M14/4/BIOLO/HP2/ENG/TZ2/XX/M

International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

MARKSCHEME

May 2014

BIOLOGY

Higher Level

Paper 2

10 pages

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** (eg. 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.).*

SECTION A

1. (a) 42 (%) *(units not required)* ***[1]***

(b) (all) epipelagic species spend less time diving / benthic spend more time;
(thus) foraging behavior/feeding location affects diving time more than species; ***[2]***

(c) 46 ($cm^3\ kg^{-1}$) *(accept answers in the range of 45.5 ($cm^3\ kg^{-1}$) to 47 ($cm^3\ kg^{-1}$))* ***[1]***

(d) benthic (species) dive for longer (than epipelagic species);
the longer the dive, the greater the oxygen stores / overall relationship is positive between dive duration and oxygen stores;
oxygen store is variable in dives of same duration (in benthic)/per minute of dive; ***[2 max]***
Award any other sensible point.

(e) (i) the depth of the dives decreases (slightly) over time;
the length/duration of the dive increases (slightly) over time;
the frequency of the dives increases over time / time spent on surface decreases; ***[2 max]***

(ii) in each dive the temperature difference decreases as the seals dive down and increases (slowly) after they rise;
temperature difference decreases over time;
but in a variable, regular fashion; ***[2 max]***

(f) vasoconstriction of skin arterioles so less blood flows to the surface to prevent heat loss from blood;
hypothalamus control with thermoreceptors/hormones to increase/decrease metabolism;
layers of fat under the skin/insulating fur to conserve body heat;
shivering to generate heat; ***[2 max]***
Accept other verifiable mechanisms explained.

(g) difference decreases (in each dive) with depth as skin temperature falls/decreases;
there is heat loss from skin to water;
vasoconstriction may reduce blood flow to the skin and thus reduce skin temperature;
difference increases after surfacing (in each dive) because skin temperature increases/rises;
increased metabolic/respiration rate (with more oxygen) may increase skin temperature; ***[3 max]***

(h) oxygen reserves used up after 3.5 minutes;
need to replenish oxygen reserves on surface;
too cold after 3.5 minutes;
need to remain on surface to raise body temperature;
have caught prey by 3.5 minutes / return to surface to eat prey; ***[3 max]***

2. (a) (i) $\left(\frac{11\,\text{mm}}{2\,\mu\text{m}} = \frac{11000}{2} =\right)(\times)5500$ ***[1]***

Accept answers in the range of (×)5000 to (×)6000.
Award the mark for correct answer only.

(ii) $\left(\frac{43\,(\text{mm})}{11\,(\text{mm})} \times 2 \quad \textbf{\textit{or}} \quad \frac{43\,(\text{mm})}{5500} = 0.0078\,\text{mm}\right)$
7.8 ***[1]***
Accept answers in the range of 7.0 to 8.8 (um).
Award the mark for correct answer only.

(b) (i) (rough) endoplasmic reticulum ***[1]***

(ii) synthesis/modification and transport of proteins ***[1]***
Synthesis of proteins for export is sufficient.
Do not accept ECF of the organelle named in (b)(i).

(c) the greater the volume the smaller the ratio of surface area to volume / *OWTTE*;
rate of production of heat/waste/carbon dioxide/oxygen consumption is a function of its volume;
smaller cells are more efficient at exchanging materials / rate of exchange of heat/waste/nutrients is a function of its surface;
ratio limits the size of the cell; ***[2 max]***

3. (a) *bird W*: *Geospiza*;
bird Z: *Camarhynchus*; } *both needed* ***[1]***

(b) bird Y/*Certhidea* has a more slender beak to pick out insects (from cracks) / OWTTE ***[1]***
Reason must be given.

(c) birds show variation in their beaks;
birds that find food have greater survival rate;
better reproductive success (than W/X/Z);
these heritable variations can lead to increase in the population of one genus/species and decrease in the others / *OWTTE*;
heritable variations lead to a change in allele frequency within a population/species; ***[3 max]***

4. (a) recessive autosomal/non sex linked ***[1]***

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

(ii) nn ***[1]***

SECTION B

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

5. (a) primary structure is the (number and) sequence/order of amino acids in a polypeptide;
secondary structures are regularly repeating structures/β-pleated sheets/α-helices (held together by H-bonds);
tertiary structure is the (specific) 3-dimensional structure of the polypeptide (held by bonds/ionic bonds/H-bonds/hydrophobic interactions/disulfide bridges/interactions between R groups);
quaternary structure links two or more polypeptides (to form one protein)/and/or describes non protein groups associated with the polypeptide; ***[4 max]***

(b) enzymes are (globular) proteins that are catalysts/lower activation energy of chemical reactions;

lock and key model:
explains specificity of enzyme-substrate;
the substrate (key) fits into/has complementary shape to the active site (lock) of the enzyme;
the active site can be changed by different chemicals/temperatures/pH so substrate cannot bind;

induced-fit model:
changes in the active site/conformational changes to allow substrate to bind;
the substrate induces the active site to change;
bonds weakened in the substrate (so easier to break);
explain reduction of activation energy/wider substrate specificity; ***[6 max]***
Accept the above points in the form of a clearly drawn annotated diagram.
*Award **[3 max]** if only one model addressed.*

(c) actin and myosin filaments are the proteins involved in muscle contraction;
(a motor neuron stimulates the) release of calcium ions;
from the sacroplasmic reticulum;
calcium reveals the binding sites on actin; *(no further credit awarded for reference to troponin/tropomysin as they are not on the syllabus)*
myosin heads form cross-bridges with binding sites on actin;
ATP binds to myosin heads;
breaking cross bridges to actin;
ATP hydrolyzed to ADP (+phosphate);
causing myosin heads to change angle/become cocked with energy from ATP;
myosin heads bind to new sites on actin further from centre of sarcomere;
ADP is released;
actin filaments slide inwards to centre of sarcomere/power stroke; ***[8 max]***

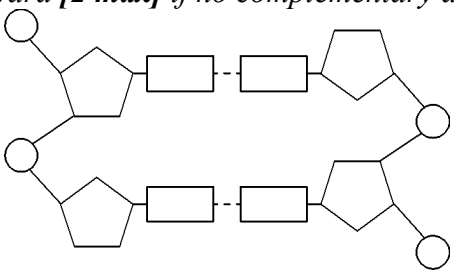
*(Plus up to **[2]** for quality)*

6. (a) deoxyribose, phosphate and base/named base properly labelled and linked;

all four bases labelled as Adenine, Thymine, Cytosine, Guanine; *(full names required for any base drawn. Do not award marks for the letters alone)*

sugar labelled and shown as a pentagon;
covalent/phosphodiester bonds correctly labelled;
complementary base pairing between A-T and C-G;
H-bonds correctly labelled;
correctly shows two antiparallel sugar-phosphate strands/backbones with linkages between phosphates and sugars connected through bases; *(phosphate and simple names such as sugar and base are acceptable labels. They must be given at least once)* ***[5 max]***

*Award **[2 max]** if no complementary double stranded molecule.*



(b) DNA changes from GAG to GTG/CTC to CAC / mRNA changes from GAG to GUG; *(accept DNA changes from GAA to GTA/CTT to CAT / mRNA changes from GAA to GUA)*

affecting the process of translation/causes different primary structure of polypeptide;
causing glutamic acid to be replaced by valine;
changing the form of hemoglobin;
changes the shape of the red blood cells / red blood cells become sickle shaped; (*reject HB sickle shaped)*
transport oxygen less efficiently/less oxygen gets to tissues;
sickled cells block capillaries;
muscular pain/severe anemia/slow growth; *(allow other appropriate symptom)*
correlated with protection against malaria in heterozygotes; ***[5 max]***

(c) (genetically modified organisms) are organisms where characteristics are altered/changed by addition or removal of a gene;
reference to the specific gene transferred to the host organism;
verifiable example of genetic modification; *(eg BT- corn/other valid examples)*
universal genetic code (allows genes to be transferred between species);
gene transfer involves splicing genes into a suitable vector/host DNA;
after placed in host, host cells are cloned;

potential benefits:
1st potential benefit; *(eg increased yields/productivity)*
2nd potential benefit; *(eg allows for the introduction of a characteristic that wasn't present within the gene pool (selective breeding could not have produced desired phenotype))*
3rd potential benefit; *(eg less use of chemical pesticides)*
Specific potential benefits related to the named examples.

harmful effects:
1st harmful effect; *(eg possibility of cross pollination)*
2nd harmful effect; *(eg could have currently unknown harmful effects / toxin may cause allergic reactions)*
3rd harmful effect; *(eg reduces genetic variation/biodiversity)* ***[8 max]***
Specific harmful effects related to the named examples.

Do not accept general or vague statements about ethical concerns (eg humans changing species/playing god).

*Award **[7 max]** if both potential benefits and harmful effects are not addressed.*

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

7. (a)

	salivary amylase	**pancreatic amylase**
source	salivary glands;	pancreas;
substrate	starch;	starch;
products	maltose;	maltose;
optimum pH	6.2–7.0/slightly acidic/neutral;	7.0–8.0/slightly basic/alkaline;

[4 max]

*The source, substrate, products and optimum pH must refer to the **named** amylase.*

(b) (original) source of energy in a food chain is from (sun)light;
captured by plants/autotrophs/producers/first trophic level;
by means of photosynthesis/converted to chemical energy/organic molecules;
plants use part of energy for own energy requirements/lost through cell respiration;
consumers use energy for own requirements from organisms in previous trophic level;
energy travels between trophic levels/producer to 1st consumer/1st consumer to 2nd consumer/2nd consumer to 3rd consumer;
not all material is assimilated/consumed/not digested/lost in faeces / OWTTE;
only a small amount of energy/(approximately) 10–20% is passed between trophic levels / most/80–90%/a large amount of the energy of a trophic level is lost (and not transferred);
loss of energy from organisms in form of heat;
energy is not recycled in an ecosystem (but nutrients are); ***[6 max]***
Award any of the above marking points in a correctly annotated diagram.

(c) pancreatic cells monitor the blood glucose concentrations;
alpha and beta cells are in the islets of Langerhans;
negative feedback mechanisms;
send hormones (through bloodstream) to target organs;
if too high, β cells (in pancreas) produce insulin;
insulin stimulates liver/muscle cells to take up glucose;
glucose is converted into glycogen (stimulated by insulin); *(do not award this marking point where it is stated that insulin directly converts glucose)*
lowering blood glucose level;
other cells are stimulated to absorb glucose and use it in cell respiration;
if glucose levels too low, α cells (in pancreas) produce glucagon;
glucagon stimulates liver/muscle cells to break down glycogen; *(do not award this marking point where it is stated that glucagon directly breaks down glycogen)*
and release glucose into the blood;
raising the blood glucose level; ***[8 max]***

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

8. (a) cell respiration is the controlled release of energy from organic compounds to form ATP;

aerobic	anaerobic
requires O_2	does not require O_2;
in (cytoplasm and) mitochondrion	in cytoplasm;
O_2 reduced	pyruvate reduced;
high yield of ATP	low yield of ATP;
high yield of NADH ($+H^+$) / $FADH_2$ produced	low/er yield of NADH ($+H^+$) / no $FADH_2$;
end products CO_2 and H_2O	end products ethanol and CO_2 (yeast/plants) / lactate (animals/humans);
can use fats/proteins (or sugars)	can only use sugars;
involves oxidative phosphorylation/electron transport chain	does not involve oxidative phosphorylation/electron transport chain;
involves Krebs cycle	does not involve Krebs cycle;

[5 max]

Answers do not need to be shown in a table format.

(b) water must be absorbed by the seed (to become metabolically active);
gibberellin is produced (in the embryo);
stimulates production of amylase;
which catalyses digestion of starch to maltose;
maltose diffuses to the growing embryo root and shoot/growth regions;
maltose is converted to glucose for (aerobic) cell respiration (to release energy);
or to synthesize materials/cellulose for plant growth; ***[5 max]***
Award the above to a clearly drawn correctly annotated diagram.

(c) Krebs cycle only occurs in aerobic conditions;
the Krebs cycle occurs in the mitochondria;
acetyl CoA from the link reaction releases an acetyl group;
$NADH+H^+$ and CO_2 are formed (with each decarboxylation);
decarboxylation/removal of CO_2 involves oxidation/oxidative decarboxylation;
and the release of energy;
acetyl group is joined to a 4-carbon molecule/C_4/oxaloacetate to form a 6-carbon molecule/citrate;
(decarboxylation changes citrate) to 5-carbon molecule/C_5;
(decarboxylation changes glutamate) to a 4-carbon molecule/C_4;
then converted into the original 4-carbon molecule/C_4/oxaloacetate and the cycle repeats;
one (molecule) of ATP is made during this step;
reduced H-carriers/ NADH and $FADH_2$ and carbon dioxide are end-products of Krebs cycle; ***[8 max]***

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