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General Certificate of Education
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Human Biology HBIO4

Bodies and cells in and out of control

Unit 4

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	(a)		3 bases (in DNA / RNA) for 1 amino acid ;	1	
1	(b)		Formation of mRNA; Using RNA polymerase/complementary base pairing / using 1 strand of DNA as a template;	2	Accept description of complementary base pairing for last point Allow "copying"
1	(c)		mRNA + ribosome; Detail of structure, eg order of codons (on mRNA) determines order of amino acids/primary structure of protein/polypeptide; Reference to binding of codon (on mRNA) to anticodon on (tRNA)/ tRNA carries specific amino acid; Peptide bond formation / condensation / joining of amino acids;	2 max	Context - at ribosome

Question	Part	Sub Part	Marking Guidance	Mark	Comments
2	(a)		Colour detected by cone cells; Fovea contains (only/mainly) cone cells; Three types of cone/cells described / each sensitive to different wavelength/to red or green or blue;	3	Max 2 if 'rods' and 'cones' confused consistently
2	(b)	(i)	Each receptor (in fovea)/each cone connected to separate neurone / rods/cells in other parts share a neurone;	1	Accept nerve cell/nerve fibre
2	(b)	(ii)	Many rods in other parts of retina; Rhodopsin/pigment in receptors/rod cells very sensitive to light / works in low light; Receptors/rods connected in groups to ganglion cell/neurone; Summation; Description of summation, eg if enough light above threshold hits any cells in the group, then get nerve impulses to brain/along optic nerve;	3 max	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
3	(a)	(i)	1 / 2;	1	
3	(a)	(ii)	3 ;	1	
3	(a)	(iii)	G ;	1	Accept F
3	(b)	(i)	A , B , C , D , E ;	1	2 max
3	(b)	(ii)	Formed by meiosis; Independent assortment / random segregation / described / random alignment; Crossing-over / described;	2 max	Allow miosis/meosis Ignore phase
3	(c)		FSH / hCG / LH / GnRH agonist;	1	Accept 'Clomifene'

Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	(a)	(i)	A;	1	
4	(a)	(ii)	H + I;	1	
4	(b)		Correct answer: 7000;; ***OR*** 1 sarcomere = $\frac{48}{16}$ (μm) and use of 21 (000) μm / use of $\frac{21\ (000)}{3}$; ***OR*** Allow for error re. interconversion of mm / μm: e.g. $\frac{21}{3}$ / $\frac{2100}{3}$;	2	Accept 6422 to 7608 Ignore working Allow 1 mark Allow 1 mark
4	(c)		Rise in Ca^{2+} (in muscle cells) / Ca^{2+} enters (muscle cells) /Ca^{2+} from SR; Leading to movement of blocking/inhibiting molecules/troponin/tropomyosin; Expose binding sites on actin/on thin filament; Allow actin-myosin interaction / cross-bridge formation /allow myosin to bind /allow filaments to slide past each other; Activate ATP-ase (on myosin);	3 max	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
5	(a)		Can control/spray herbicide on weeds among growing crop; Without harming crop; Weeds compete with crop / description eg for factor – water/light/ions; Weeds reduce yield of crop / use of herbicide increases yield;	2 max	
5	(b)	(i)	By reproduction/pollen/bacteria/named vector;	1	
5	(b)	(ii)	Mutation;	1	Accept via a vector OR By pollen/seeds carried long distances by wind/animals

Question	Part	Sub Part	Marking Guidance	Mark	Comments
6	(a)		Parents without CF → offspring with CF / 1 + 2 → 6 / 7 + 8 → 10; Each parent must have CF allele /offspring receives CF allele from both parents / both parents heterozygous / both carriers;	2	
6	(b)		**Nn** and **Nn** (no mark since awarded in 6(a) already) **N n** and **N n** ; **NN** and **Nn** and **Nn** and **nn**; Correct allocation of phenotypes to genotypes; Probability = <u>0.125</u>;	4	Accept alternative symbols Ignore X and Y Accept answers expressed as chance rather than probability, eg 1 in 8 /1 to 7 / 12.5%;

Question	Part	Sub Part	Marking Guidance	Mark	Comments
7	(a)		Oxytocin causes contraction of the (uterine) muscle/uterus;	1	
7	(b)		For: Pressure rise indicates going into labour; Barusiban lowers pressure in uterus; Against (2 max): Monkeys might react differently from humans; Sample size not known/too small/need repeat; No statistical information; No control group injected with saline/given placebo; Might be side-effects;	3 max	
7	(c)		Suckling = stimulus / (pressure) receptors in nipple/ suckling → impulses; Via hypothalamus; Pituitary releases oxytocin; Release of oxytocin → contraction of (muscles in) milk ducts; (Release of) prolactin leads to milk produced (to be released);	3 max	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
8	(a)		Menstruation ceases / ovulation ceases; Emotional problems / mood swings / depression / irritability / loss of concentration/memory; Hot flushes; Sleeping problems; Vaginal dryness; Decreased sex drive; Osteoporosis/brittle bones; Urinary problems/infections / incontinence; More abdominal fat deposits/weight gain; Hair thinning; Rise in FSH/fall in progesterone/fall in LH; Increased chance of CHD / same risk as in men;	2 max	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
8	(b)	(i)	Yes (no mark) because: Oestrogen increases rate of cell division/mitosis; Cancer is due to (uncontrolled) cell division / increased chance of mutation with increased cell division; ***OR*** Uncertain because: Artificial *in vitro* experiment / conditions in the body may be different; Macrophages/immune system destroying cells / chemical processing of oestrogen ;	2 max	Eg in proto-oncogene/tumour-suppressor gene ***OR*** Methodology: Sample size not known/no repeats; Concentration of oestrogen relative to normal not known;
8	(b)	(ii)	Ebselen reduces rate of cell division;	1	
8	(b)	(iii)	Genetic differences between women / eg re. tumour-suppressor genes/oncogenes; Body has process to remove/control cancerous cells; Oestrogen may only act on cells that are already cancerous/pre-cancerous; Amount oestrogen given just restores to normal level; Oestrogen sensitivity may be linked to environmental ,eg smoking /physiological conditions; Mutations must occur before oestrogen has an effect;	2 max	
8	(c)		Oestrogen may lead to peroxide formation/release; Peroxides affect oncogenes/tumour-suppressor genes; Loss of control of cell division;	2 max	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
9	(a)		Restriction enzyme / restriction endonuclease;	1	
9	(b)	(i)	A-G-C-T / T-C-G-A;	1	Allow A-G-C-T-T / T-T-C-G-A
9	(b)	(ii)	Joining two pieces of DNA; By complementary binding/complementary base-pairing;	2	
9	(c)	(i)	4943;	1	
9	(c)	(ii)	3;	1	
9	(c)	(iii)	2 bands disappear / only 3 bands; New band formed at heavier position/nearer to origin/higher up;	2	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
10	(a)		Correct answer: 6 / 6.25 / 6.3;; ***OR*** $\frac{1000}{160}$ / $\frac{1}{160}$;	2	Ignore working Allow 1 mark if decimal point in wrong position Allow 1 mark
10	(b)		Ref. to 'refractory period'; Requires greater stimulation; To reach threshold / threshold cannot be reached / to cause depolarisation; K^+ channels are open / more negative potential than resting potential / membrane is hyperpolarised; Na^+ channels are inactive/are closed / sodium channels will not open;	3 max	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
11	(a)	(i)	Receptor/or insulin has specific shape/tertiary structure; (Has binding site) complementary to / shape that fits (that of insulin);	2	Reject “same shape”
11	(a)	(ii)	Glycogen;	1	
11	(a)	(iii)	Membrane has lipid/hydrophobic (bi-) layer; Glucose is not lipid-soluble/not hydrophobic / is hydrophilic/polar; Transporter spans the membrane; Transporter has water-filled channel; Ref. to diffusion/facilitated diffusion; Ref. to specificity of transporter/complementary shape;	3 max	Allow ‘active transport’
11	(b)	(i)	Two suitable factors;; Examples: Sex (of patients); Amount/type of food/diet; Amount of exercise; BMI/body fat/mass; Ethnic group; Health;	2 max	Accept other sensible suggestions of control variables

Question	Part	Sub Part	Marking Guidance	Mark	Comments
11	(b)	(ii)	Type 2 diabetics have: Higher glucose; Higher insulin; Lower adiponectin/similar adiponectin; More variability / higher SD;	2 max	
11	(b)	(iii)	Range = just extremes / could be anomalous / atypical / non-representative values; Mean + SD: uses all values / shows spread about mean; Can calculate confidence limits / can be used in stats test;	2 max	
11	(c)	(i)	There is no (significant) difference between concentration of insulin in diabetics and in non-diabetics / any difference is due to chance;	1	
11	(c)	(ii)	There is a significant difference between diabetics and non-diabetics / difference is not due to chance (alone) / is unlikely to be due to chance / > 99% confident that results are not due to chance / reject the null hypothesis (assuming correct n.h. in (c) (i));	1	
11	(d)		As one parameter increases, the other decreases / there is an inverse relationship between the two parameters;	1	owtte

Question	Part	Sub Part	Marking Guidance	Mark	Comments
11	(e)		Yes, because: Obese people have reduced adiponectin (Figure 7); Low adiponectin is associated with high insulin (Figure 8 and Figure 6); High insulin/low adiponectin found in type 2 diabetics (Figure 6); ***OR*** Accept converse statements No, because: Correlation may not be significant / broad spread of data; May be other contributory factor, eg lack of exercise; Correlation does not prove causal link;	3 max	
11	(f)		Type 2 diabetics have lower (blood) adiponectin; Low adiponectin (in blood) leads to fewer glucose transporters <u>in cell membranes</u>; Less glucose is removed from blood ($\rightarrow$ higher blood glucose); High blood glucose detected by pancreas; High blood glucose stimulates release of more insulin ($\rightarrow$ higher blood insulin);	3 max	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
11	(g)		N – has high activity / acts quickly; N – will lead to greater/faster lowering of blood glucose (than G); N – (relatively) short-lived effect; N – may need >1 injection per day; N – useful around meal times; G – fairly constant level of insulin (activity);	4 max	Accept converse statements for G