**1** (a) any **three** from:

- parts of organisms have not decayed
  *accept in amber / resin*
  *allow bones are preserved*
- conditions needed for decay are absent
  *accept appropriate examples, eg acidic in bogs / lack of oxygen*
- parts of the organism are replaced by other materials as they decay
  *accept mineralised*
- or other preserved traces of organisms, eg footprints, burrows and rootlet traces
  *allow imprint or marking of organism*

**3**

(b) (i) teeth for biting (prey)
*must give structure + explanation*

**1**

claws to grip (prey)
*accept sensible uses*

**1**

wing / tail for flight to find (prey)

**1**

(ii) any **two** from:

- new predators
- new diseases
- better competitors
- catastrophe eg volcanic eruption, meteor
- changes to environment over geological time
  *accept climate change*
  *allow change in weather*
- prey dies out **or** lack of food
  *allow hunted to extinction*

**2**

**[8]**

**2** (a) (Jean Baptiste) Lamarck
*allow phonetic spelling*

**1**

(b) (snake is) covered in sediment / mud
**or**
sinks into the mud

**1**

(then) the soft parts decay / are eaten
**or**
bones / hard parts do not decay

**1**

(so) minerals enter bones
**or**
bones are replaced by minerals

**1**

(c) **Level 3 (3–4 marks):**
A detailed and coherent explanation is provided. Logical links between clearly identified, relevant points explain how the rat snake evolved through the process of natural selection.

**Level 2 (1–2 marks):**
Simple statements made, but not precisely. The logic is unclear.

**0 marks:**
No relevant content.

**Indicative content**

**statements:**
- there are lots of different colours of snakes
- some shades of green are closer to the colour of the environment (in Japan) than others
- survivors (in each generation) will breed and produce offspring

**explanations:**
- different colours are controlled by different genes / alleles / are caused by mutations
- being green means they are best suited to grassy / green environments
- being green means they are camouflaged
- those that are camouflaged best will be able to catch more food
- those that are camouflaged best will be able to avoid being eaten
- survivors' offspring will inherit the genes / alleles / mutation for the shade of green colouration

**additional examiner guidance:**
- allow converse points relating to the Texas rat snake if they clearly identify the reasons why this snake was at an evolutionary disadvantage, ie more likely to be caught and eaten by a predator
- a good level 2 answer will clearly link survival and breeding to the passing on of the advantageous genes / alleles / mutations and link the idea of colour (AO2) to a correct explanation of its significance for survival

**4**

(d) any **one** from:

- changes to the environment
- new predators
- new diseases
- new (more successful) competitors
- catastrophic event / described event

**1**

**[9]**

**3**

(a) any **two** from:

- most people still believed that God made all the animals / plants on Earth

  *allow against their 'religion'*
- insufficient evidence

  *do not allow no proof / evidence*

  *ignore 'fossil'*
- the mechanism of inheritance / genes unknown (at the time)

**2**

(b) any **four** from:

- finches separated / isolated
- genetic variation / mutation (in finch population(s))
- finches with alleles / genes best suited to their environment survive

  *Do not allow 'characteristics'*
- advantageous alleles / genes passed on (to offspring)
- after many generations / a long time, the populations can no longer successfully interbreed

  *Ignore 'speciation'*

**4**

(c) (i) vegetarian finch

**1**

(ii) **R**

**1**

(iii) mangrove **and** woodpecker finches

**1**

**[9]**

**4**

(a) (i) any **two** from:

- (dead) animal buried in sediment

  *allow imprint in mud*
- hard parts / bones do not decay **or** soft parts do decay

  *allow (one of) the conditions for decay is missing − accept example, eg oxygen / water / correct temperature / bacteria*
- mineralisation (of hard parts / bones)

  *allow replacement by other materials*

**2**

(ii) any **two** from:

- conditions not right for fossilisation
  *ignore references to soft-bodied*
- geological activity has destroyed fossils / has destroyed evidence
  *allow a named / described example − eg vulcanism / earth movements / erosion*
- fossils not yet found
  *allow description of why not yet found*

**2**

(b) any **four** from:

- separation / isolation (of different populations)
- different environmental conditions (between locations)
- mutation(s) occur **or** genetic variation (within each population)
- better adapted survive **or** natural selection occurs
  *allow 'survival of the fittest'*
  *ignore animals adapt to their environment*
  *ignore reference to stronger survive*
- favourable alleles passed on (in each population)
  *allow genes for alleles*
- eventually different populations unable to breed successfully with each other
  *allow unable to produce fertile offspring*

**4**

**[8]**

**5**

(a) selection

**1**

(b) (i) 4

**1**

(ii) ground finch / lives on the ground

**1**

(only) eats seeds
*allow eg eats seeds on / from the ground for **2** marks*

**1**

(c) Lamarck

**1**

**[5]**

**6**

(a) (i) any **two** from:

- trapped / held (since sticky)
- engulfed / covered by resin
  *allow engulfed / covered by amber*
- prevented decay.

**2**

(ii) any **two** from:

- animal / plant (dies and) body covered in sediment / mud

  *ignore ref to rock*

  *allow covered in tar / ice*
- bones / shells / hard parts do not decay
- minerals enter bones / parts are replaced by other materials / mineralisation
- preserved traces / footprints / burrows / rootlet traces / impressions / casts.

**2**

(b) (i) New technology provides more valid evidence.

**1**

(ii) any **three** from:

examples of physical factors, e.g.

*accept 3 physical factors or 3 biological factors or some of each for full marks*

- flooding
- drought
- ice age / temperature change.

*ignore pollution*

examples of biological factors, e.g.

- (new) predators (allow hunters)
- (new) disease / named pathogen
- competition for food
- competition for mates

*competition must be qualified*

- cyclical nature of speciation
- isolation
- lack of habitat or habitat change.

***if no other answers given allow** natural disaster / weather change / catastrophic event / environmental change / climate change for **1** mark*

**3**

**[8]**

**7** (a) reference to interbreeding

**1**

successfully between Island types

*allow ref. to production of fertile offspring*

*allow ref. to DNA analysis / comparison for 1 mark*

*ignore ref. to grey fox*

**1**

(b) (i) (two ancestral populations) separated / isolated (by geographical barrier / sea)

**1**

and genetic variation (in each population) **or** different / new alleles **or** mutations occur

**1**

under different environment / conditions

*allow abiotic or biotic example*

*allow different selection pressures*

1

natural selection occurs **or** better adapted survived to reproduce

1

so (favourable) alleles / genes / mutations passed on (in each population)

*ignore they adapt to their environment*

1

(ii) any **one** from:

- continued to mate with one another
- few beneficial mutations (between island varieties)
- similar conditions on each island so similar adaptations/features fit

1

**[8]**

**8** (a) organisms that reproduce together to form fertile offspring

1

(b) (i) fossils of **P** and **Q** in same stratum / layer / level / height

1

(ii) earlier − fossil in deeper layer / further down

1

(iii) the fossils of animals **S** and **T** have many features in common, but **T** is more complex that **S**

1

the fossil of animal **S** was found in a deeper layer of rock than the fossil of animal **T**

1

(c) (i) **X** has white tail / shorter tail

*allow other points eg **X** has furrier tail / smaller feet / is furrier*

***or***

***W** has sharper claws / **W** has larger claws*

**1**

(ii) two (ancestral) populations separated / isolated (by geographical barrier / by canyon / river)

**1**

genetic variation (in each population) / different alleles / different genotypes / (different) mutation(s)

**1**

different environmental conditions / example described

*allow abiotic or biotic example*

**1**

the better adapted survive / natural selection occurs

*allow survival of the fittest*
*ignore they adapt to the environment*

**1**

so (different / favourable) alleles / genes passed on (in each population)

**1**

eventually two types cannot interbreed successfully

*allow to produce fertile offspring*

**1**

(iii) any **two** from:

- environments similar / described

  *allow example, e.g. similar predator(s) / food / climate*
- therefore similar adaptations / features / phenotypes suit

  *accept suitable named feature*
- original ancestor already well adapted

  *ignore reference to not enough time for evolution.*

**2**

**[14]**

**9** (a) three billion

**1**

(b) mutation(s)

**1**

breed / reproduce

*in this order only*

*allow pass on their genes*

**1**

**[3]**

**10** (a) any **two** from:

- larger / longer / thicker
  *allow examples eg fewer toes **or** bones fused*
- fewer (bones in total)
  *allow smaller surface area touching the ground*
- fewer bones touching the ground

**2**

(b) (i) large(r) surface / area in contact with the ground

**or**

low / less pressure on ground

**1**

(so) less likely to sink into mud / ground

**or**

(so) could run fast(er)
*allow easy / easier to escape predators*

**1**

(ii) variation (in size / number / arrangement of bones)
*allow mutation(s) (in size / number / arrangement of bones)*

**1**

(and) those with large(r) / few(er) bones more suited to running **or** run faster (on harder / drier ground)

**1**

these survive **and** breed
*allow ref to offspring for breed*

**1**

(so) genes / DNA (for larger / fewer bones) passed on
*allow alleles passed on*

**1**

**[8]**