N11/4/BIOLO/HP2/ENG/TZ0/XX/M

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MARKSCHEME

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BIOLOGY

Higher Level

Paper 2

13 pages

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. Do **not** award more than the maximum marks allowed for part of a question.

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** (e.g. 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 points.

- Indicate the award of quality marks by stamping **Qcl** or **Qst** or **both** in **red** at the end of the answer and enter a mark for each in the mark panel.

SECTION A

1. (a) (i) 83 *(allow whole number answers in the range of 82 to 84)* ***[1]***

(ii) 5 *(allow 4)* ***[1]***
Do not allow answers with two different numbers.

(b) more stem cells are formed in control / jet lag reduces the release of stem cells into blood stream / greater range in control;
graph is rhythmic in control / control has more regular pattern;
greater number of stem cells produced in light period in control, whereas greater number in dark period in jet lag;
graph is shifted to the right in jet lag / stem cells are released later in time in jet lag; ***[2 max]***

(c) (hypothesis supported in control) if stem cells are harvested towards the end of the dark period / (hypothesis supported) as stem cells start increasing in dark period;
(hypothesis not supported) <u>in control</u> as peak of stem cells occurs during light period/lowest number during dark period;
(hypothesis supported) if patient is jet-lagged as more stem cells are produced in dark period; ***[2 max]***

(d) mRNA is translated to protein / involved in protein synthesis ***[1]***

(e) clenbuterol <u>and</u> isoprenaline both produce more stem cells than control;
clenbuterol releases fewer stem cells than isoprenaline / isoprenaline releases the most stem cells;
isoprenaline produces the least mRNA for CXCL12;
clenbuterol produces the same amount of mRNA for CXCL12 as control; ***[3 max]***

(f) (i) CXCL12 inhibition initially decreases occurrence of diabetes;
in the first 25 / up to 26/27/28 weeks;
CXCL12 inhibition does not prevent occurrence of diabetes (just delays it) / eventually the same level of diabetes; ***[2]***

(ii) CXCL12 breakdown allows stem cell mobilization reducing incidence of diabetes / stem cells from the bone marrow can regenerate the islets (in pancreas) ***[1]***

(g) isoprenaline is an inhibitor of CXCL12 / inhibits synthesis of CXCL12 mRNA;
delays onset of diabetes / allows stem cell mobilization / allows islet regeneration;
does not cure the disease; ***[2 max]***

(h) suffering of patients could be reduced / diseases could be cured / better treatments developed / might replace treatment with cure;
(possibly) less cost than treating disease/diabetes;
specific example of ethical conflict; { *(e.g. patient groups support use of embryotic stem cells but religious groups oppose / different views on the moral status of an embryo)*
restrictions on research in some countries due to cultural/religious traditions;
still in experimental stages / risk to patient;
specific example of risk; { *(e.g. stem cells developing into tumours / rejection / need for immunosuppressants)*
death of early-stage embryos / production of embryos for stem cell research;
use of stem cells from adults/patients could overcome these objections; ***[3 max]***

2. (a) I: palisade mesophyll/cell/layer;
II: stoma / stomatal pore / stomata / guard cell; ***[2]***

(b) *if the response is stoma*:
diffusion of carbon dioxide in/oxygen out/water vapour out / gas exchange

if the response is guard cell:
regulating the opening and closing of stomata/stoma ***[1]***

3. (a) correctly constructed Punnett square with correct gamete genotypes;

e.g.

(male gametes) \ (female gametes)	X^H	X^h
X^h	X^HX^h	X^hX^h
Y	X^HY	X^hY

genotypic ratio: 1 X^HX^h : 1X^hX^h : 1 X^HY : 1 X^hY; { *(can be inferred from cells of Punnett square)*

phenotypic ratio: 1 female hemophiliac : 1 female carrier/non-hemophiliac : 1 male hemophiliac : 1 male normal/non-hemophiliac / 50 % hemophiliac : 50 % non-hemophiliac; ***[3 max]***

*Allow ECF. Award **[2 max]** if notation used does not indicate sex linkage, i.e. if cross is Hh×hh.*

(b) release of clotting factors from platelets/damaged cells;
conversion of prothrombin to thrombin;
thrombin catalyses the conversion of fibrinogen into fibrin;
(insoluble) fibrin (net) captures blood cells; ***[2 max]***

4. (a) X: combustion / burning;
Y: photosynthesis; ***[2]***

(b) (saprotrophic) bacteria/fungi / saprotrophs ***[1]***
*Award **[0]** for decomposers.*

(c) carbon dioxide is a greenhouse gas (naturally produced by organisms);
human activity has increased the normal level of CO_2/caused enhanced greenhouse effect;
short-wave radiation from the Sun is re-radiated as longer wave radiation/ infrared/heat;
infrared/heat captured by greenhouse gases/CO_2; ***[3 max]***
Accept any of the above points shown in a clearly annotated diagram.

SECTION B

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

5. (a) *Award **[1]** each for the following structures clearly drawn and correctly labelled.*
esophagus – connected to top of stomach;
stomach – connected to small intestine;
small and large intestines – connected to each other;
liver shown as larger than the stomach with gall bladder shown under/embedded in liver;
gall bladder – connected to the small intestine (via bile duct);
pancreas – connected to small intestine (via pancreatic duct); ***[4 max]***

(b) milk contains lactose / lactose is milk sugar;
lactose is broken down to glucose and galactose;
by (the enzyme) lactase;
which is lacking in people with lactose intolerance;
lactose-free milk is sweeter than milk containing lactose;
lactase produced by small intestine / produced by yeast sometimes found in milk;
can be added directly to milk;
immobilized in beads / biotechnological techniques;
ultrafiltration of milk to remove lactose; ***[6 max]***

(c) ultrafiltration occurs in the glomerulus;
basement membrane acts as a filter;
preventing proteins/cells from passing;
(filtered) substances pass to the Bowman's capsule;
to proximal convoluted tubule (PCT);
(where there is) selective reabsorption;
(in PCT) all glucose/amino acids are reabsorbed;
(in PCT most) water reabsorbed;
surrounding the loop of Henle, is an area of high solute concentration;
in distal convoluted tubule, ions are exchanged between filtrate and blood;
collecting duct has role in osmoregulation;
ADH regulates the amount of water reabsorbed;
substances not reabsorbed are eliminated as urine; ***[8 max]***

*(Plus up to **[2]** for quality)*

6. (a) sperm produced by meiosis;
in testis/seminiferous tubules;
sperm are stored/mature in the epididymis;
sperm able to swim;
seminal vesicles add fluid;
(seminal) fluid rich in fructose;
prostate gland adds fluids;
fluid rich in proteolytic enzymes/citric acid/acid phosphatase/lipids/minerals;
(semen) contains basic amines/alkaline substances;
which neutralizes acid/hostile environment of the vagina; ***[6 max]***

(b) disc-shaped structure;
connected to the fetus by an umbilical cord;
placenta is embryonic and maternal tissue;
placental villi increase the surface area (for exchange);
fetal capillaries in placenta/placental villi;
inter-villous spaces/sinuses through which mother's blood flows;
fetal and mother's blood do not mix / small distance between fetal and mother's blood;
transfer of foods/nutrients/glucose from mother to fetus;
fetal gas exchange/transfer of oxygen from mother to fetus;
transfer of excretory/waste products/CO_2 from fetus to mother;
transfer of antibodies/hormones from mother to fetus;
secretion of estrogen/progesterone/HCG; ***[8 max]***
Allow reference to embryo instead of fetus throughout.

(c) at about 38 to 40 weeks pregnancy/end of pregnancy/progesterone levels decrease;
removes inhibition of oxytocin secretion;
(oxytocin) released from (posterior) pituitary;
oxytocin stimulates uterus contraction;
cervix widens/dilates;
increase in oxytocin increases rate and intensity of contractions;
positive feedback; ***[4 max]***

*(Plus up to **[2]** for quality)*

7. (a) *chromosome*: structure formed by DNA and proteins;
gene: a heritable factor that controls a specific characteristic;
allele: one specific form of a gene occupying the same gene locus as other alleles of the gene;
genome: the whole of the genetic information of an organism; ***[4]***

(b)

prokaryotic DNA	***eukaryotic DNA***
circular	linear;
one chromosome	many chromosomes;
not associated with proteins / naked DNA / no nucleosomes	associated with proteins / histones / nucleosomes;
plasmids present	no plasmids present;
no introns	introns and exons;
found in nucleoid region	contained in nucleus;
one replication/initiation point	many replication/initiation points;
mitochondrial and chloroplast DNA similar to prokaryotic DNA;	
both use DNA as their genetic material;	

[6 max]

Responses do not need to be shown in a table format.

(c) occurs during (S phase of) interphase/in preparation for mitosis/cell division;
DNA replication is semi-conservative;
unwinding of double helix/separation of strands by helicase;
hydrogen bonds between two strands are broken;
each strand of parent DNA used as template;
deoxynucleoside triphosphate provides energy;
synthesis continuous on leading strand but not continuous on lagging strand;
resulting in formation of Okazaki fragments (on lagging strand);
synthesis occurs in $5' \rightarrow 3'$ direction;
RNA primer synthesized on parent DNA using RNA primase;
DNA polymerase III adds the nucleotides (to the $3'$ end);
complementary base pairing;
adenine pairs with thymine and cytosine pairs with guanine; *(both pairings required) (do not accept letters alone)*
DNA polymerase I removes the RNA primers and replaces them with DNA;
DNA ligase joins Okazaki fragments/seals nicks (in sugar-phosphate backbone); ***[8 max]***
Accept any of the above points shown in a clearly annotated diagram.

*(Plus up to **[2]** for quality)*

8. (a) *labelled x-axis*: wavelength / colour;
labelled y-axis: absorbance / % absorption;
peak between 400 and 500 nm / blue light;
peak between 600 and 700 nm / red light;
blue peak higher than red peak; ***[4 max]***

(b) using energy from light to provide energy;
absorbing light/photoactivation produces an excited/high energy/free electron;
absorption of light in photosystem II gives electron to chain of carriers;
photolysis;
H^+ pumped across thylakoid membrane;
protons pass through ATP synthetase/synthase;
producing ATP;
chemiosmosis;
(chlorophyll/antenna of) photosystem I absorbs light;
cyclic and non-cyclic photophosphorylation;
(in non-cyclic photophosphorylation) photolysis of water produces $H^+/O_2/e^-$;
in cyclic photophosphorylation electron returns to photosystem I; ***[8 max]***
Accept any of the above points shown in a clearly annotated diagram.

(c) glucose transformed to sucrose;
translocation of sugars/sucrose;
by phloem;
active process / requires energy;
from source to sink;
source is photosynthetic tissue/leaves;
sink is fruits/seeds/roots/storage organs;
(sucrose) converted to starch;
stored in storage organs/roots/tubers; ***[6 max]***

*(Plus up to **[2]** for quality)*