INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

MARKSCHEME

May 2000

BIOLOGY

Higher Level

Paper 2

11 pages

SECTION A

1. (a) more energy / higher maximum / higher minimum energy for surface swimming;
penguin and sea otter both use more energy for surface than underwater swimming;
65 versus 38–39 for sea otter / 36–37 versus 19–20 for penguin; ***[2]***

(b) humans are not streamlined;
hands / feet / not adapted to swimming / have small surface area;
legs / leg muscles adapted to walking;
humans swim on the surface and surface swimming takes more energy than underwater;
lack of buoyancy / energy used to stay on the surface;
water often cold so much heat loss to the water; ***[2 max]***

(c) (i) feeding dives can go to (much) greater depths; ***[1]***
(ii) holes in the ice are near the surface and (some) prey is at greater depths; ***[1]***

(d) (i) exploration dives can go on for a longer time; ***[1]***

(ii) holes in the ice take longer to find than prey;
energy / oxygen used up faster on feeding dives; ***[1 max]***

(e) *Either* ***[max 1 mark]*** *for*
oxygen amount falls more slowly during long dives;

Or ***[max 2 marks]*** *for*
oxygen decreases by the same total amount on long and short dives;
immediate decrease on short dives but plateau then decrease on long dives;
similar rate of fall / slightly faster fall on long dives when the amount is falling; ***[2 max]***

(f) (immediate) fall in oxygen suggests aerobic / not anaerobic respiration on short dives;
anaerobic respiration on the long dives;
plateau suggests that there is anaerobic respiration;
there must be cell respiration and aerobic respiration involves oxygen use;
but myoglobin in muscles might be providing oxygen;
but extra red blood cells added to the blood might be providing oxygen;
anaerobic respiration usually only occurs when oxygen has been used up; ***[3 max]***

(g) rise in 2–hydroxypropanoate due to anaerobic respiration;
blood supply to muscles cut off during the dive;
2–hydroxypropanoate only released into the blood after the dive;
avoids toxic effects of 2–hydroxypropanoate during the dive;
fall in 2–hydroxypropanoate due to conversion back to 2–oxopropanoate / pyruvate; ***[3 max]***

2. (a) a group of genes located on the same chromosome; ***[1]***

(b) purple short and red long are recombinants;
because they have a different combination of characteristics / genotype from the parents;
(reject reasons relating to percentages) ***[2]***

(c) crossing over must take place;
between the two genes on the chromosome; ***[2]***

(d) ***([1 mark]*** *max if alleles shown without bars for chromosomes)*
two non-recombinants correct;

$$\frac{P\ L}{p\ l} \quad \text{and} \quad \frac{p\ l}{p\ l}$$

two recombinants correct;

$$\frac{P\ l}{p\ l} \quad \text{and} \quad \frac{p\ L}{p\ l}$$

[2]

(e) one centimorgan gives one crossover per 100 gametes;
answer = 12 centimorgans; ***[2]***

3. (a) removal of waste products of metabolism;
removal of toxic substances;
removal of substances in excess; ***[2 max]***

(b) blood in renal artery more oxygenated than the blood in the renal vein;
blood in renal artery contains more urea than the blood in the renal vein;
blood in renal artery contains less carbon dioxide than the blood in the renal vein;
blood in renal artery contains more glucose than the blood in the renal vein; ***[2 max]***

(c) makes the medulla hypertonic;
by raising the sodium / mineral ion concentration;
allows the production of hypertonic urine; ***[2]***

(d) basement membrane (of the glomerulus / fenestrated capillaries); ***[1]***

SECTION B

(Remember, up to TWO 'quality of construction' marks per essay)

4. (a) antibody recognition sites;
hormone binding sites;
enzymes / catalysis;
electron carriers;
pores (for facilitated diffusion);
pumps / carriers for active transport;
pigments (in retina cells);
cell to cell adhesion;
cell recognition / antigens; ***[4 max]***

(b) α helix is a secondary structure;
polypeptide is coiled into a helix:
β (pleated) sheet is a secondary structure;
polypeptide folds back on itself (several times) to form a sheet;
α helix / β (pleated)sheet / secondary structures held together by hydrogen bonds;
hydrogen bonds form between C=O and N-H groups;
hydrogen bonds at regular spacing;
dimensions of secondary structures are constant;
not all of a polypeptide forms secondary structures (in most proteins); ***[5 max]***

(c) enzymes are globular proteins;
part of the protein (surface) acts as the active site;
substrate(s) binds to active site;
shape of substrate (and active site) changed / induced fit;
bonds in substrate weakened;
activation energy reduced;

in feedback inhibition an end-product binds to the enzyme;
end-product is a substance produced in last stage of a (metabolic) pathway
binds at the allosteric site / site away from the active site;
binding causes the enzyme / active site to change shape;
substrate no longer fits the active site;
the higher the concentration of end-product the lower the enzyme activity;
enzyme catalyses the first / early reaction in pathway so whole pathway is inhibited; ***[9 max]***

(Remember, up to TWO 'quality of construction' marks per essay)

5. (a) composed of C, H and O;
relatively more C and H / less O than carbohydrates;
composed of fatty acids and glycerol;
glycerol is $CH_2OH.CHOH.CH_2OH$ / diagram to show the structure;
fatty acids are carboxyl groups with hydrocarbon chain attached / diagram to show structure;
ester bonds / diagram showing C–O–C=O;
three fatty acids / hydrocarbon chains linked to each glycerol;
12–20 carbon atoms per hydrocarbon tail / diagram showing this number;
saturated if all the C–C bonds are single / unsaturated if one or more double bonds;
whole molecule is apolar / hydrophobic; ***[6 max]***

(b) fats / triglycerides broken down into fatty acids and glycerol;
β oxidation of fatty acids;
fatty acids / fats broken down into 2-carbon fragments;
2–carbon fragments converted to ethanoyl / acetyl CoA;
used in the Krebs cycle;
ethanoyl CoA plus 4C compound to 6C compound;
oxidised to water and carbon dioxide;
$NADH + H^+$ produced in the Krebs cycle;
more energy released per gram than from carbohydrates; ***[4 max]***

(c) membranes to compartmentalise / separate from processes in the cytoplasm;
small size gives large surface are to volume ratio;
large surface area to volume ratio allows rapid uptake / release of materials;
matrix contains enzymes of the Krebs cycle;
matrix is an aqueous solution so allowing enzymes to work;
inner membrane invaginated / infolded / forms cristae to increase the surface area;
large surface area gives more space for electron transport chain / oxidative phosporylation;
inner membrane contains ATP synthetase / ATPase;
narrow gap between inner and outer membranes;
proton concentration gradient rapidly established / steeper;
chemiosmosis therefore more efficient;
DNA present to act as genetic material;
ribosomes for protein synthesis;
some proteins do not need to be imported; ***[8 max]***

(Remember, up to TWO 'quality of construction' marks per essay)

6. (a) cell body drawn and labelled with a nucleus shown inside;
axon drawn at least five times as long as the diameter of the cell body and labelled;
myelin sheath drawn and labelled;
gaps in the myelin sheath labelled as nodes of Ranvier;
at least five dendrites drawn leading to the cell body and labelled;
at least two motor end plates / synaptic knobs drawn and labelled; ***[5 max]***

(b) local currents / ions diffuse from adjacent depolarised section of axon;
resting / membrane potential reduced;
voltage-gated ion channels affected;
sodium channels open;
sodium diffuses in / moves in rapidly;
therefore fewer positive charges outside and more inside;
inside becomes positive relative to outside;
before depolarisation outside was positive relative to inside; ***[5 max]***
(Award no marks for statements about potassium movement and repolarisation)

(c) impulse reaches the motor end plates / synaptic knobs;
synaptic vesicles contain neurotransmitter / acetylcholine;
calcium enters through the presynaptic membrane;
calcium causes the vesicles to move to and fuse with the membrane / causes exocytosis;
neurotransmitter / acetylcholine released into the synaptic cleft;
diffuses across the synaptic cleft to the muscle fibre membrane / postsynaptic membrane;
binds to receptor sites;
causes depolarisation of the muscle fibre membrane / postsynaptic membrane;
by opening sodium gates;
threshold of stimulation must be reached / all or nothing effect;
enzyme / acetylcholinesterase breaks down the neurotransmitter / acetylcholine;
depolarisation causes sarcoplasmic reticulum to release calcium ions;
calcium ions cause muscle contraction; ***[8 max]***

(Remember, up to TWO 'quality of construction' marks per essay)

7. (a) epidermis / piliferous layer drawn as thin outer layer and labelled;
cortex drawn to occupy at least two thirds of the radius of the root and labelled;
endodermis drawn and labelled;
pericycle drawn adjacent to the vascular tissue and labelled;
xylem shown as central core with ridge-like projections and labelled;
phloem shown in gaps between xylem ridges and labelled;
root hairs / Casparian strips drawn and labelled; ***[5 max]***
(Award marks for the first two adaptations given and not for any subsequent ones)

(b) large air spaces;
to provide buoyancy / make plant float high in the water;

finely divided leaves / pliable leaves / stems;
to avoid damage from flowing water;

no / thin cuticle;
for better gas exchange and no danger of transpiration;

pneumatophores / breathing roots;
to supply oxygen in water logged conditions;

reduced roots / no roots;
as water easily absorbed through stem / leaf; ***[4 max]***

(c) water absorbed by osmosis;
root cells have lower water potential than soil water;
therefore water moves from soil to root;
mineral ions pumped in by active transport;
high mineral ion concentration causes low water potential;
xylem vessels have very low water potential;
water drawn into xylem from surrounding root cells;
xylem thus lowers the water potential of the surrounding root cells;
epidermis cells have hairs;
increases surface area for absorption / increases effective diameter of root;
water drawn through walls of root cells / apoplastic pathway;
branching of roots increases water absorption; ***[9 max]***