



**General Certificate of Education (A-level)**  
**June 2011**

**Human Biology**

**HBIO4**

**(Specification 2405)**

**Unit 4: Bodies and Cells In and Out of Control**

**Final**

***Mark Scheme***

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Question	Marking Guidance	Mark	Comments
1(a)	<p><u>Any <b>two</b> from:</u></p> <p>Large surface area / many villi ;</p> <p>Thin / short distance between 2 blood supplies ;</p> <p>Good blood supply / described re. many capillaries / blood spaces / countercurrent blood flow ;</p>	2 max	<p>Accept microvilli</p> <p>Reject thin membrane, Reject ‘ cell wall’</p>
1(b)	Progesterone / human chorionic gonadotrophin / hCG ;	1	
1(c)(i)	Prevents implantation / described ;	1	
1(c)(ii)	Taking of human life / ref. ‘new life’ began at fertilisation / acts after fertilisation ;	1	

Question	Marking Guidance	Mark	Comments
2(a)	Pancuronium has <u>similar</u> structure / shape to acetylcholine ; Complementary to / fits receptor ;	2	Reject <u>same</u> 're. Acetylcholine / re.receptor' Ignore 'active site'
2(b)	(Pancuronium) not removed from receptor by ACh-esterase / not broken down by ACh-esterase ; (Pancuronium) prevents ACh from binding / blocks receptor site; ACh (normally) causes opening of Na <sup>+</sup> channels / causes action potential in muscle fibre ; (Pancuronium) prevents <u>influx</u> of Ca <sup>2+</sup> ions (to start contraction) ; (Pancuronium) prevents unblocking of binding sites on actin ;	3 max	Accept converse re. pancuronium

Question	Marking Guidance	Mark	Comments
<p>3(a)(i)</p> <p>3(a)(ii)</p>	<p><u>A to B:</u> Sodium channels open / membrane more permeable to sodium (ions); Sodium ions enter ; By diffusion / from high to low concentration ; Ref. <u>sodium</u> ions have positive charge / cause change from negative to positive potential ;</p> <p><u>After B:</u> Sodium channels close; Potassium channels open / membrane more permeable to potassium ions ; Potassium ions leave ; By diffusion / from high to low concentration (ONCE only) ;</p>	4 max	<p>Mark i and ii as a whole Max 3 for each section</p> <p>Allow 'diffusion' point ONCE only Accept refs to sodium and potassium</p>
3(b)	<p>(More) respiration ; (More) energy supplied / (more) ATP supplied ; For active transport of ions / 'sodium (-potassium) pump' / pumping out sodium ions / for neurotransmitter synthesis / for vesicle movement ;</p>	3	<p>Reject anaerobic respiration Reject 'produce' energy Accept named e.g.</p>

Question	Marking Guidance	Mark	Comments
4(a)(i)	161 ;	1	
4(a)(ii)	= Value for individual ½-way up the range / 20 <sup>th</sup> value ;	1	Accept 'the middle value'
4(a)(iii)	<p><u>Any <b>two</b> from:</u></p> <p><u>For:</u></p> <p>(From graph) Bell-shaped / described re. most in middle of range &amp; fewest at extremes ;</p> <p>(From i &amp; ii) Mean = median = mode ;; = 2 marks</p> <p><u>Against:</u></p> <p>Some values lower/higher than expected ;</p> <p>Suitable comment re. small sample size ;</p>	2	
4(b)	<p>Polygenic / determined by (several) <u>genes</u> ;</p> <p>Many possible combinations of alleles ;</p> <p>Graph shows continuous variation / large no. of categories ;</p>	3	QWC

Question	Marking Guidance	Mark	Comments
5(a)	Sympathetic ;	1	
5(b)	Decreased <b>AND</b> Increased ;	1	BOTH correct for 1 mark
5(c)	<p><u>Any <b>four</b> from:</u></p> <p>A is via nerves / nerve impulses which are conducted rapidly ;</p> <p>B is via hormones which travel slowly / via blood ;</p> <p>Nerve impulses / A directly to adrenal gland / B via pituitary gland / B has extra step ;</p> <p>Steroid hormone activates gene / activates transcription / protein synthesis ;</p> <p>These activation processes take time;</p> <p>Adrenaline activates (existing) enzyme quickly;</p>	4 max.	<p>Accept any relevant correct detail</p> <p>Accept correct example</p>

Question	Marking Guidance	Mark	Comments
6(a)(i)	<p><u>Group 1</u>: To see 'normal' response / non-diabetic response / as comparison with diabetic response ;</p> <p><u>Group 3</u>: To ensure any difference was due to exenatide / not due to salt / as comparison to show effect of exenatide on diabetes / to ensure effect was not psychosomatic / to see placebo effect;</p>	2	
6(a)(ii)	<p>Different mass of person → different amount insulin secreted / larger person secretes more insulin / (valid) basis for comparisons between people ;</p>	1	Ignore refs to accuracy
6(b)	<p><u>Any three</u> from:</p> <p>Increases sensitivity of pancreas cells to glucose ;</p> <p>Increases insulin secretion (by pancreas) / similar insulin production as healthy / non-diabetic / Group 1 ;</p> <p>So more stimulation of cells / of liver / of muscles ;</p> <p>Causes more glucose uptake (from blood) / blood glucose level lowered / kept at normal level / can control blood glucose conc. ;</p> <p>Person can consume more carbohydrate / glucose / doesn't need special diet / will not develop symptoms of diabetes ;</p>	3 max	





Question	Marking Guidance	Mark	Comments
8(a)	Any <b>two</b> from: Internal temperature ↓ as skin temperature ↑ ; Followed by Internal temperature ↑ as skin temperature ↓ ; 1st phase lasts 10/15 minutes / from 25 to 35/40 minutes ;	2 max	
8(b)	(Body temp decrease) less sweat <u>evaporation</u> → skin warming ; (Body temp increase) more sweat <u>evaporation</u> → skin cooling ; Heat / energy is required to evaporate water / evaporate sweat ;	2 max	Allow 'water' for sweat
8(c)	(Iced water) cools blood (at stomach) ; Blood cools <u>hypothalamus</u> / cooled blood to <u>hypothalamus</u> ; Fewer impulses sent to sweat glands in skin ;	3	Accept vasoconstriction / hairs raised
8(d)	Correct answer: 5 ;; <b>OR</b> <u>200 x 60</u> ; 2412	2	Ignore working Allow correct answer to nearest whole number Accept 0.08 for 1 mark Allow 1 mark

Question	Marking Guidance	Mark	Comments
9(a)	No cadmium ; <u>Other conditions same</u> as cadmium-treated group ;	2	
9(b)(i)	As a measure of the effect due to cadmium / to make a comparison ;	1	
9(b)(ii)	Becoming more methylated;	1	Ignore later slight decrease/no change
9(b)(iii)	Production of more methyltransferase enzyme / increased activity of transferase ;	1	Extra <u>incorrect</u> relevant information - cancel
9(c)	RNA-polymerase could not bind (to DNA / to promoter) ; mRNA of p16 could not be made / no transcription of p16 gene ;	2	
9(d)	<u>Any four</u> from: 1. Cadmium causes expression of methyltransferase gene / increased activity transferase (from 2 to 3 weeks in) ; 2. Methyl groups on to promoter / p16 gene / suppressor (gene) ; 3. (p16) normally suppresses tumour growth ; 4. p16 protein / p16 expression falls after 4 weeks / <u>after</u> methylation ; 5. Tumour formation occurs (after 10 weeks) <u>after</u> p16 falls / <u>after</u> suppressor gene activity falls ;	4 max	

Question	Marking Guidance	Mark	Comments
10(a)	<p><u>Any <b>three</b> from:</u></p> <ol style="list-style-type: none"> <li>1. Large has higher <u>rate</u> ;</li> <li>2. Difference decreases for older women / difference mainly for younger women / for women up to ~ 38 ;</li> <li>3. Ref. use of percentages suitable for comparison.</li> <li>4. But results from only one clinic each time / small sample size ;</li> <li>5. Results may not be typical / representative / reliable ;</li> <li>6. Reference to lack of statistics – differences may not be significant ;</li> </ol>	3 max	
10(b)	<p><u>Data: Any <b>four</b> from:</u></p> <ol style="list-style-type: none"> <li>1. With own eggs / with older eggs - success rate falls with age ;</li> <li>2. With own eggs / with older eggs – no difference up to early 30s</li> <li>3. With younger eggs / with donated eggs– high success rate;</li> <li>4. With younger eggs / with donated eggs – recipient's age has no effect ;</li> <li>5. But, reduced success rate with younger eggs / with donated eggs if recipient &lt; 26 yrs ;</li> <li>6. Variation in success rate with donated eggs ;</li> </ol> <p><u>Methodology: Any <b>two</b> from:</u></p> <ol style="list-style-type: none"> <li>7. Don't know sample size ;</li> <li>8. Don't know S.D. / confidence limits / no stats ;</li> <li>9. Only one age of donor used / no other donor ages used;</li> </ol>	4 max	

10(c)(i)	DNA: TGA GGA CTC CTC mRNA: ACU CCU GAG GAG ; Polypeptide: Thr Pro Glu Glu ;	2	
10(c)(ii)	Val ;	1	
10(c)(iii)	<u>Any <b>two</b> from:</u> Degeneracy of code / explained re. mutation may code for same amino acid ; Mutation may be in non-coding DNA / in an intron ; Mutation may give stop signal (→ truncated polypeptide) ; Mutation may cause a frame shift / described ;	2 max	
10(d)	Genotype of <u>both</u> parents = $H^A H^S$ / heterozygous ; Gamete with $H^S$ (/ sickle allele) from <u>both</u> parents ; Offspring has genotype $H^S H^S$ / homozygous for sickle ;	3	Accept genetic diagram or prose account
10(e)	<u>Any <b>four</b> from:</u> Formation of bivalents / assoc. of homologous chromosomes ; Independent assortment of/ separation of <u>chromosomes</u> in meiosis (I); Separation of <u>chromatids</u> in meiosis (II); Crossing over → $H^A H^S$ in polar body I (as in <b>R</b> and <b>S</b> ) ; If no crossing over → $H^A H^A$ or $H^S H^S$ in polar body I (as in <b>P</b> and <b>Q</b> ) ;	4 max	Accept points if clearly shown in diagram(s)

10(f)(i)	DNA of polar body not used in making offspring / converse / no harm to eggs ;	1	
10(f)(ii)	<p><u>Any <b>three</b> from:</u></p> <p>Probe = single-stranded DNA ;</p> <p>Complementary to (part of) base / DNA sequence (in allele) / complementary to <math>H^S</math> allele ;</p> <p>Labelled (e.g. radioactive / fluorescent / dye) re. visibility ;</p> <p>Specifically <u>binds</u> to target DNA / is <u>H-bonded</u> to target DNA ;</p>	3 max	
10(f)(iii)	<p><u>Ticks in correct boxes in table:</u></p> <p>One row: Polar body 1 = <math>H^A H^S</math> AND Polar body 2 = <math>H^S</math> ;</p> <p>Other row: Polar body 1 = <math>H^S</math> AND Polar body 2 = <math>H^A</math> ;</p>	2	Accept ticks or other symbols if meaning is clear