



MARKSCHEME

May 2011

BIOLOGY

Standard Level

Paper 2

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General Marking Instructions

Subject Details: **Biology SL Paper 2 Markscheme**

Mark Allocation

Candidates are required to answer **ALL** questions in Section A [**30 marks**] and **ONE** question in Section B [**20 marks**]. Maximum total = [**50 marks**].

1. A markscheme often has more marking points than the total allows. This is intentional. Do **not** award more than the maximum marks allowed for part of a question.
2. Each marking point has a separate line and the end is signified by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets () in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing **OWTTE** (or words to that effect).
8. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized.
9. Only consider units at the end of a correct calculation.

Section B

Extended response questions – quality of construction

- ♦ Extended response questions for SL P2 carry a mark total of **[20]**. Of these marks, **[18]** are awarded for content and **[2]** for the quality of construction of the answer.
- ♦ Two aspects are considered:
 - expression of relevant ideas with clarity
 - structure of the answers.
- ♦ **[1]** quality mark is to be awarded when the candidate satisfies **EACH** of the following criteria. Thus **[2]** quality marks are awarded when a candidate satisfies **BOTH** criteria.

Clarity of expression:

The candidate has made a serious and full attempt to answer all parts of the question and the answers are expressed clearly enough to be understood with little or no re-reading.

Structure of answer:

*The candidate has linked relevant ideas to form a logical sequence **within** at least two parts of the **same question** (e.g. within part a and within part b, or within part a and within part c etc. but **not between** part a and part b or between part a and part c etc.).*

SECTION A

1. (a) (i) (population) 1 and (population) 2 (*both needed*) **[1]**
- (ii) (population) 11/7/7 and 11 **[1]**
- (b) $PanI^A$ 0.75 and $PanI^B$ 0.25 / 3 $PanI^A$ to 1 $PanI^B$ **[1]**
Both must be correct for the mark to be awarded, accept frequencies in form of ratio.
- (c) (i) greatest/great frequencies of $PanI^A$ at lowest/low latitudes / a rapid drop in frequency at (60–65 degrees latitude) / lowest/low frequencies at highest/high latitudes **[1]**
Answers which describe/imply the correct step-wise relationship should get credit. Answers stating or implying a negative correlation alone should not get credit.
- (ii) lowest/low frequencies of $PanI^A$ at lowest/low temperatures / a rapid increase in frequency at (8–10 degrees Celsius) / highest/high frequencies at warmest/warm temperatures **[1]**
Answers which describe/imply the correct step-wise relationship should get credit. Answers stating or implying a negative correlation alone should not get credit.
- (d) (cod with) $PanI^A$ allele selected/favoured/better adapted to warmer water;
(cod with) $PanI^B$ allele selected/favoured/better adapted to colder water;
cod that survive can reproduce and pass alleles on to offspring; **[2 max]**
It takes a whole organism to reproduce in order to pass on the allele, hence we expect reference to the fish to gain this last marking point
- (e) higher frequency of $PanI^A/PanI^A$ $PanI^A$ (cod) in warm (surface) water;
higher frequency of $PanI^B/PanI^B$ $PanI^B$ (cod) in colder (deeper) water;
interbreeding results in $PanI^A$ $PanI^B$ cod/heterozygous cod; **[2 max]**
- (f) $PanI^A$ $PanI^A$ (cod) may spread further north / $PanI^B$ $PanI^B$ (cod) may move/retreat further north;
numbers of $PanI^A$ $PanI^A$ (cod) may increase / frequency of $PanI^A$ allele may increase;
 $PanI^B$ $PanI^B$ (cod) may become extinct / frequency of $PanI^B$ allele may decrease; **[2 max]**

2. (a) Award [1] for every two correct.

<i>Enzyme</i>	<i>Source</i>	<i>Optimum pH</i>	<i>Substrate</i>	<i>Products</i>
Amylase	Salivary gland	7	starch/amylose/ glycogen;	maltose/short polysaccharides /disaccharides /dextrin;
Lipase	pancreas;	<i>Allow any pH in range 7-9.</i>	Lipids	Fatty acids and glycerol

[2 max]

(b) rate of digestion at body temperature would be too slow / enzymes increase the rate of digestion;
 enzymes break large molecules down into small/soluble molecules;
 for absorption/diffusion into blood;

[2 max]

(c) labelled sac-shaped gall bladder with a duct;
 tubule/(bile) duct shown connecting gall bladder directly to small intestine/duodenum / tubule/(bile) duct merging with the pancreatic duct before entering small intestine; *Alternative answers are accepted because of variations in human anatomy.*

pancreas drawn with pancreatic duct connected to small intestine and pancreas labelled;

[3]

A duct is preferred to a line, but since this is a diagram, both are acceptable.

3. (a) (gel) electrophoresis

[1]

(b) (track C is) not (DNA from) the father;
 some bands on track B do not occur on A or C;
 these bands must be DNA inherited from the real father;
 band in track B that does not occur on A or C identified;
Annotations to the gel illustrating the above points may be used.

4. (a) (i) interphase because no (individual) chromosomes are visible / genetic material visible as chromatin / chromosomes/DNA has not condensed / nuclear envelope/nucleolus/nucleus is visible [1]
- (ii) DNA synthesis/replication/*OWTTE*;
(cell) growth / increase in the number of organelles/specific organelle mentioned;
transcription/synthesis of RNA; [2 max]
Mark only the first process on each line if more than two processes are listed. Do not accept error carried forward if mitosis is the answer in (i).
- (b) retain the capacity to divide;
they are undifferentiated / unspecialized;
have the ability to differentiate (along different pathways) / are multipotent/pluripotent/totipotent; [2 max]
Mark only the first process on each line if more than two processes are listed.
- (c) named source of stem cells *e.g.* bone marrow / cord blood / inner cell mass of embryo / embryonic stem cells;
name of condition that is treated using the stem cells *e.g.* leukaemia / heart disease / diabetes / other possibility;
one precise detail of how the stem cells replace/ replenish (differentiated) cells that are the cause of the condition; [3]

Example:

Source: stem cells obtained from bone marrow;

Condition: leukaemia;

Detail: patient's bone marrow cells (are killed and) replaced with the stem cells;

SECTION B

Remember, up to TWO “quality of construction” marks per essay.

5. (a) *Award [1] for each of the following shown on a diagram of the carbon cycle. Award [5 max] for points not shown on a diagram.*

The following show carbon which is static within the cycle at this point in time.

carbon dioxide in air/water;
(sugars/carbon compounds in) plants/producers;
(carbon compounds in) animals/consumers;
(carbon trapped in) coal/oil/gas/fossil fuels;

The following should show arrows in direction of carbon flow.

carbon dioxide absorbed by plants/producers and used in photosynthesis;
carbon dioxide released by (cell) respiration in plants/producers;
plants/producers eaten by animals/primary consumers/herbivores;
primary consumers eaten by secondary consumers;
carbon dioxide released by (cell) respiration in animals/consumers;
plants/animals die and are decomposed by (saprotrophic) bacteria/fungi;
carbon dioxide released by combustion of coal/oil/gas/fossil fuels;
carbon dioxide released by (cell) respiration in bacteria/fungi/decomposers;
forest fires/combustion releases carbon dioxide from trees/plants;
carbon dioxide emitted by volcanoes;

[9 max]

- (b) diagram of food chain showing at least three organisms and two linkages with arrows showing direction of energy flow;
trophic level is a step/position in the movement/flow of energy through an ecosystem;
(in a field situation) observe which organisms eat each other;
producer/name from example (first trophic level) does not eat other organisms/captures energy through photosynthesis;
primary consumer/name from example (second trophic level) feeds on producers;
secondary consumer/name from example (third trophic level) feeds on primary consumers;

[4 max]

Since the command term is explain, the answer must be explicit to gain marking points d–f. Named examples for producer and consumers in diagram or explained example must represent a coherent food chain. Reject chains using general names such as fish or tree or grass. But, accept sardine or oak.

- (c) measure production of oxygen;
because oxygen is a by-product of photosynthesis;
example of technique for measuring oxygen production (count bubbles/use sensors/other);
measure uptake of carbon dioxide;
because carbon dioxide is used during photosynthesis;
example of technique for measuring carbon dioxide production (sensor, aquatic pH shift);
measure biomass of (batches of) plants;
increase in biomass gives (indirect) measure of rate of photosynthesis;
Since the command term is explain, reasons must be given to receive full marks. **[5 max]**

(Plus up to [2] for quality)

6. (a) drugs used to down-regulate the menstrual cycle;
FSH injected to stimulate many follicles to develop;
HCG injected to cause the follicles to mature;
eggs are harvested/extracted (from the follicles/ovaries);
semen sample produced/collected;
semen is processed to concentrate it / healthy sperm selected (swim-up test given);
ICSI/IntraCytoplasmic Sperm Injection where sperm is directly injected into egg
when low numbers of motility is a factor;
semen mixed with eggs in a dish/outside the body to allow fertilization;
incubated / kept at 37°C / allows embryos to develop (sufficiently for
implantation);
dish examined to choose healthiest embryo;
embryos placed in uterus/oviduct (using a catheter/long plastic tube);
one/two/three/up to four (in some countries) embryos implanted;
pregnancy test/scan used to see if procedure has been successful;
(used in cases of) blocked oviduct / low sperm count / need for genetic screening /
infertility / cannot become pregnant / need for donor embryo; [9 max]
*Accept other reasonable situations. Full marks may be awarded only if an
example is included in the answer.*
- (b) females are carriers when they have dominant and recessive alleles together;
recessive allele in carrier does not affect phenotype as dominant allele also
present;
gene is located on the X chromosome / gene is not located on Y chromosome;
females are XX so can have dominant and recessive alleles/two alleles of gene;
males are XY so only have dominant or recessive allele/one allele of gene;
hemophilia/red-green colour blindness/other example of a sex-linked
characteristic; [4 max]
- (c) (point) mutation of gene for hemoglobin;
CTC to CAC / GAG to GTG / substitution of T/thymine with A/adenine;
mRNA copy of gene is GUG instead of GAG;
valine instead of glutamic acid;
(in homozygotes) red blood cells become sickle-shaped;
(in homozygotes) less oxygen carried;
(in homozygotes) red blood cells do not survive long / burst / block blood
vessels/capillaries / circulatory problems may cause pain/organ failure/example of
symptom;
heterozygotes have malaria resistance; [5 max]

(Plus up to [2] for quality)

7. (a) cell wall protects the cell from damage;
cell wall prevents the cell from bursting;
plasma membrane pumps substances/carries out active transport;
plasma membrane controls entry and exit of substances;
cytoplasm contains enzymes that carry out metabolism;
pili are used to connect bacterial cells/can pull bacteria closer together;
flagella used for locomotion/movement of the bacterial cell;
ribosomes synthesize proteins;
(naked) DNA of main chromosome is located in the nucleoid (region);
nucleoid initiates reproduction/binary fission;
(naked) DNA/chromosome/nucleoid controls/determines cell structure/ function;
plasmids confer (luxury) functions such as disease resistance/antibiotic resistance/other;
capsule protects cell/promotes adherence; **[9 max]**
If the answer includes any eukaryotic structures, award [8 max].
- (b) both lipids and carbohydrates are primary sources of energy for organisms;
lipids store more energy per unit mass/per gram than carbohydrates / lipids generally provide 2 to 3 times the energy of carbohydrates for a given mass;
lipids provide $38 \text{ kJ g}^{-1} / 9 \text{ C g}^{-1}$ whereas carbohydrates have $17 \text{ kJ g}^{-1} / 4 \text{ C g}^{-1}$;
carbohydrates are easier to transport (than lipids) making their energy more accessible;
because lipids are insoluble (in water) whereas (small) carbohydrates are soluble (in water);
carbohydrates are more easily taken out of storage making their energy more quickly available;
carbohydrates are short-term storage molecules, whereas lipids provide long-term storage; **[4 max]**
- (c) aerobic cell respiration if oxygen available and anaerobic if unavailable;
pyruvate enters mitochondrion for aerobic respiration;
whereas pyruvate stays in the cytoplasm for processing under anaerobic conditions;
pyruvate converted aerobically into carbon dioxide and water;
whereas pyruvate converted anaerobically to lactate;
large ATP yield when oxygen available/from aerobic cell respiration;
no (further) ATP yield without oxygen; **[5 max]**

(Plus up to [2] for quality)
