DENMARK	13			POLAND	13			SWEDEN	11			GREECE	6			BULGARIA	1	Mean	15		17
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3	(d)	(ii)	<i>Idea that</i> can lead an independent life / AW ; AVP ;	1	CREDIT examples e.g. not needing regular / frequent periods on dialysis machine / able to work regular hours IGNORE ref to better quality of life unqualified or cost e.g. less need to control sodium intake
				Total 20	

Question			Answer	Mark	Guidance
(4)	(a)	T1	Ref to HRT treatments containing oestrogen and, progesterone / progestin ;	8 max	T1 CREDIT a reference to either or both hormones
		T2	Ref to timing combinations (of oestrogen and progestin) ;		T2 e.g. combined / continuous combined / cyclical timings
		T3	Ref to mode of delivery (of oestrogen and progestin) ;		T3 e.g. pills / patches / IUD device / pessary
		T4	Ref to oestrogen only HRT following hysterectomy ;		
		T5	Ref to phytoestrogens ;		T5 CREDIT named examples e.g. isoflavones
		R1	<i>Risks</i> (slight) increase in risk of, breast / endometrial / ovarian cancer ;		IGNORE cervical cancer
		R2	(slight) increase in risk of, CHD / strokes / DVT ;		R2 ACCEPT ref to MI, thrombosis,
		R3	example of named side effect of HRT ;		R3 e.g. sickness / abdominal cramps / weight gain / PMT symptoms
		B1	<i>Benefits</i> prevention of , named symptoms of menopause ;		B1 e.g. hot flushes / anxiety / sleep disturbance / memory loss
		B2	prevent decrease in bone density / reduce risk of , (hip) fractures / osteoporosis ;		
B3	reduces risk of Alzheimer's if taken before 65 ;	CREDIT REVERSE ARGUMENT as a risk e.g. increases risk of Alzheimer's if taken after 65			
				Total 8	

Question		Answer	Mark	Guidance												
5	(a)	<table border="1"> <thead> <tr> <th>Description</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><i>The region damaged by untreated glaucoma</i></td> <td>F</td> </tr> <tr> <td><i>The region where a cataract can form</i></td> <td>B</td> </tr> <tr> <td><i>The region where only cones are found</i></td> <td>D</td> </tr> <tr> <td><i>The region of the retina where both rods and cones are found</i></td> <td>C</td> </tr> <tr> <td><i>The region of the retina where no rods or cones are found</i></td> <td>E</td> </tr> </tbody> </table>	Description	Letter	<i>The region damaged by untreated glaucoma</i>	F	<i>The region where a cataract can form</i>	B	<i>The region where only cones are found</i>	D	<i>The region of the retina where both rods and cones are found</i>	C	<i>The region of the retina where no rods or cones are found</i>	E	5	
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(b)	(i)	e ;	1	CREDIT X ^e ACCEPT a single, lower case alternative letter IGNORE 'c' unless it is clearly 'lower case' IGNORE I ^e												
	(ii)	X ^e Y and X ^e X ^e	1	ecf for the allele symbol in (i)												
	(iii)	X ^E X ^e	1	ecf for the allele symbol in (i)												

Question			Answer	Mark	Guidance
5	(c)	(i)	1. nucleus / nucleolus ; 2. ribosomes ;	2	ANSWERS MUST BE IN THIS ORDER ACCEPT RER / rough endoplasmic reticulum
		(ii)	<i>idea that</i> mutation (in DNA) leads to a, stop/termination, codon OR <i>idea that</i> DNA sequence is deleted OR <i>idea that</i> mutation leads to more RNA being spliced out ; <i>idea that</i> <u>translation</u> is terminated by stop codon ; no (more) <u>amino acids</u> are added (after the stop codon) / fewer <u>amino acids</u> (in truncated protein) ;	2 max	IGNORE ref to a <u>base</u> deletion in context of shorter DNA
	(d)	(i)	reverse transcriptase ;	1	
		(ii)	somatic (gene therapy) ;	1	CREDIT augmentation (gene therapy)
	(d)	(iii)	<i>Idea that</i> disease involves a defect in a <u>single gene</u> ; no other cause ; <i>idea that</i> disease is easily identified in sufferers ; gene / gene product, is known ; gene can be delivered reliably to affected cells ;	3	Mp2 ACCEPT idea that disease will be cured / vision will be restored. Mp3CREDIT reverse argument 'easy to see if it has worked' ACCEPT 'easy to insert the gene'
				Total 17	

Question		Answer	Mark	Guidance
6	(a)	<u>anaerobic</u> respiration ;	1	Mark the first answer ACCEPT 'fermentation' in this context
	(b) (i)	lactic acid ; electron transport chain, inhibited / damaged OR no / less aerobic respiration ; anaerobic respiration product is lactate ;	3	
	(ii)	<i>Idea that</i> methanol and ethanol are similar shapes; <i>Idea that</i> ethanol binds to <u>active site</u> of , enzyme / alcohol dehydrogenase ; <i>idea that</i> less methanol converted to toxic product ;	2 max	ACCEPT methanol has a similar structure to ethanol Mp2 ACCEPT ethanol acts as a competitive inhibitor OR ethanol forms an enzyme substrate complex
	(iii)	physiological / physical (dependency) (<i>no mark</i>) AND <i>idea that</i> more active/efficient enzyme / alcohol broken down, faster / AW ;	1	DO NOT CREDIT 'psychological' even if the explanation of tolerance is correct. CREDIT reverse argument - less active/efficient enzyme / alcohol broken down, more slowly /AW
			Total 7	

Question		Answer				Mark	Guidance	
7	(a)		Medical condition or disease	Healthcare Professional	Diagnostic Test	Treatment	6 MP2 CREDIT erythrocyte count / (total) blood cell count / haemoglobin concentration / haemocytometer count / haematocrit MP3 CREDIT erythropoietin / EPO . IGNORE Iron tablets MP4 CREDIT alternative examples of an inherited or genetic condition or disease	
		1.	osteoporosis ;					
					2.	3.		
		4.	PKU/cystic fibrosis / AW ;	5.	(red) blood cell count ;.	RhEPO ;		
		6.	hyperthermia / heat stroke ;					
	(b)	(i)	<i>Idea that</i> peptide / GLP-1 would be denatured (by stomach acid) ;				1	CREDIT peptide / GLP-1, would be, digested / hydrolysed / broken down
		(ii)	<u>glycogen</u> ;				1	
		(iii)	<i>idea that</i> person feels full for longer ; <i>idea that</i> prevents rapid, digestion (of carbohydrate) / absorption (of glucose) ; <i>idea that</i> person will eat less / less risk of obesity / AW ;				1	Mp2 CREDIT ref to preventing a sudden increase in blood glucose DO NOT CREDIT less breakdown of glucose
		(iv)	alpha (cells) ; beta (cells) ;				2	

Question		Answer	Mark	Guidance
	(c) (i)	<i>idea that</i> GLP-1 circulates for longer / half life prolonged / stays active in the blood for longer ;	1	CREDIT <i>idea that</i> drug is an enzyme inhibitor ; ACCEPT <i>idea that</i> GLP-1 isn't broken down
	(ii)	<i>idea that</i> Type 1 due to, lack of / AW, insulin (secretion) ;	1	CREDIT (type 1 diabetes) treated with insulin injections
	(iii)	using / AW, glucose, tablets / drink / gel ;	1	ACCEPT reference to a named sweet foodstuff
	(d)	advise / AW, related to retinal examinations ; advise / AW, related to foot care ; advise / AW, related to diet ; advise / AW, related to BMI / weight ; advise / AW blood pressure ; advise / AW, kidney function tests ; AVP ;	3	CREDIT ref to retinopathy or eye checks CREDIT ref to neuropathy e.g. advise on exercise, ref to crisis management , information on support groups / involving family members
			Total 17	

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