International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

MARKSCHEME

May 2008

BIOLOGY

Higher Level

Paper 2

13 pages

*This markscheme is **confidential** and for the exclusive use of examiners in this examination session.*

*It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of IB Cardiff.*

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 page.

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 <u>heat</u> (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 <u>both</u> 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: presynaptic neuron/(pre)synaptic knob/bulb/bouton;
II: binding site / (post synaptic) receptor for (neurotransmitter); ***[2]***

(b) (i) (Ca^{2+}) diffuses into presynaptic neuron;
causes vesicles to migrate/move to (presynaptic) membrane;
causes vesicles to fuse with (presynaptic) membrane;
causes/leading to exocytosis/release of neurotransmitter/named example; ***[2 max]***

(ii) released in muscle cells under nervous stimulation;
binds to protein/troponin in muscle;
(troponin and) tropomyosin moves away from and uncovers binding sites;
allows myosin (head) to bind to actin (for contraction);
sarcomere shortens; ***[2 max]***

3. (a) (i) one specific/variant/alternative form of a gene on the same locus/position on a chromosome (differing from other alleles); ***[1]***

(ii) changes triplet code/codon;
different amino acid (may be) coded for/inserted;
(may) change protein/polypeptide/primary structure/sequence of amino acids / may code for a different protein;
may cause sickle cell anemia/other correctly named disease / form stop codon; ***[2 max]***

(b) (i) dihybrid cross would give 9:3:3:1 ratio in this F_2 if genes not linked;
(*give credit for punnett grid showing this*)
therefore the genes are linked;
more homozygous recessive offspring / 3:1 ratio expected if linked; ***[2 max]***

(ii) chi-squared (test); (*accept symbol)*
compare observed and expected values/results;
(chi-squared) value is obtained;
statistical table used to determine probability; ***[2 max]***
*No marks if t-test given. **[1]** max if test not named.*

SECTION B

4. (a) *Award **[1 max]** for every structure accurately drawn and correctly labelled.*
sepal;
petal;
anther;
filament;
stigma;
style;
ovary/ovule;
nectar/pedicel/receptacle; ***[5 max]***

(b) homologous chromosomes pair/form bivalents/undergo synapsis;
crossing over / gene exchange / chiasma formation;
in prophase I;
produces new combinations / recombination of alleles/genes;
random orientation of homologous (chromosome) pairs/bivalents in metaphase I;
random orientation of (sister) chromatids in metaphase II;
or accept clear annotated diagram of above.
2^n possibilities/combinations of chromosomes (n = haploid number);
non-disjunction changes chromosome number; ***[5 max]***

(c) plants produce huge amounts of pollen/ovules/seeds;
(overproduction) leads to struggle for survival;
variety caused by sexual reproduction;
fertilization is random;
variety caused during meiosis/recombination;
variety caused by mutations;
change in environmental conditions occurs;
plants with the most favourable variations/best suited survive/are selected;
reproduce and pass on (favourable) genes;
in different (environmental) conditions different plants have better/more suited traits/characteristics so different plants survive;
reference to geographic isolation;
formation of reproductive barriers / isolation;
over time/over many generations new species develop; ***[8 max]***

5. (a) diffusion is the movement of particles down a concentration gradient / higher to lower concentration / is passive;
osmosis is passive transport / diffusion <u>of water</u>;
osmosis is movement from lower solute concentration to higher / higher to lower water potential;
facilitated diffusion involves channels (in membranes);
active transport requires protein pumps/ATP/energy;
active transport is movement against concentration gradient;
correct reference to endocytosis/exocytosis/pinocytosis; ***[4 max]***

(b) root hairs/epidermal cells take up water by osmosis;
correct reference to root pressure;
symplastic pathway through <u>cytoplasm</u> (of cells);
by diffusion / down concentration gradient;
apoplastic pathway through (cortex) <u>cell walls</u>;
by capillary action;
Casparian strip blocks apoplastic pathway;
water passes into xylem;
transpiration causes the pull of water/transpiration stream (through plant); ***[6 max]***

(c) maintenance within narrow limits / constant level;
by negative feedback (mechanisms);
occurs in nephron (of kidney);
collecting duct is main site of osmoregulation;
water levels (in blood) detected / monitored;
by hypothalamus;
if (blood) water level is low (more) ADH is secreted;
by pituitary gland;
collecting duct (and distal convoluted tubule) more permeable;
correct reference to aquaporins;
more water reabsorbed;
urine concentrated;
if water level is high ADH not secreted / less ADH secreted;
less water reabsorbed;
urine dilute; ***[8 max]***

6. (a) primary structure/level: order/sequence of amino acids;
linked by peptide bonds;
determines the type/function of protein / 2º and 3º structures;

secondary structure/level: regular folding / beta-pleated sheets / spiralling / alpha-helices;
held through hydrogen bonding;

tertiary structure/level: 3-dimensional conformation of a polypeptide/protein;
held with ionic bonds, hydrogen bonds, disulfide bonds/bridges and hydrophobic bonds; (*must give at least two bonds*)
determines overall shape / a named example *e.g.*: active sites on enzymes; ***[5 max]***
*To receive full marks the candidate must mention each of the three levels, otherwise award **[4 max]**.*

(b)

Characteristic	Competitive inhibition	Non-competitive
inhibitor:	structurally/chemically very similar to substrate	different from substrate;
site of binding:	active site	binds to different site / not active site / allosteric site;
effect:	blocks active site	changes 3° structure of enzyme / conformational change of active site;
effect:	competes with substrate / prevents substrate binding	substrate cannot bind / reaction not catalyzed / decreased enzyme activity;
example:	Butanedioic acid (succinate) dehydrogenase by propanedioic (malonate) acid in the Krebs cycle / any valid example *e.g.* Folic acid synthesis in bacteria by sulfonamide Prontosil;	metal ions / Hg^{+} / Ag^{+} / Cu^{2+} / CN^{-} inhibit enzymes (cytocrome oxidase) by breaking disulfide linkages / any valid example;
effect of substrate concentration:	can be reduced by increasing substrate concentration	increasing substrate concentration does not reduce effect of inhibitor;

*Award **[1]** for every correct comparison/row. 4 max if no table.* ***[5 max]***

(c) antigens stimulate an immune response;
antibodies are produced in response to specific antigens;
antibodies are made by B-cells/lymphocytes/plasma cells;
antigen is engulfed by macrophages;
antigen is presented on macrophage membrane;
helper T-cells bind to antigen (on macrophage);
helper T-cells are activated;
helper T-cells activate B-cells;
B-cells clone;
into plasma cells and memory cells;
plasma cells produce specific antibodies to the antigen;
memory cells for long-term immunity;
a faster/stronger response later; ***[8 max]***

7. (a) (a pyramid of energy is) a diagram to show decreasing amounts of energy in successive trophic levels;
producers at the base and secondary/tertiary consumers at the top;
if diagram is drawn it must be labelled and show relative sizes.
10-20 % passed / on 80-90 % less in each successive level;
energy is used (by organisms) / lost at each trophic level;
energy is released in all respiration/lost as heat;
not all tissues are eaten *i.e.* bones/hair/cellulose / some tissues are egested/undigested / some organisms die before being eaten; ***[4 max]***
*max **[3]** marks if no reasons given.*

(b) light energy absorbed by chlorophyll (photo) activates photosystems;
electron in chlorophyll/photosystem activated/excited / raised to higher energy level;
photolysis of water replaces excited electrons;
energy passed through electron carriers/ETS;
hydrogen/high energy electrons reduce $NADP^+$;
photophosphorylation by chemiosmosis;
(some) H^+/protons pumped into thylakoid spaces;
proton gradient is created;
energy released as protons pass through ATP synthetase;
ATP produced;
correct reference to (non cyclic or cyclic) photophosphorylation;
glucose/sugar/monosaccharide produced in Calvin cycle; ***[6 max]***
Credit can be given for any of these points shown on a correctly drawn and labelled diagram.

(c) organic compounds release energy in stages; (*accept glucose*)
some ATP is produced (by substrate level phosphorylation) in glycolysis;
in link reaction acetyl CoA produced from (pyruvate);
acetyl group/2C joins a 4C sugar/oxaloacetate in the Krebs cycle to form a 6C sugar/citrate;
(two) decarboxylations/release of CO_2 back to 4C sugar;
oxidation of sugars / removal of H atoms;
NAD^+/FAD carry H^+/protons to electron transport chain;
energy released in electron transport chain/ETS;
pump H^+/protons between mitochondrial membranes to produce proton gradient / chemiosmosis;
protons pass/diffuse through ATP synthetase and ATP is produced;
by oxidative phosphorylation;
oxygen required as final electron receiver/terminal acceptor; ***[8 max]***
Credit can be given for any of these points shown on a correctly drawn and labelled diagram.