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General Certificate of Education (A-level)
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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)	Cones; 3 types - Each sensitive to different range of wavelengths / each sensitive to red or green or blue / each contains a different pigment;	2	'Different types of cones sensitive to red or green or 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/three bases/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)	Warm – lowers temperature gradient (blood to air in lungs); Less heat loss/transfer to the air; ***OR*** Water-saturated – reduces evaporation from lungs; Evaporation requires heat / causes cooling;	2	
7(b)(i)	Stimulation of receptors causes: (Increased) vasodilation / less vasoconstriction / widening of arteries/arterioles; (Increased) sweating; (More) heat loss from blood / blood cools; (Cooled blood from skin) returns to core;	3 max	Accept description of vasodilation. Ignore 'blood vessels' not veins, capillaries

7(b)(ii)	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;	2	Allow other sensible suggestions
7(c)	(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^{o} c.f. blankets by 1.9 / 2.2^{o} or blankets initial fall of 0.34^{o} / both methods stabilising after 45 – 60 minutes;	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)	Correct answer: 1.25 ;; ***OR*** (if wrong answer) $\frac{\text{measurement in µm}}{40\,000}$ / $\frac{\text{measurement in mm}}{40}$ = 1 mark	2	Ignore working 125 but wrong order of magnitude = 1 mark
10(a)(ii)	**C** has myosin / thick (and actin / thin) filaments; ***OR*** **A** has only actin / thin (/ no myosin / no thick) filaments ;	1 max	

10(b)	When contracted: Thick & thin filaments /myosin & actin overlap more; Interaction between myosin heads & actin / cross-links form; Movement of myosin head; Thin filaments / actin moved along thick filaments / myosin; Movement of thin filaments / actin pulls Z-lines closer together; Displacement of tropomyosin to allow interaction; Role of Ca^{2+} ; Role of ATP;	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)	Parental genotypes: 6 = $\mathbf{X^DY}$ AND 7 = $\mathbf{X^DX^d}$ ***AND*** Gametes correct for candidate's P genotypes – e.g. $\mathbf{X^D}$ and $\mathbf{Y}$ + $\mathbf{X^D}$ and $\mathbf{X^d}$; Offspring genotypes <u>correctly derived</u> from gametes e.g. $\mathbf{X^DX^D}$ + $\mathbf{X^DX^d}$ + $\mathbf{X^DY}$ + $\mathbf{X^dY}$; Male offspring with MD correctly identified: $\mathbf{X^dY}$; Probability = 0.25 / correct for candidates offsprings genotypes;	4	Accept ¼ / 1 in 4 / 1:3 / 25% NOT '3:1' / '1:4'
10(d)(i)	No gene fragment **G**;	1	
10(d)(ii)	Only one copy of gene fragment **F**; Male has only one X-chromosome / is XY (c.f. female has two / is XX);	2	
10(d)(iii)	10 has only one copy of gene fragment **G**; 10 has only one normal X-chromosome / has one abnormal / has only one normal allele / has one X^d / is X^DX^d / is heterozygous; 11 has two normal X-chromosomes / has 2 normal alleles / is X^DX^D / has not got X^d/has 2 copies of (F and) G;	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 cells / not just effect of injection / not just effect of salt solution;	1	
10(e)(iii)	Only one person tested so far – need more to see if similar results / need more to see if reliable; Need to assess if new (dystrophin positive) muscle fibres are functional / if muscle becomes functional; Can't tell how widespread effect is in the muscle / sample taken near injection site; Need to test for harmful side effects; Need to test if successful for other mutations of dystrophin gene; Need to assess permanence / longevity of result/insufficient time allowed in investigation; (In this patient) only small response / %; Further sensible suggestion;	4 max	