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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Biology 6416
Specification B

BYB678/B Applying Biological Principles

Mark Scheme

2006 examination – June series

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.

General Guidance for the Mark Scheme

The following conventions are used in the mark scheme:

- A semicolon (;) separates each mark point
- An oblique stroke (/) separates alternatives within a mark point
- Underlining of a word or phrase means that the term must be used by candidates
- Brackets are used to indicate contexts for which a mark point is valid, but which may just be implied by a candidate's answer
- '*Accept'* and '*reject*' show answers which should be allowed or not allowed.
- Additional instructions may be shown in *italics*

The scheme shows the minimum acceptable answer(s) for each mark point - better, more detailed, or more advanced answers are always accepted, provided that they cover the same key ideas. Occasionally, a candidate will give a biologically correct answer that has not come up at standardising. If it is equivalent in standard to the mark scheme answers, it may be credited.

In some cases a mark may be awarded for understanding of a general principle, even though the detailed mark points on the scheme have not been made. This will be indicated on the mark scheme.

All mark points are awarded independently, unless a link between points is specified in the scheme.

Converse answers are normally acceptable, unless the wording of the question rules this out.

Disqualifiers

A correct point is disqualified when the candidate contradicts it in the same answer.

The list rule

When a question asks for a specific number of points, and the candidate gives more, any wrong answer cancels a correct answer. For example, if a question asks for two points and three answers are given, two correct and one clearly wrong, the mark awarded is one, whatever the order of the answers.

Valid points from **diagrams** are credited, if they are not duplicated in the text.

Where a question asks for **differences** between X and Y, the mark may be awarded for a feature of X without the converse for Y, if it is absolutely clear which is being referred to.

BYB678/B Applying Biological Principals

Question 1

(a) *two environmental or developmental variables <u>and</u> explanation;*

examples,

all plants of the same age, so same time for cell divisions/differentiation;
all plants given the same watering, so same amount of water for cell expansion;
(reject reference to photosynthesis)
all plants given same light, so same rate of photosynthetic;
same temperature, so enzymes/named metabolic process at optimum temperature;
same named ion/minerals in soil (e.g. nitrate), so same available for a named function, (e.g. amino acid/protein synthesis); 2 max

(b) drying sample in oven (at 100°C);
a desiccator with silica gel;
(then weigh and repeat) until constant mass; 2

(c) count cells using microscope;
count number of cells in cell division/where chromosomes visible;
and then the total number of cells in field of view; 2 max

(d) only cells at tip have ability to divide/cells further back don't divide;
cells further back differentiating/named example of
(accept reference to loss of totipotent cells)
differentiated tissue/too old/reduction in plant hormone;
cell wall too thick/ vacuole too large to allow division; 2 max

(e) new cells added at tip;
cells increase in volume/larger;
increase in length (of cells);
as vacuoles get larger;
due to uptake of water (by osmosis); 3 max

Total 11

Question 2

(a) pupae survive the winter;
conserves fat/energy stores;
(reject reference to pupa feeding)
when no food/plants (for larva/adult);
temperature too cold for survival; 3 max

(b) dark period important;
group B has longer light period than group A but no diapause (so not long light induced);
interruption of dark period in group C leads to no diapause (so uninterupted dark period needed); 3

Total 6

Question 3

(a) genetic variation/ variation in gene/allele(s) in populations for cyanide production;
colder/below 0^{o}C (January) areas, cyanogenic plants die in this cold/acyanogenic survive;
non-cyanogenic allele/gene passed on more often/its frequency increases;
warmer (January) areas cyanogenic plants at advantage, because of less herbivore selection pressure/feeding;
so cyanogenic survive more often to pass on cyanogenic allele/gene. 4 max

(b) large (and equal) number of quadrats in each area;
(reject several)
random sampling method, described;
(accept described 'systematic' method)
percentage cover/point hits per quadrat/count plants;
mean/average value for each area;
statistics test to see if differences significant. 4 max

Total 8

General Principles for marking the Essay:

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

Scientific Content (maximum 16 marks)

Category	Mark	Descriptor
Good	16 14 12	Most of the material reflects a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
Average	10 8 6	Some of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any, fundamental errors. Shows a sound understanding of the key principles involved.
Poor	4 2 0	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.

Breadth of Knowledge (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most areas that might realistically be covered on 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 all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

Relevance (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
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.

Quality of language (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific 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 poorly constructed 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.

Total 25

Guidelines for marking the essay

Introduction

The essay is intended for the assessment of AO4 (Synthesis of knowledge, understanding and skills) and Quality of Written Communication (Sections 6.4 and 6.5 in the specification). Examiners are looking for

- evidence of knowledge and understanding at a depth appropriate to A level
- selection of relevant knowledge and understanding from different areas of the specification
- coverage of the main concepts and principles that might be reasonably be expected in relation to the essay title
- connection of concepts, principles and other information from different areas in response to the essay title
- construction of an account that forms a coherent response
- clear and logical expression, using accurate specialist vocabulary appropriate to A level

Assessing Scientific Content

Maximum 16 marks.
Descriptors are divided into 3 categories: Good (16, 14, 12), Average (10, 8, 6) and Poor (4, 2, 0). Only even scores can be awarded, i.e. not 15, 13, etc.
Examiners need first to decide into which category an essay comes.

A good essay

- includes a level of detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- maintains appropriate depth and accuracy throughout
- avoids fundamental errors
- covers a majority of the main areas that might be expected from the essay title. (These areas are indicated in the mark scheme. Occasionally a candidate may tackle an essay in an original or unconventional way. Such essays may be biased in a particular way, but where a high level of understanding is shown a high mark may be justified.)
- demonstrates clearly the links between principles and concepts from different areas.

Note that it is not expected that an essay must be 'perfect' or exceptionally long in order to gain maximum marks, bearing in mind the limitations on time and the pressure arising from exam conditions.

An average essay

- should include material that might be expected of grade C/D/E candidates
- is likely to have less detail and be more patchy in the depth to which areas are covered, and to omit several relevant areas
- is likely to include some errors and misunderstandings, but should have few fundamental errors
- is likely to include mainly more superficial and less explicit connections

A poor essay

- is largely below the standard expected of a grade E candidate
- shows limited knowledge and understanding of the topic
- is likely to cover only a limited number of relevant areas and may be relatively short
- is likely to provide superficial treatment of connections
- includes several errors, including some major ones

Having decided on the basic category, examiners may award the median mark, or the ones above or below the median according to whether the candidate exceeds the requirements or does not quite meet them.

Marking the essay

In marking scientific content, letters in the margin show each key area covered; these are used to assess the breadth of criteria. A single tick is used to indicate accurate coverage of each significant area, and a double tick to emphasise 'good depth of content.' Errors are indicated with a cross. A squiggly line in the margin is used to highlight irrelevance and 'Q' to highlight poor use of terminology, unclear grammar and inappropriate style.

Specific guidance for assessing Scientific Content and Breadth of Knowledge in Essays

The following provides guidance about topics which might be included in the essays. It is not an exclusive list; the assessment of scientific content does not place restrictions on topics that candidates might refer to, provided they are

- relevant;
- at an appropriate depth for A Level and
- accurate.

It is not expected that candidates would refer to all, or even most, of the topics to gain a top mark; the list represents the variety of approaches commonly encountered in the assessment to the essays. In both essays, topics either from the option modules or beyond the scope of the specification should also given credit where appropriate.

Question 4

The following topics from the specification contain material that could be relevant and used in the essay. It is not expected that candidates would necessarily include all, or most, of the topics suggested. Other apposite points, e.g. from option content, could also be used.

(a) Transfer between organisms:

14.1 food chains and feeding relationships
14.2 carbon cycle
nitrogen cycle (parts of)
10.6 digestion
10.3 cell transport

Transfer to/from the non-living environment

13.2 photosynthesis
13.3 respiration
10.4 exchange surfaces
13.5 (production and) removal of urea
14.5 human activities

From options, e.g.

15.4 agricultural ecosystems

(a) **Transfer of substances containing carbon between organisms and the environment**

Transfer between organisms:

(1) Food chains and feeding relationships (F)

- plants producers
- idea of food chains as feeding relationships
- with transfer energy
- in substances containing carbon

(2) Digestion and absorption – (possible link to bacteria and fungi) (D)

- digestion/hydrolysis of large carbon-containing compounds
- by enzymes
- producing small/soluble compounds
- which can be absorbed

(3) Transport of organic molecules in and out of cells/across exchange surface (possible link to bacteria and fungi) (T)

- organic molecules (including sugars and amino acids) cross cell membranes
- by facilitated diffusion
- active transport
- which requires ATP from respiration
- involving carrier proteins and/or enzymes

Transfer to/from the non-living environment

(4) Carbon cycle (and relevant parts of nitrogen cycle) (C)

- carbon enters biotic by photosynthesis
- leaves biotic by respiration/combustion
- role of bacteria/fungi as decomposers
- of dead organisms/ faeces/ excretory products/urea

(5) Photosynthesis (P)

- light-independent reaction
- carbon dioxide reacts with ribulose bisphosphate
- glycerate 3-P reduced to sugar
- reduced NADP and ATP from light-dependent reaction
- Calvin cycle

(6) Respiration (R)

- link reaction/Krebs cycle
- oxidation of intermediates
- generation of reduced coenzymes
- loss of carbon dioxide

(7) Exchange surfaces - for carbon dioxide
<u>for animals</u> (EA)
<u>and plants</u> (EP)

- large surface area - alveoli - mesophyll cells
- short diffusion pathways - epithelium and endothelium - thin leaves and many stomata
- maintaining diffusion gradient - capillary and respiration - photosynthesis and
- respiration in mesophyll cells (time of day)
- ventilation - breathing - via air spaces in leaf

Breadth of Knowledge

3 marks	four topics - at least one from each set of examples
2 marks	four from one set of topics
	three topics - at least one from each set
1 mark	two topics

The following topics from the specification contain material that could be relevant and used in the essay. It is not expected that candidates would necessarily include all, or most, of the topics suggested. Other apposite points, e.g. from option content, could also be used.

(b) **Cells are easy to distinguish by their shape. How are the shapes of cells related to their functions?**

Epithelial cells in animals

10.2 epithelial cells from small intestine
10.4 epithelial cells of alveoli, gill lamellae

Epidermal cells in plants

10.2 palisade mesophyll cells
10.4 stomatal guard cells
12.4 root hair cells

Reproduction

11.3 differences between egg and sperm cells

Transport of substances in organisms

12.1 red blood cells
endothelial cells of capillaries
12.4 xylem vessels
phloem sieve cells

Nervous coordination

13.6 neurones
rod and cone cells

Muscle

13.8 skeletal muscle

(b) **Animals:**

(1) Epithelial cells - intestinal, alveolar, kidney tubule, gill lamellae (E)
Two examples allowed

As appropriate, relating to transport function(s):

- (collectively) large SA
- flattened - short diffusion pathway
- folded membrane - larger SA for stated function
- podocytes - pores for filtrate formation

(2) Blood - transport (BT)

- red blood cells

- biconcave shape - increase SA for oxygen exchange
- move through capillaries

(3) Blood - exchange (BE)

- endothelial cells of capillaries
- flattened - short diffusion pathway
- fenestrated in glomerulus

(4) Blood – white cells (BS)

- phagocytes/macrophages
- 'amoeboid properties'
- related to movement into tissues/engulfing e.g. bacteria

(5) Nervous system - neurones (and Schwann cells) (N)

- dendrites - make synaptic connection to other neurones
- axon/dendron - carry nerve impulses over long distances
- shapes of relay, motor and sensory
- related to function
- myelin sheath - faster transmission of impulses

(6) Nervous system - receptors - NB could be other than light (R)

- cone/rod cells with distinctive 'heads' - containing pigment
- detect light
- dendrites to synapse with bipolar/ganglion cell(s)

(7) Muscle (M)

- elongated - contain rows of sarcomeres
- leads to contraction in length
- force generated in particular plane
- branched in cardiac - give contraction in more than one plane

(8) Ciliated (C)

- cells lining air passages/oviducts
- push mucus/eggs along
- remove trapped microorganisms/towards uterus

(9) Sperm (S)

- sperm have beating tail/flagellum
- streamlined shape
- help sperm to move
- find egg cell
- acrosome with (digestive/hydrolytic) enzymes
- digest way into egg cell

Plants and any other organisms:

(10) Hair cells – <u>of root</u> (HR)

- root - extension of epidermal cell
- increases SA
- for absorption of water and mineral ions

(11) Hair cells - <u>of leaf</u> (HL)

- leaf - extension of epidermal cell
- reduces air flow/traps air near leaf surface
- reduces water potential gradient for diffusion of water
- reduces water loss by transpiration

(12) Leaf cells (<u>guard cell structure not in specification but they might know and use)</u> (L)

- palisade mesophyll are elongated
- allows more to be packed side by side
- to absorb maximum amount of light for photosynthesis

(13) Transport in xylem and/or phloem (T)

- elongated cells
- xylem vessels no end walls/ phloem sieve cells end plates
- rows end to end to form 'tubes'
- no/less resistance to flow

(14) Bacterial cell's flagellum (B)

- rotates
- pushes against external medium
- moves bacterium

(15) Fungal hyphae (though usually cyncitial) (F)

- hyphae
- grow and branch through substrate
- increasing SA for absorption

Breadth of Knowledge

3 marks	five topics - at least two from each set of examples
2 marks	five from one set of topics
	four topics - at least one from each set
1 mark	three topics