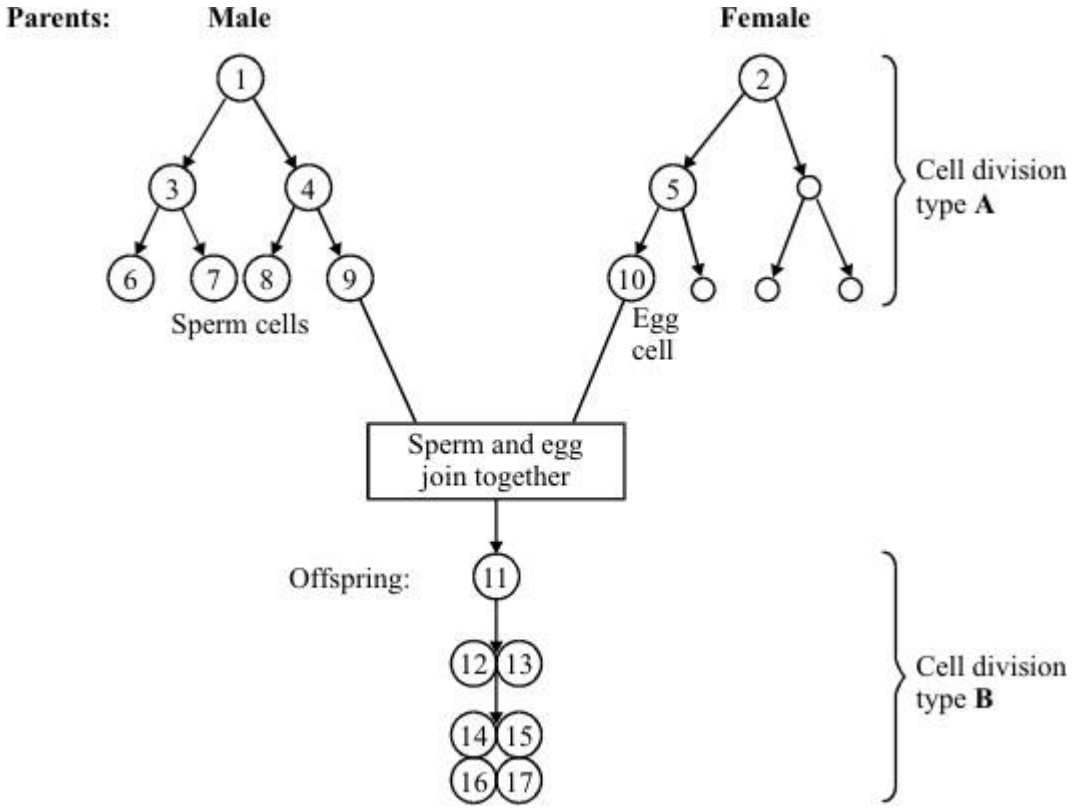
1 The diagram shows two patterns of cell division. Cell division type **A** is used in gamete formation. Cell division type **B** is used in normal growth.



(a) Name the two types of cell division, **A** and **B**, shown in the diagram.

Type **A** _____

Type **B** _____

(2)

(b) Name the process in which an egg and sperm join together.

_____

(1)

(c) Cell **1** contains 46 chromosomes. How many chromosomes will there be in:

(i) cell **10**; _____

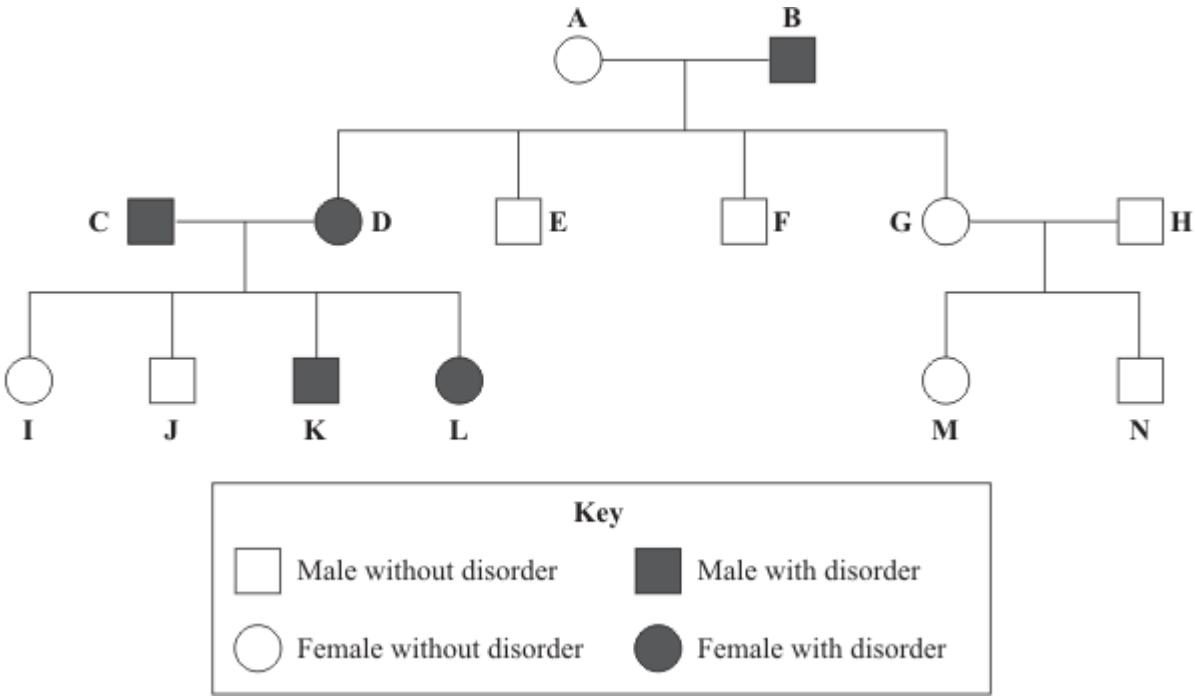
(1)

(ii) cell **14**? _____

(1)

(Total 5 marks)

2 The diagram shows a family tree in which some individuals have an inherited disorder, which may cause serious long-term health problems.



(a) What proportion of the children of **A** and **B** have the disorder?

_____

(1)

(b) Explain the evidence from the diagram which shows that the allele for the disorder is dominant.

Use the appropriate letters to identify individuals in your answer.

You may use genetic diagrams in your explanation. There is space for you to draw a genetic diagram at the top of the facing page.

_____

_____

_____

_____

_____

_____

(3)

(c) (i) What is meant by 'embryo screening'?

_____

_____

(1)

(ii) A doctor suggests that couple **C** and **D** should have their embryos screened but that couple **G** and **H** do **not** need this procedure.

Explain the reasons for the doctor's suggestions.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

3 The photograph shows a Crossbill.

A Crossbill feeds by using its bill (beak) to force apart the scales on conifer cones. It then uses its tongue to extract the seeds. If the bill is clipped it grows back again.

Scientists were interested in the evolution of the bill of the Crossbill.

In an investigation, they clipped the bills of several Crossbills so that their bills no longer crossed.

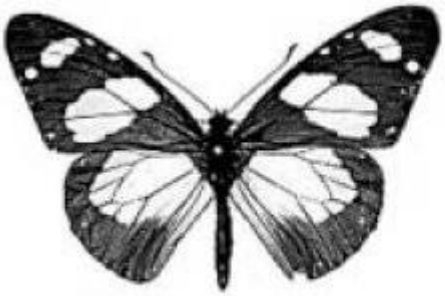
They observed that Crossbills with clipped bills took much longer to get seeds.

Use information from the investigation to suggest an explanation for the evolution of the bill in the Crossbill.

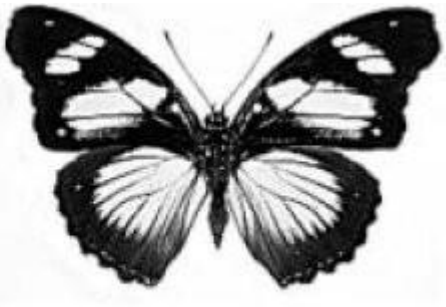
In your explanation, use the ideas of *selection*, *competition* and *mutation*.

(Total 4 marks)

4 The drawings show two different species of butterfly.



Amauris



Hypolimnas

- Both species can be eaten by most birds.
- *Amauris* has a foul taste which birds do not like, so birds have learned not to prey on it.
- *Hypolimnas* does **not** have a foul taste but most birds do not prey on it.

(a) Suggest why most birds do **not** prey on *Hypolimnas*.

(2)

(b) Suggest an explanation, in terms of natural selection, for the markings on the wings of *Hypolimnas*.

_____

_____

_____

_____

_____

_____

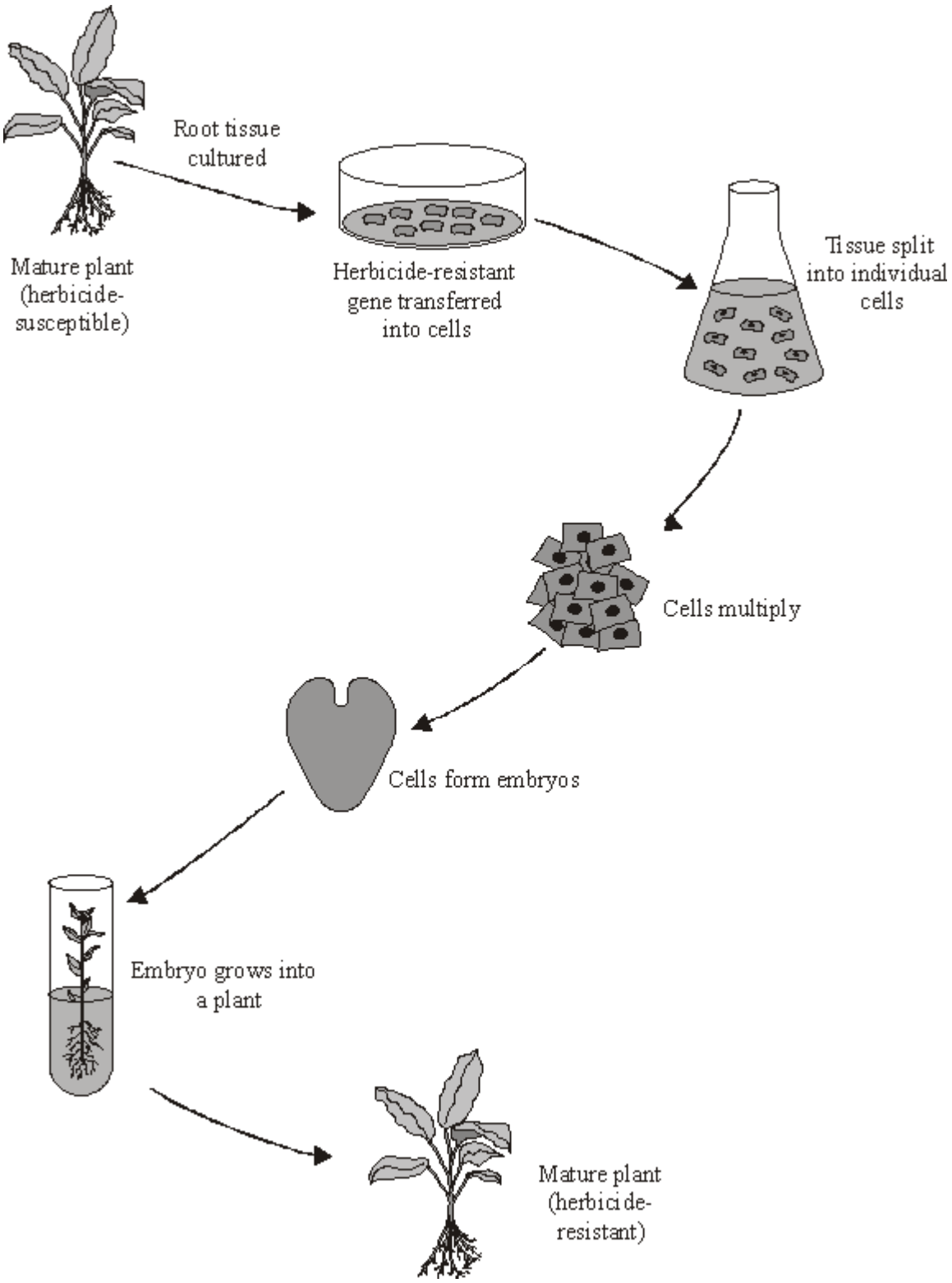
_____

_____

(3)

(Total 5 marks)

5 The diagram shows one method of producing herbicide-resistant crop plants.



(a) (i) The herbicide-resistance gene is obtained from a herbicide-resistant plant.

Which structure in a cell carries the genes?

_____

(1)

(ii) How is the herbicide-resistance gene cut out of this structure?

_____

_____

(1)

(b) Apart from having the herbicide-resistance gene, the herbicide-resistant plants are identical to the herbicide-susceptible plants.

Explain why.

_____

_____

_____

_____

(2)

(c) Suggest **one** advantage to a farmer of growing herbicide-resistant crops.

_____

_____

(1)

(d) Many people are opposed to the growing of herbicide-resistant crops produced in this way.

Suggest **one** reason why.

_____

_____

(1)

(Total 6 marks)

6 Chromosomes contain molecules of DNA. Genes are small sections of DNA.

(a) Each gene contains a code.

What does a cell use this code for?

_____

_____

_____

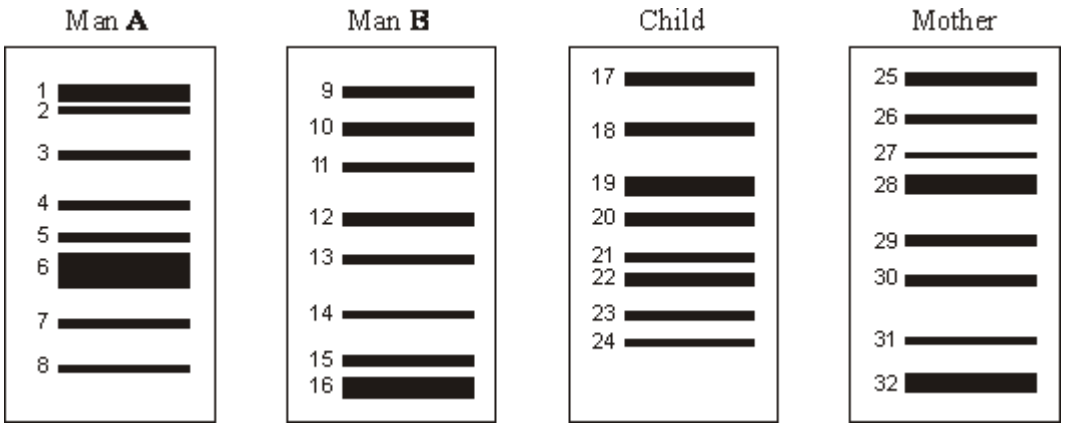
_____

(2)

(b) DNA fingerprints can be used to identify people. One example of the use of DNA fingerprints is to find out which man is the father of a child.

The diagram shows the DNA fingerprints of a child, the child's mother and two men who claim to be the child's father.

The numbers refer to the bars on the DNA fingerprints.



(i) Which man, **A** or **B**, is more likely to be the father of the child?

Use the numbers on the DNA fingerprints to explain your choice.

In your answer you should refer to all four people.

(3)

(ii) Only half the bars of the child's DNA fingerprint match the mother's DNA fingerprint.

Explain why.

_____

_____

_____

_____

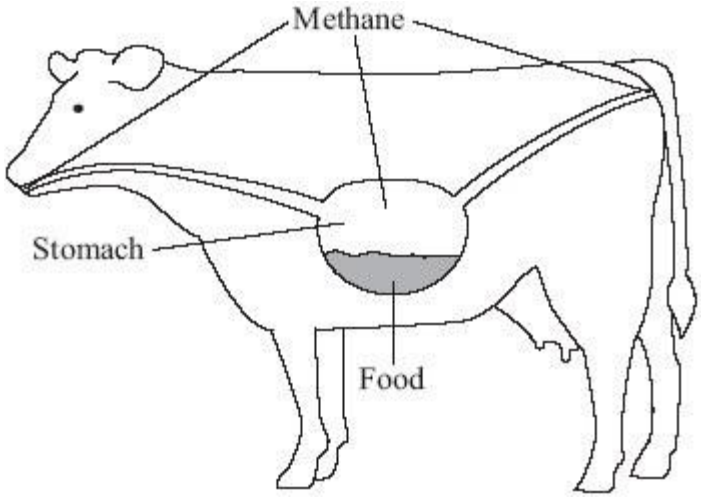
_____

(2)

(Total 7 marks)

7 Scientists are investigating how to reduce methane emissions from cattle.

Most of this methane is emitted by the cows belching.



Scientists have found that less methane is belched if the cows eat high-sugar rye grass.

This rye grass has been produced by genetic engineering.

(i) Suggest how the high-sugar rye grass might have been produced by genetic engineering.

_____

_____

_____

_____

_____

_____

(3)

(ii) Some people might object to the growing of genetically-engineered, high-sugar rye grass for feeding cattle.

Give **two** reasons why.

1. _____

_____

_____

2. _____

_____

_____

(2)

(Total 5 marks)

8 Pathogenic bacteria and viruses may make us feel ill if they enter our bodies.

(a) Why do bacteria and viruses make us feel ill?

Bacteria _____

_____

Viruses _____

_____

(2)

(b) Most drugs that kill bacteria cannot be used to treat viral infections.

Explain why.

_____

_____

_____

_____

_____

_____

(2)

(c) Antibiotic-resistant strains of bacteria are causing problems in most hospitals.

Explain, as fully as you can, why there has been a large increase in the number of antibiotic-resistant strains of bacteria.

(4)

(Total 8 marks)

9 The dodo is an extinct bird. The drawing shows an artist's impression of the bird.

The dodo lived on a small island in the middle of the Indian Ocean. Its ancestors were pigeon-like birds which flew to the island millions of years ago. There were no predators on the island. There was a lot of fruit on the ground. This fruit became the main diet of the birds. Gradually, the birds became much heavier, lost their ability to fly and evolved into the dodo.

(a) Suggest an explanation for the evolution of the pigeon-like ancestor into the flightless dodo.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) The dodo became extinct about 80 years after Dutch sailors first discovered the island in the eighteenth century.

Scientists are uncertain about the reasons for the dodo's extinction.

Suggest an explanation for this uncertainty.

_____

_____

(1)

(Total 5 marks)

10 The photograph shows a snake eating a toad.

Cane toads were first introduced into Australia in 1935. The toads contain toxins and most species of Australian snake die after eating the toad.

The cane toad toxin does not affect all snakes the same way. Longer snakes are less affected by toad toxin.

Scientists investigated how red-bellied black snakes had changed in the 70 years since cane toads were introduced into their area. They found that red-bellied black snakes had become longer by around 3 – 5 %.

Suggest an explanation for the change in the body length of the red-bellied black snakes since the introduction of the cane toads.

_____

_____

_____

_____

_____

_____

_____

_____

(Total 4 marks)

11 (a) What does the theory of evolution state?

_____

_____

_____

_____

(2)

(b) *Daphnia* are microscopic water fleas. Midge larvae prey on *Daphnia*. The midge larvae release a hormone into the water. *Daphnia* respond to these hormones by growing larger protective 'helmet'-like structures

Scientists were surprised to observe that the offspring of *Daphnia* females who had been exposed to these hormones always had larger helmets than offspring whose mothers had never been exposed to the hormones. The offspring with the large helmets went on to produce offspring with large helmets.

Explain why the scientists' observations seem to contradict the theory of natural selection.

_____

_____

_____

_____

(2)

(Total 4 marks)

Mark schemes

1 (a) A = meiosis

accept 'mieosis'

*do **not** accept 'miosis'*

1

B = mitosis

*do **not** accept 'meitosis' etc*

1

(b) fertilisation allow conception

1

(c) (i) 23

1

(ii) 46

1

[5]

2 (a) 1 in 4 / 1/4 / 1: 3 / 25% / 0.25

*do **not** accept 3:1 / 1:4 / 2:6*

1

(b) **either** from C **and** D

accept synonyms for dominant / recessive eg Normal / faulty

accept genetic diagram if clearly referring to correct individuals or genotypes on family tree

allow 'gene' for 'allele'

any **three** from:

- C **and** D have disorder

  ignore 'C & D are carriers'

- I/J don't have disorder

- C **and** D have dominant **and** recessive alleles

- recessive alleles from C **and** D passed to I/J
  or I/J have two recessive alleles

  *NB if allele was recessive then all offspring of C **and** D would have the disorder = **3** marks*

or from A **and** B

assume response refers to A + B unless contradicted

- A is homozygous recessive / rr, **and** B is heterozygous / Rr can be shown in words or symbols

  allow any symbol

- offspring can be rr **or** Rr described

  allow without key

3

(c) (i) (embryos) checked for inherited / genetic disorders / conditions

accept diseases for disorders

1

(ii) any **three** from:

- C/D have disorder / have dominant allele

  accept disease / condition

  accept 'gene' for 'allele'

  ignore reference to 'carriers'

- chance of embryo / foetus / child having disorder **or** may pass on alleles for disorder to their offspring

- C/D might want to decide on termination **or** prepare for child with disorder

- G **and** H don.t have disorder / both homozygous recessive / have no dominant alleles (for this disorder)

- so offspring (of G **and** H) cannot / don.t have disorder

3

[8]

3 any **four** from:

*max **two** marks for a Lamarck explanation*

- mutation produced a bird whose bill was crossed

  *do **not** allow birds decide to mutate*

- birds compete for <u>food</u> / <u>seeds</u>
- mutant crossbill able to obtain food faster / easier / more successfully
- selected for **or** more likely to survive
- reproduce / mate / breed / produce offspring

[4]

4 (a) wing pattern similar to *Amauris*

1

birds assume it will have foul taste

1

(b) mutation / variation produced wing pattern similar to *Amauris*

*do **not** accept breeds with Amauris*

*do **not** accept idea of intentional adaptation*

1

these butterflies survived

1

breed / genes passed to next generation

1

[5]

5 (a) (i) chromosomes

allow DNA

ignore nucleus

1

(ii) enzymes

1

(b) asexual reproduction / no gametes / no fusion / only one parent

ignore clones

1

cells all contain same genetic information / same genes (as parent) / same DNA

1

(c) can spray crop with herbicide – only weeds killed

crop survives herbicide insufficient

1

(d) any **one** from:

- fears / lack of knowledge about effects of GM food on health

allow 'think that GM food is bad for health'

*ignore not natural **or** against religion*

- crop plants may pass on gene to wild plants
- encourages use of herbicides

1

[6]

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

- to combine / use amino acids

*do **not** allow to make amino acids*

- in specific / particular / correct / right order
- to manufacture protein / enzymes / hormones

allow examples of proteins / enzymes / hormones

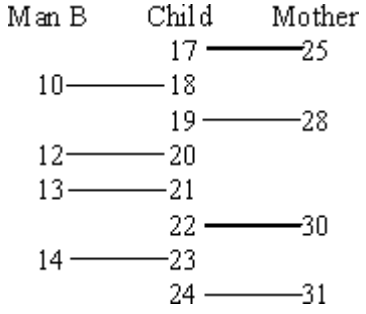
2

(b) (i) (man) B

*no mark for this **but** max **2** marks if A given*

any **three** from:

- child gets DNA / bars / lines from mother and father / parents
  ignore genes / chromosomes
- (child has) mother's 25 / 28 / 30 / 31
  or child gets 17 / 19 / 22 / 24 from mother
- (child has) man B's 10 / 12 / 13 / 14
  or child gets 18 / 20 / 21 / 23 from B



contradictions disqualify 2nd and / or 3rd marking points
ignore genes / chromosomes

- no bars / DNA / lines from man A correspond to child

3

(ii) any **two** from:

- gametes / eggs / sperm
- contain only half of (mother's / father's) DNA / chromosomes / genes / genetic information
- due to meiosis

2

[7]

7 (i) any **three** from:

ignore references to other methods eg tissue culture and embryo transplantation

- remove gene
- use of enzymes
- from plant with high sugar production

allow from bacteria

- insert gene into rye grass

3

(ii) any **two** from eg

- concern about effect on (health) of cow
- concern about effects on human (health)
- concern about food chain effects **or** effects on ecosystem
- effect on gene pool

*ignore not natural **or** cost*
ignore ethical / religious arguments
if no other marks awarded
'we don't know the long term effects' = 1 mark

2

[5]

8 (a) (bacteria) produce toxins / poisons

1

(viruses) damage / kills cells **or** toxins released from cell

1

(b) any **two** from:

- viruses live inside cells
- viruses inaccessible to drug
- drug would damage body cells / tissue

2

(c) any **four** from:

- overuse of antibiotics
- bacteria mutate

*do **not** allow antibiotic causes mutation*

- antibiotics kill non-resistant strains **or** idea of selection
- reduced competition
- resistant bacteria reproduce

4

[8]

9 (a) any **four** from:

- mutation / variation
- produces smaller wings / fatter body
  must be linked to mutation / variation
- wings no longer an advantage since no predators
  allow wings / flight not needed as no predators
- wings no longer an advantage since food on ground
  allow wings / flight not needed as food on ground
- fatter body can store more energy when fruit scarce
- successful birds breed / pass on genes

4

(b) any **one** from:

- evidence has all gone
- no scientists on island at time to record evidence
- no records (from sailors)

1

[5]

10 any **four** from

- mutation
  *do **not** accept 'had to mutate / decided to mutate'*
- produces longer snake **or** there is variation in snake length
  *do **not** accept 'had to adapt and became longer'*
- longer snake less susceptible to toxin **or** longer snake survives
- survivors reproduce
- gene passed to next generation
  allow characteristic passed to next generation

[4]

11 (a) present day organisms have evolved from simpler organisms
ignore answers in terms of natural selection

1

over long periods of time
or
millions / billions of years

1

(b) (natural selection operates on successful)
characteristics produced by chance / (random) mutation

1

in this experiment caused by hormones / environment

allow this example indicates
inheritance of acquired
*characteristics for **2** marks*

*allow this is Lamarckism only for **1** mark*

1

[4]