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MARKSCHEME

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BIOLOGY

Higher Level

Paper 2

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SECTION A

1. (a) old ***[1]***

(b) (i) old dive longer (than the young males);
young swim faster (than the old males); ***[2 max]***
Reject answers giving quoted figures without comparison

(ii) 1.5 (±0.2) km h^{-1} *(units required)* ***[1]***

(c) no ventilation/breathing/<u>air</u> available;
anaerobic respiration takes place;
oxygen not used / used up / not replaced / no oxygen / low levels of oxygen;
glucose / pyruvate is broken down to lactate;
(some) energy/ATP is produced / needed;
muscles contracting/working (during dive); ***[3 max]***

(d) *Award 1 mark for two or three of the following and 2 marks for all four.*
dive time shorter in September (than August) / little difference;
speed faster in September (than August) / little difference;
dive time shorter later in the day / little difference;
speed slower later in the day; ***[2]***

(e) both charts show (mean) dive time is longer in older whales;
little difference in either chart in speed / no trend in Fig 1 but Fig 2 shows young whales swim faster; ***[2]***

(f) data shows little difference due to number / distance of boats;
no (evidence of) harmful consequences from <u>whale-watching</u> / <u>ecotourism</u>;
not enough data (to be sure of effects);
other behaviours not studied / only two behaviour patterns studied; ***[3 max]***

(g) male behaviour;
effects of boat noise / movement / divers in the water;
effects of boat size;
effect of duration of boat visit;
aggression;
schooling / forming groups / play;
reproduction / courtship;
feeding behaviour;
communication;
direction of swimming/migration;
long-term behaviour / observations on long-term effects;
compare behaviour in areas with ecotourism with areas with none;
compare behaviour after ecotourism started with behaviour before; ***[2 max]***
Reject answers not referring to behaviour patterns or factors affecting behaviour

2. (a) (i) autosomal;
linked genes/linkage;
together on same chromosome;
as they did not separate / segregate; ***[2]***

(ii) *Accept any letters for the alleles of the two genes.*
male genotype is BbTt/$\frac{BT}{bt}$ and female genotype is bbtt/$\frac{bt}{bt}$;
Reject Bb,Tt and bb, tt.
male gametes: BT and bt/BT and bt *female gametes*: (all) bt/bt; ***[2 max]***

(iii) BbTt/$\frac{BT}{bt}$ and bbtt/$\frac{bt}{bt}$;

1 / ½ / 50% brown tailed : 1 / ½ / 50% white tail-less; ***[2]***

(b) desired/specific gene obtained/selected;
mRNA copied with reverse transcriptase;
vector used / needed to get gene into host;
restriction enzymes used to cut DNA / to open plasmid;
sticky ends added / present;
DNA /gene inserted into plasmid;
DNA / gene spliced with DNA ligase;
recombinant plasmid / recombinant DNA mixed with host cells;
use of viral vectors / *Agrobacterium* used as a vector;
shot gunning /gold /tungsten particles coated in genes and shot into host cell; ***[3 max]***

3. (a) nanophytoplankton, bacteria, phytoplankton ***[1]***
*All three needed to receive **[1]**.*

(b) (i) 1° /primary or 2° /secondary consumer *(depending on chain marked)* ***[1]***

(ii) 2° /secondary, 3° /tertiary or 4° /quaternary consumer *(depending on chain marked)* ***[1]***
Marks may not be given if the arrows are not marked on the diagram.

(c) 1 / 2 % ***[1]***

(d) more macrozooplankton / phytoplankton eaten/numbers fall;
natural selection for small/camouflaged/fast growing/fast swimming plankton;

competition between small fish is more intense;
natural selection among small fish for faster swimming/more skill in feeding;

more food for predators of small fish/named predator of small fish;
natural selection among predators for feeding on small fish/not on other prey;

changes in the gene pool/allele frequencies; ***[3 max]***

SECTION B

4. (a)

	Prokaryotic	**Eukaryotic**
DNA	naked / loop of DNA	associated with protein/histones / nucleosomes / DNA in chromosomes
location DNA	in cytoplasm / nucleoid / no nucleus	within a nucleus/nuclear membrane
membrane bound organelles	none	yes
ribosomes	70 S	80 S
plasma membrane	same structure in both groups	
cell wall	peptidoglycan / not cellulose / not chitin	cellulose / chitin / not peptidoglycan
respiratory structures	mesosomes / no mitochondria	mitochondria

*Award **[1]** for every line in the table.* ***[5 max]***

(b) named <u>prokaryotic</u> pathogen *e.g. Borrelia burgdorfen/burgdorferi*;
name of the disease caused by prokaryote *e.g.* lyme disease;
main mode of transmission *e.g.* tick bite;
second mode of transmission;
one effect of disease *e.g.* red circular, smooth rash;
second effect *e.g.* flu-like symptoms; ***[5 max]***
*If pathogen is not prokaryotic, then award **[2 max]** for this question*.

(c) antigen/pathogen engulfed by macrophage (by endocytosis);
presentation of antigen by macrophage on membrane/MHC protein;
helper T-cell binds to macrophage;
helper T-cell activated;
activated helper T-cell binds to (inactive) B-cell;
B-cell is activated by helper T-cell;
B-cells start to divide/clone;
plasma cells formed / grow;
plasma cell increases numbers of rough ER / Golgi apparatus;
B cells / clones / plasma cells begin to produce antibodies to the specific antigen;
antibodies secreted /pass out through membrane (by exocytosis);
memory cells give long-term immunity / allow rapid antibody production; ***[8 max]***

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

5. (a) double helix;
two chains of nucleotides / composed of nucleotides;
nucleotides consist of base, deoxyribose (sugar)and phosphate;
bases are adenine, cytosine, guanine and thymine;
anti-parallel / strands;
3′-5′ links between nucleotides;
hydrogen bonds between base pairs / purine and pyrimidine on opposite chains;
only A-T and G-C / complementary base pairs are A-T and G-C ;
two bonds between A-T and 3 between G-C; ***[5 max]***
Credit can be given for any of these points shown on a correctly drawn and labelled diagram.

(b) more than one gene controls/affects one characteristic;
Reject more than 2 alleles
can cause continuous variation / many different possible phenotypes;
e.g. skin colour / other valid example;
allele of each gene promotes melanin production or not / other valid example;
e.g. grain colour in wheat / other valid example;
allele of each gene promotes pigment production or not / other valid example; ***[5 max]***
If first or second example is incorrect do not accept third or subsequent examples.

(c) RNA polymerase controls transcription / is the enzyme used in transcription;
DNA is unwound by RNA polymerase;
DNA is split into two strands;
mRNA is made by transcription;
promoter region (by start of gene) causes RNA polymerase to bind;
anti-sense/template strand of DNA is transcribed;
direction of transcription is 5′-3′ ;
free nucleotide triphosphates used;
complementary base pairing between template strand and RNA nucleotides/bases;
Accept this marking point if illustrated using a diagram
RNA contains uracil instead of thymine;
terminator (sequence) stops RNA polymerase / transcription;
mRNA is released / RNA polymerase released; ***[8 max]***

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

6. (a) *light-dependent reaction*: ***[3 max]***
chlorophyll absorbs light (energy)/ photons;
electron activated/excited;
electron passed down electron carriers;
ATP produced;
$NADP^+$ reduced / reduced NADP produced / NADPH produced;

light independent reaction: ***[3 max]***
CO_2 fixed by/reacts with 5C molecule (RuBP);
rubisco/ribulose bisphophate carboxylase/RuBP carboxylase catalyses reaction;
(two) 3C molecules / glycerate 3-phosphate/GP produced;
reduced NADP and ATP used to reduce glycerate 3-phosphate/GP;
triose phosphate/TP produced; ***[6 max]***

(b) water is absorbed;
formation of gibberellin;
production of amylase;
amylase catalyzes digestion of starch to maltose / starch hydrolyzed to maltose;
maltose converted to glucose;
cell respiration; ***[4 max]***

(c) occurs in mitochondria;
oxidative phosphorylation;
electrons passed along carriers/electron transport chain;
carriers in <u>inner</u> mitochondrial membrane / cristae;
energy from electrons used to pump H^+/protons into intermembrane space;
H^+/proton (concentration) gradient formed;
ATPase/synthase in inner membrane;
movement of H^+/protons down concentration gradient through ATPase/synthase;
rotation of (head of) ATPase/synthase;
energy released produces ATP;
by phosphorylating ADP / $ADP + P_i \rightarrow ATP$;
oxygen is terminal (electron) acceptor (plus H^+ to make water); ***[8 max]***

Credit can be given for any of these points shown on a correctly drawn and labelled diagram.

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

7. (a) *Award **[1]** for each named hormone and **[1]** for its correct function, up to **[4 max]**. Do not award marks for function only.*

estrogen;
builds up uterine lining / endometrium / prevents ovulation;

progesterone;
maintains uterine lining / endometrium / pregnancy ends when progesterone level drops / inhibits contraction of uterus / prevents ovulation;

HCG;
maintains / stimulates growth of corpus luteum;

oxytocin;
stimulates contraction of uterine muscle wall; ***[4 max]***
Accept only the first two hormones named and their functions.

(b) nerve impulse reaches pre-synaptic knob / membrane;
calcium ions/ Ca^{2+} enter pre-synaptic neurone / knob;
vesicles with neurotransmitter / acetylcholine release contents;
neurotransmitter <u>diffuses</u> across synapse/synaptic cleft;
binds to receptors on post-synaptic neurone/membrane;
sodium ions/ Na^{+} enter post-synaptic neurone / sodium channels open;
depolarization / action potential /nerve impulse (in post synaptic neurone);
calcium ions/ Ca^{2+} pumped back into synaptic cleft/synapse;
neurotransmitter broken down; ***[6 max]***

(c) homeostasis is the maintenance of a constant level of the internal environment ;
within narrow limits;
involves negative feedback;

name of variable controlled;;
method of detection / monitoring;;
response to high / low levels of variable;;
how variable is brought back to set point;;

*Example 1 **[3 max]**:*
blood glucose level;
pancreas cells /islets/beta and alpha cells to monitor level;
insulin secreted with high blood glucose / glucagon with low blood glucose levels;
named method of raising / lowering level of blood glucose;

*Example 2 **[3 max]**:*
body temperature;
hypothalamus monitors temperature;
nerve impulses to skin / muscle / liver;
named method of raising / lowering level of body temperature; ***[8 max]***

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