1 (a) (i) Mitosis and meiosis are types of cell division.

For each feature in the table, tick (✓) **one** box to show if the feature occurs:

- only in mitosis
- only in meiosis.

Feature	Only in mitosis (✓)	Only in mitosis (✓)
Produces new cells during growth and repair		
Produces gametes (sex cells)		
Produces genetically identical cells		

(2)

(ii) Name the organ that produces gametes (sex cells) in:

a man _____

a woman _____

(2)

(b) **X** and **Y** chromosomes are the sex chromosomes. They determine a person's sex.

What sex chromosomes will be found in the body cells of:

(i) a man _____

(1)

(ii) a woman? _____

(1)

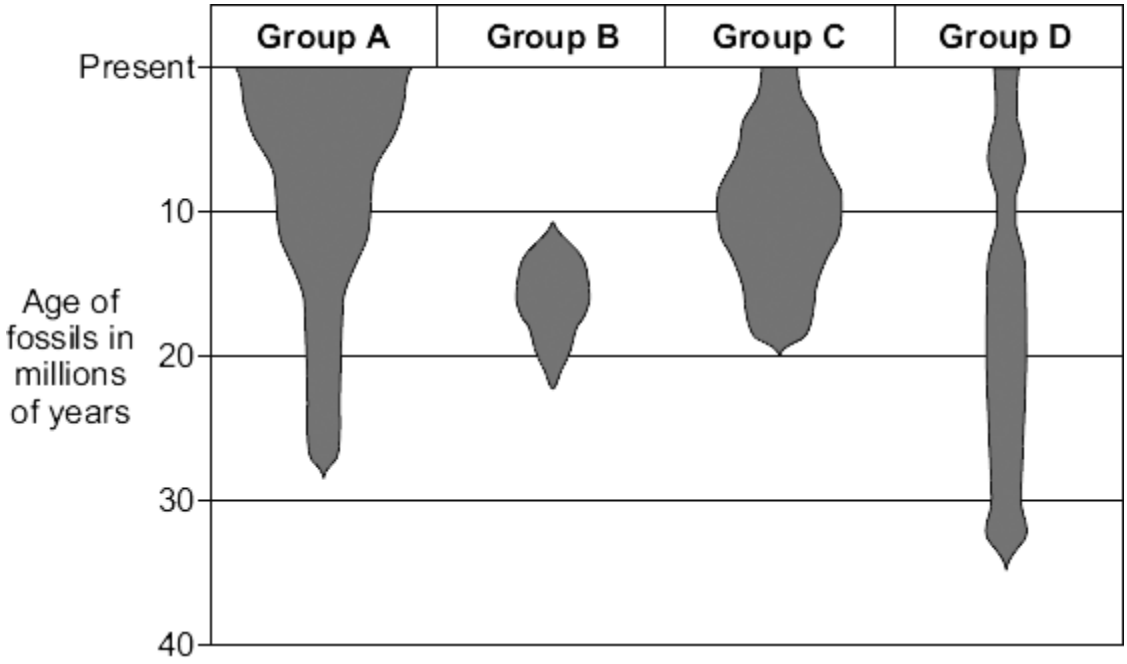
(c) A man and a woman decide to have a child.

What is the chance that the child will be a boy? _____

(1)

(Total 7 marks)

2 In the Grand Canyon, scientists have found fossils of several different groups of organisms.
The diagram shows the number and age of the fossils that the scientists found.
The width of each shaded area shows the number of fossils found.



(a) What is a fossil?

_____

_____

_____

_____

(2)

(b) (i) Which group of organisms, **A**, **B**, **C** or **D**, was the first to evolve?

(1)

(ii) Which group of organisms, **A**, **B**, **C** or **D**, is now extinct?

(1)

(iii) Give **one** environmental factor that might have caused this group of organisms to become extinct.

_____

_____

(1)

(c) Scientists suggested that, 10 million years ago, organisms of **Group C** were more common than organisms from any of the other groups.

What is the evidence for this in the diagram?

_____

_____

(1)

(d) The scientists suggested that the four groups of fossilised organisms evolved from a common ancestor.

Which of the following would provide the best evidence that their suggestion is correct?

Tick (✓) **one** box.

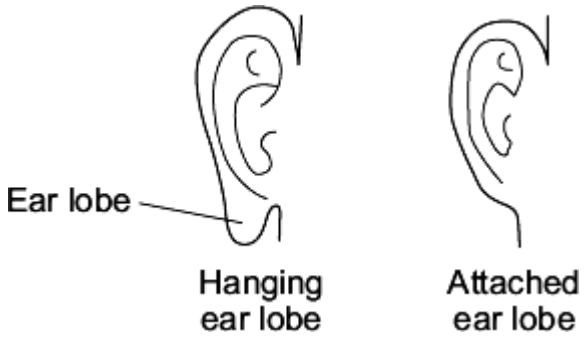
Statement	Tick (✓)
All the groups lived in the same area.	
Fossils from each group were found in the same rock layer.	
Members of the groups have similar physical structures.	

(1)

(Total 7 marks)

3 People have different shaped ear lobes, either 'hanging' or 'attached'.

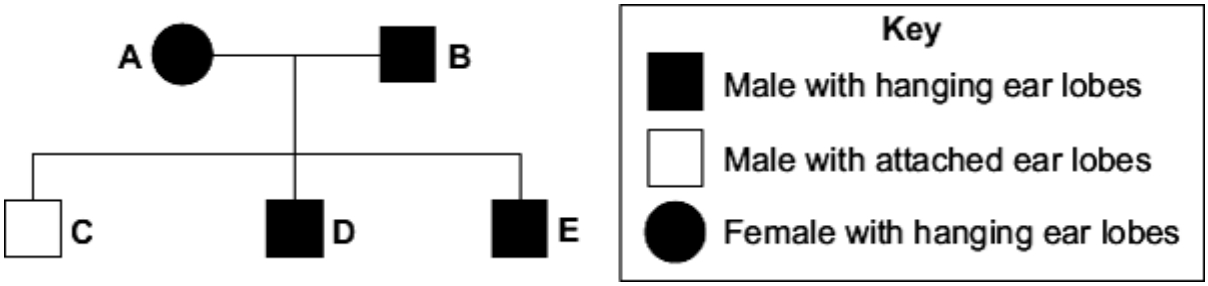
The diagrams show the two shapes of ear lobe.



A gene controls the shape of a person's ear lobes.

The diagram shows a family tree.

Parents **A** and **B** both have hanging ear lobes.



(a) The key does **not** show the symbol for a female with attached ear lobes.

Draw the symbol for the key to show a female with attached ear lobes.

Use information in the family tree and the key.

Symbol = _____

(1)

(b) Look at the family tree.

What does the information in the family tree tell you about the allele for hanging ear lobes?

Draw a ring around the correct word to complete the sentence.

The allele for hanging ear lobes is

dominant.
weak.
recessive.

(1)

(c) (i) Parents **A** and **B** have three children, **C**, **D** and **E**.
All three children are boys.

What are the chances that the next child of parents **A** and **B** will be a girl?

Draw a ring around **one** answer.

no chance (0 %) **a half (50 %)** **certain (100 %)**

(1)

(ii) Which statement explains your answer to part (c)(i)?

Tick (✓) **one** box.

Some of **B**'s sperm cells have an X chromosome. ☐

Some of **A**'s egg cells have a Y chromosome ☐

All of **B**'s sperm cells have an X chromosome. ☐

(1)
(Total 4 marks)

4 Insecticides are chemicals which kill insects.
Insecticides may be sprayed onto crops to increase crop yield.

(a) Killing insects on crops increases crop yield.

Suggest why.

_____

_____

(1)

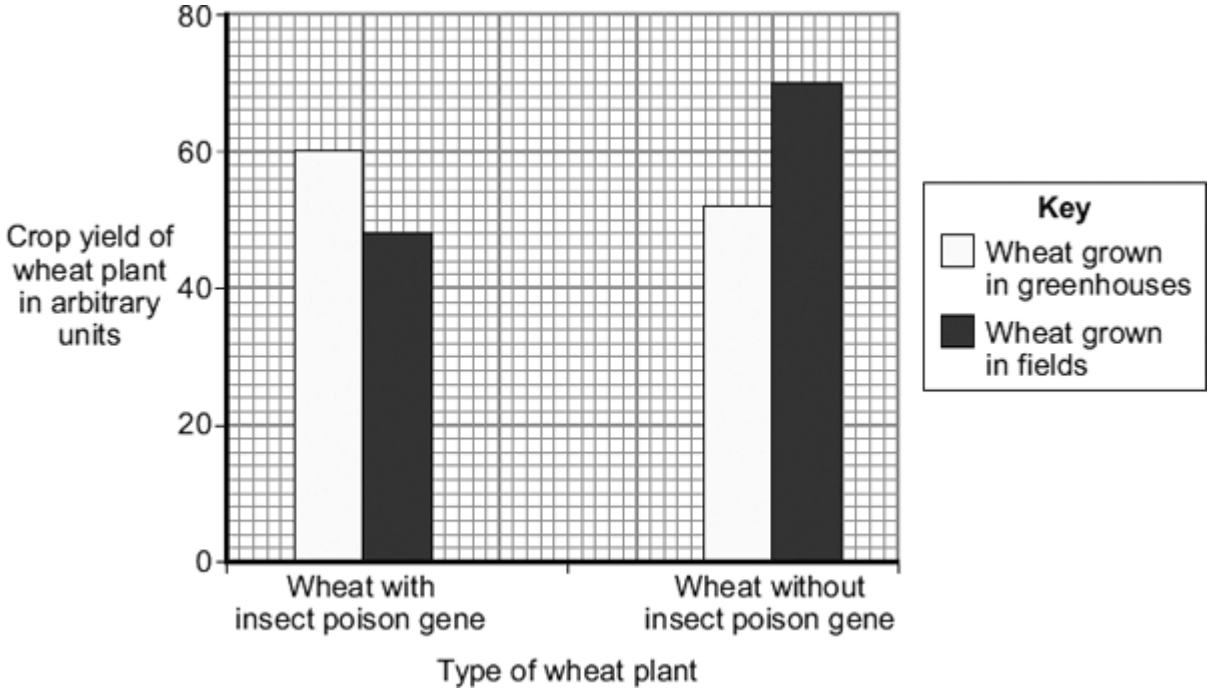
(b) A microorganism contains a gene which causes the production of an insect poison.

Scientists transferred the gene for production of the insect poison into wheat plants. This makes genetically modified (GM) wheat.

The scientists:

- grew wheat plants with the insect poison gene in fields and in greenhouses
- grew wheat plants without the insect poison gene in fields and in greenhouses
- measured the crop yield of the wheat plants.

The bar chart shows the results.



(i) What was the yield of the wheat with the insect poison gene grown in greenhouses?

_____ arbitrary units

(1)

(ii) The yield from wheat without the insect poison gene grown in greenhouses was different from the yield you gave in (b)(i).

Describe this difference in yield.

_____

_____

_____

_____

(2)

(iii) Look again at the bar chart.

What advice would you give to a farmer about the type of wheat to grow in fields?

Give a reason for your answer.

_____

_____

_____

_____

(2)

(c) Some people are concerned about the use of GM crops.

Why?

_____

_____

_____

_____

_____

(2)

(Total 8 marks)

5 Polydactyly is an inherited condition. Polydactyly is controlled by a dominant allele.

The photograph shows the foot of a baby with polydactyly.

CNRI/Science photo library

A man and his wife have three children. The man has polydactyly.

The diagram shows the inheritance of polydactyly in this family.
The diagram also shows the number of toes each person has on each foot.

In the rest of this question, the following symbols are used to represent alleles.

D = allele for polydactyly (6 toes on each foot)
d = allele for 5 toes on each foot

(a) (i) How many alleles for the number of toes will there be in **one** sperm cell?

(1)

(ii) Complete the sentence.

A sperm cell joins with an egg cell in a process called _____

(1)

(b) (i) What combination of alleles does the man have?

Tick (✓) **one** box.

DD ☐

Dd ☐

dd ☐

(1)

(ii) What combination of alleles does the man's wife have?

Tick (✓) **one** box.

DD ☐

Dd ☐

dd ☐

(1)

(c) Draw a ring around the correct answer to complete each sentence.

(i) The man and his wife plan to have a fourth child.

The probability that this child will have 6 toes on each foot is

1 in 2.

1 in 3.

1 in 4.

(1)

(ii) When Child **2** grows up, he marries a woman with 5 toes on each foot.

The probability that their first child will have 6 toes on each foot is

0.
1 in 2.
1 in 4.

(1)

(Total 6 marks)

6 Evolution is the development of new species over time.
Evidence for evolution comes from *fossils*.

(a) (i) What is a *fossil*?

_____

_____

_____

_____

(2)

(ii) How can fossils give evidence for evolution?

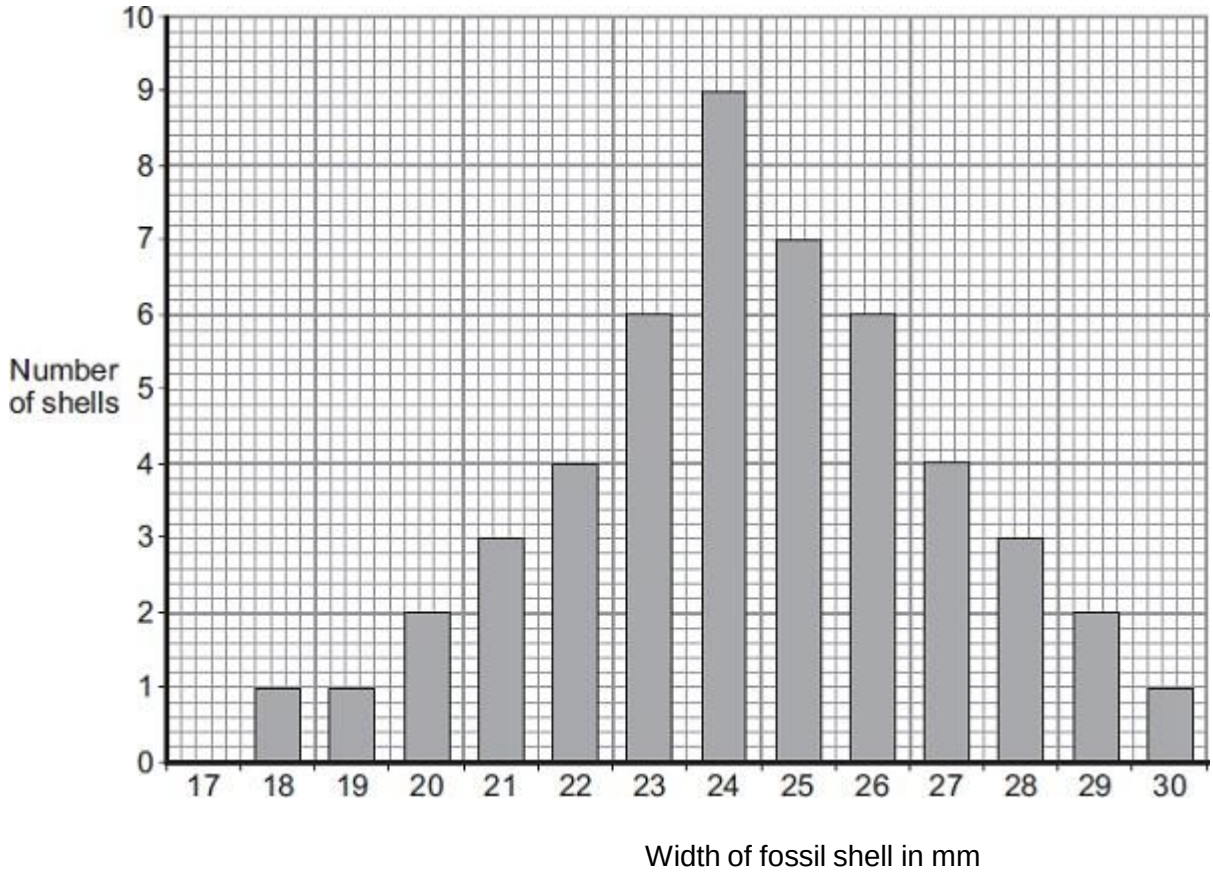
_____

_____

(1)

(b) A species of snail lived 400 million years ago.
Scientists measured the width of 49 fossil shells of this snail.

The bar chart shows the scientists' results.



(i) What is the range of the values for the width of the fossil shells for this species?

From _____ to _____

(1)

(ii) The scientists **cannot** be sure that this is the full range of fossil shell widths for this species.

Why?

_____

_____

(1)

(c) This species of snail became extinct 380 million years ago.

Give **one** possible reason why species become extinct.

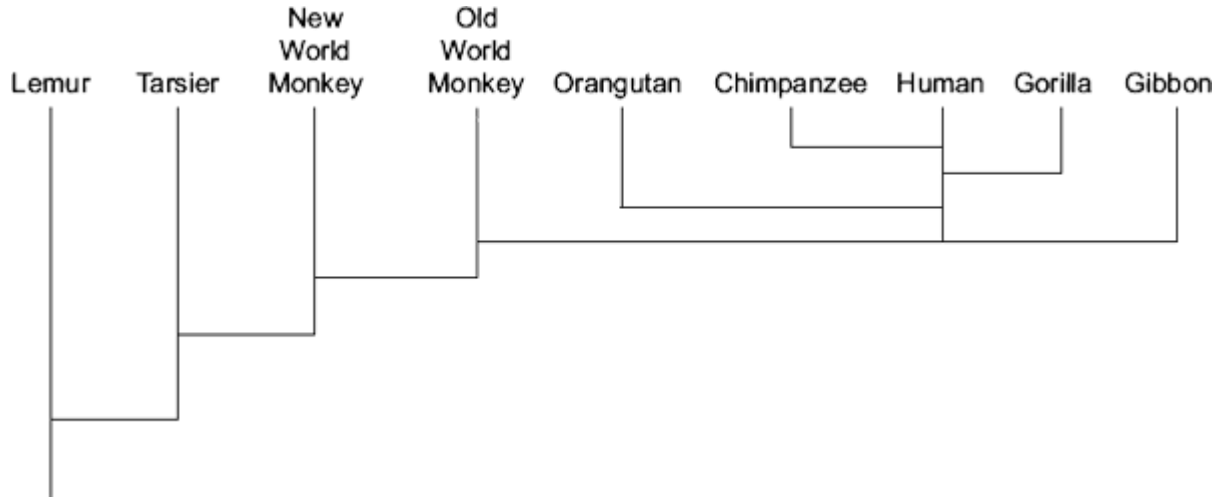
_____

_____

(1)

(Total 6 marks)

7 The diagram shows the evolution of a group called the primates.



(a) Which primate evolved first?

_____

(1)

(b) Name **two** primates that developed most recently from the same common ancestor as humans.

1. _____

2. _____

(2)

(c) (i) The theory of evolution by natural selection was suggested in the 1800s.

Which scientist suggested this theory?

_____

(1)

(ii) Use words from the box to complete the passage about natural selection.

evolution	**environment**	**generation**
mutate	**survive**	**variation**

Individual organisms of a species may show a wide range of

_____because of differences in their genes.

Individuals with characteristics most suited to the _____

are more likely to_____and breed

successfully.

The genes that have helped these individuals to survive are then passed on to

the next _____

(4)

(Total 8 marks)

8 The photographs show two breeds of cow.

Friesian cow

By Keith Weller/USDA (www.ars.usda.gov: Image Number K5176-3) [Public domain], via Wikimedia Commons

Jersey cow

By Jamain (Own work) [CC-BY-SA-3.0-2.5-2.0-1.0], via Wikimedia Commons

In parts (a) and (b) draw a ring around the correct answer to complete each sentence.

(a) Cows produce their young (calves) by

asexual reproduction.
cloning.
sexual reproduction.

(1)

(b) Cows and their calves have many similar characteristics.

(i) The information for characteristics is carried by

clones.
embryos.
genes

(1)

(ii) The information for characteristics is passed to the next generation in cells

called

- body cells.
- gametes.
- neurones.

(1)

(c) Friesian and Jersey cows can both be used for meat or to produce milk.

The information shows features of Friesian and Jersey cows.

Friesian cows	Jersey cows
Body mass up to 600 kg	Body mass up to 400 kg
Milk contains 3.4% protein	Milk contains 3.8% protein
Can be milked for 325 days after giving birth	Can be milked for 250 days after giving birth
Produce no milk for 55 days before having a calf	Produce no milk for 45 days before having a calf
Produce > 30 litres of milk per day	Produce < 30 litres of milk per day

Use **only** the information above to answer these questions.

In your answers you must make comparisons between the two breeds of cow.

(i) Give **two** advantages of a farmer keeping Friesian cows and **not** Jersey cows.

1. _____

_____

2. _____

_____

(2)

(ii) Give **two** advantages of a farmer keeping Jersey cows and **not** Friesian cows.

1. _____

_____

2. _____

_____

(2)

(d) Cow's milk is different from human milk. Cow's milk should **not** be given to young human babies.

Scientists in China have *genetically engineered* cows to produce human milk. Milk from these cows can be fed to young human babies.

(i) What is *genetic engineering*?

Tick (✓) **one** box.

Genes from one organism are transferred to a different organism	☐
Cells are separated from an embryo and are transferred to host mothers	☐
The nucleus from a body cell is transferred to an egg cell	☐

(1)

(ii) Some people are worried about using milk from genetically engineered cows, to feed human babies.

Give **one** reason why.

_____

_____

(1)

(Total 9 marks)

9 Humans reproduce sexually.

(a) Draw a ring around the correct answer to complete each sentence.

(i) At fertilisation [chromosomes / genes / gametes] join together.

(1)

(ii) At fertilisation a single cell forms. The cell has new pairs of

chromosomes.
nuclei.
gametes.

(1)

(b) A child inherits cystic fibrosis. The child's parents do **not** have cystic fibrosis.

(i) What does this information tell us about the cystic fibrosis allele?

Tick (✓) **one** box.

The allele is dominant. ☐

The allele is recessive. ☐

The allele is strong. ☐

(1)

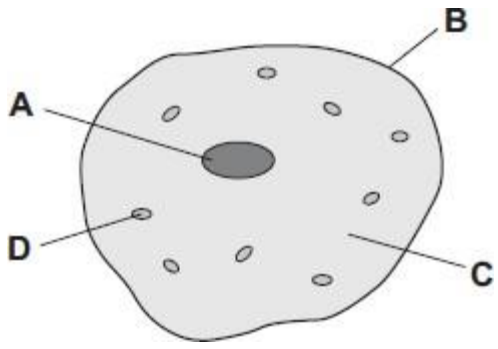
(ii) How many copies of the cystic fibrosis allele does the child have?

Draw a ring around your answer.

one **two** **four**

(1)

(c) The diagram shows a human body cell.



Which part of the cell, **A**, **B**, **C** or **D**:

(i) contains the allele for cystic fibrosis ☐

(1)

(ii) is affected by cystic fibrosis? 

(1)

(Total 6 marks)

1 (a) (i)

Feature	Mitosis only	Meiosis only
Produces new cells during growth and repair	✓	
Produces gametes (sex cells)		✓
Produces genetically identical cells	✓	

All 3 correct = **2** marks

2 correct = **1** mark

0 or 1 correct = **0** marks

2

(ii) (a man) testis / testes

accept testicle(s)

1

(a woman) ovary / ovaries

*do **not** accept 'ova' / ovule*

1

(b) (i) XY / YX

or

X and Y

1

(ii) XX

or

X and X or 2 X's

accept X

1

(c) ½ / 0.5 / 50% / 1:1 / 1 in 2

*do **not** accept 1:2 / 50/50*

allow 50:50

allow 2 in 4

1

[7]

2 (a) remains of an organism **or** bone / shell / hard part of an organism / impression

1

further detail – eg in rock / from a long time ago

if numbers, greater or equal to hundreds of years
allow made of minerals
ignore over time
ignore fossil are rocks

1

(b) (i) D

1

(ii) B

1

(iii) predation / disease / lack of food / competition / loss of habitat / climate change / catastrophic event – or volcanic eruption / flood / drought / temperature change / weather change / ice age / change in atmosphere

ignore human effects
ignore pollution effects / acid rain
allow natural disaster

1

(c) C = 'widest' thickest / wider
thicker column **or** more fossils
(of type C found)

allow biggest / er

1

(d) members of the groups have similar physical structures

extra box ticked – cancel

1

[7]

3 (a) 

*the shape must be (roughly) circular **and** not shaded, for the mark*
accept the shape drawn in the key if it is not contradictory

1

(b) dominant

1

(c) (i) a half (50%)

1

(ii) Some of B's sperm cells have an X chromosome

1

[4]

4 (a) insects don't eat / damage crop

allow idea of insects carrying plant disease

1

(b) (i) 60

1

(ii) lower (yield)

accept 'higher' if answer clearly refers to wheat with transferred gene

allow yield is only 52 ***or*** *goes down to 52*

1

by 8 (arbitrary units)

accept ecf from (b)(i) for ***2*** *marks*

1

(iii) grow / use wheat without insect poison (gene)

1

higher yield (in fields)

accept bigger crop / more wheat

ignore grows better

1

(c) *ignore unnatural / unethical / against religion unqualified*

(concerned about)

accept specific examples given

effect on populations of (wild) flowers / insects

ignore harms the environment

1

effect of <u>eating</u> GM crops on human health

allow harmful to humans if eaten

1

[8]

5 (a) (i) 1

1

fertilisation / fusion

allow <u>sexual</u> reproduction

allow fertilise / fuse

ignore joining

1

(b) (i) **Dd**

1

(ii) **dd**

1

(c) (i) 1 in 2

1

(ii) 0

1

[6]

6 (a) (i) (remains of) an organism / a bone / a shell / hard part of an organism / part of organism that does not decay / impression of an organism / footprint / burrow / rootlet trace

1

further detail – eg in rock / ice / amber / mineralisation

or

from a long time ago / many years ago

if number, > 1000 years

ignore hundreds

1

(ii) older fossils are simple(r)

must make ref to change and time

allow deeper fossils are simple(r)

or

fossils show change / adaptation with time

1

(b) (i) 18 to 30

allow 30 to 18

allow 12

ignore units

1

(ii) small sample

allow <u>only</u> 49 shells / not representative / not enough evidence

allow not all fossils found

1

(c) example of a physical factor such as flooding, volcanic activity (allow volcanoes) asteroid collisions, drought, ice age / temperature change

allow natural disaster / climate change / weather change / catastrophic event / environmental change

or

example of a biological factor such as predators / disease / competition / lack of food or mates / cyclical nature of speciation / isolation / lack of habitat or habitat change

ignore human factors eg hunting / pollution

1

[6]

7 (a) lemur(s)

1

(b) gorilla(s)

in either order

1

chimpanzee(s)

accept chimps

1

(c) (i) (Charles) Darwin

accept (Alfred) Wallace

if first name given it must be correct

1

(ii) variation

in this order

1

environment

allow phonetic spellings

1

survive

1

generation

1

[8]

8 (a) sexual reproduction

1

(b) (i) genes

1

(ii) gametes

1

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

answers must be comparative

- more meat (per cow)

  ignore bigger unqualified

- more milk each day

- can be milked for more time after giving birth / greater proportion of time

  *accept '(produce) more milk', for **1** mark, if neither more milk each day nor can be milked for more time after giving birth are given*

2

(ii) (milk contains) more protein

answers must be comparative

1

less time before having a calf when no milk produced

1

(d) (i) genes from one organism are transferred to a different organism

1

(ii) (possible) harm to babies' long term health

allow don't know long-term / side effects (on baby)

accept idea that there may be other things in (genetically engineered) cow's milk that might harm babies' health e.g. bacteria

ignore ethical / religious arguments

1

[9]

9 (a) (i) gametes

apply list principle

1

(ii) chromosomes

apply list principle

1

(b) (i) The allele is recessive

no mark if more than one box is ticked

1

(ii) two

apply list principle

1

(c) (i) **A**

apply list principle

1

(ii) **B**

apply list principle

1

[6]