



**General Certificate of Education**

**Human Biology 2406**

**HBIO4      Bodies and cells in and out of  
control**

**Mark Scheme**

*2010 examination – January series*

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Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	a	i	Seminiferous tubules;	1	Accept phonetic spellings
1	a	ii	Acrosome;	1	Accept phonetic spellings
1	a	iii	Spermatogonium labelled with M	1	Accept M on cell or touching cell
1	b		<p>Oogenesis Produces 1 cell (from meiosis);</p> <p>Polar bodies (formed);</p> <p>Uneven distribution of cytoplasm;</p> <p>Suspended in meiosis/ suspended as (primary) oocyte (until after puberty);</p> <p>Oogenesis is cyclical (sperm production is not);</p> <p>Oogenesis stops at menopause (sperm production does not);</p>	2 max	<p>Accept converse statements for sperm</p> <p>Reject secondary oocyte</p>

Question	Part	Sub Part	Marking Guidance	Mark	Comments
2	a	i	Blocks myosin binding (site) on actin;  Moves from binding site on actin due to $\text{Ca}^{2+}$ ;  Allowing myosin to bind (to actin)/crossbridge formation;	2 max	Accept converse statements
2	a	ii	Releases myosin from actin;  Causes myosin head to move/cock;  Used in active transport of $\text{Ca}^{2+}$ ;	2 max	Accept coming/moving away from actin
2	b		Antagonistic muscles /opposing pairs of muscles;  Working across/at joints;  Both contract to keep joint/the body at certain angle/upright; Isometric contraction;  Only a few fibres contract to avoid fatigue/slow muscle fibres used;	3 max	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
3	a		<p>Binds to receptor on target/liver/muscle cell;</p> <p>Causes more transport/carrier proteins to become active/move to (plasma) membrane;</p> <p>Glucose (diffuses) into cells (and lowers blood glucose);</p> <p>(Enzymes in cells) convert glucose to glycogen;</p> <p>Stimulates fatty acids/lipid/fat formation (from glucose);</p> <p>Raises rate of respiration (in cells), using more glucose;</p>	3 max	Reject reference to insulin as an enzyme
3	b	i	<p>27 : 39;</p> <p>1 : 1.44;</p>	2	<p>2 marks for 1 : 1.44</p> <p>Accept 0.69 : 1</p> <p>Accept 9 : 13</p>
3	b	ii	<p>One suitable reason; with explanation;</p> <p>e.g. undiagnosed</p> <p>Diabetic coma/brain cells not enough respiration;</p> <p>Due to low blood glucose/acidosi/s/dehydration;</p> <p>Heart attacks/coronary heart disease;</p> <p>Due to faster atheroma formation/damage to arteries;</p> <p>Kidney failure;</p> <p>Due to damage to blood vessels;</p>	2 max	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	a	i	Older people react slower/longer reaction time;  Non-active people react slower;  Older improve with practice/repeats;  Older people learn more;	2 max	
4	a	ii	One factor; with explanation;  e.g. older people have Slower nerve conduction; So nerve impulses to brain/muscles take longer;	2 max	Accept converse for younger people
4	b		Two suitable <u>physiological</u> functions;;  e.g. Decrease in basal metabolic rate/BMR; Weaker contraction of heart muscle/reduced cardiac output; Weaker contraction of skeletal/voluntary muscle; Lower production of hormones/named example;	2 max	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
5	a		Potassium channels open (and $K^+$ ions diffuse out);  Sodium channels close (and stops $Na^+$ ions diffusion in);	2	Accept references to sodium channels opening; Leading to depolarisation; Accept. Sodium pump (starts) to pump out sodium ions
5	b		(Absolute) refractory (period);	1	
5	c	i	Causes them to contract;  And relax;  Rapidly/twitch;	2 max	
5	c	ii	Cause continuous muscle contraction;  At high force;  Causing failure to breathe/heart stops pumping/ damage to bones or joints;	2 max	Accept a reasonable suggestion of harm – linked to muscle contraction

Question	Part	Sub Part	Marking Guidance	Mark	Comments
6	a		<p>More cases of asthma in females than males;</p> <p>Greater/same correlation in identical twins;</p> <p>Greater correlation in non-identical males (than non-identical females);</p> <p>No/little correlation in female non-identical twins;</p>	3 max	Accept coefficient reference for correlation
6	b		<p>(Large) genetic influence;</p> <p>Identical twins have same genotypes <u>and</u> high correlation;</p> <p>Non-identical have same environment <u>and</u> low correlation;</p> <p>(May be) linked to sex of the individual;</p>	3 max	<p>Note that absolute numbers cannot be compared due to different numbers of pairs of twins.</p> <p>Accept coefficient reference for correlation</p> <p>Accept same alleles for same genotype but reject same genes</p>



Question	Part	Sub Part	Marking Guidance	Mark	Comments
7	a		<p>Cocaine (binding) changes shape of transporter/prevents dopamine binding;</p> <p>Transporter cannot move (bound) dopamine (through membrane/protein/into cell);</p> <p>Dopamine remains/builds up in synapses (leading to feelings of pleasure);</p>	3	Reject references to active site
7	b	i	Polymerase chain reaction/PCR;	1	
7	b	ii	<p>Single-stranded DNA;</p> <p>Bases/sequence complementary to DNA/gene to be identified;</p> <p>(Radioactively/fluorescent) labelled so that it can be detected;</p>	2 max	Reject reference to a single strand of DNA
7	c		<p>Mutation changes base sequence of gene/DNA;</p> <p>(Thus) changing amino acid sequence;</p> <p>Changes tertiary structure/shape of protein/transporter;</p> <p>Cocaine binding site changes/cocaine cannot bind;</p> <p>Dopamine can still bind (and be transported);</p>	3 max	Accept references to active site

Question	Part	Sub Part	Marking Guidance	Mark	Comments
8	a		<p>All the genes; On a (full/haploid) set of chromosomes/ genes in mitochondria or chloroplasts;</p> <p><b>OR</b></p> <p>The base sequences; On a (full/haploid) set of chromosomes/all of the DNA;</p>	2 max	There are variants on these forms of words.
8	b		<p>Pfs is an antigen;</p> <p>Causes an immune response/antigen binds to cell/ B cell/causes antibody production;</p>	2	
8	c		<p>S shaped curve;</p> <p>No/not much response up to (about) 1 000 units/ no further increase above 10 000 units;</p> <p>Sharp/steep change above (about) 1 000 units; <u>Negative correlation</u>;</p>	2 max	
8	d		<p>The protein causes antibody production (in people);</p> <p>Antibody transferred to mosquito when (infected) human is bitten;</p> <p>Stops <i>Plasmodium</i> infecting mosquitoes;</p> <p>So malaria not transferred to another human;</p> <p>Over time, fewer and fewer mosquitoes carrying malaria;</p>	3 max	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
9	a		<p>Daughter (C) does not have the condition/one child doesn't have it;</p> <p>Parents must have been carriers of normal/healthy recessive/if recessive then parents homozygous (so all children affected);</p>	2	<p>Accept converse arguments (If candidates see it purely as a genetic cross diagram) D is heterozygous because E is unaffected;</p> <p>D has cancer, so the cancer allele must be dominant;</p>
9	b		<p>Father (A) would pass on X chromosome to daughter;</p> <p>She is not affected;</p>	2	<p>Accept that if D's X chromosome carried 'it', then E would be affected.</p>
9	c		<p>Only 25/young so don't know if cancer will develop;</p> <p>Don't know if her father was heterozygous or homozygous;</p> <p>If heterozygous, she has a 50% chance of carrying the allele/gene;</p> <p>If homozygous, she has a serious risk of cancer;</p>	2 max	<p>Accept E must be homozygous recessive/have two recessive alleles;</p> <p>So no chance of cancer/no more chance than rest of the population;</p>
9	d		<p>Mutation/mutagen changes DNA of cell;</p> <p>Damaged DNA not repaired/cells not killed/apoptosis doesn't happen;</p> <p>Mutation leads to loss of control/uncontrolled cell division;</p> <p>(Some of these) cells carried to other parts of the body;</p>	3 max	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
10	a		Low sperm count means few sperm enter cervix/uterus/oviducts/fallopian tubes;  Less chance of sperm getting to egg;	2	
10	b		$84 \times 10^6$ ;;  $4.2 \times 10^6$ ;	2	Correct answer 2 marks. May forget dilution factor Formula written out correctly, one mark
10	c		Count for beads should be $35 \times 10^6$ ;  Bead count for A is (36), very close to 35/true value for suspension;  Standard deviation greater for method B;  Showing greater variation in mean counts (of beads);  But SD difference very small as percentage of mean;	3 max	Accept converse arguments  Reject references to range
10	d		Method B involved diluting by a factor of 20/more/diluting small sample a lot;  Small errors in dilution give large errors in counts/not many sperm per square to count;  Have to count moving sperm;  May count twice/miss some sperm that swim out of square;	2 max	They have no details of A
10	e		To see if equipment/solutions killed sperm;  If they did, would reduce sperm count;	2	
10	f		Yes (no mark) Both below 0.05;	1	Accept below 5%

10	g		<p>Female hormone;</p> <p>Might exist/build up in muscle/meat (of cow);</p> <p>Hormone not digested/absorbed in mother's gut;</p> <p>Hormone may get from mother to baby/cross placenta;</p> <p>Affect development of testes/have feminising effect/described;</p>	3 max	
10	h		<p>Do sperm counts on large number of men;</p> <p>Compare against/find the lower end of the range of their sperm counts;</p>	2	
10	i		<p>Two reasons;; with explanations;;</p> <p>e.g.</p> <p>Used method B;</p> <p>Which does not give very accurate sperm counts;</p> <p>Questionnaire used to get information from mothers;</p> <p>They are unlikely to remember what they ate accurately;</p> <p>No information about hormone content of beef;</p> <p>Dosage likely to be important;</p>	4 max	These are likely answers but other valid lines of reasoning should be credited.

10	j	<p>Suitable reasons, e.g.</p> <p><b>Yes because</b> (no mark) Any risk to unborn child should be taken seriously; Safe levels of hormones not known;</p> <p>Significant difference in sperm count/percent with low sperm count with high beef; (And) low beef sperm count similar to other study;</p> <p><b>No because</b> Method used/questionnaire to determine beef eaten was very unreliable; (So) no real idea of hormone intake by mothers;</p> <p>Method used to count sperm not very accurate; Don't know what the mean sperm count/% of men with low sperm counts is in population that doesn't have hormone-treated cows;</p>	4 max	<p>3 max if only Yes or only No addressed. These are likely answers but other valid lines of reasoning should be credited.</p>
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