IBO

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M07/4/BIOLO/HP2/ENG/TZ1/XX/M+

MARKSCHEME

May 2007

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 total ***[32 marks]*** **and any TWO** questions in Section B ***[20 marks]*** each. Maximum total = ***[72 marks]***.

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each marking point has a separate line and the end is signified by means of a semicolon (;).
- An alternative answer or wording is indicated in the markscheme by a "/"; either wording can be accepted.
- Words in (…) in the markscheme are not necessary to gain the mark.
- Words that are <u>underlined</u> are essential for the mark.
- The order of points does not have to be as written (unless stated otherwise).
- If the candidate's answer has the same "meaning" or can be clearly interpreted as being the same as that in the markscheme then award the mark.
- Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalizing them for what they have not achieved or what they have got wrong.
- Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with **"ECF"**, error carried forward.
- Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by **"U-1"** at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

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 <u>relevant</u> 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.

<u>Clarity of expression</u>:

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.

<u>Structure of answer:</u>

The candidate has linked relevant ideas to form a logical sequence within at least two parts [(a), (b), etc.] of the question.

- 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

Accept converse answers.

1. (a) (i) the nearer to the base the insect touches the higher the success rate ***[1]***

(ii) difficult to manipulate insect at tip of long narrow beak;
beak wider open near tip;
base of beak is nearer the esophagus/throat/mouth;
more difficult to escape if insect near base / easier to hold near base; ***[1 max]***
Do not award mark if answer states that the "base of beak is wider than tip".

(b) *shape*:
short / wide; *(accept "thick" if reasoning correct, but reject "large" unqualified)*

reason:
longer beak does not increase chance of catching insect;
wide beak gives greater chance of catching insect / less chance of losing it;
larger area for catching insect with wider beak; ***[2 max]***
*Award **[1]** for shape and **[1]** for a reason.*

(c) lower wing beat frequency with greater body mass / inverse relationship / negative correlation ***[1]***

(d) damage to wing / feathers / joints;
excessive energy requirement / muscles not strong enough;
loss of stability / harder to control hovering; ***[1 max]***
Reject "rising of the humming bird".

(e) wing beat frequency limited by maximum wing tip velocity (of $16\,\mathrm{m\,s^{-1}}$);
wing beat frequency would be too low for hovering; ***[1 max]***

(f) rapid heat loss at lower temperatures;
energy from sucrose/sugar/nectar;
generate (body) heat / keep warm / maintain constant (body) temperature;
appropriate reference to respiration / muscle movement/shivering / metabolic rate; ***[2 max]***

(g) smaller volume of water ingested (therefore smaller volume of urine / more concentrated urine);
loss of water by panting / effects of cooling / evaporation (therefore smaller volume of urine / more concentrated urine); ***[1 max]***

(h) (i) 1.625 : 1 *(accept 1.6 : 1 to 1.64 : 1)* ***[1]***
Reject answers not shown as a ratio to 1.

(ii) higher ammonia concentrations (than 7.8) would be toxic / uric acid is less / non toxic;
(more) ammonia converted to uric acid (at higher temperatures);
less water for urine production / need for water conservation at higher temperatures / more water used for cooling; ***[2 max]***

(i) high energy cost of hovering / (fast) flapping of wings;
high rate of loss of body heat due to high surface area to volume ratio / small body size;
energy costs of converting ammonia to uric acid; ***[2 max]***

2. (a) *Answers must either give DNA characteristic first or specify which is DNA and which is RNA.*
deoxyribose versus ribose;
thymine versus uracil;
two strands versus one / double helix versus single strand; ***[2 max]***

(b) *Award **[2]** for four correct and **[1]** for three or two correct.*
I: small (sub)unit (of ribosome);
II: large (sub)unit (of ribosome);
III: transfer RNA/tRNA;
IV: messenger RNA/mRNA; ***[2 max]***

(c) transfer RNA/tRNA ***[1]***

(d) codon/triplet of bases to amino acid;
nucleic acid / base sequence / (m)RNA to polypeptide / protein / amino acid sequence;
genetic code has to be translated; ***[2 max]***

(e) stop/terminator / nonsense codon (is reached);
polypeptide is released;
mRNA detaches from ribosome;
subunits of ribosome separate; ***[2 max]***
Ignore references to specific codons.

3. (a) not sex-linked because the gene is not on a sex chromosome/X chromosome / is on an autosome ***[1]***
Reject "gene is located on chromosome 5".

(b) dominant;
person with FAP has one mutant and one normal allele of the gene / is heterozygous / if recessive 100 % of gametes have the mutated APC gene; ***[2]***
*Award **[0]** if alleles are identified as "recessive".*

(c) mutation only has to occur once / only one cell needs to have the mutation (to its normal APC gene);
a tumour develops from one cell;
all/huge numbers of cells in the body could become tumour cells;
tumour formation not suppressed if both copies of the APC gene in a cell are mutant; ***[2 max]***

(d) (i) <u>genetic screening</u> ***[1]***

(ii) *advantage*: ***[1 max]***
prevent birth of children with FAP / fewer deaths / less genetic disease;
eliminate mutation from the population;
reduce stress / uncertainty for parents;

disadvantage: ***[1 max]***
allows selection of embryos for implantation (which may be unethical);
leads to the euthanizing of embryos with the mutation (which may be unethical);
expensive procedure; ***[2 max]***
Reject answers relating to abortion.

SECTION B

4. (a) *Award **[1]** for each of the following clearly drawn and correctly labelled.*
phospholipid bilayer-with head and tails;
hydrophilic / phosphate / polar heads and hydrophobic / hydrocarbon / fatty acid / non-polar tails labelled;
protein – globular shape, embedded in the phospholipid bilayer;
integral protein and peripheral protein – embedded and on surface respectively;
glycoprotein with carbohydrate attached on outside;
cholesterol – shown embedded in bilayer;
thickness indicated 10 nm (±3 nm); ***[5 max]***

(b) sodium ions enter the axon/neuron/nerve fibre;
by facilitated diffusion / through (voltage gated) channels;
depolarization / inside becomes positive / inside more positive than outside;
potassium ions leave the neuron;
repolarization / inside becomes negative / outside more positive than inside;
depolarization and repolarization is an action potential/nerve impulse;
action potential propagated / depolarization of next part of axon is triggered;
diffusion of sodium ions to next part of neuron/axon;
reference to local currents;
voltage gated channels open if threshold level is reached;
concentration gradients of Na^+ and K^+ re-established by active transport;
sodium potassium pump/sodium pumped out and potassium pumped in; ***[8 max]***
Accept any of the points above if clearly explained in a diagram.

(c) osmosis;
passive / no energy required;
hypertonic / higher solute / lower water concentration than the soil / outside;
active transport into the root of mineral ions / nutrients;
root hair increases the surface area / has large surface area;
root hairs can absorb water from soil further away from the root;
water absorbed by the cell wall (of the root hair cell) is the apoplastic route; ***[5 max]***
Accept any of the points above if clearly explained in a diagram.

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

5. (a) temperature;
enzyme activity rises as temperature rises upon to an optimum / graph to show this;
rate doubles with each $10\,^{\circ}\mathrm{C}$ increase (up to optimum);
denaturation of enzymes at high temperatures / above the optimum;

pH;
enzyme activity is highest at the optimum pH / graph to show this;
different optimum with different enzymes;
denaturation of enzymes by high and low pH / extreme pHs;

substrate concentration;
enzyme activity rises as substrate concentration rises /graph to show this;
maximum enzyme activity when all active sites occupied;

allosteric factors / effectors / modulators;
bind to site other than active site; ***[6 max]***
Award marks only for the first two factors outlined.

(b) inhibitor binds to enzyme;
inhibitor is non-competitive;
binds at an allosteric site / away from the active site;
shape of active site / structure of enzyme altered / conformational change;
substrate cannot bind / reaction cannot be catalyzed;
early / first enzyme in a pathway is inhibited by product of last reaction;
the higher the end product concentration the higher the inhibition;
avoids a build-up of all the intermediates;
reversible / inhibitor can detach;
pathway restarted when there is a shortage of the end product;
named inhibitor *e.g.* ATP / other example;
named enzyme *e.g.* phosphofructokinase / other example; ***[8 max]***

(c) platelets / damaged cells release clotting factors;
in cuts / on exposure to oxygen;
Ca^{2+} ions and vitamin K necessary;
clotting factors result in production of thrombin;
thrombin catalyses / causes production of fibrin;
fibrinogen converted to fibrin;
fibrin forms a mesh that captures red blood cells; ***[4 max]***

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

6. (a) carbon dioxide to plants/producers by photosynthesis;
carbon dioxide released by respiration in plants/producers;
plants/producers to animals/consumers by feeding / heterotrophic nutrition;
carbon dioxide released by respiration in animals/consumers;
carbon dioxide released by respiration in fungi/bacteria/saprotrophs/decomposers;
formation of fossil fuels and release of carbon dioxide from them by combustion; ***[5 max]***
*Award **[2 max]** if no diagram is provided but above relationships given.*

(b) Calvin cycle;
reactions in the stroma of the chloroplast;
carbon dioxide fixed using / reacts with RuBP / ribulose bisphosphate;
catalyzed by rubisco / ribulose bisphosphate carboxylase;
glycerate 3-phosphate/GP/PGA produced;
glycerate 3-phosphate/GP/PGA is reduced;
(reduction reaction) using NADPH / reduced NADP;
converted to triose phosphate/TP/GP/GALP;
ATP used;
some triose phosphate used to regenerate ribulose phosphate;
five triose phosphates converted into three ribulose phosphates;
some triose phosphate converted to glucose (phosphate) / starch; ***[8 max]***
Accept any of the points above if clearly explained in a diagram.

(c) increased rates of photosynthesis in plants;
<u>increased</u> greenhouse effect /global warming / temperature of Earth rises;
rise in sea levels <u>and</u> flooding;
melting of glaciers / ice caps;
more extreme weather patterns / hurricanes / droughts / changing climate patterns;
loss of habitat for polar bears / other example of effect on living organism;
displacement of ecosystems;
(mass) <u>extinction</u> of species;
changes in ocean currents; ***[5 max]***

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

7. (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;
sperm duct/vas deferens – shown linking to urethra;
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; ***[5 max]***

(b) pairing of homologous chromosomes / formation of bivalents / synapsis;
during prophase I;
crossing over;
exchange of parts of non-sister chromatids / homologous chromosomes;
genes on the same chromosome are linked;
crossing over allows recombination of (linked) genes;
random orientation of (pairs of) chromosomes / bivalents;
in metaphase I;
independent assortment of genes on different chromosome types;
2^n / 2^{23} (in humans) possible combinations of chromosomes;
effectively infinite number of combinations if effects of crossing over are included;
X or Y chromosome in each sperm; ***[8 max]***

(c) differentiation;
spermatids develop into sperm / spermatozoa;
Sertoli cells help / nourish;
development of tail / helical mitochondrion / loss of cytoplasm;
maturation / sperm become able to swim in the epididymis;
addition of fluid by the seminal vesicles;
nutrients / fructose / mucus in the fluid secreted by the seminal vesicles;
addition of fluid by the prostate gland;
mineral ions / alkali in the fluid secreted by the prostate gland; ***[5 max]***

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