

# **MARKSCHEME**

**May 2007**

**BIOLOGY**

**Standard Level**

**Paper 3**

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## Subject Details: Biology SL Paper 3 Markscheme

### Mark Allocation

Candidates are required to answer **ALL** questions in each of **TWO** Options (total *[18 marks]*). Maximum total = *[36 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 underlined 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 penalizing them for what they have not achieved or what they have got wrong.
- ◆ Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- ◆ 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. Indicate this with “**ECF**”, error carried forward.
- ◆ Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by “**U-1**” at the first point it occurs. 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.

**Option A — Diet and Human Nutrition**

- A1.** (a) fats/lipids and carbohydrates/sugars **[1]**  
*Need both to receive the mark.*
- (b) both rise (from one to four months);  
those with added protein rise more slowly / those without the extra protein rise more quickly / difference increases;  
those with no added protein always higher;  
there is not a lot of difference / no significant difference between them; **[2 max]**
- (c)  $\frac{80.5(\pm 0.1) - 79.2(\pm 0.1)}{80.5(\pm 0.1)} \times 100;$   
 $= 1.6(\pm 0.3)\%$ ; (*unit not required*) **[2]**
- (d) graph shows (some evidence of) less gain in body mass with additional protein;  
the difference with additional protein is small;  
the hypothesis is not strongly supported;  
both groups may eventually regain all the body mass;  
experiment not left long enough;  
differences still increasing after three months; **[3 max]**

**A2.** (a) Award [2] for four correct answers, [1] for three or two correct answers and [0] for one correct answer.

- retinol/vitamin A;
- cyanocobalamin/vitamin B<sub>12</sub>;
- ascorbic acid/vitamin C;
- calciferol/vitamin D;
- tocopherol/vitamin E;
- etc.;

[2 max]

Do not accept vitamin B unqualified.

(b) link to health / prevention of certain diseases / deficiency diseases;  
 only needed in small amounts;  
 cannot be made by body (except vitamin D);  
 Award [1 max] for vitamin and correct use and [1 max] for vitamin and effect of deficiency.

<i>Vitamin</i>	<i>Use</i>	<i>Effect of deficiency</i>
retinol/A	visual pigment/bone growth;	poor night vision / anemia;
cyanocobalamin / B <sub>12</sub>	coenzyme in nucleic acid metabolism;	anemia;
ascorbic acid / C	antioxidant/ helps bone formation;	scurvy;
calciferol/D	helps calcium uptake for bones/teeth;	rickets/bow legs;
tocopherol/E	antioxidant;	anemia;

[3 max]

**A3.** (a) the liver

[1]

(b) (cholesterol) is required for cell membrane structure / converted to steroids e.g. sex hormones / synthesizing bile;  
 high cholesterol diets combined with saturated fats can be harmful;  
 saturated fats lead to high levels of LDL (low density lipoproteins);  
 LDLs retain cholesterol in the body;  
 high (blood) cholesterol can lead to atherosclerosis/plaques in artery/heart attack/  
 stroke/hardening of arteries;  
 polyunsaturated fats can however protect against this effect;  
 very little (about 20% ) cholesterol comes from the diet;

[4 max]

**Option B — Physiology of Exercise**

- B1.** (a)  $78 (\pm 2) \text{ pg cm}^{-3}$  (*units required*) [1]
- (b) less increase in plasma concentration of CK in creatine treated group compared to the control group;  
no/less increase in plasma concentration of LDH in creatine treated group compared to the control group;  
both creatine treated groups show reduction in indicators of cell death / greater reduction in LDH; [2 max]  
*Accept numerical comparisons.*
- (c) both indicators of inflammation increase (after the race);  
the indicators increase in both the control and the creatine treated group;  
but the increase in the creatine treated group is less than the control group for both indicators / TNF and PG;  
the differences are big enough to be significant (especially for PG);  
PG =  $65 : 285 \text{ pg cm}^{-3}$ , TNF =  $45 : 122 \text{ pg cm}^{-3}$ ;  
blood samples after the race may have been taken too early; [3 max]
- (d) performance enhancing drugs artificially improve the performance of an athlete;  
they may put the athlete's health at risk;  
the creatine used here improves recovery after a sports event;  
in this respect it is not being used to enhance the athlete's performance during the sporting event;  
unless the athlete is running several marathons/long distance races in quick succession;  
creatine may have other effects on the athlete's metabolism / only used for five days;  
a long-term analysis should be done; [4 max]
- B2.** (a) same basic diagram but with actin filaments closer together;  
actin filaments overlapping;  
overall length of sarcomere shown is shorter; [2 max]
- (b) exercising muscles require more  $\text{O}_2$  and produce more  $\text{CO}_2$ ;  
 $\text{CO}_2$  concentration in the blood rises and blood pH drops;  
pH /  $\text{CO}_2$  change detected by sensors in arteries;  
pH /  $\text{CO}_2$  sensors stimulate breathing/respiration centre of the brain; [2 max]
- (c) lactate/lactic acid accumulation;  
depletion of carbohydrate/glycogen supplies in muscle; [2]

- B3.** the nervous system is divided into the central nervous system / CNS (brain and spinal cord) and the peripheral nerve system / PNS (nerves);  
CNS consisting of brain and spinal cord;  
PNS consisting of motor and sensory nerves;  
sensory neurons carry impulses to the CNS;  
motor neurons carry impulses from the CNS;
- Accept any of the above if clearly explained in a labelled diagram.*

**[2 max]**

**Option C — Cells and Energy**

- C1.** (a) under low light intensity *T. weissflogii* has more iron in its cells / *T. oceanica* has less iron in its cells than *T. weissflogii*;  
between light intensities of 75 to 250 units iron concentrations decrease in *T. oceanica* but increase in *T. weissflogii*;  
under high light intensity slightly more iron concentration in *T. weissflogii*;  
between 25 and 75 units iron concentration in *T. oceanica* increases but decreases in *T. weissflogii*; [2 max]
- (b) in low light intensity the concentration of iron in the cells increases (or *vice versa*) (this is mainly true for both high and low levels of iron);  
this increase in cellular iron could be due to increased numbers of chloroplasts/an increase in photosynthesis/an increase in the concentration of photosynthetic molecules when light is limiting;  
this could be due to the cells being in/adapting to cloudy water; [2 max]
- (c) oceanic waters are deficient in iron;  
*T. oceanica* requires less iron for photosynthesis;  
oceanic waters are clear so light levels are high;  
*T. oceanica* can photosynthesise at its highest rates; [3 max]
- (d) *T. oceanica* populations would diminish [1]
- C2.** (a) *Diagram to include the following structures clearly drawn and correctly labelled.*  
inner and outer membrane;  
cristae;  
inter membrane space;  
ribosomes;  
(inner) matrix; [3 max]
- (b) gain in electrons / gain of hydrogen / loss of oxygen [1]

- C3.** (a) *secondary structure: [2 max]*  
folding/pleating of polypeptides to form  $\beta$ -pleated sheets / coiling of polypeptides to form  $\alpha$ -helix;  
held in place by hydrogen bonds;  
make structure stable;  
contributes to strength of fibrous proteins;  
provide structural role in organisms;  
*e.g.*  $\alpha$ -helix is keratin /  $\beta$  sheet is silk;

*tertiary structure: [2 max]*

- 3-D shape;  
due to bonding between amino R-groups/residues;  
hydrogen bonds / disulphide bridges / sulphur bonds/ ionic bonds;  
form globular proteins;  
which are soluble;  
*e.g.* lysozyme/ enzymes;

**[4 max]**

- (b) change in shape of enzyme's active site;  
improves fit of enzyme and substrates;  
brought about when the substrate molecules bind with the enzyme;  
enzyme changes from inactive to active form;  
permits some enzymes to bind with several substrates;  
distorts/weakens bonds in substrates;  
lowers activation energy;  
*Accept any of the above if clearly explained in a labelled diagram.*

**[2 max]**

**Option D — Evolution**

- D1.** (a) 
$$\frac{[(3 \times 0.75) + (5 \times 1.25) + (4 \times 1.75) + (2 \times 2.25) + (2 \times 2.75) + (1 \times 3.25) + (1 \times 3.75)]}{18};$$
  
 = 1.81; [2]
- (b) flying birds have a higher degree of asymmetry than flightless birds;  
 flying birds show more variation in their asymmetry than flightless birds; [2]
- (c) (i) *Archaeopteryx* (probably) could not fly;  
 the mean asymmetry for *Archaeopteryx* is below the range for modern flying birds;  
 within the range of modern flightless birds; [2 max]
- (ii) the evidence is weak;  
 very few specimens of *Archaeopteryx* are available so they may not be representative;  
 the specimens/feathers of *Archaeopteryx* may have been altered during fossilization; [2 max]
- D2.** (a) Award [2] for four correct answers, [1] for two or three correct answer and [0] for one correct answer.  
 forward facing eyes/binocular vision;  
 large brains;  
 flexible shoulder joints / shoulder blades on the dorsal side of the thorax;  
 manual dexterity / power grip / opposable thumb / grasping grip;  
 finger pads / nails not claws;  
 skull adapted for upright posture;  
 pronation / rotating hand; [2 max]
- (b) cooling of the planet (at 2.5 million years ago);  
 drying of the climate / thinning of forests;  
 this may have led to switching to more meat in the diet / probably scavenging kills of larger predators;  
 change to bipedal habit;  
 hands used for tools;  
 increase in brain size;  
 improved tool manufacture/use;  
 changes in contemporary fauna and flora recorded in fossil deposits support the idea;  
 vegetarian diet insufficient for brain growth;  
 artifacts include tools associated with fossil *H. habilis* (“handy man”);  
 evidence from *H. habilis* rare; [4 max]

**D3.** (a) *Any two of the following.*

DNA / proteins / RNA

*Accept a named protein e.g. hemoglobin.*

**[1]**

- (b) the origin of life elsewhere in the universe;  
life arrived (on early earth) from outer space;  
today's organisms evolved from these extraterrestrial organisms;  
life must have survived in outer space;  
life arrived as spores/seeds/by a comet/asteroid;

**[3 max]**

**Option E — Neurobiology and Behaviour**

- E1.** (a) it is a control;  
to verify that playing of any sound does not affect the behaviour; **[1 max]**
- (b) (i) percentage of vigilance increases for both calls;  
increase in vigilance higher for audible calls;  
whisper increases from 31 % to 52 % / shows 21 % increase, audible increases  
from 39 % to 89 % / shows 50 % increase; **[2 max]**
- (ii) the squirrels can hear the audible sound better;  
the audible sound carries further;  
squirrels might associate danger more with audible calls; **[1 max]**
- (c) a definition of altruism *e.g.* if the behaviour of an animal is harmful to itself but  
helpful to another animal;  
if an audible sound can be heard by a predator too the caller risks attracting the  
attention of the predator;  
the caller is reducing its chance of survival to help increase the chance of survival  
of others;  
audible sound is an example of altruism;  
if the ultra sound/whisper call is inaudible to the predator the caller is under less/no  
risk;  
the caller is not reducing its chance of survival;  
whisper sound is not an example of altruism; **[4 max]**
- E2.** (a) innate behaviour develops independently of the environment / inherited (in genes),  
learned behaviour reflects the environmental conditions experienced by individuals  
/ learnt in your lifetime **[1]**
- (b) *description of kinesis: [2 max]*  
kinesis occurs when an animal is reacting to/ moving away from, an unpleasant  
stimulus;  
from no particular direction;  
increases speed of random movement;  
increases rate of turning;  
example *e.g.* woodlice in a choice chamber will move from dry to damp conditions;  
stays away from hostile environment so increases chance of survival;  
*description of taxis: [2 max]*  
taxis is a directional locomotory response;  
stimulus from one direction;  
example *e.g.* *Euglena* will move towards light (phototaxis);  
the animal moves toward a favourable environmental condition/away from unpleasant  
stimulus so increase its chance of survival; **[4 max]**
- (c) geese eggs were raised artificially/in an incubator/without parents;  
goslings/baby geese were exposed to various objects/Lorenz soon after hatching;  
they were then tested by giving them a choice of objects to choose from;  
imprinted animals followed the object they had been exposed to at hatching;  
showed imprinting was irreversible;  
imprinting occurs at a critical period soon after hatching; **[3 max]**

**E3.** Award [2] for four correct answers [1] for two or three correct answers and [0] for one correct answer.

I. photoreceptor;

II. chemoreceptor;

III. mechanoreceptor / thermoreceptor;

IV. thermoreceptor / chemoreceptor / mechanoreceptor;

[2 max]

**Option F — Applied Plant and Animal Science**

- F1.** (a)  $(55 - 20) = 35 (\pm 2)\%$  (*units required*) [1]  
*Calculations do not need to be shown.*
- (b) initially/at day 140 after harvesting both have little effect on sprouting / only slight increase compared with control;  
 at 168 days AMO increases sprouting but CCC inhibits it as compared to control;  
 finally at 182 days both AMO and CCC treatments increase sprouting compared to control;  
 at 182 day AMO increases sprouting more than CCC; [3 max]
- (c) inhibitors of gibberellic acid encourage sprouting;  
 therefore, gibberellic acids inhibit sprouting; [2]
- (d) spray harvested potatoes with gibberellic acid [1]
- F2.** (a) *fuel:*  
 Colsa / a named species of tree / maize / sugar cane/sugar beet / rape seed;  
*Do not accept tree or wood unqualified.*
- clothing:*  
 cotton / flax / hemp / *Linum* / nettle;
- building materials:*  
 oak / pine / palm / hemp / bamboo / named tree species; [1 max]  
*Do not accept tree, wood or leaves unqualified.*
- (b) *crop production: [2 max]*  
 a single variety of a species is grown;  
 large fertilizer input needed increases yield;  
 the species is cultivated for many successive seasons;  
 permits farmers to specialize in one crop / allows increased mechanization/permits larger fields/larger farms;
- pest invasion: [2 max]*  
 but pest species numbers/populations will increase as their resources/food is increased;  
 repeated cultivation of the same crop means that pest species populations will continue to increase in successive generations/years;  
 fewer habitats for predators of pests; [4 max]
- (c) increased milk yield;  
 increased muscle growth for meat; [2]

- F3.** (a) sexual reproduction of closely related individuals / production of offspring between closely related individuals *[1]*
- (b) maintains genetic diversity/ biodiversity;  
reservoir of alleles that may have future value in crossing / selective breeding;  
*e.g.* disease resistance / climatic tolerance / pre-adaptation improving commercial value  
/ *e.g.* such as muscular oxen selected for ploughing later selected for meat production;  
ancient breeds could be a source of alleles for genetic engineering;  
F<sub>1</sub> hybrid vigour is restored by using ancient breeds; *[3 max]*

**Option G — Ecology and Conservation**

- G1.** (a) a direct relationship / as the size of the hawk increases so does the size of the prey / positive correlation [1]
- (b) (i) all the hawks take prey smaller/lighter than themselves;  
the difference between the mass of the hawk and its prey is greater for smaller hawks than for bigger hawks;  
females of *Accipiter cooperii* have the greatest difference between themselves and their prey; [2 max]
- (ii) even though the predators are larger than their prey their numbers/population density will be less than their prey [1]
- (c) female hawks always have a greater mass than the males [1]
- (d) female hawks and male hawks do not feed on the same prey;  
males hawks spend more energy than female hawks / male hawks are more active than female hawks so they do not grow so large / males invest more of their food energy in movement and less in growth / males are not egg laying;  
male hawks are adapted to be more agile than female hawks;  
male hawks spend more time defending their territory than female hawks / male hawks spend less time feeding;  
accept a reasonable genetic answer; [2 max]
- G2.** (a) CITES = Convention on International Trade in Endangered Species;  
promotes the sustainable exploitation of species;  
by means of a multilateral/intergovernmental agreement;  
CITES assesses the status of species threatened with extinction;  
CITES catalogues the threatened species (in appendices);  
(appendix 1) no trade at all;  
(appendix 2) trade permitted with strict control/under licence;  
(appendix 3) local restrictions in parts of the range of the species;  
CITES meets every two years/regularly to reassess the status of species; [4 max]
- (b) niche can be defined as an “ecological space” or an “ecological role”;  
the niche is defined by  
where the species lives in the ecosystem/ habitat;  
how the species obtains its food/ nutrition;  
the interactions with other species in the ecosystem/ relationships; [3 max]
- (c) *This does not need to be an indicator of pollution.*  
*e.g.* trout/mayfly/stonefly young stages are indicators of oxygen rich water;  
rat tailed maggots indicate high levels of water pollution/low oxygen levels;  
American Dipper shows good water quality;  
Gray Jay sensitive to temperature change;  
lichens indicates clean air;  
foxglove (*Digitalis purpurea*) indicator of acidic soil; [1 max]

- G3.** (a) I. energy ingested by tertiary consumers / energy flowing through tertiary consumers; [2]  
II. gross primary productivity / energy flowing through producers; [2]
- (b) (net dry mass) of organic matter in living organisms/environment (in a given area usually per square kilometre) [1]
-