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MARKSCHEME

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BIOLOGY

Higher Level

Paper 2

14 pages

SECTION A

1. (a) the pheasant uses more power / energy than the duck (to fly at all speeds);
the overall shape of the curves is the same;
the most efficient flying velocity is the same for both birds / slightly higher for pheasants;
the velocity that uses the least power for flight is lower for the duck than the pheasant;
(Reject the duck is more efficient at using energy to fly) ***[3 max]***

(b) the mass of the duck is lower than the mass of the pheasant;
more energy / power needed for greater mass; ***[1 max]***

(c)

pheasant	**OR**	**duck**
energy used divided by metres travelled; *(need not be stated and can be accepted if this is shown in the working)*		energy used divided by metres travelled;
3.8 – 4.0 $J\,m^{-1}$ at V;		2.6 – 2.8 $J\,m^{-1}$ at V;
5.3 – 6.3 $J\,m^{-1}$ at least power velocity;		3.0 – 4.0 $J\,m^{-1}$ at least power velocity;

(Penalise lack of units once only. Accept $J\,s^{-1}$ ms^{-1} for the units.)

*Accept for **[1]** only answers in which the candidate calculates velocity divided by power for V and for least power. Also accept for **[1]** only answers in which the candidate shows that from V to least power, velocity is reduced proportionately more than power.* ***[3]***

(d) 26 (flaps); ***[1]***

(e) vigorous contractions during take off **and** landing, less vigorous contractions during fast flight;
decreasingly vigorous contractions during take off and fast flight / increasingly during landing;
fewer contractions per unit time in (later stages) of fast flight than other phases;
most vigorous contractions during landing;
(Accept active / activity or electrical activity throughout instead of contractions) ***[3 max]***

(f) TB is used (mainly) for <u>landing</u>; ***[1]***

(g) the upstroke of the wing; ***[1]***

(h) similar frequency to the SB muscles / same number of contractions;
the peaks of activity would be out of phase / alternate with those of the SB and TB; ***[2]***

2. (a) 100 to 110 mm; ***[1]***
(Penalise if no units included only if not already penalised in question 1)

(b) count from lowest value upwards / highest value downwards to find the central value;
plot a cumulative frequency histogram and deduce the median from this; ***[1 max]***

(c) 66 – 68 %; ***[1]***

(d) gives a measure of spread of the results (about the mean) / of the amount of variation;
can be used to compare this data with another sample / population;
indicates the reliability of a sample / used in statistical tests / significance tests; ***[2 max]***

(e) skin colour; height; mass; other possible answers; ***[2 max]***
(Reject eye colour and hair length)

(f) polygenic inheritance;
the interaction of two or more genes controlling the same character;
each gene has a small effect on the phenotype; ***[2 max]***
(Reject polymorphism and multiple allele.)

3. (a) in both species the codons for leucine and glycine are the same;
the same triplets / codons code for the same amino acids in both organisms;
same four nitrogenous bases used;
codons consist of three bases in both; ***[2 max]***

(b) (in species I) serine is coded for by two different codons / AGC and AGU;
a substitution mutation replacing C for U in the codon has no effect on the amino acid translated;
the genetic code is a degenerate code / several codons translate into the same amino acid; ***[2 max]***

(c) AAG TCG CCG TCA TGT; ***[1]***

(d) (i) reverse transcriptase; ***[1]***

(ii) (host cells infected with) retroviruses / HIV;
(Reject AIDS in place of HIV) ***[1]***

(e) mRNA produced by eukaryotes is spliced before it is translated;
introns are removed from the mRNA (sequence leaving exons); ***[1 max]***

SECTION B

(Remember, up to TWO 'quality of construction' marks per essay)

4. (a) (primary structure is a) chain of amino acids / sequence of amino acids;
(each position is occupied by one of) 20 different amino acids;
linked by peptide bonds;

secondary structure formed by interaction between amino and carboxyl / –NH and –C=O groups;
(weak) hydrogen bonds are formed;
(α-)helix formed / polypeptide coils up;
or (β-)pleated sheet formed;
tertiary structure is the folding up of the polypeptide;
stabilised by disulphide bridges / hydrogen / ionic / hydrophobic bond;
quaternary structure is where several polypeptide subunits join;

conjugated proteins are proteins which combine with other molecules;
for example metals / nucleic acids / carbohydrates / lipids; ***[9 max]***

(b) solubility depends on what amino acids / R groups are present;
smaller proteins are more soluble than big ones;
proteins with many polar / hydrophilic amino acids / R groups are more soluble / soluble;
proteins with polar / hydrophilic amino acids / R groups **on the outside** are soluble;
example of a polar amino acid / group;
globular proteins are more soluble than fibrous proteins;
solubility of proteins may also be affected by conditions (pH, temperature, salinity);
denaturation makes proteins insoluble;
proteins do not form true solutions in water but colloidal solutions; ***[4 max]***

(c) genes code for proteins / polypeptides;
one gene **one** polypeptide;
(one) gene is transcribed into (one) mRNA;
mRNA is translated by a ribosome to synthesise a polypeptide;
if the information on a gene is changed / mutated this may alter the structure of a protein;
genetic information transcribed by eukaryotes is edited before it is translated;
polypeptides may be altered before they become fully functional proteins; ***[5 max]***

(Remember, up to TWO 'quality of construction' marks per essay)

5. (a) water is a substrate / reactant / raw material / for photosynthesis / equation for photosynthesis;
water is a source of electrons;
to replace those lost by chlorophyll / photosystem II;
water is a source of H^+ needed to produce NADPH + H^+;
photolysis / splitting / breaking of water;
water for non-cyclic photophosphorylation / ATP production;
light independent reactions occur in water;
water is transparent so photosynthesis can take place underwater / light can penetrate to chloroplasts; ***[4 max]***

(b) *(Up to **[4]** from the following:)*
ammonia is very soluble in water / ammonia is very toxic;
ammonia is used by amphibian larvae / aquatic amphibia as their toxic waste;
excretion of the ammonia is easy for an aquatic animal as it dissolves in the surrounding water;

urea is quite soluble in water / it is not as toxic as ammonia;
adult amphibians use urea as their nitrogenous waste;
necessary water can be consumed in humid habitats to flush the urea from the amphibian's body;

uric acid is insoluble so birds do not need to fly with / carry so much water to excrete it;
uric acid is insoluble so no water is needed to excrete it / it is non-toxic so it can be stored in the body;
uric acid is used by birds;
habitat of birds is terrestrial and may be dry requiring maximum water conservation;
insoluble waste product essential during development inside egg;

*(**[1]** for the following:)*
the type of nitrogenous waste excreted by these animals is related to the availability of water in their habitats; ***[5]***

(Remember, up to TWO 'quality of construction' marks per essay)

(c) *(Up to **[9]** for the following:)*

as a coolant;
thermal capacity of water is high;
therefore fluids containing water can carry away much heat;
the latent heat of vaporisation of water is high;
water released onto the surface (sweat / saliva) carries away much heat by evaporation;

as a transport medium;
water dissolves many substances;
water remains liquid over much of the range of the Earth's temperatures;
as a fluid, water is used as a medium to transport biological materials;
e.g. blood / lymph / other suitable example;
water can transport heat;
water currents disperse larval forms of marine species / sperm / eggs;

water as a habitat;
water is densest at 4 °C / water freezes at the surface first;
water bodies are thermally stable;
water is transparent / light sensitive receptors can operate under water;
water has a high surface tension / some animals can walk / live on the surface film; ***[9 max]***

(Remember, up to TWO 'quality of construction' marks per essay)

6. (a) *This may be answered by means of a series of diagrams but they must be clearly labelled and annotated. Marks should only be awarded for the points below whether shown clearly in diagrams or in prose.*

chromosomes condense / supercoil / become shorter and fatter;
homologous chromosomes pair up (as bivalents / tetrads);
there is an exchange of material between the homologous pairs / crossing over;
homologous pairs of chromosomes are joined by chiasmata;
pairs of homologous chromosomes become attached to the spindle fibres (Metaphase I);
the homologous chromosomes are arranged across the equator of the spindle;
the homologous pairs randomly orientate towards opposite poles of the spindle;
spindle fibres (attached to centromeres / kinetochores) pull chromosomes of each pair to opposite poles;
two nuclei form with haploid (n) set of chromosomes in each (Telophase I) (and cytoplasm divides);
short interphase with no replication of the chromosomes;
chromosomes stay condensed and new spindles form (Prophase II);
chromosomes align across the equator (Metaphase II);
centromeres divide and chromatids separate (Anaphase II);
two new nuclei form (Telophase II) and the cytoplasm divides;
four haploid (n) cells produced;
*(Reject four haploid **gametes** produced)*

[9 max]

(b) mitosis multiplies the germ cells to produce oogonia;
cell volume increased / cell grows (after mitosis) (oogonium to primary oocyte);
meiosis;
unequal division of cytoplasm during meiotic divisions;
small polar bodies formed and break down *(accept three polar bodies formed)*;
one haploid egg formed per meiosis;
oogenesis begins in the fetal ovary of the girl and it is only totally completed at fertilisation;

[5 max]

(c) more germ cells in testes than ovary / more germinal epithelium;
all four products of meiosis become sperm versus one only becoming an egg;
continuous sperm production versus monthly egg production;
early stages of oogenesis only in the fetus so finite number of cells for oogenesis;
reference to progesterone inhibiting FSH secretion and thus egg production;
no eggs produced during pregnancy;
eggs not produced after menopause;

[4 max]

(Remember, up to TWO 'quality of construction' marks per essay)

7. (a) ***([9]** for the following:)*

bryophytes
small plants;
no true stems or leaves;
rhizoids only;
dominant plant is haploid / is the gametophyte;
spores produced in a capsule;
non-vascular / lack of xylem and phloem;

filicinophytes
seedless;
vascular tissues / xylem and phloem;
roots;
leaves and stems;
spores produced in clusters / spores usually produced under the leaves;
prothallus / small gametophte / gametophyte grows independently;

coniferophyta
seeds not enclosed in ovary / pericarp / fruit;
pollen and ovules;
cones;
often have narrow leaves / thick waxy cuticle;
vascular tissue / xylem and phloem;

angiospermophytes
flowers / flowering plants;
ovules / seed are enclosed;
fruits;
xylem vessels; ***[9 max]***

(b) ***([6 max]** from the following:)*

water needed;
water causes swelling which bursts the testa / seed coat / water softens the testa / seed coat;
water mobilises soluble food reserves / enzymes / medium for metabolic processes;
water rehydrates cells / tissues;
water transports hydrolysed food reserves;
water transports growth promoters / hormones;
water dilutes / washes out growth inhibitors;

oxygen needed;
oxygen required for (aerobic) respiration;
which provides ATP for metabolic activity;

warmth increases enzyme activity *(reject enzymes denatured)*;
fire breaks down inhibitors;
chilling breaks down inhibitors;
light breaks down inhibitors / stimulates germination in some species;
degradation of testa makes it more permeable to water / gases; ***[6 max]***

(c) ***([3 max]** for the following:)*

all wild plants should be conserved;
trees should be conserved as sinks of carbon dioxide / habitats for animals;
wild species which may have commercial value (*e.g.* pharmaceuticals);
wild relatives of domesticated plants / crop plants / *e.g.* of crop plant that should be conserved;
as they carry useful genes / characteristics for breeding programmes;
species of plants which are endangered / threatened;
species upon which endangered animals depend;

[3 max]