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BIOLOGY

Higher Level

Paper 3

14 pages

Option D – Evolution

D1. (a)   fewer males per females;
small population on island (may lead to) inbreeding / (deleterious) alleles appearing that decrease fertility;
shortage of food / overcrowding;
better breeding sites;
(Do not accept more females)							*[1 max]*

(b) (i) mainland population has more heterozygotes as more genes polymorphic;		*[1]*

(ii)   variation needed to respond to environmental change;
island population has less variation so more vulnerable to change;
polymorphism allows better chance that some animals could adapt / survive;
island population cannot migrate / escape;						*[2 max]*

(c)   Hardy-Weinberg equilibrium occurs if allele frequency remains constant over generations / a population is not in Hardy-Weinberg equilibrium if allele frequencies have changed over generations;
founder population is probably not at Hardy-Weinberg equilibrium;
island population is probably small and not likely to be in equilibrium / so genetic drift a factor to move from Hardy-Weinberg equilibrium;
could be at Hardy-Weinberg equilibrium because allele frequencies may not have changed / alleles are fixed;								*[2 max]*

D2. (a)

(Kingdom)	Animalia
(Phylum)	Chordata
(Sub-phylum)	Vertebrata
(Class)	Mammalia
(Order)	Primata
(Family)	Hominidae
(Genus)	*Homo*
(Species)	*sapiens*

(4 to 6 correct [1], 7 to 8 correct [2]. Award [1] if 7 to 8 correct, but incorrect order.)							*[2 max]*

(b) (i) grasp / manipulation / climbing;						*[1]*

(ii) stereo / binocular vision / depth perception;					*[1]*

D3. (a) *([1] for any of the following; [4 max].)*
RNA (possibly) the first genetic material;
before DNA;
RNA can act as catalyst / template for its own replication;
RNA can act as catalyst for chemical reactions / act as enzymes / ribozyme;
reference to ribozymes in modern ribosomes;
other experimental evidence;   *[4 max]*

(b)   geographical distribution;
ring species / other evidence from geographical distribution;

biochemistry;
cytochrome c / other biochemical evidence;

fossils / palaeontological;
fossilised horse ancestors / other evidence;

homologous structures;
pentadactyl limb / vertebrate embryos / other;

recent observed evolution;
resistance to antibiotics / insecticides / heavy metal tolerance / other recent
example;   *[6 max]*

Option E – Neurobiology and behaviour

E1. (a)   *([1] for any of the following with **both** caste and role; [6 max].)*
queen: reproduction;
drone / male: fertilise queen / reproduction;
workers / (sterile females): wax making;
worker / nurse: feed larvae / secrete royal jelly;
worker / forager: look for food / nectar / pollen;
worker: clean / ventilate hive;
worker / soldier: protect hive;
worker / scout: communicate location of food to rest of hive;   *[6 max]*

(b)   *([1] for any of the following; [4 max].)*
Behavioural problems:
loss of coordination / reflexes / vision;
loss of reasoning / judgement;
Health problems:
liver damage / neuron damage;
harm to fetal development / fetal alcohol syndrome;
addiction;
Social problems:
accidents in home / work / on the road;
violence in home / crime;
unemployment / financial problems;   *[4 max]*

E2. (a)   Young fish / smolts move downstream (in May);
young fish move into sea (June to August);
reproducers move from sea upstream (from June to August / winter);   *[2 max]*

(b)   *([1] for one of the following; [2 max].)*
sexual maturation / courtship / fertilization;
mature adults lay eggs / reproduce in river;
eggs fertilized / develop to smolts in river;
smolts / post-smolts mature in sea;
reproducers die during winter;   *[2 max]*

(c)   *([1] for method and [1] for control; [2 max].)*
extract substances from young smolts and put in different rivers / put live smolts in
different rivers;
other rivers with no smolts (control);
and observe behaviour of reproducers in both new rivers;
OR
(any feasible experiment with control is acceptable, *e.g.* take smolts out of some
rivers and compare movements of reproducers in rivers with smolts;)   *[2 max]*

E3. (a) (i) *([1] for example.)*
e.g. (random) movement of wood lice to find a moist area;   *[1]*

(b) (i) *([1] for example.)*
e.g. positive phototaxis / movement to light in honey bees;   *[1]*

(ii) *[1]* for detail of when the response is used;
[1] for the advantage / importance in survival;

e.g. *(where chemotaxis in moths was given in (b)(i))*
male moths moves towards the source of a pheromone;
therefore finds a female that is ready to be mated;   *[2 max]*

Option F – Applied plant and animal science

F1. (a) control results are higher at Wakefield than Craigieburn;
much higher in 94–5 and slightly higher / similar in 95–6;
higher result in 94–5 than 95–6 in Wakefield but 95–6 higher than 94–5 in Craigieburn;   *[2 max]*

(b) *support for hypothesis:*
hand pollination increased fruit % (above control) at Craigieburn;
exclusion of pollinators did (significantly) reduce fruit % at Wakefield;

against the hypothesis:
hand pollination does not always increase fruit % at Wakefield;
exclusion of pollinators did not reduce fruit % at Craigieburn;   *[3 max]*

(c) *([1] for any one statement; [1 max].)*
amount of pollen / ovules produced by plants;
insufficient resources / nutrients / minerals;
herbivore / parasite affecting flower development;
climate / rainfall / temperature;
genetic factors;   *[1 max]*

F2. (a) *([1] for any of the following; [2 max].)*
apical dominance is eliminated / diminished;
auxins produced in apex inhibit lateral growth;
remove auxins / apex allows lateral growth;   *[2 max]*

(b) *([1] for any one of the following; [2 max].)*
auxin / kinetin / cytokinin promotes root growth;
low ratio kinetin / auxin promote root growth;
auxins promote branch-root growth;   *[2 max]*

F3.   (a)   *([1] for any of the following points with an explanation; [6 max].)*
artificial adjustment of oestrus cycle / application of hormones / progesterone /
prostaglandins / melatonin allows for timing / synchronisation of ovulation;
artificial insemination for genetic improvement / control timing / cost effective /
reduce disease transmission;
in vitro fertilisation gives control over success rate;
use of cloning to reproduce identical quality animals;
vaccinations to prevent disease;
nutrition: high quality food for better health / adapted for specific needs;
medicines for treatment of diseases / prevention of transmission;
use of surrogate / foster mothers to maximise reproductive capacities;
use of cesareans to protect health of mother and offspring;   *[6 max]*

  (b)   *([1] for any of the following or any other valid point; must include at least one
issue of each, [4 max].)*
biological issues: transfer of diseases to humans;
rejection / foreign antigens on animal organs cause antibody reaction;
function not identical to human organs;
ethical issues: wrong to use animals as organ factories for humans;
use of pig organs, for example, religious issue for some cultures;   *[4 max]*

Option G – Ecology and conservation

G1. (a) *([1] for each statement; [4 max].)*
(Each statement must be qualified e.g. gross production is greater in higher temperatures than in lower temperatures)
temperatures;
rainfall;
light intensity;
light duration;
soil quality / nutrients;
density of plant population;
leaf area index;
CO_2 concentrations in aquatic ecosystems;   *[4 max]*

(b) *For each of **three named** renewable energy sources award [1 max] for an advantage and [1 max] for a disadvantage.*

Renewable Energy Source	Advantage	Disadvantage
Solar	Free energy source; Inexpensive for water and home heating; Low environmental impact; Safe source;	Photocells production still expensive; Irregular source: requires storage system; Limited amount of useful energy;
Hydro-electric	Free energy source; Well developed technology; Relatively low operating and maintenance costs; High net useful energy;	Risks of dams breaking; Flooding of large areas; Destruction of ecosystems; Blocks silt movement to lower areas such as deltas; Environmental effect; Dams fill with silt;
Tides	Inexpensive; Low environmental impact on air; Moderate useful energy in selected areas with high daily tides;	Few areas with sufficient tides; Environmental impact on coastal areas;
Geo-thermal	Low to moderate environmental impact; Inexpensive heating for homes and industry in area;	Limited areas accessible; Requires large amount of water;
Wind	No pollution (CO_2, smog, *etc.*) / low environmental impact; Technology well developed;	Aesthetic pollution of wind farms; Not constant / insufficient in some areas; Requires storage system;
Oceans	Almost infinite supply as uses heat stored in ocean (thermal gradients); Low environmental effect;	Problem of damage by storms; Limited areas with sufficient gradient for sufficient useful energy; Requires storage / transfer of energy;

[6 max]

Accept methane (biogas from decomposition) or wood / charcoal with appropriate advantages and disadvantages

G2. (a) (i) *([1] for both.)*
                both decrease (due to human predation);   *[1]*

           (ii) *([1] for both.)*
                both increase (due to lack of / decrease in predators / consumers);   *[1]*

     (b) *([1] for each statement; [2 max].)*
          Concholepas is predator of *Perumytilus* / humans decrease *Concholepas* by predation;
          Perumytilus population increases;
          Perumytilus out competes the barnacles for food / space;   *[2 max]*

     (c) *([1] for each effect; [2 max].)*
          wider base / more productivity / higher density macroalgae produce more food / energy;
          extra trophic level / humans as 3rd trophic level;   *[2 max]*

G3. (a) (i) Bacteria / monera / Prokaryotae;
                producers;   *[1 max]*

           (ii) by oxidising inorganic compounds (to make ATP);   *[1]*

     (b) *([1] for **one** correct example of each; [2 max].)*
          electron donors: H_2S / NH_3 / NO_2^- / S;
          electron acceptors: O_2 / SO_4^{2-} / NO_2^- / NO_3^-;   *[2 max]*

Option H – Further human physiology

H1. (a) (i) *([1] for any one of the following.)*
    direct / positive relationship / correlation; *[1]*

    (ii) *([2] for the following.)*
    the level rises during a lifetime;
    the level is an average 30 (±5) mg higher in adults / example of different
    values of adults and young in one state / point; *[2]*

  (b) *([1] for any of the below or any other valid implication, [3 max].)*
    most of the population is below the level of 200 mg 100 cm^{-3};
    all young people are below 200 mg 100 cm^{-3};
    few of the population / (4-5 states) are at risk of heart attacks because of high cholesterol; *[3 max]*

H2. (a) (i) Less (available) oxygen in air / blood / decreased partial pressure of oxygen; *[1]*

    (ii) *([1] for any of the following; [1 max].)*
    nausea;
    fatigue;
    headache / dizziness;
    difficulty in breathing; *[1]*

  (b) *([1] for one of the following **comparisons**; [2 max].)*
    indigenous larger lungs / pulmonary surface / larger vital capacity;
    traveller faster breathing / rate of ventilation;
    traveller (starts) producing more red blood cells / erythrocytes while indigenous has more; *[2 max]*

H3. (a) *([1] for each correct statement; [4 max].)*
    higher (hydrostatic) pressure in blood than tissue fluid;
    plasma from capillaries to tissue fluid;
    plasma / interstitial / tissue fluid contains small proteins / dissolved substance / no
    red blood cells / no large proteins;
    interstitial / tissue fluids move into lymph ducts / lymphatics;
    lymph is excess tissue fluid that is not reabsorbed by capillaries;
    lymph absorbs fat in small intestine / microvilli;
    lymph nodes store / clone lymphocytes in immune reaction; *[4 max]*

  (b) *([1] for each of the following combinations of structure **and** function, or any other*
    correct combination; [6 max].)
    definition of an exocrine gland;
    drawing with a labelled secretory cell;
    much rough endoplasmic reticulum: high production of proteins / enzymes;
    much ribosomes: high production of proteins / enzymes;
    large / active golgi apparatus: processing / packaging of products of exocytosis;
    formation of vesicles on golgi apparatus: transport;
    formation of vesicles on plasma membrane surface: exocytosis (into duct);
    large numbers of mitochondria: energy production;
    high levels of mRNA production: protein formation;
    high levels of amino acids: protein production;
    plasma membrane opens onto duct (of gland): release of products; *[6 max]*