

GCE

Human Biology

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

Advanced GCE

Mark Scheme for June 2015

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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

Here is the mark scheme for this question paper.

Question		Answer	Mark	Guidance															
1	(a)	<p><i>not constant because</i> idea that internal conditions, fluctuate / AW ;</p> <p><i>stable because</i> idea of set, limits / points ;</p>	2	<p>CREDIT a response which uses examples e.g. core body temperature or water potential in blood plasma 'blood glucose levels rise and fall between 4 and 8 mmoldm⁻³ so are not constant' = 2 marks</p> <p>ACCEPT idea of optimum or normal level</p>															
	(b)	<table border="1"> <thead> <tr> <th rowspan="2">Feature or activity</th> <th colspan="2">Branch of autonomic nervous system</th> </tr> <tr> <th>Parasympathetic</th> <th>Sympathetic</th> </tr> </thead> <tbody> <tr> <td>Type of neurone</td> <td style="background-color: #cccccc;"></td> <td>motor ;</td> </tr> <tr> <td>Process triggered in liver cells</td> <td><u>glycogenesis</u></td> <td><u>glycogenolysis</u> ;</td> </tr> <tr> <td>Effect on heart rate</td> <td>decrease</td> <td>increase ;</td> </tr> <tr> <td>Neurotransmitter released at the SAN</td> <td><u>acetylcholine</u></td> <td style="background-color: #cccccc;"></td> ;</tr></tbody></table>	Feature or activity	Branch of autonomic nervous system		Parasympathetic	Sympathetic	Type of neurone		motor ;	Process triggered in liver cells	<u>glycogenesis</u>	<u>glycogenolysis</u> ;	Effect on heart rate	decrease	increase ;	Neurotransmitter released at the SAN	<u>acetylcholine</u>	
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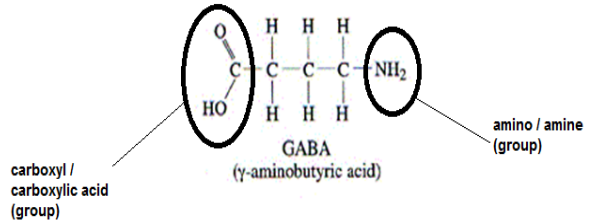
 4 | **DO NOT CREDIT** incorrect spelling of underlined terms since these have been provided |

Question		Answer	Mark	Guidance
	(c) (i)	<p>muscles contract (and relax), repeatedly / rapidly / AW ;</p> <p>(muscle cells) respire more ;</p> <p>idea that respiration / metabolism, releases heat / is exothermic ;</p>	3	<p>DO NOT CREDIT 'muscles contract' without some further qualification</p> <p>DO NOT CREDIT 'respiration' unqualified - look for idea of an increase in respiration rate / increase in metabolic rate</p> <p>DO NOT CREDIT 'produces energy'</p>
	(ii)	<p>1 (warm water leads to) blood vessels in, skin / extremities, (vaso)dilating ;</p> <p>2 (more) heat (energy) is lost ;</p> <p>3 <i>idea of</i> (warm) blood diverted from core to, skin/extremities OR (cold) blood circulated from skin / extremities to core</p>	2	<p>DO NOT CREDIT 'blood vessels dilate' without reference to location</p> <p>ACCEPT description of core e.g. from organs / named organs</p>
	(d) (i)	hypothalamus ;	1	ACCEPT phonetic spelling
	(ii)	medulla (oblongata) ;	1	ACCEPT phonetic spelling

Question	Answer	Mark	Guidance
	<p>(iii) two symptoms of hypothermia ;</p> <p><i>core rewarming</i> temperature of, medulla (oblongata) / X, restored (rapidly) and idea that heart rate / pulse rate, is controlled (by medulla) ;</p> <p>temperature of, medulla (oblongata) / X, restored (rapidly) and idea that breathing rate, is controlled (by medulla) ;</p> <p>cerebrum temperature is restored and speech controlled (by cerebrum) ; cerebrum temperature is restored and cognitive function controlled (by cerebrum) ;</p> <p>temperature of, medulla (oblongata) / X, restored (rapidly) and shivering, is controlled by autonomic nervous system (in medulla) ;</p> <p>cerebellum temperature is restored (faster) and movement coordination, restored / AW ;</p>	<p>1</p> <p>2</p>	<p>CREDIT any two of the following symptoms for one mark:</p> <p>stops shivering little or no breathing weak/irregular/no pulse difficulty speaking poor coordination / laboured movement confusion</p> <p>IGNORE unconscious</p> <p>LOOK FOR a link made from a symptom to restoring the temperature in the part of the brain responsible for that activity for the remaining two marks.</p> <p>ACCEPT ref to frontal lobe, motor cortex</p> <p>ACCEPT reference to muscles being coordinated by the cerebellum for this mark ACCEPT movement becomes less laboured</p>
		<p>Total 16</p>	

Question		Answer	Mark	Guidance
2	(a)	<p><i>karyotypes</i></p> <p>K1 2.1a has 46 chromosomes / DS karyotype has 47 ;</p> <p>K2 2.1a has 2 copies of chromosome 21/ DS karyotype has 3 ;</p> <p>K3 2.1a Chromosome 14 copies are different sizes / DS chromosome 14 same size ;</p> <p>1 (translocation) occurs during meiosis ;</p> <p>2 chromosomes / chromatids, break and rejoin ;</p> <p>3 <i>idea that</i> a piece of chromosome <u>21</u> attaches (to chromosome 14) ;</p> <p>4 both copies of chromosome 14 and 21 segregating independently ;</p> <p>5 <i>idea that</i> one gamete has (both) chromosome 21 an additional piece of chromosome 21 ;</p> <p>6 <i>idea that</i> (this) gamete, fertilised by / fertilises, a normal gamete ;</p>	6	<p>ACCEPT a stage in meiosis e.g. prophase 1</p> <p>CREDIT mps 2 to 6 if shown on annotated diagrams.</p> <p>CREDIT sperm or oocyte for gamete in mps 5 and 6</p> <p>CREDIT description of a normal gamete e.g. one copy of 21</p> <p>ACCEPT mp6 in context of Trisomy 21</p>
		<p>QWC ;</p>	1	<p>LOOK FOR ONE mark from K1 - K3: AND mps 5 and 6</p>

Question		Answer	Mark	Guidance
	(b) (i)	<i>idea that</i> a reason given for information being sensitive ;	1	Look for ideas such as: 'women might not want people to know because they feel guilty OR people don't want to be discriminated against or judged OR to comply with legislation e.g. on safeguarding DO NOT CREDIT ideas about 'privacy' without some further qualification.
	(ii)	improvements in (antenatal) screening techniques / AW ; increase in, population / birth rates / pregnancies ; <i>idea that <u>more</u> women now screened ;</i> <u>more</u> older women having children / AW ; <i>idea that</i> increasing age is risk factor (for DS) ;	2	CREDIT example such as introduction of nuchal fold screening or serum testing or 'triple' test in antenatal care IGNORE reference to improvements in karyotyping ACCEPT improvements in medical technology ACCEPT idea that younger women are now being screened.
	(iii)	<i>idea of fetal viability / AW ;</i>	1	CREDIT statements which refer to increase chance of a fetus with DS miscarrying naturally
			Total 11	

Question		Answer	Mark	Guidance
3	(a)	<p>complete carboxyl group circled and labelled</p> <p>AND</p> <p>complete amine group circled and labelled ;</p> <p>OR</p> <p>Both groups circled</p> <p>AND</p> <p>carboxyl, amino on dotted lines in that order ;</p>	1	 <p>carboxyl / carboxylic acid (group)</p> <p>GABA (γ-aminobutyric acid)</p> <p>amino / amine (group)</p>

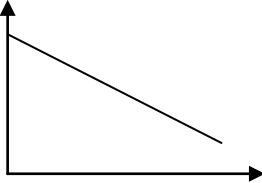
Question	Answer	Mark	Guidance
<p>(b)</p> <p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p> <p>6</p>	<p>nerve impulse / action potential, causes, influx / AW, of calcium ions / Ca²⁺ (into pre-synaptic / inhibitory neurone) ;</p> <p>(causes) vesicles to fuse / AW, with the pre-synaptic membrane and release GABA ;</p> <p>GABA diffuses across the synaptic cleft ;</p> <p>binds to (complementary) receptors on, post - synaptic neurone (membrane) / neurone P (membrane) ;</p> <p><i>idea that</i> influx / AW, of chloride (ions) makes, the post synaptic neurone / neurone P, more negative / hyperpolarised ;</p> <p><i>idea that</i> (not enough sodium ions can enter so) the threshold potential not reached ;</p>	<p>5</p>	<p>DO NOT CREDIT 'Calcium' or Ca⁺ but penalise ONCE only ACCEPT 'calcium enters' if calcium ion channels have been referred to</p> <p>ACCEPT a clear implication of inhibitory neurone</p> <p>2. CREDIT exocytosis of GABA</p> <p>CREDIT 'chloride ion channel' for receptor</p> <p>ACCEPT lower for negative</p> <p>ACCEPT a suitable value for threshold</p>
	<p>QWC</p>	<p>1</p>	<p>mp 1,2 in that order plus mp 5 or mp 6</p>

Question			Answer	Mark	Guidance
3	(c)	(i)	<p>any two from:</p> <p>restlessness / involuntary movements / twitching /shaking muscle / bone pain diarrhoea vomiting sweating / fever irritability / anger / aggression increased heart rate confusion hallucinations depression seizures headache insomnia fatigue mood swings</p>	1	<p>Mark the first answer on each line</p> <p>ACCEPT alternative correct symptoms</p>
		(ii)	Parkinson's (disease) ;	1	<p>CREDIT Tetanus, Meniere's disease, Multiple sclerosis</p> <p>IGNORE anxiety</p>
				Total 9	

Question		Answer	Mark	Guidance
4	(a)	<p><i>Idea of fatigue / extreme tiredness (elderly person or carer) ;</i></p> <p>emotional concern (<i>either</i>) ;</p> <p><i>(Problem for elderly person)</i></p> <p>consequence of being active at night ;</p> <p>consequence of feeling tired sleepy during the day;</p> <p><i>(Problem for carer)</i></p> <p>Reason for feeling concerned / worried /AW ;</p> <p>idea that elderly will need 24 hour access to care ;</p> <p><i>economic concern (either elderly person or carer)</i></p> <p>increased cost of care qualified ;</p>	3	<p>Feeling, lonely/disorientated/anxious/ irritable, angry, short-tempered, depressed</p> <p>e.g. falls when no one else is about to help / gets cold / misses meals</p> <p>e.g. social isolation / not feeling able to go out / 'missing out'/ not enough exercise</p> <p>e.g. worried that a person may hurt themselves</p> <p>e.g. might get called in middle of the night / idea of full time care, 24 hour care</p> <p>e.g. Look for a cost reference linked to e.g. need for 24h care OR need for alarm systems OR need to have heating on 24h.</p>
	(b) (i)	<p>(W is an) <u>endocrine</u> (gland)</p> <p>AND</p> <p>(melatonin is a) <u>hormone</u> ;</p> <p><i>idea that W secretes (melatonin) into blood (stream) ;</i></p>	2	<p>CREDIT correct reference to W being an endocrine gland and melatonin being hormone anywhere within the answer.</p> <p>IGNORE ref to specific glands e.g. pituitary</p> <p>ACCEPT amine</p> <p>ACCEPT reference to melatonin being transported in the blood</p>

Question		Answer	Mark	Guidance
4	(b) (ii)	<p><i>housebound</i> <i>idea that</i> light (intensity) is lower, in house/artificial light AND ref to SCN stimulated during day / melatonin (secretion) changing ;</p> <p><i>untreated glaucoma</i> optic nerve damaged / ref to tunnel vision / reduced peripheral vision AND SCN / gland W , not stimulated / does not respond /(high) melatonin in day / low melatonin at night</p> <p><i>Alzheimer's</i> Beta amyloid protein / tau protein / plaques / neurofibrillary tangles so SCN damaged / not stimulated OR gland W / described,damaged / not stimulated (and does not produce melatonin) ;</p>	3	<p>CREDIT idea of constant light so no variation in melatonin / not normal pattern</p> <p>ACCEPT melatonin higher/ lower than it should be / low at night / melatonin high <u>in the day</u> ;</p> <p>DO NOT CREDIT 'optic nerve is damaged' without further qualification</p> <p>ACCEPT melatonin secreted in day / not at night</p>
	c (i)	<p>MRI scan ;</p> <p>does not use, X-rays / (ionising) radiation, which can increase cancer risks / AW ;</p>	2	<p>ACCEPT CT or CAT scan for one mark only since this could be used for measurements</p> <p>CREDIT fMRI</p> <p>IGNORE PET scan or Ultrasound</p> <p>CREDIT reference to radiation being carcinogenic or causing DNA damage or mutations</p>

Question		Answer	Mark	Guidance
	(ii)	<p><i>independent variable</i> age (of population / individuals / AW) ;</p> <p><i>controlled variable</i> variations in gland size / diameter OR genetic variation / ethnicity OR gender ;</p>	2	<p>Mark the first answer on each line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>IGNORE time as independent variable CREDIT ageing</p> <p>ACCEPT 'time' as a controlled variable</p>

Question			Answer	Mark	Guidance
4	(c)	(iii)	age on X axis with unit symbol AND melatonin concentration on Y axis with unit symbol ; line or 'plotted points' sloping down from left to right ;	2	ACCEPT 'years' for age CREDIT a.u. or any unit of concentration such as mmol dm^{-3} , $\mu\text{g / cm}^3$, $\mu\text{g / L}$ or % ACCEPT correct use of negative exponent or solidus e.g. $\mu\text{g dm}^{-3}$ OR $\mu\text{g / dm}^3$ DO NOT CREDIT use of negative exponent combined with solidus e.g. $\mu\text{g / dm}^{-3}$ 
				Total 14	

Question			Answer	Mark	Guidance
5	(a)	(i)	<p><i>idea that</i> glucose is a respiratory substrate OR (plasma) glucose is the <u>only</u> respiratory substrate for neurones OR if blood glucose too low neurones lose function / AW ;</p>	1	<p>IGNORE ref to preventing hyper or hypo glycaemia without further qualification</p> <p>CREDIT idea of preventing a coma</p>
		(ii)	<p>hypothalamus AND (posterior) pituitary ;</p>	1	<p>Mark the first answer on each line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>BOTH answers required for 1 mark</p> <p>DO NOT CREDIT anterior pituitary</p>

Question			Answer	Mark	Guidance
5	(b)	(i)	<p>insulin ;</p> <p>injections / pump / insulin pen ;</p> <p><i>idea that</i> injected prior to a meal</p> <p>OR blood glucose measured to determine how much insulin is needed ;</p> <p>binds to receptors on,(cell surface membrane(s) of, liver / fat / muscle (cells) ;</p> <p><i>idea that</i> it, <u>promotes</u> / <u>increases</u> uptake of glucose ;</p> <p><i>idea that</i> it promotes / triggers, the conversion of glucose to glycogen / <u>glycogenesis</u> ;</p> <p> </p> <p><i>idea that</i> use of glucose in respiration, is increased</p> <p>OR glucose is respired preferentially to, fats/fatty acids ;</p>	5	<p>IGNORE epipen</p> <p> </p> <p>ACCEPT 3 or 4 times a day</p> <p> </p> <p>CREDIT '<u>more</u> glucose is taken up'</p> <p> </p> <p>DO NOT CREDIT a description if an incorrect term or incorrectly spelled term is then used as this is a contradiction</p> <p>e.g. 'stimulates glycogenolysis which is the conversion of glucose to glycogen' = 0 MARK</p> <p>DO NOT CREDIT 'insulin converts glucose to glycogen'</p> <p> </p> <p>DO NOT CREDIT 'increase in respiration of glucose'</p>

Question	Answer	Mark	Guidance
	<p>(ii) more / AW,(ADH) AND decrease (in urine volume) ;</p> <p><i>justification</i> (high blood glucose) lowers water potential, (stimulating /AW, release of ADH) ;</p> <p>(ADH triggers) more water reabsorption (so a lower urine volume) ;</p>	3	
(c)	<p>(i) (<i>region</i>) proximal convoluted tubule AND (<i>blood vessel</i>) capillary ;</p> <p>(PCT) has microvilli / has carrier / channel proteins (for uptake) ;</p> <p>(capillary has) wall one cell thick / AW OR (capillary has) fenestrations / gaps / pores ;</p>	2	IGNORE 'because this is the region where glucose is reabsorbed' as a reason as this does not use the diagram.
	<p>(ii) <i>idea that</i> (membrane has) fluid (mosaic) structure ;</p> <p><i>Idea that</i> proteins 'float' in (phospho)lipid bilayer ;</p>	2	

Question			Answer	Mark	Guidance
5	(c)	(iii)	<i>mechanism</i> facilitated diffusion / active transport / co-transport ; <i>idea that</i> number of (channel / carrier) proteins is limiting / AW ; <i>idea that</i> glucose is filtered out but not all reabsorbed ; no glucose, transport proteins / uptake, in other regions of nephron ;	3	IGNORE ref to incorrect part of nephron ACCEPT descriptions e.g. 'there are too many glucose molecules for channels to cope with' ACCEPT 'glucose in filtrate is not reabsorbed'
	(d)	(i)	blood/ plasma ;	1	ACCEPT liver
		(ii)	(region) cortex / AW ; (reason) <i>idea that</i> proteins normally too large to cross (basement membrane) ;	2	ACCEPT ref to glomerulus/ glomeruli / basement membrane IGNORE renal capsule ACCEPT idea of proteins being too large to be filtered out of glomerulus
				Total 20	

Question			Answer	Mark	Guidance
6	(a)	(i)	(age) when, periods / ovulation , stops ; <i>idea that</i> this is, for non-surgical reason / due to decline in follicular activity ;	2	CREDIT correct reference to absence of hysterectomy IGNORE reference to HRT
		(ii)	<i>idea that</i> one population may have more / fewer, women who, are unemployed / smoke / have a higher BMI / AW ; <i>idea that</i> median not affected by, extremes / outliers OR mean is affected by, extremes / outliers / anomalies ; median not affected by large numbers at one age OR mean is affected by large numbers at one age ;	2	CREDIT reference to smoking, unemployment, BMI, use or oral contraception, heart disease risk factors, ethnicity etc varying between populations LOOK FOR idea that highest and lowest ages can be very different (but the mid- point will still be the same) IGNORE ref to range LOOK FOR larger numbers in one group (e.g. early menopause) affect mean / do not affect median
	(b)		no / less, oestrogen / progesterone secreted ; (due to damage to) follicular cells; no / less development of, endometrium / uterine lining OR FSH stays high ; idea of damaged oocytes destroyed ;	2	

Question		Answer	Mark	Guidance
	(c) (i)	C - cytosine AND T - thymine ;	1	ACCEPT phonetic spelling for cytosine DO NOT CREDIT cysteine DO NOT CREDIT 'thiamine'
	(ii)	restriction (endonuclease enzyme) ; palindrome / palindromic ; phosphodiester / covalent (bond) ;	3	ACCEPT phonetic spelling throughout
	(iii)	<i>describe:</i> C variant gives 2 bands AND T variant gives 1 band ; C variant band <u>closer</u> to bottom(of gel) / T variant band(s) <u>closer</u> to top (of gel) ; <i>explain:</i> <i>idea that</i> enzyme does not 'cut' T variant / enzyme cuts C variant ; <i>idea that</i> GAATTT / T variant, no longer complementary to active site of, restriction / EcoR1, enzyme ;	3	ACCEPT idea that more bands / lines seen in C variant CREDIT C variant (band(s)) moved further (down the gel towards anode / away from the wells) / T variant (band) moved less distance (down the gel) ACCEPT idea that restriction enzyme does not recognise / fit / bind to T variant region
			Total 13	

Question			Answer	Mark	Guidance
7	(a)	(i)	7 (μm) ;;	2	<p>Correct answer = 2 marks</p> <p>If answer is incorrect, award one mark for correct working - (2 or 20 or 20 000) \div 2 800 OR (1.9 or 19 or 19 000) \div 2 800</p> <p>Award one mark for an answer which has not been rounded 7.142..... OR 6.785....</p>
		(ii)	<i>idea that narrow <u>lumen</u> / roughened endothelium / blood clot, causes (red blood cells to fragment) ;</i>	1	ACCEPT description of blood clot e.g formation of fibrin mesh causing fragmentation of red blood cells
		(iii)	sickle cell (anaemia) / AVP ;	1	

Question	Answer	Mark	Guidance
7 (b) (i)	<p><i>Named treatment for <u>short term</u>:</i> <u>Haemodialysis</u> ; <u>peritoneal dialysis</u> ;</p> <p><i>long term treatment</i> kidney transplant ;</p> <p><i>organ / donor detail</i> matched MHC antigens / blood groups between donor and recipient OR use of close relative to obtain tissue match OR ref to cadaver / xenotransplants ;</p> <p><i>recipient detail</i> use of immunosuppressant to prevent rejection ; <i>idea of control of diet / low salt ;</i></p> <p><i>operation detail</i> connection of renal artery and vein / connection to alternative artery (iliac) / old kidney left in place ;</p> <p><i>detail of alternative <u>long term</u> treatment peritoneal dialysis</i> dialysis fluid introduced into abdominal cavity OR peritoneum acts as the partially permeable membrane OR reference to CCPD / described</p>	5	<p>DO NOT CREDIT 'kidney or renal' dialysis DO NOT CREDIT haemodialysis as a long term treatment</p> <p>ACCEPT 'alternative treatment' as 'long term'</p> <p>ACCEPT alternative correct details</p> <p>CREDIT description of CCPD such as attached overnight to a dialysis exchanger</p>

Question			Answer	Mark	Guidance
7	(b)	(ii)	(injections of) erythropoietin / EPO ; <i>explanation:</i> (EPO) stimulates, RBC synthesis ; as (damaged) kidneys not making EPO ; OR (packed red blood cell, whole blood) transfusion ; as (damaged) kidneys not making EPO ; (so) RBC synthesis not stimulated (by EPO) ;	3	
	(c)		recessive ; homozygous / double, recessive ; <u>sex</u> ; pedigree ; fifty / 50 ;	5	
				Total 17	

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

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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Facsimile: 01223 552553

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