



General Certificate of Education (A-level)
January 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)	<u>Cones</u> ; 3 types - <u>Each</u> sensitive to <u>different</u> range of wavelengths / each sensitive to red <u>or</u> green <u>or</u> blue / <u>each</u> contains a <u>different</u> pigment;	2	'Different types of cones sensitive to red <u>or</u> green <u>or</u> blue' = 2 marks Allow 3 types sensitive to red, green and blue
1(b)	Ciliary muscles contract; Suspensory ligament slackens / less pull on lens; Lens bulges / becomes thicker; Lens bends / refracts / converges light rays more;	3 max	Ignore 'lens becomes bigger'

Question	Marking Guidance	Mark	Comments
2(a)(i)	Progesterone;	1	
2(a)(ii)	Day 11 – 13 (in range); Peak in LH;	2	Ignore FSH, oestrogen Accept progesterone starts to rise
2(b)	Inhibits (release / production of) FSH; Prevents development of follicle / prevents ovulation / prevents or inhibits LH (release);	2	Accept converse re. role of FSH

Question	Marking Guidance	Mark	Comments
3(a)	AUGACA ;	1	
3(b)	Removal of introns / removal of non-coding / some RNA / described;	1	
3(c)(i)	Anticodon/ <u>three bases</u> /triplet on tRNA; (Complementary) base pairing to mRNA codon / described re. A – U and G – C;	2	Allow anticodon to codon pairing for 1 mark Q
3(c)(ii)	Condensation;	1	Accept peptide bond formation

Question	Marking Guidance	Mark	Comments
4(a)	Metabolic rate / Respiration rate <u>at rest</u> / energy release/use at rest;	1	
4(b)(i)	To allow comparison (with other people) / to standardise the results / to calculate a valid mean; People are different sizes; BMR is measured by heat loss; Amount of energy/heat lost (/ used) dependent on S.A./heat lost via skin;	2 max	Allow ref. to height / mass / surface area
4(b)(ii)	Less synthesis / loss of muscle with age / decreased hormone production;	1	Accept correct named hormone – e.g. thyroxine / oestrogen
4(c)	Any two suitable physiological functions e.g. Cardiac output/stroke volume; Nerve conduction velocity; Muscle tone; Movement at joints; Skin elasticity; Menstrual cycle / ovulation; Senses – e.g. hearing / sight; Any two other correct examples;	2 max	Must relate to physiological function Accept arthritis Accept menopause Accept deafness / long sight

Question	Marking Guidance	Mark	Comments
5(a)	(Nerve impulse causes) Ca^{2+} to enter presynaptic neurone/membrane; (Ca^{2+} entry) causes fusion of vesicles with presynaptic membrane / causes exocytosis / release of transmitter;	2	
5(b)	Vesicles / neurotransmitter / dopamine (only) in / from A; OR Receptors (only) on B;	1	
5(c)(i)	Dopamine and cocaine have similar shapes (in part); Cocaine can <u>fit</u> transporter;	2	Reject ref. to 'active site'
5(c)(ii)	Cocaine blocks transport of dopamine out of gap / into A; Dopamine concentration rises / is maintained / remains; <u>Continues</u> to stimulate/bind to <u>receptors</u> ; Causes <u>continued</u> firing of impulses (in B);	3 max	Ignore ref. to 'active site'

Question	Marking Guidance	Mark	Comments
6(a)	Departure from normal level / from set value; Causes changes to restore norm / to reverse departure;	2	
6(b)	Cholesterol inhibits expression of gene coding for synthase; No reaction possible without synthase enzyme / synthase catalyses (step in) mevalonate production;	2	Accept inhibits transcription or translation of synthase gene
6(c)	Less mevalonate produced / less cholesterol produced / lower cholesterol in cytoplasm; (Greater) concentration gradient for uptake of cholesterol; Less inhibition of gene for cholesterol transporter protein; More cholesterol transporter proteins; (More) cholesterol taken into cells / taken out of blood;	3 max	

Question	Marking Guidance	Mark	Comments
7(a)	<p>Warm – lowers temperature gradient (blood to air in lungs);</p> <p>Less heat loss/transfer to the air;</p> <p>OR</p> <p>Water-saturated – reduces evaporation from lungs;</p> <p>Evaporation requires heat / causes cooling;</p>	2	
7(b)(i)	<p>Stimulation of receptors causes:</p> <p>(Increased) vasodilation / less vasoconstriction / widening of arteries/arterioles;</p> <p>(Increased) sweating;</p> <p>(More) heat loss from blood / blood cools;</p> <p>(Cooled blood from skin) returns to core;</p>	3 max	Accept description of vasodilation. Ignore 'blood vessels' not veins, capillaries

7(b)(ii)	<p>Suitable suggestion + explanation: e.g. Lowers metabolism / respiration rate (in heart tissue); Insufficient energy for heart to function / for heart to contract / go into shock; OR Cools medulla / cardiac centre in brain; Reduces stimulation of heart / fewer impulses to heart / go into shock;</p>	2	Allow other sensible suggestions
7(c)	<p>(Yes because) no initial temperature drop; lowers risk of cardiac arrest / shock; steady/more gradual temperature rise; (No because) Blanket method raises (core) temperature to higher value; Blanket method raises temperature more rapidly (after 8 minutes); Appropriate use of figures: e.g. RES-Q-AIR raises temp. by 1.4° c.f. blankets by 1.9 / 2.2° or blankets initial fall of 0.34° / both methods stabilising after 45 – 60 minutes;</p>	4 max	3 max if only Yes / No addressed

Question	Marking Guidance	Mark	Comments
8(a)(i)	Haploid = any from E to N AND Diploid = any from A to D;	1	
8(a)(ii)	In spermatogenesis: Even distribution of cytoplasm between the gametes / no polar bodies / all products become gametes/ meiosis completed before release of sperm;	1	
8(b)(i)	Chromosomes are in (homologous) pairs; Crossing- over occurs / chiasmata present;	2	
8(b)(ii)	D;	1	
8(c)	<u>Pro:</u> Sperm concentration or percentage motile sperm decrease as smoking increases; <u>Con:</u> e.g. much overlap of ranges / greatest (individual) value sperm conc. in smokers of 11-20 cigarettes; <u>Cautionary comment:</u> Changes seem only slight / may not have significant effect / need to analyse statistically / very few individuals in > 20 category;	3	

Question	Marking Guidance	Mark	Comments
9(a)(i)	Amount of mRNA > amount of DNA / multiple copies of mRNA; Insulin mRNA/the specific mRNA is found in pancreas cells; Introns / non-coding information present in DNA / these removed in mRNA / corr. ref. post-transcriptional modification;	2 max	
9(a)(ii)	Enzyme 1 = reverse transcriptase; Enzyme 2 = (DNA)-polymerase;	2	
9(a)(iii)	Hydrogen (bonds) / H-(bonds);	1	
9(b)(i)	Primers;	1	
9(b)(ii)	To allow H-bond re-formation / to allow joining of primers/P (and Q) to (single-stranded) DNA / converse re. high temp. breaks H-bonds / prevents joining;	1	
9(b)(iii)	To mark region of DNA to be 'copied' / to show enzyme where to start; (Enzyme) needs starting strand onto which to attach nucleotides;	2	Allow idea of extending pre-existing chain
9(b)(iv)	32 ;	1	

Question	Marking Guidance	Mark	Comments
10(a)(i)	<p>Correct answer: 1.25 ;;</p> <p>OR (if wrong answer)</p> <p>$\frac{\text{measurement in } \mu\text{m}}{40\,000} / \frac{\text{measurement in mm}}{40} = 1 \text{ mark}$</p>	2	<p>Ignore working</p> <p>125 but wrong order of magnitude = 1 mark</p>
10(a)(ii)	<p>C has myosin / thick (and actin / thin) filaments;</p> <p>OR</p> <p>A has only actin / thin (/ no myosin / no thick) filaments ;</p>	1 max	

10(b)	<p>When contracted:</p> <p>Thick & thin filaments /myosin & actin overlap more;</p> <p>Interaction between myosin heads & actin / cross-links form;</p> <p>Movement of myosin head;</p> <p>Thin filaments / actin moved along thick filaments / myosin;</p> <p>Movement of thin filaments / actin pulls Z-lines closer together;</p> <p>Displacement of tropomyosin to allow interaction;</p> <p>Role of Ca^{2+} ;</p> <p>Role of ATP;</p>	4 max	Allow ref. to 'sliding filament mechanism' / described if no other marks awarded
10(c)(i)	8 has DMD but 3 and 4 do not / 12 has DMD but 6 and 7 do not / neither parent has the condition but their child has;	1	Allow parents 3 and 4 give 8, parents 6 and 7 give 12
10(c)(ii)	4 AND 7 ;	1	

10(c)(iii)	<p>Parental genotypes: 6 = $X^D Y$ AND 7 = $X^D X^d$</p> <p>AND</p> <p>Gametes correct for candidate's P genotypes – e.g. X^D and Y + X^D and X^d;</p> <p>Offspring genotypes <u>correctly derived</u> from gametes e.g. $X^D X^D$ + $X^D X^d$ + $X^D Y$ + $X^d Y$;</p> <p>Male offspring with MD correctly identified: $X^d Y$;</p> <p>Probability = 0.25 / correct for candidates offsprings genotypes;</p>	4	<p>Accept $\frac{1}{4}$ / 1 in 4 / 1:3 / 25%</p> <p>NOT '3:1' / '1:4'</p>
10(d)(i)	No gene fragment G ;	1	
10(d)(ii)	<p>Only one copy of gene fragment F;</p> <p>Male has only one X-chromosome / is XY (c.f. female has two / is XX);</p>	2	
10(d)(iii)	<p>10 has only one copy of gene fragment G;</p> <p>10 has only one normal X-chromosome / has one abnormal / has only one normal allele / has one X^D / is $X^D X^d$ / is heterozygous;</p> <p>11 has two normal X-chromosomes / has 2 normal alleles / is $X^D X^D$ / has not got X^d/has 2 copies of (F and) G;</p>	3	
10(e)(i)	To prevent rejection / prevent antibody production vs. injected cells / injected cells have (foreign) antigen (on surface);	1	

10(e)(ii)	Shows effect of <u>cells</u> / not just effect of injection / not just effect of salt solution;	1	
10(e)(iii)	<p>Only one person tested so far – need more to see if similar results / need more to see if reliable;</p> <p>Need to assess if new (dystrophin positive) muscle fibres are functional / if muscle becomes functional;</p> <p>Can't tell how widespread effect is in the muscle / sample taken near injection site;</p> <p>Need to test for harmful side effects;</p> <p>Need to test if successful for other mutations of dystrophin gene;</p> <p>Need to assess permanence / longevity of result/insufficient time allowed in investigation;</p> <p>(In this patient) only small response / %;</p> <p>Further sensible suggestion;</p>	4 max	