International Baccalaureate®
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MARKSCHEME

May 2010

BIOLOGY

Higher Level

Paper 2

General Marking Instructions

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]**

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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 <u>underlined</u> 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. 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.

9. 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.

SECTION A

1. (a) *most*: white-throated sparrow/WS
least: American robin/AR
(both needed to award the mark) ***[1]***

(b) 5% / 5.03% / 5.3% *(unit required) (Accept answers in the range of 5% and 5.3%)* ***[1]***
No indication needed of whether percentage difference is an increase or decrease.

(c) both birds show an increase in mass at Site 1 and a decrease at Site 2;
MW has a greater increase than HT at Site 1; *(do not accept larger/greater change)*
MW has a greater decrease than HT at Site 2; *(accept negative change)*
MW has larger mass change at both sites/Site 1 and Site 2; ***[2 max]***
Do not accept answers quoting only numerical statements.

(d) HT data is reliable whereas AR data is unreliable / differences not significant / uncertainty higher with AR;
(because) error bars/variation/range/standard deviation large for AR / larger for AR than for HT;
(because) smaller sample of AR than of HT; ***[2 max]***
Do not accept comments about whether the data is accurate or not.

(e) all have a higher concentration of triglyceride at Site 1 than at Site 2;
HT (and WS) highest at both sites/at Site 1;
MW lowest at Site 1 and AR lowest at Site 2; ***[2 max]***
Do not allow answers quoting only numerical statements.

(f) triglyceride higher at Site 1 because more fat deposition / HT eats more;
butyrate higher at Site 2 because more fat/triglyceride utilized / HT fasts more; ***[2]***

(g) (data supports hypothesis) because mean mass at Site 1 is greater than at Site 2 (for all birds);
because mass gained at Site 1 but mass falls (mostly) at Site 2 (over 17 years);
because triglyceride levels higher at Site 1 / butyrate levels higher at Site 2 / more fat deposited at Site 1 / more fat utilized at Site 2 / more fasting at Site 2; ***[2 max]***

(h) *advantage*:
need to capture bird only once to get data / no need to mark and catch birds again;
more informative data can be gathered; *(do not accept unqualified "more precise")*

disadvantage:
removal of blood is more stressful/risky for the bird than weighing;
danger of infection / spread of disease / harm to birds;
extra time/money/laboratory equipment is needed to analyse results;
could include fat/triglyceride/butyrate from previous/long-term feeding;
nutrients from food eaten at these sites may not have been absorbed yet; ***[1 max]***
*Award **[1]** for one advantage and one disadvantage that are not the converse of each other. Do not allow a second advantage or second disadvantage given in the answer.*

2. (a) (i) 50 000 *(Accept answers in the range of 50 000 to 53 000)* ***[1]***

(ii) 0.1 μm *(units required)* ***[1]***
Allow answers in the range of 0.09 μm to 0.12 μm.

(b) *Award **[1]** for any two of the following.*
growth/production of (extra) body cells; *(do not accept cell growth)*
<u>first</u> stage of spermato/oo/gametogenesis / forming oogonia/spermatogonia;
embryo development;
wound healing / (tissue) repair / hair growth / replacement of skin cells; *(do not accept repairing cells)*
clonal selection / division of lymphocytes (for antibody production); ***[1 max]***
Do not accept asexual reproduction. Do not award a mark if one of the first two answers is incorrect.

(c) stem cells are undifferentiated cells;
embryo cells are stem cells;
stem cells can differentiate in many/all ways / are pluripotent/totipotent;
differentiation involves expressing some genes but not others;
stem cells can be used to repair/replace tissues/heal wounds; ***[3 max]***

(d) (i) estrogen <u>and</u> progesterone do not drop/continue rising (after day 21);
because corpus luteum continues to secrete them / embryo secretes HCG;
to maintain/increase uterus lining/endometrium; ***[2 max]***

(ii) *Award **[1]** for any two of the following.*
pre-natal development of male genitalia;
stimulates spermatogenesis / sperm production;
maintenance of sex drive/libido;
puberty / development of secondary sexual characteristics / penis growth / pubic hair / body hair / facial hair / beard / deeper voice; ***[1 max]***
Do not award the mark if one of the first two roles given is incorrect.

3. (a) <u>hydrogen bonds</u> between nucleotides on opposite strands/ complementary bases/adenine and thymine <u>and</u> cytosine and guanine; *(reject letters instead of base names)*
covalent bonds between nucleotides within strands/between sugar/deoxyribose and phosphate; ***[2]***

(b) hydrogen bonding between water molecules;
breaking (hydrogen bonds) needs/removes energy/heat;
hydrogen bonds must break when water evaporates/vaporizes; ***[2 max]***

(c) pyruvate/pyruvic acid → lactate/lactic acid;
glucose → (pyruvate/pyruvic acid) → lactate/lactic acid; ***[1 max]***
Accept correct chemical equation with formulae.

4. (a) carrier has (one copy of) a recessive allele;
must also have a dominant allele to prevent having the condition/disease; ***[2]***

or

cannot be homozygous dominant or they would not carry the recessive allele;
cannot be homozygous recessive or they would have the condition/disease;

(b) (i) *Award **[1]** for every two correct answers.*
I. bacterial cell/bacterium/prokaryote;
II. plasmid;
III. inserted/engineered/cloned/desired DNA/gene / DNA/gene from donor cell;
IV. genetically modified/transformed/GM/recombinant organism/cell/ bacterium/host cell containing recombinant plasmid; ***[2 max]***

(ii) restriction enzymes / endonucleases;
ligases;
reverse transcriptase; ***[1 max]***
*Award **[1]** for two correct answers.*

SECTION B

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

5. (a) small subunit and large subunit;
mRNA binding site on small subunit;
<u>three</u> tRNA binding sites / A, P and E tRNA binding sites;
protein <u>and</u> RNA composition (in both subunits); ***[4 max]***

(b) fibrous proteins are strands/sheets whereas globular proteins are rounded;
fibrous proteins (usually) insoluble whereas globular proteins (usually) soluble;
globular more sensitive to changes in pH/temperature/salt than fibrous;
fibrous proteins have structural roles / other specific role of fibrous protein;
globular proteins used for catalysis/transport/other specific role of globular protein;
another role of globular protein;
named fibrous proteins *e.g.* keratin/fibrin/collagen/actin/myosin/silk protein;
named globular protein *e.g.* insulin/immunoglobulin/hemoglobin/named enzyme; ***[6 max]***
Do not accept statements about fibrous proteins having only secondary structure and globular proteins having only tertiary structure.

(c) auxin is a plant hormone;
produced by the tip of the stem/shoot tip;
causes transport of hydrogen ions from cytoplasm to cell wall;
decrease in pH / H^+ pumping breaks bonds between cell wall fibres;
makes cell walls flexible/extensible/plastic/softens cell walls;
auxin makes cells enlarge/grow;
gene expression also altered by auxin to promote cell growth;
(positive) phototropism is growth towards light;
shoot tip senses direction of (brightest) light;
auxin moved to side of stem with least light/darker side
causes cells on dark side to elongate/cells on dark side grow faster; ***[8 max]***
Accept clearly annotated diagrams for phototropism marking points.

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

6. (a) occurs in cytoplasm;
hexose is phosphorylated using ATP;
hexose phosphate is split into two triose phosphates;
oxidation by removal of hydrogen; (*do not accept hydrogen ions/protons*)
conversion of NAD to NADH ($+H^+$);
net gain of two ATP / two ATP used and four ATP produced;
pyruvate produced at the end of glycolysis; ***[5 max]***
Accept glucose/fructose/6C sugar instead of hexose.
Accept 3C sugar/glyceraldehyde instead of triose.

(b) α cells (of pancreas) produce glucagon;
glucagon promotes release of glucose/breakdown of glycogen by liver cells;
glucagon secreted when blood glucose levels are low / raises blood glucose levels;
β cells (of pancreas) produce insulin;
insulin promotes glucose uptake/storage of glycogen by liver/body/muscle cells;
insulin secreted when blood glucose levels are high / lowers blood glucose levels;
negative feedback mechanism; ***[5 max]***
Do not accept answers implying that insulin or glucagon catalyse glucose-glycogen conversions directly.
*Award **[3 max]** if the response suggests that the hypothalamus has a role in regulation of blood glucose.*

(c) urine of diabetics contains glucose;
whereas urine of non-diabetics contains no glucose;
glomerular filtrate contains glucose / glucose filtered out;
glucose (normally) reabsorbed from filtrate/into blood;
through wall of / in the proximal convoluted tubules;
blood glucose concentration higher than normal in diabetics;
reabsorption not completed / pumps cannot reabsorb all glucose in diabetics;
glucose in urine can be detected using test strips;
type I diabetes is lack of insulin secretion / lack of β cells;
type II diabetes is body cells not responding to insulin / not absorbing glucose; ***[8 max]***

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

7. (a) *Award **[1]** for each of the following clearly drawn and correctly labelled.*
head and midpiece/mid-section/body;
tail/flagellum; *(at least four times length of the head and containing fibres)*
acrosome; *(shown as distinct structure near front of head)*
nucleus; *(occupying more than half the width or length of head)*
mitochondria; *(as repetitive structures inside membrane of mid piece)*
centriole; (*between head and midpiece*)
(plasma) membrane; *(shown as single line covering whole cell)*
microtubules; (*in 9 plus 2 array*) ***[5 max]***

(b) crossing over/chiasmata formed during prophase I of meiosis;
pairing of homologous chromosomes/synapsis;
chromatids break (at same point); (*do not accept chromatids overlap)*
non-sister chromatids join up/swap/exchange alleles/parts;
X-shaped structure formed / chiasmata are X-shaped structures;
chiasma formed at position where crossing over occurred;
chiasmata become visible when homologous chromosomes unpair;
chiasma holds homologous chromosomes together (until anaphase); ***[5 max]***
Accept the above points in an appropriately annotated diagram.

(c) non-disjunction;
chromosomes/chromatids do not separate / go to same pole;
non-separation of (homologous) chromosomes during anaphase I;
due to incorrect spindle attachment;
non-separation of chromatids during anaphase II;
due to centromeres not dividing;
occurs during gamete/sperm/egg formation;
less common in sperm than egg formation / function of parents' age;
Down syndrome due to extra chromosome 21;
sperm/egg/gamete receives two chromosomes of same type;
zygote/offspring with three chromosomes of same type / trisomy / total 47 chromosomes; ***[8 max]***
Accept the above points in an appropriately annotated diagram.

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

8. (a) CO_2 is a greenhouse gas;
increases in CO_2 increase/enhance the greenhouse effect;
greenhouse effect is a natural phenomenon but not its increase;
Earth receives short wave radiation from the sun;
reradiated from Earth as longer wave radiation/infra red/heat;
CO_2 /greenhouse gases trap/absorb longer wave radiation/infra red/heat;
global warming happened during same time/period as CO_2 rise;
CO_2 concentration correlated (positively) with global temperature / global temperature increases as CO_2 concentration increases;
(causal) link accepted by most scientists;
no proof that man-made increases in CO_2 have caused global warming; ***[5 max]***

(b) those proposing something must prove that it causes no harm;
before they start to do it;
objectors do not have to prove that there will be harm;
activities that risk/threaten/may cause harm are banned;
trials/tests must be done first;
precautionary principle is applied when possible consequences are severe;
precautionary principle should be used in the case of global warming;
action should be taken to reduce CO_2 emissions before proved it is the cause;
another example of implementation of the precautionary principle; ***[5 max]***

(c) natural selection (in correct context);
better-adapted individuals survive/more likely to survive;
more reproduction/genes passed on by better adapted individuals;
name of species; *(accept even if remainder of answer is invalid)*
description of original/decreasing phenotype;
type of environmental change that led to evolution;
consequence of environmental change
description of new/increasing phenotype;
genetic basis of phenotypes;
reason for new phenotype being better adapted;
detail of reason for adaptedness of new phenotype; ***[8 max]***

The following has been provided as an example answer.
great tit;
bird that lays its eggs in spring;
global warming/climate change;
more caterpillars (on trees) in early spring;
laying eggs earlier in spring;
time of egg laying is (partly) genetically controlled;
eggs laid early hatch at start of period of greatest food abundance;
more young can be fed/young grow faster/fewer deaths;

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