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General Certificate of Education
June 2010

Biology BIOL5

Control in cells and in organisms

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.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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.

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Although specific marks are not awarded in questions 1 – 7, marks awarded will take in to account the quality of written communication. Credit will only be awarded where candidates have presented information clearly and coherently and have used the specialist vocabulary indicated in the mark scheme for this unit. Specific references to quality of written communication are included in the Comments column in this mark scheme.

Question	Marking guidance	Mark	Comments
1(a)(i)	Taxis;	1	Ignore references to positive and negative, and prefixes such as photo- Accept taxes/tactic Allow phonetic spelling
1(a)(ii)	Moves towards stimulus/towards light;	1	Direction must be correct.
1(b)	Gravity; Antennae involved; Doesn't show light is involved/doesn't respond to light as they are unable to see/as eyes are covered;	3	Accept geotaxis
1(c)	Helps them to leave the soil/ground/reach the surface; Disperse/produce new colonies; Avoid competition;	2 max	

<table>
<tr><th>Question</th><th>Marking guidance</th><th>Mark</th><th>Comments</th></tr>
<tr><td>2(a)</td><td><table>
<tr><td>DNA</td><td>✓</td><td>2</td></tr>
<tr><td>mRNA</td><td>x</td><td>1</td></tr>
<tr><td>tRNA</td><td>✓</td><td>1</td></tr>
</table></td><td>2</td><td>One mark for each correct column
Regard blank as incorrect in the context of this question
Accept numbers written out: two, one, one</td></tr>
<tr><td>2(b)(i)</td><td>Marking principles
1 mark for complete piece transcribed;

1 mark for complementary bases from sequence transcribed;</td><td>2</td><td>Correct answer
UGU CAU GAA UGC UAG

but allow 1 mark for complementary bases from section transcribed, providing all four bases are involved</td></tr>
<tr><td>2(b)(ii)</td><td>Marking principle
1 mark for bases corresponding to exons taken from 2(b)(i)</td><td>1</td><td>Correct answer
UGU UGC UAG
If sequence is incorrect in 2(b)(i), award mark if section is from exons. Ignore gaps.</td></tr>
</table>

Question	Marking guidance	Mark	Comments
3(a)	(Ion) channel proteins open; Sodium in; Changes membrane potential/makes inside of axon less negative/positive/depolarisation/ reaches threshold; More channels open/positive feedback;	3 max	Accept other phrases for ion channel proteins providing that it is clear that it is something through which ions pass. Reject carrier. First marking point relates to opening. Third point must relate to more (channels) opening.
3(b)	Potassium channels open; Potassium out; Sodium channels close;	3	Do not penalise candidate who refers to sodium or potassium. Ions are mentioned in question. Reject pump
3(c)	Pump/active transport/transport against concentration gradient; Of sodium from axon/sodium out/of potassium in;	2	Do not penalise candidate who refers to sodium or potassium. Ions are mentioned in question

Question	Marking guidance	Mark	Comments
4(a)	LH rises; Increase in progesterone; Progesterone inhibits LH; (Then) LH falls;	3 max	The question requires explanation of control of LH Answer must relate to progesterone and LH. General answers should not gain credit here. Points 1 and 2 must relate to graph so reject secretes, makes etc
4(b)(i)	Corpus luteum; Progesterone produced;	2	Do not credit references to progesterone being needed.
4(b)(ii)	A lot of/ rise in oestrogen; Associated with follicle growth/development/ LH surge; ***OR*** Fall in oestrogen; Follice breaks down; Surge in LH (before ovulation); (LH) stimulates ovulation/release of egg; ***OR*** Fall in LH (after ovulation); Inhibited by progesterone;	4	

Question	Marking guidance	Mark	Comments
5(a)	RNA polymerase;	1	DNA polymerase is incorrect Ignore references to RNA dependent or DNA dependent Allow phonetic spelling
5(b)(i)	(Receptor/transcription factor) binds to promoter; Stimulates RNA polymerase/enzyme X; Transcribes gene/increase transcription;	2 max	
5(b)(ii)	Other cells do not have the/oestrogen/ ERα receptors;	1	But do not accept receptors in general.
5(c)	Similar shape to oestrogen; Binds receptor/prevents oestrogen binding; Receptor not activated/will not attach to promoter/no transcription;	2 max	Accept alternative Complementary to oestrogen; Binds to oestrogen; Will not fit receptor;

Question	Marking guidance	Mark	Comments
6 (a)	Will replace themselves/keep dividing/replicate; Undifferentiated/can differentiate/develop into other cells/totipotent/multipotent/pluripotent;	2	 Accept tissues
6 (b)	Reverse transcriptase;	1	Allow phonetic spelling
6(c) (i)	Alters base/nucleotide sequence/causes frame shift; Different sequence of amino acids in polypeptide/protein/primary structure; Alters tertiary structure;	2 max	Accept any reference, such as adding bases, to changing the base sequence of the gene. Reject deletion/substitution. Idea of sequence essential so not makes different amino acids. Accept answers involving stop/start codons and effect on protein.
6 (c) (ii)	Affects tumour suppressor gene; Inactivates (tumour suppressor) gene; Rate of cell division increased/tumour cells continue to divide;	2 max	Ignore answers relating to oncogenes.May gain third point.
6 (d)	Yes SCID patients unlikely to survive/quality of life poor unless treated; Cancer that develops is treatable/only affects 25%/five children; No Risk of developing cancer is high/25%; Cancer may recur/may not be treated successfully in future/only short time scale so more may develop cancer;	2 max	No mark for yes or no. Marks are for supporting argument based on biological reasoning. Accept any points

Question	Marking guidance	Mark	Comments
7 (a) (i)	Contains more/large amount of succinic dehydrogenase; (Slow fibres) have lots of mitochondria/ (slow fibres) respire aerobically;	2	Accept "the enzyme" since only one being discussed
7 (a) (ii)	Near edge/outside; Short distance for diffusion of oxygen/Allows rapid diffusion/more diffusion of oxygen; Oxygen used by mitochondria/electron transfer system in mitochondria;	3	 Ignore glucose Accept carbon dioxide Accept effect of carbon dioxide on cell e.g. carbon dioxide changes pH/carbon dioxide affects enzymes
7 (b) (i)	Measure with graticule/eyepiece scale; Calibrate against something of known size: ***OR*** Estimate/measure field diameter with a scale; Estimate number of fibres to cover diameter;	2	Q Last point could be a calibrated slide/haemocytometer/red blood cell or reasonable alternative Accept Mount on ruler/haemocytometer/graph paper; use this to measure size; Note position of ruler must be specified and correct
7 (b) (ii)	Equivalent measurements taken; At random to avoid bias/avoid choice of particular fibres; Large number to be representative/minimise effect of extremes/of anomalies;	2 max	As a stained slide is provided reject references to safety. Ignore reliable

Question	Marking guidance	Mark	Comments
8 (a) (i)	Eaten; Containing carbohydrate/sugar; Glucose absorbed from intestine/into blood; Long time after insulin injection/needs more insulin/has not taken insulin; Does not convert glucose to glycogen/glucose not taken up from blood;	2 max	
8 (a) (ii)	Shows positive correlation/directly proportional; A range of results for a particular value/values (for different colours) overlap; Urine test only an arbitrary scale/not directly related to concentration/colour is subjective/few colour values;	3	Accept description
8 (b)	Glycogen to glucose/glycogenolysis; By activating enzymes; Gluconeogenesis;	2 max	If name incorrect this disqualifies. Allow explanation in terms of glucose from a non-carbohydrate/named non-carbohydrate source.

Question	Marking guidance	Mark	Comments
9 (a) (i)	To cut the DNA;	1	Reject breakdown, cutting out
9 (a) (ii)	To separate the (pieces of) DNA;	1	
9 (b)	Complimentary base sequence/complementary DNA; Binds to both (haplotypes); Label would show up in both;	2 max	Idea of complimentarity required
9 (c) (i)	Bottleneck; Present population descended from small number/fewer than 100/1970 population; With small number few haplotypes/little genetic variation /little genetic diversity/few base sequences;	2 max	
9 (c) (ii)	All descended from Italian wolves/founder effect;	1	Reject same wolves. Must convey idea of descendents Accept there would be more if larger samples
9 (d) (i)	Y chromosome inherited/comes from male parents/only found in males;	1	
9 (d) (ii)	Mitochondria in egg/female gamete/no mitochondria come from sperm/male gamete;	1	
9 (e) (i)	Allows comparison; Different (sized) areas covered;	2	
9 (e) (ii)	Wolves do not eat all of prey animal/do not eat (large) bones/skin; Inedible parts make up different proportions/wolf eats different proportions;	2	

9 (f)	Limited by food/prey; As prey increases so do wolf numbers/positive correlation; Large range so other factors involved;	2 max	

Introduction

The essay is intended to assess a candidate's ability to bring together principles and concepts from different areas of biology, express ideas clearly and logically and use appropriate specialist vocabulary. It also provides an opportunity for candidates to demonstrate that they have met the ideals of stretch and challenge required to gain an A* grade. Because of this, essays are deliberately worded such that they allow candidates the freedom to respond in a variety of ways. Candidates are offered a choice of essay and it is important that the final mark reflects the quality of work, not the choice of essay.

The marking scheme considers four skill areas

S Scientific content
B Breadth of knowledge
R Relevance
Q Quality of written communication

In practice, this means that we are looking for

- evidence of knowledge and understanding in keeping with an A-level course of study
- selection of material relevant to the title, and drawn from different areas of the specification
- the ability to present an argument coherently and logically, using appropriate biological language.

Each of the skill areas is considered and matched against a series of descriptors to give the total mark. Notes are provided to assist in the application of the mark scheme to specific essay titles. Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is likely that it will. The notes must therefore be seen as no more than guidelines providing an indication of areas of the specification from which suitable factual material may be drawn.

Plans should be considered in awarding marks. Examiners are instructed to ignore the plan when reading the essay. They should then return to the plan. If further credit can be awarded because of material contained in the plan, this is done. Under no circumstances can a candidate lose credit for incorrect information contained in the plan.

Assessing scientific content

In assessing this area, note the following

- The maximum mark is 16
- Only even marks are awarded (16, 14, 12 etc). Intermediate marks (15, 13, 11 etc) cannot be used. This restricts examiners' choice and increases the reliability of the marking.
- Descriptors are given for 16, 12, 8, 4 and 0 marks. Work is matched to these descriptors. If a particular essay is considered to fall between the criteria for two descriptors an intermediate even mark (14, 10, 6 etc) is awarded.
- Candidates have approximately 40 minutes to plan and write their essays. It is important that candidates who allocate their time wisely should be able to gain maximum marks for what it is possible to write in this time. In practice, this amounts to between three and four sides of normal handwriting.
- Essays do not have to be perfect to gain higher marks. The amount of detail required by the specification should always be born in mind. Average A-grade candidates should be able to achieve 12 marks so it would not be unreasonable to expect around 15% of candidates to achieve such a mark.

Category	Mark	Descriptor
Exceptional	**16**	Material accurate and of a high standard throughout, reflecting a sound understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. In addition, there are some significant references to material that indicates greater depth or breadth of study.
	14	
Good	**12**	Most of the material is of a high standard reflecting a sound understanding of the principles involved and a knowledge of factual detail generally in keeping with an A-level course of study. Material accurate and free from fundamental errors, but there may be minor errors that detract from the overall accuracy.
	10	
Average	**8**	A significant amount of the content is of appropriate depth. Shows a sound understanding of most of the principles involved and knowledge of factual detail generally in keeping with a programme of A-level study. Most of the content is accurate with few fundamental errors.
	6	
Poor	**4**	Material presented is largely superficial with only occasional content of appropriate depth. Shows some understanding of some of the basic principles involved. If greater depth of knowledge is demonstrated, then there are fundamental errors.
	2	
Unacceptable	**0**	Such material as is relevant is both superficial and inaccurate. Fails to demonstrate evidence of knowledge in keeping with a programme of A-level study.

In marking scientific content, the first decision to be made is the category into which the essay falls. Examiners will discuss a range of specimen scripts at the standardising meeting that help them to make this decision. In general:

An exceptional essay

- reflects the detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- is free from fundamental errors
- maintains appropriate depth and accuracy throughout
- includes two or more paragraphs of material that indicates greater depth or breadth of study

A good essay

- reflects the detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- is free from fundamental errors
- maintains appropriate depth and accuracy throughout

An average essay

- contains a significant amount of material that reflects the detail that could be expected from a knowledge and understanding of relevant parts of the specification. In practice this will amount to about half the essay.
- is likely to reflect limited knowledge of some areas and to be patchy in quality
- demonstrates a good understanding of basic principles but will contain some errors and evidence of misunderstanding

A poor essay

- contains much material which is below the level expected of a candidate who has completed an A-level Biology course although there will be occasional valid points
- Contains fundamental errors reflecting a poor grasp of basic principles and concepts

Having decided on the basic category, examiners may award the mark above or below this according to whether the candidate has exceeded the requirements or just failed to meet them.

Assessing breadth

In assessing this area, note the following

- The maximum mark is 3
- The mark scheme will include notes which indicate how the marks for breadth should be awarded for individual essays. In determining the mark awarded for breadth, content should ideally be taken from each of the areas specified if maximum credit is to be awarded. Where the content is drawn from two areas, two marks should be awarded and where it is only taken from a single area, one mark should be awarded. However, this should only serve as a guide. The list is not exhaustive and examiners are prepared to offer credit for the incorporation of relevant material from other areas of study.
- Marks are awarded independently. Therefore it is possible for a candidate to gain full credit for breadth even though much of the essay is below the standard expected.

The general descriptors in the table below form the basis for awarding the mark for breadth.

Mark	Descriptor
3	A balanced account making reference to most of the areas that might realistically be covered in an A-level course of study
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with almost all material based on a single aspect
0	Material entirely irrelevant

The descriptors should be interpreted using these guidelines.

Essay A **Carbon dioxide may affect organisms directly or indirectly. Describe and explain these effects**.

Section	
	Carbon dioxide affects the physiology of organisms
1.4	Pulmonary ventilation and the mechanism of breathing
4.3	Light-independent reaction of photosynthesis. Limiting factors
5.1	Role of chemoreceptors in controlling heart rate
	The direct effects of increasing carbon dioxide concentration
4.6	Respiration, photosynthesis and human activity giving rise to short-term fluctuations and long-term change. Yield of crop plants Carbon cycle
	Indirect effects of increasing carbon dioxide concentration
4.6	Role of carbon dioxide in producing global warming; Life cycles and number of insect pests; Distribution of animals and plants;
1.2	Effect of temperature on enzymes;

Essay B **The causes of disease in humans**

Section	
	Pathogens
1.1	Pathogens include bacteria, viruses and fungi
	Pathogens cause disease by damaging cells and producing toxins
1.3	Cholera bacteria produce toxins resulting in diarrhoea
1.4	Symptoms and transmission of pulmonary tuberculosis
2.10	Horizontal gene transmission and MRSA
	Lifestyle
1.1	Risk factors associated with cancer and coronary heart disease
1.4	The effects of fibrosis, asthma and emphysema on lung function
1.5	The biological basis of heart disease
	Genetics
2.2	Differences in bases may lead to non-functional enzymes
2.5	Relationship between the cell cycle and cancer
5.6	Proto-oncogenes and tumour suppressor genes
	Gene mutations

Assessing relevance

In assessing this area, note the following

- The maximum mark is 3
- Marks are awarded independently. Therefore it is possible for a candidate to gain full credit for relevance even though much of the essay is below the standard expected.
- Be reasonable in considering material presented in the introduction to the essay. Many candidates will incorporate material of marginal relevance in the opening paragraph.
- Essays which are very short (under a page in length) should not be awarded 3 marks. Consideration should be give to awarding a maximum of 1 or 2 marks according to the amount written.

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for use of marginally relevant introductory material
2	Material generally selected in support of title but some of the main content of the essay is only of marginal importance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

In essay (a) do not penalise references to respiration and carbon dioxide as irrelevant.
In essay (b) do not penalise references to antibiotic resistance as irrelevant.

Assessing quality of written communication

In assessing this area, note the following

- The maximum mark is 3
- Marks are awarded independently. However, it is unlikely that a candidate will gain full credit for the quality of written communication without a substantial proportion of the essay content being of the standard expected.
- Essays which are very short (under a page in length) should not be awarded 3 marks. Consideration should be give to awarding a maximum of 1 or 2 marks according to the amount written.
- Be reasonable in considering material presented at the end of the essay. Some candidates will be rushed and may incorporate information in note form.

Mark	Descriptor
3	Material is logically presented in clear English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally constructed poorly and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

Definition of symbols to be used when marking the essay

Essay symbols

V Valid
X Wrong
+ Over and above A level
Q Poor QWC
N Irrelevant

Category	Mark	Scientific Content Descriptor
Exceptional	**16**	Material accurate and of a high standard throughout, reflecting a sound understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. In addition, there are some significant references to material that indicates greater depth or breadth of study.
	14	
Good	**12**	Most of the material is of a high standard reflecting a sound understanding of the principles involved and a knowledge of factual detail generally in keeping with an A-level course of study. Material accurate and free from fundamental errors, but there may be minor errors that detract from the overall accuracy.
	10	
Average	**8**	A significant amount of the content is of appropriate depth. Shows a sound understanding of most of the principles involved and knowledge of factual detail generally in keeping with a programme of A-level study. Most of the content is accurate with few fundamental errors.
	6	
Poor	**4**	Material presented is largely superficial with only occasional content of appropriate depth. Shows some understanding of some of the basic principles involved. If greater depth of knowledge is demonstrated, then there are fundamental errors.
	2	
Unacceptable	**0**	Such material as is relevant is both superficial and inaccurate. Fails to demonstrate evidence of knowledge in keeping with a programme of A-level study.

Mark	Beadth Descriptor
3	A balanced account making reference to most of the areas that might realistically be covered in an A-level course of study
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with almost all material based on a single aspect
0	Material entirely irrelevant

Mark	Relevance Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for use of marginally relevant introductory material
2	Material generally selected in support of title but some of the main content of the essay is only of marginal importance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

Mark	Quality of written communication Descriptor
3	Material is logically presented in clear English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally constructed poorly and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.