A-Level Biology

Genetic Diversity and Natural Selection

Mark Scheme

Time available: 62 minutes
Marks available: 54 marks

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1.

(a) 1. Different primary structure/amino acid sequence;

2. Different tertiary structure/shape of active site;

3. Enzyme-substrate complexes more likely (with enzyme from AD^F allele);

Accept converse for AD^S

Accept is more complementary

3

(b) Avoids bias

OR

Results (likely to be) reliable/repeatable;

1

(c) 1. Flies with AD^F/allele have selective advantage (in presence of alcohol);

Accept converse for AD^S

Accept description of selective advantage

2. So insects (with AD^F more likely to) reproduce;

3. Pass on ADF (allele/gene);

4. (So) allele frequency increases;

4

(d) Answer = Directional selection

1

[9]

2. (a) Histogram

1. Linear scale for *y* axis;
2. Linear scale for *x* axis;
3. Correct bar widths **and** touching;
4. All bar heights plotted accurately;

OR

Bar chart accept for 3 marks,

5. Linear scale for *y* axis;
6. Labelled bars of equal width **and** not touching;
7. All bar heights plotted accurately;

OR

Graph accept for 2 marks,

8. Linear scale for *y* axis;
9. All co-ordinates plotted accurately for frequency density;

Reject answers where data for frequency density and birth mass not used

4

(b) Correct answer for **2 marks** = 20 000;;

Accept for 1 mark, rearranged equation (eg number of babies = frequency density × range of mass)

2

(c) 1. Survival increases as the birth mass increases;

2. Survival decreases with smoking;
3. Effect of smoking (on number) similar at all birth masses;

3

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3.

(a) **Type of selection**

1. Directional;

Reason:

2. One extreme selected/removed/favoured/chosen
OR
One extreme allowed to breed;

Ignore references to adaptations/natural selection

Accept large fish/small fish for 'extreme'

2

(b) 1. As a baseline/control;

2. To show effect of no selection
OR
To show what happens in a normal population/naturally
OR
To show effect of/compare with tank A/tank C;

Ignore reference to type of selection

Accept not removing/not catching/not fishing for 'selection'

Accept genetic drift for 'no selection'

Accept no fishing/no selection/no caught fish for 'normal population'

Accept to compare with other results

2

(c) Correct answer for 2 marks

(How much greater) 1.6 to 1.7;;

Accept for 1 mark,
1.2 : 1 **and** 2 : 1

Accept for 1 mark,
4.1 : 3.4 **and** 4.8 : 2.4

Accept $\frac{5}{3}$ *for 2 marks*

2

(d) **Not supported because**

1. (Sea) fishing reduces (mean) mass of fish;

2. Because large fish removed
OR
Because small fish escape/put back
OR
Because fishing (model) like Tank C;

But

3. Information from (only) one species
OR
Sea fishing catches other/different (types of) species;

4. No statistical test;

5. Size of tank may affect fish growth;

6. Fish in tanks are all same age/sea fish not all the same age;

7. No measure of number of fish (removed)/ only measured mean mass
OR
No measure of (total) yield of fish
OR
No measure of reproductive success of fish;

8. Removal of 90% of population is unlikely to be replicated in the sea fishing;

9. Sea fish do not have life cycle of one year
OR
Sea fish do not reproduce all at the same time;

2 max for "But"

3 max

[9]

4.

(a) Locus;

Accept: loci

1

(b) Differences in DNA / differences in base sequence of DNA;

Accept: number of different alleles / size/variation in gene pool

Reject: genes

1

(c)
1. Jack Russell (genetic) diversity is (significantly) greatest;
2. Bull terrier (genetic) diversity is (significantly) smallest / is most inbred;
3. Miniature terrier and Airedale terriers are similar;

1-3: do not credit just a list of values

4. Standard deviations do not overlap / do overlap with correct ref to significance;

Reference to significance must be relevant to examples given

Max 3

(d)
1. (Bull terrier) breeding has included a genetic bottleneck/ small population/more inbreeding/ greater selection (pressure);

Accept: founder effect

2. Reduced number of different alleles/size of gene pool;

Reject: decrease in number of genes

Ignore ref to mutations

OR

3. Miniature (terrier) breeding has included more outbreeding/less selection (pressure);
4. Increased number of different alleles/larger gene pool/more variety of alleles;

Reject if genes used instead of alleles

Reject: lower frequency of alleles

Ignore ref to mutations

2

[7]

5. (a) 2 of the following pairs:

Mark for explanation must be paired with correct change in structure

1. Larger leaves;

2. Photosynthesis;

OR

Accept converse descriptions of leaves, root and stem: longer root, taller stem, smaller leaves

3. Larger / bigger / thicker root;

4. Storage;

OR

5. Stem shorter / absent;

Accept converse correct explanation

6. Less energy used in stem growth / more energy for producing sugar;

4 max

(b) Beet ready quicker / less time required / allows land to be used again / harvested earlier;

Allow more crops / many harvests. Ignore references to yield / profit

1

(c) 1. (Diversity) reduced / fewer different alleles / less variation / smaller gene pool;

2. As <u>alleles</u> have been chosen / rejected;

2

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6. (a) Difference in DNA / base sequence / difference in alleles / genes / gene pool;

Neutral: 'fewer alleles' unless qualified e.g. fewer different alleles.

1

(b) Environmental;

Accept: Environment

1

(c) Reduced (genetic diversity);

As fewer different / varied alleles / genes / reduced gene pool;

2

[4]

7. (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]