

**GCE**

**Human Biology**

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

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.

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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 <u>not</u> given
	error carried forward
	information omitted
	ignore
	reject

Question		Answer	Mark	Guidance									
1	(a) (i)	<i>Idea of cards with different coloured spots making a number ; CVD sufferers see, some but not others / a different number ;</i>	2	<b>CREDIT</b> Ishihara cards <b>ACCEPT</b> CVD sufferers don't see the numbers / incorrectly identify the number <b>DO NOT CREDIT</b> incorrectly identify the colour									
	(ii)	retina / fovea / macula <b>and</b> cone (cell) ;	1	<b>Both required for 1 mark</b>									
	(iii)	<i>Idea that</i> cone cells require high light intensity (to perceive colour) ;	1	<b>IGNORE</b> reference to a control variable <b>CREDIT a reverse argument</b> e.g. in dim light cone cells, would not be stimulated / wont work (so no colours seen)									
	(b) (i)	probability = 100% ;  <i>explanation:</i> <b>E1</b> 2 and 3 must be heterozygous as they inherit $X^r$ from dad (and $X^R$ from mum) ;  <b>E2</b> <i>idea that</i> (3 and) 4 must be, heterozygous / carriers, as pass on $X^r$ to their sons / has an affected son ;	3	Explanations based only on father's genotype can only access <b>E1</b> Assume 'they' = 2,3 and 4  <b>E1 ACCEPT</b> statements such as ' Father is $X^r$ so all the daughters have this'  <b>E2 ACCEPT</b> (3 and 4) have affected children									
	(ii)	Parent 5 = $X^R X^r$ Parent 6 = $X^r Y$ ;  <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td></td> <td><math>X^r</math></td> <td>Y</td> </tr> <tr> <td><math>X^R</math></td> <td><math>X^R X^r</math></td> <td><math>X^R Y</math></td> </tr> <tr> <td><math>X^r</math></td> <td><math>X^r X^r</math></td> <td><math>X^r Y</math></td> </tr> </table> ;  7 = $X^r Y$ 8 = $X^R X^r$ 9 = $X^r X^r$ 10 = $X^R Y$ ;		$X^r$	Y	$X^R$	$X^R X^r$	$X^R Y$	$X^r$	$X^r X^r$	$X^r Y$	3	Both parental genotypes = <b>1 mark</b> <b>DO NOT CREDIT</b> $Y^r$ OR $X^r X^r$ for mp 1 but allow ECF  Correct gametes in punnet square = <b>1 mark</b>  Correct genotype with offspring number = <b>1 mark</b>  <b>DO NOT CREDIT</b> if gender is incorrect (7 and 10 are male on the pedigree and 8 and 9 are female
	$X^r$	Y											
$X^R$	$X^R X^r$	$X^R Y$											
$X^r$	$X^r X^r$	$X^r Y$											

Question		Answer	Mark	Guidance
	(iii)	<i>idea that</i> colour blindness has minimal effect on quality of life ;	1	<b>ACCEPT</b> statements such as 'this condition is not serious / life threatening / AW.
(c)		<i>Idea that</i> inability to see food, is a <u>selective disadvantage</u> / natural <u>selection</u> operating ;  CVD / red-green deficiency / AW, individuals more likely to die, young / before reproducing / AW ;  ref to food poisoning (as cause of death) ;  <i>idea that</i> red-green / colour-blind / deficiency, allele not passed on ;	3 max	<b>IGNORE</b> reference to survival without qualification <b>CREDIT</b> reverse argument  <b>CREDIT</b> mp1 and 3 for 'being more susceptible to food poisoning is a selective disadvantage'  <b>ACCEPT</b> gene (instead of allele) <b>CREDIT</b> reverse argument e.g. advantageous alleles passed on
(d)	(i)	<i>disease</i> - tuberculosis / TB ;  <i>explanation</i> - idea that treatment involves many months of taking antibiotics ;	2	<b>ACCEPT</b> other diseases treated by long term antibiotic therapy, e.g. severe acne, tonsillitis  <b>ACCEPT</b> HIV/ Cancer  <i>Explanation</i> (HIV/Cancer) idea of suppressed immunity so more susceptible to infections (so more antibiotics)

Question		Answer	Mark	Guidance
	(ii)	cataracts ; reduces amount of light entering the eye (so cones can't respond) ;  <b>OR</b> glaucoma ; damages optic nerve ;  <b>OR</b> type 2 / mature onset diabetes ; causes breakdown of retina / retinopathy ;	<b>2</b>	Mark as a whole Award one mark for the condition and one mark for the related explanation in any order.  <b>ACCEPT</b> phonetic spelling
<b>Total</b>			<b>18</b>	

Question			Answer	Mark	Guidance
2	(a)	(i)	A - rough endoplasmic reticulum / ribosome , B - Golgi (apparatus) C - mitochondria ; (rough endoplasmic reticulum / A) for protein synthesis / translation ;  (Golgi / B) for packaging into, (secretory) vesicles / AW ;  (mitochondria / C) for synthesis of ATP for, exocytosis / protein synthesis / transport through the cell ;	4	One mark for all organelles correctly identified  <b>ALLOW</b> error carried forward for role in synthesis or secretion if letter incorrectly identified.  <b>ACCEPT</b> 'packaging for exocytosis'  <b>CREDIT</b> a related process which requires ATP e.g. activation of tRNA
		(ii)	DNA replication / described ; <i>idea of checking DNA</i> (for mutations) ; mitosis ; transcription / (m) RNA synthesis ;	2 max	<b>IGNORE</b> 'DNA copied' <b>IGNORE</b> meiosis (as chromosomes are identical)
		(iii)	idea that they do not have a cell wall ;	1	<b>IGNORE</b> ref to vacuole
	(b)	(i)	haemocytometer ;	1	<b>ACCEPT</b> 'microscope'
		(ii)	33 ; ;	2	If answer incorrect, or incorrectly rounded, look for  33.22.....  <b>OR</b> 5 ÷ 0.301 <b>OR</b> 16.6(112....)/ 16.5 / 16.4 for one mark

Question		Answer	Mark	Guidance
	(c)	1. a (small) circular, piece / AW, of DNA ; 2. <i>idea of</i> separate to the bacterial genome ; 3. used as a <u>vector</u> (for human gene) ; 4. cut (plasmid/vector) with restriction, enzymes / endonuclease , forming a, sticky end / AW ; 5. <i>idea of</i> gene of interest having, complementary sticky ends ; 6. gene of interest and plasmid, anneal / described ; 7. DNA ligase used to, form phosphodiester bonds / AW ; 8. plasmid, taken up / AW, by bacterial cell ;	6	<b>ACCEPT</b> 'loop of DNA'  <b>ACCEPT</b> a description of a 'sticky end' <b>DO NOT CREDIT</b> 'cut DNA out of the plasmid'  <b>CREDIT</b> this in the context of both plasmid and gene of interest being cut with the same restriction enzyme  <b>ACCEPT</b> a description e.g. hydrogen bonds forming between the overlapping sticky ends / sticky ends pair up  <b>ACCEPT</b> idea of sealing up the sugar-phosphate backbone.  <b>ACCEPT</b> a description such as electroporation <b>ACCEPT</b> plasmid inserted (into bacterial cell)
		<b>QWC ;</b>	1	<b>LOOK FOR:</b>  <b>MPs 1, 3, 6 and 8.</b>
	(d) (i)	(uracil) needed for (synthesis of) RNA ;  (RNA) required for protein synthesis / transcription / translation ;	2	<b>ACCEPT</b> is present in RNA  <b>CREDIT</b> reverse statement 'without (RNA) there is not protein synthesis'



		<b>(ii)</b>	Yeast cell, has taken up the plasmid / transformed / (been successfully) genetically modified OR a mutation (has occurred) ;	<b>1</b>	<b>DO NOT CREDIT</b> 'this causes a gene mutation'
			<b>Total</b>	<b>20</b>	

Question			Answer	Mark	Guidance
3	(a)	(i)	H ;	1	<b>Mark the first answer.</b> If an additional answer is given that is incorrect, then = <b>0 marks</b>  <b>IGNORE D</b>
		(ii)	E ;	1	<b>Mark the first answer.</b> If an additional answer is given that is incorrect, then = <b>0 marks</b>
		(iii)	H,F,G ;	1	<b>All 3 letters in any order = 1 mark</b> If an additional answer is given that is incorrect, then = <b>0 marks</b> <b>IGNORE D</b>
		(iv)	L	1	<b>Mark the first answer.</b> If an additional answer is given that is incorrect, then = <b>0 mark</b>
	(b)	(i)	<i>idea that they are not producing (enough) insulin / they are taking insulin injections ;</i>  <i>idea that beta cells have been destroyed by immune system / anti - beta cell antibodies detected ;</i>  <i>idea that were diagnosed when young ;</i>	<b>2 max</b>	

Question			Answer	Mark	Guidance																		
	(ii)	<p><i>evidence for</i></p> <p><i>idea that (for total and moderate response) most of the patients with diabetes, show a response to virus / have virus</i></p> <p><b>OR</b></p> <p>most people without diabetes do not have virus ;</p> <p><i>idea that (last column/strong response) all patients with, strong response have diabetes</i></p> <p><b>OR</b></p> <p>no strong response to diabetes in controls ;</p> <p><i>evidence against</i></p> <p><i>idea that percentage of subjects with weak response is, (nearly) same / less, in diabetics and controls ;</i></p> <p>supporting figures from table ;</p>	3 max	<table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="4">Response to tests for presence of virus (%)</th> </tr> <tr> <th>Total</th> <th>Weak</th> <th>Moderate</th> <th>Strong</th> </tr> </thead> <tbody> <tr> <td>Patient with type 1 diabetes</td> <td>74</td> <td>23</td> <td>41</td> <td>10</td> </tr> <tr> <td>Control subject</td> <td>29</td> <td>24</td> <td>5</td> <td>0</td> </tr> </tbody> </table> <p>e.g. 74% of diabetics have virus / only 29% of non-diabetics have virus</p> <p><b>DO NOT CREDIT</b> if no % given but penalise once only <b>CREDIT</b> a calculated difference</p>		Response to tests for presence of virus (%)				Total	Weak	Moderate	Strong	Patient with type 1 diabetes	74	23	41	10	Control subject	29	24	5	0
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	(c)	<p><i>idea that HLA-DR / MHC genes/alleles are inherited</i></p> <p><b>OR</b></p> <p>haplotypes are inherited ;</p>	1	<b>DO NOT CREDIT</b> ref to type 1 diabetes being inherited																			

	<b>(d)</b>	<b>(i)</b>	obesity / BMI over 30 / ;  <i>(associated with)</i> lack of exercise / too high an intake of fats / carbohydrates / AW ;	<b>2</b>	<b>ACCEPT</b> 'overweight' 'high BMI'  <b>CREDIT</b> a reference to any lifestyle choice linked to obesity  <b>IGNORE</b> age

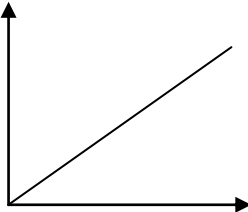
Question		Answer	Mark	Guidance
	(ii)	<p><i>idea that</i> many people undiagnosed ;</p> <p><i>reason</i> do not visit doctors / have not been tested ;</p> <p><b>OR</b> <i>idea that</i> onset is gradual (so they don't realise they have it)</p> <p><b>OR</b> (people) not aware of the symptoms</p> <p><b>OR</b> people not aware of risk of being overweight ;</p>	2	
		<b>Total</b>	<b>14</b>	

Question		Answer	Mark	Guidance
4	(a)	calcium ; sarcoplasmic reticulum ; diastole ; motor ; increase / rise ; homeostasis / PNS / peripheral nervous system ;	6	

Question	Answer	Mark	Guidance																				
(b)	<p><i>Supports the statement</i></p> <p>1. compliance decreases with age (in both groups) ;</p> <p>2. compliance, (always) much higher in athletes / decreases much less in athletes  <b>OR</b>  compliance lower in sedentary (group) / decreases more in sedentary group ;</p> <p>3. figs to support a statement ;</p> <p>4. <i>idea that</i> low compliance results in high blood pressure (in sedentary)  <b>OR</b>  high compliance results in low blood pressure (in athletes) ;</p> <p>5. <i>idea that</i> high blood pressure increases risk of CHD  <b>OR</b> low blood pressure reduces risk of CHD ;</p> <p>6. <i>idea that</i> (high blood pressure) damages artery wall ;</p> <p>7. <i>idea that</i> (damage / low compliance/ high blood pressure) increases risk of, atherosclerosis / described ;</p> <p><i>Does not support statement</i></p> <p>8. <i>idea that</i> other (named) factors also linked to CHD ;</p>	6	<table border="1"> <thead> <tr> <th></th> <th>YOUNG</th> <th>MIDDLE AGE</th> <th>OLD</th> <th>Difference (Y to O)</th> </tr> </thead> <tbody> <tr> <td>SEDENTARY</td> <td>2.05</td> <td>1.25</td> <td>1.2</td> <td>0.85</td> </tr> <tr> <td>ATHLETES</td> <td>2.15</td> <td>1.6</td> <td>1.65</td> <td>0.5</td> </tr> <tr> <td><i>difference</i></td> <td>0.1</td> <td>0.35</td> <td>0.45</td> <td></td> </tr> </tbody> </table> <p><b>IGNORE</b> ref. to negative correlation as this is given in the stem of the question</p>		YOUNG	MIDDLE AGE	OLD	Difference (Y to O)	SEDENTARY	2.05	1.25	1.2	0.85	ATHLETES	2.15	1.6	1.65	0.5	<i>difference</i>	0.1	0.35	0.45	
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	QWC ;	1	<b>AWARD</b> for MPs 1,2 and 3 plus one further mark point from 4 to 7																				

Question			Answer	Mark	Guidance
	<b>c</b>	<b>(i)</b>	phyto-estrogen / named phyto-oestrogen / source of phyto-oestrogen ; antioxidants / named antioxidant ;	<b>1</b>	<b>CREDIT</b> soya, isoflavones  <b>IGNORE</b> exercise
		<b>(ii)</b>	reduction in oestrogen production ; reduction in progesterone production ; increased blood concentrations of LDL/cholesterol ; decrease in bone density ; increase in body fat ; decrease in muscle mass ; ovulation / menstruation stops ; FSH increases ;	<b>2 max</b>	<b>IGNORE</b> ref to morphological changes
			<b>Total</b>	<b>16</b>	



Question		Answer	Mark	Guidance
5	(a)	<p><i>Idea that</i> urea is a metabolic waste product / waste product of cellular metabolism ;</p> <p>(produced from) deamination of (excess) amino acids  <b>OR</b>            (from) ammonia ;</p>	2	<b>ACCEPT</b> <u>nitrogenous</u> waste
	(b) (i)	<p><i>Idea that</i> this osmolality lowers water potential of plasma (below the normal threshold) ;</p> <p>(low water potential) detected by (osmo)receptors ;</p> <p>in hypothalamus ;</p> <p>ref to potential change in neurosecretory cells ;</p> <p>(causes) ADH release from (posterior) pituitary ;</p>	4 max	
	(ii)	<p>horizontal axis label (plasma) ADH concentration (<math>\text{pg cm}^{-3}</math>)  <b>AND</b>            vertical axis label urine osmolality (<math>\text{mosm kg}^{-1}</math>) ;</p> <p>line drawn showing a positive correlation ;</p>	2	<p><b>IGNORE</b> the absence of units  <b>DO NOT CREDIT</b> incorrect units</p> <div style="text-align: center;">  </div> <p><b>CREDIT</b> a line which rises and then plateaus even if axes are the other way around</p>

Question		Answer	Mark	Guidance
	(c) (i)	<u>haemodialysis</u> ;	1	
	(ii)	(acts as a) pump (for blood) <b>OR</b> to maintain, (blood) pressure / flow	1	
	(iii)	partially permeable ;	1	<b>ACCEPT</b> semi-permeable (as this is an artificial membrane)
	(iv)	bubble/air, trap (detector) ;	1	<b>CREDIT</b> air detector clamp / removes air (bubbles)
(d)	(i)	(glyco)protein <b>OR</b> (MHC) / (HLA) antigen ;	1	<b>CREDIT</b> polypeptide
	(ii)	(uterus) endometrium ;	1	<b>ACCEPT</b> lining of uterus
	(iii)	mitosis <b>and</b> meiosis ;	1	Both required for one mark
	(iv)	<u>xenograft</u>	1	<b>ACCEPT</b> xenotransplantation
(e)	(i)	<i>stage 3 - idea of animal welfare issues ;</i>  <i>stage 4 - idea of cultural objections to having contact with pigs</i> <b>OR</b> <i>stage 4 - idea of safety issues due to viruses in pig genome</i> <b>OR</b> <i>idea of animals should not be used as a commodity ;</i>	2 max	<b>One mark for each stage. Mark the first answer.</b>  <b>CREDIT</b> statements which refer to the pigs being in an unnatural environment.  <b>CREDIT</b> references to a named culture  <b>IGNORE</b> general reference to disease transfer  <b>ACCEPT</b> 'should not raise animals just for human use'

Question		Answer	Mark	Guidance
	(ii)	<p><i>idea that fewer human organs available than patients needing them ;</i></p> <p><i>idea that reduces need for (costly) dialysis ;</i></p> <p><i>idea that reduces the (illegal) trade in donor kidneys ;</i></p> <p><i>idea that reduces risk of rejection ;</i></p> <p>idea that (other) people don't need surgery to have (donor) kidney removed ;</p>	2 max	<p><b>CREDIT</b> statements such as 'people die while waiting for a suitable kidney to become available'</p> <p><b>CREDIT</b> other well argued justifications e.g. a human life is more valuable than a pig's life</p>
<b>Total</b>			<b>20</b>	

Question			Answer	Mark	Guidance
6	(a)	(i)	(a) traumatic brain injury ;	1	
		(ii)	(protein =) <u>fibrinogen</u> ;  <b>Max 3 from:</b> fibrinogen converted to fibrin ; <i>idea that</i> fibrin is an insoluble molecule ; (fibrin) forms (protein) mesh ; <i>idea that</i> clotting / clot, limits spread of blood further into brain tissue ;	4 max	
		(iii)	anticoagulant / named anticoagulant ;	1	<b>CREDIT</b> warfarin, heparin, aspirin
	(b)	(i)	(patient) cannot remember name from a short time before / keeps asking the same question(s) ;	1	
		(ii)	show photos to help them to identify people ; play memory games (regularly) ;	1	<b>IGNORE</b> 'rehabilitation' <b>CREDIT</b> alternative reasonable suggestions <b>IGNORE</b> cognitive therapy
	(c)		MRI (scan) / CT (scan) / PET (scan) ;	1	
	(d)	(i)	26 ;;	2	If answer is incorrect or incorrectly rounded, award one mark for: (16 ÷ 100) or 0.16 x 160 <b>OR</b> 25.6 <b>OR</b> 25
		(ii)	<i>Idea that</i> smoking / tobacco, is linked to, atherosclerosis / described <b>OR</b> smoking / tobacco linked to raised blood pressure <b>OR</b> smoking / tobacco increases risk of blood clotting ;	1	<b>IGNORE</b> idea of another variable <b>OR</b> smoking increases the risk of strokes without further explanation
			<b>Total</b>	<b>12</b>	

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