

Human Biology

Advanced GCE **F225**

Genetics, Control and Ageing

Mark Scheme for June 2010

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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 Answers	Marks	Additional Guidance
1	a	A glomerulus / (blood) capillaries ; B (renal) capsule / Bowman's capsule ; C (kidney / proximal / distal / convoluted) tubule ;	3	IGNORE ref to cuboidal epithelial cells DO NOT CREDIT Loop of Henle or collecting duct as these are not in the cortex

Question			Expected Answers	Marks	Additional Guidance
	c	i	glycosidic ;	1	DO NOT CREDIT 'oxygen bridge' as this term is not exclusive to glycosidic bonds. CREDIT phonetic spelling
		ii	soluble ; unreactive / inert / cannot be broken down (into monosaccharides) / AW ; non-toxic / few (adverse) side-effects ; small enough to pass through filter ;	2 max	DO NOT CREDIT references to insulin but penalise once only ACCEPT alternative ways of describing this e.g. inactive ACCEPT 'no side effects' CREDIT idea that inulin is a small molecule DO NOT CREDIT 'completely removed from the blood, or not reabsorbed or not secreted into the tubules' as these are given in the question

Question		Expected Answers	Marks	Additional Guidance
	d i	50 to 80 ; $\mu\text{mol dm}^{-3}$;	2	Both figures required for the mark. CREDIT range in reverse i.e. 80 to 50 ACCEPT a range of ± 2 on 50
	ii	(some) creatinine is reabsorbed ; (some) creatinine is secreted into the tubules ; (plasma creatinine conc) varies with factors other than filtration rate ; named factor ;	2 max	DO NOT CREDIT references to creatinine but penalise once only LOOK FOR IDEA that something other than GFR causes fluctuations in concentration eg gender / BMI / age / diet / race / fitness weight / height / surface area / heart muscle damage trained athletes have more muscle mass / exercise A statement such as 'body builders will have higher creatinine plasma concentrations than most people' = 2 marks (1 for recognising that another factor is involved and 1 for the named factor)

Question	Expected Answers	Marks	Additional Guidance
e	<p><i>advantage eg</i> delivered by trained professionals ; does not rely on family member / AW ;</p> <p>(at home) can select hours for treatment ; (so) gives control back to patient / AW ; allows social interaction / AW ;</p> <p><i>disadvantage eg</i> may require treatment several times a week ; difficult to carry on normal life / AW ; diet is restricted ;</p> <p>AVP ; AVP ;</p>	4 max	<p>CREDIT advantages and disadvantages in correct context – an ‘advantage’ point could be a ‘disadvantage in some circumstances so look for justification given by candidate</p> <p>DO NOT CREDIT same point twice if given as both an advantage and a disadvantage</p> <p>CREDIT may require frequent hospital visits</p> <p>CREDIT idea that mobility or working hours are limited CREDIT an example e.g. low salt</p> <p>CREDIT any reasonable advantage or disadvantage or an amplification of any of the marking points eg can prolong life idea eg not as much risk as a transplant eg cheaper compared to a transplant eg time consuming DO NOT CREDIT ‘cheaper’ or ‘expensive’ or cost references without further qualification A statement such as ‘relies on trained professionals who can supply social support or advice’ = 2 marks (1 for marking point 1, and 1 AVP for development of the idea)</p>
	Total	21	

Question		Expected Answers	Marks	Additional Guidance
2	a	<i>gene</i> length / section, of DNA ; coding for / AW, a polypeptide / protein ; <i>allele</i> different / alternative, form of a gene ; occupying same, locus / position (on homologous chromosomes) ;	4	DO NOT CREDIT 'a strand' or 'a bit' or 'a part' ACCEPT 'a piece of DNA' or 'a sequence of bases in DNA'

Question		Expected Answers	Marks	Additional Guidance															
2	b	<table border="1"> <thead> <tr> <th>name</th> <th>phenotype</th> <th>genotype</th> </tr> </thead> <tbody> <tr> <td>Dominique</td> <td>A</td> <td>$I^A I^O$;</td> </tr> <tr> <td>Ann</td> <td>B</td> <td>$I^B I^O$;</td> </tr> <tr> <td>Pawel / Gwen</td> <td>A</td> <td>$I^A I^O$;</td> </tr> <tr> <td>Gwen / Pawel</td> <td>B</td> <td>$I^B I^O$;</td> </tr> </tbody> </table>	name	phenotype	genotype	Dominique	A	$I^A I^O$;	Ann	B	$I^B I^O$;	Pawel / Gwen	A	$I^A I^O$;	Gwen / Pawel	B	$I^B I^O$;	4	<p>If candidate transposes genotype and phenotype, penalise once and then apply error carried forward leaving a maximum of three possible marks.</p> <p>CREDIT $I^A i$ or $I^B i$ as alternatives to $I^A I^O$ and $I^B I^O$</p> <p>The blood groups given for Pawel and Gwen must be different for both marks to be awarded</p>
name	phenotype	genotype																	
Dominique	A	$I^A I^O$;																	
Ann	B	$I^B I^O$;																	
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Question		Expected Answers	Marks	Additional Guidance		
	c	<p>Lucy / blood group O, has no <u>A</u> antigens ;</p> <p>Molly / blood group A, has <u>A</u> antigens ;</p> <p>Lucy / blood group O, has (anti-) A antibodies ;</p> <p>(the A) antigen (on Molly's cells) reacts with (anti-A) antibody (in Lucy's plasma) / AW ;</p> <p>agglutination ;</p>	4 max	<p>IGNORE ref to universal donor</p> <p>IGNORE ref to B and O antigens</p> <p>DO NOT CREDIT 'no antigens'.</p> <p>IGNORE anti-B antibodies</p> <p>LOOK FOR idea of the interaction between antibody and antigen</p> <p>ACCEPT idea of clumping</p> <p>DO NOT CREDIT 'clotting'</p> <p>DO NOT CREDIT 'immune response' as the antibodies are Isoantibodies</p>		
	d	i		<p>sequence of bases on one <u>strand</u> is reversed on the other strand / AW ;</p> <p><u>GGATCC</u> and <u>CCTAGG</u> ;</p>	2	<p>DO NOT CREDIT if both strands are not implied</p> <p>ACCEPT idea of complementary base pairs to indicate the two strands</p> <p>LOOK FOR information in a diagram that implies two strands of DNA</p>
		ii		<p>1 37 ;</p> <p>2 28 ;</p> <p>3 31 ;</p>	3	

Question			Expected Answers	Marks	Additional Guidance
		iii	parents are P and R ; child has, more bands in common with P and R / AW OR only 1 band in common with Q ;	2	DO NOT CREDIT idea of one band in common with P or R as this is also true of Q DO NOT CREDIT 'same strands' as P and R
			Total	19	

Question			Expected Answers	Marks	Additional Guidance
3	a	i	some donors donate more than one organ ;	1	<p>ACCEPT a specific example eg some donors may donate heart and lungs / both kidneys</p> <p>ACCEPT idea of some organs being split (liver) IGNORE reference to domino transplants</p>
	a	ii	<p>1 cadavers / dead bodies / corpses / deceased people ;</p> <p><i>advantage</i> no trauma to the donor ; could help relatives to cope with grief / AW ; could use many organs ;</p> <p><i>disadvantage</i> difficult to ask bereaved relatives ; difficult to find a suitable recipient with right tissue match ; organs less viable / deteriorate ;</p> <p>2 living donor ;</p> <p><i>advantage</i> greater chance of tissue match, with relative ; members of family more likely to want to help ;</p> <p>could be a financial incentive (for non relatives) ;</p>		<p>Look for idea that relatives feel better if they know that something positive has come from a traumatic event</p> <p>CREDIT reverse argument for 'living donor'</p> <p>CREDIT reverse argument for a disadvantage 'pressure on relative to donate'</p> <p>ACCEPT idea of people being paid for donations</p>

Question	Expected Answers	Marks	Additional Guidance
	<p><i>disadvantage</i> risk to health of donor ;</p> <p>only applies to, paired organs / organs that can be split ;</p> <p>could lead to exploitation / selling of body parts not ethical ;</p> <p>3 animal donors / xenotransplants ;</p> <p><i>advantage</i> limitless supplies available / AW ;</p> <p><i>disadvantage</i> some, religious / cultural / animal welfare, groups would find this unacceptable ; transfer / emergence, of viruses / new diseases ; more likely to be rejected / AW ;</p> <p>4 <u>domino transplants</u> / described ;</p> <p>AVP ;</p>	<p>8 max</p>	<p>ACCEPT description such as ‘remaining organ may fail for donor’ or ‘donor is subjected to unnecessary risk from surgery’</p> <p>ACCEPT idea that only applies to kidneys (2) or liver (can be split)</p> <p>ACCEPT the idea of a disease ‘jumping’ species</p> <p>ACCEPT idea that stronger immunosuppressants required</p> <p>ACCEPT idea that following a heart-lung transplant, the removed heart may still be healthy and can be donated.</p> <p>CREDIT eg stem cells to grow organs OR any reasonable advantage or disadvantage OR an amplification of any of the marking point eg cost of repairing damage caused by operations to remove organs</p>
	<p>QWC ;</p>	<p>1</p>	<p>AWARD for stating at least 2 named sources AND 1 advantage and 1 disadvantage linked to EACH of the 2 sources</p> <p>CREDIT if advantage or disadvantage is stated for that source This may be a ‘given mark’ if the same marking point had already been awarded for a different source.</p>

Question		Expected Answers	Marks	Additional Guidance
	b	i		
		aqueous, humour ;	1	DO NOT CREDIT humour alone or vitreous humour or aqueous fluid ACCEPT phonetic spelling
		ii		
		high, solute / named solute, concentration in corneal cells ; water potential in, M / aqueous humour, is, less negative / higher ; (water moves in by) osmosis ;	2	ACCEPT ref to water potential gradient if it is clear that water is coming from region M. CREDIT reverse argument 'corneal cells have a lower water potential' DO NOT CREDIT ref to high or low water potential without ref to which regions are high and low. A statement 'corneal cells have a lower water potential due to high level of dissolved protein' would score 2 marks
	c			
		no blood <u>plasma</u> ; (so) no antibodies (to interact with the graft) ; no (risk of) rejection ;	2 max	ACCEPT idea of no adverse immune response / less risk of rejection CREDIT reverse argument
	d			
		(subject at, fixed / specific) distance from chart ; light intensity (standardised) ; cover one eye / test 1 eye at a time ; random projection of letters (to avoid rote learning) ; idea of a standardised chart / letter size ;	2 max	DO NOT CREDIT 'distance is at least 6 metres' since this implies that distance does not have to be constant
Total			17	

Question	Expected Answers	Marks	Additional Guidance
4 a	<p>increase of / rise in , TSH / thyroxine) ;</p> <p>detected by, (cells in) hypothalamus ; (hypothalamus) reduces, release of, TRH /TSH;</p> <p>decrease / fall in, (plasma) TSH ;</p> <p>less stimulation of thyroid gland / AW ; (leading to)decrease, fall in (plasma) thyroxine ;</p>	3 max	<p>DO NOT CREDIT increase in thyroxine in <i>body</i></p> <p>DO NOT CREDIT 'high levels of thyroxine'</p> <p>ACCEPT 'thyroxine levels <i>get</i> too high / higher / excessively high' as this implies that a rise has occurred</p> <p>ACCEPT stops or prevents or inhibits release of TRH /TSH</p> <p>ACCEPT TRF instead of TRH</p> <p>ACCEPT secretion instead of release</p> <p>DO NOT CREDIT less TSH released as this marking point is about the concentration in the blood plasma</p> <p>DO NOT CREDIT less thyroxine released as this marking point is about the concentration in the blood plasma</p>

Question	Expected Answers	Marks	Additional Guidance
b	<p>body temperature, increases / rises / maintained ;</p> <p>AVP ;</p> <p style="text-align: right;">1 max</p> <p>(as) increase in (aerobic), <u>respiration</u> (rate) ;</p> <p>respiration, releases heat (energy) / is exergonic / is exothermic ;</p> <p>because more (respiratory) enzyme activity ;</p> <p style="text-align: right;">2 max</p>	3 max	<p>e.g. weight loss (due to more respiratory substrate / fats being utilised) / increase in appetite</p> <p>DO NOT CREDIT increase in metabolic rate, as stated in Q</p> <p>IGNORE reference to heat production or heat as a by-product DO NOT CREDIT idea that more ATP causes more respiration</p>

Question		Expected Answers	Marks	Additional Guidance
	c	i		ACCEPT phonetic spelling ACCEPT 'complementary'
		Golgi (apparatus / body) ; antigen ; variable / hypervariable ; substrate ; <u>active site</u> ; enzyme-substrate complex / ESC / E-S complex ;	6	
		ii		eg to prevent masking of the colour by / other chemicals blood cells DO NOT CREDIT unqualified references to contamination
		to remove any (unbound / free) TSH / antigen ; to remove any (unbound / free), antibody-enzyme complex / enzyme ; to prevent false positives / AW ; AVP ;	2 max	
Total			14	

Question		Expected Answers	Marks	Additional Guidance
5	a	(uses) X-ray ; DEXA / DXA / CT / dual / comparative scan ; wrist / heel / finger (measurements) ; hip / spine (measurements) ; measurements used to <u>calculate</u> T-score ;	3 max	ACCEPT hand or foot as peripheral IGNORE references to appearance of the X-ray image as the question is about how the scan is carried out not how the results are interpreted.
	b	i	4 340 ; ;	AWARD ONE MARK ONLY for 4 339.5 If answer is incorrect, look for evidence of correct working for 1 mark $(165 \times 2\ 630) \div 100$ or $(165 \div 100) \times 2\ 630$

Question		Expected Answers	Marks	Additional Guidance
	ii	<p>1 as age increases prevalence rises in both males and females ;</p> <p>2 increase is greater in females than in males ;</p> <p>3 males have higher prevalence than females, up to 65-69 / until age 70 - 74 ;</p> <p>4 prevalence same (in males and females), at age 70-74 ;</p> <p>5 females have higher prevalence from age 75 – 79 ;</p> <p>figures to support ; ;</p>	4 max	<p>CREDIT ecf if incorrect figure calculated in 5b(ii)</p> <p>CREDIT 'osteoporosis' instead of vertebral fractures</p> <p>CREDIT reverse argument for comparative figures</p> <p>ACCEPT 'until 69 / 70'</p> <p>ACCEPT 'from age 74/75/85+'</p> <p>For each figure mark,</p> <p>ACCEPT raw figures to show similarity or difference between males and females with units</p> <p>ACCEPT figures from final column without units as this compared males and females</p> <p>CREDIT figures marks if units quoted at least once</p> <p>CREDIT differences calculated between age groups</p>
		QWC ;	1	1 similarity (1 or 4) AND 1 difference (2, 3 or 5), each supported by data

Question	Expected Answers	Marks	Additional Guidance
	<p>iii</p> <p>males not prescribed HRT / HRT treatment for females ;</p> <p>(HRT contains) oestrogen ;</p> <p>osteoporosis in males is not due to decline in hormones;</p>	2 max	<p>IGNORE references to progesterone / testosterone</p>
c	<p>i</p> <p>increase intake of foods high in calcium ;</p> <p>named example ;</p> <p><u>vitamin D</u> supplements ;</p>	2 max	<p>DO NOT CREDIT increase intake of 'calcium' alone eg dairy product / milk / milk based product / cheese / calcium supplement</p> <p>DO NOT CREDIT vitamin supplement unqualified</p> <p>DO NOT CREDIT 'vitamin D' without further qualification e.g. 'foods enriched with vitamin D'</p>
	<p>(ii)</p> <p>blood, does not clot / clots more slowly ;</p> <p>Ca²⁺ / Ca⁺⁺, required for formation of thrombin ;</p> <p>OR</p> <p>nerve transmission slowed / AW ;</p> <p>Ca²⁺ / Ca⁺⁺, required for synaptic transmission vesicles / AW ;</p> <p>OR</p> <p>muscle movement slowed / AW ;</p> <p>Ca²⁺ / Ca⁺⁺, required for detaching tropomyosin from actin / AW ;</p>	2 max	<p>IGNORE references to teeth</p> <p>ACCEPT 'bleeding time increases'</p> <p><i>Role</i> of calcium must be <i>precisely</i> described.</p> <p>DO NOT CREDIT 'calcium needed for blood clotting, synapses or muscle contraction' unqualified as explanations</p> <p>One mark for consequence and one mark for the correctly linked explanation</p>
Total		16	

Question		Expected Answers	Marks	Additional Guidance
6	a	<p>depolarisation / action potential / description ; (occurs only) at node of Ranvier ;</p> <p>myelin sheath, insulates / prevents ions crossing membrane ;</p> <p>impulse jumps from node to node / saltatory conduction ;</p> <p>local circuit between nodes ;</p> <p>sodium ions, flow / move sideways (away positively charged region) ; sodium channels open, in next node / next node depolarises ;</p> <p>one-way transmission due to, refractory period / hyperpolarisation ;</p>	5 max	<p>ACCEPT marking points on a labelled diagram</p> <p>Look for the idea that this is where sodium and potassium ions are exchanging</p>
	b	<p>sensory neurones (only) ;</p> <p>(sensation / feeling, has gone but) movement (of tongue) requires motor neurones ;</p>	2	<p>DO NOT CREDIT if motor / relay neurone also stated as being affected</p>

Question	Expected Answers	Marks	Additional Guidance
c	anaesthetic (molecule) changes shape / charge / AW ; forms <u>complementary</u> shape to sodium channel protein / binds to opposite charge on sodium channel ;	2 max	CREDIT reference to allosteric effect As 'anaesthetic molecule' is in the question, assume 'it' refers to the molecule unless otherwise stated Look for the idea that the anaesthetic is now attracted to the binding site since it now has a charge difference
d	bind to (opiate) receptors ; on (surface) membrane of <u>sensory</u> neurones ; <u>cell signalling</u> / activation of G proteins (in membrane) ; trigger, second messenger / cAMP / description ; inhibits opening of calcium (ion) channels ; (vesicles) do not release neurotransmitter ; no, post-synaptic potential / described ;	4 max	IGNORE reference to pre or post synaptic membranes ACCEPT no calcium ions enter presynaptic neurone DO NOT CREDIT 'no calcium' ACCEPT neurotransmitter not released ACCEPT 'no sodium channels open in, post-synaptic neurone / interneurone
Total		13	

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