M12/4/BIOLO/HP2/ENG/TZ2/XX/M

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

# MARKSCHEME

## May 2012

## BIOLOGY

## Higher Level

## Paper 2

14 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) (the) placebo ***[1]***

(b) as a basis/baseline for comparison / used as a control ***[1]***

(c) a. in first seven days / same for all treatment groups;
b. (after day 7) antibody production/the immune response is reduced by anti-fever drugs/less than the placebo;
c. ibuprofen reduces antibody production the least / aspirin/acetaminophen reduces antibody production more than ibuprofen;
d. acetaminophen reduces antibody production the most;
e. after day 14, the production of antibodies slows for all treatments;
f. correct quantitative comparison; { *(e.g. by day 14 the aspirin/acetaminophen have reduced antibodies to one third/half as many antibodies as the placebo / after 28 days, the production of antibodies with acetaminophen is only 30%/aspirin is 45%/ibuprofen is 60% of the placebo value / OWTTE)* } ***[3 max]***

(d) acetaminophen ***[1]***

(e) a. monocytes move out of blood at the site of infection (to promote an immune response);
b. negative/below baseline levels of/fewer monocytes in blood means that more of them have entered tissues/are promoting an immune response;
c. acetaminophen (and placebo) show negative values (in first week);
d. indicating that (acetaminophen) promotes movement of monocytes into tissues/ development of macrophages;
e. monocyte migration from blood/conversion to macrophages is generally reduced by the use of anti-fever drugs (by day 10);
f. macrophages increase antibody production (by lymphocytes); ***[3 max]***

(f) a. anti-fever drugs reduce the immune response/not advisable as treatment of cold;
b. conclusion not clear / anti-fever drugs should be used; { *(based on incorrect interpretation of monocyte data, ECF from (e))* }
c. anti-fever medicine decreases antibody count <u>and</u> increases nasal obstruction;
d. reduce monocyte movement / conversion to macrophages in tissues / *vice versa*;
e. slowing recovery/rejection of rhinovirus/elimination of the disease;
f. ibuprofen has the least impact on antibody production/nasal obstruction;
g. research has used a relatively small sample;
h. anti-fever drugs may allow people to continue their normal activities; ***[3 max]***

**2.** (a) $25.8\,kJ\,g^{-1}$ *(units needed)* ***[1]***

(b) a. walnut has the greatest variation in energy content;
b. because the standard deviation/range (much) greater for walnuts than for potato chips;
c. the small standard deviation/range for potato chips indicates that the data are clustered closely around the mean / the large standard deviation/range for walnuts indicates that the data are spread out further from the mean;
d. 68 % of the values will fall within one standard deviation of the mean which is $\pm 2.0\,(kJ\,g^{-1})$ for walnuts but only $\pm 0.1\,(kJ\,g^{-1})$ for the potato chip / *OWTTE*; ***[2 max]***

(c) energy source/storage / insulation / provision of essential fatty acids / hormones / waterproofing / component of membranes / buoyancy / bile salts / protection of internal organs ***[1]***
*Only award marks to the first function if candidate gives more than one function.*

**3.** (a) (i) endocrine glands / named endocrine gland *(e.g. pancreas/hypothalamus/ pituitary/ovary/testes)* ***[1]***
*Do not accept gland alone.*

(ii) cells / tissues / named cells/tissue *(e.g. muscles / muscle tissue / muscle cells / epithelial tissue / other reasonable example)* ***[1]***
*Do not accept alveolus or named organ.*

(b) a. high density of capillaries surrounding alveoli;
b. large surface area due to shape / large number of alveoli;
c. thin walls / walls one cell thick; *(do not accept membranes)*
d. moist layer covering the (inner) surface of the alveoli; ***[3 max]***
*Award **[2 max]** for a list of features.*

(c) a. capillaries walls thin/one cell thick for better diffusion; { *(do not accept membranes)*
b. small diameter/narrow lumen to fit into small places/between cells;
c. small diameter for greater surface area for molecular exchange;
d. pores between cells of the walls so plasma can leak out;
e. pores between cells of the walls allow phagocytes/immune components to enter tissues;
f. only one red blood cell allowed to pass at a time for efficient oxygen uptake; ***[3 max]***

**4.** (a) (i) palisade mesophyll/layer ***[1]***

(ii) guard cells ***[1]***

(iii) vascular bundle/tissue / xylem (vessel) ***[1]***

(b) a. reduced/few leaves/needles to lower surface area;
b. rolled leaves to increase humidity around stomata;
c. spines to collect water;
d. waxy cuticle;
e. fewer stomata/closing of stomata;
f. stomata in pits to increase humidity;
g. CAM metabolism so stomata can remain closed during light;
h. $C_4$ photosynthesis so stomata can remain closed during light; ***[2 max]***

(c) a. would make it easier to stand upright (against gravity)/structural support / allows (angiospermophytes) to be bigger;
b. could put leaves higher in the air to get more sunlight;
c. transport of water supply/nutrients from roots to other tissues;
d. could (more efficiently) transport/translocate sugars/food from leaves for storage; ***[3 max]***

## SECTION B

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

**5.** (a) a. contraction / movement;
b. acts as a catalyst/enzymes / specific example of an enzyme function;
c. structure / support / specific example of a structural/support role;
d. transport;
e. defence / immunity;
f. as hormones / communication;
g. DNA packing / histones;
h. other function; ***[4 max]***

(b) a. large molecules (proteins) must be digested into small molecules;
b. a protease/pepsin digests proteins into polypeptides;
c. pepsin works in the stomach / requires an acid/low pH/pH 2 to work;
d. polypeptides are digested by a protease/trypsin into amino acids;
e. trypsin acts in the small intestine / requires a basic pH/pH 8/high pH;
f. amino acids absorbed by diffusion/active transport;
g. absorption occurs in the villus/microvilli of the small intestine;
h. (amino acids absorbed) into capillaries;
i. blood carries amino acids throughout the body;
j. amino acids diffuse into cells/are absorbed by active transport;
k. cells use amino acids to build proteins;
l. assimilation is when amino acids become part of a cell;
m. proteins are synthesized at the ribosomes/ER of the cell; ***[6 max]***

(c) a. motor neuron stimulates the muscle fibre;
b. calcium ions are released (from sarcoplasmic reticulum);
c. calcium ions bind to troponin;
d. tropomyosin moved / binding sites of actin revealed;
e. ATP binds (to myosin) causing cross-bridges to break;
f. ATP becomes ADP causing myosin heads to change angle/become cocked;
g. (myosin) heads attach to (new) actin sites/form cross-bridge;
h. ADP released;
i. myosin heads move actin filaments toward centre;
j. making sarcomere shorter;
k. calcium ions are reabsorbed (into the sarcoplasmic reticulum);
l. muscle fibre relaxes; ***[8 max]***
*Award the above points if shown in a clearly drawn, correctly annotated diagram.*

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

**6.** (a) a. gene is a sequence of DNA bases;
b. DNA/gene codes for a specific sequence of amino acids/polypeptide;
c. enzymes are proteins/composed of polypetides;
d. sequence of amino acids determines tertiary structure/folding/shape of active site;
e. change in the gene/mutation will affect the active site/function of an enzyme;
f. enzymes are involved in replication/transcription of genes;
g. enzymes are involved in synthesis of polypeptides; ***[4 max]***

(b) a. metabolic pathways can be a sequence/chain of reactions;
b. they can be cycles of reactions;
c. different enzymes control each reaction in the sequence/cycle;
d. accumulation of an end-product can inhibit the first enzyme of the sequence/ pathway;
e. (an end-product inhibitor) joins an allosteric site/a site separate from active site;
f. attachment at the allosteric site changes the shape of the active site;
g. preventing the binding of substrate;
h. until the level of the end-product is reduced (and the inhibition removed);
i. this is an example of negative feedback; ***[6 max]***

(c) a. lactose is a disaccharide/sugar (found in milk);
b. lactase digests lactose into galactose and glucose;
c. lactase produced naturally by yeast;
d. biotechnology companies isolate lactase for use in food processing;
e. lactase can be added to milk to reduce the level of lactose in the milk;
f. (or) lactase can be put on a surface / immobilized enzyme;
g. lactose-intolerant people cannot drink milk (unless it is lactose-reduced);
h. galactose and glucose are sweeter than lactose;
i. so less sugar is needed in food production from milk;
j. bacteria ferment glucose and galactose more quickly than lactose, so production of yoghurt/cottage cheese is faster (providing an economic benefit);
k. galactose and glucose are more soluble so improve the texture of ice cream;
l. other legitimate advantage/disadvantage of use of lactose-reduced milk; ***[8 max]***

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

**7.** (a) a. pollination is the transfer of pollen to the stigma/carpel/pistil of a flower;
b. pollen grains grow a pollen tube down the style to the ovule;
c. male and female gametes/nuclei join/fuse (in the ovule/ovary) during fertilization;
d. the ovary matures into a fruit;
e. dispersal of seeds depends on the fruit;
f. example of seed dispersal; { *(e.g. pods split open to scatter seeds, e.g. animal eats fruit / ingests and egests seed)* } ***[4 max]***

(b)

| | ***spermatogenesis*** | ***oogenesis*** |
|---|---|---|
| a. | both start with germ cells/germinal epithelium (of gonad); | |
| b. | both start with mitosis to produce many cells; | |
| c. | both involve cell growth before mitosis; | |
| d. | both involve meiosis/reduction division/create haploid cells; | |
| e. | occurs in testes | occurs in ovaries; |
| f. | millions/large numbers produced daily | one/few produced per month; |
| g. | released during ejaculation | released during ovulation/mid-way through cycle; |
| h. | begins during puberty | egg production begins before birth; |
| i. | continues throughout life | production stops at menopause; |
| j. | four sperm made per meiosis | only one egg produced per meiosis; |
| k. | polar bodies not produced/equal division | polar bodies produced/uneven division of cytoplasm; |
| l. | cytoplasm is reduced in sperm | cytoplasm is enhanced in eggs; |
| m. | sperm are motile | eggs are not motile; |

***[8 max]***

*To award **[8 max]**, responses must provide at least one similarity. Responses do not need to be shown in a table format.*

(c) a. members of a species tend to produce more offspring than can survive;
b. competition for available resources occurs;
c. habitat has a carrying capacity/limit to the population it can support;
d. overpopulation is when carrying capacity is exceeded;
e. the habitat may be destroyed by exploitation by the species;
f. food web may be interrupted;
g. an example; { *(e.g. greater abundance of predators may be stimulated by overpopulation of prey / prey may be reduced because of over-abundance of predators)*
h. invasion of new habitats by the overpopulating species/migration;
i. natural selection (of successful variations);
j. evolution of a species (with new characteristics);
k. mortality will exceed natality / death of individuals will reduce population (to carrying capacity);
l. example of effect of limiting factor; *(e.g. spread of disease)* ***[6 max]***

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

**8.** (a) a. cohesive properties help in transpiration pull/movement of water in plants;
b. high surface tension allows some animals to stride across its surface;
c. high latent heat of evaporation/large amounts of energy required for evaporation makes it a good coolant;
d. high specific heat capacity causes it to maintain environmental temperatures;
e. low density as ice forms insulation of lakes allowing life below;
f. transparency for photosynthesis;
g. transparency for vision in animals;
h. solvent properties make it the medium for metabolic reactions;
i. solvent properties allow transport of (soluble) molecules/food; ***[6 max]***

(b) a. osmoregulation is control of water balance in organisms/blood/tissues/cytoplasm;
b. ADH regulates water levels/solute concentration of the blood;
c. produced/released when water in blood is too low;
d. it increases the permeability of the collecting ducts / increase in the reabsorption of water;
e. leads to more aquaporins (in collecting duct cell membranes);
f. lower volume/less urine is produced/urine more concentrated; ***[4 max]***

(c) a. water enters roots through the root hairs by osmosis;
b. root hairs provide an extended surface area (for active transport and osmosis);
c. active transport of ions from soil into the roots (enhances osmotic pressure);
d. osmotic pressure moves water into the xylem;
e. water is carried (in a transpiration stream) in the xylem;
f. adhesion of water to the inside of the xylem helps move water up;
g. cohesion of water to itself enhances water movement up the xylem;
h. water diffuses into air spaces (in spongy mesophyll) of leaves;
i. it passes out through the stomata by evaporation/transpiration;
j. evaporation sets up a transpiration pull that keeps the water moving;
k. guard cells control the rate of transpiration pull/evaporation;
l. xylem vessels are tubes with helical rings to enhance water movement/resist low pressure; ***[8 max]***

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