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MARKSCHEME

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BIOLOGY

ExamsBuddy

Higher Level

Paper 2

10 pages

General Marking Instructions

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 signified 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 writing ***OWTTE*** (or words to that effect).

8. 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.

10. Only consider units at the end of a calculation. Unless directed otherwise in the markscheme, unit errors should only be penalized once in the paper.

SECTION A

1. (a) on Day 1 / at end of Day 1 / after one day / after the first day / at start of second day **[1]**
*Award **[0]** for on Day 2 or after Day 1.*

(b) <u>two</u> oral doses daily of saline (for ten days);
one saline injection on Day 1/at end of Day 1/after one day/after the first day/at start of second day; **[2]**
*Award **[0]** for on Day 2 or after Day 1.*

(c) PAN + early edaravone group received edaravone for the first five days/first half of experiment/from Day 0 to Day 4 and PAN-only group did not **[1]**
*To award **[1]** reference to both groups is required. Award **[0]** for 4 or $4\frac{1}{2}$ days.*

(d) $205\,\text{mg day}^{-1}$ *(units required)* **[1]**
Allow answers in the range of 200 to 210 mg day^{-1}.

(e) on Day 3 little/no difference / both levels very low;
protein increases in both during the experiment; } *Can be mentioned in separate parts of the responses.*
protein higher in PAN-only group by an increasing amount / increases faster in PAN-only group;

protein levels are higher in the PAN-only group on all days / after Day 3 / on Day 6 and day 9; } *Accept comparative statements such as more than double.*
145 versus 45 on Day 6 / 350 versus 110 on Day 9 / increase from Day 3 to Day 6 is 130 versus 35 / increase from Day 6 to Day 9 is 205 versus 65; } *Allow answers in the range of ±5%. Accept numerical comparisons expressed as percentages.* **[3 max]**

(f) lower (increase in) protein/greater reduction/best results with early dose rather than with continuous;
more (increase in) protein/smaller reduction/worse results with late dose than with continuous;
differences may not be significant;
partial support / does not fully support / comparison of continuous with late supports hypothesis but continuous with early does not;
timing of dose more important than duration; **[3 max]**

(g) PAN increases TBArs levels / TBArs levels highest in PAN-only group;
PAN causes oxidation of/damage to membrane (lipids);
edaravone reduces/prevents increase in TBArs levels; *Do not allow PAN + edaravone lowers TBArs.*
edaravone prevents oxidation of membrane lipids / reduces/prevents effect of PAN;
early edaravone is more effective than late/continuous;
overlap of error bars shows differences may not be significant; ***[3 max]***

Do not allow late or continuous edaravone has no effect. Apart from the first marking point do not allow statements that are merely comparing the results.

(h) proteins retained (in blood) during ultrafiltration (in a healthy person);
proteins are large (molecules);
proteins lost/leak from blood/into filtrate/into Bowman's/renal capsule;
large enough pores/holes/spaces formed for proteins to pass through;
glomerulus/capillary walls/podocytes/Bowman's/renal capsule damaged;
proteins are too big to be reabsorbed later/in proximal convoluted tubule; ***[3 max]***

2. (a) *The structures underlined must be labelled.*

at least one nucleotide with deoxyribose linked to base and phosphate; *Labels need not be on the same nucleotide. Do not allow sugar.*

phosphate and deoxyribose linked C_3 to C_5; *Position required, not label. Straight line from C_4 to phosphate is acceptable. Do not penalize if the second strand is not antiparallel and the bonding is therefore incorrect on it.*

(complementary) bases labelled with at least one of each of A, G, T and C correctly linked to C_1;

hydrogen bonds between correct complementary bases; *Bond numbers not required.*

correct antiparallel orientation shown; *(as seen by shape or orientation of sugar)* ***[4 max]***

(b) (eight) histone (proteins);
DNA wrapped around histones/nucleosome;
further histone holding these together; ***[2 max]***
Do not allow histone wrapped around DNA.

(c) primary structure is (number and) sequence of amino acids;
joined by peptide bonds;
tertiary structure is the folding of the polypeptide/secondary structure/alpha helix;
stabilized by disulfide/ionic/hydrogen bonds/hydrophobic interactions;
tertiary structure gives three dimensional globular shape/shape of active site; ***[3 max]***

3. (a) character affected/influenced/defined/determined/controlled by two or more genes ***[1]***

(b) human skin colour can vary from pale to very dark / amount of melanin varies;
skin colour/melanin controlled by (alleles from) at least three/several genes;
no alleles are dominant / alleles are co-dominant / incomplete dominance;
many different possible combinations of alleles;
skin colour controlled by cumulative effect/combination of genes/alleles; ***[2 max]***
Award the above marking points for any other valid example.

(c) sex linked condition;
carried on an X chromosome / absent from Y chromosome;
if present in male causes colour blindness;
(allele is) recessive so heterozygous females are not colour blind;
homozygous females are colour blind; ***[3 max]***
Do not allow carried on sex chromosome.

SECTION B

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

4. (a) *Award **[1]** for each structure clearly drawn and correctly labelled. Accept a plan diagram without individual cells.*
upper and lower epidermis;
palisade mesophyll under upper epidermis $\frac{1}{3}$ to $\frac{1}{2}$ of leaf thickness;
spongy mesophyll/layer in lower half of leaf;
vein showing separate areas of xylem above phloem;
stoma/stomata labelled in (lower) epidermis;
two guard cells; *(at least one must be labelled for mark)* ***[4 max]***

(b) (chlorophyll/antenna) in photosystem II absorbs light;
absorbing light/photoactivation produces an excited/high energy/free electron;
electron passed along a series of carriers;
reduction of $NADP^+$ / generates $NADPH + H^+$;
absorption of light in photosystem II provides electron for photosystem I;
photolysis of water produces H^+ / O_2;
called non-cyclic photophosphorylation;
in cyclic photophosphorylation electron returns to chlorophyll;
generates ATP by H^+ pumped across thylakoid membrane / by chemiosmosis / through ATP synthetase/synthase; ***[6 max]***

(c) both light and temperature can be limiting factors;
other factors can be limiting;
graph showing increase and plateau with increasing light / description of this;
graph showing increase and decrease with increasing temperature / description of this;

light:
affects the light-dependent stage;
at low intensities insufficient ATP;
and insufficient $NADPH + H^+$ produced;
this stops the Calvin cycle operating (at maximum rate);

temperature:
affects light-independent stage / Calvin cycle;
temperature affects enzyme activity;
less active at low temperatures / maximum rate at high temperatures;
but will then be denatured (as temperature rises further); ***[8 max]***
*Award **[5 max]** if only one condition is discussed.*

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

5. (a) *Award **[1]** for each structure clearly drawn and correctly labelled.*
ovary – shown adjacent to but not joined to oviduct/fallopian tube;
oviduct/fallopian tube – shown as a tube leading into a uterus;
uterus – shown with a thicker wall than oviduct/fallopian tube;
vagina – shown leading from the uterus, connected to the cervix;
cervix – shown as a constriction between the vagina and uterus;
endometrium – shown as inner lining of uterus; ***[4 max]***

(b) follicles secrete estrogen / FSH stimulates secretion of estrogen;
(rapid) increase in estrogen stimulates FSH/LH production;
estrogen also stimulates repair/thickening of endometrium/uterus lining;
LH causes follicle to produce less estrogen/more progesterone;
corpus luteum secretes more estrogen/progesterone;
progesterone maintains/stimulates thickening of endometrium/uterus lining;
estrogen/progesterone inhibit FSH/LH secretion;
estrogen/progesterone levels fall after day 21–24 if no embryo/fertilization;
lower concentration of estrogen/progesterone allows disintegration of endometrium/uterus lining / menstruation occurs; ***[6 max]***
*Award **[4 max]** if only one hormone is explained.*

(c) transfer of foods/nutrients/glucose from mother to fetus;
fetal gas exchange/transfer of oxygen from mother to fetus;
transfer of excretory products/CO_2 from fetus to mother;
transfer of antibodies/hormones from mother to fetus;
secretion of estrogen/progesterone
from approximately 12 weeks / when ovary/corpus luteum stops secretion;
disc shaped structure;
connected to the fetus by an umbilical cord;
embryonic tissue invades/grows into the uterine wall;
placental 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; ***[8 max]***
Allow reference to embryo instead of fetus throughout.

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

6. (a) *Award **[1]** for each structure clearly drawn and correctly labelled. Whole cells not necessary.*
(plasma) membrane – single line surrounding cytoplasm;
nucleus – with a double membrane and pore(s) shown;
mitochondria(ion) – with a double membrane, the inner one folded into internal projections, shown no larger than half the nucleus;
rough endoplasmic reticulum – multi-folded membrane with dots/small circles on surface;
Golgi apparatus – shown as a series of enclosed sacs with evidence of vesicle formation;
ribosomes – dots/small circles in cytoplasm/ribosomes on rER;
lysosome; ***[4 max]***
*Award **[0]** if plant cell is drawn. Award **[2 max]** if any plant cell structure (e.g. cell wall) is present.*

(b)

prokaryotic	**eukaryotic**
naked DNA	protein associated with DNA;
DNA in cytoplasm / nucleoid / no nucleus	DNA in nucleus / nucleus present;
circular DNA	linear chromosomes/DNA molecules;
no mitochondria	mitochondria;
70S ribosomes present	80S ribosomes present;
no membrane bound organelles	internal membranes form organelles;
pili present	pili absent;
plasmids (sometimes) present	plasmids absent;
cell wall present	cell wall only present in plants/fungi; *Do not accept cell wall sometimes present.*
flagella solid	flagella flexible/membrane-bound;

[6 max]

(c) DNA replication is semi-conservative / each strand of DNA acts as template;
(DNA) helicase separates two strands/forms a replication fork;
new strand built / nucleotides added in a 5′ to 3′ direction;
(deoxy)nucleoside triphosphates hydrolysed to provide energy for nucleotide formation/base pairing;
on one strand DNA polymerase III builds continuous strand;
on other strand short chains of DNA/Okazaki fragments are formed;
each short chain starts with RNA primer;
added by RNA primase;
then remainder of chain of DNA built by DNA polymerase III;
DNA polymerase I removes RNA primer and replaces it by DNA;
DNA ligase joins DNA fragments together forming complete strand;
replication only occurs at a single replication fork; ***[8 max]***
Award credit for any of the above points clearly drawn and accurately labelled.

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

7. (a) *Award **[1]** for each structure clearly drawn and correctly labelled. Schematic diagrams are acceptable.*
right and left ventricles – not connected shown larger than atria;
right and left atrium – not connected, thinner walls than ventricles;
right ventricle has thinner walls than left ventricle / *vice versa*;
atrio-ventricular valves / tricuspid and bicuspid valves – shown between atria and ventricles;
aorta and pulmonary artery – shown leaving the appropriate ventricle with semilunar valves shown;
pulmonary vein and vena cava – shown entering appropriate atrium; ***[4 max]***
Vessels must join unambiguously to correct chamber.

(b) cells/tissue is damaged/cut/bruised;
damaged cells/platelets release clotting factors;
(clotting factors cause the) production of thrombin;
blood plasma contains soluble fibrinogen;
fibrinogen converted into fibrin;
by thrombin;
forms a net of fibres trapping blood cells;
forming a clot / prevents blood loss / entry of bacteria/pathogens;
cascade of reactions/series of stages prevent accidental clotting/speed up clotting; ***[6 max]***

(c) *benefits*: ***[6 max]***
immunity results
can limit pandemics/epidemics/spread of infectious diseases;
diseases can be eradicated/smallpox eliminated;
reduces mortality/deaths due to disease;
can protect vulnerable groups/young/old/with other conditions;
decreases crippling effects of diseases (such as polio);
decreased health care costs;

risks: ***[6 max]***
may produce (mild) symptoms of the disease;
human error in preparation/storage/administration of vaccine;
individual may react badly to vaccine / defective immune system / hypersensitive/allergic reaction;
immunity may not be life-long / booster required;
possible toxic effects of mercury-based preservatives/thimerosal; ***[8 max]***

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