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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) (i)	F;	1	
1 (a) (ii)	A;	1	
1 (a) (iii)	D;	1	
1 (b) (i)	No receptors / no rods and cones / <u>only</u> neurones;	1	Ignore ‘blind spot’ / ‘optic nerve’
1 (b) (ii)	Prevents / reduces reflection / described;	1	

Question	Marking Guidance	Mark	Comments
2 (a)	1. Release of adrenaline from the adrenal gland = sympathetic; 2. Increased heart rate = sympathetic; 3. Dilation of arterioles leading to the skin = parasympathetic; 4. Constriction of arterioles leading to the small intestine = sympathetic;	2	All 4 correct = 2 marks 2 or 3 correct = 1 mark 0 or 1 correct = 0 marks
2 (b)	1. Hormone travels via blood (which is slow) / nerve impulse travels quickly / ref. to time taken for hormone to build up to effective concentration; 2. Hormone activates a gene / requires (RNA or protein) synthesis;	2	

Question	Marking Guidance	Mark	Comments
3 (a)	1. Damp clothes – (water) <u>evaporation</u> → cooling / heat loss; 2. Dry clothes – trapped air for insulation / described; 3. Reduce heat loss by conduction to (cold) water; 4. Shivering uses energy reserves;	2 max	Ignore radiation
3 (b)	1. HELP position reduces surface area; 2. Swimming uses energy (reserves) / requires respiration; 3. Swimming → contact with new, colder water / staying still traps warm(er) water next to the body; 4. Swimming increases T^o gradient / causes vasodilation **or** staying still decreases T^o gradient / allows vasoconstriction;	3 max	

Question	Marking Guidance	Mark	Comments
4 (a)	1. Parental genotypes correct: 6 = Hh ***AND*** 7 = hh ***AND*** Gametes H and h + h; 2. Offspring genotypes Hh + Hh; 3. Offspring phenotypes Affected Unaffected; 4. Probability = 0.5;	4	1. Only (If other symbols used, must be defined) Ignore X and Y 2. Allow correct for candidate's gametes / P genotypes 3. Allow correct for candidate's offspring genotypes 4. Only – but accept $\frac{1}{2}$ / 1 in 2 / 2 in 4 / 1:1 / 50%
4 (b)	1. Mutation / exposure to eg ionising radiation / mutagenic chemical; 2. Antecedents die before showing symptoms eg run over by a bus; 3. Not natural parents eg illegitimacy/adoption;	2 max	
4 (c)	1. Huntington's is late onset / no symptoms initially; 2. Reproduce before selection can act / before symptoms appear;	2	

Question	Marking Guidance	Mark	Comments
5 (a)	<u>Diagram</u>: 1. One complete sarcomere, (long & thin) with longitudinal rods; 2. Correct pattern of thick & thin filaments + Z-lines; <u>Labelling</u>: 3. P to H-zone / region with just thick filaments; 4. Q to I-band / region with just thin filaments; 5. R to A-band (but outside of H-zone) / region with thick & thin filaments;	2 2	All 3 labels correct = 2 marks 2 labels correct = 1 mark 1 or 0 labels correct = 0 marks
5 (b)	**P** (no mark) 1. Thin filaments slide over / along thick filaments / thick & thin filaments slide over / along each other; 2. Thin filaments meet / overlap / enter region **P** / enter H-zone;	2	Allow 'H' Max 1 mark if wrong region
5 (c)	1. Ca^{2+} enter motor neurone $\rightarrow$ release of acetylcholine; 2. Rise in Ca^{2+} (in muscle fibre) / Ca^{2+} enter (muscle fibre); 3. Movement of blocking molecules / troponin / tropomyosin; 4. Expose (binding) sites on <u>actin</u> / on <u>thin</u> filament; 5. Allow actin-myosin interaction / cross bridge formation / allow myosin head to bind; 6. Activate ATP-ase (on myosin);	4 max	Reject 'active' sites

Question	Marking Guidance	Mark	Comments
6 (a) (i)	1. In absence of uracil – product A is formed / concentration A increases; 2. When uracil added – very little A is formed / concentration A increases very little / production of A ceases;	2	Uracil and A must be mentioned at least once for full marks 'The concentration' = A If uracil not mentioned – no marks
6 (a)(ii)	1. Prevents product / A being converted into B / uracil **or** prevents uracil being made; 2. A accumulates in the mixture / (does not disappear) / so concentration of A can be measured **or** otherwise uracil would inhibit ATC-ase;	2	
6 (b) (i)	1. Fits different site on enzyme / allosteric site / not active site; 2. Alters shape of active site; 3. Substrates can no longer fit active site;	2 max	Active site must be mentioned at least once
6 (b) (ii)	1. If sufficient uracil then no more is made / substrates not wasted making unwanted uracil; 2. Other intermediates / A / B do not accumulate; 3. (At a branch point so) can use substrates to make other substances / not use other substances;	2 max	Ignore references to saving energy

Question	Marking Guidance	Mark	Comments
7 (a)	1. Methylation / demethylation of DNA / of cytosine; ***OR*** 2. Acetylation / deacetylation of histone;	1 max	Reject 'mutation' / description of mutation
7 (b) (i)	1;	1	
7 (b) (ii)	3;	1	
7 (c) (i)	Meiosis involves association of (homologous) <u>pairs</u> of chromosomes / bivalent formation / separation of homologous <u>pairs</u> / with 3 copies cannot <u>pair</u> properly;	1	
7 (c) (ii)	1. Otherwise might breed with native fish and pass on GM to offspring / produce rapidly-growing offspring; 2. Disturbance of food chains eg consume large number of prey species; 3. Gene may have unforeseen effects on phenotype / on offspring;	2 max	

Question	Marking Guidance	Mark	Comments
8 (a)	1. Neurotransmitter combines with receptor (on post-synaptic membrane); 2. Neurotransmitter / ACh opens Na^+ (ion) channels; 3. Na^+ ions enter; 4. Causes depolarisation / described / raises potential / decreases potential difference / exceeds threshold / reaches threshold;	3 max	Reject combines with active site
8 (b) (i)	1. GABA causes opening of ion channels; 2. Cl^- ions enter (postsynaptic neurone) AND K^+ ions leave; 3. Increased concentration of negative ions inside / decreased concentration of positive ions inside; 4. (Resting potential restored) as K^+ ions and Cl^- ions pumped back / return by active transport;	3 max	Allow potassium channels /chloride channels
8 (b) (ii)	1. Action potential involves raising potential / decreasing potential difference / making more positive / depolarisation; 2. With GABA, less likely to raise potential above threshold / less likely to reach threshold; 3. Need more Na^+ entry / need more impulses (from same or other neurones) / need more summation;	3	Accept threshold is increased
8 (c)	Control of whether postsynaptic neurone 'fires' or not / 'firing' not inevitable / can balance stimulation and inhibition / can override stimulation / eg	1	Accept appropriate example – eg overriding pain

Question	Marking Guidance	Mark	Comments
9 (a) (i)	(On graph) – '**X**' on either or both of the glucose peaks at 08:30 / 18:30;	1	
9 (a) (ii)	1. Insulin <u>lowers</u> blood glucose / <u>stimulates</u> uptake of glucose by cells / by liver / by muscles; **OR** 2. High blood glucose <u>stimulates</u> insulin secretion;	1 max	Reject lowers body glucose Reject high body glucose
9 (a) (iii)	1. High<u>er</u> glucose concentrations in diabetic; 2. Takes long<u>er</u> time to decrease / remains high (after each meal);	2	
9 (b) (i)	1. Correct answer: 40;; **OR** (if answer incorrect) 2. $\frac{20 \times 16 \times 60}{480}$ **or** $\frac{2}{3}$ **or** 0.67(h);	2	1. Ignore working. 2 marks 2. Allow 1 mark
9 (b) (ii)	1. Glucose from glycogen / 'glycogenolysis'; 2. (Glucose / glycogen) stored in liver / in muscles; 3. Glucagon / adrenaline causes glucose release **or** raises blood glucose **or** causes glycogen → glucose; 4. 'Gluconeogenesis' / described;	3 max	'Glycogen' and 'glucagon' – <u>correct</u> spellings only eg from amino acids / from fat

Question	Marking Guidance	Mark	Comments
10 (a) (i)	1. FSH (secretion) causes; 2. Follicle growth / development; 3. Follicle → oestrogen;	3	
10 (a) (ii)	1. Stimulates development of endometrium / thickening of uterus lining; 2. Inhibits (release of) FSH; 3. Stimulates (release of) LH; 4. (LH / consequence of high oestrogen) causes ovulation; 5. Falling levels of oestrogen → menstruation;	4 max	Ignore uterus wall Ignore release of FSH
10 (b) (i)	Progesterone;	1	Allow progestogen Allow phonetic spellings
10 (b) (ii)	1. Inhibits release / production of FSH / LH; 2. Prevents development of follicle / prevents ovulation; 3. Thickens cervical mucus as barrier to sperm;	2 max	
10 (c) (i)	1. Menstruation ceases / ovulation ceases / infertility; 2. Increased FSH / LH release; 3. Emotional problems / mood swings / depression / irritability / loss of concentration / memory; 4. Hot flushes; 5. Sleeping problems; 6. Vaginal dryness; 7. Decreased sex drive; 8. Urinary problems / infections / incontinence; 9. More abdominal fat deposits / weight gain; 10. Hair thinning; 11. Increased risk of CHD;	2 max	Allow periods stop

10 (c) (ii)	1. Oestrogen increases calcium content of bones; 2. (Statistically) significant difference from placebo; 3. SDs do not overlap; 4. Especially pronounced in 1st year of treatment / lesser increase in subsequent years; 5. If treatment is stopped, effect decreases / need to maintain oestrogen treatment;	4 max	4. Accept appropriate use of figures from graph
10 (d) (i)	1. Negative correlation between blood uc-osteocalcin & calcium content / described re. increase in one & decrease in the other; 2. Weak correlation / low correlation coefficient / r is only (–)0.375 / wide distribution of points; 3. But correlation is (statistically) significant (since P<0.05) **or** <5% (probability) that due to chance / not just chance; 4. Can reject null hypothesis (of no correlation); 5. But correlation does not prove a causal relationship;	4 max	
10 (d) (ii)	1. Raloxifene lowers uc-osteocalcin (in blood); 2. Significant effect (c.f. placebo); 3. Lower uc-osteocalcin associated with high calcium content (of the bones); 4. Raloxifene increases calcium in bones / reduces osteoporosis; 5. Oestrogen (also) raises / maintains calcium content of bones; 6. But oestrogen activates MYB gene / oncogene **or** raloxifene does not; 7. (Prolonged) oestrogen treatment may lead to breast cancer **or** raloxifene will not;	5 max	