

Human Biology

Advanced GCE

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

Mark Scheme for June 2012

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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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Annotations

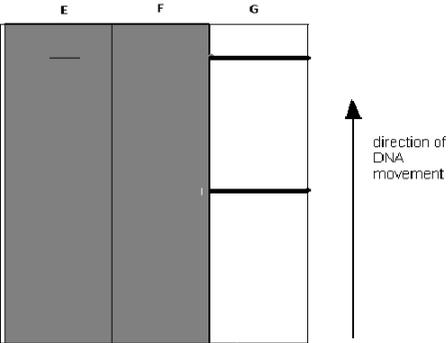
Annotation	Meaning
	Correct answer
	Incorrect response
	Benefit of Doubt
	Not Benefit of Doubt
	Error Carried Forward
	Given mark
	Underline (for ambiguous/contradictory wording)
	Omission mark
	Ignore
	Correct response (for a QWC question)
	QWC* mark awarded
	Verbal Construction

*Quality of Written Communication

Question		Answer	Marks	Guidance		
1	(a)	<p>P sensory neurone / dendron ;</p> <p>Q cell body / nucleus ;</p> <p>R intermediate / relay / association, neurone ;</p> <p>S motor neurone / axon ;</p>	4	<p>Penalise 'nerve' instead of 'neurone' once only</p> <p>P DO NOT CREDIT dendrite, axon</p> <p>Q IGNORE dorsal root ganglion</p> <p>R CREDIT interneurone R IGNORE connector neurone</p> <p>S DO NOT CREDIT dendron</p>		
	(b)	(i)		<p>1 (sudden) blow to head / head suddenly and violently hits an object / AW ;</p> <p>2 causes (physical) damage to brain / description ;</p>	2	<p>1 CREDIT idea of violent shaking</p> <p>2 e.g. bleeding (into the brain)</p> <p>2 IGNORE references to 'causes injury' as 'injury' is given in the question</p>

Question	Answer	Marks	Guidance
	<p>(ii)</p> <p>1 <i>idea that</i> image shows differences in magnetic field ;</p> <p>2 detail of molecular response ;</p> <p>3 locates, position / extent of / size of, <u>injury</u> ;</p> <p>4 locates, blood clot / bleed / swelling / loss of myelin sheath ;</p> <p>5 shows areas which are, (metabolically) active / respiring ;</p> <p>6 <i>idea of</i> comparison between scan of damaged, tissue / brain and normal / undamaged, tissue / brain ;</p>	4 max	<p>IGNORE refs to other parts of the body</p> <p>ACCEPT idea of use of magnet / magnetic field (to obtain an image)</p> <p>2 e.g. aligns water molecules haemoglobin responds differently to oxyhaemoglobin lines up hydrogen (atoms / ions), protons</p> <p>3 look for idea of ‘how much’, ‘where’ ‘how big’ ‘area of’ damage</p> <p>4 look for idea of <u>type</u> of damage e.g. ‘bruising’, haemorrhaging</p> <p>CREDIT a description of activity in terms of balance between oxyhaemoglobin and haemoglobin – this would also get mp 2.</p>
	Total	10	

Question			Answer	Marks	Guidance
2	(a)	(i)	some, erythrocytes / red blood cells, are, sickle shaped / not biconcave / AW ; A / C / D (as example of sickled cell) ;	2	Mark point 1 must refer to red blood cell OR erythrocyte CREDIT red blood cell shape is abnormal compared to B / E DO NOT CREDIT if candidate implies that all the red blood cells are sickle shaped. 'D is sickled shape' gets 1 mark 'D is a sickled shape red blood cell' gets 2 marks
		(ii)	nucleus of neutrophil is, purple / darker than other structures / AW ; pink / red /purple, cytoplasm ; neutrophil looks different when compared with, other cells / red blood cells / erythrocytes ; <i>idea that</i> colours indicate Leishman's (stain) has been used (which is a differential stain) ;	2	CREDIT idea that neutrophil is visible for mark point 3 DO NOT CREDIT this mp for a reference to staining or colour – the idea is that the staining now allows you to see it Look for idea that the pink / purple colours are indicative of a named differential stain
	(b)	(i)	cuts / AW, DNA <u>strand</u> (s) / phosphodiester bond ; at <u>specific</u> (recognition) site / sequence OR <i>Mst II</i> <u>only</u> cuts at CCTNAGG ; site complementary to, active site of (restriction) enzyme ; (enzyme recognises) palindromic sequence / AW ; (some enzymes) produce / AW, sticky ends / blunt ends ;	3 max	ACCEPT 'cuts sugar-phosphate backbone' DO NOT CREDIT 'cuts DNA' alone DO NOT CREDIT recognition site alone ACCEPT idea that only cuts where sequence starts with CCT and ends in AGG CREDIT a description of a palindromic sequence

Question			Answer	Marks	Guidance
2	(b)	(ii)	idea of fewer recognition sites / restriction sites ; (so)idea of fewer cuts / AW ;	2	CREDIT idea that CCTGAGG does not occur as often Look for idea that there will be longer lengths of DNA between 'cuts'
	(c)		one bar in line with the bar in F AND one bar in line with the bar in G ; 	1	
	(d)		co-dominance / co-dominant ;	1	Mark the first answer only. If a second answer is given which is incorrect the mark = 0 ACCEPT SCA is autosomal recessive idea of incomplete dominance

Question			Answer	Marks	Guidance
2	(e)		quaternary / 4 ⁰ ; affinity ; oxygen / O ₂ ;	3	ACCEPT phonetic spelling DO NOT CREDIT '0'
	(f)	(i)	<i>double-blind</i> <i>idea that</i> doctor / experimenter and patient /subject, do not know who is receiving, HU / placebo ; <i>randomised</i> subjects allocated into either HU or placebo group by chance ;	2	ACCEPT randomisation method or description such as random number tables DO NOT CREDIT 'randomly' or 'at random' without further explanation

Question	Answer	Marks	Guidance
	(ii) $8.6 - 5 = 3.6$; $(3.6 \div 5) \times 100$;	2	$\frac{(8.6 - 5)}{5} \times 100\%$ gets 2 marks CREDIT other methods of calculation if candidates make clear the reasoning behind their calculation e.g. $8.6 \div 5 = 172\%$ $5 = 100\%$ $(8.6 = 172\%)$ $172 - 100 = 72\%$ OR $5 = 100\%$ 1% of 5 = 0.05 $0.05 \times 172 = 8.6$ OR $(5.00 \div 100) \times 72 = 3.6$ $5.00 + 3.6 = 8.6$ OR $100 \div 5 = 20$ $20 \times 8.6 = 172$ $172 - 100 = 72$

Question	Answer	Marks	Guidance																			
	<p>(iii) <i>In treated group / group given HU / group with increase in fetal haemoglobin</i></p> <p>fewer hospital admissions for treatment ;</p> <p>fewer blood transfusions ;</p> <p>fewer deaths due to sickle cell disease ;</p> <p>data quote for two factors (with units (%) for hospital admissions only) ;</p>	<p>3 max</p>	<p>IGNORE references to neutrophil increase (as not specific to SCA)</p> <p>CREDIT reverse argument for the untreated group</p> <p>DO NOT CREDIT 'fewer deaths' without qualification</p> <p>IGNORE neutrophil data quotes OR fetal haemoglobin data quotes</p> <p>CREDIT a correct calculated difference</p> <table border="1" data-bbox="1279 703 2069 1217"> <thead> <tr> <th data-bbox="1279 703 1525 839">factor being measured</th> <th data-bbox="1525 703 1727 839">result for individuals given HU</th> <th data-bbox="1727 703 1912 839">result for individuals given placebo</th> <th data-bbox="1912 703 2069 839">calculated difference</th> </tr> </thead> <tbody> <tr> <td data-bbox="1279 839 1525 975">admissions to hospital for sickle cell crisis over 2 years (%)</td> <td data-bbox="1525 839 1727 975" style="text-align: center;">2.4</td> <td data-bbox="1727 839 1912 975" style="text-align: center;">3.9</td> <td data-bbox="1912 839 2069 975" style="text-align: center;">1.5</td> </tr> <tr> <td data-bbox="1279 975 1525 1078">number of blood transfusions over 2 years</td> <td data-bbox="1525 975 1727 1078" style="text-align: center;">55</td> <td data-bbox="1727 975 1912 1078" style="text-align: center;">79</td> <td data-bbox="1912 975 2069 1078" style="text-align: center;">24</td> </tr> <tr> <td data-bbox="1279 1078 1525 1217">number of deaths related to sickle cell anaemia</td> <td data-bbox="1525 1078 1727 1217" style="text-align: center;">2</td> <td data-bbox="1727 1078 1912 1217" style="text-align: center;">4</td> <td data-bbox="1912 1078 2069 1217" style="text-align: center;">2</td> </tr> </tbody> </table>				factor being measured	result for individuals given HU	result for individuals given placebo	calculated difference	admissions to hospital for sickle cell crisis over 2 years (%)	2.4	3.9	1.5	number of blood transfusions over 2 years	55	79	24	number of deaths related to sickle cell anaemia	2	4	2
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Question	Answer	Marks	Guidance
	<p>(iv)</p> <p>(placebo individuals) more erythrocyte breakdown ;</p> <p>damaged erythrocytes / AW, stimulate immune response ;</p> <p>(placebo individuals) more likely to get diseases / AW ;</p> <p>neutrophils engulf / digest, bacteria / pathogens / damaged erythrocytes / AW ;</p> <p>neutrophils are <u>phagocytic</u> ;</p> <p>(placebo) results in more blood transfusions ;</p> <p>neutrophil increases in response to foreign cells (in transfused blood) ;</p> <p>AVP ; ;</p>	<p>2 max</p>	<p>DO NOT CREDIT reference to immune response to SCA</p> <p><i>idea that</i> damage caused by SCA to cells or tissues stimulates immune response</p> <p>DO NOT CREDIT unqualified references to neutrophils destroying sickled cells</p> <p>e.g. idea that placebo stimulates, neutrophil production / immune response</p> <p>OR</p> <p> HU inhibits neutrophil production</p> <p>e.g. placebo affect other processes in bone marrow (as well as production of fetal haemoglobin)</p>
	<p>Total</p>	<p>23</p>	

Question			Answer	Marks	Guidance						
3	(a)	(i)	<table border="1"> <thead> <tr> <th>name of cell</th> <th>letter</th> </tr> </thead> <tbody> <tr> <td>ganglion cell</td> <td>E ;</td> </tr> <tr> <td>bipolar cell</td> <td>D ;</td> </tr> </tbody> </table>	name of cell	letter	ganglion cell	E ;	bipolar cell	D ;	2	If answers are incorrect, allow and ERROR CARRIED FORWARD into (ii) only if cells are identified by EITHER a colour OR a letter in the sequence being described
name of cell	letter										
ganglion cell	E ;										
bipolar cell	D ;										

Question	Answer	Marks	Guidance
	(ii) 1. rhodopsin <u>absorbs</u> light ; 2. (causing) (11)-cis-retinal to be converted to (all-)trans-retinal ; 3. (retinal) changes shape / no longer fits opsin binding site ; 4. (changed retinal) causes sodium (ion) channels (in rod cell membrane) to close ; 5. rod cell (membrane) becomes, hyperpolarised / -70mv ; 6. no, neurotransmitter / glutamate released / AW ; 7. (so) bipolar neurone / green cell, depolarised / AW ; 8. bipolar cell releases (named) neurotransmitter ; 9. neurotransmitter binds to receptors on, ganglion cell / post-synaptic cell / red cell / E ; 10. (causes) depolarisation / action potential / AW , in ganglion cell / red cell / E ;	6 max	<i>Note potential error carried forward from part (i)</i> 5 Look for idea that the voltage becomes more negative 6 DO NOT CREDIT acetylcholine 7 CREDIT description of sodium ions entering bipolar cell ACCEPT idea of an action potential in bipolar cells 8 CREDIT acetylcholine 8 DO NOT CREDIT glutamate CREDIT description of sodium ions entering ganglion cell
	QWC ;	1	Award if mp 1 – 5 is followed by mp 6 -8 followed by 9 or 10

Question		Answer	Marks	Guidance										
(b)	(i)	<p><u>gene(s)</u> carried / locus is present, on a sex chromosome / X chromosome / Y chromosome ;</p> <p>(on) X but not on the Y chromosome ;</p>	2	<p>DO NOT CREDIT 'allele(s)'</p> <p>CREDIT idea that gene is found on only one of the sex chromosomes</p> <p>'gene is <u>only</u> found on the X chromosome' = 2 marks 'gene found on X or Y chromosome' = 2 marks</p>										
	(ii)	<table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="background-color: #cccccc;"></td> <td>letter</td> </tr> <tr> <td style="background-color: #cccccc;"></td> <td>Y</td> </tr> <tr> <td style="background-color: #cccccc;"></td> <td>B</td> </tr> <tr> <td style="background-color: #cccccc;"></td> <td>B</td> </tr> <tr> <td style="background-color: #cccccc;"></td> <td>R</td> </tr> </table> <p>; ; ; ; ;</p>		letter		Y		B		B		R	4	
	letter													
	Y													
	B													
	B													
	R													
	(iii)	<p>Ishihara (pseudo-isochromatic colour plate) exam / shown a card with different coloured spots / AW ;</p> <p>(asked to state) shape / image / number / letter, shown on card ;</p> <p>different, shape / image / number / letter, appears if colour blind ;</p> <p>(colour blindness) not treatable / AW ;</p> <p>need to make allowances / AW ;</p> <p>AVP ;</p>	4 max	<p>CREDIT idea that people who are colour blind do not see the letter / shape</p> <p>CREDIT example such as traffic lights and reading books</p> <p>e.g. safety issues / specified safety issue e.g. idea that other members of family can be made aware</p>										

Question		Answer	Mark	Guidance
	(c)	<p><i>macular degeneration</i> macular / this, is region where most cones are found / AW ;</p> <p>fewer / only few, cones in periphery ;</p> <p><i>cataracts</i> less light entering eye / AW ;</p> <p>cones require, high light intensity / AW ;</p>	3 max	<p>CREDIT idea that fovea in this region (area where only cones are found)</p> <p>CREDIT idea of lens preventing light getting through / lens being cloudy</p>
		Total	22	

Question		Answer	Marks	Guidance
4	(a)	<p><i>drug</i></p> <ol style="list-style-type: none"> 1. a substance taken into the body AW ; 2. modifies, physiology / body function ; 3. modifies, mental function ; 4. statement in support ; <p><i>physical dependency</i></p> <ol style="list-style-type: none"> 5. results from repeated , <u>alcohol</u> abuse / <u>heavy drinking</u> ; 6. idea that withdrawal of alcohol leads to physical symptoms ; 7. statement in support ; <p><i>psychological dependency</i></p> <ol style="list-style-type: none"> 8. depend on <u>alcohol</u> to feel good / AW ; 9. statement in support ; 	6 max	<p>ACCEPT either letter or paraphrasing of statements for mark points 4, 7 and 9.</p> <p>1 Look for idea of <i>taking</i> the drug</p> <p>2 ACCEPT ‘affects the way the body functions’</p> <p>3 ACCEPT ‘affects how you feel /think’</p> <p>4 <i>statement K, L, M</i></p> <p><i>For mark points 5 and 6, answer must refer to alcohol or drinking</i></p> <p>6 ACCEPT withdrawal symptoms (from alcohol) for mp 6</p> <p>7 <i>statement K, L, M</i></p> <p><i>For mark point 8, answer must refer to alcohol or drinking</i></p> <p>9 <i>statement J, K, M</i></p>
		QWC ;	1	<p>Award if mp 1 OR 4 AND 7 AND 9 have been awarded</p> <p style="text-align: right;">Continued on page 15.....</p>

Question			Answer	Marks	Guidance
					<p>STATEMENTS:</p> <p>J Some people find drinking alcohol more important than anything else they might do during the day</p> <p>K Alcohol is a depressant but, as it acts on the limbic system of the brain, the effect is to reduce inhibitions and anxieties</p> <p>L One serious alcohol withdrawal symptom is called delirium tremens. This includes shaking, sweating, diarrhoea and seizures and requires urgent medical attention as it can be life threatening</p> <p>M Delirium tremens cause you to feel agitated, confused, paranoid and experience hallucinations</p>
	(b)	(i)	<p>Mark the first 2 answers only</p> <p>glycolysis ; lactate breakdown ;</p> <p>amino acid breakdown ;</p>	2 max	<p>IGNORE reference to AEROBIC or ANAEROBIC respiration</p> <p>ACCEPT breakdown of glucose</p> <p>DO NOT CREDIT 'protein' CREDIT deamination of amino acids</p>

Question			Answer	Marks	Guidance
4	(b)	(ii)	<p>risk of / AW, <u>hypoglycaemia</u> / (diabetic) coma ;</p> <p><i>idea that</i> (named) carbohydrate will boost blood sugar level ;</p> <p>(because) Type 1 diabetics take insulin (to lower blood sugar) ;</p> <p>idea that insulin, also lowers blood glucose / lowers blood glucose even further ;</p>	2 max	<p>DO NOT CREDIT 'low blood sugar' unless qualified that the level is below normal threshold / 'too low'</p> <p>IGNORE reference to 'food' increasing blood sugar</p> <p>DO NOT CREDIT 'alcohol reduces amount of glucose that can be produced by the liver' as this is given in the question stem</p>
	(c)	(i)	<p><i>in younger age groups</i> fewer deaths in total ;</p> <p>alcohol related deaths are a higher proportion of deaths ;</p>	2	<p>CREDIT reverse argument in older age groups CREDIT idea that overall deaths are lower</p> <p>CREDIT idea that more deaths in older people due to other causes / other chronic conditions (<i>NOT ALCOHOL RELATED</i>)</p>

Question			Answer	Marks	Guidance															
4	(c)	(ii)	<p><i>in 15-24 age group</i> fewer deaths in total ; most / higher proportion of, deaths due to acute events ; fewer / lower proportion of, deaths due to chronic conditions ;</p> <p>no deaths directly related to alcohol AND some deaths in 55-64 years age group ;</p> <p>figures in support ;</p>	4 max	<p>CREDIT reverse argument in 55-64 years age group CREDIT reverse argument in 55-64 years age group CREDIT reverse argument in 55-64 years age group</p> <p>CREDIT 2 values and two different age groups OR a calculated difference between 2 age groups.</p> <table border="1"> <thead> <tr> <th>Age group (years)</th> <th>Acute events</th> <th>Chronic events</th> <th>Directly caused by alcohol</th> <th>Total Deaths</th> </tr> </thead> <tbody> <tr> <td>15 - 24</td> <td>360</td> <td>40</td> <td>0</td> <td>440</td> </tr> <tr> <td>55 - 64</td> <td>260</td> <td>1050</td> <td>950</td> <td>2 250</td> </tr> </tbody> </table> <p>tolerance from graph is +/- 50</p>	Age group (years)	Acute events	Chronic events	Directly caused by alcohol	Total Deaths	15 - 24	360	40	0	440	55 - 64	260	1050	950	2 250
Age group (years)	Acute events	Chronic events	Directly caused by alcohol	Total Deaths																
15 - 24	360	40	0	440																
55 - 64	260	1050	950	2 250																
			Total	17																

Question		Answer	Marks	Guidance
5	(a)	<p>1 idea that blood pressure is part of internal environment / AW ;</p> <p>2 (homeostasis) maintains conditions, around fixed point / kept within limits / stable ;</p> <p>3 (shows) <u>negative feedback</u> ;</p> <p>4 stimulus / fall in blood pressure, offset by, response / increase in blood pressure ;</p> <p>5 (mechanism) has receptors / AW ;</p> <p>6 example of receptor ;</p> <p>7 (mechanism) has effectors / AW ;</p> <p>8 example of effector ;</p> <p>9 AVP ;</p>	6 max	<p>1 Look for this idea <u>anywhere</u> within the answer</p> <p>2 idea of a norm, within limits, stable</p> <p>4 ACCEPT idea of 'return to normal' after fall or rise</p> <p>e.g. cells in kidney cortex</p> <p>e.g. smooth muscle</p> <p>e.g. despite increased stress / blood loss, uses autonomic nervous system</p>
	(b)	<p>(i)</p> <p>1 (cells in wall of) convoluted tubule ;</p> <p>2 distal ;</p> <p>3 (cells in wall of) collecting duct ;</p> <p>4 inside cells / in, cytoplasm / nucleus ;</p>	2 max	<p>1 IGNORE proximal or distal for this mark</p> <p>2 DO NOT CREDIT if proximal and distal given</p> <p>1 and 2 ACCEPT DCT only = 2 marks ACCEPT PCT and DCT = 1 mark</p> <p>3 IGNORE ref to loop of Henle</p>
		<p>(ii)</p> <p>(sodium ions) lower water potential of blood (plasma) ; water enters, blood / blood vessels, by osmosis / down a water potential gradient ; increase in blood <u>volume</u> ;</p>	2 max	

Question		Answer	Marks	Guidance												
5	(c)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">incorrect term</th> <th style="width: 50%;">appropriate term</th> </tr> </thead> <tbody> <tr> <td>condensation</td> <td>hydrolysis</td> </tr> <tr> <td>identical ;</td> <td>complementary ;</td> </tr> <tr> <td>ester ;</td> <td>peptide ;</td> </tr> <tr> <td>substrate ;</td> <td>product ;</td> </tr> <tr> <td>angiotensinogase ;</td> <td>angiotensinogenase ;</td> </tr> </tbody> </table>	incorrect term	appropriate term	condensation	hydrolysis	identical ;	complementary ;	ester ;	peptide ;	substrate ;	product ;	angiotensinogase ;	angiotensinogenase ;	6 max	The appropriate term must correspond to the incorrect term given on each row.
incorrect term	appropriate term															
condensation	hydrolysis															
identical ;	complementary ;															
ester ;	peptide ;															
substrate ;	product ;															
angiotensinogase ;	angiotensinogenase ;															
	(d)	<p>(calcium ion) channels open ;</p> <p>calcium <u>ions</u> enter (the cells) ;</p> <p>(calcium ions) bind to / alters , troponin ; detach tropomyosin from actin ;</p> <p>expose myosin binding site (on actin) ;</p>	2 max	<p>DO NOT CREDIT 'sodium ion channels open'</p> <p>DO NOT CREDIT calcium enters / Ca⁺ enters</p> <p>CREDIT a description e.g. 'displaces protein which prevents myosin head binding to actin'</p>												
Total			18													

Question		Answer	Marks	Guidance
6	(a)	<p>fertility of, females / mothers, drops suddenly / AW ;</p> <p>(due to) menopause / AW ;</p> <p>no equivalent drop in males, male fertility declines gradually / no male menopause ;</p> <p>idea that sperm , viability / number / production declines with age ;</p>	3 max	<p>IGNORE reference to fewer births as this is a description not an explanation. DO NOT CREDIT 'drops' unqualified</p> <p>ACCEPT a description</p> <p>CREDIT males produce sperm (from puberty) throughout life</p>
	(b)	<p>not legal to have sex under 16 ; boys did not admit to sex under 16 ;</p> <p>puberty happens later in boys than girls ;</p> <p>mothers did not name father ; AVP ;</p>	2 max	<p>IGNORE refs to pregnancy termination (as not relevant to Q)</p> <p>CREDIT reverse argument</p> <p>e.g. harder to collect data / data not recorded (for given reason)</p>
	(c)	(i)	2	<p>Correct answer with units = 2 marks Correct answer with units but not rounded (4.05 / 4.06) = 1 mark</p> <p>Correct answer rounded correctly but no units = 1 marks</p> <p>ACCEPT dm³ per min OR dm³ / min</p>

Question			Answer	Marks	Guidance
6	(c)	(ii)	<p>Mark the first answer on each prompt line</p> <p>lungs become less elastic ; rib cage moves less freely / AW ; fall in vital capacity ; increase in residual volume ; reduction in PEFr ; reduction in FEV₁ ; fewer alveoli ; loss of cilia ;</p>	3 max	<p>DO NOT CREDIT ref to change in tidal volume ref to changes due to disease</p> <p>CREDIT arthritis in rib cage</p> <p>ACCEPT 'FEV' or forced expiratory volume or a description</p>
			Total	10	

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