

## Mark schemes

- (a) (No – no mark)

**1**

Graph / bar chart only shows number of species, not the name of the species.

1

- (b) (No – no mark)

1. Mutations are spontaneous / random;
2. Only the rate of mutation is affected by environment;
3. Different species do not interbreed / do not produce fertile offspring;
4. So mutation / gene / allele cannot be passed from one species to another.

*Ignore references to correlation does not prove causation*

4

- (c)
1. Initially one / few insects with favourable mutation / allele;
  2. Individuals with (favourable) mutation / allele will have more offspring;
  3. Takes many generations for (favourable) mutation / allele to become the most common allele (of this gene).

3

- [8] (a) 1. No interbreeding / gene pools are separate / geographic(al) isolation;

**2**

*Accept: reproductive isolation as an alternative to no interbreeding.*

2. Mutation linked to (different) markings/colours;
3. Selection/survival linked to (different) markings/colours;
4. Adapted organisms breed / differential reproductive success;

*Note: 'passed on to offspring' on its own is not sufficient for reproduction.*

5. Change/increase in allele frequency/frequencies;

5

- (b) 1. (Compare DNA) base sequence / base pairing / (DNA) hybridisation;

*Ignore: compare chromosomes / 'genetic make-up'.*

*Accept: (compare) genes / introns / exons.*

*Note: reference to **only** comparing alleles is 1 max.*

2. Different in six (species) / different in different species / similar in three (subspecies) / similar in same species/subspecies;

*Ignore: compare chromosomes / 'genetic make-up'.*

*Reject: 'same alleles/ same DNA bases in three species/subspecies'.*

*Note: mark point 2 can be awarded without mark point 1.*

2

[7]

- (a) 0.32.

**3**

Correct answer = 2 marks

Accept 32% for 1 mark max

Incorrect answer but identifying 2pq as heterozygous = 1 mark

2

- (b) 1. Mutation produced *KDR minus* / resistance allele;  
2. DDT use provides selection pressure;  
3. Mosquitoes with *KDR minus* allele more likely (to survive) to reproduce; 4.  
Leading to increase in *KDR minus* allele in population.

4

- (c) 1. Neurones remain depolarised;  
2. So no action potentials / no impulse transmission.

2

- (d) 1. (Mutation) changes shape of sodium ion channel (protein) / of receptor(protein);  
2. DDT no longer complementary / no longer able to bind.

2

[10] (a) 1. Geographic(al) isolation;

4

2. Separate gene pools / no interbreeding / gene flow (between populations);

*Accept: reproductive isolation*

*This mark should only be awarded in context of during the process of speciation. Do not credit if context is after speciation has occurred.*

3. Variation due to mutation;  
4. Different selection pressures / different abiotic / biotic conditions / environments / habitats;

*Neutral: different conditions / climates if not qualified*

*Accept: named abiotic / biotic conditions*

5. Different(ial) reproductive success / selected organisms (survive and) reproduce;

*Accept: pass on alleles / genes to next generation as equivalent to reproduce*

6. Leads to change / increase in allele frequency.

*Accept: increase in proportion / percentage as equivalent to frequency*

6

- (b) 1. Capture / collect sample, mark and release;  
2. Method of marking does not harm lizard / make it more visible to predators;  
3. Leave sufficient time for lizards to (randomly) distribute (on island) before collecting a second sample;  
4. (Population =) number in first sample × number in second sample divided by number of marked lizards in second sample / number recaptured.

4

- (c) 1. High concentration of / increase in carbon dioxide linked with respiration at night / in darkness;
2. No photosynthesis in dark / night / photosynthesis only in light / day; *Neutral: less photosynthesis*
3. In light net uptake of carbon dioxide / use more carbon dioxide than produced / (rate of) photosynthesis greater than rate of respiration;
4. Decrease in carbon dioxide concentration with height;  
*More carbon dioxide absorbed higher up*  
*Accept: less carbon dioxide higher up / more carbon dioxide lower down*
5. (At ground level) less photosynthesis / less photosynthesising tissue / more respiration / more micro-organisms / micro-organisms produce carbon dioxide.  
*Neutral: less leaves unqualified or reference to animals*

5

[15] (a) 1. Allows (valid) comparison;

5

2. Number / sample size may vary;

2

- (b) 1. Increased chance of (severe malaria) with blood group A / decreased chance of (severe malaria) with sickle cell;  
*Accept: converse for mild malaria i.e. increased chance of mild malaria with sickle cell / decreased chance of mild malaria with blood group A.*  
*Accept: if answer is comparative e.g. greatest risk of severe malaria with blood group A.*

2. One mark for one of the following:

almost equal chance with blood group O / slightly greater chance of mild malaria with O / slightly lower chance of severe malaria with O / 2.5 x / 2.48 x / more than twice the chance of severe with blood group A / (almost) 50% / half the chance of severe malaria with sickle cell / twice the chance of mild malaria with sickle cell;

*Neutral: answers which only refer to or use ratios.*

2

- (c) 1. Individuals with the **Hb<sup>C</sup>** (allele) reproduce;
2. Pass on **Hb<sup>C</sup>** (allele) which increases in frequency;
3. **Hb<sup>A</sup> Hb<sup>A</sup>** individuals less likely to survive / reproduce / frequency of **Hb<sup>A</sup>** (allele) decreases;

3

[7]



6

- (i) 1. Identical twins show genetic influence / differences between

them show environmental influence;

*Neutral: allows a comparison*

*It must be clear which set of twins is being referred to*

2. Non-identical twins (also) show an environmental / non-genetic influence;

*It must be clear which set of twins is being referred to*

*Do not credit repetition of bullet points in stem*

2

- (ii) Genes play a greater role / environment plays a lesser role;

*Must be comparative*

*Neutral: genes are involved*

*Neutral: involves genes and the environment*

1

- (iii) Any suitable suggestion for a maximum of two marks e.g.:

*Neutral: 'environment' as in question stem*

*Neutral: unqualified ideas such as health / lifestyle*

1. Age;
2. Sex (non-identical twins);
3. Family / medical history (of mental illness);
4. No use of recreational drugs;
5. Ethnic origins;

2 max

[6]

7

- (a) 1. Chlorophyll absorbs light energy;

*Accept light energy 'hits' chlorophyll*

*Accept photon for light energy*

2. Excites electrons / electrons removed (from chlorophyll); *Accept higher energy level as 'excites'*
3. Electrons move along carriers / electron transport chain releasing energy;



*Accept movement of  $H^+$  / protons across membrane releases energy*

4. Energy used to join ADP and Pi to form ATP;  
*Negate 'produces energy' for either mark but not for both*  
*Accept energy used for phosphorylation of ADP to ATP*  
*Do not accept P as Pi*
5. Photolysis of water produces protons, electrons and oxygen;  
*3. and 4.*
6. NADP reduced by electrons / electrons and protons / hydrogen;  
*Accept NADP to NADPH (or equivalent) by addition of electrons / hydrogen*  
*Do not accept NADP reduced by protons on their own*

5 max

- (b)
1. Variation / variety;
  2. Mutation;  
*Do not accept answers which suggest the mutation is caused by copper*
  3. Some plants have allele to survive / grow / live in high concentration of copper / polluted soils;  
*Reference to immunity disqualifies this mark*  
*Do not disqualify mark for references to allele providing resistance to copper*
  4. (Differential) reproductive success / adapted organisms reproduce;
  5. Increase in frequency of allele;
  6. No interbreeding (with other populations) / separate gene pool / gene pool differs (from other populations);  
*Accept reproductive isolation*

5 max

[10]

- (a) All the fish / all the species / all the populations / all the organisms;

8

*Must indicate all / every species.*



*Reject answers that suggest other fish / organisms might be present.*

1

- (b) (i) 1. Capture sample, mark and release;
2. Appropriate method of marking suggested / method of marking does not harm fish;  
*E.g. Cutting a fin / attaching a tag / paint / marker.*
3. Take second sample and count marked organisms;  
*May be awarded from equation if not given here.*

$$\text{Population} = \frac{\text{No in sample}_1 \times \text{No in sample}_2}{\text{Number marked in sample}_2};$$

4.

*Accept any valid alternative to equation or answer expressed as a ratio.*

3 max

- (ii) One suitable reason;

*Accept other valid answers, which must, however, relate to breeding / only works if population constant.*

*E.g. population increases / changes (between first and second sample)*

1

- (c) 1. With different mouth eats different food / has different way of feeding / specific mouth shape for specific food;  
*Catches more food and gas exchange are neutral*
2. Competition between species / interspecific competition is reduced;  
*Reject intraspecific*

2

[7] (a) (i) Non-living / physical / chemical factor / non biological;

9

*Do not accept named factor unless general answer given.*

1

- (ii) Accept an abiotic factor that may limit photosynthesis / growth;

*Reject altitude / height*

Water

Named soil factor

*Not "soil" / "weather"*

Light

Carbon dioxide

*Accept Oxygen*

Incline / aspect

Wind / wind speed

1

- (b) 1. Correct explanation for differences between day and night e.g. photosynthesis only during the daytime / no photosynthesis / only respiration at night;

2. Net carbon dioxide uptake during the day / in light

**OR**

No carbon dioxide taken up at night / in dark / carbon dioxide released at night / in dark;

3. At ground level more respiration / in leaves more photosynthesis;

4. Carbon dioxide produced at ground level / carbon dioxide taken up in leaves;

*Principles*

***Comparing day and night / light and dark***

*1. Explanation in terms of photosynthesis / respiration*

*2. Effect on carbon dioxide production / uptake*

***Comparing leaves with ground level***

*3. Explanation in terms of photosynthesis / respiration*

*4. Effect on carbon dioxide production / uptake*

*2 and 4 must relate to why the change occurs*

4

- (c) 1. Variation in original colonisers / mutations took place;

2. Some better (adapted for) survival (in mountains);

2. *Allow "advantage so able to survive"*

3. Greater reproductive success;

4. Allele frequencies change;

*4. Reject gene / genotype*

3 max

[9]

10

- (a) (i) Two marks for correct answer of 4;;

One mark for calculation involving  $0.2 \times 0.2$  or 0.04;

2

- (ii) 0.2 / the frequency remains the same;

*Reject if wrong frequency is quoted*

1

- (b) (i) 1. There is a probability of 5% / 0.05;

2. That difference in frequencies / difference in results are due to chance;

*Accept 95% probability changes in frequencies not different as a result of chance*

2

- (ii) 1. Directional;

2. The recessive allele confers disadvantage / the dominant allele confers advantage / more likely to survive / reproduce;

*Assume "it" to refer to the recessive allele*

*2. References to selection do not gain credit as the term is in the question. Allow reference to phenotype / enzyme functionality (instead of allele) when describing advantage / disadvantage.*

2

- [7] (a) (i) Antibiotics kill other bacteria / *Clostridium* is resistant;

11

Less / no competition so (*Clostridium*)

reproduces / replicates / multiplies / increases in number;

*Reference to bacteria being 'immune' negates first marking point.*

*Reference to mitosis negates second marking point.*

2

- (ii) Immune system less effective / more likely to have other infections / been in hospital;

*Accept: 'Weak / lower' immune system'.*

1

- (b) Attaches to active site (of enzyme);

(Methicillin) is a competitive inhibitor / prevents monomers / substrate attaching (to enzyme);

*'Competes for active site' = 2 marks.*

*Neutral: 'Prevents monomers joining / attaching to each other'.*

*Allow one mark max for answers relating to non-competitive inhibitor changing active site / preventing substrate attaching. Do not penalise Methicillin forms an enzyme / substrate complex.*



2

- (c) (i) Have other illness / medical condition / 'weak' immune system / disease /infection;  
*Reject: Due to 'other factors', 'are smokers', 'are obese' unless related to disease or illness.*

1

- (ii) Increase up to 2006 / 20 (per 100 000) then decreases;

1

- (iii) Correct answer in range of 52 – 59.1% = two marks;

Incorrect answer but shows change as between 4.8 – 5.2 / shows correct subtraction giving this change e.g. 14 – 9 = one mark.

2

- [9] (a) Shows mass of wheat seedlings when grown on their own;

12

Allows percentage to be calculated / allows comparison / allows effect of competition to be seen;

2

- (b) 1. Interspecific competition / ryegrass reduces growth of wheat;  
 2. Justification by using values;  
*100% with wheat but less when grown with ryegrass*  
 3. Competition between shoots had a greater effect than competition between roots;  
 4. Justification by use of values;  
*46% when shoots compete / in Y / 76% when roots compete / X*  
*When marking please number marking points*  
*E.g. 4 means a mark awarded for point 4.*

4

- (c) Growth involves enzymes / enzyme-controlled reactions;

Lower temperature means less kinetic energy / fewer collisions / fewer E–S complexes formed;

Wheat and ryegrass affected to a different extent;

*Accept other valid physiological processes such as growth involves diffusion / lower temperature means less kinetic energy / molecules move slower.*

2 max

- [8] (a) Same number of ryegrass seedlings in distilled water;

13

- (b) (i) Produce null hypothesis;

1

Carry out Spearman Rank correlation test / find correlation coefficient;

Use values to show  $P < \text{critical value}$  / find probability of results being due to chance;

*Accept valid example*

*E.g. There is no correlation between inhibition of germination and the concentration of the extract.*

2 max

(ii) May be another factor / named factor (that also inhibits germination);

*e.g. amount of water in extract*

1

(c) (i) Extract inhibits ryegrass germination / extract stops ryegrass starting to grow;

Inhibition of root length / causes ryegrass to have shorter roots;

2

(ii) Scientists crushed plants to get extract;

Plants might not secrete substances in the extract into the soil;

These substances might get broken down in the soil;

Wheat and ryegrass might not grow at the same time / wheat plants might not produce substance when ryegrass is growing;

Concentration of extract in the soil might be different from that in solution;

3 max

[9] (a) 1. (Colonisation by) pioneer (species);

14

2. Change in environment / example of change caused by organisms present;

3. Enables other species to colonise / survive;

4. Change in diversity / biodiversity;

5. Stability increases / less hostile environment;

6. Climax community;

*Example of change e.g. formation of soil / humus / organic matter / increase in nutrients;*

*Do not accept genetic diversity for mark point 4.*

5 max

(b) 1. Geographical isolation;

2. Variation due to mutation;

3. Different environmental / abiotic / biotic conditions / selection pressures;
4. Selection for different / advantageous, features / characteristics / mutation / /allele / differential reproductive success / (selected) organisms survive and reproduce;
5. Leads to change in allele frequency;

*In this question must refer to allele where appropriate, not gene.*

5

[10] (a) Small surface area to volume ratio / more fat;

15

Lose less heat (to the environment) / for insulation when they are sitting on eggs;

2

- (b) (i) The further north / higher the latitude, the higher the percentage (of white snowgeese);

1

- (ii) Snow lying longer / melts slower further north / at greater latitudes;

White geese better camouflaged (further north);

Predation linked to survival / reproductive success;

**Q** *In order to gain the last marking point, candidates must explain how survival or reproductive success is affected.*

3

- (c) Snow melts earlier / snow melts further north / less snow;

White geese decreasing as less well camouflaged / at disadvantage / blue geese increasing as better camouflaged / at an advantage;

2

- (d) (i) Stabilising;

*Do not accept stable*

1

- (ii) Few geese survive at the extremes / most survive from the middle of the range;

1

[10] (a) (i) To cut the DNA;

16

*Reject breakdown, cutting out*

1

- (ii) To separate the (pieces of) DNA;

1

- (b) Complimentary base sequence / complementary DNA; binds to both (haplotypes);

Label would show up in both;

*Idea of complementarity required*

2

(c) (i) Y chromosome inherited / comes from male parents / only found in males;

1

(ii) Mitochondria in egg / female gamete / no mitochondria come from sperm / male gamete;

1

(d) (i) Allows comparison;

Different (sized) areas covered;

2

(ii) Wolves do not eat all of prey animal / do not eat (large) bones / skin;

Inedible parts make up different proportions / wolf eats different proportions;

2

(e) Limited by food / prey; as prey increases so do wolf numbers / positive correlation;

Large range so other factors involved;

2

[12] (a) Kingdom / phylum / class;

17

1

(b) (i) 6;

1

(ii) Family;

1

(iii) The two species of *Mirounga* shared a common ancestor more recently than they did with *Monarchus tropicalis*;

1

(c) Difference in DNA / base sequence / alleles / genes;

1

[5

] (a) Cannot make (active) enzyme A (which converts precursor to linamarin) / cannot make

18 linamarin;

1

(b) (i) **AL** + **Al** + **aL** + **al** ;

1

- (ii) Meiosis separates alleles / homologous chromosomes / pairs of chromosomes;  
Independent assortment / means either of **A** / **a** can go with either of **L** / **l**;  
*Accept "random segregation" but cancel if reference to crossing-over*

2

- (c) From parental genotypes: **AaLl** × **AaLl** (no mark)  
Note: If wrong parental genotypes / wrong gametes: ALLOW correct derivation of offspring genotypes = 1 max

Correct derivation of offspring genotypes; max 2 marks if error in Punnett square

	<b>AL</b>	<b>Al</b>	<b>aL</b>	<b>al</b>
<b>AL</b>	AALL	AALl	AaLL	AaLl
<b>Al</b>	AALl	AaLl	AaLl	Aall
<b>aL</b>	AaLL	AaLl	aaLL	aaLl
<b>al</b>	AaLl	Aall	aaLl	aall

Correct identification of offspring genotypes with at least one **A** and two **l** alleles (= grey cells in above table);

Correct proportion: 3 / 16 / 3:13 / 18.75% ;

3

- (d) (i) There was no (significant) difference in damage between cyanogenic and acyanogenic / being cyanogenic has no effect;
- (ii) The difference (from expected / from chance variation) is significant / difference / results not just due to chance;  
Reject null hypothesis;  
Being cyanogenic does help protect from slug damage;

1

3

- (e) High slug population:
- Find only cyanogenic plants / only cyanogenic plants survive;
  - (Cyanide release) limits / stops feeding by slugs / slugs killed; *Accept: converse argument re. acyanogenic plants*

Low slug population:

- Find both types of plant;
- Less selection pressure on plants from slugs / no selective advantage / no selection / described;

4

[15]

19

- (a) (i) 2;

*Allow 1.75*

1

- (ii)  $30 / 60 \div$  answer to part (i) if incorrect;

*Allow 34(.315)*

1

- (b) Song characteristic of species / differs between species;

Song linked to courtship at night / living underground;

2

- (c) Females not attracted to call of male / does not recognise male;

Because of differences in song;

Necessary precursor to mating;

Hybrids are sterile;

2 max [6]

- (a) Table completed as below:

20

Kingdom	Animalia / Animals
Phylum	Chordata
Class	Mammalia
Order	Rodentia
Family	Caviidae
Genus	<i>Cavia</i>
Species	<i>porcellus</i>

Column 1 correct;

Column 2 correct;

- (b) Mutation occurs;

Correct e.g. of isolating mechanism

e.g.

temporal – different breeding seasons / feeding times /

ecological / behavioural – different courtship displays / different niches / habitats /

feeding areas /

mechanical – mismatch of reproductive parts /

Different selection pressures operate / changes in allele frequency / divergence of gene pools;

(c) Using candidate's symbols for alleles –  
e.g. B = black, b = brown, S = short, s = long:

Gametes correctly derived from candidate's parental genotypes: SB   Sb   SB   sB;

offspring genotypes correct:    SSBB    SsBB    SSBb    SsBb;

4

**1**

21

*"By electrons" need not be stated in each marking point if it can be reasonably inferred that the candidate is referring to electrons*

(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] (a) 1. frequent use of antibiotic creates selection pressure / antibiotic kills bacteria;

22

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 =  $2pq = 2 \times 0.1 \times 0.9 / 2 \times$  candidates  $p \times$  candidates  $q$ ;

4 max

[9] (a) (i) Continuous variation – range of values / not discrete categories / many

23 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]

- (a) principle of intraspecific competition;

24

for amount of food available;  
more energy needed to find food / less energy to produce eggs;



OR

number of territories;  
more energy spent fighting / defending territory;

OR

availability as prey;  
predators spend less time searching for nests;

2 max

- (b) (i) age of bird - young or old birds produce fewer eggs; time of breeding - early or late breeding less food available / temperature effect; genotype - variation in genetic ability to produce eggs; quality of territory - description of some relevant resource in territory;  
*(reject food as resource in territory if given in(a))*  
predation of eggs - lays more to replace eaten eggs;

1 max

- (ii) when high number of eggs, each individual young will receive less food; reference to mortality rates to disease / predators for low numbers of eggs; so in both cases low number of offspring will reach maturity / survive; so less likely to pass on genes / alleles;

3

[6] (a) 1 4 year cycles;

25

- 2 predator / stoat peaks after prey / lemming;  
3 lemmings increase due to low numbers of stoats / available food;  
4 more food for stoats so numbers increase;  
5 increased predation reduces number of lemmings;  
6 number of stoats decreases due to lack of food / starvation;

6

- (b) smaller populations have fewer different alleles / more homozygosity / less heterozygosity / smaller gene pool / lower genetic variability; migrants bring in new alleles / increase gene pool;

2

- (c) geographical isolation of populations; variation present in population(s); different environmental conditions / different selection pressures / different phenotypes selected;  
change in genetic constitution of populations / gene pools / allele frequency;

4

[12]

- (a) colder / below 0°C (January) areas, cyanogenic plants die in this cold / acyanogenic

**26**

survive; non-cyanogenic allele / gene passed on more often / its frequency increases; warmer (January) areas cyanogenic plants at advantage, because of less herbivore selection pressure / feeding; so cyanogenic survive more often to pass on cyanogenic allele / gene.

4 max

- (b) large (and equal) number of quadrats in each area; *(reject several)* random sampling method, described; *(accept described 'systematic' method)* percentage cover / point hits per quadrat / count plants; mean / average value for each area; statistics test to see if differences significant.

4 max

[8] (a) variation present in (original population);

**27**

(copper) tolerant individuals more likely to survive;  
(these reproduce and) pass on genes (to next generation / offspring);  
more / increase (in frequency) of copper tolerance alleles / genes;

4

- (b) 1. reproductively isolated / no interbreeding (due to different flowering times);  
2. conditions different for two populations / different selection pressures;  
3. different features or plants are selected or survive / different adaptations;  
4. populations become (genetically) different / unable to produce fertile offspring;

4

[8] (a) zooplankton nearer surface at night;

**28**

algae only found at surface;  
photosynthetic;  
no / little light below 30 / 40m;

3

- (b) (i) with increasing time predators have been present in the lake, the greater the depth at which the zooplankton occur during the day;
- (ii) variation in migration behaviour; vertical migration reduces chance of predation / prey can't be seen in low light intensity; those that migrated more likely to reproduce; genes / alleles (for behaviour) passed to next generation; increase in frequency of gene / allele in population;

1

3 max

[7]

(a) breed together;

**29** if fertile offspring, then same species;

2

(b) isolation 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] (a) Genetic (factors)/genes/alleles/mutations/meiosis;

**30**

1

Environmental (factors)/environment;

1

(b) New species form from different populations/groups/gene pools;

1

In different areas/from isolated populations;

*Accept alternatives/descriptions for 'populations'*

1

[4] (a) Formation of new species / reproductive isolation;

**31**

*Ignore ref. to mechanisms involved*

From a population (living in the same area / place) / without geographical isolation;

2

(b) Small shell of T,

*Accept converse statements*

Wave action (greatest) at top of shore;

*Note – pairs of statements – environmental factor; and possible effect on survival;*

Only small snails can get into cracks in rock (to shelter);

Thick shell of M,

More crabs in middle shore;

*No mark for giving differences*

Thicker shelled snails less easy to break open;

**OR**

More rocks in middle shore to be moved by waves;

Thicker shelled snails less easily broken by rocks;

Large opening of T,

More wave action likely to wash snails away;

Larger opening, (suggests) snails with larger foot to hold on with  
less likely to be washed away;

**OR**

Smaller opening of M,

More crabs in middle shore;

Snails with smaller opening harder to get claws into;

**4 max**

- (c) Reproductive isolation required for speciation;

*Accept descriptions of reproductive isolation*

Isolation by male choice / form T males nearly always choose

form T female, so (nearly) reproductively isolated (from form M);

Behavioural isolation / mechanism;

**2 max**

**[8]**