IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
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N06/4/BIOLO/HP2/ENG/TZ0/XX/M+

MARKSCHEME

November 2006

BIOLOGY

Higher Level

Paper 2

10 pages

General Marking Instructions

Subject Details: Biology HL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A total ***[32 marks]*** **and any TWO** questions in Section B ***[20 marks]*** each. Maximum total = ***[72 marks]***.

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each marking point has a separate line and the end is signified by means of a semicolon (;).
- An alternative answer or wording is indicated in the markscheme by a "/"; either wording can be accepted.
- Words in (…) in the markscheme are not necessary to gain the mark.
- Words that are <u>underlined</u> are essential for the mark.
- The order of points does not have to be as written (unless stated otherwise).
- If the candidate's answer has the same "meaning" or can be clearly interpreted as being the same as that in the markscheme then award the mark.
- Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising them for what they have not achieved or what they have got wrong.
- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded.
- Units should always be given where appropriate. Omission of units should only be penalized once. Ignore this, if marks for units are already specified in the markscheme.
- Do not penalize candidates for errors in 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 [(a), (b), etc.] of the question.

- 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*).

SECTION A

1. (a) (i) sweet potato ***[1]***

(ii) palmitic acid ***[1]***

(b) levels of palmitic acid;
higher level of palmitic acid (above 21.3) in chill sensitive plants / lower level of palmitic acid (below 21.3) in chill resistant plants;
ratio of unsaturated to saturated fatty acids;
lower ratio of unsaturated to saturated fatty acids in chill sensitive plants / higher ratio of unsaturated to saturated fatty acids in chill resistant plants; ***[2 max]***

(c) membranes of chill resistant plants are more fluid at lower temperatures / have a lower melting point / low saturated fatty acid composition / *OWTTE* ***[1]***

(d) respiration/chemiosmosis/ATP production/electron transport will decrease ***[1]***

(e) increased membrane leakage with greater chill treatment/lower temperature ***[1]***

(f) -4.0°C *(unit required)* ***[1]***

(g) elevated levels of CO_2 make plants less tolerant to freezing (below 4.0°C) / effect is most pronounced at -6.5°C ***[1]***

(h) $1.3(\pm 0.1)\,\mu\text{mol m}^{-2}\,\text{s}^{-1}$ *(unit required)* ***[1]***

(i) at normal levels of CO_2 concentration, photosynthesis decreases slightly until -4.0°C then drops significantly after -4.0°C;
at elevated levels of CO_2 concentration, photosynthesis decreases more sharply (until it reaches zero) at -6.5°C;
plants grown in elevated levels of CO_2 concentration have lower photosynthetic rates during frosting treatment; ***[2 max]***

(j) decrease in enzyme activity / freezing water / lower rates of diffusion of CO_2 / decreased molecular motion / other reasonable answer ***[1]***
Do not accept lower light levels.

(k) plants may suffer frost/freezing damage at higher/warmer temperatures;
elevated levels of CO_2 may make plants more susceptible to chilling injuries;
climate may be warmer so plants may suffer fewer chilling periods;
(natural selection/evolution) may lead to change in fatty acid composition / plants will evolve adaptations to new climate / no change; ***[2 max]***

2. (a) a pathogen is an organism (or virus) that causes a disease ***[1]***

(b) *active immunity*: immunity due to production of antibodies by organism itself;
passive immunity: due to acquisition of antibodies produced from another organism; ***[2]***

(c) antigen presentation by macrophages;
activation of T-helper cells;
activation of B cells;
B cells divide to plasma cells and memory cells;
plasma cells secrete antibodies; ***[3 max]***

3. (a) 0.012 plants m^{-2} *(units required)* ***[1]***

(b) use the (random) quadrat method;
throw quadrat / use a random number table to place quadrats / quadrats done on a transect;
plant species in each quadrat are counted and totalled;
mean plants per quadrat × number of quadrats / use formula to arrive at population; ***[3 max]***

(c) lag phase = slow population growth / small change in population size;
exponential phase = population growing/expanding quickly / natality greater than mortality / no effect of limiting factors / resources plentiful;
transitional phase = mortality rate increasing / limiting factors begin to influence growth;
plateau phase = natality is equal to mortality / carrying capacity is reached; ***[3 max]***

4. (a) AUGCUAGAC ***[1]***

(b) regulator gene produces a protein/repressor molecule;
repressor binds to operator;
prevents RNA polymerase from binding to promoter;
gene is not transcribed;
inducer (molecule) deactivates repressor; ***[2 max]***

(c) DNA wrapped around <u>eight histone</u> proteins ***[1]***

SECTION B

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

5. (a) *Responses must define homeostasis to receive full marks, if not award* ***[4 max]****.*
homeostasis:
maintains the internal environment at a constant level / between narrow limits;
blood pH;
carbon dioxide;
blood glucose;
body temperature; ***[5 max]***

(b) *Award* ***[1]*** *for each of the following structures of the kidney clearly drawn and correctly labelled.*
cortex shown at the edge of kidney;
medulla shown inside the cortex with pyramids;
pelvis shown on the concave side of the kidney;
ureter shown connected to the pelvis on the concave side;
renal artery and vein shown originating from the concave side;
calyx/papilla; ***[4 max]***

(c) ultrafiltration / high pressure in the glomerulus;
glomerular filtrate produced in Bowman's capsule;
flows to proximal convoluted tubule;
80% of water reabsorbed;
filtrate enters descending limb / loop of Henle;
descending limb permeable to water / water drawn out by osmosis;
ascending limb pumps sodium into tissues;
ascending limb impermeable to water;
decrease in filtrate concentration (in ascending portion);
concentration in distal convoluted tubule equals concentration in proximal convoluted tubule;
high solute concentration ADH released /ADH controls water balance;
ADH makes collecting duct water permeable to water;
so water can move to tissues / so the urine is more concentrated; ***[9 max]***
Details of how ADH is controlled hormonally should not be credited.
Accept any of the above if clearly explained in a labelled diagram.

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

6. (a) named phases: prophase, metaphase, anaphase and telophase;
prophase nuclear membrane disappears / chromosomes condense (become visible) / spindle microtubules appear;
metaphase chromosomes (composed of sister chromatids) line-up at equatorial plane;
anaphase (sister) chromatids/chromosomes separate/move to (opposite) poles;
telophase nucleus begins to reform / cytokinesis starts and chromosomes decondense (become invisible); ***[4 max]***
Accept any of the above if clearly explained in a labelled diagram.

(b) (law of segregation) states that for a pair of alleles, each gamete receives only one of the alleles;
meiosis has two divisions;
cells go from diploid to haploid;
(law of independent assortment) states that the segregation of alleles of one gene is independent of the segregation of the alleles of another gene;
alleles of a gene are carried on homologous chromosomes;
homologues line-up at metaphase I;
homologues of one chromosome line-up independently of homologues of other chromosomes at metaphase I;
homologues separate at anaphase I ;
homologues of different chromosomes separate randomly at anaphase I ;
haploid cells have a random assortment of homologues;
only unlinked genes (or genes that are far apart on the chromosome) assort independently; ***[8 max]***

(c) *Award **[1]** for each row, up to **[6 max]**.*

Spermatogenesis	**oogenesis**
both are a process of meiosis;	
both start with cells produced by mitosis;	
millions produced every day	one produced every 28 days;
sperm production start at puberty	egg production starts in fetus;
sperm production continuous through life	egg production stops at menopause;
four sperm produced by meiosis	one egg and polar bodies produced;
occurs in testes	occurs in ovaries;
not much growth phase	significant growth phase;
equal divisions of cytoplasm	unequal divisions of cytoplasm;

[6 max]

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

7. (a) two strands of DNA;
anti-parallel;
3′ to 5′ linkages;
purine / pyrimidine;
A-T / G-C base pairing;
hydrogen bonds;
sugar-phosphate backbone; ***[5 max]***
Award ***[3 max]*** *if answer does not include a diagram.*

(b) genetic screening: testing an individual for the presence/absence of a gene;

advantages: ***[4 max]***
individuals can see if they are carriers of a gene before they have children;
fewer children with genetic disease;
lower long-term health costs;
frequency of harmful alleles reduced;
allows early diagnosis of disease;
treatment can start for disease;
prepare parents emotionally/financially for affected children;
plant/animal breeders can screen plants/animals for desired traits;

disadvantages: ***[4 max]***
risk of false negative/false positive;
increase in abortion;
against religious beliefs;
cost to administer;
can discriminate against people / selection of genetic traits;
deny health insurance;
if diagnosed with genetic disease can lead to emotional problems; ***[9 max]***

(c) use reverse transcriptase on mature mRNA to make DNA;
cut plasmid with restriction enzymes;
sticky ends added to donor DNA;
place plasmid and DNA together;
use DNA ligase to splice them together;
place plasmids within *E. Coli*;
test uptake with antibiotics;
culture *E. Coli* with recombinant plasmids; ***[4 max]***

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

8. (a) high levels of light;
low humidity;
windy conditions;
(relatively) high temperatures;
high number of leaves / (open) stomata;
an actively growing/photosynthesizing plant;
low air pressure / low levels of carbon dioxide; ***[5 max]***

(b) CAM/C4 physiology;
reduced leaves;
rolled leaves;
sunken stomata;
thick cuticle;
hairs;
water storage tissue;
wide-spreading network of shallow roots;
vertical stems to avoid mid-day sun; ***[4 max]***

(c) *definition*: ***[3 max]***
evolution is the process of cumulative change over time;
some variation has to be inherited;
increased reproduction of individuals with favourable characters over time;
thus, species adapt to the environment;

Award ***[3 max]*** *for each example.*
named example;
environmental change;
evolutionary response;

e.g. antibiotic resistance of bacteria;
exposure of bacteria to antibiotics;
survival and reproduction of bacteria with resistant gene;

e.g. heavy metal tolerance in plants / melanism in ladybugs / pepper moths; ***[9 max]***

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