M10/4/BIOLO/HP2/ENG/TZ1/XX/M+

International Baccalaureate®
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# MARKSCHEME

## May 2010

## 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) oxygen concentration falls as temperature rises / negative correlation/inverse relationship;
steady decline below 4.2/4.3/4.4 °C / vice versa:
rapid decrease between 4.2/4.3/4.4 °C and 5 °C;
zero oxygen concentration at/above 9 °C; ***[2 max]***

(ii) warmer water can hold less oxygen / lower oxygen solubility as temperature rises;
lower oxygen concentration of water reaching gills / less oxygen available from the water to diffuse into the gills;
higher metabolic rate / faster rates of respiration / more oxygen consumption as temperature rises; ***[2 max]***

(b) not enough energy/ATP/aerobic respiration (for muscle contraction/movement) ***[1]***

(c) (i) rising trend overall;
annual rise and fall / fluctuations; ***[2]***

(ii) ($CO_2$ emissions from) increased burning of fossil fuels/deforestation/other anthropogenic factor;
variation in photosynthesis rates during the year / variations in $CO_2$ uptake in the oceans; ***[2]***

(d) (i) diffusion in both directions during each year;
diffusion from atmosphere to water during most of the year;
diffusion from water to atmosphere for part of year/autumn/fall/seasonal;
increasing diffusion from water to atmosphere in later years; ***[2 max]***

(ii) (no net diffusion because) concentrations will become equal / there will be no gradient;
water concentration higher than atmospheric concentration as often as atmospheric concentration higher than water concentration; ***[1 max]***

(e) (i) 300 ppm *(Allow answers in the range 295–305 ppm) unit must be included to earn mark.* ***[1]***

(ii) 3.3 °C *(Allow answers in the range 3.0–3.3 °C) unit must be included to earn mark.*
***N.B.*** *A maximum of* ***[1]*** *per exam can be deducted for a missing unit.* ***[1]***

(f) positive correlation / higher temperature with higher $CO_2$ concentration ***[1]***

(g) oceans may cease to act as sink / store for $CO_2$;
atmospheric $CO_2$ concentration may then rise more rapidly;
atmospheric $CO_2$ concentration is higher than for at least 400 000 years/any time in recent (geological) time;
Antarctic temperatures will (probably) rise higher than at any time in 400 000 years/any time in recent (geological) time;
rising (sea water) temperature would reduce oxygen availability in water;
significant changes in habitat/abiotic factors;
populations may not be able to adapt; ***[3 max]***

**2.** (a) fructose/ribose/ribulose/deoxyribose other monosaccharides apart from glucose and galactose ***[1]***

(b) (i) disaccharide ***[1]***

(ii) hydrolysis ***[1]***

(c) it allows people who are lactose intolerant/have difficulty digesting lactose to consume milk (products);
galactose and glucose taste sweeter than lactose reducing need for additional sweetener (in flavoured milk products);
galactose and glucose are more soluble than lactose / gives smoother texture / reduces crystalization in ice cream;
(bacteria) ferment glucose and galactose more rapidly (than lactose) shortening production time (of yoghurt/cottage cheese); ***[3 max]***

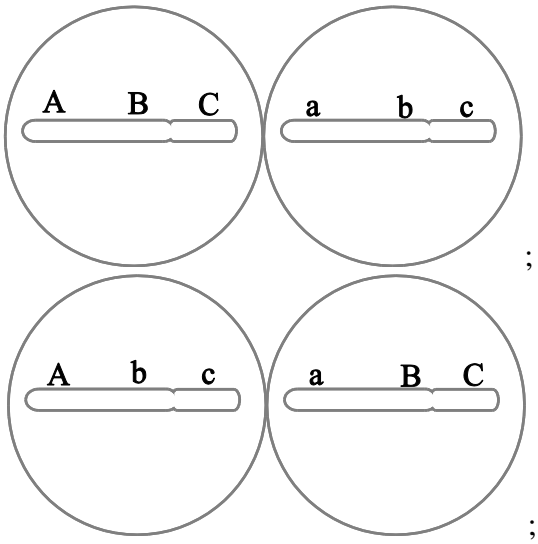
(d) less denaturation / enzymes last longer at lower temperatures;
lower energy costs / less energy to achieve 5 °C compared to 48 °C;
reduces bacterial growth / reduces (milk) spoilage;
to form products more slowly / to control the rate of reaction; ***[2 max]***

**3.** (a) (i) autosomes because the sex chromosomes/X and Y chromosomes would be different lengths/sizes / would have different genes ***[1]***

(ii) homologous because they have paired/formed a bivalent / tetrad / there is crossing over between the chromosomes / they have the same genes (in the same sequence) / they are the same size and shape ***[1]***

(b) first prophase/first metaphase/prophase I/metaphase I ***[1]***

(c)




;

;

*Allow **[1]** only if the C allele is not on the short arm or the A and B alleles are not on the long arm. Use a maximum of two ticks in your marking.* ***[2]***

(d) (gene) linkage / autosomal linkage ***[1]***

## SECTION B

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

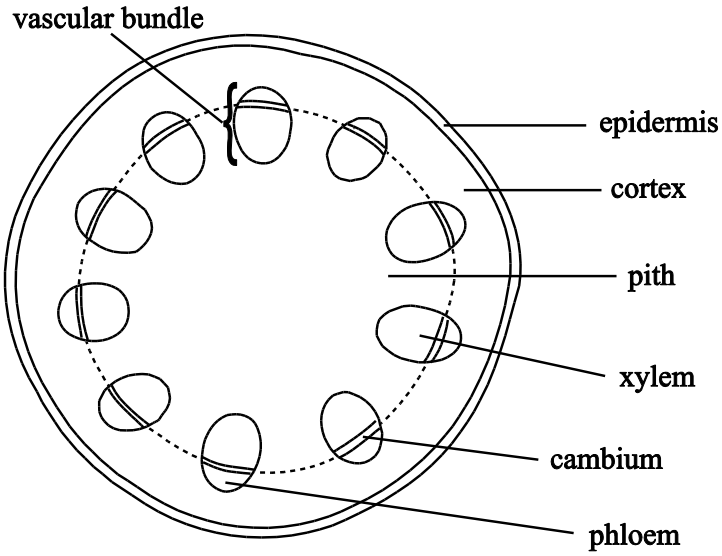
**4.** (a) plasma/water;
dissolved gases / $CO_2$ / $O_2$;
erythrocytes / red blood cells;
leucocytes / white blood cells;
lymphocytes and phagocytes;
platelets;
hormones / named hormone(s);
amino acids / albumin / antibodies;
salts / minerals / ions other named solute in plasma apart from glucose, urea and plasma proteins; ***[5 max]***

(b) blood glucose concentration monitored by pancreas/islets/beta cells;
(more) insulin secreted in response to high blood glucose / glucose above threshold level;
insulin stimulates cells to absorb glucose;
glucose used in cell respiration (rather than lipids);
glucose converted to glycogen;
by liver/muscle cells;
glucose converted to fatty acids / triglycerides / fat;
negative feedback process; ***[5 max]***
*Accept these points if clearly made in an annotated diagram.*

(c) (filtrate formed by) ultrafiltration;
glucose / amino acids / soluble components enter Bowman's capsule;
proteins in blood plasma but not in filtrate / proteins not filtered out (of blood);
glucose not in urine (normally);
(selective) reabsorption (of glucose);
in the proximal convoluted tubule;
by active transport / microvilli increase the surface area;
little/no urea reabsorbed
concentration increases / urea more concentrated in urine than in blood plasma;
water reabsorbed from filtrate;
by osmosis;
in descending limb of nephron / in proximal convoluted tubule;
salts actively transported into the medulla (from filtrate);
creating concentration gradient/hypertonic medulla;
collecting duct permeability altered depending on blood solute concentration; ***[8 max]***

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

**5.** (a) *Award **[1]** for each of these structures clearly drawn and labelled.*
epidermis shown on the outside with thickness less than 10 % of overall diameter;
cortex labelled between the outer layer of the stem and the vascular bundles;
xylem shown on the inner side of the vascular bundles;
phloem shown on outer side of the vascular bundles;
vascular bundle with some way of indicating the entire structure;
pith shown in centre;
cambium shown between xylem and phloem; ***[5 max]***




(b) mineral ions are absorbed by active transport;
large surface area;
branching (increases surface area);
root hairs;
root hair cells have carrier protein/ion pumps (in their plasma membrane);
(many) mitochondria in root (hair) cells;
to provide ATP for active transport;
connections with fungi in the soil/fungal hyphae; ***[5 max]***

(c) photosynthesis rate increases as temperature rises (up to an optimum temperature);
(due to) increase in the rate of enzyme catalysed reactions/light independent reactions/the Calvin cycle;
(steep) drop in rate of photosynthesis above the optimum;
at high temperatures enzymes/Rubisco/RuBP carboxylase denature(s);
graph with correctly labelled axes showing relationship between temperature and rate of photosynthesis;
transpiration rate increases as temperature rises;
(energy/heat leads to more) to more evaporation of water (in the leaf);
faster diffusion of water vapour at higher temperatures;
relative humidity falls as temperature rises / warmer air can hold more water vapour;
stomata may close at very high temperatures reducing the transpiration rate;
some plants open their stomata at very high temperatures to cool by transpiration; ***[8 max]***

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

**6.** (a) *name of component* ***[1 max]*** *e.g.* plant cell wall/cellulose/interstitial matrix/basement membrane/glycoprotein/bone matrix;

*functions* ***[3 max]***
*EITHER*
*e.g.* (plant cell wall) strengthens/supports the cell/plant (against gravity);
prevents the entry of pathogens;
maintains the shape of plant cells;
allows turgor pressure/high pressure to develop inside the cell;
prevents excessive entry of water to the cell;

*OR*
helps cells to stick together/adhere;
needed to hold cells/tissues together / example of cells/tissues holding together;
forms interstitial matrix / forms basement membrane to support single layers of cells;
*e.g.* around a blood capillary;
forms (part of the) filtration membrane in the glomerulus; ***[4 max]***

(b) vesicles carry material to plasma membrane;
vesicle fuses with membrane;
(by joining of) phospholipid bilayers;
aided by the fluidity of the membrane;
material released/expelled from the cell;
membrane flattens;
name of example *e.g.* exocytosis of neurotransmitter / exocrine secretion/endocrine secretion / hormone secretion / release of cortical granules;
outline of example: (in the presence of calcium), neurotransmitter vesicles release their contents into the synapse / hormones released from one cell have an effect on another cell *etc*.; ***[5 max]***
*Accept these points if clearly made in an annotated diagram.* ***[4 max]*** *if no example given.*

(c) translation involves initiation, elongation/translocation and termination;
mRNA binds to the small sub-unit of the ribosome;
ribosome slides along mRNA to the start codon;
anticodon of tRNA pairs with codon on mRNA:
complementary base pairing (between codon and anticodon);
(anticodon of) tRNA with methionine pairs with start codon / AUG is the start codon;
second tRNA pairs with next codon;
peptide bond forms between amino acids;
ribosome moves along the mRNA by one codon;
movement in 5′ to 3′ direction;
tRNA that has lost its amino acid detaches;
another tRNA pairs with the next codon/moves into A site;
tRNA activating enzymes;
link amino acids to specific tRNA;
stop codon (eventually) reached; ***[9 max]***

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

**7.** (a) *Award **[1]** for each pair of statements in the table and **[1]** for any statement below the table.*

| Unique sequences | Highly repetitive sequences |
|---|---|
| occur once in genome | occur many times; |
| long base sequences | short sequences/5–300 bases; |
| (may be) genes | not genes; |
| (may be) translated / coding sequences | never translated; |
| small differences between individuals | can vary greatly; |
| exons (are unique sequences) | introns (may be repetitive); |
| smaller proportion of genome | higher proportion of genome; |

satellite DNA is repetitive;
repetitive sequences are used for profiling;
prokaryotes do not (usually) contain repetitive sequences; ***[5 max]***

(b) *Award **[1]** for each of these structures clearly drawn and labelled.*
four nucleotides shown in diagram with one nucleotide clearly labelled;
base, phosphate and deoxyribose (shown as pentagon) connected between the correct carbons and labelled at least once;
backbone labelled as covalent bond between nucleotides correctly shown as 3′ to 5′ bond;
two base pairs linked by hydrogen bonds drawn as dotted lines and labelled;
two H bonds between A and T and three H bonds between C and G;
adenine to thymine and cytosine to guanine; *do not accept initials of bases*
antiparallel orientation shown; ***[5]***

(c) DNA sample obtained;
from hair/blood/semen/human tissue;
DNA amplified / quantities of DNA increased by PCR/polymerase chain reaction;
satellite DNA/highly repetitive sequences are used/amplified;
DNA cut into fragments;
using restriction enzymes/restriction endonucleases;
gel electrophoresis is used to separate DNA fragments;
using electric field / fragments separated by size;
number of repeats varies between individuals / pattern of bands is unique to the individual/unlikely to be shared;
*Award **[5 max]** for methods.*

forensic use / crime scene investigation;
example of forensic use *e.g.* DNA obtained from the crime scene/victim compared to DNA of suspect / other example of forensic use;
paternity testing use *e.g.* DNA obtained from parents in paternity cases;
biological father if one half of all bands in the child are found in the father;
genetic screening;
presence of particular bands correlates with probability of certain phenotype / allele;
other example;
brief description of other example; ***[8 max]***
*Award **[4 max]** for aims.*

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