



MARKSCHEME

November 2012

BIOLOGY

Higher Level

Paper 2

*This markscheme is **confidential** and for the exclusive use of examiners in this examination session.*

*It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Assessment Centre.*

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) natural human (surfactant) [1]
- (b) main component of all surfactants is phospholipids;
 (natural human surfactant) has less phospholipids (than synthetic surfactants);
 (natural human surfactant) has more cholesterol (than (synthetic surfactant) A);
 (natural human surfactant) has more free fatty acids than (synthetic surfactant) A and less than (synthetic surfactant) B;
 (natural human surfactant) has more proteins (than synthetic surfactants); [2 max]
- } (comparison with both synthetic surfactants required)
- (c) hydrophilic groups facing the surface/are in the moist lining/water and hydrophobic tails facing outwards/are in the air [1]
Award [0] for a description of a phospholipid bilayer. The orientation of both hydrophilic and hydrophobic parts must be included.
- (d) growth reduced (by increases in concentration)/negative correlation [1]
- (e) *The question asks to compare how each surfactant affects each bacterium. However, some responses will instead compare how each bacterium is affected by each surfactant. Accept both types of answer.*
 (synthetic surfactant) A decreases growth of GBS most and *S. aureus* and *E. coli* much less/slightly;
 (synthetic surfactant) B decreases the growth of GBS (and of *S. aureus* slightly) but increases the growth of *E. coli*;
 modified human surfactant decreases growth of GBS (and *S. aureus*) but no (significant) effect on *E. coli*;
 GBS greatly inhibited by (synthetic surfactant) A but less/slightly by (synthetic surfactant) B and modified human surfactant;
S. aureus (slightly) inhibited by all three surfactants;
E. coli increased by (synthetic surfactant) B but (synthetic surfactant) A and modified human surfactant have no significant effect; [3 max]
- (f) *(hypothesis supported as)*
 (synthetic surfactant) A has proteins and decreases bacterial growth;
(hypothesis not supported as)
 modified human surfactant has no proteins and decreases bacterial growth;
 (synthetic surfactant) B has proteins and enhances growth (of *E. coli*);
 GBS inhibited more by modified human surfactant which has no protein than (synthetic surfactant) B which has protein;
S. aureus inhibited more by modified human surfactant which has no protein than by the other (surfactants) which have protein; [3 max]
Do not accept answer without reference to proteins.
- (g) as concentration of (synthetic surfactant) B increases, more antibiotic W is needed to inhibit growth;
 (synthetic surfactant) B concentration does not affect concentration of antibiotic V needed; [2]

- (h) antibiotic V inhibits growth of *S. aureus*;
(synthetic surfactant) B does not increase the growth of *S. aureus*/inhibits growth of *S. aureus* at 1.0 mg ml;
antibiotic V might not inhibit growth (of *S. aureus*) at (synthetic surfactant) B concentrations above 1.0 mg ml;
- (synthetic surfactant) B increases *E. coli* growth;
antibiotic V might not control *E. coli*;
- (synthetic surfactant) B decreases growth of GBS;
antibiotic V not needed to control GBS infections;

[2 max]

2. (a) Award [1] for two correct labels.

- I. biceps;
- II. humerus;
- III. cartilage;
- IV. synovial fluid/synovial cavity;

[2 max]

- (b) I. (contracts to) move/raise forearm/lower arm/radius / flex/bend arm at elbow;
II. reduces friction / prevents bone rubbing on bone / absorbs shock;

[2]

Do not accept answers that do not specify the movement caused by I, or state that I lifts the arm.

Do not allow ECF answers.

3. (a) (i) carbon dioxide / methane / oxides of nitrogen / water vapour / ozone / CFCs [1]
- (ii) incoming shorter-wave radiation/UV/visible passes through Earth's atmosphere;
 converted to longer-wave radiation/heat/infrared;
 atmosphere absorbs/traps longer-wave radiation/infrared/heat; [2 max]
Answers can be given in the form of an annotated diagram.
Answers must specify long wave/infrared/heat and short wave radiation.
- (b) (i) increased rates of decomposition (of detritus in permafrost);
 expansion of the range of habitats available to temperate species;
 loss of ice habitat;
 changes in distribution of prey species affecting higher trophic levels;
 increased success of pest species/pathogens;
 rise in sea levels; [2 max]
Mark only the first two answers given.
- (ii) rate of photosynthesis increases as temperature increases;
 rate of transpiration increases as temperature increases;
 shift in plant distribution / *OWTTE*; [1 max]

4. (a) (i) I: glomerulus;
 II: (descending limb of) loop of Henle; } (both needed) [1]
- (ii) III: selective re-absorption of glucose/minerals/amino acids/water/ useful substances;
 absorption by active transport/using ATP of glucose/minerals/ amino acids/useful substances; [1 max]

(b)

	<i>plasma proteins / mg 100 ml⁻¹</i>	<i>glucose / mg 100 ml⁻¹</i>	<i>urea / mg 100 ml⁻¹</i>
<i>blood plasma in renal artery</i>	(740)	(90)	(30)
<i>glomerular filtrate</i>	0	(90)	30 (or slightly less);
<i>urine</i>	0	0	(much) greater than 30;

[2]

Award [1] for each correct row.

- (c) collecting duct has water channels/aquaporins/is permeable to water;
 high solute concentration of medulla / medulla is hypertonic;
 reabsorption of water allows excretion of concentrated urine (antidiuresis);
 secretion of ADH/vasopressin increases permeability of collecting duct to water / *vice versa*; [3 max]

SECTION B

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

5. (a) X and Y chromosomes determine sex;
 females XX and males XY;
 X chromosome is larger than / carries more genes than the Y chromosome;
 22 types/pairs of autosomes;
 males and females have same types of autosomes; **[4 max]**

- (b) sex-linked / due to gene on the X chromosome;
 more common in males who only receive one X chromosome;
 female is hemophilic if homozygous recessive / homozygous recessive normally fatal;
 X^H for dominant/normal allele and X^h for recessive/ } (accept in Punnett
 hemophilia allele; } grid/square)
 example in Punnett grid/square with correct parental genotype and gametes;
 correct genotypes of offspring;
 correct phenotype ratio or percentage;

eg

	X^H	X^h
X^H	$X^H X^H$	$X^H X^h$
Y	$X^H Y$	$X^h Y$

half the males are hemophilic and half of the females are carriers / OWTTE; **[6 max]**
 Allow marks for correct genotypes if the alleles are not shown superscript on an X, as long as the Y chromosome is indicated.
 Do allow marking point d. if the letters for the dominant and recessive allele are not upper and lower case versions of the same letter.

- (c) one (homologous) chromosome is from the mother and one from the father;
 homologous chromosomes pair (in prophase I);
 crossing over/chiasma formation in prophase I;
 recombination of linked genes / alleles/genes swapped;
 many possible points of crossing over;
 crossing over occurs at random positions;
 due to crossing over the two chromatids of metaphase I chromosomes are not identical;
 random orientation (of bivalents) in metaphase I;
 in anaphase/at end of metaphase I chromosomes move to opposite poles;
 independent assortment of chromosomes/genes;
 $2^n/2^{23}$ combinations (without considering crossing over);
 four genetically different nuclei/gametes from each meiosis; **[8 max]**
 Accept any of the above points in a clearly annotated diagram.

(Plus up to [2] for quality)

6. (a) sulfur – part of amino acids / proteins;
 calcium – strengthening/formation of bones / muscle contraction / synaptic transmission;
 phosphorus – formation of nucleic acids / ATP / GTP / NADP / phospholipids;
 iron – formation of hemoglobin / transport of oxygen;
 sodium – nerve impulse / sodium-potassium pump / osmoregulation;
 potassium – nerve transmission / sodium-potassium pump / osmoregulation;
 magnesium – part of chlorophyll molecule; **[4 max]**
- (b) plants absorb minerals in ionic form/mineral ions;
 nitrate / phosphate / potassium / other example of mineral;
 minerals can be absorbed by (facilitated) diffusion;
 (diffusion is) movement of ions from high to low concentration/down concentration gradient;
 root hair cells provide a large surface area for absorption;
 fungal hyphae help to absorb minerals/phosphate;
 minerals absorbed by active transport;
 as mineral ion concentration is smaller outside the root than inside / absorbed against a concentration gradient;
 active transport requires energy/ATP;
 occurs through pump/carrier proteins;
 proton pump transports hydrogen ions/H⁺ out of cell (allowing mineral movement in); **[8 max]**
- (c) occurs in cytoplasm (of cell);
 substrate is hexose/glucose/fructose;
 phosphorylation of glucose/fructose/hexose;
 to form hexose diphosphate/glucose 6-phosphate;
 requires ATP;
 glucose/fructose/hexose (diphosphate) converted into (two) pyruvates/three carbon compounds;
 oxidation;
 to produce (two) NADH+ H⁺/ (two) reduced NADs;
 net gain of two ATP (per glucose); **[6 max]**

(Plus up to [2] for quality)

7. (a) *Award any of the following clearly drawn and correctly labelled.*
 cell wall; *(shown as a double line)*
 plasma membrane; } *(less than the width of wall)*
 } *(reject inner surface of cell wall labelled as cell membrane)*
 nucleoid/(region containing) naked DNA (distinguished from rest of cytoplasm)
 ribosome; *(dots in cytoplasm)*
 cytoplasm;
 flagella; *(at least a quarter as long as the cell)*
 pili; *(less than a quarter as long as the cell)* **[4 max]**
Award [3 max] if any specifically eukaryotic structure shown.
- (b) helicase uncoils DNA/splits DNA into two strands;
 (RNA) primase adds short length of RNA/primer;
 primer allows attachment of (DNA) polymerase;
 DNA polymerase III copies DNA;
 adds nucleotides in the 5' to 3' direction;
 uses deoxynucleoside triphosphates/nucleotides that are free in cell;
 two phosphates removed to release energy (required for the process);
 (complementary base pairing of) adenine with thymine and guanine } *(reject A with T*
 with cytosine; } *and C with G)*
 (leading) strand replication towards the replication fork;
 short pieces of daughter DNA / Okazaki fragments (on lagging strand);
 DNA polymerase I removes the RNA primers/replaces them with DNA;
 (DNA) ligase joins short fragments/seals nicks;
 by making sugar-phosphate bond; **[8 max]**
- (c) translation is protein/polypeptide synthesis;
 formed by (ribosomal) RNA and proteins; *(both needed)*
 about 20 nm/30 nm / 80S in eukaryotes;
 organized into a tertiary structure/globular shape;
 a small subunit and a large one;
 (three) binding sites for tRNA on/in large subunit;
 A, P and E sites;
 binding site for mRNA on surface/in small subunit;
 two tRNA can bind at the same time;
 ribosomal RNA catalyses formation of peptide bond; **[6 max]**

(Plus up to [2] for quality)

8. (a) sperm breaks through follicle cells/cells surrounding the ovum;
triggers acrosome reaction;
proteases/hydrolytic enzymes (of acrosome) released;
digestion of zona pellucida;
plasma membranes of sperm and egg fuse;
sperm nucleus enters egg;
cortical reaction;
hardening/cross linking of glycoproteins in zona pellucida;
preventing sperm from entering; **[6 max]**
- (b) disc-shape organ that attaches to (inside of) uterus;
connected to the fetus by the umbilical cord;
produces hormones/HCG that maintain pregnancy;
estrogen and progesterone maintain uterine lining;
nutrients/oxygen from mother's blood transferred to fetal blood;
antibodies from mother's blood transferred to fetal blood (through umbilical vein);
waste products transferred from fetal blood to maternal blood (through umbilical artery);
embryonic tissue invades/grows into the uterine wall;
placental/chorionic villi increase the surface area (for exchange);
fetal capillaries in placenta/placental villi;
inter-villous spaces/sinuses through which mother's blood flows;
small distance between fetal and mother's blood / narrow placental barrier /
mother and fetal bloods do not mix; **[8 max]**
Allow reference to embryo instead of fetus throughout.
- (c) level of progesterone decreases (drastically) just before birth;
removing inhibition of oxytocin secretion;
oxytocin produced by pituitary gland;
oxytocin causes contractions of uterus;
uterine contractions cause impulses to be sent leading to more oxytocin secretion;
positive feedback; **[4 max]**

(Plus up to [2] for quality)
