M08/4/BIOLO/HP2/ENG/TZ2/XX/M

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MARKSCHEME

May 2008

BIOLOGY

Higher Level

Paper 2

14 pages

Subject Details: Biology HL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A **[32 marks]** and **TWO** questions in Section B **[2 × 20 marks]**. Maximum total = **[72 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 markscheme, 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 sheet.

Section B

Extended response questions - quality of construction

- Extended response questions for HL 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 the ***[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) 23:00 h (hours); *(units not required)* ***[1]***

(ii) 37.1°C *(units required)* ***[1]***
Accept less precise answers in the range 37.05°C to 37.15°C.

(b) all drop in (core) temperature with the light on/between 7:00 and 9:00 / with light off (core) temperature is higher;
all rise after 09:00/from 9:00–11:00;
fasting period drops fastest/to lowest level / control period drops the least;
all reach about 37°C / similar (core) temperature by 17:00;
*Award **[0]** if only values are quoted, without an effective comparison or generalization.* ***[2 max]***

(c) during the night / in dark / at 23:00 / between 19:00 and 5:00;
have higher (core) temperature;
generate more (waste) heat (with more activity); ***[2 max]***

(d) (i) positive / direct / as VO_2/oxygen consumption rate increases (core) temperature increases/*vice versa* ***[1]***

(ii) (aerobic) cell respiration requires oxygen;
if more oxygen is being consumed (per minute);
more heat (energy) is being generated;
more (waste) heat raises (core) temperature; ***[2 max]***

(e) (i) both have similar (range of core) temperatures;
control rats have higher oxygen consumption (for the same core temperature);
correlation is stronger/more linear for control rats / VO_2 values more variable for control rats;
higher slope/faster increase in fasting rats; ***[2 max]***
*Award **[0]** if only values are quoted, without an effective comparison or generalization.*

(ii) fasting rats remain immobile / little movement;
huddle together / reduce exposed surface area;
vasoconstriction / no sweating; ***[2 max]***

(f) $6.6(\pm 0.1)$°C *(units required)* ***[1]***
Calculation is not required.

(g) leptin increases both the (core) temperature and oxygen consumption/ VO_2;
(increases VO_2 indicates) an increase in respiration;
which releases more heat / greater energy expenditure/heat generation; ***[2 max]***

(h) combination of fasting and light decrease (core) temperature (in rats) / *vice versa*;
leptin/hormone increases (core) temperature;
leptin/hormone seems to have a greater effect (% increase) than light and fasting (% decrease);
increased respiration causes increase in (core) temperature;
limited sets of data to determine effect;
variability of data limits strength of conclusion; ***[3 max]***
*Award **[2 max]** if answer only refers to two factors.*

2. (a) (i) prophase I / metaphase I *(must include I)* ***[1]***

(ii) anaphase II *(must include II)* ***[1]***

(b) (i) inheritance of trait/character/characteristic affected by more than one gene/number of genes ***[1]***

(ii) skin colour depends on amount of pigment/melanin;
three/four or more/multiple genes influence human skin colour;
each gene codes for melanin production;
continuous variation of phenotypes (with more genes) / results in a great variety of skin colours;
if all dominant alleles inherited, very dark skin / *vice versa* / example genotypes to illustrate point; ***[2 max]***

3. (a) *Award **[1]** for any three of the following when related to conserving water.*
reduced leaves / spines; *(accept small leaves but do not accept thin leaves)*
CAM/C4 physiology;
rolled leaves;
leaves with hairs;
thick cuticle;
reduced number of stomata;
pits of stomata (with hairs);
water storage tissue; *(reject deep or extended roots)*
low growth form / vertical growth;
annual plants with short-life cycle; ***[3 max]***
Accept only the first three adaptations given.

(b) (i) uric acid ***[1]***
Accept only the first waste product named.

(ii) excreted with little water/as a paste advantage because flight means cannot carry much water ***[1]***
To award the mark both water and flight ideas are required.

(c) (i) *Loop of Henlé:*
increase solute concentration of the medulla/in cells and tissue fluid in medulla / set up osmotic gradient in the medulla;
reclamation of salts <u>and</u> water;
counter current multiplier; ***[1 max]***

(ii) *collecting duct:*
(osmoregluation of water content of blood by) absorbing water (or not) from the urine ***[1]***

(iii) *ADH:*
increases/promotes the re-absorption of water in the <u>collecting duct</u> / makes collecting duct permeable to water ***[1]***

SECTION B

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

4. (a) *Award **[1]** for each of the following clearly drawn and correctly labelled.*
nucleotides – labelled with at least two shown;
sugar, phosphate and base – labelled correctly and positioned in relation to one another; *Accept absence of C5 or A/T/C/G in absence of word "base".*
sugar attached to base – clearly shown linked to C1; *C1 does not need to be labelled.*
deoxyribose – drawn as a pentagon;
covalent bond in S-P backbone/between sugar and base; ***[4 max]***

(b) plasmid – small loops of DNA in bacteria;
remove plasmid from bacteria;
restriction enzyme/endonuclease cuts/cleaves (at target sequence) in plasmid;
sticky ends left/made/added at ends of cut plasmid;
isolate mRNA of specific gene;
DNA copies made with reverse transcriptase / cut donor DNA with the same restriction enzyme;
DNA ligase joins the DNA (to sticky ends) of open plasmid;
(results in) recombinant plasmid;
uptake/insert plasmid to (host) cell;
clone cells; ***[6 max]***
Award credit for any of the above points in clearly drawn and correctly labelled diagram.

(c) helicase uncoils/splits DNA double helix;
RNA primase;
(creates a primer for) DNA polymerase III to bind/begin replication;
deoxyribonucleoside triphosphates (free in cell);
two phosphates removed to release energy;
DNA polymerase III adds nucleotides in 5′ to 3′ direction;
A paired with T / C paired with G;
discontinuous copying / Okazaki fragments / short lengths of DNA formed (between RNA primers) on lagging strand;
continuous on leading strand;
DNA polymerase I removes RNA primers/replaces them with DNA;
DNA ligase joins the fragments;
initiated at many points in the (eukaryotic) chromosomes; ***[8 max]***

*(Plus up to **[2]** for quality)*

5. (a) *Award **[1]** for each of the following clearly drawn and correctly labelled.*
outer membrane;
inner membrane – folded into thin cristae;
cristae – shown as thin;
matrix;
intermembrane space – shown as thin;
(70S) ribosomes;
ATP synthase – shown on the inner membrane surface;
(naked) loop of DNA; ***[4 max]***

(b) *photosynthesis*: ***[3 max]***
chloroplasts/photosystems: for light absorption/photosynthesis;
stroma: light-independent reactions / Calvin cycle;
thylakoid membranes of chloroplast: chemiosmosis / photophosphorylation/light dependent reactions;
thylakoid space: build up H^+ concentration gradient;
inner membrane of thylakoid: electron transfer;
inner membrane: ATP synthesis;

cell respiration: ***[3 max]***
mitochondria: for ATP production/aerobic respiration;
cytoplasm: glycolysis / matrix: Krebs cycle/oxidative phosphorylation/link reaction;
double / inner membranes of mitochondria: chemiosmosis / oxidative phosphorylation;
intermembrane space: build-up H^+ concentration gradient;
inner membrane of mitochondria: electron transfer;
inner membrane: ATP synthesis; ***[6 max]***
Answers must indicate location <u>and</u> process to receive a mark.
Do not award a mark if it is ambiguous whether the candidate is discussing photosynthesis or respiration.

(c) a food chain includes a producer and consumers;
represents the direction of energy flow;
energy loss occurs between trophic levels;
due to material not consumed/assimilated;
and from heat loss due to cell respiration;
energy passed on from one level to next is $10-20\%$;
which limits length of food chain;
photosynthesis / producers convert solar energy to chemical energy (in organic molecules);
consumers obtain necessary energy from eating organisms of previous trophic level;
an energy pyramid shows the flow of energy from one tropic level to the next (in a community);
units are energy per unit area per unit time / $J\,m^{-2}\,yr^{-1}$;
Pyramid of energy – properly drawn, each level no more than one fifth the width of the level below it, with three correctly labelled trophic levels *e.g.* producer, primary consumer; ***[8 max]***

*(Plus up to **[2]** for quality)*

6. (a) *Award **[1]** for each of the following clearly drawn and correctly labelled.*
common/scientific name of plant;
testa / seed coat – shown with some thickness if view is internal;
micropyle;
hypocotyl/radicle/embryo root;
plumule/epicotyl/embryo shoot – epicotyl shown closer to plumule than hypocotyls;
cotyledon; ***[4 max]***
*Award **[3 max]** if dicotyledonous seed not named or if diagram does not match name or if no external view shown.*

(b)

Spermatogenesis	**Oogenesis**
in testis	in ovary;
many functional gametes	one functional gamete;
continuous / starts at puberty	monthly / starts in fetus / ends with menopause;
spermatagonia divide by mitosis (2*n*) / starts with mitosis	oogonia divide by mitosis (2*n*) (in fetus) / starts with mitosis;
spermatagonia grow into primary spermatocytes (2*n*)	oogonia grow into primary oocytes (2*n*) (form primary follicles in fetus);
first meiotic division to two secondary spermatocytes (*n*) / equal division of the cytoplasm	first meiotic division to one large oocyte (*n*) and one polar body (degenerates) / unequal division of cytoplasm;
second meiotic division to four spermatids (*n*)	second meiotic division stopping at prophase II;
spermatids mature / differentiate into spermatozoa	after fertilization second meiotic division completed with a second polar body; ***[6 max]***

*Award **[5 max]** if table is not used.*

(c) meiosis results in four haploid cells/gametes;
random assortment of chromosomes;
in metaphase I;
gives rise to variety of haploid gametes;
2^n possible gametes where *n* is the haploid number;
crossover may occur between homologous chromosomes;
in prophase I;
causes new combinations of genetic material/alleles;
non-disjunction causes changes in chromosome numbers;
infinite variety in gametes;
random process of fertilization;
random process of mating;
new combinations even with same parents;
mutation can occur in prophase I *e.g.* deletion / inversion / translocation; ***[8 max]***

*(Plus up to **[2]** for quality)*

7. (a) natality/immigration causes increased population size;
mortality/emigration causes decreased population size;
predation / disease / any other limiting factor decreases population size;
population change = (natality + immigration) – (mortality + emigration);
natural disasters / density independent factors; ***[4 max]***

(b) pathogen is a disease causing organism/virus;
antigen is foreign protein/molecule in body;
macrophages engulf antigen/pathogen;
display antigen on membrane;
activate helper T-cells;
which activate B-cells;
to divide and clone;
to produce plasma cells;
which produce antibodies;
which inactivate/bind to the antigens;
memory cells for long-term protection; ***[6 max]***

(c) glucose levels increase in blood after eating;
pancreas cells monitor glucose levels;
beta cells (of the islets) in the pancreas detect high glucose levels;
produce insulin;
causes cells to take up glucose (for energy use);
excess stored in liver/muscle as glycogen;
decreases glucose levels;
low glucose levels stimulate alpha (islet) cells in the pancreas;
produce glucagon;
stimulate the release of glucose from liver/breakdown of glycogen;
raises glucose levels;
normal levels of glucose maintained by homeostatic / negative feedback mechanisms; ***[8 max]***

*(Plus up to **[2]** for quality)*