

Mark Scheme (Results) Summer 2007

GCE

GCE Biology SNAB (6136/01)

General Principles

Symbols used in the mark scheme

Symbol	Meaning of symbol
; semi colon	Indicates the end of a marking point.
eq	Indicates that credit should be given for other correct alternatives to a word or statement, as discussed in the Standardisation meeting. It is used because it is not always possible to list every alternative answer that a candidate may write that is worthy of credit.
/ oblique	Words or phrases separated by an oblique are alternatives to each other.
{ } curly brackets	Indicate the beginning and end of a list of alternatives (separated by obliques) where necessary to avoid confusion.
() round brackets	Words inside round brackets are to aid understanding of the marking point but are not required to award the point.
[] square brackets	Words inside square brackets are instructions or guidance for examiners.

Crossed out work

If a candidate has crossed out an answer and written new text, the crossed out work can be ignored. If the candidate has crossed out work but written no new text, the crossed out work for that question or part question should be marked, as far as it is possible to do so.

Spelling and clarity

In general, an error made in an early part of a question is penalised when it occurs but not subsequently. The candidate is penalised once only and can gain credit in later parts of the question by correct reasoning from the earlier incorrect answer.

No marks are awarded specifically for quality of language in the written papers, except for the essays in the synoptic paper. Use of English is however taken into account as follows:

- the spelling of technical terms must be sufficiently correct for the answer to be unambiguous
 - e.g. for amylase, 'ammalase' is acceptable whereas 'amylose' is not
 - e.g. for glycogen, 'glicojen' is acceptable whereas 'glucagen' is not
 - e.g. for ileum, 'illeum' is acceptable whereas 'ilium' is not
 - e.g. for mitosis, 'mytosis' is acceptable whereas 'meitosis' is not
- candidates must make their meaning clear to the examiner to gain the mark.
- a correct statement that is contradicted by an incorrect statement in the same part of an answer gains no mark - irrelevant material should be ignored.

Question 1

Maximum mark

- a) has gene(s) which increase chance of developing CVD / eq;
named example of gene (e.g. SRY, APOE4, AZE, MTHFR);
genes do not necessarily mean you will develop the disease /eq;
{other risk factor / named risk factor}also contributes to chance of developing CHD;
3 marks
- b) more than one gene can (cause the condition) / the condition is caused by different genes in different people;
1 mark
- c) one copy of APOE ϵ 4 increases risk (3 fold / 2 copies increases risk 8 fold) in French people;
Alzheimer's tends to affect the elderly / eq;
high rate of death among pygmies (due to {disease / accidents}) means that few survive to an age where Alzheimer's will be seen / eq;
APOE ϵ 4 may be less dangerous to {pygmies / Africans} than Europeans / environmental differences / eq;
APOE ϵ 4 has negligible effect on reproductive success so may not be selected against / invisible to natural selection / eq;
3 marks
- d) Falling childhood mortality rates / {elimination / reduction} of most fatal childhood infectious diseases / eq;
1 mark

Question 1 continued

Maximum mark

- e) reproduction is less common when food is in short supply;
- less energy / resources given over to reproduction (when energy / food is in short supply);
- {energy / calorie} deprived flies reduce gene expression for genes involved in reproduction;
- {energy / calorie} deprived flies increase gene expression for genes involved in the immune system;
- enhanced immune system;
- immune system protects against {disease / other causes of ageing / cancer / diabetes / autoimmune disease};
- restricted growth aids survival;
- ref. IGF;
- marsupial mice spend most of their adult life copulating and die young;
- restricted diet may result in fewer free radicals being released;

3 marks

- f) superoxide dismutase protects against free radicals / few free radicals means less damage to DNA / eq;
- {SOD(1)/overactive superoxide dismutase} may cause {amyotrophic lateral sclerosis (ALS)/neurological disease/Lou Gehrig disease/early death};
- SOD may kill neurones / eq;
- SOD linked to Down's syndrome;
- free radical theory of aging may be wrong / eq;
- gene may {have other roles / moonlight} (that may be harmful);
- SOD results in production of {hydrogen peroxide / H₂O₂};
- need balance between SOD and catalase to avoid damage / eq;

3 marks

Question 1 continued

Maximum mark

- g) i) MARKS IN THIS SECTION NEED TO BE IN CONTEXT
- identify the gene responsible for the disease;
- {use of / design} a gene probe for the disease gene;
- further detail of probe (e.g. complementary to gene / radioactively labelled / fluorescently labelled);
- extract DNA from patient / cheek cell swab / eq;
- {cut / digest} DNA using restriction {enzymes / endonuclease};
- separate DNA using gel electrophoresis;
- further detail of gel electrophoresis;
[e.g. use of {agarose/polyacrylate} gel / apply {current through/pd across} / DNA moves towards anode / smallest fragments move {fastest / furthest}];
- treat with alkali to make DNA single stranded;
- southern blotting / transfer onto a {nylon/nitrocellulose} membrane;
- disclosure using x-ray film / UV light / laser;
- provide counselling (with results);
- ask for family history of the disease/eq;
- 4 marks
- ii) advantage: can avoid passing disease onto children if negative / if positive can use Preimplantation Genetic Diagnosis / eq / change diet to delay {onset/symptoms} of disorder / peace of mind with negative result / suitable ref. to existing children / choose not to have children (if positive) to avoid passing on / eq;
- disadvantage: no known cure available so increased stress with positive result / worry that subsequent children may inherit the disease / eq / insurance discrimination / high insurance premiums / ref to abortions / may choose not to have children due to risk / eq / increased risk of miscarriage (due to antenatal screening);
- 2 marks
- Total 20 marks

Question 2

Maximum mark

- a) i) lack of oxygen / eq;
anaerobic respiration (produces lactate);
(respiration) produces reduced NAD / NADH H⁺ / NAD H₂ / reduced co-factors;
pyruvate produced by glycolysis;
pyruvate converted to lactate (in anaerobic conditions);
lactate production oxidises NADH so glycolysis can continue/eq;
in anaerobic respiration {glucose / lactate} cannot be fully oxidised / correct reference to Krebs cycle / oxidative phosphorylation / suitable ref. to mitochondria /eq;
allows continued production of ATP;

4 marks

- ii) the difference {cannot be explained by chance/is really caused by diving / not some other factor};
the {probability/chance} that the difference could be due to chance/accident is less than 5% / 0.05 / 1 in 20 / 95% confident that difference is not due to change alone;

2 marks

- iii) correct description of change of lactate in dives of different duration e.g. little change in blood lactate concentration up to six minutes, faster increase in blood lactate concentration after {five / six} minutes / eq / ref. to greater variability of blood lactate in longer dives;
in dives of up to {five / six} minutes there is enough oxygen (in the lungs / blood / body) to maintain (largely) aerobic respiration /in a dive of six to twelve minutes (all / most) oxygen gets used up therefore respiration (more / or less) entirely anaerobic / eq;

2 marks

Question 2 continued

Maximum mark

- b) heart rate decreases when the seal dives / rises when the seal surfaces;

use of figures to emphasise that the HR falls very low from e.g from 130 - 150 beats per minute to 10 - 30;

at the surface increases supply of oxygen to remove lactate / to repay oxygen debt;

ref. to moving the lactate away from the muscles / to the liver;

when submerged little oxygen carried to muscles in blood / eq;
correct ref. to cardiovascular centre / correct ref. to nerve action on the SAN / reflex action;

ref. to myoglobin;

4 marks

- c) (i) QRS (complex);

resulting in contraction of ventricles / ventricular systole;

2 marks

- (ii) 90 - 120 bpm;

20 - 40 bpm;

2 marks

- d) (i) {shock / disruption of control mechanisms / eq} at the sudden change in temperature at the {lower temperature / 25°C};

35°C is close to normal body temperature (therefore less of a shock than 25°C);

reduced (blood) circulation to conserve heat / a thermoregulatory mechanism / vasoconstriction (to surface) ;

ref. to diving reflex / bradycardia;

2 marks

- (ii) she hyperventilated / filled her body / lungs / blood with as much oxygen as possible before diving;

she {had prepared herself mentally / was afraid / stressed} and this caused the increase in heart beat;

ref. to adrenaline / hormone;

ref. to autonomic nervous system / sympathetic nervous system;

2 marks

Total 20 marks

3. Some people claim that many medical problems, such as the shortage of suitable organs needed for transplant surgery, may become a thing of the past simply by extracting some stem cells from a patient and inserting a specific gene or genes. 'Manipulating stem cells - a miracle cure or a dangerous diversion?'

	<p>Breadth: maximum of 6 marks</p> <p><i>These marks are to be awarded to the candidate if they successfully introduce the general area of Biology relevant to the essay title. If a relevant B point is awarded then the corresponding A point should also be awarded. Key ideas to look for are in bold type - the candidate need only show evidence that he or she realises that key idea is appropriate in the essay to gain a breadth (A) mark.</i></p>		<p>Depth: maximum of 8 marks</p> <p><i>These marks are awarded to candidates for demonstrating an understanding of relevant A level biological detail expanding on the areas of biology introduced in A. This list is not exhaustive but is designed to give an idea of the type of response worthy of credit for a (B) mark.</i></p> <p><i>Allow a maximum of 4 B marks per corresponding A mark.</i></p>
A1	Description of Stem Cells:	B1a B1b	<p>Cells that are able to differentiate into more than one cell type/eq;</p> <p>Correct descriptions making use of the words totipotent, pluripotent and/or multipotent;</p>
		B1c B1d	<p>Reference to cell/ nuclear division as source of new cells;</p> <p>Good description of mitosis and/or cell cycle including details such names of phases;</p>
		B1e B1f/g	<p>Introduction of concept that cells specialise during their development;</p> <p>Good description of gene switching/induction/inactivation such as the use of transcription factors/methylation [2 marks available for excellent description including 2 methods of specialisation]</p>
A2	Source of embryonic stem cells:	B2a B2b	<p>IVF as a source of spare embryos;</p> <p>Details of how IVF tends to produce excess embryos and that those embryos may be stored for long periods in liquid nitrogen.</p>

		B2c B2d	Cloning to produce embryonic stem cells; Details of a suitable cloning technique; e.g. description of how Dolly was cloned
A3	Other sources of stem cells:	B3a B3b	Coral blood (from placenta/umbilical cord); Explanation that placenta/umbilical cord contains stem cells that will be identical to the new born child and they may be harvested and stored or used.
		B3c B3d	Adult stem cells; Example of tissue that contains stem cells e.g. bone marrow, testes, etc
A4	Therapeutic uses of Stem cells	B4a/b	Credit two specific examples of a tissue/organ that could be replaced/healed through the use of stem cells e.g. repairing spinal cord injuries
A5	Cloned/Adult stem cells are less likely to be rejected by the patient	B5a	Details of the specific immune system and reasons why traditional transplants may be rejected
		B5b	Details of why cloned cells are not going to be rejected by the immune system e.g. ref to antigens/MHCs etc.
		B5c	No need to use immune suppressant drugs with stem cells/converse.
A6	Adult stem cells will need to be reprogrammed	B6	Use of chemical signals to enable stem cells to differentiate to produce the desired cell types.
A7	Stem cells can be manipulated by gene therapy	B7a	Details of how to insert a gene into a stem cell
		B7b	Description of a suitable vector e.g. liposome, retrovirus, etc

		B7c	Example of specific disorder/disease that could be treated through gene therapy e.g. cystic fibrosis, diabetes, SCID etc
		B7d	Further detailed explanation of the case study named in B7c e.g. replace gene for insulin production into pancreatic stem cells and stimulate them into becoming Islet cells
A8	Alternatives to the use of stem cells	B8a B8b	Xenotransplantation. Details and examples e.g. heart valves from pigs
		B8c	Dangers of xenotransplantation e.g. new viruses become active/ or need for genetic modification of the animal so that it is not rejected by the immune system
		B8d B8e	Prosthetic replacements Specific example e.g. artificial heart valves or hearts, limbs
A9	Ethical Issues	B9a B9b	eugenics Issues described related to selection of embryos, designer babies etc through genetic modification
		B9c B9d	Pro-life issues Discussion about embryos having the potential for independent life in the future - should we be allowed to manipulate/destroy
		B9e B9f	Technology may be misused Once therapeutic cloning is possible others will use the technology for reproductive cloning or similar.
A10	Dangers/Disadvantages	B10a B10b	Developmental deformities/Cancers Explanation linked to cells not being fully reprogrammed/ new mutations/

		B10c B10d	Premature aging of cells/organism Chromosomes come from an older donor nucleus - shorter telomeres etc.
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Unpacking the question: The C points might be made as discrete points in the introduction and/or conclusion or indirectly as part of the way the factual material has been presented in the body of the essay. But it should be possible to identify precisely where each C mark has been awarded by, for example, writing C₁ or C₂ on the script.

C1 Recognition that embryonic stem cells have more potential than adult stem cells but they raise more ethical issues regarding their use.

C2 An issue of balancing risks and benefits for any new therapies.

C3 Adult stem cells will not need to be cloned, but will need to be reprogrammed and may be harder to extract.

C4 Issue of whether it is better to make use of spare embryos resulting from IVF rather than disposing of them.

C5 Essay provides a balanced argument that includes at least 2 good examples of the use of stem cells and 1 danger/ethical problem associated with the use of stem cells.

C6 Discussion of how the human genome project has helped identify candidate genes for gene therapy.

C7 Evidence that candidate is aware of the key issues of needing to understand the precise series of chemical signals required for cells to specialise successfully and form the correct tissues/organs required.

C8 reference to the role of clear legislation/supervision of work in these key areas e.g. outline of the role of the Human Fertilisation and Embryology Authority (HFEA).

C9 Recognition that stem cells may be cultured and manipulated in tissue culture before use/storage

C10 Need for greater research/understanding careful testing before proceeding with new therapies

C11 Key question is about the status of the embryo - a ball of undifferentiated cells or a potential human being.

C12 Tissue typing may reduce need for cloning as we may only need a few stem cell lines to avoid tissue rejection in most people.

D: Coherence, clarity and expression of the answer:

maximum of 4 marks

This strand will award students for style of their answer and is quite distinct from mentioning the big ideas (C). It isn't *what* candidates say but *how* they say it.

4 marks: A truly synoptic essay which links together information from different parts of the specification in a coherent and logical style (introduction. Conclusion, good use of paragraphs and well illustrated by examples). Good spelling, punctuation, grammar and sound use of technical terminology.

3 marks: Good logical structure with good spelling, punctuation, grammar and sound use of technical terminology, but tends to be a collection of information which, although relevant, tends to be disjointed and only partly attempts to synthesise information.

2 marks: A reasonably coherent account that includes satisfactory spelling, punctuation and grammar, which tends to be disjointed. A collection of information with little or no attempt to link ideas together.

1 mark: Some relevant information is presented in an intelligible way using correctly formulated simple sentences.

0 marks: The use of English is not adequate to convey scientific information beyond naming a list of examples. A candidate who has scored some marks (particularly in strand A) for mentioning some relevant points may nevertheless fail to score marks in strand D if he or she fails to form simple sentences.

Note that the maximum total mark which can be awarded is 20

4. The effect of global climate change on the World ecosystems is often seen as a potential catastrophe. Yet agriculture, wild species and ecosystems are able to adapt to climate change and have done so many times in the past.
The biological effects, including the consequences for agriculture, that may result from global warming in the 21st Century: catastrophic or just different?

	<p>Breadth: max 6 marks <i>These marks are to be awarded to the candidate if they successfully introduce the general area of Biology relevant to the essay title. If a relevant B point is awarded then the corresponding A point should also be awarded. Key ideas to look for are in bold type - the candidate need only show evidence that he or she realises that key idea is appropriate in the essay to gain a breadth (A) mark.</i></p>		<p>Depth: max 8 marks <i>These marks are awarded to candidates for demonstrating an understanding of relevant A level biological detail expanding on the areas of biology introduced in A. This list is not exhaustive but is designed to give an idea of the type of response worthy of credit for a (B) mark. Allow a maximum of 4 B marks per corresponding A mark.</i></p>
A1	Global warming is happening at present/the surface air temperature/sea temperature is getting warmer:	B1a B1b	Plenty of data from direct records going back over >100 years/pollen analysis/dendrochronology/ice cores; Climate change related to global warming includes changes/increased temperature <u>and</u> {changes in rainfall pattern}/some places become drier/wetter;
		B1c B1d	Discussion of the natural carbon cycle and how human activity may be changing the natural balance. <i>Might be the result of humans burning fossil fuels but could be due to other non-anthropogenic causes/the contribution of CO₂ emissions due combustion of fossil fuel to global warming is difficult to evaluate;</i>
		B1e	Explain the possible link between greenhouse gases and global warming;
A2	Climate change may cause sea levels to rise	B2a B2b B2c	Loss of agricultural land due to sea level rise Increased sea flooding may result in salt contamination of agricultural land Only plants with halophytic adaptations / modifications may be able to survive in many areas

A3	Global warming has happened in the past	B3a B3b	There was global warming at the end of Ice Age: Ice Age ended (in UK) about 10 000 BC/12 000 BP/12 thousand years ago [accept +/- 2000y];
		B3c	Examples to illustrate the scale of the effect e.g. (In UK) from tundra to forest/species entered UK across land bridge;
		B3d	Reference to time scale e.g. (tundra to forest in UK) in a few thousand/anything in the range 2000 to 5000 years;
A4	Some species survive by change in distribution /{growing / living} elsewhere	B4a	Some species may grow further north/at higher altitude;
		B4b	Species lost (from a particular place/example) will be replaced by ones from further South;
		B4c	How habitat fragmentation may make species dispersal/migration/succession harder than in the past;
		B4d B4e	Appropriate reference to seed dispersal in enabling <u>plant</u> species to grow somewhere else; Example to illustrate B4d;
		B4f	Ref to animal migration compared to plant dispersal;
A5	Reference to succession as a way ecosystem/vegetation may change;	B5	Example to illustrate how succession works e.g. new species arrives and out-competes indigenous species/{new species/loss of old species} may change/modify the (ecological) conditions/specific example;
A6	Some species will face extinction/ population decline;	B6a B6b B6c	Species on mountain tops/northern coast may have nowhere to migrate to; Species may lose niche/habitat etc and may not be able to adapt/compete well enough to survive/ effects of disrupted food chains; Extinction rate currently extremely high.

A7	Effects on Agriculture	B7a B7b	Farmers in a particular place will grow <u>different</u> crops /keep different (domestic) animals; Example to illustrate e.g. maize will grow/already growing further north;
		B7c B7d	(Agricultural) Winners <u>and</u> losers: Some places will no longer be as good for agriculture as they are now/will become deserts/ some places will be better for agriculture/desertification may take place; Example to illustrate candidates response to B7c e.g. sub-Saharan Africa/Spain/Mediterranean area Grow more maize/sunflowers in Scotland Overgrazing/effects of (human) overpopulation in {marginal areas/eq/the Sahel} made even worse/more severe;
A8	Pests/animal vectors/weeds may become more numerous/spread north/become more widespread;	B8	Examples of species which might benefit e.g. Witch weed (in Africa)/mosquitoes carrying malaria (further north) / other suitable examples of specific plants or animals;
A9	Behaviour of plants and/or animals may change	B9	Disruption of breeding cycles/animals may hatch at a different time to their prey species/{seeds may not germinate/ plants may not flower} without cold stimulus
A10	(Wild species) may change by evolution/natural selection;	B10a	Correct reference to <u>mutations</u> /random change in genes/DNA change;
		B10b	'new' genes might provide new adaptations that will enable the species to <u>survive</u> / <u>compete</u> better with pre-existing species;
		B10c	(Struggle for survival <u>and</u> survival of the fittest) - the individuals which survive will provide genes for future generations/will reproduce faster than the original variants;
A11	There will be loss of biodiversity	B11a	Species will become extinct faster than new ones evolve so there will be fewer species in the world

		B11b	(Why loss of biodiversity matters) means loss of genes/genetic variation limiting {evolutionary change/ability to adapt in the future/source of genes for use in plant breeding/GM in the future
A12	Plant breeding/GM will produce new varieties able to cope with new conditions	B12a B12b	Outline description of how plants may be modified through genetic modification and/or details of selective breeding. Example: produce drought resistant/temperature resistant varieties with heat resistant enzymes/salt tolerance (in context of rising of sea level/similar examples;
A13	Reference to computer models to predict climate change	B13	Qualification e.g. only make predictions not provide certainty/predictions continually improving/derived from a lot of data/based on extrapolation of current trends/specific example e.g. (some models predict) drier in SE England wetter in Scotland;

C: Unpacking the question: the focus of this of this question is on the *biological effects including agricultural consequences of global warming. It is not primarily about the greenhouse effect nor issues surrounding combustion of fossil fuels although these may gain a mention when discussing uncertainties and difficulties of making predictions. Nor is it primarily about whether global warming is taking place or not although observing that it is clearly taking place and mentioning some of the evidence for this could be a good place to start. Some of the points below might have already have been awarded a mark under B but the C mark is for making connections.*

To be awarded a mark for each of the points below a candidate must have made the point in bold type and to have qualified it sufficiently to show they know what they mean - the material that is not in emboldened is intended to illustrate how the idea might be qualified rather than a prescriptive mark scheme. The C points might be made as discrete points in the introduction and/or conclusion or indirectly as part of the way the factual material has been presented in the body of the essay. But it should be possible to identify precisely where each C mark has been awarded by, for example, writing C₁ or C₂ on the script.

C1 Might not be as bad as all that - e.g the extent of global warming is difficult to predict;

C2 Linked to C1: because of several possible scenarios e.g {if Atlantic conveyor/Gulf Stream breaks down UK will be much colder otherwise UK will be warmer}/{future levels of anthropogenic CO₂ production from fossil fuel are difficult to predict/if humans reduced CO₂ production from fossil fuels may take time to make a difference}/ Ref. to education about global warming;

C3 The global warming which ended the last Ice Age was much greater than the current global warming predictions

C4 Linked to C3: Yet successional processes, dispersal and natural selection took care of it bringing change not catastrophe;

C5 The rate of change may happen too fast for biological processes like dispersal, succession and evolution to keep pace and this may disrupt ecosystems/make it more difficult to feed the world's human population/lead to greater loss of biodiversity than previous climatic change/Ice Age;

C6 Humans have fragmented natural habitats making it more difficult for living organisms to disperse as the climate changes;

C7 Might be a catastrophe for the human race but not for the global ecosystem:

C8 Linked to C7: the world is already over-populated/ climate change could result in mass human starvation/war over dwindling resources and dry land/collapse of world economy/much of world's population lives in places likely to be flooded by rising sea level. But the ecosystem, unhindered by the negative effects of humans could become more stable/have more biodiversity.

C9 In the past what appears to be catastrophic has led to major evolutionary change/ has been ecologically/biologically creative.

C10 Linked to C9: For example, the meteor/asteroid which is said to have caused the demise of most of the Dinosaurs when it collided with the earth might well have accelerated the evolution of mammals - including humans. There might be fewer humans but they might be an evolutionary improvement!

C11 Science and Technology will cope - it always does;

C12 Linked to C11: A lot of scientists are studying global warming and climate change so we know what needs to be done/GM technology will be used to produce crops able to survive in a warmer climate/we shall adapt our {homes/cities/energy sources/ways of producing food}...

D: Coherence, clarity and expression of the answer:

maximum of 4 marks

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