IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

MARKSCHEME

MAY 2006

BIOLOGY

Higher Level

Paper 2

12 pages

SECTION A

1. (a) $2.4\ (\pm\ 0.1)\,\text{ml}\,O_2\,g^{-1}\,h^{-1}$ *(units required)* ***[1]***

(b) as temperature rises oxygen consumption decreases / negative correlation / inverse proportion (from $6\,^{\circ}C$ to 30-32 $^{\circ}C$);
but fairly stable/little effect above $31(\pm1)\,^{\circ}C$; *(units required)* ***[2]***

(c) temperature below which animals' oxygen consumption increases / temperature below which animals respiration rate increases (to maintain body temperatures);
temperature at which animal reaches minimal oxygen consumption / temperature above which oxygen consumption remains steady / possible increase; ***[1 max]***

(d) (i) sloth ***[1]***

(ii) *e.g.* at $17\,^{\circ}C$ has 100% of metabolic rate and at $-20\,^{\circ}C$ has $280(\pm5)\%$ (of metabolic rate) / a change in $37\,^{\circ}C$ corresponds to a change of $180(\pm5)\%$ (of metabolic rate);
$180 \div 37 = 4.9(\pm0.2)\%$ (of metabolic rate) per degree of temperature change/$\,^{\circ}C^{-1}$; ***[2 max]***
Award full marks for correct calculation of slope using other figures.
*Award **[1]** in case of ECF of a correct calculation with incorrect figures.*

(e) to produce heat;
maintain constant body temperature; ***[1 max]***

(f) tropical mammals have a greater increase in metabolic rate as the temperature drops / arctic mammals have a (more) gradual change in metabolic rate as temperature drops;
tropical mammals have a higher lower critical temperature;
values for arctic mammals are extrapolated/estimated/not proven/less certain;
tropical mammals are not (as well) adapted to cold temperatures / they live where little temperature change occurs;
arctic mammals have more/thicker fur/more insulation to help keep warm;
tropical mammals use BMR to regulate temperature more than arctic mammals; ***[3 max]***

(g) (i) $65.0 - 32.5 = 32.5(\pm0.5)\,\text{mm}$ *(units required)* ***[1]***

(ii) the values for thickness are only of length and not the density / number of hairs per surface area (that could be greater in the reindeer);
does not include thickness of each hair (that could be greater in the reindeer) / different compositions/materials;
does not include amount of air trapped in fur for insulation (that could be greater in the reindeer);
different colours of hair affect absorption light energy; ***[1 max]***

(h) (i) beaver drops by about $1.9 (\pm 0.1)\ W\ dm^{-2}$ / from $2.05 (\pm 0.05)\ W\ dm^{-2}$ to about $0.20 (\pm 0.05)\ W\ dm^{-2}$ *(units required)* ***[1]***

(ii) increase in metabolic rate (to generate heat);
fat insulation (to maintain heat);
fast muscle movements (to generate heat);
vasoconstriction/decreased blood flow to surface; ***[1 max]***
Accept any other reasonable suggestion.

(i) (increases in) both are adaptations to maintain body temperature;
mammals are homeotherms / must maintain constant body temperature;
increased metabolic rate produces more energy to maintain body temperatures;
thicker the fur, the greater the insulation value;
animals with high fur thickness do not change BMR as quickly as animals with lower fur thickness;
examples of animals with greater fur thickness and lower critical temperatures;
greater fur thickness, less need for increased metabolic rate to maintain temperature / less fur thickness requires higher metabolic rate to maintain body temperature;
thicker fur saves energy stores during cold temperatures when food is scarce;
animals in two data sets are not identical / insufficient data; ***[3 max]***

2. (a) (i) use of data to give a valid argument why it is dominant;
e.g. not (likely to be) recessive because no instance of offspring without a parent with the phenotype / if recessive, I-2, II-1 and II-8 would all need to be carriers (which is unlikely);

(ii) use of data to give a valid argument why it is not sex-linked;
e.g. males and females both affected / not X-linked because I-1 could not produce a male child with the disease; ***[2 max]***

(b) (i) *III-1*: fhfh and *III-2*: FHfh; *(or equivalent)* ***[1]***

(ii) 0.5 / 50 % ; ***[1]***

(c) 100 % (as has FH allele) / high probability; ***[1]***

3. (a) *Award **[1]** for each correct structure **and** its role.*

	Structure	Role
I:	mitochondria	produce ATP/site of (aerobic) respiration;
II:	nucleus	contains genetic information/produces RNA / site of replication;
III:	(rough) endoplasmic reticulum	(site of) translation/protein production/protein transport;

[3]

(b) (i) A in nucleus / A in mitochondria ***[1]***

(ii) B in a mitochondrion ***[1]***

(c) (i) insulin / glucagon ***[1]***
Do not accept proteins.

(ii) vesicles formed at/bud off from RER;
product carried to Golgi apparatus (and modified there);
vesicles carry product to plasma membrane;
fuse with membrane;
release product (to lumen) / exocytosis;
ATP used / energy required; ***[3 max]***

SECTION B

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

4. (a) sepal;
petal;
anther;
filament;
stigma;
style;
ovary; ***[4 max]***
*Award **[1]** for each structure accurately drawn and correctly labeled.*

(b) *transport*: ***[3 max]***
water transported in xylem vessels;
transpiration pull;
due to loss of water vapour from leaves (and stems) / evaporation of water from leaves;
cohesion of water molecules (due to hydrogen bonds) / continuous column of water;
capillarity/adhesion;
transpiration stream is flow of water within the plant;
transpiration stream is flow of water from roots through the plant;

abiotic factors: ***[3 max]*** *(accept inverse statements)*
light: in day guard cells are open so increases evaporation and transport of water;
temperature: higher temperatures increase evaporation and transport of water;
wind: more wind, faster evaporation and increase transport;
humidity: higher humidity in air decreases (rate of transpiration) and transport;
CO_2 concentration: if high, stomata close and lower transpiration rate; ***[6 max]***

(c) chemiosmosis is synthesis of ATP coupled to electron transport and proton movement;
photophosphorylation is the production of ATP with energy from light;
light energy causes photolysis/splitting of water;
electrons energized (from chlorophyll)/photoactivation;
photolysis provides (replacement) electrons for those lost from excited chlorophyll;
photolysis provides protons/ H^+ (for thylakoid gradient);
electron transport (carriers on membrane of thylakoid;)
causes pumping of protons/ H^+ across thylakoid membrane/into thylakoid space;
protons/ H^+ accumulate in thylakoid space /proton gradient set up;
protons/ H^+ move down concentration gradient;
into stroma;
flow through ATPase/synthetase;
leading to ATP formation; ***[8 max]***

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

5. (a) *Award **[1]** for each structure accurately drawn and correctly labeled.*
haploid nucleus;
(two) centrioles;
cytoplasm (must show large volume relative to nucleus – suggest four to one ratio of diameter at a minimum);
(first) polar cell / polar body (needs to be drawn on the outside of the cell);
plasma membrane;
follicle cells / corona radiata;
cortical granules (need to be drawn in vicinity of plasma membrane);
zona pellucida; ***[4 max]***

(b) *Award **[1]** for each of the following pairs up to **[6 max]**.*

Mitosis	**Meiosis**
one cell division	two divisions / reduction division;
chromosome number does not change (*do not award mark for diploid cells produced as mitosis can occur in haploid cells*)	converts diploid to haploid cells;
products genetically identical	products genetically diverse;
separation of sister chromatids in anaphase	separation of homologous chromosomes in anaphase I and sister chromatids in anaphase II;
no crossing over	crossing over in prophase I;
no formation of tetrads / no synapsis	formation of tetrads / synapsis;
produce cells for growth / tissue repairs / asexual reproduction	produce sexual cells / gametes for sexual reproduction;
two cells produced	four cells produced;
daughter cells with both copies of chromosomes/random assortment does not occur;	random assortment of maternal / paternal chromosomes (provides genetic diversity);
replication of DNA in interphase	replication in interphase I;
four phases: prophase, metaphase, anaphase, telophase	same four phases twice;

[6 max]

(c) crossing over (in prophase I);
new combinations/recombination/exchange of alleles;
non-disjunction / chromosomal mutation can occur creating new varieties;
genetic mutations can occur creating new varieties;
random alignment of homologous chromosomes at metaphase I / independent assortment;
variety of chromosomes set 2^n / 2^{23} (in humans);
random mating in population creates new genetic combinations;
random fertilization of one sperm with one egg;
variations allow for better chances for survival / better adaptation;
more likely to survive to reproductive age;
variation allows a population to survive environmental change; ***[8 max]***

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

6. (a) *Award **[1]** for each of the following clearly drawn and correctly labelled.*
relative position of atoms correctly shown;
individual amino acids labeled;
peptide linkage labeled correctly;
NH_2 at one end and COOH group at other / NH_3^+ and COO^-;
R group coming off the alpha carbon in each amino acid; ***[4 max]***

(b) mRNA carries copy of DNA / gene;
binds to ribosomes (in cytoplasm);
codons of mRNA pair with anticodons / complementary base pairing of tRNA;
3′ end with CCA for attaching specific amino acid;
some amino acids have more than one tRNA / degeneracy;
tRNA activating enzymes bind a specific amino acid to tRNA;
two tRNAs bind to ribosome;
one holds the growing polypeptide;
amino acids bonded by peptide linkage;
after peptide is transferred, one tRNA is released;
ribosome shifts position;
translation consists of initiation, elongation and termination;
occurs in 5′ to 3′ direction;
start and stop codons;
polysomes / group of ribosomes may translate one mRNA at once; ***[8 max]***

(c) *definition*: ***[4 max]***
homeostasis maintains the internal environment at a constant level / between narrow limits;
involves monitoring levels of variables;
correcting change with negative feedback;
variables affecting enzyme function are under homeostatic control;

examples: ***[4 max]***
*Award **[2 max]** for outlining each example of homeostatic role in enzyme function. Award marks for other suitable examples not outlined below.*
pH is under homeostatic control;
e.g. proteases optimal activity at 1.5 / acidic pH;
hunger/eating affects substrate concentration;
e.g. while eating starch, more activity of salivary amylase to digest starch;
control of excess substances in storage / condensed form;
e.g. glucose condensed to glycogen (by specific enzyme in liver);
negative feedback keeps substrate/product levels within range;
e.g. ATP inhibition of phosphofructokinase in glycolysis;
temperature controlled to avoid denaturing enzymes; ***[6 max]***

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

7. (a) *Award **[1]** for every two linkages correctly shown. Award **[3 max]** if fewer than eight organisms are correctly named. Deduct **[1 max]** for arrows in the wrong direction. Reject responses that state plant, grass, bird, insect or other broad groups of organisms. Acceptable examples maple, egret, trout, marine iguana, Biston betularia. Deduct **[1 max]** if organisms are unlikely to encounter one another in their habitat. Deduct **[1 max]** if any chain does not have a producer/ source of organic material.* ***[4 max]***

(b) surplus amino acids are degraded to nitrogenous compounds;
freshwater fish excrete/produce ammonia;
toxic, but diluted by abundant water;
birds fly and need to be light / little water;
birds excrete uric acid;
have little water and uric acid is insoluble and non-toxic;
birds and mammals can live in dry habitats and need little water to excrete N-products / water conservation;
mammals excrete urea;
soluble in blood, (relatively) non-toxic (and excreted in the kidneys);
trade-off between energy conservation and water conservation; ***[6 max]***

(c) *general statements*: ***[3 max]***
vaccinations stimulate antibody production / immunity;
against/resistance to specific pathogens / artificial immunity;
use either weakened pathogens or specific antibodies;
primary response to first vaccination / secondary response to second vaccination;
memory cells (are cloned) maintain long-term immunity;

benefits: ***[3 max]***
eradicated some diseases *e.g.* smallpox / polio;
decrease child mortality;
MMR/mumps, measles and rubella prevent long-term health problems;
e.g. deafness / blindness / heart damage from rubella / male infertility from mumps;
prevent epidemics / pandemics;

dangers: ***[3 max]***
too many vaccinations may lower body's immunity to new diseases;
immunity may not be life-long / may have severe version as adults *e.g.* measles;
some vaccines may cause serious side effects;
e.g. whooping cough vaccine may cause encephalitis / toxic effects (Hg) in some vaccines / allergic reactions;
may contract disease from vaccine; ***[8 max]***
Examiners are encouraged to identify where marks are being awarded from, i.e. the general statements, benefits statements or dangers statements.

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