



MARKSCHEME

May 2013

BIOLOGY

Higher Level

Paper 2

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Subject Details: Biology HL Paper 2 Markscheme

Mark Allocation

Candidates are required to answer **ALL** questions in Section A [**32 marks**] and **TWO** questions in Section B [**2 % 20 marks**]. Maximum total = [**72 marks**]

1. A markscheme often has more marking points than the total allows. This is intentional.
2. Each marking point has a separate line and the end is shown by means of a semicolon (;).
3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
4. Words in brackets () in the markscheme are not necessary to gain the mark.
5. Words that are underlined are essential for the mark.
6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.
7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect).
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking indicate this by adding **ECF** (error carried forward) on the script.
10. Do **not** penalize candidates for errors in units or 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 **within** at least two parts of the **same question** (eg within part a and within part b, or within part a and within part c etc. but **not between** part a and part b or between part a and part c etc.).*

- ♦ 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 marks.
- ♦ Indicate the award of quality marks by stamping **Qcl** or **Qst**, or both in **red** at the end of the answer and enter a quality mark of 0, 1 or 2 in the mark panel.

SECTION A

1. (a) positive/direct relationship / correlation (in all four groups) / (all four groups) accumulated fat over time [1]
- (b) body fat accumulation increased over time for all four groups; fructose caused the (significantly) greatest accumulation of fat and water the least; sucrose and artificial sweetener/diet soft drink had the same increase; sucrose, artificial sweetener and water did not start accumulating fat until after 20 days while fructose increased from the beginning; [2 max] } (both needed)
- (c) glucose-fed group has no/little increase in triglycerides while fructose-fed group has a (large) increase; glucose-fed group has smaller variability than the fructose-fed group; more triglycerides in fructose-fed group than glucose-fed group (from week 2 to week 10); [2 max]
- (d) raised blood glucose/sugar levels/higher glucose in the urine; decreased glycogen; excess glucose will be converted to fat/increase obesity; possibility of developing diabetes type II } (do not award this mark if answer late/adult onset diabetes; } refers to type 1 diabetes) [2 max]
- (e) glucose has a much greater range of uptake / vice versa; but a (much) lower mean/uptake / vice versa; there is no overlap (so there is clear evidence); [2 max]
- (f) fructose [1]
- (g) cancer is uncontrolled mitosis/cell division; sugar is an energy source/nutrient needed for mitosis/cell division; ribose is used to produce nucleic acids/DNA/RNA; production of nucleic acid is necessary for mitosis; [2 max]
- (h) evidence that fructose causes (body) fat accumulation/obesity; evidence that fructose is related to increased (blood) triglycerides which are correlated with obesity/coronary heart disease; evidence that fructose is related to reduced insulin sensitivity/diabetes; evidence that fructose is used in ribose synthesis but no clear evidence that fructose causes pancreatic cancer; [3 max]

2. (a) (i) HhFf × HhFf / (both) HhFf; [1]

(ii)

gametes	HF	Hf	hF	hf
HF	HHFF	HHFf	HhFF	HhFf
Hf	HHFf	HHff	HhFf	Hhff
hF	HhFF	HhFf	hhFF	hhFf
hf	HhFf	Hhff	hhFf	hhff

all gametes shown correctly on Punnett grid;
all offspring genotypes correct; [2]

(iii)

<i>ratio</i>	<i>phenotypes</i>
9	high oil four seeds;
3	high oil two seeds;
3	low oil four seeds;
1	low oil two seeds;

[2 max]

Award [1] for any **two** correct phenotypes.

(b) (i) no Y chromosome [1]

(ii) yes as there is only one X chromosome/chromosome missing/only 45 chromosomes [1]

3. (a) mortality / fatal disease / predation / competition / other cause of death; emigration; [2]

(b) (in prophase I) crossing over/chiasmata formation (between homologous chromosomes);
 random alignment of homologues/bivalents in metaphase I / independent assortment of homologues / chromosomes;
 second division of meiosis separates alleles further;
 combinations of alleles in gametes is unlimited/ 2^n ; [3 max]

4. (a) region/site where a substrate binds [1]

(b) shape of active site matches that of the substrate;
 chemical properties/charges of active site attract the substrate;
 active site can change to induce fit of substrate; [2 max]

(c) changes the charge/ionization of amino acids/R-groups;
 changes 3-D structure (of active site)/tertiary structure / denatures enzyme;
 substrate no longer binds/fits so decreases activity;
 could increase activity if optimum pH of enzyme is acidic; [2 max]

SECTION B

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

- 5. (a) Award [1] for each structure clearly drawn and correctly labelled, up to [4 max].
 cell wall – a uniformly thick wall;
 pili – hair-like structures connected to cell wall / flagellum – at least length of the cell;

plasma/cell membrane – represented by a continuous single line; } *(may be labelled as the innermost wall line)*

- ribosomes (70S) – drawn as small discrete dots;
 - naked DNA/nucleoid – region with DNA not enclosed in membrane;
 - plasmid – circular ring of DNA;
 - cytoplasm – the non-structural material within the cell;
- [4 max]**
- Award [2 max] if any eukaryotic structure is shown.*

- (b) transcription is the copying of a strand of DNA into RNA/RNA formation;
 RNA polymerase binds to promoter region of DNA;
 anti-sense strand as template / only one strand copied;
 RNA polymerase unwinds DNA/separates the strands;
 RNA nucleotides/nucleoside triphosphates pair with complementary bases on DNA;

Adenine to Thymine, Cytosine to Guanine, and Uracil to Adenine; } *(do not accept letters alone)*

- added at 3' end / strand grows 5' to 3';
 - RNA nucleotides joined with covalent/sugar-phosphate bonds;
 - RNA polymerase separates from DNA when reaches terminator/termination sequence;
 - no introns/post-transcriptional modification/RNA splicing (as occurs in eukaryotes);
- [6 max]**

- (c) vaccines contain a dead/weakened form of the pathogen/bacteria/virus;
 vaccine introduced to the body by injection/on surface of skin/orally;
 antigens in the vaccine cause antibody production;
 antigen/pathogen engulfed by macrophage/phagocyte;
 each type of lymphocyte recognizes specific antigen;
 macrophages activate helper T-cells;
 which activate B-cells;
 B-cells divide to form clones/memory cells;
 B-cells divide to form plasma cells/antibody producing cells;
 result is (specific) immunity;

vaccination/first exposure causes slow production of antibodies and lower level of antibodies; } *(this idea can be illustrated on a diagram or graph)*

contact with the disease leads to rapid production and higher level of antibodies; } *(this idea can be illustrated on a diagram or graph)*

- second/booster shot to stimulate memory cells/more production of antibodies; **[8 max]**

(Plus up to [2] for quality)

6. (a) glucose (from photosynthesis) stored as starch;
 starch stored (as granules) in chloroplast/in plastids;
 (starch stored) in seeds/storage roots/stem tubers;
 stored as lipids/oils;
 (lipid/oils storage) in seeds;
 lipids store twice as much energy per gram as starch; **[4 max]**
- (b) pyramid of energy shows the flow of energy from one trophic level to the next (in a community);
 units of pyramids of energy are energy per unit area per unit time/ $\text{kJ m}^{-2} \text{yr}^{-1}$;
 bar width is proportional to the energy stored (in the biomass) in that trophic level;
 the first/lowest trophic level is producers;
 second level is primary consumers/herbivores;
 third level of secondary consumers/carnivores;
 only a small amount (10 to 20 %) of energy of one level is passed to the next;
 bar width/energy stored in the trophic level decreases (proportionally) as you go up each level;
 pyramid shows that there is a limit to the length of food chains; **[6 max]**
Award any of the above marking points to a correctly drawn and clearly labelled pyramid.
- (c) normal body core temperature constant/ 36.5 to 37.5 °C; } (accept single values
within this range)
 regulated by negative feedback/homeostatic mechanisms;
 hypothalamus is the centre of thermoregulation;
 hypothalamus sends impulses to the body to increase/decrease temperatures;
 release of sweat (by sweat glands in the skin) if skin temperature rises;
 evaporation of water cools the body; (*concept of evaporation must be mentioned*)
 heat is transferred by blood;
 transfer of heat from body core in blood to surface;
 if temperature rises, increased flow of blood/heat to the } (do not accept
veins, arteries
or capillaries)
 skin/vasodilation of skin blood vessels/arterioles;
 if temperature drops, decreased flow of blood/heat to the } (do not accept
veins, arteries
or capillaries)
 skin/vasoconstriction of skin blood vessels/arterioles;
 shivering increases heat production (in muscles);
 example of one behavioural mechanism; } (eg reducing activity (to lower body
temperature) / reducing exposed
surfaces (to reduce heat loss) **[8 max]**

(Plus up to [2] for quality)

7. (a) *Descriptions of properties expected not lists of properties.*

hydrogen bonding:

high specific heat capacity requiring large amounts of energy to break the H-bonds/to raise the temperature;

boiling point is high/100 °C as H-bonds must be broken to change from liquid to gas;
cooling effect of evaporation due to H-bonds taking energy from liquid water to break / high latent heat of evaporation;

water molecules on surface resistant to forces because of surface tension;

water is most dense at 4 °C due to more regular hydrogen bonding;

polarity:

water molecules stick together through cohesion; (*full idea required*)

water molecules stick to other polar molecules through adhesion;

} (*full idea required*)

good solvent of polar organic molecules;

[4 max]

- (b) active transport of solutes from soil into roots;

draws water by osmosis

root hairs provide a large surface area for water uptake;

carried through xylem vessels;

transpiration is the loss of water (vapour) from leaves and stems / stomata;

(transpiration) creates suction/pull/negative pressure;

cellulose wall with rings of lignin give strength to resist (low) pressure;

water pulled up due to capillary action/cohesion/adhesion;

continuous column of molecules/transpiration stream;

[6 max]

- (c) water only plays a role in non-cyclic photophosphorylation;

chlorophyll absorbs light/photons and activates electrons of photosystem II;

excited/active electrons of photosystem II are passed to carriers;

photolysis is the splitting of water;

produces O₂ and H⁺/proton and electrons;

O₂ released (as waste);

electrons (from water) replace lost electrons in photosystem II;

electrons from photosystem II pass (through carriers) to photosystem I;

electrons from photosystem I pass to NADP⁺ (in stroma);

NADP⁺ accepts H⁺/proton (from water) to form NADPH;

electron flow causes protons pumped across thylakoid membranes/into the thylakoid space;

creating a proton concentration gradient;

chemiosmosis couples electron transport to ATP synthesis;

protons pass through ATP synthase/synthetase;

NADPH/H⁺/proton is passed to the light-independent reactions (to fix carbon);

[8 max]

(Plus up to [2] for quality)

8. (a) *Must be description of types not a list.*
(simple) diffusion when molecules move down a concentration gradient directly through membrane/unaided by carrier molecule;
(passive transport by) facilitated diffusion through (specific) channel proteins;
osmosis of water via aquaporins/from area of low solute concentration to area of high solute concentration;
active transport against a concentration gradient using protein pumps/ATP;
vesicles attach to plasma membrane and release materials to exterior/ exocytosis;
cell membrane invaginates/pinches off to bring material to interior / endocytosis / phagocytosis; **[4 max]**
- (b) FSH stimulates estrogen secretion by follicle cells;
at start of menstrual cycle;
leading to development of endometrium;
(FSH and) LH (rise to a peak and) causes egg to be released/ovulation;
causes follicle cells to secrete less estrogen/more progesterone;
progesterone maintains endometrium/uterine lining
LH promotes change of follicle to corpus luteum;
secretion of LH and FSH regulated by negative feedback;
regulated/inhibited by high estrogen and progesterone levels;
low progesterone levels cause menstruation; **[6 max]**
- (c) disc shaped structure
embedded in uterus wall;
connected to fetus by umbilical cord;
contains fetal and maternal structures/tissues;
placental villi/maternal intervillous space provide large surface area for exchange of materials;
blood of fetus and mother flow close to each other (but no mixing);
materials exchanged/diffuse (through membranes) between mother and fetal blood;
oxygen/nutrients/antibodies/other substances diffuse (through membranes) to fetus;
CO₂ and wastes diffuse (through membranes) to mother;
caffeine/drugs/alcohol/viruses from mother may damage fetal development;
takes over role of corpus luteum (to produce hormones);
produces hormones/estrogen/progesterone/HCG; **[8 max]**

(Plus up to [2] for quality)
