



General Certificate of Education (A-level)
June 2012

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)	1. Ciliary muscle: <u>contracts</u> ; 2. Suspensory ligament: slackens / less pull on lens / looser; 3. Lens: bulges / becomes thicker / fatter / more 'rounded' / more convex; OR 3. Lens: bends / refracts / converges light rays more;	3	2. Accept 'relaxes' 3. Ignore 'lens becomes bigger / smaller' QWC
1 (b)	1. (Only) cones at fovea; 2. (Cones) each have own neurone to brain / do not share / receptors elsewhere share a neurone / no (retinal) convergence;	2	2. Allow no summation (by cones)
Total		5	

Question	Marking Guidance	Mark	Comments
2 (a)	<ol style="list-style-type: none"> 1. Chemical/correct example released from ductless gland / from endocrine gland / secreted into blood; 2. Affects specific tissue / target tissue / organ / cell(s) (elsewhere in the body); 3. Effect = change in physiology / metabolism / switching gene on or off; 	2 max	<ol style="list-style-type: none"> 2. Allow specific receptor 3. Accept other correct specific example or effect – e.g. turn on enzyme production
2 (b)	<p>Three suitable effects of adrenaline eg;;;</p> <ol style="list-style-type: none"> 1. Increased heart rate / stroke volume / cardiac output; 2. Dilation of pupils; 3. Vasoconstriction (/ described) / reduced blood flow in skin / gut; 4. Vasodilation (/ described) / increased blood flow in (skeletal) muscles; 5. Glycogen → glucose / raises blood glucose; 6. Contraction of erector pili muscles / hair stands on end; 7. Relaxes bronchioles / bronchial dilation / airways wider; 8. Increased blood pressure; 9. Inhibits peristalsis; 10. Relaxation of sphincters of bladder / anus; 	3 max	Ignore consequential effects.
Total		5	

[illegible]

Question	Marking Guidance	Mark	Comments
4 (a)	<ol style="list-style-type: none"> Departure from normal level / set value / a change occurs; Causes changes to restore to norm / to reverse departure; 	2	Accept use of example to illustrate.
4 (b)	<ol style="list-style-type: none"> (Shivering) releases / produces heat; From (increased) respiration / metabolism; 	2	<p>Accept releases energy NOT '...produces energy'</p> <p>Ignore 'raises temperature'</p> <p>'Respiration is exothermic' = 2 marks.</p>
4 (c)	<ol style="list-style-type: none"> Warming → reduced temp. gradient so less heat loss; Humid → less heat loss by evaporation (from lungs); Effect of raised temperature on physiology <p>E.g. increases rate of chemical reactions / → suitable temperature for metabolism / respiration / → suitable temperature for heart / nerve / muscle functioning / brain / hypothalamus / thermoregulatory centre can now coordinate heat loss / heat gain processes of the body;</p>	3	<ol style="list-style-type: none"> Allow warm air warms blood (in lungs) <p>Accept other suitable example</p>
Total		7	

[illegible]

Question	Marking Guidance	Mark	Comments
6 (a)	Only cells with kanamycin resistance (gene) – and hence Bt gene – can grow / can survive ;	1	
6 (b)	<ol style="list-style-type: none"> Cells produced by <u>mitosis</u> (from original Bt cell); All DNA / genes / chromosomes of the cell are <u>copied</u> / each offspring cell receives a <u>copy</u> / all offspring cells genetically identical; (All new cells are) produced from cells / tissue with Bt gene; 	2 max	<ol style="list-style-type: none"> Accept offspring are a clone
6 (c)	<ol style="list-style-type: none"> Possible transfer of resistance <u>gene</u> to other (pathogenic) species of bacterium; Unable to use <u>kanamycin</u> to kill these bacteria / treat disease; 	2	<ol style="list-style-type: none"> Do not accept 'cannot use antibiotics' (unqualified)
6 (d)	<ol style="list-style-type: none"> Human gut pH is too low / lower than pH10; Bt protein not activated in human gut / low pH in stomach denatures Bt protein; No receptor for protein in human gut / denatured / non-activated Bt protein will not attach to any receptor in human; Humans cook maize which denatures Bt protein; Changed shape of (cooked) Bt protein will not fit receptor; 	3 max	<ol style="list-style-type: none"> Accept 'acidic' for lower Accept pH values if less than 10 as equivalent to 'lower'
Total		8	

Question	Marking Guidance	Mark	Comments
7 (a)	A = sodium / Na / Na ⁺ AND B = potassium / K / K ⁺ ;	1	
7 (b)	Time during which axon cannot be stimulated / during which a new action potential cannot be generated / needed to restore ion concentrations (across axon membrane) / repolarise;	1	Ignore references to ion channels closed
7 (c) (i)	1. Refractory period = 2 (ms) / use of '2' in calculation; 2. $\frac{1000}{2} = 500$ or $500 \times 2 = 1000$;	2	
7 (c) (ii)	1. Higher intensity stimulus → higher frequency of action potentials; 2. Above a certain intensity, all → same / maximum frequency of APs;	2	QWC
Total		6	

Question	Marking Guidance	Mark	Comments
8 (a)	<ol style="list-style-type: none"> DNA = 2 chains (of nucleotides) / bases (H)-bonded in pairs / = a 'double helix'; Each base pair / nucleotide (pair) is a constant length; 	2	Allow A-T / G-C
8 (b) (i+ii)	<ol style="list-style-type: none"> Short length of <u>single</u>-stranded DNA/RNA/nucleotides; With complementary bases to (part of) Hb-DNA / ref. A to T and G to C in primer-target / to gene or DNA under investigation; 	2	
8 (b) (iii)	To produce many copies / enough for analysis / too little in original sample / only 2 copies per cell;	1	Allow 'make more...'
8 (c) (i)	<ol style="list-style-type: none"> Both have H^A and H^S / are heterozygous; Parental H^A is cut (\rightarrow 55 bp fragment); Parental H^S is not cut (\rightarrow 110 bp fragment); 	3	<p>Ignore 'carriers'.</p> <p>Accept 'They each have two copies of Hb gene only one of which can be cut' for 1 mark.</p> <p>Reject 'haemoglobin' cut</p>
8 (c) (ii)	<ol style="list-style-type: none"> Fetus <u>has</u> sickle cell anaemia; Fetus is $H^S H^S$ / homozygous for sickle cell anaemia / <u>only</u> has H^S / does not have H^A; 	2	<ol style="list-style-type: none"> Do NOT accept 'fetus probably has sickle cell anaemia' <p>Accept 'fetus has sickle cell anaemia, as it <u>only</u> \rightarrow 110bp fragment / as DNA not cut' for 2 marks.</p>
Total		10	

Question	Marking Guidance	Mark	Comments										
9 (a) (i)	<p>1. Genotype of woman = $I^A I^O dd$ <u>AND</u> footballer could = $I^A I^O Dd$ / $I^A I^O DD$ / woman + footballer = $I^A I^O$ <u>AND</u> woman = dd + footballer = Dd / DD OR Starting with gametes OR Woman's gametes = $I^A d + I^O d$ Man's gametes = $I^A D + I^O D$ or $I^A d + I^O D$;</p> <p>2. I^O inherited from both parents / in a gamete from each parent;</p> <p>3. D from male <u>AND</u> d from female;</p> <p>4. Genotype of baby = $I^O I^O Dd$ / $I^O I^O Dd$ indicated as blood group O and Rhesus positive / baby is $I^O I^O$ <u>AND</u> Dd;</p>	4	<p>Accept these points from a prose account and / or genetic diagram(s) e.g.</p> <table><tr><td>Woman</td><td>Footballer</td></tr><tr><td>$I^A I^O dd$</td><td>$I^A I^O Dd$ / $I^A I^O DD$</td></tr><tr><td>↓</td><td>↓</td></tr><tr><td>$I^O d$</td><td>$I^O D$</td></tr><tr><td colspan="2">Baby = $I^O I^O Dd$ = 4 marks</td></tr></table> <p>Ignore any references to X/Y</p>	Woman	Footballer	$I^A I^O dd$	$I^A I^O Dd$ / $I^A I^O DD$	↓	↓	$I^O d$	$I^O D$	Baby = $I^O I^O Dd$ = 4 marks	
Woman	Footballer												
$I^A I^O dd$	$I^A I^O Dd$ / $I^A I^O DD$												
↓	↓												
$I^O d$	$I^O D$												
Baby = $I^O I^O Dd$ = 4 marks													
9 (a) (ii)	<p>(Many) other men with I^O and D (in their genotype) / other men with phenotype ARh^+ / ORh^+; OR Footballer is $I^A I^A$;</p>	1	Accept with the 'same' genotype / with the same phenotype										
9 (b) (i)	<p>1. At birth, some of baby's RBCs / blood enter mother's blood;</p> <p>2. Baby's blood has D-antigen / Rh+ antigen;</p> <p>3. Causes mother's (WBCs) to make anti-D antibodies;</p> <p>4. Mother's (anti-D) antibodies can cross placenta at next pregnancy;</p>	3 max	<p>2. Reject WBCs have D-antigen. Accept plasma cells / lymphocytes.</p>										

9 (b) (ii)	<p>1. Injected anti-D combine with Rh+ RBCs / combine with D-antigen (from 1st fetus);</p> <p>OR</p> <p>Injected antibodies destroy D-antigen;</p> <p>2. Prevent active immunisation / described / prevents mother making anti-Rh antibodies;</p>	2	
Total		10	

Question	Marking Guidance	Mark	Comments
10 (a)	<ol style="list-style-type: none"> 1. FSH stimulates growth / development / maturation of follicles / oocyte; 2. Follicle / ovary releases oestrogen; 3. Oestrogen causes growth / development / thickening of uterus lining; 4. Oestrogen (initially) inhibits FSH release; 5. Release of LH / increased concentration of LH causes ovulation; 6. Release of LH / increased concentration of LH causes corpus luteum formation; 7. Corpus luteum releases progesterone; 8. Progesterone promotes / maintains / causes thickening of uterus lining; 9. Progesterone inhibits production of FSH / LH; 10. Falling oestrogen / progesterone → menstruation / described / → increase in FSH; 	5 max	<ol style="list-style-type: none"> 1. Reject production / division / multiplication <p>QWC</p>
10 (b) (i)	<ol style="list-style-type: none"> 1. FSH produced by / released from pituitary; 2. FSH enters the blood / FSH transported via blood; 3. FSH not broken down / broken down only slowly / not all used / is present in excess; 4. Urine derived from blood; 5. FSH concentration in urine proportional to FSH concentration in blood / dependent on FSH concentration in blood / proportional to FSH production; 	3 max	<ol style="list-style-type: none"> 3. Allow does not (all) enter cells. 5. Accept the more FSH in blood / produced the more there will be in urine.

10 (b) (ii)	<p>Similarities:</p> <ol style="list-style-type: none"> Both increase from 8 / 9 / 10 years onwards / during puberty OR both constant or low before this / before puberty; Identical up to early 20's / initially; <p>Differences:</p> <ol style="list-style-type: none"> Female > male from early 20's onwards / after puberty; Female has rapid rise in late 30's / early 40's / before menopause c.f. male slight rise/stays low; Female falls from 60's onwards c.f. male falls after 70's/80's/ female falls before male; Fall in female is greater than fall in male; 	4 max	Max 3 if only differences described
10 (b) (iii)	<p>Two suitable changes e.g.;;</p> <ol style="list-style-type: none"> Menstruation ceases / ovulation ceases; Emotional problems / mood swings / depression / irritability / loss of concentration / loss of memory; Hot flushes; Sleeping problems; Vaginal dryness; Decreased sex drive; Osteoporosis / brittle bones; Facial hair / voice deepening; Urinary problems / infections / incontinence; More abdominal fat deposited / weight gain; Hair thinning; Fall in progesterone / fall in LH / fall in oestrogen; Increased chance of CHD / same risk as in men ; 	2 max	<p>Allow infertility</p> <p>Allow enters menopause</p> <p>Allow dry skin</p>

10 (c) (i)	<ol style="list-style-type: none"> 1. FSH levels vary throughout menstrual cycle; 2. Need to standardise / to make (valid) comparisons / to remove a variable / to see effect of alcohol / caffeine (rather than effect of hormone level) 	2	Do NOT allow incorrect variation
10 (c) (ii)	<ol style="list-style-type: none"> 1. SD makes use of <u>all</u> values / shows spread about the mean; 2. Range = just extreme values; 3. Extremes could be anomalous / atypical / SD is more representative; 4. SD enables statistics test; 	3 max	<ol style="list-style-type: none"> 1. Ignore reference to 'range' about mean 3. Allow 'outliers' <p>Allow purpose of a stats test – e.g. to measure significance of difference / to see if variation is due to chance</p>
10 (d) (i)	No (significant) difference / any difference is due to chance / caffeine has no effect;	1	

10 (d) (ii)	<p>For:</p> <ol style="list-style-type: none"> 1. Increased caffeine → increased FSH / positive correlation <u>AND</u> increased alcohol → decreased FSH / negative correlation ; <p>Against:</p> <ol style="list-style-type: none"> 2. But stats. test shows differences are not significant / SDs overlap / are due to chance; 3. Stats. test indicates should accept null hypothesis; 4. Some groups / one group very small / overall sample (93) too small; 5. Small group size may be non-representative / atypical / give non-reliable stats. / lacks validity; 6. Same women in both investigations / there are 2 independent variables; 7. Some results from the 2 investigations may 'cancel out'; 8. If consumption were increased more then may show a significant effect / amounts of substances used in current investigation too small; 9. Only one investigation / need to repeat; 10. Size / type of alcoholic 'drinks' may vary / were not standardised; 11. Possibly unreliable reporting by women of their level of consumption; 12. Other confounding variable(s) were not controlled / named example – e.g. BMI / race / diet / exercise / genetic factors / age; 	5 max	<p>Max 4 if no point 'for'</p> <p>Accept correctly identified as alcohol ≥ 4 / caffeine ≥ 300</p>
Total		25	