Natural and Artificial Selection

Mark Scheme 5

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Selection and evolution
Sub Topic	Natural and artificial selection
Booklet	Theory
Paper Type	Mark Scheme 5

Time Allowed :   **59   minutes**

Score   :   **/ 49**

Percentage :   **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a** random / spontaneous **;**

    <u>mutation</u> **;**

    base / nucleotide / triplet, change / substitution **; R** addition / deletion   2]

  (b) (i) as altitude increases frequency of A^0 increases **; ora** for A^1

        A^0 more frequent at high altitudes / A^1 more frequent at low altitudes / intermediate frequency of either allele at intermediate altitude **;**   [2]

    (ii) *idea of* (pre-existing) genetic variation in deer mouse population **;**

        at high altitude mice with, glycine / A^0, more likely to survive / have selective advantage **; ora**

        mice (with A^0) reproduce (at high altitude) **; ora**

        and pass on the A^0 allele **; ora**

        partial pressure / concentration, of O_2 acts as a selection pressure **;**

        ref. to disadvantage of haemoglobin with very high affinity at low altitude **;**

        as less able to unload oxygen (in respiring tissues) **;**   [max 4]

                                          [Total:8]

2	**(a)**		parental genotypes ; e.g. AaBb x AaBb gametes ; correct use of punnett square ; F1 genotypes ; F1 phenotypes ; (must link to genotypes) yellow and sphere $\frac{1}{16}$;	**[6]**
	(b)	**(i)**	contract / die from, malaria ;	**[1]**
		(ii)	contract / die from, sickle-cell anaemia ;	**[1]**
	(c)		resistant to malaria ; detail ; more likely to survive ; and reproduce ; pass on sickle-cell allele ;	**[3 max]**
				[Total: 11]

3 **(a (i)** 1. coelacanth α chain has higher percentage of matches ;

2. with both adult and larval amphibians

3. coelacanth β chain has higher percentage of matches with larval amphibians (rather than adults) ;

4. figures to support mp1 or mp3 or mp6 (comparing coelacanth with lungfish

5. supports closer relationship of coelacanth and amphibia

6. (but) lungfis β chain has higher percentage of matches with adult amphibian (than coelacanths) ;

7. does not support suggestion / supports closer relationship lungfish and amphibia

[max 4]

(ii) 1. larvae aquatic **and** adults (partly) terrestrial / AW ;

2. different oxygen concentration available

3. need haemoglobins with different oxygen affinities   [max 2]

(b) (i) 1. idea of, unchanging / constant, environment ;

2. oxygen concentration acts as a selective agent

3. organisms best adapted to these conditions survive   ora

4. extreme (phenotypes) selected against

5. ref. narrow range of genetic variation / allele frequency maintained

6. sketch graph

7. ref. mutation   [max 3]

(ii) 1. ref. change in oxygen concentration ;

2. (low) oxygen concentration acts as selective agent

3. some individuals (in population) are better adapted

4. these are more likely to survive   ora

5. <u>directional selection</u>

6. sketch graph

7. populations develop in different concentrations of oxygen

8. <u>disruptive selection</u>

9. sketch graph

allow either mp6 or mp9 but not both   [max 3]

(c) 1. (same) species separated into separate populations ;

2. (by) geographical isolation / named example

3. prevents interbreeding between populations / no gene flow

4. ref. to different selection pressures

5. change in allele frequencies

6. eventually do not successfully interbreed

7. <u>allopatric speciation</u> ;

8. ref. to genetic drift / founder effect / different mutations / (different) new alleles   [max 3]

[Total: 15]

4 **(a)** 1 occur during <u>meiosis I</u> ;
   crossing over
2 between non-sister chromatids ;
3 of, (a pair of) homologous chromosomes / a bivalent ;
4 in <u>prophase 1</u> ;
5 at chiasma(ta) ;
6 exchange of genetic material / AW ;
   ***R** genes unqualified*
7 <u>linkage groups</u> broken / AW ;
8 new combination of <u>alleles</u> (within each chromosome) ;
   independent assortment
9 of homologous chromosomes pairs / bivalents ;
10 each pair lines up independently of others ;
11 line up on equator ;
12 (during) <u>metaphase 1</u> ;
13 results in gametes that are genetically unique / AW ;   [9 max]

(b)

	artificial selection		*natural selection*
14	selection (pressure by) humans	**or**	environmental selection pressure ;
15	genetic diversity lowered	**or**	genetic diversity remains high ;
16	inbreedin common	**or**	outbreeding common ;
17	loss of vigour / inbreeding depression	**or**	increased vigour / less chance of inbreeding depression ;
18	increased homozygosity / decreased heterozygosity	**or**	decreased homozygosity / increased heterozygosity ;
19	no isolation mechanisms operating	**or**	isolation mechanisms do operate ;
20	(usually faster	**or**	(usually) slower ;
21	selected feature for human benefit	**or**	selected feature for organism's benefit ;
22	not for, survival / evolution	**or**	promotes, survival / evolution ;

[6 max]

[Total: 15]