

**Published Mark Scheme for
GCE A2 Biology**

January 2010

MARK SCHEMES (2010)

Foreword

Introduction

Mark Schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16- and 18-year-old students in schools and colleges. The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes therefore are regarded as a part of an integral process which begins with the setting of questions and ends with the marking of the examination.

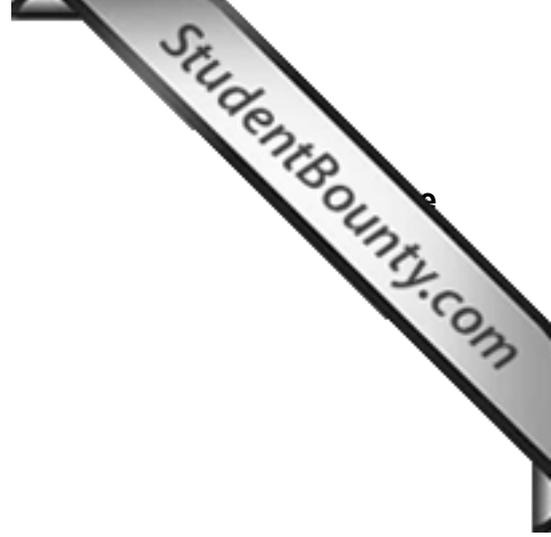
The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

The Council hopes that the mark schemes will be viewed and used in a constructive way as a further support to the teaching and learning processes.

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Specification



Rewarding Learning

ADVANCED
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Biology

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Physiology and Ecosystems

[AB211]

MONDAY 25 JANUARY, AFTERNOON

MARK SCHEME

/ denotes alternative points
 ; denotes separate points
 Comments on mark values are given in bold
 Comments on marking points are given in italics

Section A

- 1** (a) **A** centron/cell body
B Schwann cell/myelin sheath
C axon/axoplasm
D node of Ranvier
Four for [3], Three for [2], Two for [1] [3]
- (b) Arrow away from centron/from left to right; [1]
- (c) Schwann cell (myelin) insulates axon/action potentials (depolarisation) only occur at the nodes of Ranvier;
 the action potentials jump from node to node/saltatory conduction;
Unacceptable phrasing – ‘insulator of impulse’ or ‘impulse cannot travel through myelin sheath’. [2] 6
- 2** (a) **Any two from:**
 • passively from the mother
 • via the placenta
 • in breast milk (especially the colostrum) [2]
- (b) Many babies are no longer receiving the antibodies in the milk/ (low levels in breast milk)/antibodies are not replaced; degradation of the antibodies/antibodies used up;
Unacceptable phrasing ‘antibodies die’ [2]
- (c) The antibodies presence in some babies would destroy the vaccine/ high levels of the antibody inhibits the production of plasma and memory cells;
Unacceptable phrasing – ‘antibodies kill vaccine (antigens)’ [1] 5

- 3 (a) Block shorter than other results; [1]
- (b) **Any four from**
- the agar blocks received auxin from the tips/moves from agar blocks into the decapitated coleoptiles/metal sheet prevents lateral movement of auxin
 - auxin stimulates cell expansion/cell elongation
 - blocks A and B produce the same growth as auxin has diffused equally into blocks A and B/light from above
 - block C produced more growth as there is more auxin available /block D produced the least growth as there is least auxin available
 - most auxin diffuses down the shaded side/less auxin diffuses down the illuminated shade [4]
- (c) Blocks A and B allow comparison/act as a control experiment/ the growth stimulus (production of auxin) is even when light is from above/confirms that lateral illumination influences movement of auxin; [1] 6
- 4 (a) **A** cardiac muscle; branching/intercalated discs/limited striation; [2]
- B** smooth muscle; spindle-shaped cells/single nucleus/no striation; [2]
- C** skeletal/striated/voluntary muscle; striation/multiple nuclei; [2]
- (b) (i) Actin and myosin/or converse; [1]
- (ii) **Any two from**
- the I (light) bands occur where there are actin (thin) filaments only
 - the A (dark) bands occur where there are myosin (thick) filaments
 - actin (thin) and myosin (thick) filaments overlap (within the A-band)
 - each myosin filament is surrounded by six actin filaments (in the region of overlap within the A-band)
 - the H-zone consists of myosin filaments only (at the middle of the A-band) [2] 9

- 5 (a) 62431 as numerator;
 $\div 263970000 \times 100 = 0.024\%$ (0.0237%);
 [consequent to answer above] [2]
- (b) Beef is easier to digest than grass/grass (cellulose) is more difficult to digest;
 more energy from beef is available for human growth as less is lost to
 faeces/less energy from grass is available for cattle as more is lost in
 faeces/cattle use more energy in the digestive process (eg chewing)/
 energy consuming symbiotes in the cows gut; [2]
- (c) (i) Addition of fertilizers to the grassland;
 greater mineral uptake allows plants to build more cellular structures/
 example of a particular ion and what it is used for;
Unacceptable phrasing – ‘nutrients for growth’
or
 Increased drainage of the grassland;
 promotes aerobic conditions needed by nitrifying (or decomposing)
 bacteria/increases active uptake of mineral ions/plant root respiration/
 prevents the action of denitrifying bacteria;
or
 Treatment of grassland with pesticides/herbicides;
 reduces grazing by other animals/reduces competition from other
 plants;
or
 Grow genetically modified/selectively bred plants;
 with higher yields/less undigestible material; [2]
- (ii) Move cattle indoors to reduce their movement/to keep them warm;
 less energy is wasted in movement, so more energy is available for
 laying down tissue/less energy is used to generate heat;
or
 Feeding silage/high protein food;
 silage is high energy food/winter fodder/amino acids build up more muscle;
or
 Parasitic infections kept in check with drug treatments;
 less energy lost to parasite feeding, so more energy is available for laying
 down tissue;
or
 Treatment of cattle with hormones;
 to promote greater laying down of muscle tissue;
or
 Selective breeding/genetically modified;
 to increase muscle development for higher yield; [2]

- 6 (a) **A** Photosynthesis;
B Respiration (plant and animal);
C Decomposer (saprophytic) respiration/decomposition; [3]

(b) **Any five from**

- traps longer wavelength radiation (infra-red rays)/heat/limits radiation into space (heat loss)
- resulting in a rise in global temperature/global warming
- leading to melting of the polar ice caps/thermal expansion of the seas and oceans with resultant loss of low altitude coastal land and changes to global weather patterns (climate change) causing changes in rainfall patterns and rise in temperature may lead to increased desertification
- may lead to changes in species ranges, causing localised extinctions and colonisation by 'exotic' species/appropriate example of a biofic effect
- a rise in temperature and carbon dioxide levels may increase the rate of photosynthesis
- suggested remedies to global warming, eg. planting more trees

Not phrasing which includes reference to UV radiation and/or ozone depletion [5]

- (c) (i) SO_2/NO_2 ; [1]

- (ii) Death of plants/defoliation;
 low pH damages cuticle/epidermis (making them susceptible to infection)/low pH leaches valuable minerals from soil/low pH releases aluminium/which is toxic to plant roots;
or
 Death of fish due to mucus build up on gills/due to loss of food/lower numbers of fish eggs;
 low pH leads to a build up of aquatic aluminium/low pH may directly damage fish eggs/low pH may kill invertebrates:

or
 Death of amphibians;
 low pH may make amphibians susceptible to fungal infections/
 low pH may directly damage amphibian eggs; [2]

- 7 (a) Monocultures offer an enormous food source (concentrated food source) for any pest species/allow rapid colonisation and spread of the pest species/
no break in pest life cycle; [1]
- (b) (i) The moth population begins to rise again (towards the end of July)/
mite populations grow (during July); [1]
- (ii) No bioaccumulation/no transfer to other ecosystems (e.g. soil,
aquatic);
Not phrasing like 'no accumulation' or 'damages other organisms' [1]
- (c) *Stethorus punctum* is the predatory mite;
its population graph peaks after that of its prey/as predator numbers increase
prey numbers decrease;
Not phrasing such as 'predator follows prey' [2]
- (d) (i) Biological control;
- (ii) Is species specific/pest is controlled all year round/potentially harmful
chemicals not sprayed on food crops/no problems with bioaccumulation
in the food chain/when used as the sole method of pest control crops
may be sold as organic and achieve a higher price/increases biodiversity
within the ecosystem/after initial set up costs it may be cheaper;
- (iii) Pest is not totally eliminated (so grower has to put up with some
damage to crops)/initial research may be long and expensive/biological
control agent may itself become a pest/may not cope with surges in pest
numbers/biological control agent may have an adverse effect on
non-pest species/may die out and need to be re-introduced; [3]
- (e) (i) **Any three from**
- moths are captured, marked and released
 - some marked moths may be kept back (not released) to ensure
the nontoxicity of the marker
 - enough time for assimilation into the orchard population/time shorter
than life expectancy/breeding cycle
 - a second sample of the moth population is taken and the numbers
of marked (and unmarked) individuals are recorded
 - the population size is estimated as 'first sample size (S_1) ×
second sample size (S_2) ÷ number of recaptured (marked in
second sample)'; [3]
- (ii) Period between first and second capture is not longer than the
life expectancy/ensure marking does not affect moth's survivability
behaviour/mark stays on for length of experiment/no migration occurring
/no births or deaths occurring/marked moths mix with the population
(if not awarded above)/proportion of marked individuals in second
sample equals proportion of total marked individuals (in first sample)
in the population; [1]

8 (a) Any four from

- basement membrane is the filter
 - most proteins are too big to pass through
 - very small proteins pass through
 - smaller proteins are reabsorbed by endocytosis/pinocytosis
 - glucose being a smaller molecule all passes through the membrane
 - the glucose is reabsorbed by active transport
- [4]

(b) Any four from

- sodium is a similar proportion in both the filtrate and the plasma/ is filtered
 - sodium ions and water are reabsorbed in proportional amounts through the proximal tubule
 - sodium ions are concentrated by the bottom of the loop of Henle
 - provides an osmotic gradient through the medulla/creates an increasingly negative solute potential in the lower reaches of the medulla
 - provides potential for osmotic extraction of water (from the collecting duct)
 - in the distal tubule the sodium content of the plasma is adjusted (actively absorbed)
 - sodium ions may be concentrated by extraction of water (in distal tubule)
- [4]

(c) Absorption of water in the proximal tubule increases the urea concentration (fivefold/by 500%);
later reabsorption of water further increases the urea concentration/
some urea is absorbed into the nephron;

[2]

(d) Any two from

- only some of the fluid (about 20%) leaves the plasma thus reducing the volume and therefore the pressure in Bowman's capsule is lower
 - friction with the walls reduces the flow/hydrostatic pressure is reduced (as fluid moves through the nephron)
 - and flow rate falls as water is removed by osmosis
- [2]

(e) Any three from

- chilling reduces the rate of respiration/metabolic rate (*not energy*)
 - reduces production of ATP
 - causes a reduction in the rate of active transport/operation of carrier proteins
 - rate of reabsorption is not quick enough for glucose to be fully removed from the filtrate
- [3]

Section B

A minimum of three from each section

The iris:

- light hitting the retina causes a response in the iris / the iris controls the amount of light entering the eye
- in bright light circular muscles in the iris contract (and radial muscles relax) to reduce the diameter of the pupil / amount of light entering the eye
- this protects the retina from damage
- in dim light the radial muscles contract (and circular muscles relax) to dilate the pupil / increase the amount of light entering the eye
- to ensure sufficient light can reach the retina to stimulate photoreceptors

The lens:

- the lens is for fine adjustment of the convergence of light onto the retina (at the front the transparent cornea is responsible for much of the refraction/convergence of light) / the lens is responsible for accommodation of light onto the retina
- for a distant object tension in the eyeball (ciliary body relaxed) causes the suspensory ligaments to become taut and thus pull the lens into a thinner shape
- which means it is less converging / less refracting / has longer focal length
- for a near object the ciliary muscles contract which reduces the tension on the suspensory ligaments
- without tension the elastic lens becomes fatter
- thus causing greater convergence / greater refraction / a shorter focal length

The rods:

- rods contain the photosensitive pigment rhodopsin which is readily broken down (bleached) in low light intensity
- if threshold level is reached an action potential is initiated in the receptor neurone
- in bright light (normal daylight) rods remain bleached (rhodopsin broken down)
- the opsin and retinine only recombine when darker conditions prevail - the time taken for this is known as dark adaptation
- several rods synapse with one bipolar neurone / rods exhibit retinal convergence (and so sensitivity)
- the resultant convergence allows summation of generator potentials / transmitter substance so that in dimmer light a threshold level is reached
- convergence results in a lack of visual acuity / poor resolution

The cones:

- cones contain the pigment iodopsin which is only broken down in high light intensity
- each cone synapses individually with bipolar neurones
- which gives cones greater visual acuity / greater resolution
- there are three types of cone
- each type of cone has a different type of iodopsin sensitive to red, green or blue light
- the variety of colours we perceive depends on the relative amount of stimulation of each of these three types

[16]

Quality of written communication:

2 marks: The candidate expresses ideas clearly and fluently through well-linked sentences, which present relationships and not merely list features. Points are generally relevant and well-structured. There are few errors of grammar, punctuation and spelling.

1 mark: The candidate expresses ideas clearly, if not always fluently. The account may stray from the point or may not indicate relationships. There are some errors of grammar, punctuation and spelling.

0 marks: The candidate produces an account that is of doubtful relevance or obscurely presented with little evidence of linking ideas. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the account. [2]

Section B	18
Total	90

