

GCE

Human Biology

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

Advanced GCE

Mark Scheme for June 2017

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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 <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 ;</i> CVD sufferers see, some but not others / a different number ;	2	CREDIT Ishihara cards ACCEPT CVD sufferers don't see the numbers / incorrectly identify the number DO NOT CREDIT incorrectly identify the colour									
	(ii)	retina / fovea / macula and cone (cell) ;	1	Both required for 1 mark									
	(iii)	<i>Idea that</i> cone cells require high light intensity (to perceive colour) ;	1	IGNORE reference to a control variable CREDIT a reverse argument e.g. in dim light cone cells, would not be stimulated / wont work (so no colours seen)									
	(b) (i)	probability = 100% ; <i>explanation:</i> E1 2 and 3 must be heterozygous as they inherit X^r from dad (and X^R from mum) ; E2 <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 E1 Assume 'they' = 2,3 and 4 E1 ACCEPT statements such as ' Father is X^r so all the daughters have this' E2 ACCEPT (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>X^r</td> <td>Y</td> </tr> <tr> <td>X^R</td> <td>$X^R X^r$</td> <td>$X^R Y$</td> </tr> <tr> <td>X^r</td> <td>$X^r X^r$</td> <td>$X^r Y$</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 = 1 mark DO NOT CREDIT Y^r OR $X^r X^r$ for mp 1 but allow ECF Correct gametes in punnet square = 1 mark Correct genotype with offspring number = 1 mark DO NOT CREDIT 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	ACCEPT 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	IGNORE reference to survival without qualification CREDIT reverse argument CREDIT mp1 and 3 for 'being more susceptible to food poisoning is a selective disadvantage' ACCEPT gene (instead of allele) CREDIT 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	ACCEPT other diseases treated by long term antibiotic therapy, e.g. severe acne, tonsillitis ACCEPT 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) ; OR glaucoma ; damages optic nerve ; OR type 2 / mature onset diabetes ; causes breakdown of retina / retinopathy ;	2	Mark as a whole Award one mark for the condition and one mark for the related explanation in any order. ACCEPT phonetic spelling
			Total	18	

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 ALLOW error carried forward for role in synthesis or secretion if letter incorrectly identified. ACCEPT 'packaging for exocytosis' CREDIT 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	IGNORE 'DNA copied' IGNORE meiosis (as chromosomes are identical)
		(iii)	idea that they do not have a cell wall ;	1	IGNORE ref to vacuole
	(b)	(i)	haemocytometer ;	1	ACCEPT 'microscope'
		(ii)	33 ; ;	2	If answer incorrect, or incorrectly rounded, look for 33.22..... OR 5 ÷ 0.301 OR 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	ACCEPT 'loop of DNA' ACCEPT a description of a 'sticky end' DO NOT CREDIT 'cut DNA out of the plasmid' CREDIT this in the context of both plasmid and gene of interest being cut with the same restriction enzyme ACCEPT a description e.g. hydrogen bonds forming between the overlapping sticky ends / sticky ends pair up ACCEPT idea of sealing up the sugar-phosphate backbone. ACCEPT a description such as electroporation ACCEPT plasmid inserted (into bacterial cell)
		QWC ;	1	LOOK FOR: MPs 1, 3, 6 and 8.
	(d) (i)	(uracil) needed for (synthesis of) RNA ; (RNA) required for protein synthesis / transcription / translation ;	2	ACCEPT is present in RNA CREDIT reverse statement 'without (RNA) there is not protein synthesis'

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

Question			Answer	Mark	Guidance
3	(a)	(i)	H ;	1	Mark the first answer. If an additional answer is given that is incorrect, then = 0 marks IGNORE D
		(ii)	E ;	1	Mark the first answer. If an additional answer is given that is incorrect, then = 0 marks
		(iii)	H,F,G ;	1	All 3 letters in any order = 1 mark If an additional answer is given that is incorrect, then = 0 marks IGNORE D
		(iv)	L	1	Mark the first answer. If an additional answer is given that is incorrect, then = 0 mark
	(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>	2 max	

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>OR</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>OR</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>DO NOT CREDIT if no % given but penalise once only CREDIT 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>OR</p> <p>haplotypes are inherited ;</p>	1	DO NOT CREDIT ref to type 1 diabetes being inherited																			

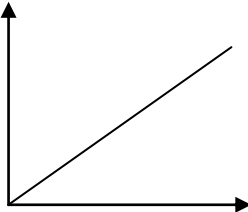
	(d)	(i)	obesity / BMI over 30 / ; <i>(associated with)</i> lack of exercise / too high an intake of fats / carbohydrates / AW ;	2	ACCEPT 'overweight' 'high BMI' CREDIT a reference to any lifestyle choice linked to obesity IGNORE age

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>OR <i>idea that</i> onset is gradual (so they don't realise they have it)</p> <p>OR (people) not aware of the symptoms</p> <p>OR people not aware of risk of being overweight ;</p>	2	
		Total	14	

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

Question	Answer	Mark	Guidance																				
<p>(b)</p> <ol style="list-style-type: none"> 1. compliance decreases with age (in both groups) ; 2. compliance, (always) much higher in athletes / decreases much less in athletes OR compliance lower in sedentary (group) / decreases more in sedentary group ; 3. figs to support a statement ; 4. <i>idea that</i> low compliance results in high blood pressure (in sedentary) OR high compliance results in low blood pressure (in athletes) ; 5. <i>idea that</i> high blood pressure increases risk of CHD OR low blood pressure reduces risk of CHD ; 6. <i>idea that</i> (high blood pressure) damages artery wall ; 7. <i>idea that</i> (damage / low compliance/ high blood pressure) increases risk of, atherosclerosis / described ; <p><i>Does not support statement</i></p> <ol style="list-style-type: none"> 8. <i>idea that</i> other (named) factors also linked to CHD ; 	<p><i>Supports the statement</i></p>	<p>6</p>	<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>IGNORE 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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	<p>QWC ;</p>	<p>1</p>	<p>AWARD for MPs 1,2 and 3 plus one further mark point from 4 to 7</p>																				

Question			Answer	Mark	Guidance
	c	(i)	phyto-estrogen / named phyto-oestrogen / source of phyto-oestrogen ; antioxidants / named antioxidant ;	1	CREDIT soya, isoflavones IGNORE exercise
		(ii)	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 ;	2 max	IGNORE ref to morphological changes
			Total	16	

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 OR (from) ammonia ;</p>	2	ACCEPT <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 (pg cm^{-3}) AND vertical axis label urine osmolality (mosm kg^{-1}) ;</p> <p>line drawn showing a positive correlation ;</p>	2	<p>IGNORE the absence of units DO NOT CREDIT incorrect units</p> <div style="text-align: center;">  </div> <p>CREDIT 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) OR to maintain, (blood) pressure / flow	1	
	(iii)	partially permeable ;	1	ACCEPT semi-permeable (as this is an artificial membrane)
	(iv)	bubble/air, trap (detector) ;	1	CREDIT air detector clamp / removes air (bubbles)
	(d) (i)	(glyco)protein OR (MHC) / (HLA) antigen ;	1	CREDIT polypeptide
	(ii)	(uterus) endometrium ;	1	ACCEPT lining of uterus
	(iii)	mitosis and meiosis ;	1	Both required for one mark
	(iv)	<u>xenograft</u>	1	ACCEPT 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> OR <i>stage 4 - idea of safety issues due to viruses in pig genome</i> OR <i>idea of animals should not be used as a commodity ;</i>	2 max	One mark for each stage. Mark the first answer. CREDIT statements which refer to the pigs being in an unnatural environment. CREDIT references to a named culture IGNORE general reference to disease transfer ACCEPT '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>CREDIT statements such as 'people die while waiting for a suitable kidney to become available'</p> <p>CREDIT other well argued justifications e.g. a human life is more valuable than a pig's life</p>
Total			20	

Question			Answer	Mark	Guidance
6	(a)	(i)	(a) traumatic brain injury ;	1	
		(ii)	(protein =) <u>fibrinogen</u> ; Max 3 from: 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	CREDIT 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	IGNORE 'rehabilitation' CREDIT alternative reasonable suggestions IGNORE 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 OR 25.6 OR 25
		(ii)	<i>Idea that</i> smoking / tobacco, is linked to, atherosclerosis / described OR smoking / tobacco linked to raised blood pressure OR smoking / tobacco increases risk of blood clotting ;	1	IGNORE idea of another variable OR smoking increases the risk of strokes without further explanation
			Total	12	

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