IBO

IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
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N04/4/BIOLO/HP2/ENG/TZ0/XX/M+

MARKSCHEME

November 2004

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.
- 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 mark scheme 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.
- 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 in 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).

- The important point is to be consistent in the awarding of the quality points.

SECTION A

1. (a) 47-49 % *(units are not needed)* ***[1]***

(b) *D. melanogaster* / *Drosophila* has few genes with one exon;
highest percentage has 2 exons;
most genes have 5 or fewer exons;
a few genes have 10 or more exons / more than 8;
maximum number of exons does not exceed 60; ***[2 max]***

(c) (i) *S. cerevisiae* / yeast has most genes with only 1 exon while mammals 5 exons is most frequent;
no yeast genes have more than 5 exons while some mammal genes have greater than 60 exons;
mammal genes contain more exons on average;
with a wider distribution than yeast; ***[2 max]***

(ii) *S. cerevisiae* / yeast is a unicellular organism / mammals are multicellular / complex;
mammals have more transcriptional regulation;
S. cerevisiae smaller in size / more compact genome; ***[1 max]***

(d) gene size – mRNA size = intron size / 25.0 – 2.1 = 22.9 kb;
average size of intron = $\frac{22.9}{14 \text{ introns}}$ = 1.6 (± 0.1) kb; *(unit required)* ***[2]***

(e) smaller genes usually have less introns / larger genes have more introns / relationship not clear;
dystrophin and collagen have same number of introns but the dystrophin gene is larger;
albumin has more introns but is smaller than the gene for phenylalanine hydroxylase; ***[2 max]***

(f) 2.4 kb (1 amino acid / 3 bases) = 800 amino acids ***or*** 799 amino acids ***[1]***

(g) epsilon and zeta (globin) ***[1]***

(h) gamma genes (mostly) expressed before birth and beta genes expressed after birth;
beta-globin levels rise at 28(±2) weeks of gestation while gamma levels decrease/as one rises, the other falls;
gamma-globin expression starts at 0-2 weeks whereas beta-globin starts at 26 (±2) weeks/gamma expression starts earlier;
one month after birth hemoglobin has equal mixture of beta-globin and gamma-globin;
gamma levels go to zero while beta becomes a regular part of hemoglobin; ***[3 max]***

(i) *10 weeks after gestation*:
two alpha-globins with two gamma-globins / 49 (50) % alpha and 48 (49) % gamma;

2 months after birth:
variety of molecules all containing alpha and two chains from the other three types / 6 % delta, 14 % gamma, 35 % beta, 50 % alpha; ***[2]***

2. (a) (i) centromere;
(ii) sister chromatids / chromatids; ***[2]***
Do not accept chromosome(s).

(b) non-disjunction;
the failure of homologues / sister chromatids to separate during meiosis;
anaphase I / anaphase II;
two copies of chromosome 21 in gamete;
fertilization leads to trisomy / trisomy 21; ***[3 max]***

(c) crossing over (in prophase I) leads to new combinations of alleles;
random alignment of homologues (at metaphase I) produces new chromosome combinations/independent assortment; ***[2 max]***

3. (a) *For a diagram of a nephron, award* ***[1]*** *for every two of the following structures clearly drawn and correctly labelled.*
glomerulus;
Bowman's capsule;
proximal convoluted tubule;
loop of Henle;
ascending <u>and</u> descending both labeled;
distal convoluted tubule;
collecting duct;
afferent arteriole / efferent arteriole; ***[3 max]***

(b) difference in diameter of efferent and afferent arteriole;
leads to blood in glomerulus at high pressure;
capillary wall is fenestrated / has pores / holes;
basement membrane has pores;
pores in basement membrane prevent large (protein) molecules from leaving blood plasma / only allows passage of small molecules;
passive process; ***[3 max]***

(c) (large) proteins in blood plasma but not in glomerular filtrate;
all other substances equal in concentration; ***[2]***

SECTION B

4. (a) water is transparent / allows light to pass through for photosynthesis;
cohesion of water molecules allow transport in plants;
solvent - chemical reactions take place in water;
many substances dissolve in water and can be transported;
high boiling point making liquid water available to organisms / water is liquid over a range of temperatures;
water is most dense at $4^{\circ}C$ so ice floats over water providing winter habitat;
high specific heat capacity so stable environment (internal/external);
high surface tension - supports (near) surface dwelling organisms;
coolant - absorbs heat when it evaporates / changes states; ***[5 max]***

(b) goes against concentration gradient / from low concentration to high concentration;
requires hydrolysis of ATP / requires energy from ATP;
proteins in membrane utilized;
specificity of carriers;
e.g. Na^{+}-K^{+} pump / other suitable examples;
may involve conformational change in carrier protein;
moves ions / solutes;
maintains chemical / electrical gradient; ***[5 max]***

(c) nerve impulse travels to end of presynaptic neuron;
triggers influx of Ca^{2+};
causes synaptic vesicles to fuse with membrane;
release neurotransmitter molecules into synaptic cleft;
(neurotransmitter) crosses / diffuses across channel;
(neurotransmitter) binds to receptors on next / postsynaptic neuron;
causes ion channels to open on neuron;
e.g. Na^{+} diffuse into postsynaptic neuron;
can inhibit/excite;
by hyperpolarizing/depolarizing;
neurotransmitter degraded;
Ca^{2+} pumped back into the synaptic cleft;
acetylcholine / GABA / dopamine / serotonin / other examples of neurotransmitter; ***[8 max]***

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

5. (a) *For a diagram of a mature sperm, award **[1]** for each of the following structures clearly drawn and labelled correctly.*
acrosome;
head with nucleus;
tail;
middle piece with mitochondria; ***[3 max]***

(b) *structure*: ***[3 max]***
placenta is composed of fetal and maternal tissues;
villi increase surface area;
vascularization / capillaries within placental villi;
intervillous spaces through which maternal blood flows;

function: ***[4 max]***
secretes estrogen to maintain uterine lining;
secretes progesterone to maintain uterine lining;
gas / nutrient exchange for fetus;
removes waste products;
acquiring passive immunity / antibodies cross placenta;
secretes HCG; ***[6 max]***

(c) negative feedback (to maintain homeostasis);
insulin produced in β-cells;
glucagon produced in α-cells;
glucose levels monitored in Islet of Langerhans in pancreas;

after meal blood glucose level goes up;
insulin is secreted;
causes muscle / liver / adipose cells to take up glucose;
stored as glycogen / lipid;
return blood glucose levels to normal;

when blood glucose goes down between meals;
glucagon is secreted;
causes breakdown of glycogen to glucose in the liver;
blood glucose levels return to normal; ***[9 max]***

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

6. (a)

bryophytes	*angiospermophytes*
non-vascular / no xylem	vascular / xylem;
seedless	seeds;
gametophyte dominant generation	sporophyte dominant generation;
no flowers	flowering;
no true leaves / stems	true leaves / stems;
rhizoids	roots;
no cuticle	cuticle;
no fruits	fruits;
motile sperm / male gamete	pollen;

[5 max]

(b) *To receive full marks responses must address all three parts.*

light: ***[2 max]***
causes stomatal opening in morning, increasing transpiration;
increasing light increases transpiration;
because stomatal opening increases;
no light causes stomatal closure, reducing transpiration;

wind : ***[3 max]***
removes water / vapour from around leaf;
increases water vapour / humidity gradient so increases transpiration;
increases transpiration / lack of wind can reduce transpiration;
no increase in transpiration if humidity is 100 %;

humidity : ***[3 max]***
high humidity reduces water vapour gradient so lowers transpiration;
high humidity lowers transpiration rate;
lowering humidity can increase transpiration rate (**to a point**);
at very low humidity stomata may shut down; ***[8 max]***

(c) absorption of water;
gibberellic acid produced in embryo;
stimulates production of amylase;
catalyses the breakdown of starch to maltose;
maltose diffuses to embryo;
used for energy production and growth; ***[5 max]***

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

7. (a) name of pathogen;
method of transmission;
effect;
second effect;

e.g.: cholera;
Vibrio cholerae;
contaminated water;
diarrhoea;
extreme dehydration; ***[5 max]***

(b) *benefits*: ***[5 max]***
prevent disease;
eliminate diseases:
e.g. smallpox;
prevent epidemics;
healthier society;
reduce medical cost;
less job absenteism;
disease free cattle / more food;

dangers: ***[3 max]***
allergic reactions / anaphylactic shock;
weakened virus becomes virulent / causes the disease;
e.g. sabin vaccine / other example;
harmful side-effects;
e.g. encephalitis with whooping cough vaccine / possible link with MMR and autism / other examples; ***[8 max]***

(c) plasmid is a small piece of circular DNA;
plasmid removed from (host) cell;
cleaved with restriction enzymes;
genes / DNA fragments from another organism cleaved by same restriction enzyme;
(can be) inserted into plasmid;
spliced together by DNA ligase;
inserted into host cells;
inserted into *E. coli* to clone the gene; ***[5 max]***

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