



MARKSCHEME

May 2013

BIOLOGY

Standard Level

Paper 2

9 pages

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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.
2. Each marking point has a separate line and the end is shown 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 **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. When marking indicate this by adding **ECF** (error carried forward) on the script.
10. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

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** (eg 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 marks.
- ◆ Indicate the award of quality marks by stamping **Qcl** or **Qst**, or both in **red** at the end of the answer and enter a quality mark of 0, 1 or 2 in the mark panel.

SECTION A

1. (a) 0.38 (*allow any value in the range 0.37–0.39*) [1]
- (b) as the ratio increases, the symptoms decrease;
between 0 and 0.16 (*accept 0.14 – 0.18*) symptoms decrease/are moderate;
between 0.16 (*accept 0.14 – 0.18*) and 0.4 (*accept 0.38 – 0.42*) symptoms are mild;
between 0.38 and 0.41 mice may have mild or no symptoms;
after 0.4 (*accept 0.38 – 0.42*) there are no symptoms; [3 max]
- (c) a. (ratio would have been) 0.5/1 to 2;
b. no symptoms; [2]
- (d) $90 \mu\text{m}^2$ (*accept 75 – 100*) (*units required*) [1]
- (e) higher/highest median area of synapses;
higher/highest maximum/minimum area of synapses;
higher/highest 25th/75th percentile; [2 max]
- (f) the higher the rAChE, the milder the symptoms/damage (first graph);
with or without OP, rAChE decreases area of synapses / rAChE reduces the damage to synapses (second graph);
(but still) some increase in area/damage to synapses (with OP) even with rAChE;
the study was done on mice with no evidence that its results extend to humans; [2 max]
2. (a) (i) Golgi apparatus/complex/body [1]
Reject Golgi vesicle and Golgi unqualified.
- (ii) endocytosis/phagocytosis/pinocytosis [1]
Reject exocytosis.
- (b) fluidity of membrane allows change of shape/invagination/formation of vesicles;
phospholipids can move / phospholipid bilayer makes membrane fluid/flexible;
weak bonding between phospholipid tails;
bends/kinks in the phospholipid tails prevent close packing;
cholesterol affects membrane fluidity; [2 max]
- (c) moves substances up/against a concentration gradient / from lower to higher concentration;
protein/pump (in membrane) that moves material; (*reject channels*)
ATP is used; (*reject energy alone*)
example/labeled diagram showing mechanism; [3 max]

3. (a) autotrophs make their own food/organic molecules/organic matter and heterotrophs feed on/obtain their food/organic molecules from other organisms; autotrophs use/require inorganic molecules/CO₂ and heterotrophs require (complex) organic molecules; [2]
- (b) (i) Cnidaria have radial symmetry while Mollusca have bilateral symmetry; Cnidaria have tentacles/nematocysts/stinging cells while Mollusca do not; Mollusca (may) have a (hard) shell while Cnidaria do not; Mollusca have a mouth and anus while Cnidaria have only one opening; Mollusca have a muscular/large foot while Cnidaria do not; other valid external difference; [1 max]
- (ii) Annelida are segmented while Mollusca are not (visibly segmented); Annelida may have bristles/chetae/chaetae while Mollusca do not; Mollusca (may) have a (hard) shell while Annelida do not; Mollusca have a muscular/large foot while Annelida do not; other valid external difference; [1 max]
4. (a) growth (of cells); transcription/protein synthesis/translation; DNA replication / genetic material copied; production of organelles/mitochondria/chloroplasts; named normal activity of cell (*eg active transport, movement, secretion*); [3 max]
NB Do not accept G1, S, G2 unless linked to correct process.
- (b) metaphase showing chromosomes on equator with spindle fibres; *Chromosomes must be shown as two chromatids ie 2 strands.* anaphase showing single-stranded chromosomes with spindle fibres migrating to poles; [2]
Award [1 max] if plasma membrane not shown.
- (c) sexual reproduction promotes variation in species; independent assortment of genes / random orientation of chromosomes in metaphase/meiosis; crossing-over provides new combinations of alleles; production of great variety of gametes (by meiosis) / different combinations of chromosomes in gametes; (random) combination of gametes from both parents (in fertilization); (genetic) variation allows natural selection which leads to evolution; [3 max]

SECTION B

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

5. (a) water is a polar molecule / hydrogen bonding;
 (makes it) (versatile) solvent;
 example of dissolved substance (*eg* salts/proteins or other example);
 (water is) fluid/liquid at body temperature;
 example of transported material (*eg* nutrients/metabolic wastes/gases/
 hormones/blood cells or other example);
 high heat capacity/specific heat allows water to carry heat without warming up;
 (allows) blood to move heat (for warming/cooling/homeostasis); **[4 max]**
- (b) *Arteries: [3 max]*
 thick walls to withstand high pressure/maintain blood flow/pressure;
 collagen fibres/elastic fibres/connective tissue (in outer layer) give wall
 strength/flexibility/ability to stretch and recoil;
 (smooth) muscle layer (contracts) to maintain pressure;
 narrow lumen maintains high pressure;
 smooth endothelium for efficient transport/reduced friction;
- Capillaries: [3 max]*
 wall has one layer of cells allowing (fast) diffusion of substances;
 pores to allow lymphocytes/plasma to exit / to increase permeability;
 extensive branching increases surface area for exchange of materials;
 small diameter allows them to fit between cells/perfuse tissue;
 narrow diameter increases oxygen diffusion from RBC;
- Veins: [3 max]*
 thin walls allow (skeletal) muscles to exert pressure on veins;
 thin outer layer of collagen/elastic/muscle fibres provide structural support;
 wide lumen allows great volume of blood to pass;
 valves prevent backflow; **[8 max]**
NB Every structure requires a function for the mark.
- (c) leucocytes/phagocytes/macrophages can recognize pathogens/foreign matter;
 (phagocytes) engulf pathogens by endocytosis/phagocytosis;
 migration to tissues/squeezing out of capillaries;
 each pathogen has specific antigens;
 leukocytes/lymphocytes produce antibodies by reacting to specific antigen/
 pathogens;
 antibody joins to (specific) antigen inactivating/destroying them;
 lymphocyte makes a clone/copies itself;
 thus increasing the total number of (specific) antibodies; **[6 max]**

(Plus up to [2] for quality)

6. (a) blue and red light absorbed (the most);
greatest absorption in blue light;
red light absorbed in high amounts;
least/no absorption of green light / green light is reflected/transmitted; [4]
Allow answers shown in an annotated diagram/graph.

- (b) *Relationship between photosynthesis and carbon dioxide concentration: [4max]*
photosynthesis uses carbon dioxide;
CO₂ fixed/made into organic molecules/compounds by photosynthesis;
lowering carbon dioxide level in atmosphere;
annual/seasonal fluctuations of carbon dioxide levels could be related to
photosynthesis;
caused by increased photosynthesis during spring/summer;

Consequences: [5 max]

enhanced greenhouse effect caused by raised levels of carbon dioxide;
causing global warming;
rising of ocean levels / melting of polar ice caps/glaciers;
changes in weather (patterns);
ocean acidification;
alter food webs;
changes/loss of habitat;
changes in distribution of plants and animals;
may lead to extinction;

[8 max]

- (c) precautionary principle is a guideline for decision-making;
some human-induced change can be very large/perhaps catastrophic;
those responsible for the change must prove it will cause no harm before
proceeding;
those opposing the change do not have to prove that there will be harm;
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;
an example of application of the principle;
a second example;

[6 max]

NB Any example cited must include action and purpose of action as in each of these:

- *company reducing greenhouse gas emission to lessen effect on global warming, even though human impact on global warming is still debated*
- *proving that a GMO (eg BT corn) will not harm unintended species (eg butterflies) before widespread use*
- *testing a new drug to avoid any harmful effects it may have on general population*
- *delaying dam construction until it is shown that dam will not harm endangered plants/animals/archeological treasures in ecosystem.*

(Plus up to [2] for quality)

7. (a) *codominant allele*: (pair of) alleles that both affect the phenotype when present in a heterozygote / both alleles are expressed;
recessive allele: an allele that produces its characteristic phenotype only when present in homozygous state / is expressed when dominant allele not present;
locus: the (particular) position of a gene on a chromosome/homologous chromosomes;
sex linkage: a gene located on a sex chromosome/X/Y/X or Y chromosome; [4]

(b) *Example / annotated Punnett grid showing a cross between blood groups showing:*
 parental genotype (for example I^Ai and I^Bi therefore A and B phenotypes);
 gametes of one parent; (*shown in Punnett grid*)
 gametes of other parent; (*shown in Punnett grid*)
 genotypes of offspring; (*shown in Punnett grid*)
 phenotypes of offspring expressed as a ratio or possibly in the Punnett grid;
 blood group different to parent shown and identified (*ie ii is blood group O*); [6]
Award [4 max] if correct notation not used.
Award [2 max] if Punnett grid is not used.

NB Other possible crosses could be used as long as the offspring include one or more offspring of a different phenotype from either of the parents.

(c) hemophilia is due to a recessive allele/is a recessive trait / X^H is normal allele and X^h is hemophilia allele;
 hemophilia is sex linked;
 allele/gene is on the X chromosome;
Reject disease/hemophilia carried on X chromosome.
 (sex chromosomes in) females are XX while males are XY;
 Y chromosomes do not have the allele/hemophiliac males are X^hY;
 males inherit their X chromosome from their mother/do not pass the allele to sons;
 males have only one copy so recessive trait/allele is not masked;
 males have a 50 % chance of hemophilia/receiving the allele if mother is a carrier;
 carrier is heterozygous for the gene/is X^HX^h;
 dominant/normal allele masks the recessive allele (so clotting is normal);
 females inherit one X chromosome from father and one from mother;
 affected/hemophiliac males have carrier daughters;
 hemophilia allele could have been inherited from either parent; [8 max]
Accept the points above explained either in text or clearly using a Punnett grid or genetic diagram but not for simply reproducing an unlabelled Punnett grid or diagram without explanation.

(Plus up to [2] for quality)