Name: _____

Class: _____

Date: _____

Inheritance, Variation and Evolution part 10 AQA Triple Biology

Time: **80 minutes**

Marks: **78 marks**

Comments:

1. Genetic material is made of DNA.

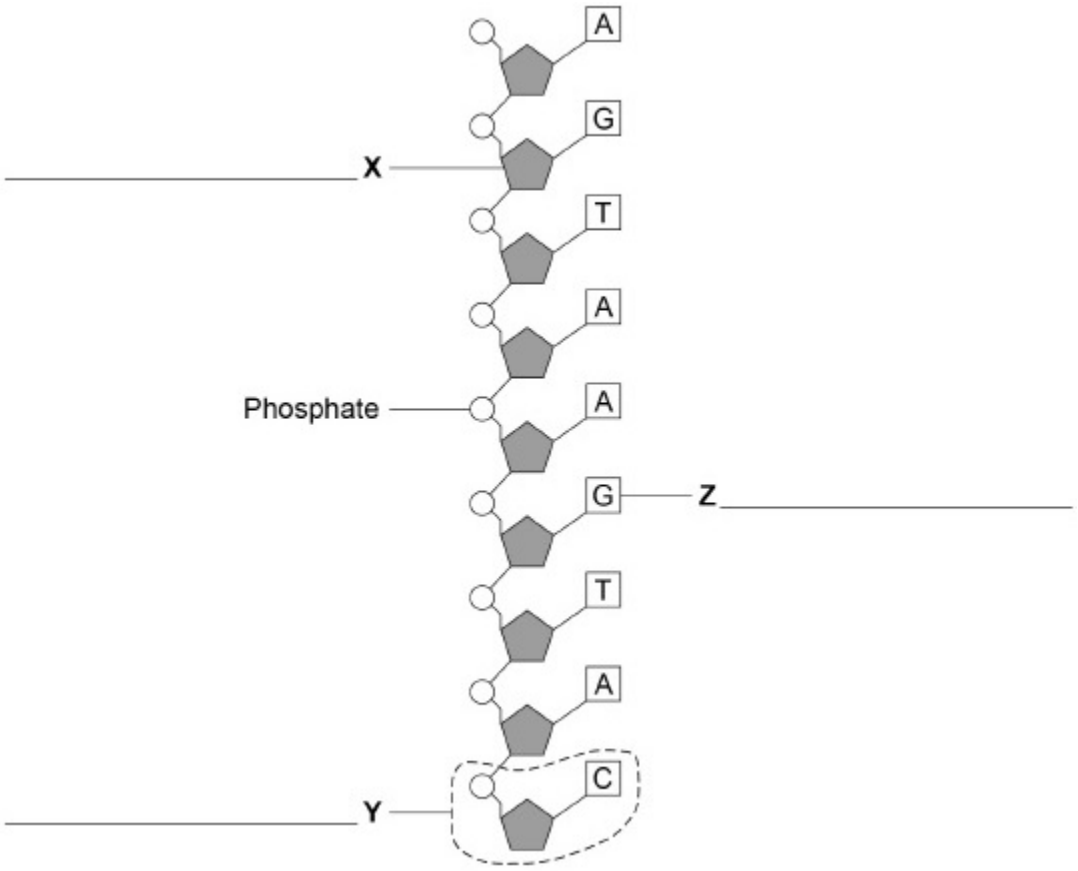
(a) Which structures in the nucleus of a human cell contain DNA?

_____

(1)

Figure 1 shows part of one strand of a DNA molecule.

Figure 1



(b) Label parts **X**, **Y** and **Z** on **Figure 1**.

Choose answers from the box.

Base	**Fatty acid**	**Nucleotide**	**Sugar**	**Glycerol**

(3)

(c) A complete DNA molecule is made of two strands twisted around each other.

What scientific term describes this structure?

_____

(1)

(d) DNA codes for the production of proteins.

A protein molecule is a long chain of amino acids.

How many amino acids could be coded for by the piece of DNA shown in **Figure 1**?

Tick (✓) **one** box.

2 ☐ 3 ☐ 9 ☐ 18 ☐

(1)

(e) Scientists have now studied the whole human genome.

Give **two** benefits of understanding the human genome.

1 _____

_____

2 _____

_____

(2)

(Total 8 marks)

2. Ragwort is a weed that grows on farmland.

Ragwort is poisonous to horses.

(a) Plan an investigation to estimate the size of a population of ragwort growing in a rectangular field on a farm.

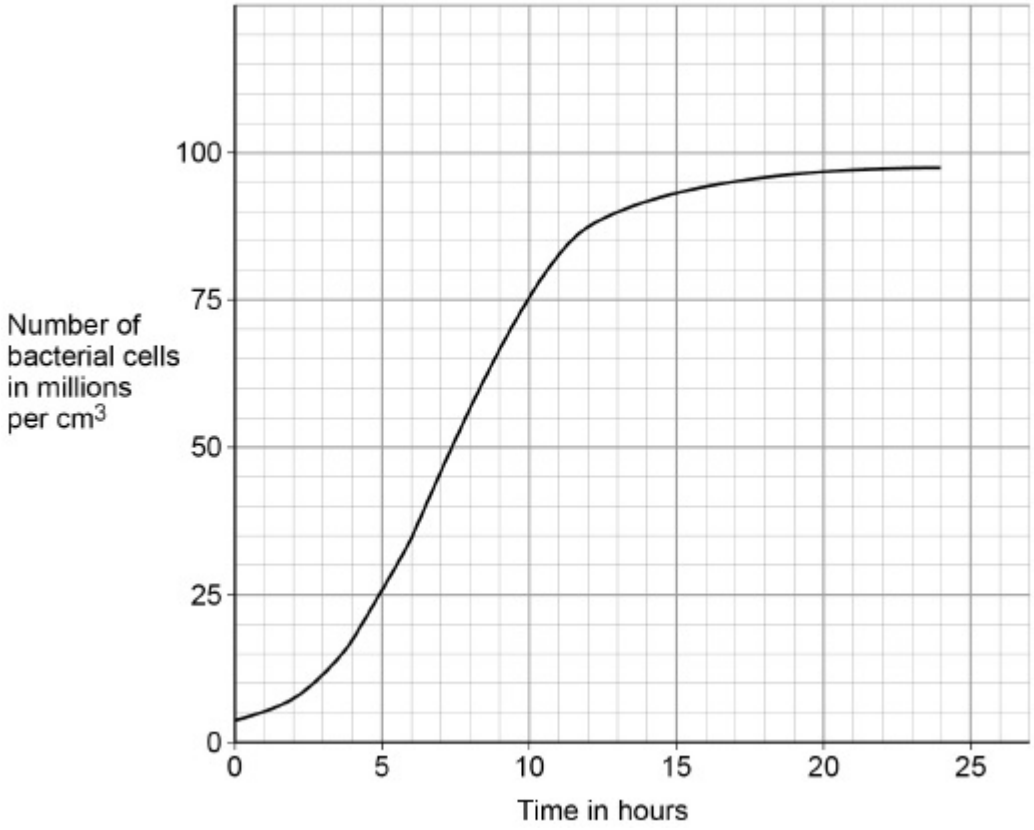
(4)

The herbicide glyphosate will kill ragwort and other weeds.

Scientists use bacteria for the genetic engineering of crop plants to make the crops resistant to glyphosate.

Figure 1 shows the growth of a culture of the bacteria in a solution of nutrients at 25 °C

Figure 1



(b) Why did the rate of reproduction increase between 2 hours and 7 hours?

_____

_____

(1)

(c) After 12 hours, the rate of reproduction decreased.

Suggest **three** ways the scientists could maintain a high rate of reproduction in the bacterial culture.

1 _____

_____

2 _____

_____

3 _____

_____

(3)

(d) The rate of reproduction of the bacteria is fastest at 7 hours.

How many times faster is the rate of reproduction at 7 hours than the rate at 12 hours?

_____

_____

_____

_____

_____

_____

_____

_____

Rate at 7 hours is _____ times faster.

(4)

(e) Scientists transferred a gene for resistance to the herbicide glyphosate into the bacteria.

The genetically-modified (GM) bacteria can then transfer the glyphosate-resistance gene to a crop plant.

Explain the advantage of making crop plants resistant to glyphosate.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 15 marks)

3. In the mid-19th century, a scientist studied inheritance in pea plants.

The scientist's work was the beginning of our modern understanding of genetics.

(a) What is the name of this scientist?

Tick **one** box.

Alfred Russel Wallace ☐

Charles Darwin ☐

Gregor Mendel ☐

Jean-Baptiste Lamarck ☐

(1)

(b) In the mid-20th century, other scientists identified the chemical substance that makes up genetic material.

What is the name of the chemical substance that makes up genetic material?

Tick **one** box.

- Carbohydrate ☐
- DNA ☐
- Lipid ☐
- Protein ☐

(1)

(c) A gene often has two alleles.

One allele is dominant and the other allele is recessive.

When is a recessive allele expressed as a characteristic?

Tick **one** box.

- When the dominant allele is not present ☐
- When the recessive allele is inherited from the female parent ☐
- When the recessive allele is inherited from the male parent ☐
- When the recessive allele is present on only one of the chromosomes ☐

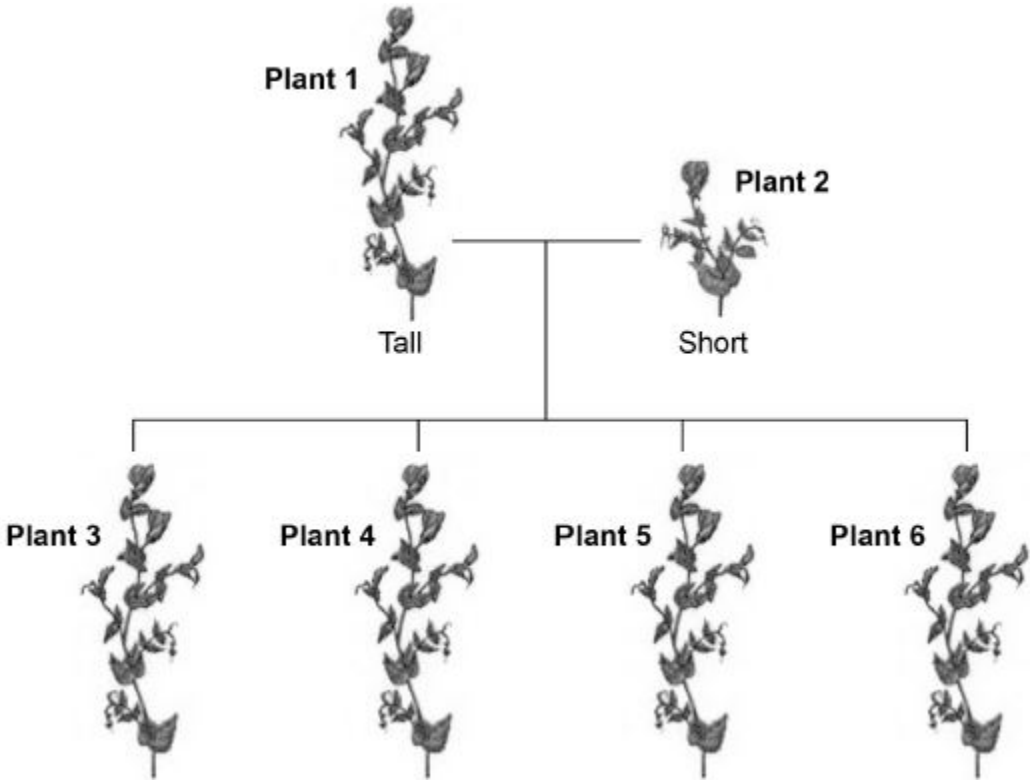
(1)

A scientist investigated the inheritance of height in pea plants.

The scientist crossed tall pea plants with short pea plants.

Figure 1 shows the scientist's results.

Figure 1



In questions **(d)** and **(e)**, use the following symbols to represent alleles:

T = the dominant allele for tall.

t = the recessive allele for short.

(d) In **Figure 1**, the genotype of plant **1** is **TT**.

Give the genotype of plant **2**.

_____

(1)

(e) The scientist crossed plant **3** with plant **4**.

Complete **Figure 2** to show the offspring produced from this cross.

Figure 2

		Male gametes: T	Male gametes: t
Female gametes	T	TT	
Female gametes	t		

(2)

(f) Draw a circle around **one** of the homozygous offspring in **Figure 2**.

(1)

(g) What is the ratio of tall plants : short plants in the offspring in **Figure 2**?

Ratio of tall plants : short plants = _____ : _____

(1)

(Total 8 marks)

4. Fossils give evidence about organisms that lived a long time ago.

(a) Scientists have found very few fossils of the earliest life forms.

Give **one** reason why.

_____

_____

(1)

Below is a photograph of a fossilised fish.

(b) Suggest how the fossil in the photograph above was formed.

_____

_____

_____

_____

(2)

(c) The species of fish shown in the photograph above is now extinct.

Give **two** possible causes of extinction.

1. _____

_____

2. _____

_____

(2)

Modern fish species have evolved from fish that lived a long time ago.

Evolution is caused by mutation and natural selection.

(d) What is a mutation?

Tick **one** box.

A change in a gene	☐
Accidental damage to an organism	☐
An organism with a new characteristic	☐
The loss of a species	☐

(1)

(e) Describe the process of natural selection.

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

5. Cell division is needed for growth and for reproduction.

(a) The table below contains three statements about cell division.

Complete the table.

Tick **one** box for each statement.

	Statement is true for		
Statement	**Mitosis only**	**Meiosis only**	**Both mitosis and meiosis**
All cells produced are genetically identical			
In humans, at the end of cell division each cell contains 23 chromosomes			
Involves DNA replication			

(2)

Bluebell plants grow in woodlands in the UK.

- Bluebells can reproduce sexually by producing seeds.
- Bluebells can also reproduce asexually by making new bulbs.

(b) One advantage of asexual reproduction for bluebells is that only **one** parent is needed.

Suggest **two** other advantages of asexual reproduction for bluebells.

1. _____

_____

2. _____

_____

(2)

(c) Explain why sexual reproduction is an advantage for bluebells.

(4)

(Total 8 marks)

6. Living organisms are classified into the following groups:

- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- Species

(a) Which scientist first suggested this type of classification system?

Tick **one** box.

Alfred Russel Wallace	☐
Carl Linnaeus	☐
Charles Darwin	☐
Gregor Mendel	☐

(1)

The stone plant, *Lithops bromfieldi*, is adapted to live in very dry deserts.

Figure 1 shows several stone plants.

Figure 1

(b) Give the genus to which the stone plant belongs.

_____

(1)

(c) The stone plant has many adaptations that help it to survive in the desert.

Draw **one** line from each adaptation to how the adaptation helps the stone plant to survive.

Adaptation	How the adaptation helps survival
	Can trap a lot of light
Plants look like stones	Absorb water from deep in the ground
Leaves with thick, waxy cuticles	Help cross-pollination
Many long, branching roots	Are not easy to see and so are not eaten
Thick, fleshy leaves	Reduce water loss
	Store water

(4)

The jerboa is a small desert animal.

Figure 2 shows a jerboa.

Figure 2

The jerboa is adapted for survival in the desert.

The jerboa spends the daytime in its underground burrow.

The jerboa only leaves its burrow to look for food during the night.

(d) Describe how these adaptations help the jerboa to survive in the desert.

_____

_____

_____

_____

(2)

(e) What type of adaptations are described in Question (d)?

Tick **one** box.

Behavioural ☐

Functional ☐

Structural ☐

(1)

(Total 9 marks)

7. **Figure 1** shows a ring-tailed lemur.

Figure 1

The table below shows part of the classification of the ring-tailed lemur.

Classification group	**Name**
Kingdom	*Animalia*
Phylum	*Chordata*
	Mammalia
	Primates
	Lemuroidea
Genus	*Lemur*
	catta

(a) Complete the table above to give the names of the missing classification groups.

(2)

(b) Give the binomial name of the ring-tailed lemur.

Use information from the table above.

_____

(1)

Lemurs are only found on the island of Madagascar.

Madagascar is off the coast of Africa.

Scientists think that ancestors of modern lemurs evolved in Africa and reached Madagascar about 50-60 million years ago.

Today there are many species of lemur living on Madagascar.

Figure 2 shows information about water currents.

Figure 3 shows the distribution of three species of lemur on Madagascar.

Figure 2

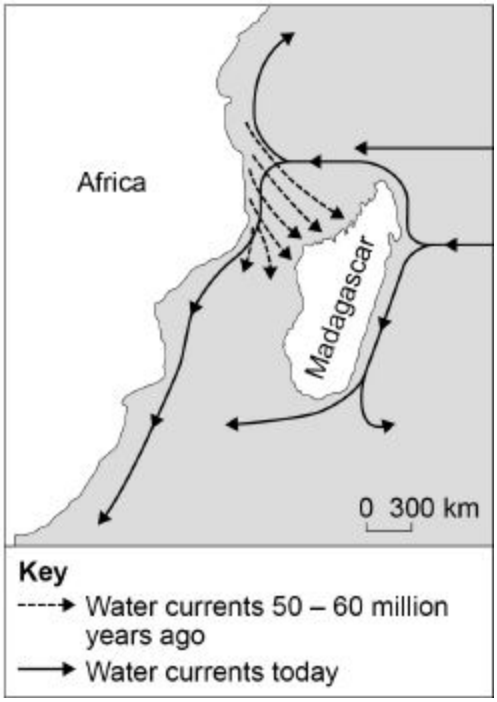
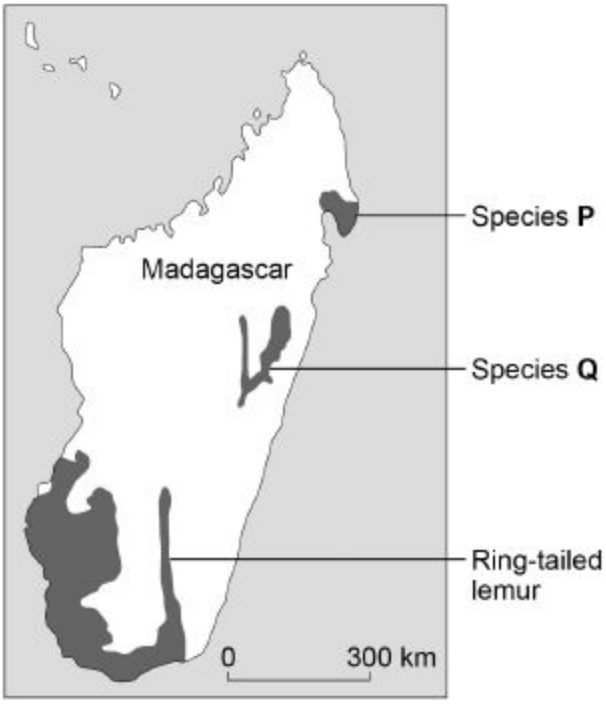


Figure 3



(c) Suggest how ancestors of modern lemurs reached Madagascar.

_____

_____

(1)

(d) Describe how the ancestors of modern lemurs may have evolved into the species shown in **Figure 3**.

(5)

(Total 9 marks)

8. Chromosomes carry genetic information.

Chromosomes are found in nearly all human cells.

(a) How many chromosomes are there in most human body cells?

Tick **one** box.

23 ☐

24 ☐

46 ☐

48 ☐

(1)

(b) How many chromosomes are there in a human gamete cell?

_____

(1)

(c) Complete the sentences.

Choose the answers from the box.

sexual reproduction	**binary fission**	**egg**	**fertilisation**	**meiosis**
mitosis	**ovary**	**sperm**	**testis**	**uterus**

The female gamete is called the _____.

The male gamete is called the _____.

The female gamete is produced in the _____.

Gametes are produced by a type of cell division

called _____ .

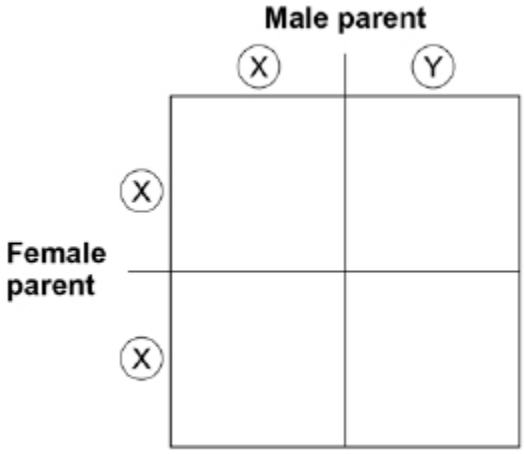
Male and female gametes join together in a process

called _____ .

(5)

In humans, the sex chromosomes are called **X** and **Y**.

The diagram shows the inheritance of sex chromosomes.



(d) Complete the diagram above to show the sex chromosomes inherited by the offspring.

(2)

(e) What is the chance that a child produced by these parents will be female?

Tick **one** box.

1 in 2 ☐

1 in 3 ☐

1 in 4 ☐

3 in 4 ☐

(1)

(f) The parents shown in the diagram above have five children.

Give **two** reasons why these children all look different from each other.

1. _____

_____

2. _____

_____

(2)

(Total 12 marks)

1.

(a) chromosome(s)

allow gene(s) / allele(s)

1

(b) X = sugar

1

Y = nucleotide

1

Z = base

1

(c) double helix

1

(d) 3

1

(e) any **two** from:

allow descriptions or named examples

- diagnosis of inherited / genetic disorder

  allow research / understand genetic disorders
- gene therapy **or** treatment of inherited disorders
- understanding (human) evolution **or** understanding ethnic origins (of a person) **or** understanding ancestry
- tracing human migration patterns

  allow other examples – eg identification of criminals (1)
  paternity determination (1)

2

[8]

2.

(a) **Level 2:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

3–4

Level 1: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.

1–2

No relevant content

0

Indicative content

- use of quadrat
- (quadrat) of given area / dimensions – e.g. 0.25 m^2 or 1 m × 1 m
- quadrats are placed randomly
- method of obtaining randomness – e.g. random coordinates from a calculator **or** throw over shoulder **or** throw with eyes closed
- suitable number of quadrats (10 or more **or** a large number)
- count number of plants (in each quadrat)
- calculation of mean per quadrat or per unit area
- determination of area of field (length × width)
- population = mean per m^2 × area of field

(b) more bacteria so more divisions / reproduction (per unit time)

1

(c) any **three** from:

- add (more) sugar
- add (more) amino acids / protein

  if neither point given, allow add (more) nutrients
- add (more) oxygen
- increase temperature

  allow in range 26 °C to 40 °C

  allow maintain optimum temperature
- remove toxins / waste **or** maintain pH
- stir the culture

  *if no other mark awarded allow **1** mark for add more food*

3

(d)

*an answer in the range of 2.9 to 3.4 scores **4** marks*

*an answer in the range of 2.08 to 3.77 scores **3** marks*

tangent drawn to the curve at 12 hours

*do **not** accept if there is an incorrect tangent at 7 hours*

1

calculation of rate at 7 hours $\frac{\Delta y}{\Delta x}$

allow an answer that correctly rounds to a value in range 10.0 to 11.7

1

calculation of rate at 12 hours $\frac{\Delta y}{\Delta x}$

allow an answer that correctly rounds to a value in range 3.1 to 4.8

1

3.3

allow in range 2.9 to 3.4 if both rates are in the correct ranges

1

(e) can use the glyphosate / weed killer to kill weeds but not kill / affect crop

*allow **only** kills weeds*

1

(so) less competition for light / water / minerals / ions

allow less competition for nutrients

ignore food / carbon dioxide / space

1

(so) crops have high(er) yield

allow crops grow better / well

1

[15]

3. (a) Gregor Mendel

1

(b) DNA

1

(c) when the dominant allele is not present

1

(d) tt

allow homozygous recessive

1

(e)

	T	t
T	TT	Tt
t	Tt	tt

*all 3 correct = **2** marks*

*2 correct = **1** mark*

*0 or 1 correct = **0** marks*

allow tT for Tt

2

(f) circle drawn around either TT or tt on Figure 2

allow circles drawn round both

1

(g) correct ratio from part **(e)** e.g. 3 : 1

allow multiples of stated ratio

*allow 3 : 1 if no answer to part **(e)***

1

[8]

4.

(a) (organism) soft-bodied

allow lack hard parts / skeleton / shell

allow (organism) eaten / decayed

or

(fossil) destroyed

allow buried (very) deep
allow they are (very) small

1

(b) any **two** from:

- the fish (dies) buried in sediment / sand / mud

  allow other examples of sediments
  *do **not** accept rock(s)*

- (only) the soft parts decayed / eaten **or** the hard parts / bones did not decay or were not eaten

- mineralisation occurred

  allow description of mineralisation e.g. bones turned to stone
  allow imprinted (in the sediment)

2

(c) any **two** from:

ignore pollution

- drought
- ice age / global warming
- volcanic activity

  allow earthquakes / tsunami

- asteroid / meteor collision
- (new) predators

  allow hunters / poachers
  allow eaten

- (new) disease / named pathogen
- competition for food

  allow lack of food

- competition for mates

  allow isolation or lack of mates

- lack of habitat or habitat change

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

2

(d) a change in a gene

1

(e) there is variation (between members of a species)

allow mutation

1

better adapted survive

allow 'survival of the fittest'

1

(reproduce and) pass on (favourable) allele(s) / gene(s) / mutation(s) / DNA / genetic material

ignore pass on characteristic(s)

1

allow in terms of an example

[9]

5. (a)

	statement is true for		
	mitosis only	**meiosis only**	**both mitosis and meiosis**
all cells produced are genetically identical	✓		
in humans, at the end of cell division each cell contains 23 chromosomes		✓	
involves DNA replication			✓

3 correct = ***2*** *marks*
2 correct = ***1*** *mark*
0 or 1 correct = ***0*** *marks*

2

(b) any **two** from:

ignore references to one parent only

- many offspring produced
- takes less time

allow asexual is faster

- (more) energy efficient
- genetically identical offspring

allow offspring are clones

- successful traits propagated / maintained / passed on (due to offspring being genetically identical)
- no transfer of gametes or seed dispersal

allow no vulnerable embryo stage
allow no need for animals

- not wasteful of flowers / pollen / seeds
- colonisation of local area

must imply local area

2

(c) genetic variation (in offspring)

1

(so) better adapted survive

allow reference to natural selection or survival of the fittest

1

(and) colonise new areas by seed dispersal
or
can escape adverse event in original area (by living in new area)

must imply new area

1

many offspring **so** higher probability some will survive

1

*allow bluebell example described (**max 3** if not bluebell)*

[8]

6. (a) Carl Linnaeus

1

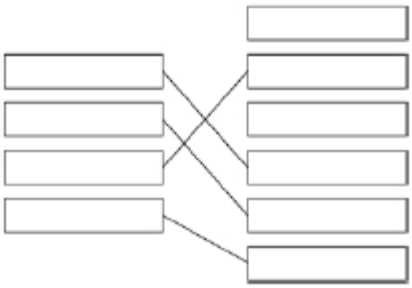
(b) Lithops

extras cancel

ignore capitalisation / non-capitalisation

1

(c)



1 *mark per line*

extra line from adaptation negates the mark for that adaptation

1
1
1
1

(d) any **two** from:

- cooler underground / at night
  or
  the jerboa can keep cool
- loses less water
  or
  sweats less
- less likely to be seen (by predators / prey)

2

(e) behavioural

1

[9]

7. (a)

Classification group	**Name**
Class	*Mammalia*
Order	*Primates*
Family	*Lemuroidea*
Species	*catta*

all 4 correct = ***2*** *marks*
2 or 3 correct = ***1*** *mark*
0 or 1 correct = ***0*** *marks*

2

(b) Lemur catta

ignore capitalisation / non-capitalisation of initial letters
ignore italics / non-italics
ignore underlining / non-underlining

1

(c) carried by (favourable) currents on masses of vegetation

allow description of currents from Figure 2
ignore swimming

1

(d) isolation of different populations

1

habitat variation between lemur populations

allow examples − biotic (e.g. food / predators) or abiotic (e.g. temperature)

1

genetic variation or mutation (in each population)

1

better adapted survive (reproduce) **and** pass on (favourable) allele(s) to offspring

*allow natural selection **or** survival of the fittest **and** pass on (favourable) allele(s) to offspring*
allow gene(s) / mutation as an alternative to allele(s)

1

(eventually) cannot produce fertile offspring with other populations

allow cannot reproduce 'successfully' with other populations
ignore cannot reproduce unqualified

1

[9]

8. (a) 46

1

(b) 23

allow ecf from 2.1 – ie half of answer given in 2.1

1

(c) egg

1

sperm

1

ovary

1

meiosis

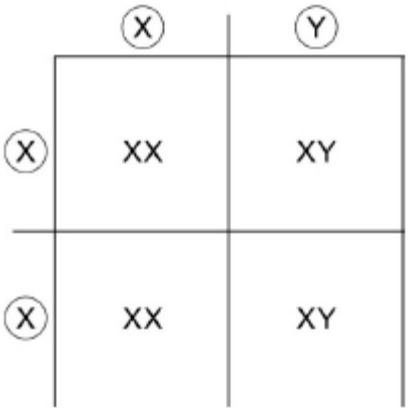
1

fertilisation

1

correct order only
correct spelling only

(d)



*all 4 correct = **2** marks*
*2 or 3 correct = **1** mark*
*0 or 1 correct = **0** marks*
ignore correct / incorrect identification of male and female offspring

2

(e) 1 in 2

1

(f) any **two** from:

- multiple genes determine appearance
  allow several / many genes determine appearance
- different combinations of alleles
  allow description of combinations of alleles' allow genes for alleles
- different environmental effects
  allow example e.g. eat different diets
- from different egg / sperm

2

[12]