



**General Certificate of Education (A-level)**  
**January 2012**

**Human Biology**

**HBIO4**

**(Specification 2405)**

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

**Post-Standardisation**

***Mark Scheme***

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Question	Marking Guidance	Mark	Comments
1(a)	<ol style="list-style-type: none"> <li>Active transport;</li> <li>Of sodium ions out /potassium ions in (across the membrane);</li> <li>Sodium channels closed / membrane not permeable to sodium ions;</li> </ol>	2 max	Accept Sodium/Potassium pump
1(b)	<p><b>A</b></p> <ol style="list-style-type: none"> <li>Vesicles containing transmitter substance/named e.g.;</li> <li>Release contents (into synapse) when action potential reaches synapse / when calcium ions enter (the pre synaptic membrane);</li> <li>Frequency/Amount of these released related to frequency of action potentials (transmitted/in post-synaptic membrane);</li> </ol> <p><b>B</b></p> <ol style="list-style-type: none"> <li>Receptor for transmitter substance;</li> <li>Specific;</li> <li>(When bound) cause opening of sodium channels/formation of action potential / depolarisation;</li> </ol>	4 max	<p>Accept - nerve impulses</p> <p>Accept - influx of sodium ions</p>

Question	Marking Guidance	Mark	Comments
2(a)	<ol style="list-style-type: none"> <li>1. Gene machine;</li> <li>2. Create from mRNA / use reverse transcriptase;</li> <li>3. Restriction enzymes (to cut from DNA);</li> <li>4. PCR (to produce many copies);</li> </ol>	2 max	Accept – use of DNA probe to identify (you have the correct) gene;
2(b)(i)	An organism whose genetic material/DNA/genes/genome has been altered (by genetic engineering/humans);	1	
2(b)(ii)	A gene that identifies a genetically modified organism;	1	<p>Reject references to gene probes</p> <p>Accept examples / a genetically controlled characteristic that identifies organisms</p>
2(c)(i)	<p>Suitable non-coding DNA</p> <p>e.g. Introns/junk DNA/VNTR (or described);</p>	1	
2(c)(ii)	A gene that controls (the expression of) <u>another</u> gene;	1	

Question	Marking Guidance	Mark	Comments
3(a)	<ol style="list-style-type: none"> <li>1. Tropomyosin/troponin;</li> <li>2. Binds to myosin binding site on actin (filament);</li> <li>3. Moves, allowing myosin to bind;</li> </ol> <p><b>OR</b></p> <ol style="list-style-type: none"> <li>4. Calcium ions;</li> <li>5. Activates the ATPase on myosin;</li> <li>6. Cause tropomyosin/troponin to move;</li> <li>7. Exposing myosin binding site on actin/allowing myosin to bind to actin;</li> </ol> <p><b>OR</b></p> <ol style="list-style-type: none"> <li>8. ATP;</li> <li>9. Provides energy to detach myosin from actin;</li> <li>10. (And) move myosin head;</li> </ol>	3 max	<p>Accept</p> <p>Neurotransmitter; Binds to receptor on muscle membrane;</p> <p>Leads to influx of calcium ions;</p> <p>QWC</p> <p>Accept binds to tropomyosin/troponin</p>
3(b)	<ol style="list-style-type: none"> <li>1. Myosin arranged with tails towards middle/heads pointing out;</li> <li>2. The myosin are attached to each other, so can't move;</li> <li>3. Myosin heads move actin past them;</li> <li>4. Myosin heads (only) pull actin in one direction/inwards/towards the middle;</li> <li>5. Actin (attached to Z lines, so) pulls the Z lines inwards;</li> </ol>	3 max	<p>QWC</p> <p>Accept push or pull</p>

Question	Marking Guidance	Mark	Comments
4(a)	<p><b>I<sup>A</sup> and I<sup>B</sup></b></p> <ol style="list-style-type: none"> <li>Only 1 triplet/codon changes;</li> <li>Only one amino acid is changed;</li> <li>Leads to small/little change in tertiary structure of enzyme/active site still formed;</li> <li>So still able to bind to substrate / enzyme substrate complex formed;</li> </ol> <p><b>I<sup>o</sup></b></p> <ol style="list-style-type: none"> <li>Changes all triplets/codons/get frameshift (after mutation);</li> <li>(Deletion) leads to change in all amino acids (after mutation/frameshift);</li> <li>Leads to big changes in active site/active site not formed / tertiary structure is changed;</li> <li>Not able to bind to substrate / no enzyme substrate complex formed;</li> </ol>	4 max	Accept - a substitution can lead to the same amino acid;
4(b)	<ol style="list-style-type: none"> <li>Parental genotypes <b>I<sup>A</sup> I<sup>o</sup> and I<sup>B</sup> I<sup>o</sup></b>;</li> <li>Offspring genotypes <b>I<sup>A</sup> I<sup>o</sup>, I<sup>B</sup> I<sup>o</sup>, I<sup>A</sup> I<sup>B</sup>, I<sup>o</sup> I<sup>o</sup></b>;</li> <li>Offspring phenotypes <b>A B AB O</b> ;</li> <li>Probability <b>0.25 / 25% / ¼</b> ;</li> </ol>	4	<p>If parental genotypes wrong, can award 2<sup>nd</sup> and 3<sup>rd</sup> points on basis of their stated genotypes.</p> <p>Phenotypes to correspond to genotypes</p> <p>Accept I<sup>A</sup> , I<sup>B</sup> , I<sup>A</sup>I<sup>B</sup> , I<sup>o</sup> for phenotypes</p> <p>Accept 1 in 4/ 1:3</p>

Question	Marking Guidance	Mark	Comments
5(a)	<ol style="list-style-type: none"> <li>1. Refraction (of light);</li> <li>2. By cornea/lens;</li> <li>3. (Fine) focus by lens changing shape;</li> <li>4. Role of ciliary muscle;</li> <li>5. Role of suspensory ligaments;</li> </ol>	3 max	<p>Accept – Bending of light</p> <p>Reject contraction in points 3 and 5</p>
5(b)	<ol style="list-style-type: none"> <li>1. Brain 'makes up' a line/fills the gap/assumes line goes through;</li> <li>2. Based on what it can see/expects to see/memory/the surroundings;</li> </ol>	2	Accept past experiences
5(c)	<ol style="list-style-type: none"> <li>1. Gap in line would not fall on blind spot in right eye/both eyes at once;</li> <li>2. So brain would get information about the gap/use bottom up perception;</li> </ol>	2	Accept cancels out effect of the blind spot

Question	Marking Guidance	Mark	Comments
6(a)	<ol style="list-style-type: none"> <li>1. Change in inherited gene function;</li> <li>2. Without change in genotype/gene/base sequence (of DNA);</li> <li>3. Caused by environmental factor;</li> </ol>	2 max	<p>Reject reference to mutations</p> <p>Ignore references to maternal/paternal</p>
6(b)	<ol style="list-style-type: none"> <li>1. <u>Negative correlation</u>;</li> <li>2. (And) the more overweight a boy is, the less ghrelin he has in his blood;</li> </ol>	2	
6(c)	<ol style="list-style-type: none"> <li>1. Larger/higher concentrations are in boys with syndrome;</li> <li>2. But overlap with boys without syndrome;</li> <li>3. The highest ghrelin concentration / about 680 is in boy who is not obese/has BMI of about 25;</li> <li>4. A boy with the syndrome who has the lowest ghrelin concentration / ghrelin concentration of about 150 but is obese / has a BMI of about 48;</li> <li>5. No/weak correlation (for boys with the syndrome);</li> <li>6. Only a few results, so conclusion may not be reliable;</li> <li>7. Other factors not considered (that lead to obesity);</li> <li>8. Can't be sure because no statistical analysis;</li> </ol>	3 max	<p>Reject references to not knowing the sample size</p>



Question	Marking Guidance	Mark	Comments
7(a)	<ol style="list-style-type: none"> <li>1. Hormones released into blood;</li> <li>2. Takes longer for blood to reach target (than nerve impulses would);</li> </ol> <p><b>OR</b></p> <ol style="list-style-type: none"> <li>3. Hormones act by changing physiology;</li> <li>4. Takes time to make new enzymes/proteins/cell component/example described;</li> <li>5. Nerve impulses produce immediate response from target muscle/gland;</li> </ol>	2 max	<p>Accept converse statements for nervous control</p> <p>Accept doesn't go directly to the target</p>
7(b)	<ol style="list-style-type: none"> <li>1. Stress perceived by/related to brain/cerebral cortex/forebrain;</li> <li>2. Nerve impulses to hypothalamus;</li> <li>3. (This affects hypothalamus) causing (increase) in ACTH;</li> <li>4. More ACTH causes (more) adrenaline to be released;</li> <li>5. Adrenaline stimulates the heart to beat faster;</li> <li>6. Acts on SAN;</li> </ol>	5 max	
7(c)	<ol style="list-style-type: none"> <li>1. High responders brain/mind more affected by stress;</li> <li>2. Causes <u>more</u> (nerve) impulses/stimulation to/of hypothalamus;</li> </ol>	2	Accept – high responders are more sensitive to stress

Question	Marking Guidance	Mark	Comments
8(a)	<ol style="list-style-type: none"> <li>1. To raise FSH in blood / to give to women without enough FSH in blood;</li> <li>2. Causes follicles to develop (in ovary);</li> <li>3. So (more) ovulations/eggs (to collect);</li> </ol>	2 max	<p>QWC Idea of more than one follicle develops and more than one oocyte/egg produced</p> <p>Accept eggs to mature</p>
8(b)	<ol style="list-style-type: none"> <li>1. Stops/greatly reduces/inhibits the peak in/production of LH;</li> <li>2. This prevents ovulation;</li> <li>3. So no oocyte/egg to fertilise;</li> </ol>	3	Ignore references to FSH etc
8(c)	<ol style="list-style-type: none"> <li>1. IUD doesn't prevent fertilisation/zygote development;</li> <li>2. IUD prevents implantation of embryo;</li> <li>3. Some see this as abortion/killing unborn child;</li> </ol> <p><b>OR</b></p> <ol style="list-style-type: none"> <li>4. IUD has to be inserted in uterus/cervix;</li> <li>5. This more painful/invasive than taking levonorgestrel / requires visit to doctor (or hospital);</li> </ol>	2 max	<p>Accept arguments based on failure rate/causes of IUD</p> <p>Reject egg implants</p> <p>Accept fertilised egg onwards implants</p>

Question	Marking Guidance	Mark	Comments
9(a)(i)	Mass of cells dividing/growing out of control;	1	
9(a)(ii)	When cells from tumour have spread to other parts of body/ metastasis has happened;	1	QWC
9(b)	<ol style="list-style-type: none"> <li>1. Mdm/proteins have specific shapes/structures;</li> <li>2. Only complementary shapes bind together;</li> </ol>	2	<p>Accept complementary</p> <p>Reject references to enzymes or active sites</p>
9(c)	<ol style="list-style-type: none"> <li>1. (new) tumour has few blood vessels, so little oxygen;</li> <li>2. This should activate production of p53 protein;</li> <li>3. P53 protein stops growth/kill cancer cells/repair cancer cells' DNA;</li> <li>4. Cells in tumour produce (a lot of) HDAC in low oxygen conditions;</li> <li>5. This prevents p53 being produced/p53 gene being expressed/transcribed;</li> <li>6. Removal of acetyl groups (by HDAC) prevents transcription (of p53 gene);</li> <li>7. So not enough p53 protein/expression to stop tumour growth;</li> </ol>	5 max	

Question	Marking Guidance	Mark	Comments
10(a)	<ol style="list-style-type: none"> <li>1. Insulin binds to receptor on target cell/named (membrane);</li> <li>2. Leads to more transport proteins for glucose;</li> <li>3. (More) glucose enters cells (from blood which lowers conc. in blood);</li> <li>4. Insulin causes increase in activity of enzymes;</li> <li>5. that convert glucose to glycogen/synthesise fat;</li> <li>6. Insulin leads to higher metabolic rate (in target cells) / more respiration;</li> </ol>	3 max	<p>Reject insulin converts glucose to glycogen</p> <p>Accept glycogenesis</p>
10(b)	<ol style="list-style-type: none"> <li>1. Fat, sugar and alcohol all energy sources / high in calories/joules;</li> <li>2. High intake associated with obesity;</li> <li>3. High blood glucose concentration / high insulin production;</li> <li>4. Exercise increases energy/glucose use by body/respiration;</li> <li>5. So it helps combat obesity/reduces fat formation/uses fat reserves;</li> <li>6. Alcohol can damage the liver, so less/slower glucose take up from blood / fewer insulin receptors;</li> </ol>	3 max	<p>Accept converse</p> <p>Accept converse</p>
10(c)	Questionnaire used and people might not tell the truth/not be able to record information	1	Accept other valid arguments

	accurately/subjective/qualitative;		
10(d)	<ol style="list-style-type: none"> <li>Group A had large decreases in fat and sugar eaten;</li> <li>No (significant) / not much difference in decrease in alcohol;</li> <li>Group A increased exercise more;</li> <li>Suitable reference to probability values;</li> </ol>	4	<p>Accept group A are more likely to have changed their habits</p> <p>Ignore references to alcohol</p>
10(e)	<p>Yes,</p> <ol style="list-style-type: none"> <li>Group B given less advice and took less action;</li> <li>So at greater risk of diabetes which could have serious health implications / greater risk of named health problem;</li> </ol> <p>No,</p> <ol style="list-style-type: none"> <li>Not put at risk by the study directly;</li> <li>People in (Group B) were given (suitable) advice/would have given informed consent;</li> <li>It's up to them to decide what to do;</li> </ol>	2 max	<p>Ignore references to bullying</p> <p>Accept descriptions of 'informed consent'</p> <p>Accept they were volunteers / they did show some improvement</p>
10(f)	<ol style="list-style-type: none"> <li>Less rise in glucose (after one year);</li> <li>They remove glucose from the blood faster;</li> <li>After 1 year, drop from 165 to 115/of 50 units after 2 hrs / increase reduced from about 60 to about 20;</li> <li>Also produce less insulin / insulin acts faster / insulin more effective;</li> <li>After 1 year, drop from 100 to 50/50 units after 2 hrs /</li> </ol>	4 max	<p>Accept range of 165 to 117</p> <p>Accept dropped by about 30%</p> <p>Accept dropped by 50% or 60%</p>

	the increase reduced from about 85 to about 35;		
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