M12/4/BIOLO/HP2/ENG/TZ1/XX/M

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

MARKSCHEME

May 2012

BIOLOGY

Higher Level

Paper 2

13 pages

General Marking Instructions

Assistant Examiners (AEs) will be contacted by their team leader (TL) through Scoris™, by e-mail or telephone – if through Scoris™ or by e-mail, please reply to confirm that you have downloaded the markscheme from IBIS. The purpose of this initial contact is to allow AEs to raise any queries they have regarding the markscheme and its interpretation. AEs should contact their team leader through Scoris™ or by e-mail at any time if they have any problems/queries regarding marking. For any queries regarding the use of Scoris™, please contact emarking@ibo.org.

If you have any queries on **administration** please contact:

Risha Ali
Subject Operations
IB Assessment Centre
Peterson House
Malthouse Avenue
Cardiff Gate
Cardiff CF23 8GL
GREAT BRITAIN

Tel: +(44) 29 2054 7777

Fax: +(44) 29 2054 7778

E-mail: risha.ali@ibo.org

1. Follow the markscheme provided, award only whole marks and mark only in **RED**.

2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.

3. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded.**

4. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases use Scoris™ annotations to support your decision. You are encouraged to write comments where it helps clarity, especially for re-marking purposes. Use a text box for these additional comments. It should be remembered that the script may be returned to the candidate.

5. Personal codes/notations are unacceptable.

6. Where an answer to a part question is worth no marks but the candidate has attempted the part question, enter a zero in the mark panel on the right-hand side of the screen. Where an answer to a part question is worth no marks because the candidate has not attempted the part question, enter an "NR" in the mark panel on the right-hand side of the screen.

7. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers. Scoris™ will only award the highest mark or marks in line with the rubric.

8. Ensure that you have viewed **every** page including any additional sheets. Please ensure that you stamp "seen" on any page that contains no other annotation.

9. 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 got wrong. However, a mark should not be awarded where there is contradiction within an answer. Make a comment to this effect using a text box or the "CON" stamp.

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.

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 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 ***[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. The stamps will **not** automatically award marks.

SECTION A

1. (a) 2200 *(allow answers in the range 2175–2225)* ***[1]***

(b) 800 *(allow answers in the range 750–850)* ***[1]***

(c) more surveys in summer / fewer in winter;
larger average/biggest number sighted (per survey) in winter / converse;
larger <u>total</u> number of dolphins (from adding up all surveys) in summer;
variation in both seasons / overlap in numbers between summer and winter; ***[2 max]***
Do not accept answers relating to distribution.
Do not accept answers stating that the dolphin population is higher in winter.

(d) (i) more evenly distributed in summer than in winter (across latitudes);
many near Cape Hatteras/35.0/2–35.4/6 °N in winter/more than in summer;
more dolphins overall in the survey area in winter than in summer;
wider summer range / reaches 36.6 and 34.2 °N / less far N and S in winter;
unimodal distribution in winter versus bimodal in summer / *OWTTE*; ***[2 max]***

(ii) seasonal variation in food supply/prey/predators/water temperatures;
migration to find food/prey/warmer water/mates;
migrating dolphins rest/congregate near Cape Hatteras/35.2 – 35.4 °N;
Cape Hatteras /35.2 – 35.4 °N may be a mating area in the winter;
seasonal variation in human activity / valid example;
more food/warm water between mainland and Cape Hatteras in winter; ***[1 max]***

(e) male dolphin with the lowest body mass has the highest LCT_w;
with larger dolphins/above 180/185/187 kg no change in LCT_w with body mass;
weak negative correlation / as mass increases LCT_w drops / *vice versa*;
uncertainty due to small amount of data; ***[2 max]***

(f) *Accept any of the following points about the female:*
older so (possibly) has a lower metabolic rate / other result of age;
higher surface area to volume ratio (than male);
less active than males so releasing less metabolic heat;
less insulation due to subcutaneous fat/adipose tissue;
suckling / pregnant / part of mass was fetus; ***[1 max]***

(g) supported as water temperature affects metabolic rate;
supported as dolphins will avoid areas with water below their LCT_w;
water temperature is unlikely to be a factor for bigger males;
wide (latitude) range in summer suggests temperature does not determine range;
few animals / only one female / only narrow range of latitudes investigated;
data may not be reliable since the study was conducted in captivity; ***[2 max]***

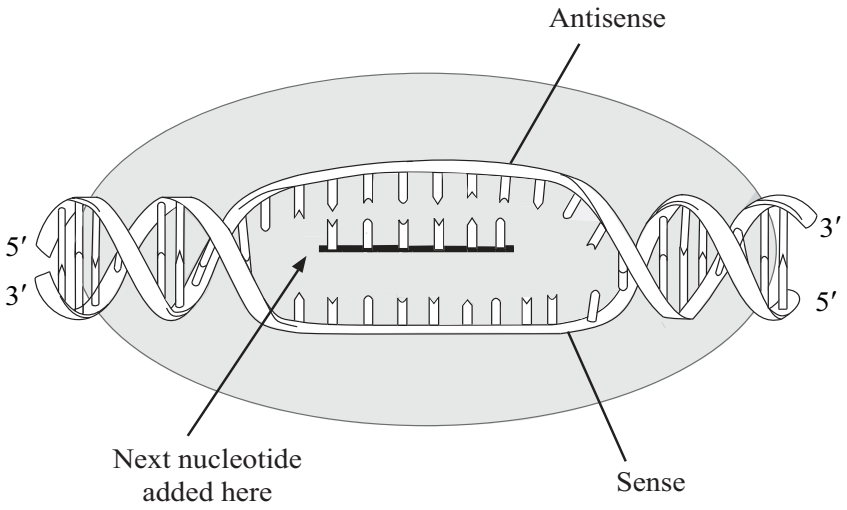
(h) may migrate/move range further north;
migrate to area with cooler/suitable water temperature;
ocean currents may change;
most productive waters/food supply may be further north;
distribution more spread out (due to warmer waters in more areas); ***[2 max]***

(i) data can be collected over a larger area/in more areas/in wider range of conditions;
increase the amount of data / allows comparisons / data can be shared;
funding can be increased so surveying can be more intense/extensive; ***[1 max]***

2. (a) helicase / RNA primase / (DNA) ligase ***[1]***

(b) DNA fragments/sections (formed) on the lagging strand;
because replication must be in the 5′ – 3′ direction;
replication starts repeatedly and moves away from replication fork; ***[2 max]***

(c) (i) both strands clearly labelled ***[1]***
Check carefully whether the correct strand has been labelled if the labels are shown in helical parts of the DNA.
Reject if the sense strand label points to the mRNA.



(ii) a clearly drawn arrow pointing at the free 3′ end of the mRNA strand or to the first free nucleotide on the antisense strand to the left of the mRNA or to a nucleotide added by the candidate to the left hand end of the mRNA ***[1]***

3. (a) myogenic contraction / muscles contract without stimulus from a nerve;
pacemaker/SA node initiates each heart beat/stimulates atria to contract;
nerves carry impulses from the brain to speed up and slow down the heart;
medulla (of the brain) monitors blood pressure;
epinephrine/adrenaline increases rate/strength of contractions; ***[3 max]***

(b) valves open/close due to blood pressure differences;
valves prevent backflow/only allow unidirectional flow;
atrioventricular valves between ventricles and atria;
semilunar valves between arteries and ventricles; ***[2 max]***
Accept mitral/bicuspid and tricuspid in place of atrioventricular.
Accept aortic and pulmonary in place of semilunar valves.

4. (a) mother receives hormone treatment/FSH to stimulate egg development;
eggs and sperm collected/harvested / eggs taken from ovary;
egg fertilized outside the body/in a dish/in a lab;
develops into embryo;
embryo(s) implanted (artificially) in mother's body/uterus; ***[3 max]***
Do not accept egg/fertilized egg/zygote implanted.

(b) (i) Sertoli cell / nurse cell ***[1]***

(ii) nourishes maturing sperm(atozoa) / protects sperm from lymphocytes ***[1]***

(c) crossing over in prophase 1/between chromatids;
random orientation of bivalents/homologous pairs in metaphase 1;
random orientation of chromatids/chromosomes in metaphase 2; ***[2]***

SECTION B

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

5. (a) a. (mono-, di- and polysaccharides) consist of one, two and many units;
b. example of monosaccharide (*e.g.* glucose/ribose/galactose/fructose);
c. example of disaccharide (*e.g.* maltose/lactose/sucrose);
d. example of polysaccharide (*e.g.* starch/glycogen/cellulose); ***[4]***

(b) a. digestion is the breakdown of large molecules into small molecules;
b. to allow diffusion / to make food soluble;
c. so foods can be absorbed into the bloodstream/body;
d. so foods can move from bloodstream into cells;
e. small molecules can be joined to form the organism's (unique) macromolecules;
f. hydrolysis is aided by enzymes;
g. hydrolysis requires water;
h. polysaccharides (hydrolysed) to disaccharides/monosaccharides/specific example;
i. proteins/polypeptides (hydrolysed) to amino acids;
j. fats/lipids/triglycerides (hydrolysed) to fatty acids and glycerol; ***[6 max]***

(c) a. inhibitors reduce enzyme activity/reduce the rate of reaction;

Competitive inhibitors:
b. have a similar shape to the substrate;
c. bind to/attach to/enter the active site;
d. block/compete for occupation of the active site / prevent substrate binding;
e. example (*e.g.* succinate dehydrogenase by malonate);
f. increase in substrate concentration reduces inhibition / graph showing this;

Non-competitive inhibitors:
g. not chemically similar / different shape to substrate;
h. attach to a different part of the enzyme/allosteric site;
i. shape of the active site changes preventing/reducing substrate binding;
j. example of non-competitive inhibition (*e.g.* respiratory enzymes by cyanide);
k. increases in substrate concentration do not reduce inhibition / graph showing this;
l. end-product inhibitors are non-competitive; ***[8 max]***

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

6. (a)
a. (stem cells) have/retain the capacity to divide;
b. can be used to produce cell cultures/large number of identical cells;
c. can be used to repair/replace damaged/lost cells/tissue;
d. (stem cells) are undifferentiated / have not yet differentiated/specialized;
e. can differentiate/specialize in different ways / are pluripotent/totipotent;
f. can be used to form a variety of different tissues / form organs;
g. used in medical research;
h. used in treatment of (named) disease; ***[5 max]***

(b)
a. gene transfer takes a gene from one species/organism and inserts it into another;
b. using plasmid/viral vector/ballistic impregnation/electroporation;
c. use of reverse transcriptase to obtain gene from mRNA;
d. restriction enzyme/endonuclease used to cut out/excise gene;
e. (same) restriction enzyme used to cut open plasmid;
f. sticky ends used to link DNA/link gene to plasmid;
g. DNA ligase used to seal nicks/splice;
h. bacterium takes in plasmid / plasmid transferred to bacterium/plant/host cell;
i. valid documented example (*e.g.* human insulin from bacterium/yeast / salt-tolerant tomato plant / carotene/vitamin A in rice / herbicide/Roundup/glyphosate resistance in crop plants / factor IX/clotting factor in sheep milk / low phosphate feces in pigs; ***[5 max]***

(c) *Definition and construction of karyotypes:*
a. karyotype is the number and type / image of chromosomes in a cell;
b. cells collected from chorionic villus / by amniocentesis;
c. requires cells in metaphase / stimulate cells to divide and reach metaphase;
d. burst cells and spread chromosomes / photo taken of chromosomes;
e. chromosomes are arranged in pairs;
f. according to size/structure/position of centromere/banding pattern;

Uses for karyotypes:
g. karyotypes used to identify sex/gender;
h. male is XY and female XX;
i. used to identify chromosome mutations/abnormal numbers/non-disjunction;
j. Down syndrome due to extra chromosome 21 / other trisomy/aneuploidy example;
k. used for pre-natal diagnosis of chromosome abnormalities;
l. may lead to a decision to abort the fetus;
m. prepare for consequences of abnormality in offspring; ***[8 max]***

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

7. (a)
a. gases/O_2 and CO_2 enter/exit the leaf through the stomata;
b. by diffusion / down the concentration gradient;
c. photosynthesis maintains concentration gradients/high O_2 and low CO_2 in the leaf;
d. guard cells open the stomata during the day / close the stomata at night;
e. gases/O_2/CO_2 move through air spaces in the spongy (mesophyll);
f. CO_2 dissolves in moisture in (mesophyll) cell walls; ***[5 max]***

(b)
a. burning of (fossil) fuels/coal/oil/gas releases carbon dioxide;
b. deforestation/loss of ecosystems reduces carbon dioxide uptake;
c. methane emitted from cattle/livestock/melting permafrost/waste dumps;
d. heating of the atmosphere/global warming/climate change;
e. melting of ice caps/glaciers/permafrost / sea level rise / floods / droughts / changes in ocean currents / more powerful hurricanes / extreme weather events / other abiotic consequence;
f. changes in species distributions/migration patterns / increased decomposition rates / increases in pest/pathogen species / loss of ice habitats / other biotic consequence; ***[5 max]***

(c)
a. factor nearest its minimum/furthest from its optimum is limiting;
b. increasing a limiting factor with other factors constant increases the rate;
c. increasing a non-limiting factor with other factors constant has no effect on rate;

d. light intensity is limiting in dim/low intensity light / at night;
e. photosynthesis (directly) proportional to intensity up to plateau / graph to show this;
f. light intensity affects the light-dependent reactions/production of ATP/NADPH;

g. temperature limiting at low and high temperatures;
h. optimum temperature with lower rates above and below plateau / graph to show this;
i. low temperatures limit the rate of light-independent reactions/Calvin cycle;
j. RuBP carboxylase/rubisco does not fix carbon dioxide at high temperatures;

k. carbon dioxide concentration is limiting in bright light and warm temperatures;
l. photosynthesis is (directly) proportional to CO_2 concentration up to plateau / graph to show this;
m. low CO_2 concentration limits carbon fixation/reaction between CO_2 and RuBP; ***[8 max]***

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

8. (a) a. maintaining (stable) internal environment/conditions;
b. within (narrow) limits;
c. example (*e.g.* body temperature / blood pH / blood glucose / water / CO_2 concentration);
d. levels of these variables are monitored (internally);
e. negative feedback mechanisms / *OWTTE*; (*reject if positive feedback included*)
f. involves hormonal / nervous control; ***[4 max]***

(b) a. maintained close to 36.7/37 °C/98.6 °F;
b. heat is transferred/distributed in body by blood;
c. hypothalamus contains thermoreceptors;
d. hypothalamus monitors temperature/sends message to effectors/causes response;
e. (vaso) dilation of skin arterioles warms skin/cools body;
f. (vaso) constriction of skin arterioles retains body heat;
g. skin/sweat glands produce sweat to cool the body when overheated;
h. removal of heat through evaporation of sweat;
i. shivering generates heat / increased metabolism / hair erection to retain heat;
j. example of behavioural change to warm/cool the body to thermoregulate; ***[6 max]***

(c) a. osmoregulation is maintenance of water balance of blood/tissues;
b. loop of Henle creates hypertonic conditions in the medulla;
c. water reabsorbed as filtrate passes through collecting duct;
d. hypothalamus monitors/controls water balance/content of blood;
e. controls secretion of ADH by (posterior) pituitary gland;
f. ADH is released when blood too concentrated/too little water/hypertonic;
g. ADH makes the collecting duct more permeable to water;
h. due to more aquaporins;
i. more water reabsorbed (in response to ADH);
j. less water in urine/urine more concentrated/urine hypertonic;
k. no/less ADH when blood too dilute/too much water/hypotonic;
l. collecting duct less permeable/less water reabsorption/more water in urine; ***[8 max]***

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