GENETIC DIVERSITY AND ADAPTATION 2 – Mark schemes

Q1.

(a) (So results) can be compared / so measurement is the same each time / because eye is not perfectly round / uniform;

Accept eye opens to different amounts

1

(b) (i) 1. Eye (diameter) is smaller and antennae longer;

2. Antennae detecting touch;

3. Data only refers to shrimps / data may not apply to all animals / only in one area;

The principle here is that candidate has recognised that both features confirm suggestion. Exact wording does not matter.

2 max

(ii) 1. Standard deviation gives a measure of spread / variation;

2. More standard deviations overlap, the less likely it is that differences are real / significant / the more likely they are caused by chance;

Do not accept range

Accept converse.

Although we are looking for the idea of significance, we cannot require this term.

2

(c) (i) Qualitative statement about

difference in size /

difference in variation /

overlap in size;

Quantitative statement about

difference in size /

difference in variation /

overlap in size;

Supported by relevant two sets of figures from graph;;

Note simplistic answer involving a quantitative statement gains 1 mark.

More specific answer involving quantitative information gains 2 marks.

2

(ii) (No) for same body length, antenna are longer / antenna are shorter / some with longer body have short antennae / some with shorter body length have longer antennae;

OR

(Yes) positive correlation in open / in cave;

Habitat not critical as a term.

Must refer to idea of same habitat

Accept description

1

(d) More alleles of each gene / shrimps in open have all the alleles;

Candidates are required to use the information from the table. Must therefore refer to alleles.

1

(e) 1. A small number of shrimps were / went into the cave;

2. All / high proportion of shrimps had allele L;

3. Cave population descended from these / these reproduce;

3

(f) (i) 1. Cross shrimps from two sites / watch courtship;

2. Breed young together / observe mating;

3. Allow 1 mark for any method of improving quality of results e.g. carry out reciprocal crosses / large number of crosses / isolate beforehand;

Other valid equivalent suggestions should be accepted.

(ii) If same species the shrimps would breed, producing fertile young / courtship species specific;

Accept any form of evidence – mating / laying eggs / giving birth to young.

3

[15]

Q2.

(a) Isolation / quarantine / 'kept separate';

Screening / testing (of patients / doctors etc);

Sterilisation of wards / equipment / method to improve hygiene;

Do not allow improve 'hygiene' or 'cleanliness' without named example such as 'washing hands' use of gloves etc.

2 max

(b) May not all be absorbed;

May be broken down / metabolised / excreted quickly;

To kill the microorganisms / bacteria;

Reference to antibiotic resistance;

Reference to becoming 'immune' negates last marking point.

2 max

(c) (i) P;

1

(ii) S;

1

(d) (i) Prevents bias;

Vested interest (of scientists);

Prevents 'placebo' / positive / negative / psychological effects / 'demand characteristics' (in volunteers);

2 max

(ii) Age;

Ethnicity;

Lifestyle;

Body mass;

Health;

Sex of person;

Ignore references to same or different

2 max

(e) Gradual / slight increase followed by rapid / greater increase;

Allow more detailed descriptions which describe similar trend of gradual increase followed by rapid increase.

1

[11]

Q3.

(a) Recognition of same species;

Stimulates release of gametes;

Recognition of mate / opposite gender;

Indication of sexual maturity / fertility;

2 max

(b) (i) Internal fertilisation / fertilisation occurs in pouch / limited area;

Q *The term fertilisation is not required in the answer but must be implied.*

1

(ii) Protection from predators (developing in pouch);

1

(c) (i) Less stress caused to seahorse / quicker / more accurate method / body is curved / head is linear;

Q *Do not accept "easier" unless qualified.*

1

(ii) Head length proportional to body length / or described;

1

(d) Positive correlation between head / body lengths of male and female / female and male with similar head / body lengths pair together;

1

(e) Use line of best fit;

And extrapolate / extend line as required;

2

(f) (Compare) DNA;

Sequence of bases / nucleotides;

Compare same / named protein;

Sequence of amino acids / primary structure;

Immunological evidence – not a mark

Inject (seahorse) protein / serum into animal;

(Obtain) antibodies / serum;

Add protein / serum / plasma from other (seahorse) species;

Amount of precipitate indicates relationship;

***Q** The marks awarded for reference to DNA and sequence of bases / nucleotides must be in a different context to DNA hybridisation.*

6 max

[15]

Q4.

(a) (i) Faster / greater / more effective response in children;

Do not accept children have more haemoglobin

1

(ii) Use line of best fit;

1

Extrapolate / extend line (and read from graph);

Allow calculation using rate of increase per day = one mark. However for both marks this must be linked to line of best fit.

1

(iii) More than one polypeptide chain;

Allow many polypeptide chains.

'Haemoglobin has four polypeptide chains' must be in correct context to gain mark.

1

(b) (i) Has same water potential;

Allow converse for effect of using distilled water or a concentrated solution.

1

No (net) water movement / osmosis;

1

Cells will not swell / burst / change size;

No osmotic lysis = two marks

1

(ii) Pernicious anaemia (cells) greater range / spread / variation of diameters / widths;

Some pernicious anaemia (cells) wider than 9 (μm) / some less than 5.5 (μm) / without pernicious anaemia none more than 9 (μm) / none less than 5.5 (μm);

Pernicious anaemia (cells) peak / most frequent at 8.5 (μm) / peak / most frequent at higher diameter / / without pernicious anaemia peak / most frequent at 7 (μm) / peaks at lower diameter;

There are several alternatives for marking points 2 and 3

2 max

[9]

Q5.

(a) (i) to ensure that no unwanted bacteria will be present;

1

(ii) to check that bacteria cells do not die anyway / to show water / solvent has no effect on growth;

1

(b) some bacteria are resistant / some areas of dish have no antibiotic / antibiotic not spread evenly;

1

[3]

Q6.

(a) group of organisms with similar features;
can (interbreed to) produce fertile offspring;

2

(b) directional selection;
any TWO from
selection against one extreme / for one extreme;
against broadest beaks in B and narrowest beaks in **A** / for narrowest in **B** and broadest in **A**;
whole distribution / range / mean / mode / median is shifted towards favoured extreme;

3 max

[5]

Q7.

(a) Excitation of chlorophyll molecule / electrons / energy of (pairs of) electrons raised to higher energy level;

Electron(s) emitted from chlorophyll molecule;

Electron(s) to electron transport chain;

Loss of energy by electron(s) along electron transport chain;

Energy lost by electron(s) is used to synthesise ATP;

From ADP + Pi;

"By electrons" need not be stated in each marking point if it

can be reasonably inferred that the candidate is referring to electrons

max 5

(b) Little green light reaches bottom as absorbed by surface dwellers / water;
Red and blue not absorbed and so penetrate;
Variation in pigments of sediment dwellers;
Bacteria with chlorophyll at an advantage as chlorophyll absorbs red and blue;
(Survive to) reproduce in greater numbers and pass on advantageous alleles / genes in greater numbers / increase in frequency of advantageous alleles in subsequent generations;
Increase in frequency / numbers of bacteria with chlorophyll;

6

[11]

Q8.

(a) 1. frequent use of antibiotic creates selection pressure / antibiotic kills bacteria;
2. bacteria with mutation / resistance have (selective) advantage over others / described;
3. (survive to) reproduce more than other types pass on advantageous allele / mutated allele in greater numbers;
4. frequency of (advantageous) allele increases in subsequent generations;
(penalise use of "gene" instead of allele once only)
5. frequency of resistant types increases in subsequent generations;

5

(b) correct answer = 0.18;
And three marks for three of:
$p + q = 1$ and $p^2 + 2pq + q^2 = 1$;
$0.01 = q^2$;
$q = 0.1$;
$p = 0.9$
frequency of heterozygotes = $2pq = 2 \times 0.1 \times 0.9$ / 2 × candidates p × candidates q;

4 max

[9]

Q9.

(a) (i) Continuous variation – range of values / not discrete categories / many categories / no gaps;

1

(ii) Crossing over / chiasmata;
Random segregation / independent assortment;
In meiosis I and meiosis II;

max 2

(b) Range influenced by single 'outlier' (*accept anomaly*) / converse for S.D.;
S.D. shows dispersion / spread about mean / range only shows highest and lowest values / extremes;
Or
S.D. allows statistical use;
Tests whether or not differences are significant;

max 2

[4]

Q10.

(a) 1. Occurs in an unchanging environment;

1

+

2. Selection against extremes / selection for the mean / mean / median / mode unaltered
3. Range / S.D is reduced
4. Increasing proportion of populations becomes well adapted to environment;

4

(b) 1. All plants are acyanogenic below –4 °C and (most) cyanogenic above +10 °C;
2. Cyanogenic plants' cells freeze below –4°;
3. Releasing cyanide (into their own tissues) / damaging / killing plants / disrupting metabolism;
4. Selective advantage not to produce cyanide at –4 °C;
5. Slugs present at higher temperatures / not usually present / inactive at lower temperatures and cyanide production kills / deters slugs;

5

[10]

Q11.

(a) breed together;
if fertile offspring, then same species;

2

(b) <u>isolation</u> of two populations;
variation already present due to mutations;

different environmental conditions / selection pressures leading to selection of different features and hence different alleles;
different frequency of alleles;
separate gene pools / no interbreeding;

4

(c) selection of mate dependent on colour pattern;
prevents interbreeding / keeps gene pools separate;

2

[8]

Q12.

(a) (i) <u>EITHER:</u> Correct answer: 3.45 / 3.44 / 3.4 = 2 marks
<u>OR:</u> Understanding of ∑n(n-1) / use of 134 / (2 + 90 + 12 + 30)
+ wrong answer = 1 mark

max 2

(ii) Takes account of number of individuals / abundance / population size (as well as number of species);

1

(b) The species at A / *F.spiralis* loses less water / loses water less rapidly / loses less mass;

The species at A / *F.spiralis* better adapted to / can survive where exposed for longer / to drier conditions;

The species at A / *F.spiralis* avoids competition For named aspect – e.g. light / substratum / space / CO_2;

ACCEPT converse argument re. F. serratus

3

[6]

Q13.

(a) Tapes / string / axes laid out at right angles / grid area;
Method of obtaining random co-ordinates;
Do not allow "Use random number generator"

2

(b) (i) Decrease then remain constant;
From 200 cm / over 150 cm;

2

(ii) Oxygen decreasing because soil becomes more compacted / not replaced;
Decrease in oxygen leads to fewer aerobes surviving;

2

(c) Anaerobic bacteria replace aerobic as oxygen decreased by aerobic bacteria;
Remove competition;
Aerobic bacteria no longer able to survive in these conditions;

3

(d) (i) Near the surface / in top 50 cm;
Table shows decrease with time at greater depths;

2

(ii) Decrease;
Fewer aerobic bacteria with depth;
Oxygen concentration decreases / less oxygen at depth;

3

(e) Probability greater than 95% / 0.95;
Results are not due to chance / results are significant;
Because bars do not overlap;

3

(f) Plot as graph;
Draw line of best fit;
Read off appropriate value;

3

[20]

Q14.

(a) greater environmental influence than genetic;

1

(b) identical twins have same genotype / converse for non-identical;
compare identical and non-identical twins / identical twins who have been separated / non-identical twins in same environment;
if genetic - similarity between identical twins / converse;
large sample required / use a statistical test;

4

[5]

Q15.

(a) mitosis;
genetically / genes / genotype identical;

(reject same genes)

(ignore references to asexual reproduction)

2

(b) (different)
environmental conditions / named environmental factor / mutation;

1

(c) dispersal / prevent overcrowding / competition / colonise ;
increased number of (proven) offspring; *(not quicker)*

2

[5]

Q16.

(a) sections of chromatids exchanged;
sections have different alleles;
new combinations of (linked) alleles;

(allow 1 mark for idea that 'genes' are exchanged, if no other marks gained)

3

(b) (i) length controlled by many genes / polygenes;
each gene may have different alleles / idea of additive effects;
OR
environmental factors / or named factor;
how named factor may affect growth of seeds;

2 max

(ii) 1. selection of large seeds for sowing;
2. higher proportion of alleles for long length / loss of alleles for short seeds from population;
3. (possible appearance of) new alleles through mutation;
4. process repeated over many generations;

(G - allow 1 mark idea for that 'largeness' selected, survives and inherited)

4

[9]

QWC 1

Q17.

(a) description of interspecific competition / competition between <u>species</u> / birds with beaks of different lengths;
link <u>length</u> of beaks to different <u>positions</u> of prey / reference to named bird with particular prey e.g. curlews with longer beaks able to feed on ragworms;

2

(b) variation in beak length in curlews / one species;
longer / more curved beaked curlews outcompete / at advantage / suggested advantage e.g. larger / curled beaks access more food;
reproduction;
genes passed on (to offspring);

4

(c) body has lower water potential;

water diffuses along a water potential gradient / by osmosis;

2

[8]

Q18.

(a) To sterilise/kill bacteria;
So that only one kind of bacteria present on agar plate/to prevent contamination (by bacteria);

2

(b) Clear zone / inhibition zone is where bacteria have not grown/been inhibited/killed;
Antibiotic diffuses out of paper disc/into agar;
Bacterium **A** inhibited/killed by tetracycline/tetracycline has little effect on bacterium **B**;
Bacterium **B** inhibited/killed by penicillin/bacterium **A** resistant to penicillin;
Both kinds of bacteria resistant to streptomycin;

Q *Ignore references to 'immune'*

4 max

[6]

Q19.

(a) Hydrolysis;

Accept breaking of peptide bonds

1

(b) Adding fluorine changes shape/different shape from other proteins;
Do not fit active site (of protease);
Induced fit not produced;

2 max

(c) (i) Suitable example;
e.g. Flaming spreader/ use lid of Petri dish as umbrella/ clean bench with disinfectant/ sterilise agar in autoclave;

Ignore references to wearing gloves, unless suitably qualified and unqualified references to 'clean'

1

(ii) All the AMPs killed/inhibited the bacteria/AMPs with fluorine more effective than frog AMP;
Not All fluorine AMPs are equally effective;
Diameter/area of clear zone indicates effectiveness;
Only used one kind of bacterium/need to repeat using other bacteria;
Need to repeat the investigation/only one plate used;
Credit suitable measurements or calculations;

3 max

[7]