

Human Biology

Advanced GCE **2867/01**

Genetics, Homeostasis and Ageing

Mark Scheme for June 2010

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Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annesley
NOTTINGHAM
NG15 0DL

Telephone: 0870 770 6622
Facsimile: 01223 552610
E-mail: publications@ocr.org.uk

Question			Expected Answers	Marks
1	(a)		alveoli are less elastic ; lungs are less efficient (in oxygen uptake) ; lung capacity is smaller / AW ; (results in) reduced oxygen supply to organs ; max oxygen uptake with exercise is reduced /AW ; AVP ; e.g. ref to diaphragm / intercostals muscles less strong / AW, thorax expands less / reduction in peak flow rate, ref to arthritic changes in ribs	3 max
	(b)	(i)	atherosclerosis / described ; arteriosclerosis / hardening of blood vessel walls ; arteries less elastic ; ability of heart to pump blood / cardiac output , declines / AW ; thickening of wall of left ventricle ; increased blood pressure ; increased risk of CHD ; angina ; aneurysm ; haemorrhage ; embolism ; thrombosis ; varicose veins ;	3 max
		(ii)	increased risk of CHD ; if not given in b(ii) more prone to suffer from , strokes / coronary thrombosis ; (may lead to a) lack of mobility ; (may make it) difficult to carry out, everyday tasks / activities ; (may result in) need for , nursing / residential care / dependence on others ; frequent visits to the doctor / stays in hospital / dependency on medication ; inability to work / early retirement / loss of income ;	3 max
	(c)		disability allowance ; increase NHS resources / more hospital beds / other example ; more / better, residential / nursing , homes ; payments to extended family who work as carers ; increased access to public transport / reduced fares / AW ; AVP ; ; e.g. advice on how to lead a healthy lifestyle / AW	3 max
				[Total:12]

Question			Expected Answers	Marks
2	(a)	(i)	438 ; ; <i>Correct answer = 2 marks</i> <i>If answer incorrect, allow 1 mark for $70\,000 \div 160$</i> <i>ecf 1 max</i>	2
		(ii)	no duct ; numerous capillaries ; secretes , hormones / named e.g. ; directly into blood ;	2 max
		(iii)	<u>alpha</u> cells ; secrete glucagon ; converts glycogen into glucose / glycogenolysis ; increases the conversion of , amino acids / protein / lipid / fat , into glucose or gluconeogenesis AW ; stops insulin production / AW ;	3 max
	(b)	1 2 3 4 5	condensation reaction / described ; no other reactants required ; forms a <u>glycosidic</u> bond ; to form , polymer / polysaccharide / glycogen ; which is , a compact / insoluble , storage molecule ;	3 max
continued				

Question 2 cont'd			Expected Answers	Marks
	(c)		<p>Max 4 if none of the points 1 – 6 have been credited.</p> <ol style="list-style-type: none"> 1. glucose decreases the water potential of the blood ; 2. water moves down water potential gradient from cells (into blood) / AW ; 3. large volumes , water / urine , excreted /AW ; 4. body become(s) dehydrated or (excessive) thirst ; 5. enzymes cannot function efficiently ; 6. change in, electrolytes / named e.g., concentration ; <p>glucose in urine ; tiredness / fatigue qualified ; <i>R organ damage</i> damage in brain / coma / become unconscious / dizziness ; <i>R fainting</i> excess glucose converted to fat / ref. to ketones / ketoacidosis / breath smelling of pear drops / AW ;</p> <p>risk of gangrene in extremities ; glucose crystallises in lens / denatures lens ; cataract ; damage to capillaries in retina ; macular degeneration ;</p>	6 max
				[Total:16]

Question			Expected Answers	Marks
3	(a)	(i)	D cerebrum / cerebral hemisphere ; <i>A frontal lobe</i> E medulla (oblongata) ; <i>A pons (Varolli)</i> F cerebellum ; G corpus callosum ; <i>A ventricles</i>	4
		(ii)	D conscious thought / coordination of voluntary activity / learning / reasoning / intelligence / association of incoming information ; E regulation of autonomic activities / heart rate / blood pressure control / breathing rate / pharyngeal activity (e.g. coughing) ; F coordination of balance / muscle coordination / reflex control of posture / control of locomotory activities ; G (nerve fibre tract) linking left and right hemispheres / AW ;	4
	(b)		<i>changes to max 5</i> 1 neurones shorter or neurones have fewer, neural connections / synapses / dendrites / axons ; 2 tangled clumps of microtubules / tau protein / neurofibrillary tangles / AW ; 3 disrupt cell metabolism ; 4 (beta) amyloid / protein, plaques develop between neurones ; 5 lower than normal amounts of, neurotransmitter / Ach ; 6 deficiency of choline acetyltransferase ; 7 enlarged ventricles ; 8 neurones, lost / die ; 9 qualification (e.g. brain 10% mass loss after 80yrs) ; 10 ref. to possible inherited cause by mutated beta amyloid gene on chromosome (21) ; 11 AVP ; e.g. change in beta amyloid protein / AW <div style="text-align: right;">(5 max)</div> <i>symptoms to max 4</i> 12 loss of memory ; 13 short-term memory ('circuits') destroyed / AW ; 14 recent memory cannot be transferred to long-term memory ; 15 deterioration in language ; 16 loss of , cognitive function / awareness ; 17 personality changes ; 18 loss of social skills / confusion / described ; <div style="text-align: right;">(4 max)</div>	8 max
			QWC – legible text with accurate spelling, punctuation and grammar ;	1
				[Total:17]

Question			Expected Answers					Marks
4	(a)	(i)	A glomerulus / glomerular capillaries ; <i>R arterioles</i> B proximal / first, (convoluted) tubule ; C loop of Henle ; D blood <u>capillary</u> network / vasa recta / capillaries ;					4
		(ii)		<i>structural feature</i>		<i>adaptation to function</i>		
			A	large SA / thin endothelium / one cell thick / fenestrations / differing diameters of afferent and efferent vessels	;	appropriate adaptation (e.g. increased pressure therefore ultrafiltration)	;	
			B	convoluted / winding tube / microvilli / mitochondria / close to capillaries / intercell spaces / basal tubules	;	appropriate adaptation (e.g. compact / increased SA for <u>selective reabsorption</u>)	;	
			C	long / ascending / descending / protein carriers / channels / pump / thick / thin	;	appropriate adaptation (e.g. ascending impermeable to water / no osmosis / descending permeable to water / osmosis)	;	
			D	tightly applied to / surrounding , tubule / endothelium , thin / one cell thick	;	appropriate adaptation (e.g. ref. to osmosis qualified)	;	8
	(b)		all arrows correct ;					1
	(c)		(simple) diffusion only / AW ; wastage of nutrients at equilibrium / AW ; (membrane) not selective ; not self regulating / not homeostatic / needs external monitoring / AW ; (intravenous needles cause) damage to blood vessels ; risk of infection ; need to watch fluid intake / need strict diet / AW ; time spent on machine / expense / shortage of equipment ;					4 max
								[Total:17]

Question			Expected Answers	Marks
5	(a)	1	GH gene, synthesised / isolated / AW ;	7 max
		2	(usually from) mRNA ;	
		3	ref. to reverse transcriptase ;	
		4	correct ref. to cDNA ;	
		5	cut with , restriction enzyme / endonuclease / named e.g. ;	
		6	to form sticky ends / sticky ends added ;	
		7	specific / palindromic , base sequence ;	
		8	(genetically engineered / recombinant) plasmid ;	
		9	pBR322 ;	
		10	cut with <u>same</u> (restriction) enzyme ;	
		11	through the antibiotic resistance gene ;	
		12	complementary sticky end / AW ; <i>A match R the same</i>	
		13	hydrogen bonds form ;	
		14	between complementary base pairs ;	
		15	DNA ligase ;	
		16	joins sugar phosphate backbone ;	
		17	(<i>E. coli</i> / bacterium , takes up plasmids) in presence of , calcium ions / Ca^{2+} ;	
		18	detail ; e.g. multiply and produce hGH ref. to recombinant DNA plasmid is vector transgenic bacterium	
			QWC - clear, well organised using specialist terms ; at least 4 of the terms indicated above in bold	1
	(b)	(i)	boy shorter than 90% of other boys / less than 10% of boys are that short / AW ; of the same age / AW ;	2
		(ii)	<i>family history</i> height is (partly) genetically determined ; <i>R inherited</i> he could have a genetic disease ; achondroplasia / CF / other suitable e.g. ; AVP ; e.g. same problem in family (2 max)	6 max
			<i>tests for malnutrition</i> too little food would retard growth ; lack of , protein / energy , for hGH production ; too little , iodine / named vitamin / other named mineral , qualified ; AVP ; (2 max)	
			<i>CT scans of the brain</i> (anterior) pituitary gland (in brain) produces growth hormone ; tumour / trauma , interferes with production / described ; hypothalamus , produces hGH releasing factor / stimulates hGH production ; <i>R releases</i> AVP ; (2 max)	
			continued	

Question 5 cont'd			Expected Answers	Marks
		(iii)	<p>growth spurt at puberty ; very little growth afterwards / grow more during childhood ; ends of long bones / epiphyses , fuse ; AVP ; e.g. hGH would only increase muscle mass absence of hGH could produce weak muscles <i>R will remain short</i></p>	2 max
				[Total:18]

Question			Expected Answers	Marks
6	(a)	(i)	<i>Any pair in correct sequence = 1</i> gorilla / chimpanzee gibbon orang-utan gorilla / chimpanzee ; ;	2
		(ii)	contradicts ; banding , similar between chimpanzee and gorilla / different from human ; suggests , common ancestor / closer relationship than human and chimp ; orang-utan appears to be more closely related to human ; broadly similar pattern in all primates ; common ancestor / shows related ;	2 max
	(b)		chromosomes 12 and 13 in chimpanzee fuse to form human chromosome 2 ; AVP ; e.g. each human chromosome carries fewer genes / ora / AW	1 max
	(c)		<i>advantages</i> direct maternal descent / AW ; no , crossing-over / chiasmata / recombination ; not mixed with , paternal DNA / AW ; mutates faster than nuclear DNA ; can show human migration ; <i>disadvantages</i> can only show changes , within gene pool / within species / via mother ; if individual , does not reproduce / only has sons ; very little DNA ; mutation rate may not be constant ;	2 max
				[Total:7]

Question			Expected Answers	Marks
7	(a)	(i)	sex linkage ;	1
		(ii)	<p>form of a gene ; 1 max</p> <p>expressed in the absence of the dominant allele / AW ; <i>ora</i></p> <p>if , both alleles are recessive / homozygous , then trait is expressed ;</p> <p>if sex linked then expressed when single ; 1 max</p>	2 max
	(b)		<p><i>parental genotypes</i> $X^N X^n$ x $X^n Y$;</p> <p><i>gametes</i> X^N X^n X^n Y ;</p> <p><i>F₁ genotypes</i> $X^N X^n$ $X^N Y$ $X^n X^n$ $X^n Y$;</p> <p>50% / 0.5 / 1 in 2 / 1 : 1 / ½ ;</p>	4
	(c)		<p><i>cannot because</i></p> <p>(father) must pass Y chromosome to son ;</p> <p>(father's) X chromosome not passed to son ;</p>	1 max
	(d)	(i)	<p>female must , be homozygous / have two colour blind alleles / be $X^n X^n$;</p> <p>mother was , carrier / $X^N X^n$ / sufferer / $X^n X^n$;</p> <p>father was , colour blind / sufferer / $X^n Y$;</p> <p>lower probability of female inheriting two colour blind alleles than male inheriting one ;</p> <p>ref. to figs. (8 and 0.7) ;</p>	2 max
		(ii)	<p><i>A ora throughout</i></p> <p>not so life-threatening / not such a severe condition ;</p> <p>likely to survive to reproduce ;</p> <p>not so much selection against ;</p> <p>AVP ; e.g. suitable ref. allele frequency</p> <p>female needs to be homozygous</p>	2 max
	(e)		<p>applies pressure ;</p> <p>detail ; e.g. vasoconstriction occurs</p> <p>blood becomes more viscous / AW ;</p> <p>blood flows more slowly ;</p> <p>AVP ;</p>	3 max
continued				

Question 7 cont'd			Expected Answers	Marks
	(f)			
		(i)	different supplies of blood (vessels) / AW ; muscle bleeds more heavily than the ankle / other valid e.g. ; bleeding of head , more dangerous / heavier ; drug slower to reach head ; AVP ; e.g. must maintain blood flow to the brain / AW	3 max
		(ii)	blood would create pressure in the brain ; brain damage ; loss of function ; e.g. of function ; AVP ;	3 max
		(iii)	larger / more reliable / AW , supply ; no risk of , blood-borne infections / HIV / other e.g. ; purer ; no risk of rejection ;	2 max
				[Total:23]

Question			Expected Answers	Marks
8	(a)		secretes fluid to carry the sperm ; <i>A seminal fluid</i>	1
	(b)	(i)	specific cell marker ; <i>R specific to prostate / protein</i> triggers antibody production ; AVP ;	1 max
		(ii)	diagnosis not reliable ; 40% with level above 10ng cm^{-3} will not have it ; level will depend on initial size of prostate / AW ; slow growing (in elderly) ; not cost effective ;	3 max
		(iii)	ultrasound scan ; MRI scan ; CT scan ; PET scan ; AVP ; e.g. biopsy thermography	2 max
	(c)		ethnic origin / race ; genetic ; black Americans have higher incidence than other ethnic backgrounds ; diet ; France and Italy both similar diet but differ ; black American highest and Chinese lowest ; different exposure to , mutagens / named ; comparative figs in support ; AVP ; ; e.g. could be due to different detection rates, ref to varying levels of economic development	3 max
				[Total:10]

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OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

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