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Mark Scheme (Results)

Summer 2014

GCE Biology (6BI05)
Paper 05

Unit 5: Energy, exercise and coordination

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.

( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Mark
1(a)(i)	A ;	(1)

Question Number	Answer	Mark
1(a)(ii)	C ;	(1)

Question Number	Answer	Mark
1(a)(iii)	B ;	(1)

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	1. increased risk of obesity / eq ; 2. (coronary) heart disease / CHD / eq ; 3. diabetes / eq ; 4. high blood pressure / strokes ; 5. osteoporosis ;	1 ACCEPT overweight 2 ACCEPT build-up of cholesterol in {arteries / blood vessels}, CVD, atheroma 5 ACCEPT decrease in bone density	(2)

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	1. wear and tear on joints / eq ; 2. suppression of immune system / susceptibility to { respiratory tract infections / eq} / eq ;	1 ACCEPT damage to joints, ligaments, osteoarthritis, arthritis, wearing away of cartilage, stress fractures, named e.g. tennis elbow, RSI must be qualified 2 ACCEPT URT for upper respiratory tract, infections of the airways, reduced numbers of white blood cells IGNORE asthma	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	1. identical twins (agreement) is greater / eq ; 2. credit correct manipulation of the data e. g. {41% more / 2.4x as much / 141% higher / eq} agreement than non-identical twins ; 3. idea that alleles are involved ; 4. idea that non-identical have genetic differences ; 5. idea that because less than 100% then some other factor is involved ;	ACCEPT converse where appropriate 2. ACCEPT 41% difference 3. ACCEPT gene alternatives 3 and 4 IGNORE genes / DNA unqualified 4. ACCEPT identical twins are genetically the same	(4)

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	idea that there is less of a gap between the results ;	ACCEPT expressed as numbers, results similar (to each other), identical twin result is lower, non-identical higher	(1)

Question Number	Answer	Additional Guidance	Mark
2(b)	1. idea that active areas have more {oxygen / oxygenated blood} ; 2. active areas involved in face recognition will be identified / eq ; 3. idea of level of brain activity between identical twins and non identical twins is compared ; 4. to offer supportive evidence / improve validity of study ; 5. idea that fMRI shows brain activity in real time ; 6. idea of high resolution ; 7. comment on safety / eq ;	3. areas more active / more oxygenated blood flowing to areas in identical twins compared with non-identical twins 3. idea of {more / eq} areas showing activity in common in identical twins than non-identical 5. IGNORE 3D image 6. ACCEPT more detail 7. fMRI does not use X rays	**(4)**

Question Number	Answer	Additional Guidance	Mark
3(a)	1. idea that (some) have less myoglobin present ; 2. less blood / fewer red blood cells / less haemoglobin ; 3. as fewer capillaries present / eq ; 4. idea that respiration is (mainly) anaerobic ;		(2)

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	negative feedback ;	ACCEPT -ve feedback, biofeedback is negative	(1)

Question Number	Answer	Additional Guidance	Mark
***3(b)(ii)**	(QWC – spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. idea that low pH is due to acid in the blood ; 2. *lactate* taken to *liver* / eq ; 3. reference to oxygen debt / EPOC ; 4. used to convert *lactate* back to *pyruvate* ; 5. with production of *reduced* NAD / eq ; 6. {*lactate* / *pyruvate*} converted to *glucose* / *glycogen* ; 7. *pyruvate* into *mitochondria* ; 8. idea of *chemoreceptors* detecting change in pH ; 9. idea of response e.g. increased { nerve impulse rate from *medulla* / breathing rate / heart rate} ; 10. (dissolved) CO_2 from blood (*diffuses*) into *alveoli* / eq ;	QWC emphasis is spelling ACCEPT *lactic* acid for *lactate* throughout and *pyruvic* acid for *pyruvate* 1. Accept for acid: *lactic acid*/*lactate*/(dissolved) CO_2 5. ACCEPT $NADH_2$ and NADH + H^+ 7. ACCEPT *lactate*, *matrix* as equivalent to mitochondria	**(5)**

Question Number	Answer	Additional Guidance	Mark
3(b)(iii)	1. reference to arterioles ; 2. muscles contracting to restrict diameter / eq (in shunts) ; 3. muscles relaxing to increase diameter / eq (of arterioles) ; 4. to redirect blood {away from deeper arterioles / into surface arterioles} / eq ; 5. to increase blood flow { into capillaries / towards surface } / eq ; 6. (so more heat lost) through radiation ;	IGNORE ref to relaxation of hair erector muscles 2. ACCEPT vasoconstriction 3. ACCEPT muscles relax to dilate arteriole ; 3. ACCEPT vasodilation 4. ACCEPT shunt vessels 5. More blood enters = to increase blood flow	**(4)**

Question Number	Answer	Additional Guidance	Mark
4(a)	1. mice of different mass / eq ; 2. idea of concentration is a controlled variable ; 3. idea of increases validity of investigation or conclusions ; 4. maybe harmful in high doses / eq ;	ACCEPT converse statement where appropriate 1. IGNORE ref to diff sizes unqualified 2. to overcome effect of {lighter mice receiving proportionately a higher dose / heavier mice receiving proportionately a lower dose} / to keep concentration per kg of mouse constant ; 3. ACCEPT so comparisons can be made 4. ACCEPT concentration for dose	(3)

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	1. increases the ratio; 2. by { 0.3 / 17.6%} ; 3. inner membrane is larger / eq ;	1. ACCEPT ratio is higher 2. ACCEPT 18% 3. ACCEPT increases the surface area of inner membrane ACCEPT converse IGNORE it is smaller	(2)

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)		ACCEPT converse where appropriate	
	1. idea that fatigue may be due to less ATP ;	1. ACCEPT running out, running short	
	2. inner membrane is the site of {electron transport chain / oxidative phosphorylation / eq} ;	2+3 ACCEPT crista for inner membrane	
	3. {more inner membrane / greater inner surface area} then more electron transport chain / eq ;	3. ACCEPT more aerobic respiration	
	4. more ATP made / eq ;	4. ACCEPT idea that more ATP present/available	
	5. detail of ATP synthesis e.g. ref to chemiosmosis, H^+ down electrochemical gradient through ATP synthase ;	5. This mp is independent of quantity	
	6. (so) delays onset of fatigue / eq ;	6. ACCEPT ref to muscles can contract for longer	
	7. by 34 seconds in {group A / those fed epicatechin} ;	7. gains Mp6 as well if states comparison e.g. 34s longer to fatigue	
			(5)

Question Number	Answer	Mark
5(a)(i)	B (between 12 and 15 hours) ;	(1)

Question Number	Answer	Mark
5(a)(ii)	D (phytochrome) ;	(1)

Question Number	Answer	Additional Guidance	Mark
5(a)(iii)	any two of the following standardised: water / eq mineral ion concentrations / eq light intensity / eq wavelength of light CO_2 concentration, temperature pH soil type ;	IGNORE seed ACCEPT named mineral ion	(2)

Question Number	Answer	Additional Guidance	Mark
5(a)(iv)	idea of using shorter time intervals e.g. 1 hour intervals ;	ACCEPT a description e.g. repeat with 12 hours of light, 13 hours, etc Ignore ref to more data collected unqualified	(1)

Question Number	Answer	Additional Guidance	Mark
5(b)	any one from: temperature water availability the {wavelength / quality} of light intensity of light {edaphic / named edaphic} factor ;	IGNORE ref to pollinators	(1)

Question Number	Answer	Additional Guidance	Mark
5(c)(i)	outer segment / internal membranes / inner membranes / vesicles ;	IGNORE ref to top, end, outer layer	(1)

Question Number	Answer	Additional Guidance	Mark
5(c)(ii)	<table><tr><th rowspan="2">Description</th><th colspan="3">Statement</th></tr><tr><th>Opsin binds to the rod cell membrane</th><th>Rhodopsin bleaches</th><th>ATP used</th></tr><tr><td>Rhodopsin responding to light</td><td>✓</td><td>✓</td><td>×</td></tr><tr><td>Rhodopsin being reset</td><td>×</td><td>×</td><td>✓</td></tr></table> Any two correct for 1 mark ;	IGNORE blank boxes IGNORE hybrid tick/crosses (✓)	(3)

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional Guidance</th><th>Mark</th></tr>
<tr><td>6(a)</td><td>
<table>
<tr><th>Labelled structure</th><th>Name of structure</th><th>One function</th></tr>
<tr><td>A</td><td>Medulla (oblongata) ;</td><td>Controls {breathing / heart / eq} ;</td></tr>
<tr><td>C ;</td><td>Cerebral hemisphere/ cerebrum / frontal cortex ;</td><td>Feel emotions</td></tr>
</table>
</td><td>For A ACCEPT involuntary muscles or named e.g. swallowing, vomiting, sneezing
IGNORE brain stem

For cerebrum, reject cerebellum
For cerebrum, accept frontal lobe/prefrontal / cerebral cortex</td><td>(4)</td></tr>
</table>

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	1. idea that cuts at a specific sequence of bases ; 2. idea of (generates) sticky ends ; 3. so easier to join together / eq ;	1. ACCEPT DNA sequence 3. ACCEPT to produce {same / complementary / eq} sticky ends (in plasmid and (human) gene)	(2)

Question Number	Answer	Additional Guidance	Mark
6(b)(ii)	1. the chemical could be a {transcription factor / hormone} ; 2. idea of interaction at (bacterial) cell (surface) membrane ; 3. idea of transcription factor being activated ; (e.g. transcription initiation complex formed, binds to transcription factor) or counters inhibitor ; 4. ref to promoter region ; 5. idea of transcription occurs e.g. RNA polymerase binds, mRNA produced ;	2. ACCEPT binds to cell surface membrane/passes through 3. ACCEPT triggers secondary messenger to be released {into cytoplasm/from (inner side of) membrane} 5. NOT DNA polymerase	**(3)**

Question Number	Answer	Additional Guidance	Mark
6(b)(iii)	(ribosome has) larger and smaller subunit / (ribosomal) protein and rRNA ;	ACCEPT ref to 2 subunits ACCEPT 30S and 50S subunits	**(1)**

Question Number	Answer	Additional Guidance	Mark
6(b)(iv)	1. larger lumen so easier to put into blood / eq ; 2. (less muscle / thinner wall) so easier to penetrate / eq ; 3. (blood) pressure less so less damage to vein / eq ; 4. idea that vein is easier to find;	ACCEPT converse when appropriate IGNORE ref to 'going to the heart' 3. ACCEPT (blood) pressure less so less blood loss 4. ACCEPT nearer the skin surface/easier to access	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(a)	1. involves prophase, metaphase, anaphase and telophase ; 2. idea that produces two nuclei ; 3. idea that these are genetically identical to original ;	IGNORE ref to 46 chromosomes unqualified IGNORE ref to body cells/somatic cells unqualified 1. NOT if cytokinesis or interphase included as part of mitosis 2. ACCEPT produces two cells 3. ACCEPT parental ACCEPT clones (of parent) IGNORE repair, growth, asexual reproduction	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(b)	1. (SAN) is myogenic / description given ; 2. electrical activity from SAN causes atria to contract / eq ; 3. idea that activity of SAN can be changed by nerve impulses e.g controlled by medulla ; 4. credit detail of nervous control e.g. more impulses from accelerator increases heart rate ;	4. ACCEPT more { impulses from sympathetic / noradrenaline} increases heart rate more {impulses from vagus / more impulses from parasympathetic / acetylcholine} decreases heart rate	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(c)	1. idea that lactase gene {activated / transcribed} ; 2. (synthesis of) lactase / eq ; 3. hydrolysis of lactose / glycosidic bonds broken ; 4. to produce glucose AND galactose ;		**(3)**

Question Number	Answer	Additional Guidance	Mark
7(d)	1. idea that a better model than guinea pigs or mice ; 2. idea of animal rights ; 3. easy to culture / eq ; 4. (HeLa cells) susceptible to disease / HPV / eq ;	1. ACCEPT ref to only HeLa {cells/DNA} are human 2. ACCEPT {fewer / no} ethical issues welfare of animals 3. ACCEPT cheaper (as continual supply)	**(2)**

Question Number	Answer	Additional Guidance	Mark
* 7(e)	(QWC – spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. idea that {motor neurone / cell body / nucleus} is destroyed ; 2. depolarisation does not occur in the neurone / (insufficient so) no action potential set up in the neurone ; 3. detail of (depolarisation / action potential) not occurring in neurone e.g. Idea Na^+ does not diffuse into neurone ; 4. {neurotransmitter / named neurotransmitter} not{released / produced / eq} at junction with muscle / eq ; 5. detail of lack of neurotransmitter release e.g. vesicles (containing neurotransmitter) do not {move / fuse} with {presynaptic membrane / eq} / eq ; 6. Ca^{2+} not released into muscle cytoplasm ; 7. Ca^{2+} not released from sarcoplasmic reticulum ; 8. no Ca^{2+} to {activate / eq} troponin ; 9. idea that muscle does not contract ;	QWC emphasis is clarity of expression 1. Accept idea of damage to myelin sheath/Schwann cells 3. ACCEPT Na^+ / cation channels {non-functional / eq} 4. ACCEPT {neurotransmitter / named neurotransmitter} not{released / produced / eq} at {motor neurone presynaptic membrane / motor end plate} 6. ACCEPT Ca^{2+} not released into sarcoplasm	**(6)**

Question Number	Answer	Additional Guidance	Mark
7(f)		NB If candidates consider viral genetic material in terms of DNA produced from RNA then still works	
	1. contains basis / eq ;	1. ACCEPT both have (4) bases / nucleotides	
	2. contain phosphate (groups) ;		
	3. have a pentose sugar ;	3. ACCEPT 5C sugar	
	4. reference to phosphodiester bonds ;	4. ACCEPT phosphoester	
	5. idea of discrete strands ;	5. ACCEPT linear	**(3)**

Question Number	Answer	Additional Guidance	Mark
7(g)	1. smooth shown as dominant / wrinkled shown as recessive e.g. use of upper and lower case ;	these could be gleaned from gametes	
	Parental generation:		
	2. both types shown as homozygous ;		
	F1:		
	3. all shown as heterozygous ;		
	F2:		
	4. genetic diagram to show that 75% are smooth / 25% are wrinkled ;	4. diagram should show genotypes	**(4)**

Question Number	Answer	Additional Guidance	Mark
7(h)	1. all the {DNA / eq} found in {a human / the human species / eq} ; 2. idea of genes {on different chromosomes / different positions on same chromosome} ;	1. ACCEPT all the bases / introns and exons for DNA eq ACCEPT population for species 2. ACCEPT locus/loci for position	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(i)	1. product (of p53 gene) {stops / eq} development of tumour cells / eq OR product {stops / regulates} progression {of cell cycle / towards mitosis} ; 2. acts as an inhibitor of {transcription / protein synthesis / eq} / eq ; 3. idea that {DNA / eq} repair ; 4. idea that leads to apoptosis ;	1. ACCEPT product stops tumour cells growing/ dividing 1. ACCEPT keeps it in interphase / named mitotic stage / interferes with mitosis progress 4. ACCEPT shortens telomeres	**(2)**

Question Number	Answer	Additional Guidance	Mark
7(j)	1. protein / glycoprotein ; 2. reference to this being CD4 ; 3. found on cell (surface) membrane / eq ; 4. that acts as a {receptor / named receptor} for HIV / eq ;	1. IGNORE ref to haemoglobin 4. ACCEPT receptor for gp120	**(2)**

Question Number	Answer	Mark
7(k)	200 (nucleotides) ;	**Clerical (1)**

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