**General Certificate of Education (A-level)
January 2013**

Human Biology HBIO4

(Specification 2405)

Unit 4: Bodies and Cells In and Out of Control

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 events which all examiners participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Question	Marking Guidance	Mark	Comments
1 (a)	1. Departure from norm (/ from set value); 2. Causes change to restore norm / to reverse departure;	2	Allow from 'optimum' Allow definition in terms of temperature regulation Idea of returning to norm = 2 marks
1 (b)	Hypothalamus;	1	Must be phonetic Extra part(s) of brain cancel – e.g. medulla
1 (c) (i)	2 and 13;	1	
1 (c) (ii)	1. <u>Evaporation</u> (of sweat / of water); 2. <u>Evaporation</u> requires heat / energy / cools the skin (and hence the blood);	2	Extra processes cancel – e.g. radiation Evaporation of sweat cools body / cools blood = 1 mark (point 1.)

Question	Marking Guidance	Mark	Comments
2 (a)	1. (Mitochondria perform aerobic) respiration; 2. Release energy / make ATP; **OR** 3. (Mitochondria) release energy / make ATP; 4. For swimming / movement;	2	1. Reject 'anaerobic' Reject energy 'for respiration' 2. Ignore 'contains ATP' 2. & 3. Reject: 'make' energy
2 (b) (i)	23;	1	
2 (b) (ii)	Fertilisation restores number to 46 / to the diploid number / to the 'full' number / to prevent doubling of the number of chromosomes / to prevent having too many chromosomes;	1	Allow references to abnormalities caused by, say, 22 or 24 chromosomes
2 (c)	1. Contains / releases enzymes; 2. Breaks down surface / membrane / zona pellucida of oocyte / egg / allows sperm to penetrate egg / allows sperm nucleus to enter;	2	Allow correct example, e.g. protease / lipase

Question	Marking Guidance	Mark	Comments
3 (a) (i)	3;	1	
3 (a) (ii)	2;	1	
3 (b) (i)	(Graph shows) continuous variation / many categories / not discrete categories / shows a normal distribution;	1	Ignore shows a 'range' of results Accept reference to a 'spread' of results
3 (b) (ii)	Environment / named aspect – e.g. schooling / books / social interactions / diet;	1	
3 (c)	Mental age = actual age;	1	Allow worked example

Question	Marking Guidance	Mark	Comments
4 (a)	1. Cell multiplication / cell division / mitosis which is out of control; **OR** 2. A tumour that undergoes metastasis;	1	1. Ignore cell 'growth' 2. Allow description
4 (b)	1. Higher incidence in males than in females; 2. More rapid increase in males; 3. Higher incidence with increasing age; 4. No-one under 30 has cancer of larynx; 5. Other correct observation;	2 max	
4 (c)	In human population: 1. (Positive) correlation; 2. Between <u>amount</u> of tobacco used / number of years smoking & number of cases of cancer of the larynx; **OR** In laboratory experiments: 3. Larynx tissue subjected to tobacco (extracts) in the laboratory; 4. Becomes cancerous / shows mutations / shows chromosome damage / shows increased cell division;	2	Accept description of positive correlation: increase in tobacco use and increase in cancer of the larynx = 2 marks If just 'more larynx cancer in smokers' = 1 mark

Question	Marking Guidance	Mark	Comments
5 (a)	X = cone <u>and</u> Y = rod;	1	Both required for 1 mark.
5 (b)	Rods / type Y cells present /fovea has only cones / fovea has only X cells / fovea has only one type of receptor / fovea has <u>no</u> rods;	1	Accept incorrect names of cells of types X and Y from candidate's answer to (a) Reject 'few rods in fovea'
5 (c) (i)	1. (Each receptor cell has) separate neurone to brain / separate bipolar neurone /separate ganglion cell; 2. Impulses from each receptor kept separate / no retinal convergence;	2	2. Allow 'information' instead of impulses
5 (c) (ii)	1. Several Y connected to same neurone to brain / same bipolar cell / same ganglion cell; 2. Stimulation of each individual cell is sub-threshold / is insufficient / cells together cause above-threshold stimulation of neurone / of bipolar cell / of ganglion cell; 3. Summation / described;	3	Allow 'show retinal convergence' Ignore rhodopsin sensitivity Accept each cell Y cannot produce action potential on its own Reject temporal summation

Question	Marking Guidance	Mark	Comments
6 (a)	Rate of respiration <u>at rest</u> / rate of energy release <u>at rest</u> / rate of energy use <u>at rest</u>;	1	Ignore 'metabolic rate at rest'
6 (b) (i)	1. To allow comparison (with other people) / to standardise the results / to calculate a valid mean; 2. People are different sizes; ***OR*** 3. BMR is measured by heat loss; 4. Amount of energy / heat lost (/used) is dependent on SA /heat is lost via the skin;	2 max	2. Allow reference to height / mass / SA
6 (b) (ii)	1. Less (subcutaneous) fat in males; 2. Higher rate of heat loss in males; ***OR*** 3. More muscle (tissue) in males; 4. Male has / muscle has higher respiration rate;	2 max	Accept converse points for females 4. Reject context of exercise
6 (b) (iii)	Less synthesis / loss of muscle with age / decreased hormone production / decreased thyroxine production;	1	
6 (b) (iv)	Any **two** suitable physiological functions – e.g. 1. Cardiac output / stroke volume; 2. Nerve conduction velocity / reaction speed; 3. Muscle tone; 4. Movement at joints; 5. Skin elasticity; 6. Named sense – e.g. hearing / sight; 7. 2nd named sense – e.g. sight / hearing; 8. Any other correct example – eg memory loss / reduced protein synthesis;	2 max	 4. Accept arthritis 5. Accept wrinkles 6. Accept deafness / long sight 'Senses' unqualified = 1 mark 8. Ignore menstrual cycle / ovulation / ref. menopause (since not in males)

Question	Marking Guidance	Mark	Comments
7 (a) (i)	1. Induction of labour / uterine contraction; 2. Stimulation of milk release / 'let down' / contraction of milk ducts; 3. Induction of maternal behaviour / 'bonding';	2 max	1. Allow myometrium contracts Reject endometrium contracts 2. Ignore milk 'production' 3. Allow lactation
7 (a) (ii)	1. (Stimulates) growth of follicles; 2. (Stimulates) ovulation / formation of corpus luteum; 3. Maintenance of the corpus luteum; 4. Secretion of oestrogen / progesterone;	1 max	
7 (b)	1. Hypothalamus + buffer ***OR*** all conditions the same; 2. No oxytocin;	2	
7 (c) (i)	10^{-10} mol dm^{-3} and control: 1. Oxytocin increases release of LRF by 4 to 5 times (c.f. control) / effect is significant; 2. No overlap of error bars with oxytocin & control;	2	
7 (c) (ii)	10^{-10} mol dm^{-3} and 10^{-7} mol dm^{-3}: 1. No significant difference between different oxytocin concentrations; 2. Overlap of error bars between different oxytocin concentrations;	2	

Question	Marking Guidance	Mark	Comments
8 (a) (i)	1. Overcome bias / expectation of doctor / expectation of patient / prevent doctors treating patients differently; 2. See 'real' effect of drug / to give valid results / not just psychosomatic effect;	2	2. Accept 'knowing could alter the results' Reject 'more accurate'
8 (a) (ii)	Check reliability / repeatability / validity of result / significance of any difference in results / large sample needed for statistical test / to increase reliability / to identify anomalies / reduce effect of any other factors;	1	Reject 'accurate' Accept 'more representative' Accept 'to check effect is not due to chance' Accept 'to detect any side effects'
8 (a) (iii)	1. Some ill people are not treated / not helped / treatment deliberately withheld / may prolong suffering of those given placebo; 2. Patients on new drug are exposed to potential side effects / new drug may not be 'safe';	2	
8 (b)	1. After a meal blood glucose concentration rises; 2. Linagliptin reduces DPP-4 activity / reduces enzyme activity / inhibits DPP-4 <u>and so</u> increases / maintains GLP-1 concentration (in blood) / <u>so</u> less GLP-1 is inactivated; 3. More insulin released (by pancreas) <u>and example of consequence</u>; 4. Extra insulin overcomes reduced sensitivity (of cells) to insulin; 5. Less glucagon released (by pancreas) <u>and example of consequence</u>;	4 max	3. e.g. helps to lower blood glucose / stimulates uptake of glucose by cells / increases glycogen synthesis / fat synthesis; 5. e.g. prevents raising of blood glucose / prevents conversion of glycogen to glucose

Question	Marking Guidance	Mark	Comments
9 (a)	1. <u>Actin</u>: In A + I; 2. <u>Myosin</u>: In A + H / in A;	2	
9 (b) (i)	1. Correct answer: 3 ;; *OR* (if wrong answer) 2. Use of measured sarcomere length ÷ scale bar length; *OR* 3. '3' but wrong order of magnitude;	2	1. Ignore working 2. e.g. 48 ÷ 16 / 96 ÷ 16 Allow 1 mark 3. Allow 1 mark
9 (b) (ii)	48 / correct for candidate's answer to (b)(i);	1	Accept in range 48 – 50
9 (c) (i)	In table: 1. Mitochondria: low high; 2. Rate fatigue: high low;	2	
9 (c) (ii)	1. Overall rate of contraction limited by rate of ATP-splitting / rate of action of ATP-ase; 2. ADP is bound to myosin 'head' / described / ADP enables myosin-actin interaction; 3. ATP-splitting / energy from ATP moves myosin head / causes actin to move relative to myosin / causes power stroke / causes (re-)cocking: 4. (Fresh) ATP molecule needed to detach myosin head (from actin)	3 max	Allow description Allow faster ATP-ase causes faster contraction

Question	Marking Guidance	Mark	Comments
10 (a)	1. Parental genotypes: **X^{H}Y** and **X^{H}X^h** **AND** Gametes: **X^H** **Y** and **X^H** **X^h**; 2. Offspring genotypes: **X^{H}X^H** **X^{H}X^h** **X^{H}Y** **X^{h}Y**; 3. Offspring phenotypes: 	Normal female	Normal female/ carrier	Normal male	Haem-ophiliac male;	 4. Probability: 0.25;	4	1. Only 2. Allow correct for candidate's gametes / P genotypes 3. Allow correct for candidate's offspring genotypes 4. Allow ¼ / 1 in 4 / 1 : 3 / 25%
10 (b) (i)	U / Uracil;	1	Reject codons e.g. not 'UGA'
10 (b) (ii)	C / Cytosine;	1	Reject codons e.g. not 'CGA'
10 (b) (iii)	Substitution;	1	
10 (c) (i)	1. <u>Single-stranded</u> piece of DNA; 2. Complementary base pairing / described re. A to T and G to C / binds specifically to (part of) a gene / to a DNA sequence; 3. Enables replication / starts DNA synthesis / starting point for DNA polymerase;	2 max	Allow polynucleotide for DNA Ignore 'sticky ends' Ignore references to 'beginning and end'
10 (c) (ii)	1. Primers mark / attach to <u>both</u> ends of DNA section / identifies section of DNA to be replicated; 2. Attach on <u>opposite</u> strands of the DNA; 3. <u>Different</u> base sequences at each of the 2 locations;	3	 Allow: DNA is replicated in one direction only;
10 (c) (iii)	180;	1	

10 (d) (i)	1. Sequence of bases at (restriction) site does not fit <u>active site</u> of other restriction enzymes / only fits <u>active site</u> of *Bst*BI / Normal DNA (in Factor IX <u>gene</u>) <u>does</u> fit / mutated DNA does <u>not</u> / *Bst*BI has specific (shaped) <u>active site</u>; 2. *BstBI* does <u>not</u> cut DNA at site altered by mutation / <u>only</u> cuts DNA at the unaltered site; 3. So mutated and normal DNA give different results (in diagnostic test);	3	1. Must mention <u>active site</u> Accept 'is complementary to' as 'fits' Reject reference to enzyme action on 'Factor IX' (= a protein)

10 (d) (ii)			3	One mark per correct row

	60	120	180
1. Mrs Romanov	✓	✓	✓;
2. Haemophiliac son			✓;
3. Non-haemophiliac son	✓	✓	;

10 (e)	Pro PGD: 1. Detected at earlier stage / 3 days c.f. 16 weeks; 2. Detected before pregnancy; 3. No (increased) chance of miscarriage; 4. Does not involve abortion / less trauma / less pain / ethical comparison; 5. Can freeze some unaffected embryos for a later pregnancy; Con PGD: 6. IVF is an invasive procedure; 7. Destroy some embryos; 8. Higher incidence of false positives; 9. Higher financial cost / £6000 c.f. £160 / £1060; 10. Only 25% success rate;	6 max	Accept converse argument for amniocentesis 2. Accept only healthy embryos implanted