



MARKSCHEME

May 2014

BIOLOGY

Higher Level

Paper 2

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.).*

SECTION A

1. (a) 53 (%) (allow a range from 52 to 54 %) [1]
- (b) proteasome inhibitor decreases survival;
small decrease/fluctuations/little difference initially and larger decrease above 10/at 20; [2]
Reject negative correlation.
- (c) (i) systolic: 34 (mm²) (allow a range of 33.5 to 34.5 mm²)
diastolic: 77.5 (mm²) (allow a range of 77–78mm²) [1]
Both needed for [1].
- (ii) 10 (mm²) (allow a range of 9 to 11 mm²) [1]
Do not penalise if no working.
- (d) increases systolic area but decreases (mean) diastolic relative to control;
systolic effects larger / significant differences with systolic but not diastolic;
differences between control and treatment get less after treatment/from Day 14
with systolic area but stay about the same with diastolic; [2 max]
Reject answers stating that the diastolic area is increased.
- (e) (hypothesis supported as) treated area decreases/differences decrease between
treated and untreated area after end of treatment/after Day 21/after Day 14;
(hypothesis not supported as) at the end of the experiment/21 days after the end of
treatment/on day 42 there is still a significant difference; [2]
*N.B. the question refers only to the systolic area – do not award marks for
answers relating to diastolic area.*
- (f) small reduction after one week and (much) larger reduction after three weeks;
the longer the treatment the larger the reduction/reduces oxygen consumption over
time; [1 max]
- (g) oxygen used in/needed for aerobic respiration;
oxygen used at end of/to accept electrons from electron transport chain;
respiration releases energy/produces ATP in cells;
Reject produces energy/produces energy in the form of ATP.
ATP production requires oxygen; [2 max]
- (h) *One marking point corresponds to each of the three graphs in both pros and cons.*
might be safe because:
does not affect heart cell survival (significantly) at concentrations below 20;
effect on systolic area/on heart seems to be reversible;
oxygen consumption does not drop much in the first week (of treatment);
could be dangerous due to:
reduced survival/death of non-tumor/cardiac muscle cells / non-specific;
reduced volume/pressure of blood pumped by heart / more blood left in ventricles;
reduced aerobic respiration/mitochondrial activity / damage to mitochondria; [3 max]
*Do not award marks for answers that merely restate data from the graphs such as
systolic area or oxygen consumption are reduced.*

2. (a) (i) peptide
Do not accept polypeptide. [1]
- (ii) messenger RNA/mRNA [1]
- (b) *Award [1] for two or three of the following points and [2] for four of them.*
one tRNA detaches from/leaves the ribosome;
tRNA moves from one binding site to another / ribosome moves on along the mRNA;
tRNA that moves/is moved is carrying the (growing) polypeptide;
another tRNA carrying an amino acid binds to the ribosome; [2 max]
- (c) group of ribosomes translating/bound to one mRNA at the same time;
(same) polypeptide/protein synthesised in large amounts/faster; [2]
Reject answers stating that polysomes make large amounts of different proteins.
3. (a) (i) X: germinal epithelium cell / spermatogonia;
Reject germ cells.
Y: Leydig/interstitial cell; [2]
- (ii) produce/secrete testosterone [1]
- (b) meiosis/meiosis I [1]
Reject meiosis II.
- (c) $160\mu\text{m}/0.16\text{mm}/0.016\text{cm}$ (allow a range of 150 and 170 μm) [1]
Do not penalize excessive numbers of significant figures.
4. (a) gametes (in cross are) $ab \times AB$ Ab aB and ab;
The gametes can be shown encircled, labelled, or on sides of a Punnett square.
genotypes of offspring (shown on a Punnett square are) AaBb Aabb aaBb and aabb;
The Punnett square does not need to have more than one line.
ratio (is) 1 purple starchy : 1 purple waxy : 1 white starchy : 1 white waxy; [3]
Also accept answers given correctly as fractions or percentages.
- (b) water carried in xylem vessels;
low pressure / tension / pulling forces / suction/ sucking / transpiration pull;
(generated by) evaporation/transpiration of water in leaves;
cohesion of water molecules by hydrogen bonds;
adhesion of water (molecules) to walls/sides of xylem (vessels); [3 max]

SECTION B

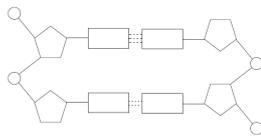
Remember, up to TWO “quality of construction” marks per essay.

5. (a) *Award [1] for each of the following correctly drawn and labelled:*
 cell body and nucleus – *star shaped body with nucleus inside;*
 dendrites – *as multiple long/narrow protrusions from the cell body;*
 axon – *at least three times as long as the cell body not including the dendrites;*
 myelin sheath/Schwann cells and nodes of Ranvier – *sheath with gaps/narrowings;*
 motor end plates – *shown as widened ends of multiple branches of the nerve fibre;* **[4 max]**
Reject the points for axon and myelin sheath if the labelling line does not clearly point to the structure.
- (b) impulse/message/action potential/depolarization reaches the pre-synaptic membrane;
 calcium channels open;
 calcium diffuses into/calcium ions enter (pre-synaptic) neuron;
 vesicles of neurotransmitter fuse with membrane (of pre-synaptic neuron);
 release of neurotransmitter by exocytosis;
diffusion of neurotransmitter across cleft/synapse;
 neurotransmitter binds to receptor in (post-synaptic) membrane/neuron;
 ion channels open and sodium/positively charged ions enter;
 depolarization/action potential/impulse in post-synaptic neuron/membrane;
 neurotransmitter broken down by enzymes; **[8 max]**
Apart from point d, acetylcholine or another specific neurotransmitter is acceptable in place of neurotransmitter.
- (c) heart cells can contract on their own / myogenic (muscle contraction);
 contractions/heart beat controlled by/starts at pacemaker/sinoatrial node;
 pacemaker/sinoatrial node is in the wall of the right atrium;
 signal to contract transmitted from across the atria/heart muscle/heart wall;
 nerves/impulses from medulla (of brain) to heart;
 one nerve increases rate and another nerve decreases it;
 epinephrine/adrenalin increases rate; **[6 max]**
Reject noradrenalin.
Details of events in the cardiac cycle are not relevant and should not be rewarded.
Do not award marks for reference to the autonomic, sympathetic or parasympathetic nervous systems as these are Option E topics.

(Plus up to [2] for quality)

6. (a) *The C1, C3 and C5 positions do not need to be labelled but must be shown correctly for the first three mark points to be awarded.*

phosphate labelled and each phosphate shown joined to C5 of sugar;
 nucleotides in each chain linked by a bond from phosphate to C3 of sugar;
 deoxyribose labelled and each shown joined to a base by C1;
 hydrogen bonds labelled and shown linking each base to another base;
Accept dotted or solid lines for H bonds and either two or three bonds, not one.
Do not penalise if the number of bonds between A≡T and C=G is incorrect.
 adenine/A joined to thymine/T and guanine/G joined to cytosine/C;
 two strands shown inverted/antiparallel to each other as indicated by the sugars;
 phosphate end labelled 5' and sugar end labelled 3' at ends of both strands; **[6 max]**
Allow marking point g even if the sugars are incorrectly drawn.



The diagram shows suitable shapes for the phosphates, deoxyriboses and bases.

Do not penalise if more than four nucleotides are shown.

- (b) cut DNA into fragments using restriction enzymes/endonucleases;
 satellite DNA/(short) repeated sequences are used;
 PCR used to amplify/copy many times (satellite) DNA;
 DNA fragments separated by size / DNA separated by gel electrophoresis;
 pattern of bands/fragments compared to bands of suspected person/criminal; **[4 max]**

- (c) genetic modification is transfer of genes/DNA from one organism to another;
 named example of organism modified;
Accept binomials or common names.
 name of gene transferred / name of organism from which gene was obtained;

*Award [1] each for **up to four** benefits (points d to g).*

*Award [1] each for **up to four** harmful effects (points h to k).*

Do not accept points relating to relative costs or other economic factors.

Only accept benefits or harmful effects relating to the first specific example given.

eg

corn/maize crops modified;

using gene from *Bacillus thuringiensis*/Bt toxin gene;

benefits:

makes corn resistant to pest/corn borer;

producing higher crop yields;

less land needed for crops (as is more efficient) / more land for wildlife;

less pesticide needed;

harmful effects:

non-target/beneficial insects might be harmed / non-target specific;

gene might spread to other plants (by cross-pollination);

(possibility of) allergic reactions when crop is eaten / side effects in humans;

only favoured countries have the technology / increases inequality;

[8 max]

(Plus up to [2] for quality)

7. (a) Award **[1]** for each of the following correctly drawn and labeled:
cortex – outer part of kidney;
medulla – inner part of kidney shown with pyramids/variation in thickness;
pelvis – in centre of kidney;
ureter – leaving kidney from pelvis;
renal vein – attached to concave side of kidney/to pelvis;
(renal) artery – attached to concave side of kidney/to pelvis; **[5 max]**
Up to [1] can be awarded (point a) if the candidate has drawn a diagram of a nephron and has indicated the position of cortex and medulla correctly.
- (b) excess glucose in blood / hyperglycemia;
symptoms are excessive thirst / frequent urination / dehydration / fatigue;
Reject weight loss as a symptom of Type II diabetes.
unresponsive to insulin / insulin resistance / not enough insulin produced;
Reject no insulin.
linked to/risk factor is obesity/diets high in sugar/fat;
late onset / onset is usually adulthood/after childhood;
insulin not required (usually) / insulin ineffective as a treatment;
treated with low sugar diets/low GI/glycemic index foods; **[5 max]**
Reject low carbohydrate diet.
Do not award a mark simply for stating that glucose is present in the urine as this is in the question.
- (c) glucose filtered out of blood (plasma) in glomerulus;
glucose reabsorbed from filtrate in proximal convoluted tubule;
by active transport;
reference to specific pumps for glucose / limited capacity for glucose uptake;
in diabetic patients glucose concentration in plasma is high;
not all glucose can be reabsorbed (in PCT) /capacity for reabsorption exceeded;
no glucose reabsorption after the proximal convoluted tubule;
glucose still present at end of nephron/collecting duct/in the ureter/bladder;
Do not award a mark simply for stating that glucose is present in the urine as this is in the question.
type I diabetes treated with insulin;
insulin reduces the glucose concentration of blood/plasma/filtrate;
Reject regulates glucose concentration.
all glucose reabsorbed from filtrate in Type I diabetics if treated; **[8 max]**

(Plus up to [2] for quality)

8. (a) Award [1] for each of the following shown using labelled arrows or notes on a diagram. Accept carbon dioxide or CO₂ throughout.

carbon dioxide/CO₂ in atmosphere/water;
 (cell) respiration producing CO₂ in atmosphere;
photosynthesis (fixing) CO₂ from atmosphere into producers/plants;
 death/decomposition transforming C in plants/animals to C in bacteria/fungi/saprotrophs;
 fossilization converting carbon in organisms to fossil fuels/coal/oil/natural gas;
 combustion/burning of fossil fuels/coal/oil/natural gas/peat producing CO₂ /
 weathering of shells/rocks releasing CO₂;
 combustion/burning of producers/forests producing CO₂;
 feeding (organic C) in producers/plants to (organic C) in consumers/animals;
 feeding (organic C) in consumers to other consumers; [6 max]
If candidates do not show on their diagram that carbon is in the form of carbon dioxide, do not award the first marking point but allow other marking points.

- (b) no photosynthesis at very low/no CO₂ concentration;
 positive correlation between increasing amount of CO₂ and photosynthesis rate;
 at high CO₂ concentration (rate of photosynthesis) reaches a plateau;
Points above may be awarded if clearly shown on an annotated graph.

carbon dioxide used in the light independent reactions/Calvin cycle;
 oxygen release measured by counting/measuring volume of bubbles in water;
 (changes in) oxygen concentration measured using oxygen probe/electrode;
 oxygen is a product of light dependent reactions so it is a measure of the rate; [4 max]

- (c) *anaerobic respiration:*
 glucose transformed into (two molecules of) pyruvate/pyruvic acid;
Accept this point in any part of the answer.
 oxidation reactions using NAD/NAD⁺ / producing reduced NAD/NADH;
 smaller amount of energy released/ATP produced than in aerobic;
 NAD/NAD⁺ regenerated by reducing pyruvate/transfer of hydrogen to pyruvate;
 pyruvate to CO₂ and ethanol in yeast/in alcoholic fermentation;
 pyruvate to lactic acid in humans/in lactic/lactate fermentation;

aerobic respiration:
 pyruvic acid/pyruvate fully oxidized/fully broken down;
 by the link reaction and Krebs cycle;
 reduced NAD/NADH passes electrons to electron transport chain;
 proton/H⁺ gradient generated;
 oxygen required as terminal electron acceptor;
 proton gradient used by ATP synthase/synthetase to produce ATP; [8 max]

(Plus up to [2] for quality)