



MARKSCHEME

May 2000

BIOLOGY

Standard Level

Paper 3

Option A — Diet and Human Nutrition

- A1.** (a) 12 (arb units); (*Do not penalise lack of units*) [1]
- (b) (i) most is (whole) egg **and** least is gelatin; [1]
- (ii) egg is high in essential amino acids / contains all amino acid / protein is more soluble / can be digested quicker / different primary structure;
gelatin lacks one/some essential amino acids / is low quality protein / protein is less soluble / is digested less quickly; [2]
- (c) person is unable to store protein beyond a certain level;
person is unable to absorb more (in the gut);
person is unable to assimilate more / synthesise protein faster;
(excess is) excreted;
(excess is) deaminated; [2 max]
- A2.** (a) (i) nerve action / propagation of action potentials / potassium pump;
muscle fibre / cell contraction;
maintain electrolyte balance / concentration / solute potential of body fluids; [1 max]
- (ii) formation of / precursor of visual purple / rhodopsin / visual pigment / functioning of rods;
maintenance of epithelial tissues; [1 max]
- (iii) ensure peristalsis efficient / help (muscles of) digestive system ‘push’ food along / prevent constipation;
(possibly) reduce instances of some intestinal cancers;
slow passage of food along intestine to ensure enzyme action and time for absorption; [1 max]
- (b) Name of deficiency disease **and** nutrient involved;
symptom of the disease;
function of the nutrient in the body; [2 max]
(*e.g. scurvy is vitamin C deficiency / ascorbic acid deficiency;
cuts fail to heal / teeth drop out and gums bleed;
ascorbic acid is needed for collagen production / formation of healthy connective tissue;*)
- A3.** definition of malnutrition as an unbalanced diet / overeating or undereating / lack of essential nutrients;
possibly caused by ignorance due to a lack of education about nutrition;
economic conditions may mean a lack of money and an inability to purchase ‘correct’ foods;
economic conditions of a country may make some foods expensive / unavailable;
economic conditions of considerable wealth may mean people buy and eat too much food – obesity;
economic conditions may mean low yields due to pests or lack of fertilisers and hence lack of nutrients;
economic conditions may prevent purchase of agricultural technology;
large families may lead to malnutrition; (*this is social or economic*)
social conditions may lead to intestinal diseases (dysentery, diarrhoea) and hence non-retention of nutrients;
social conditions may lead to unrest / civil disturbance (or war) and hence no crops and so malnutrition;
social conditions / pressures may ‘force’ people to disorders such as bulimia or anorexia; [4 max]
(*[3 max] if only one condition (social or economic) is mentioned*)

Option B — Physiology of Exercise

- B1.** (a) 1600 – 1650 N; (*penalise lack of units once **only** an the whole exam*) [1]
- (b) the athlete is between strides / mid-stride / the foot (feet) is not on the ground (so no downward force); [1]
- (c) 3.5 ± 0.2 s (*no working is necessary*) [1]
- (d) line(s) with similar shape with flat plateaux and troughs fairly similar; time taken for each cycle is less; [2]
- (e) fractures of bones of ankle / toes;
snapping tendons / tearing muscles / ligaments;
tendinitis;
sprained / twisted ankle;
cartilage damage; [1 max]
- B2.** (a) a few seconds / two to ten seconds; [1]
- (b) it acts as a store of oxygen / it binds (one molecule of) oxygen (per molecule of myoglobin);
when oxygen concentration in the muscle falls to a very low value it can release oxygen;
to maintain aerobiosis / allows aerobic cell respiration to continue for longer; [2 max]
- (c) lactate (2-hydroxy propanoate) is (slowly) converted back to pyruvate (2-oxo propanoate) / lactate is broken down;
which creates $\text{NADH} + \text{H}^+$ which must be re-oxidised using oxygen from the air;
(which leads to) ‘panting’ after exercise has been completed / increased breathing;
(some of the) oxygen is used to replenish the myoglobin;
(some ATP produced is used to) reform creatine phosphate; [2 max]
- B3.** inhibitory neurones release transmitters across synapses;
that make some post-synaptic / synaptic membranes less sensitive to transmitters (from excitatory neurones);
(this may be done) by blocking some receptor sites (competitively);
so that one muscle does not contract when the other does / definition of antagonistic muscles;
the contraction of one muscle of a pair stimulates the inhibition of the other muscle of the pair;
they allow ‘fine-tuning’ of the control process;
they enable all muscles to be partly working and therefore ready to contract at short notice; [4 max]

Option C — Cells and Energy

C1. (a) *Chlorobium*; [1]

(b) (i) Similarity: both have a peak of absorption / peak (due to chlorophyll) at long/short wavelengths;

Difference: neither can absorb at more than 750 nm;
Porphyridium has an extra peak midway / at about 550 nm; [2]

(ii) *Porphyridium* has phycobilins whereas *Chlorella* does not / has an extra pigment; [1]

(c) the first peak (about 450 nm) is the same for both organisms and so indicates the same chemical;
 the second peak for *Chlorobium* is at a much longer wavelength implying a different chemical; [2]

C2. (a) as hormones;
 as part of contractile structures / muscle;
 catalysts / enzymes;
 hair / finger nails / other structural function;
 pigments (in the retina);
 blood clotting;
 food storage (in seeds / milk);
 pH buffering (in blood);
 transport of oxygen / other chemicals;
 provide energy;
 antibodies;
 osmotic balance; [3 max]

(b) fibrous proteins are elongated whereas globular are rounded;
 fibrous proteins contain much secondary structure but globular have less (usually)
 fibrous proteins do not fold up to form tertiary structure but globular do (usually);
 fibrous proteins are (usually) less soluble in water than globular;
 fibrous proteins (usually) have structural functions and globular non-structural [2 max]

C3. outer membrane isolates the contents from the cytoplasm / allows essential molecules to cross;
 intermembrane space allows a reservoir of H⁺ ions to be created;
 membranes are electrical insulators;
 cristae / large surface area of inner membrane allows many electron-carriers / ATP synthetases;
 ATP synthetase molecules span the inner membrane and allow flow of H⁺ ions out through channels;
 matrix provides a stable environment for the Krebs cycle / contains enzymes for Krebs cycle;
 (Allow [1] for stating function of mitochondria / describing one aspect of structure) [4 max]

Option D — Evolution

- D1.** (a) the mean percentage of leaf area killed is (much) lower for the population 0.6 km from the station;
the median is higher for the 60 km population;
greater % of leaf area killed at 60 km;
leaves are damaged in both populations; **[2 max]**
- (b) population 0.6 km from the station; **[1]**
- (c) (initially) many of them would be killed;
those naturally more resistant (with appropriate genes / alleles) would survive / through natural selection;
but with some restricted growth;
these plants would crossbreed and spread;
the distribution of plants would become similar to the one 0.6 km in the question;
the population would evolve to become more resistant; **[3 max]**
- D2.** (a) cooling of the Earth (surface and interior);
(release of water from the interior to) form clouds;
condensation of water / rain seas and rivers form;
build up of gases released from the land and sea / hydrogen sulphide / methane / methanal;
reducing atmosphere created;
(electrostatic charges) creating lightning;
various organic chemicals created;
(Do not accept volcanic activity on its own) **[3 max]**
- (b) protein / polypeptide / DNA / gene sequences (gradually) change;
due to accumulation of mutations;
rate of change is relatively constant;
measuring biochemical differences between species; **[2 max]**
- D3.** cultural evolution is passing down knowledge / ideas between generations;
example of cultural evolution *e.g.* art / agriculture / language / technology *etc.*;
possibly more important than genetic evolution;
there may well be an inherited capacity to acquire culture;
knowledge / education increases survival chances;
culture is changing very rapidly / cultural evolution is rapid;
human lifestyles therefore change rapidly;
some traditions have been lost;
cultural evolution was not as important in early evolution, (where fitness in the general sense was paramount); **[4 max]**

Option E — Neurobiology and Behaviour

- E1.** (a) 0.5 – 8 kHz (± 0.2) (*Penalise the lack of units **only** once in the whole exam*) [1]
- (b) both give a longer call in situation I than in situation II;
both give a wider range of frequencies in situation II than I;
similar range of frequencies in I;
length of call in I is similar; [2]
- (c) calls made in I are monotonous (pure tone) and so probably make it difficult for the birds to be located;
warn other birds of the presence of a predator;
call in I is quite long to draw the attention of more animals;
calls in II can be made several times for time of call in I;
in II, more chance of producing an annoying frequency;
calls in II cover many frequencies so they are loud to alert the predator to its presence;
scare the predator away (especially if there are many callers); [3 max]
- E2.** (a) I. Lens / pupil;
II. (Suspensory) ligament(s);
III. Fovea / yellow spot (*do not accept retina*); [3]
- (b) there are three different types of cone cell;
there are three different forms of the visual pigment;
each responds to a different colour / red, blue or green;
other colours are perceived by differential stimulation of these; [2 max]
- E3.** (*If no example then the maximum possible is [2 marks]*)
movement towards a stimulus is said to be positive / movement away is said to be negative;
such responses (of the whole organism) are called taxes;
the responses enable animals to move towards something beneficial (*e.g.* food, water);
the responses enable animals to move away from something harmful (*e.g.* bright light, harmful chemicals);
responses may also involve greater speeds;
suitable named example of a positive response;
suitable named example of a negative response; [4 max]

Option F — Applied Plant and Animal Science

- F1.** (a) China (695 million tonnes); *[1]*
- (b) similarity: same quantity of root crops produced for both regions;
both regions produce more cereals than other crops;
both regions have pulses as their lowest production;
both regions produce more vegetables than meat; *[1 max]*
- difference: Latin America produces more pulses than Western Europe (but less of everything else);
total productivity of Latin America is much less than that of Western Europe; *[1 max]*
- (c) Africa;
smallest production of food per unit of population;
24 million tonnes per 1 % of population / other suitable use of figures; *[3 max]*
- (d) expensive / high energy use;
food may deteriorate during transport / lose nutritional value; *[1 max]*
- F2.** (a) promote rooting;
induce flowering at required times;
prolong the period of flowering make plants larger / keep cut flowers alive longer;
produce fruits without seeds;
promote seed germination;
kill weeds; *[3 max]*
- (b) nutrient depletion;
pest invasion;
increased crop production;
more efficient land use; *[2 max]*
- F3.** faster (muscle) growth / extended milk yields / more meat;
improved efficiency of feed conversions / higher profits;
possibility of residues affecting humans / consumer resistance;
concerns over animal welfare / suffering; *[3 max]*

Option G — Ecology and Conservation

- G1.** (a) *M. lineata* was found on the west part of the coast whereas *S. alveolata* was not;
S. alveolata was found further east / nearer the river mouth / only on southern coast;
both were found along the south coast;
M. lineata was more widespread than *S. alveolata* [2 max]
- (b) salinity of the water;
wave action;
temperature of the water;
tidal movements;
food supply;
breeding territory / grounds;
presence of predators / fishermen;
river currents; [2 max]
- (c) for the location, accept any point in the water in the right half of the diagram;
highest death rates in this area; [2]
- G2.** (a) temperate forest has a much greater biodiversity than tundra;
the biodiversity of temperate forests is generally reduced in winter compared with summer;
this is true also of tundra but the range of changes is generally much less;
the primary productivity of temperate forest is much greater which may contribute to the greater biodiversity;
the range of habitats / niches is greater in temperate forests which leads to more biodiversity;
no trees / few flowering plants in tundra but many in temperate forests; [2 max]
- (b) data collection: important to determine what is happening to the type / numbers of species;
monitor whether people / organisations are adhering to legislation; [1 max]
- legislation: making picking / collecting / killing / harming species illegal;
ensuring land is set aside for conservation; [1 max]
- captive breeding: useful for small / scattered populations that cannot breed in the wild;
removes danger of predators / starvation / natural disasters; [1 max]
- G3.** oxygen converted from gas to water by respiration / respiration uses oxygen;
water is hydrolysed in photosynthesis to produce gaseous oxygen / photosynthesis produces (gaseous) oxygen;
nitrites are converted to nitrates by some bacteria (using oxygen);
ammonia is converted to nitrites using gaseous oxygen by some bacteria;
nitrates are reduced back to nitrogen and the oxygen is converted to water;
these conversions are carried out by enzymes;
light energy is used to hydrolyse water in photosynthesis; [4 max]
-