



MARKSCHEME

May 2009

BIOLOGY

Standard Level

Paper 2

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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. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. 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. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. Indicate this with **ECF** (error carried forward).
10. Only consider units at the end of a calculation. Unless directed otherwise in the mark scheme, unit errors should only be penalized once in the paper. Indicate this by writing **-1(U)** at the first point it occurs and **U** on the cover page.

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.).*

- ◆ It is important to judge this on the overall answer, taking into account the answers to all parts of the question. Although, the part with the largest number of marks is likely to provide the most evidence.
- ◆ Candidates that score very highly on the content marks need not necessarily automatically gain [2] marks for the quality of construction (and *vice versa*).
- ◆ The important point is to be consistent in the awarding of the quality points. For **sample scripts for moderation** the reason why quality marks have been awarded should be stated.
- ◆ Indicate the award of quality marks by writing **Q2, Q1** or **Q0** in **red** at the end of the answer.

SECTION A

1. (a) (i) maize not modified/transformed with Bt (genes) / maize that did not have Bt gene added / not genetically modified / untreated maize [1]
- (ii) $50 - 12 = 38 \text{ (mm}^2\text{)}$; *Accept* $12 - 50 = -38$
 $(38 \div 50) \times 100 = (-)76\%$; (*ECF*) [2]
- (b) there was a decrease in damage by all three types of stem borers compared to control;
 there was almost no change in damage by *Eldana* compared to control;
 there was almost no damage/little effect (to Bt maize type A) by *Sesamia* (and *Eldana*);
Busseola caused the most damage (to Bt maize type A); [2 max]
- (c) very efficient at controlling *Sesamia*;
 type B is the most effective against the three stem borers collectively;
no type of Bt maize controlled *Busseola* well / vice versa *i.e.* *Busseola* not well controlled by any types of Bt maize;
all types of Bt maize decreased *Sesamia* damage (significantly) / Bt maize type E not damaged by *Sesamia* / vice versa;
 Bt maize types C/H/I had more damage caused by *Busseola* (than was caused in the control) / vice versa;
all types of Bt maize decreased *Eldana* damage (to some extent) / type B was not damaged by *Eldana* / vice versa;
Eldana damage low in control / less effect;
 cannot determine efficiency since data is about leaf damage and stem borers may feed (preferentially) on other structures/stems/roots; [2 max]
- (d) $(268 - 215 =) 53\text{g}$ [1]
(Accept answers in range 51–57g. Units required. No workings required.)
- (e) mass increases in all three groups;
 increase is more rapid in beginning and tapers off later in the study;
 mass seems to be levelling off in rats fed Bt and non-Bt maize / rate of increase in mass is slowing down;
 rats fed rat food always have higher mass/greater mass increase than those fed either type of maize; [2 max]

- (f) all three foods result in the same pattern of growth/mass gain / highest rate of growth at start of study / tapering off later in the study;
Bt maize causes same amount of growth as non-Bt maize / appears to be as good a food source as non-Bt maize / there is no significant difference between Bt and non-Bt maize (in terms of mass gain);
corn (both types) appears to cause less growth/mass gain than rat food / vice versa;
genetic modification does not affect growth/mass gain;
no evidence to support risk of Bt maize to growth/mass gain;
study does not investigate other possible risks of Bt maize to rats;
sample size is small / only 12 rats (in each group) so this may not be enough to give trends;
only female rats tested, no males;

[3 max]

2. (a) Both name and function required to achieve [1].

A: name: flagella/flagellum

function: used for locomotion / beats in whip-like action to propel cell;

B: name: pili/pilus

function: used for adhesion (to another cell/surface) / transfer of genetic material (between cells);

ECF, for one mark, can be applied if both parts of the pair are reversed.

[2]

(b) Award [1] for a similarity.

both have a plasma/cell membrane/ribosomes/cytoplasm/genetic material;

Award up to [2] for differences. Candidate must make a valid comparison, not simply describe each. Award [2 max] if features of prokaryotic and eukaryotic cells are not compared directly, item by item, although a table is not necessary.

| Prokaryote | Eukaryote |
|--------------------------------------------|------------------------------------------------------------------------------------------------------|
| naked DNA | DNA associated with proteins; |
| DNA in cytoplasm / no nucleus | DNA enclosed in nuclear envelope/membrane / nucleus; |
| <u>70S</u> ribosomes | <u>80S</u> ribosomes; |
| no membrane-bound organelles | internal membranes that form membrane-bound organelles; |
| circular chromosome | linear chromosomes; |
| fission | mitosis; |
| no introns or exons | introns and exons; |
| smaller in size (approximately) 10 microns | larger in size up to (approximately) 100 microns; |
| cell wall present | cell wall only present in <u>plants/fungi</u> ; <i>Do not accept cell wall sometimes present.</i> |

[3 max]

3. (a) site on surface/portion of the enzyme/protein to which the substrate binds [1]
- (b) enzymes fit together with substrates similar to a lock and key;
 active site has shape that gives specificity;
 enzymes catalyze a reaction with a specific substrate;
 example of named enzyme and its substrate;
 substrate held precisely in (optimum) position to make/break bonds/carry out reaction / chemical interaction occurs between enzyme and substrate; [3 max]
Accept these points shown in an annotated drawing.

4. (a) (from 1960–2005) atmospheric CO₂ concentration increases/strong positive trend / increase between 1960–2005 of 65 ppm/figures to that effect;
 CO₂ released by human activities contributes to the increase;
 examples of human activities *e.g.* combustion of fossil fuels / deforestation;
 seasonal/annual fluctuations (do not prevent long-term increase); [3 max]
- (b) some human-induced change can be very large/perhaps catastrophic;
 those responsible for the change must prove it will cause no harm before proceeding;
 appropriate (environmental/medical *etc.*) example *e.g.* companies must immediately reduce emission of greenhouse gases even though proof of human impact on global warming is still debated;
 is reverse of historical practice / previously those concerned about change had to prove it will do harm to prevent such changes from going ahead / paradigm shift; [2 max]

5. *Must be genuine differences not descriptions of one type of diabetes followed by description of other type of diabetes. If two totally separate descriptions/no paired statements are written, award [2 max].*

| Type I diabetes | Type II diabetes |
|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| early-onset/childhood diabetes / usually develops in those under 20 years old <i>Do not accept present at birth.</i> | adult-onset diabetes / usually occurs in those over 40 years old; |
| inability to produce sufficient quantities of insulin | inability to respond to insulin (due to insufficient receptors on target cells); |
| target cells remain sensitive to insulin | target cells less sensitive to insulin; |
| genetic predisposition/virus/autoimmune disorder / destruction of (pancreatic) beta cells involved | is linked with dietary/lifestyle factors / increased fatty acids in blood; |
| requires daily injections of insulin / beta cell transplant | controlled by diet/exercise/weight loss/medication but not insulin injections; |

[3 max]

SECTION B

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

6. (a) *Award [1] for each of the following clearly drawn and correctly labelled.*
 phospholipid bilayer – double row of opposing phospholipids, tails to inside;
 phospholipid – with head and two tails;
hydrophilic/phosphate/polar (heads) and hydrophobic/hydrocarbon/fatty acid/non-polar (tails) labelled;
 integral protein – embedded in the phospholipid bilayer;
 protein channel – integral protein showing clear channel/pore;
 peripheral protein – on the surface;
 glycoprotein – with carbohydrate attached on one side;
 cholesterol – shown embedded in bilayer; **[5 max]**
- (b) vesicles formed from rER transport proteins to Golgi apparatus;
 these vesicles fuse with membranes of Golgi apparatus;
 proteins are processed as they move through Golgi apparatus;
 (transport) vesicles bud off/leave Golgi apparatus;
 vesicles move through cytoplasm;
 (vesicles) fuse with plasma membrane;
 contents released to outside of cell / exocytosis;
 cells use vesicles to secrete substances such as hormones/digestive enzymes/other appropriate example;
 vesicles may contain cell products other than proteins; **[6 max]**
Credit drawings which fully explain the points above.
- (c) *To achieve [1] answer must name the structure and relate it to its function.*
 the villus has a large surface area to volume ratio;
 microvilli increase surface area for absorption;
 thin surface (epithelial) layer so products of digestion can pass easily through;
 channel proteins located in plasma membrane used for facilitated diffusion;
 network of capillaries inside each villus (so only short distance) for movement of absorbed products;
 capillaries transport absorbed nutrients/sugars and amino acids away from small intestine;
 blood flow in capillaries maintains concentration gradient;
 central lymph vessel/lacteal to transport absorbed fats/fatty acids away from small intestine;
 large number of mitochondria provide ATP needed for active transport;
 protein pumps in membrane (of microvilli) carry out active transport;
 pinocytosis occurs at surface (epithelial) layer; **[7 max]**
Accept any of the points above shown in a drawing.

(Plus up to [2] for quality)

7. (a) *e.g.*

○ phosphate;
 ◡ deoxyribose;
 □ (nitrogenous) base / specific name *e.g.* adenine, thymine, guanine, cytosine;
 — covalent bond;

[3 max]

Award [1] for each labelled item shown above.

Award [2 max] if the two nucleotides are not shown in a single strand.

- (b) plasmid removed from bacteria;
 plasmid cleaved/cut open by restriction enzymes;
 desired gene/DNA extracted from donor;
 DNA from donor cleaved using same restriction enzyme;
 results in sticky ends;
 with complementary base sequences;
 pieces of DNA from two organisms mixed;
 ligase used to splice pieces (DNA);
 recombinant plasmids formed;
 insertion into host cells;
- [6 max]**
- (c) translation is the synthesis of proteins/polypeptide chain/specific sequence of amino acids;
 translation occurs in cytoplasm/ribosomes;
 uses information on the mRNA;
 mRNA carries the genetic information of DNA;
 mRNA binds to ribosome;
 mRNA contains series of codons/base triplets;
 tRNA binds with an amino acid and carries it to the ribosome;
 tRNA has the anticodon that is complementary to the codon on the mRNA;
 two tRNAs bind to a ribosome/mRNA at the same time;
 (peptide) bond forms between two amino acids (carried by tRNA molecules to the ribosome);
 the first tRNA detaches, ribosome moves along mRNA and another tRNA carrying an amino acid binds;
 process repeats forming chain of amino acids/polypeptides;
- [9 max]**

(Plus up to [2] for quality)

8. (a) Award [1] for each of the following structures clearly drawn and correctly labelled. Adjacent structures mentioned in each marking point must be recognizable in the drawing for the mark to be awarded, but need not be correctly labelled.

testes/testis – shown inside scrotum;

scrotum – shown around testes;

sperm duct/vas deferens – shown connected to urethra;

penis/erectile tissue – penis shown with erectile tissue inside;

urethra – shown linking bladder / upper side of prostate gland to end of penis;

epididymis – shown connected to sperm duct;

seminal vesicle – shown branched off sperm duct (not off the urethra);

prostate gland – shown positioned where sperm duct connects with urethra;

bladder – showing urethra leading away;

[5 max]

- (b) two sex chromosomes are X and Y;
one sex chromosome inherited from each parent;
XX results in female;
XY results in male;
sex determined by sperm/father;
sex-linked genes are those located on the sex chromosomes / usually refers to genes on X chromosome;
recessive sex-linked traits appear more frequently in males since they only have one X chromosome;

hemophilia is an example of a gene located on the X chromosome/sex-linked;

female carriers are heterozygous / $X^H X^h$;

males with hemophilia are $X^h Y$ / normal males are $X^H Y$;

sons (of carrier females) have 50% probability of showing the trait (even if father is normal);

daughters ($X^h X^h$) of hemophiliac father and carrier mother can be affected / daughters who receive an affected X from each parent will have hemophilia;

[7 max]

The points above can be gained by annotated Punnett squares.

Candidates may introduce a lettering system for haemophilia genotypes which does not include H and h. Accept other letters for superscripts, but same alphabetical letter should be used throughout, dominant form should appear as upper case letter and recessive as lower case letter.

- (c) *To award full marks, discussion must contain both pro and con considerations.*

pros/positive considerations: [3 max]

chance for infertile couples to have children;
decision to have children is clearly a conscious one due to difficulty of becoming pregnant;
genetic screening of embryos could decrease suffering from genetic diseases;
spare embryos can safely be stored for future pregnancies/used for stem cell research;

cons/negative considerations: [3 max]

IVF is expensive and might not be equally accessible;
success rate is low therefore it is stressful for the couple;
it is not natural/cultural/religious objections;
could lead to eugenics/gender choice;
could lead to (unwanted) multiple pregnancies with associated risks;
production and storage of unused embryos / associated legal issues / extra embryos may be used for (stem cell) research;
inherited forms of infertility might be passed on to children;

[6 max]

Accept any other reasonable answers.

(Plus up to [2] for quality)
