M11/4/BIOLO/HP2/ENG/TZ1/XX/M

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MARKSCHEME

May 2011

BIOLOGY

Higher Level

Paper 2

13 pages

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]**

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 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 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.

9. Only consider units at the end of a correct calculation.

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.).*

SECTION A

1. (a) (i) both (moderately) acidic / similar acidity / rural (slightly) more acidic / lower pH/*converse* ***[1]***

(ii) urban areas have overall more (atmospheric) pollution/*converse*;
levels of each pollutant are much higher concentrations in urban areas;
qualified by correct example *e.g.* more solid pollution/more lead *e.g.* nitrous oxide is almost eighty times higher in urban areas; ***[2 max]***
Comparative terms are required to award the mark.

(b) (overall) growth/biomass was greater in urban areas;
greater growth/biomass in urban areas for roots / below ground;
greater growth/biomass for shoots / above ground;
growth/biomass was (more) variable in urban areas;
shoot/above ground growth/biomass always greater than root biomass; ***[2 max]***

(c) (i) unlikely to be the cause because differences in pH are small ***[1]***

(ii) yes because higher growth in areas where there is higher pollution;
might not be cause / correlation rather than cause and effect;
pollutant might have stimulated growth / acted as fertilizer in urban areas;
(no because) pollutant did not negatively affect growth (as more pollution in urban areas/area with higher growth); ***[2 max]***

(d) lowest ozone exposures in urban areas / highest ozone exposure in rural/agricultural areas;
lower ozone exposure in forested than agricultural areas;
highest range in agricultural areas / lowest range in forested areas;
wide range of ozone exposures in each area; ***[2 max]***
[1 max] *if candidates are referring to months/x axis as time.*

(e) (strong) negative correlation/lower shoot biomass/less growth with higher ozone exposure;
ozone exposure is lower in urban areas/other reference to graph on page 6;
ozone is toxic/damages plants impacts photosynthesis;
(hypothesis is) higher growth rates (in urban areas) are due to lower ozone exposure;
(hypothesis is) both factors/ozone and air pollution may have played a role in growth differences; ***[3 max]***
Do not accept hypotheses involving pH. Accept converse of above points.

2. (a) (i) interphase because no (individual) chromosomes are visible / genetic material visible as chromatin / chromosomes/DNA has not condensed / nuclear envelope/nucleolus/nucleus is visible ***[1]***

(ii) DNA synthesis/replication/*OWTTE*;
(cell) growth / increase in the number of organelles/specific organelle mentioned;
transcription/synthesis of RNA; ***[2 max]***
Mark only the first process on each line if more than two processes are listed. Do not accept error carried forward if mitosis is the answer in (i).

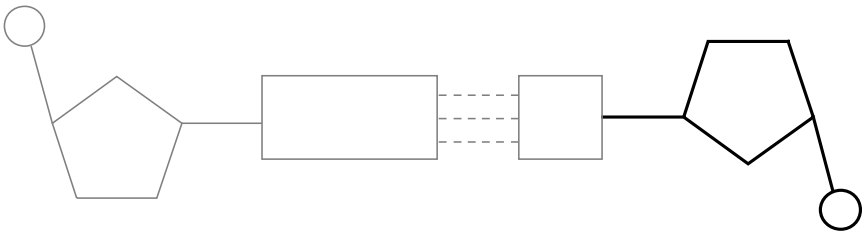
(b) retain the capacity to divide;
they are undifferentiated / unspecialized;
have the ability to differentiate (along different pathways) / are multipotent/pluripotent/totipotent; ***[2 max]***
Mark only the first process on each line if more than two processes are listed.

(c) named source of stem cells *e.g.* bone marrow / cord blood / inner cell mass of embryo / embryonic stem cells;
name of condition that is treated using the stem cells *e.g.* leukaemia / heart disease / diabetes / other possibility;
one precise detail of how the stem cells replace/ replenish (differentiated) cells that are the cause of the condition; ***[3]***

Example:
Source: stem cells obtained from bone marrow;
Condition: leukaemia;
Detail: patient's bone marrow cells (are killed and) replaced with the stem cells;

3. (a) *Both must be correct for the mark to be awarded.*
I. phosphate and II. hydrogen bond(s) ***[1]***

(b) deoxyribose and phosphate added to base to show antiparallel orientation ***[1]***
Labels are not required but location of bonds and shape of deoxyribose must be correctly shown.



(c) transcription ***[1]***

(d) polymerase chain reaction/PCR;
(DNA obtained from) blood/semen/hairs/other source of tissue;
combined with necessary raw materials/one example of raw material;
in thermal cycler / (PCR) machine;
DNA replicated many times; ***[2 max]***

4. (a) arthropoda/arthropods;
jointed legs/limbs/appendages/(hard) exoskeleton; ***[2]***
Use error carried forward if incorrect phylum but correct observation such as anelida because it is segmented/has bristles. This answer would earn one mark.

(b) fossils show changes over time (in organisms);
fossilized organisms are different from existing ones;
(yet) share features with existing organisms / homologous structures;
suggest common ancestry;
show intermediate stages in evolution of groups / missing link fossils; ***[2 max]***

(c) natural selection;
over time/generations;
range/variation in size of eye (in the trilobite population);
individuals with larger eyes are more likely to survive;
example of selective advantage of large eyes *e.g.* can see predators / find food;
surviving individuals reproduce and pass on their genes/large eyes to offspring; ***[2 max]***

SECTION B

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

5. (a) integral proteins are embedded in the membrane/phospholipid bilayer;
peripheral proteins are on the surface of the membrane;
some integral proteins (are transmembrane proteins that) extend from one side of the membrane to the other;
hormone binding sites;
e.g. insulin;
enzymes;
e.g. sucrase / succinate dehydrogenase;
cell adhesion;
cell-to-cell communication recognition / antigenic markers / glycoproteins / contact inhibition;
channels/pores for passive transport/facilitated diffusion;
pumps/carriers for active transport;
receptors for neurotransmitters;
such as acetylcholine;
electron carriers;
e.g. electron transport chain of cellular respiration;
pigments (in rods/cones); ***[8 max]***
Award any of the above points if clearly drawn in an annotated diagram.

(b) non-polar amino acids cause channel proteins to embed in a membrane;
polar amino acids at either end cause channel proteins to be transmembrane / retain protein position in membrane;
polar amino acids lining pore allow polar particles to pass through/form hydrophilic channels through membranes;
polar amino acids on surface of enzyme allow it to dissolve in water;
polar and non-polar amino acids contribute to the specificity of an enzyme;
non-polar amino acids of surface of enzyme allow it to embed in a membrane;
polar amino acids at active site of enzyme attract polar substrates;
positively charged amino acids attract negatively charged substrate / vice versa;
non-polar amino acids at active site attract non-polar substrate; ***[5 max]***
Award any of the above points if clearly drawn in an annotated diagram.

(c) *Answers do not need to be shown in a table format. Award marks only when there is a comparison of both types of inhibition.*

Competitive inhibition	**Non-competitive inhibition**
substrate and inhibitor are (chemically) similar/same shape	substrate and inhibitor are (chemically) not similar/different shape;
inhibitor binds to active site	inhibitor binds away from the active site/allosteric site / diagram to illustrate difference;
inhibitor does not change the shape of the active site	inhibitor changes the shape of the active site;
increases in substrate concentration reduce the inhibition	increases in substrate concentration do not affect the inhibition / annotated graph to illustrate the difference;
both types of inhibitor reduce enzyme activity;	
both types of inhibitor bind to the enzyme;	
both types of inhibitor prevent the substrate from binding to the active site;	
example *e.g.* succinate dehydrogenase is inhibited by malonate	example *e.g.* pyruvate kinase is inhibited by alanine;

[5 max]

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

6. (a) sweat/perspiration secreted/produced;
evaporation of sweat causes cooling/heat to be removed from skin;
skin arterioles become wider/vasodilate;
more blood flows through (capillaries in) the skin;
heat carried to the skin / skin becomes warmer / skin reaches core temperature;
more heat lost by skin to the environment;
behavioural responses / reduced activity / other example of behaviour resulting in cooling; ***[5 max]***

(b) ADH is secreted when the solute concentration of the blood is too high/*OWTTE*/*converse*;
ADH makes the collecting duct more permeable to water / when not secreted the collecting duct is less permeable to water;
(causes) more aquaporins in the (membranes of cells in the) collecting duct;
collecting duct passes through medulla;
increasing salt concentration of medulla / hypertonic medulla;
leading to osmosis / more water is reabsorbed (from the collecting duct);
so volume of urine is less / urine more concentrated;
(without ADH) higher flow rates so less time for water reabsorbtion;
(without ADH) dilute / large volume of urine is produced; ***[5 max]***

(c) ventilation occurs within the lungs;
trachea divides to form two bronchi;
bronchi divide to form bronchioles;
several divisions of bronchioles;
alveoli connected to bronchioles;
trachea/bronchi/bronchioles/airways lined with cilia/ciliated epithelium;
diaphragm and intercostal muscles;
trachea/bronchi have rings/c-shaped pieces of cartilage;
alveolus is an (air) sac;
very small / diameter is (about) 100μm;
many alveoli so large total surface area;
wall of alveolus is a single layer of cells;
cells in alveolus wall are very thin;
surrounded by a network of capillaries;
some (larger) cells in the wall secrete fluid/surfactant/natural detergent; ***[8 max]***
Award any of the above points if clearly drawn in a diagram.

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

7. (a) *Answers do not need to be shown in a table format.*

	Spermatogenesis	**Oogenesis**
number of gametes produced	many / millions per day	one per month/menstrual cycle/28 days / about 400 eggs per life time;
products of meiosis	four / equal division of the cytoplasm / no polar bodies;	one / unequal division of the cytoplasm / polar bodies;
start of process	at puberty	begins during fetal development;
duration of production	throughout adult life	ends at menopause;
timing of release	produced continuously / released during ejaculation	released at ovulation / in the middle of the menstrual cycle;
both spermatogenesis and oogenesis involve meiosis;		
both produce haploid cells/nuclei;		
both occur in gonads	occurs in testes	occurs in ovaries;

[5 max]

(b) meiosis;
independent assortment/random orientation of bivalents/pairs of chromosomes/homologous chromosomes;
in metaphase I;
$2^{23}/2^{n}$ possible combinations (where n is the haploid number of chromosomes);
crossing over / recombination of linked genes;
during prophase I;
can occur anywhere along a chromosome;
random orientation of chromatids (in metaphase II);
(gene) mutations may occur; ***[5 max]***

(c) drugs used to (down-)regulate/stop the menstrual cycle;
hormones/FSH injected to stimulate many follicles to develop;
HCG injected to cause the follicles to mature;
eggs are harvested/extracted from the follicles/ovaries;
semen/sperm sample produced/collected;
semen is processed to concentrate it / sperm screened/given a swim-up test;
semen/sperm mixed with eggs/oocyte / in a dish/in glass;
fertilization occurs;
embryos/blastocyst placed in uterus/oviduct (using a catheter/long plastic tube);
Do not accept fertilized egg or zygote.
one/two/three/up to four (in some countries) embryos implanted;
pregnancy test/scan used to see if procedure has been successful / genetic screening to assess health of fetus;
(used in cases of) blocked oviduct / low sperm count;
need for donor embryo in cases of female infertility / donor sperm in case of male infertility; *Accept other reasonable situations.* ***[8 max]***

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

8. (a) plants/producers fix carbon (dioxide)/use carbon (dioxide) in photosynthesis;
sugars/carbon compounds (produced) in plants/producers from photosynthesis;
(carbon compounds in) plants/producers eaten by animals/primary consumers/herbivores;
(carbon compounds in) primary consumers eaten by secondary consumers/ passed along food chain;
carbon compounds/sugars/organic molecules digested and absorbed by consumers;
carbon dioxide released by cell respiration (in plants/animals/consumers);
plants/animals die and are decomposed by (saprotrophic) bacteria/fungi;
carbon dioxide released by cell respiration in bacteria/fungi/decomposers;
enzymes released to digest/hydrolyse carbon compounds in organic matter;
forest fires/combustion releases carbon dioxide;
humans burn fossil fuels adding carbon dioxide to the atmosphere; ***[8 max]***
Award any of the above points if clearly drawn in an annotated diagram.

(b) ribulose bisphosphate/RuBP and carbon dioxide react together;
(this is) carbon fixation/part of light-independent reactions;
catalysed by RuBP carboxylase/Rubisco;
glycerate 3-phosphate/GP produced;
glycerate 3-phosphate/GP reduced/converted to triose phosphate/TP;
using NADPH/(NADPH+H^+) and ATP;
from the light-dependent reactions;
some triose phosphate used to regenerate RuBP;
some triose phosphate used to synthesize glucose (phosphate)/starch; ***[5 max]***

(c) water needed to rehydrate the seed;
gibberellin released / active after water absorbed;
gibberellin needed to produce amylase;
water needed to allow substances inside the seedling to be transported;
oxygen needed for (aerobic) cell respiration;
warmth needed to speed up metabolism/enzyme activity;
warmth indicates that it is a favourable season for germination/spring;
some seeds need a cold period to stimulate germination;
some seeds need fire to stimulate germination;
some seeds need to pass through an animal (gut) to stimulate germination; ***[5 max]***

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