Q1.  
Figure 1 shows a fish called a carp.

The characteristics of an animal can be a result of:

- only genetic causes
- only environmental causes
- both genetic and environmental causes.

(a) Give one characteristic shown in Figure 1 for each different cause.

Only genetic causes _________________________________________________

Only environmental causes __________________________________________

Both genetic and environmental causes __________________________________

___________________________________________________________________

(3)

(b) Two alleles control the body colour of carp:

- brown (B)
- blue (b).

The brown allele is dominant to the blue allele.

The genetic cross from breeding two carp is shown in Figure 2.

Figure 2

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>b</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>Bb</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Complete Figure 2.
(c) Draw a ring around one blue offspring shown in Figure 2.

(d) What is the probability that the offspring from this genetic cross will be brown?
   Tick two boxes.
   0
   0.25
   0.5
   1.0

(e) Carp can produce large numbers of offspring.
   The two carp crossed in Figure 2 had 260 000 offspring.
   Approximately how many offspring are expected to be brown?
   Brown carp offspring = __________________________

(f) A pond contains carp used for breeding.
   The carp for breeding are brown or blue.
   A red carp has been seen.
   The red carp was not added to the pond.
   Suggest what might have caused the red carp to appear.
   ____________________________________________
   ____________________________________________

Q2.
   The diagram shows a time line for the evolution of humans.
(a) (i) How many millions of years ago did humans first use fire? \[\text{millions of years ago}\] (1)

(ii) Which human ancestor, P, Q, R or S, was the first ancestor to use tools? (1)

(iii) For how many millions of years did human ancestor R live on Earth? (1)

(b) How do we know that human ancestors P, Q, R and S lived on Earth?

_______________________________________________________________

_______________________________________________________________

_______________________________________________________________

(1)

(c) Which scientist suggested that humans have evolved from ape-like ancestors?

Draw a ring around one answer.

Darwin  Mendel  Semmelweiss

(1)

(Total 5 marks)

Q3.
The diagram shows a method of producing a large number of plants which all look the same. Cells taken from the bud can be split into many groups. Each group of cells is then grown under the same conditions.

(i) What do scientists call organisms which are all produced from one parent and which all look the same? Draw a ring around one answer.

- clones
- communities
- populations

(1)

(ii) Give two reasons why plants produced by this method will all look the same.

1. ______________________________________________________________
2. ______________________________________________________________

(2) (Total 3 marks)

Q4.

(a) Alleles are different forms of the same gene.

Why does a person usually inherit two alleles of each gene?

____________________________________________________________

(1)

(b) Some humans are albino (they have white hair and pale skin). This condition is caused by a recessive allele, n. The other allele, N, causes a coloured pigment to be made.

There are three possible combinations of these alleles:
(i) Which one of these combinations will an albino person have?

(ii) Two non-albino parents can sometimes have an albino child.

Which one of the following combinations of alleles must these two parents have?

Tick (☑) the box next to the correct answer.

Tick one box only.

<table>
<thead>
<tr>
<th>Parent 1</th>
<th>Parent 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NN</td>
<td>NN</td>
</tr>
<tr>
<td>NN</td>
<td>Nn</td>
</tr>
<tr>
<td>Nn</td>
<td>Nn</td>
</tr>
<tr>
<td>nn</td>
<td>nn</td>
</tr>
</tbody>
</table>

(1) (Total 3 marks)

Q5.

The diagrams show one of the experiments performed by a scientist called Mendel.

He bred sweet pea plants.
In the sentences below, cross out the two lines which are wrong in each box.

Mendel proposed that flower colour was controlled by inherited factors.

The first generation plants show that the red factor is dominant environmental recessive.

The second generation plants show that the white factor is dominant environmental recessive.

We now call inherited factors chromosomes gametes genes.

These factors are passed from generation to generation in gametes glands organs.

The red-flowered sweet pea plants did not all grow to the same height.
This was due to factors.

Q6.

Choose words from this list to complete the sentences below.

bones extinct fossils
muscles rocks

In the past some types of animals and plants have died out.

They have become ________________.

We know about these animals and plants because we find them as ________________.

Sometimes the hard parts of animals such as ________________ did not decay.

In other cases the bodies of animals and plants were replaced by minerals.

You can still see their shape in ________________.

(Total 4 marks)

Q7.

Fossils give us evidence for the theory of evolution.

The diagrams show how a fish became a fossil.

(a) In the sentences below, cross out the two lines which are wrong in each box.
(b) Give one way in which fossils provide evidence for the theory of evolution.


(1)
(Total 5 marks)

Q8.
Choose words from this list to complete the sentences below.

coal dinosaurs extinct fossils rocks

Many animals and plants which once existed have died out.
They are now __________________________.

We know about them because their remains formed
__________________________ which are found in __________________________.

(Total 4 marks)

Q9.
Sometimes an adult offspring will show a distinct variation from its parents, like a zebra appearing to have no stripes.

(a) (i) Changes of this sort are called ______________________________.

(ii) Which part of the cell has chemically changed to cause this variation? Circle the correct answer.

- Cytoplasm
- gene
- membrane
- nucleus

(b) Give a cause of this type of chemical change in a cell.

___________________________________________________________________

___________________________________________________________________

(c) Use zebras as an example to explain the term species.

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

(Total 5 marks)

Q10.
Men and women produce different gametes (sex cells).
In sexual reproduction the male and female gametes join together. What is the name for this process?

___________________________________________________________________  (1)

(b) Complete the sentences about sex cells.

(i) Male gametes are called __________________________
    They are produced in the __________________________
    (2)

(ii) Female gametes are called __________________________
     They are produced in the __________________________
     (2)

(Total 5 marks)

Q11.

(a) In sexual reproduction a sperm cell joins with an egg cell.

Complete the sentences by choosing the correct words from the box.

| bladder | kidney | liver | lung | ovary | testis |

(i) The organ in which a sperm cell is made is the __________________________  (1)

(ii) The organ in which an egg cell is made is the __________________________  (1)

(b) What name is given to the process in which sperm cells and eggs cells join together?

___________________________________________________________________  (1)

(c) Two new cells are formed from one cell by asexual reproduction.
How, genetically, does the nucleus of new cell C compare with:

(i) the nucleus of the other new cell B:

(ii) the nucleus of the original cell A?

(Total 5 marks)

Q12.
The diagram shows a timeline for the evolution of some dinosaurs.

The mass of each dinosaur is shown in the brackets by its name.

(a) Name one dinosaur which lived between 100 and 150 million years ago.

(b) Which dinosaur did Ornitholestes evolve from?

(c) Apart from body size and mass, give one other difference between Lagosuchus
and Alamosaurus.

(d)  (i) Which dinosaur had the largest mass?

(1)

(ii) What happened to the mass of dinosaurs during evolution?

(1)

(e) We know about dinosaurs from their fossils. Describe one way in which fossils are formed

(1)

(f) Complete the sentence by using the correct words from the box.

[billion  complex  large  million  simple  thousand]

The theory of evolution states that all species of living things have evolved from _________________ life forms which first developed more than three _________________ years ago.

(2)

(Total 8 marks)

Q13.

These are all dogs. They are in the same species.

<table>
<thead>
<tr>
<th>Type:</th>
<th>Great Dane</th>
<th>Yorkshire Terrier</th>
<th>Standard Dachshund</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight:</td>
<td>54 kg</td>
<td>3.5 kg</td>
<td>9 kg</td>
</tr>
<tr>
<td>Height to shoulder:</td>
<td>57 cm</td>
<td>25 cm</td>
<td>20 cm</td>
</tr>
</tbody>
</table>
(a) What does it mean to be *in the same species*?

___________________________________________________________________

___________________________________________________________________

(2)

(b) Complete the following sentences.

• When dogs reproduce the ________________________ produces sperm in the
  ______________________ and the female produces eggs in the ________________

• Sperm and eggs are also called __________________

• During mating, the sperm and eggs fuse together. This is known as
  __________________

• Once this has happened the ___________________ starts to develop in the
  uterus of the mother.

(6)

(c) Explain why puppies have some of the characteristics of both parents.

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

(2)

(Total 10 marks)

Q14.

In humans, the sex chromosomes \( X \) and \( Y \) determine whether the baby will be male or female (its gender).

(a) (i) Draw a genetic diagram to show how gender is inherited. The male has \( XY \) chromosomes and the female has \( XX \).

(ii) What is the likelihood of obtaining a male child?

___________________________________________________________________

(1)

(b) In the 16th century Henry VIII was the King of England. He blamed some of his wives for giving birth to daughters instead of sons. With our present day knowledge of genetics this mistake could not be made today. Explain why Henry VIII was
Q15.
The chromosomes for determining the gender or sex of a person are labelled X and Y.

(a) Complete the Punnett Square to show the genotype of parent 2 and of the four offspring.

(b) Which parent is the mother?

(c) What are the chances of getting a baby boy?

Q16.
(a) Complete the following passage

Chromosomes carry genetic information. Chromosomes are made up of __________________. Human body cells contain 46 chromosomes. There are twenty-two matching pairs but the final pair does not always match. It is these two
that determine the gender, or sex, of the human. If you are a __________________
the final pair of chromosomes matches. If you are a ______________________
the final pair of chromosomes does not match.

(b) Draw a labelled diagram to show that there is an equal chance of parents producing a baby boy or girl. Use the symbols X and Y for the chromosomes.

Q17.
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.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Tick (✓)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All the groups lived in the same area.</td>
<td></td>
</tr>
<tr>
<td>Fossils from each group were found in the same rock layer.</td>
<td></td>
</tr>
</tbody>
</table>
Q18.

Animals have adaptations that enable them to survive.

(a) The photograph shows an echidna.

The echidna has pointed spines on its back.

Explain how these spines might help the echidna to survive.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(b) The photograph shows a caterpillar.
Explain how the caterpillar’s appearance might help it to survive.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
(c) Draw a ring around the correct answer to complete each sentence.

(i) Evolution can be explained by a theory called

- genetic engineering
- mutation
- natural selection

(1)

(ii) This theory was suggested by a scientist called Charles

- Darwin
- Lamarck
- Semmelweiss

(1)

(iii) This scientist said that all living things have evolved from

- monkeys
- dinosaurs
- simple life forms

(1)

(d) Many religious people oppose the theory of evolution.
Q19.

There are two types of reproduction, asexual and sexual. Use the words in the box to complete the sentences about reproduction.

You may use each word once or not at all.

<table>
<thead>
<tr>
<th>asexual</th>
<th>eggs</th>
<th>gametes</th>
<th>fertilisation</th>
<th>inheritance</th>
</tr>
</thead>
<tbody>
<tr>
<td>ovaries</td>
<td>sexual</td>
<td>sperms</td>
<td>testes</td>
<td>variation</td>
</tr>
</tbody>
</table>

The genetic information from the mother is carried in the ____________________
which are made in the ____________________.

The genetic information from the father is carried in the ____________________
which are made in the ____________________.

In ________________ reproduction, offspring are produced that are genetically different from either parent.

This happens because genetic information from each parent is carried in the ________________ and joined together during ________________ to develop into a fetus.

In ________________ reproduction, genetically identical offspring are produced because no mixing of genetic material takes place.

(Total 8 marks)

Q20.

Scientists began to keep records of cases of H5N1 bird flu in humans in January 2004.

The graph shows the total number of cases of bird flu in humans and the total number of deaths up to January 2006.
(a) (i) How many people had died from bird flu up to 01/07/05?

(ii) Describe, as fully as you can, how the number of cases of bird flu in humans changed between 01/07/04 and 01/01/06.

(b) At present, humans can only catch bird flu from contact with infected birds. The bird flu virus may mutate into a form that can be passed from one human to another.

Explain why millions of people may die if the bird flu virus mutates in this way.
Q21.
The photographs show two varieties of moths, X and Y. The moths belong to the same species. The moths are resting on a tree trunk in open countryside.

(a) Which variety of moth, X or Y, is more likely to be killed by insect-eating birds? Give a reason for your answer.

Variety of moth: _____________________________________________________

Reason ____________________________________________________________

(b) In an experiment, large numbers of each variety of moth were caught in a trap.

- They were marked with a spot of paint on the underside of one wing and then released.
- A few days later, moths were again trapped and the number of marked moths was counted.
- The experiment was carried out in a woodland polluted by smoke and soot, and also in an unpolluted woodland.

The results are shown in the bar graph.
(i) When the moths were being marked, suggest why the paint was put on the underside of the wing and not on the top.

__________________________________________________________________________________________ (1)

(ii) What percentage of moths of type X was recaptured in:

the polluted woodland; __________________________________________

the unpolluted woodland? ________________________________________ (2)

(iii) In each woodland, only a small number of marked moths of both varieties were recaptured. Suggest one reason for this.

__________________________________________________________________________________________ (1)

(c) (i) The colour of the moths is controlled by a gene. The dark form was first produced by a mutation in the gene.

What chemical, found in a gene, is changed by a mutation? Draw a ring around your answer.

carbohydrate  DNA  fat  protein

(1)

(ii) Some of the offspring from the original dark moth were also dark. What caused this?

__________________________________________________________________________________________ (1)

(Total 7 marks)
Complete each sentence by choosing the correct terms from the box.

<table>
<thead>
<tr>
<th>23</th>
<th>46</th>
<th>ADH</th>
<th>DNA</th>
<th>XX</th>
<th>XY</th>
<th>YY</th>
</tr>
</thead>
<tbody>
<tr>
<td>dominant</td>
<td>female</td>
<td>male</td>
<td>recessive</td>
<td>strong</td>
<td>weak</td>
<td></td>
</tr>
</tbody>
</table>

A gene is made up of a substance called _______________. Genes are found on chromosomes and most human cells contain ________________ pairs of chromosomes. In females the two sex chromosomes are _________ but in males the two sex chromosomes are ________.

Alleles are alternative forms of a gene. Two healthy parents can sometimes have a child with a genetic disorder such as cystic fibrosis. This is because cystic fibrosis is caused by a ________________ allele. The two parents are healthy because they also have the ________________ allele.

(Total 6 marks)

Q23.

(a) **Figure 1** shows a minke whale. Whales live in the sea.

![Figure 1](image)

Write down two ways in which the body of the whale is adapted for swimming.

1. ________________________________________________________________________
   ________________________________________________________________________

2. ________________________________________________________________________
   ________________________________________________________________________

(b) **Figure 2** shows the skeleton of a minke whale.
Figure 3 shows the fossil skeleton of an extinct whale.

(i) Apart from size, give **two** differences between the skeleton of the minke whale and the fossil skeleton of the extinct whale.

1. ____________________________________________________________  
   ____________________________________________________________

2. ____________________________________________________________  
   ____________________________________________________________

(ii) In each of the sentences below, draw a ring around the correct answer.

Life on Earth first developed more than three __________ years ago.

[ ] billion  
[ ] million  
[ ] thousand

Fossils __________ the theory of evolution.

[ ] disprove  
[ ] give evidence for  
[ ] prove

(Total 6 marks)
Read the article from a recent newspaper.

‘King Kong’ with inch-wide teeth who walked alongside early man.

The largest ape that walked on Earth was a prehistoric animal that weighed up to 540 kg. It was 3 metres tall and had inch-wide teeth. This giant ape roamed bamboo forests until 100 000 years ago. It is quite likely that the giant ape lived at the same time as early humans.

(a) What evidence might scientists have that the great ape existed?

___________________________________________________________________
___________________________________________________________________

(b) The drawing is an artist’s impression of what the giant ape might have looked like.

Why do scientists not know exactly what the animal looked like?

___________________________________________________________________
___________________________________________________________________

(1)

(c) Scientists do not know why this giant ape became extinct.

Suggest two reasons why this giant ape became extinct.
Q25.

The diagram shows a spider plant during one type of reproduction.

Complete the sentences using words from the box.

<table>
<thead>
<tr>
<th>asexual</th>
<th>characteristics</th>
<th>chromosomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>gametes</td>
<td>genes</td>
<td>mitosis</td>
</tr>
</tbody>
</table>

(a) The colour and shape of the leaves of a spider plant are known as ________________________________________________________________

(b) The shape of the leaves is controlled by ________________________________________________________________

(c) The thread-like structures inside the nucleus of the cells are called ________________________________________________________________

(d) The spider plant produces new cells in the runner by a process called ________________________________________________________________
Q26.
The photographs show a zorse and its parents, a zebra and a horse.

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

The zorse was produced by

cloning
asexual reproduction
sexual reproduction

(b) Explain the appearance of the zorse.

Use both words from the box in your explanation.
Q27.

A woman gives birth to triplets.
Two of the triplets are boys and the third is a girl.
The triplets developed from two egg cells released from the ovary at the same time.

The diagram shows how triplets A, B and C developed.

(a) Which stages on the diagram show gametes?

Draw a ring around your answer.
(b) Embryo B is male.

Which of the following explains why embryo B is male?

Tick (✓) one box.

Cell P has an X chromosome; cell R has an X chromosome. ☐

Cell P has a Y chromosome; cell R has an X chromosome. ☐

Cell P has an X chromosome; cell R has a Y chromosome. ☐

(1)

(c) The children that develop from embryos A and C will not be identical.

Explain why.

You may use words from the box in your answer.

________________________

________________________

________________________

________________________

________________________

(2)

(d) Single cells from an embryo at Stage 7 can be separated and grown in a special solution.

(i) What term describes cells that are grown in this way?

Draw a ring around your answer.

alleles screened cells stem cells

(1)

(ii) What happens when the cells are placed in the special solution?

Tick (✓) two boxes.

The cells divide ☐

The cells fertilise ☐
The cells differentiate
The cells separate

(iii) Give one use of cells grown in this way.

______________________________________________________________

______________________________________________________________

(iv) Some people might object to using cells from embryos in this way.

Give one reason why.

______________________________________________________________

______________________________________________________________

(Total 9 marks)

Q28.

Scientists have produced many different types of GM (genetically modified) food crops.

(a) Use words from the box to complete the sentence about genetic engineering.

| clones | chromosomes | embryos | genes |

GM crops are produced by cutting ____________________________ out of the ____________________________ of one plant and inserting them into the cells of a crop plant.

(b) Read the information about GM food crops.

- Herbicide-resistant GM crops produce higher yields.
- Scientists are uncertain about how eating GM food affects our health.
- Insect-resistant GM crops reduce the total use of pesticides.
- GM crops might breed naturally with wild plants.
- Seeds for GM crops can be bought from only one manufacturer.
The numbers of bees will fall in areas where GM crops are grown.

Use this information to answer these questions.

(i) Give **two** reasons why some farmers are in favour of growing GM crops.

1. ____________________________________________________________
   ____________________________________________________________

2. ____________________________________________________________
   ____________________________________________________________

(ii) Give **two** reasons why many people are against the growing of GM crops.

1. ____________________________________________________________
   ____________________________________________________________

2. ____________________________________________________________
   ____________________________________________________________

(Total 6 marks)

Q29.

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

Which scientist suggested this theory?

______________________________________________________________________________

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

<table>
<thead>
<tr>
<th>evolution</th>
<th>environment</th>
<th>generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>mutate</td>
<td>survive</td>
<td>variation</td>
</tr>
</tbody>
</table>

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 _______________________________

(Total 8 marks)

Q30.
The family tree shows the inheritance of a disorder caused by a dominant allele.

Fiona and Eric have two children George and Harriet.

The son, George, has the disorder.

The daughter, Harriet, does not have the disorder.
(i) Use the key to draw the symbol for Harriet next to her name on the family tree.

(ii) The symbol D represents the dominant allele for the disorder. The symbol d represents the recessive allele.

Fiona has the pair of alleles dd.

Write the correct pairs of alleles in the boxes.

Harriet has the pair of alleles ____________

A person with the disorder could have

the pair of alleles ____________ or the pair of alleles ____________

(b) Before Harriet was born, a doctor suggested that Fiona should have the embryo 'screened'.

(i) Give one reason why the doctor suggested screening.

Tick (✔) one box.

To check for the D allele

To check the sex of the embryo

To cure the disorder

(ii) Why do some people believe that embryos should not be screened?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(Total 7 marks)

Q31.

Scientists have discovered how to produce genetically modified (GM) hens’ eggs.

Some proteins produced in GM eggs can be used as drugs to treat humans.
The diagram shows how this is done.

(a) Which type of reproduction is involved when the cockerel mates with the hen?
Tick (✓) one box.

- Asexual
- Cloning
- Sexual

(b) From which part of a human are the genes cut?
Tick (✓) one box.

- Chromosome
- Embryo
- Glands

(c) Read the information about genetically modified animals.
- GM animals might escape and breed with wild animals.
• Genetic modification can produce fast-growing animals for food.
• Genetic modification can be used to clone animals in danger of extinction.
• Using GM animals can reduce the number of animals used in medical research.
• Animals have the right to be free from genetic modification.

Use only this information to answer these questions.

(i) Give two reasons why many people are in favour of genetically modified animals.
1. ____________________________________________________________
2. ____________________________________________________________

(ii) Give two reasons why many people are against genetically modified animals.
1. ____________________________________________________________
2. ____________________________________________________________

(Total 6 marks)

Q32.
Humans reproduce sexually.

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

(a) (i) At fertilisation genes join together.

   chromosomes
   sex cells

(ii) At fertilisation a single cell forms, which has new pairs of

   chromosomes.
   nuclei.

   sex cells.

(b) Cystic fibrosis can be inherited by children whose parents do not have it.

   (i) A person who has cystic fibrosis has three copies of the

       cystic fibrosis allele.
(ii) The cystic fibrosis allele is recessive.

Choose the correct answer from the box to complete each sentence.

<table>
<thead>
<tr>
<th>cell membrane</th>
<th>cell wall</th>
<th>cytoplasm</th>
<th>nucleus</th>
</tr>
</thead>
</table>

(i) The part of the cell labelled B is the _______________________________  

(ii) The part of the cell labelled C is the _______________________________  

(d) Which part of the cell, A, B, C or D:

(i) contains the allele for cystic fibrosis

(ii) is affected by cystic fibrosis?

Q33.

Maize plants reproduce sexually to form maize cobs. Each maize cob has many seeds.

The colour of the seeds is controlled by a gene. The gene has two alleles, purple and yellow.

The diagram shows the cobs produced by breeding maize plants.
(a) Use words from the box to complete the sentences.

<table>
<thead>
<tr>
<th>dominant</th>
<th>environmental</th>
<th>recessive</th>
</tr>
</thead>
</table>

(i) The first generation plants show that the purple allele is ____________________________ (1)

(ii) The second generation plants show that the yellow allele is ____________________________ (1)

(b) The allele for purple can be represented by the letter A. The allele for yellow can be represented by the letter a.

(i) What alleles does a yellow seed have?

Draw a ring around one answer.

AA  Aa  aa (1)

(ii) What alleles does a purple seed from a first generation plant have?

Draw a ring around one answer.
A student counted 334 purple seeds and 110 yellow seeds on this maize cob. What is the approximate ratio of purple seeds to yellow seeds on the cob?

Tick (✓) one box.

3 purple : 1 yellow

1 purple : 3 yellow

1 purple : 1 yellow

Q34.

When scientists look at dividing cells under a microscope, they can see strands that contain a chemical called DNA.

A photograph of these strands can be cut up and re-arranged.

The diagram shows an arrangement of the strands from a human cell.
(a) What name is given to the strands containing DNA shown in the diagram?

Draw a ring around one answer.

- alleles
- chromosomes
- genes

(b) Look carefully at the diagram.

(i) The cell was taken from a man and not from a woman.

How can you tell?

____________________________________________________________________________________

(ii) What evidence is there that the strands are from a body cell, and not from a gamete?

Tick (✓) one box.

- The strands are arranged in order of size.
- The strands are in pairs.
- Gametes are made in the testes and ovaries.

(iii) When a human cell is not dividing the strands containing DNA are not clearly visible.

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

In a human cell, the DNA is normally found in the

- cell membrane.
- cytoplasm.
Q35.
Soay sheep live wild on an island off the north coast of Scotland. No people live on the island.

Over the last 25 years, the average height and mass of the wild Soay sheep have decreased.

The scientists think that climate change might have affected the size of the sheep.

(a) More Soay sheep are now able to survive winter than 25 years ago.

What change in the climate may have helped more Soay sheep to survive winters?
___________________________________________________________________
___________________________________________________________________

(b) Complete the sentences.

(i) Soay sheep show variation in size because of differences in their
___________________________________________________________________

(ii) The change in the size of the Soay sheep over 25 years can be explained by Darwin’s
theory of ________________________________

Q36.
The diagram shows the family tree of a pair of pigs, A and B. Pigs A and B have four offspring, C, D, E and F.

Some of the pigs have a genetic disorder.
(a) Which pig, A, B, C, D, E or F, is:

(i) a male pig with the genetic disorder

(ii) a female pig without the genetic disorder?

(b) Draw a ring around the correct answer to complete the sentences.

Pig C has the genetic disorder.

(i) Pig C inherited the genetic disorder from

   pig A.
   pig B.
   pig E.

(ii) The gene for the genetic disorder was passed on in

   an embryo.
   an enzyme.
   a gamete.

(c) Pig F is a male.

Complete the diagram to show how the sex of pig F depends on the inheritance of the sex chromosomes X and Y.

The sex chromosomes of pig B and the egg cells have been completed for you.
Q37.  
(a) Human body cells contain 46 chromosomes.

How many chromosomes are there in a human sperm cell?  
(i)  
(ii) Name the part of the sperm cell that contains the chromosomes. 

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

(i) In human females, the sex chromosomes are 

X and X.  
X and Y.  
Y and Y. 

(ii) In human males, the sex chromosomes are 

X and X.  
X and Y.  
Y and Y. 

(c) A man might release 300 million sperm cells at a time.  

How many of these sperm cells would contain an X chromosome?
Q38.
The diagram shows a strawberry plant.
The parent plant grows side shoots.
New plants grow on the side shoots.

The new plants will all have the same inherited characteristics as the original parent plant.
Complete the sentences to explain why.
Use words from the box.

(a) The new plant is produced by ___________________________ reproduction.

(b) In this type of reproduction, body cells divide by ____________________________

(c) The new plant has the same ______________________________ as the parent plant.

Q39.
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.

___________________________________________________________________
(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

(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.

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________
(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)

Q40.

Cystic fibrosis is an inherited disorder.

Mr and Mrs Brown do not have cystic fibrosis but they have a child with cystic fibrosis.

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

(i) The allele for cystic fibrosis is a

- dominant allele.
- recessive allele.
- carrier allele.

(1)

(ii) Mr and Mrs Brown are both

- carriers.
- immune.
- infected.

(1)

(b) The diagram shows how the allele for cystic fibrosis can be inherited by Mr and Mrs
Brown’s children.

(i) Give the number of one person in the diagram who has cystic fibrosis.

(ii) The chance that Mr and Mrs Brown’s next child will have cystic fibrosis is ________________________________

(c) A genetic counsellor describes to Mr and Mrs Brown one way of screening embryos for cystic fibrosis.

• Some eggs are collected from Mrs Brown.
• The eggs are then fertilised in a dish.
• Several embryos may start to develop.

The photograph shows how doctors take one cell from each embryo when it is only 3 days old.

• The DNA in the cell from each embryo is tested for cystic fibrosis.
• Doctors select one embryo that is unaffected and place it in Mrs Brown’s uterus.
• The embryo then develops into a baby.
Use the information to suggest **one** advantage and **one** disadvantage of screening embryos in this way.

**Advantage**

___________________________________________________________________

**Disadvantage**

___________________________________________________________________

(2)

(Total 6 marks)

Q41.

Living things can be classified into groups.

(a) Scientists look at structures inside cells to classify living things.

Suggest **one** structure found in cells that can be used to classify living things.

___________________________________________________________________

(1)

(b) The table below shows one system for classifying humans.

<table>
<thead>
<tr>
<th>X</th>
<th>Animalia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum</td>
<td>Chordata</td>
</tr>
<tr>
<td>Class</td>
<td>Mammalia</td>
</tr>
<tr>
<td>Order</td>
<td>Primates</td>
</tr>
<tr>
<td>Family</td>
<td>Hominidae</td>
</tr>
<tr>
<td>Genus</td>
<td>Homo</td>
</tr>
<tr>
<td>Species</td>
<td>Sapiens</td>
</tr>
</tbody>
</table>

Who devised this system of classification?

Tick **one** box.

Darwin

Linnaeus

Wallace

Woese

(1)

(c) Look at the table above.
**Q42.**

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 = ______________________________  

(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.  

(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 %)

(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.

(Total 4 marks)

Q43.  
(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.

<p>| Feature | Only in Mitosis | Only in Meiosis |</p>
<table>
<thead>
<tr>
<th>mitosis (✓)</th>
<th>mitosis (✓)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produces new cells during growth and repair</td>
<td></td>
</tr>
<tr>
<td>Produces gametes (sex cells)</td>
<td></td>
</tr>
<tr>
<td>Produces genetically identical cells</td>
<td></td>
</tr>
</tbody>
</table>

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

- a man ______________________
- a woman ____________________

(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 ______________________

(ii) a woman? ____________________

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

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

(Total 7 marks)

Q44.

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

The photograph shows the foot of a baby with polydactyly.
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?

(ii) Complete the sentence.

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

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

Tick (✓) one box.

- DD
- Dd
- dd

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

Tick (✓) one box.

- DD
- Dd
- dd
(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.

(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.

(Total 6 marks)

Q45.

The photographs show two breeds of cow.

Friesian cow

Jersey cow

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

(a) Cows produce their young (calves) by

cloning.
asexual reproduction.

sexual reproduction.

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

clones.
(i) The information for characteristics is carried by 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.

<table>
<thead>
<tr>
<th>Friesian cows</th>
<th>Jersey cows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass up to 600 kg</td>
<td>Body mass up to 400 kg</td>
</tr>
<tr>
<td>Milk contains 3.4% protein</td>
<td>Milk contains 3.8% protein</td>
</tr>
<tr>
<td>Can be milked for 325 days after giving birth</td>
<td>Can be milked for 250 days after giving birth</td>
</tr>
<tr>
<td>Produce no milk for 55 days before having a calf</td>
<td>Produce no milk for 45 days before having a calf</td>
</tr>
<tr>
<td>Produce &gt; 30 litres of milk per day</td>
<td>Produce &lt; 30 litres of milk per day</td>
</tr>
</tbody>
</table>

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. __________________________________________________________________________

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

1. __________________________________________________________________________
(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

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

Give one reason why.

______________________________________________________________

______________________________________________________________

______________________________________________________________

(Total 9 marks)

Q46.

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?

______________________________________________________________

______________________________________________________________
(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 ________________

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

__________________________________________________________________________________

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

Give one possible reason why species become extinct.

__________________________________________________________________________________

(Total 6 marks)
Q47.
Humans reproduce sexually.

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

(i) At fertilisation **genes** join together.

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

(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.

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

Draw a ring around your answer.

- one  
- two  
- four

(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

(ii) is affected by cystic fibrosis?

(Total 6 marks)

Q48.

Scientists have produced many different types of GM (genetically modified) food crops.

(a) Use words from the box to complete the sentence about genetic engineering.

<table>
<thead>
<tr>
<th>clones</th>
<th>chromosomes</th>
<th>embryos</th>
<th>genes</th>
</tr>
</thead>
</table>

GM crops are produced by cutting ______________________ out of the ______________________ of one plant and inserting them into the cells of a crop plant.

(b) Read the information about GM food crops.

- Herbicide-resistant GM crops produce higher yields.
- Scientists are uncertain about how eating GM food affects our health.
- Insect-resistant GM crops reduce the total use of pesticides.
- GM crops might breed naturally with wild plants.
- Seeds for a GM crop can only be bought from one manufacturer.
- The numbers of bees will fall in areas where GM crops are grown.

Use this information to answer these questions.

(i) Give two reasons why some farmers are in favour of growing GM crops.

1. ____________________________________________________________

2. ____________________________________________________________

(ii) Give two reasons why many people are against the growing of GM crops.

1. ____________________________________________________________
Q49.
Fossils give us information about organisms from a long time ago.

(a) Amber is a solid, glass-like material. Amber is formed from a thick, sticky liquid which oozes out of pine trees.

The image shows two fossil insects in amber.

(i) Suggest how the insects came to be preserved in the amber.

(ii) Give two other ways fossils are formed.

1. 

2. 

(b) The fossil record shows that many organisms, including the dinosaurs, became
extinct 65 million years ago.

One theory was that volcanic activity might have caused this mass extinction. Many scientists believe that this extinction was caused when an asteroid collided with the Earth.

(i) A new scientific theory may replace an old theory.

Why might this happen?

Tick (✓) one box.

Evidence from amber is unreliable.  
Internet evidence is more reliable than fossil evidence.  
New technology provides more valid evidence.

(ii) Give three reasons, other than volcanic activity and collision with an asteroid, why a species may become extinct.

1. ____________________________________________________________  
   ______________________________________________________________

2. ____________________________________________________________  
   ______________________________________________________________

3. ____________________________________________________________  
   ______________________________________________________________

(Total 8 marks)

Q50.

When humans reproduce, chromosomes and genes are passed on to the next generation.

In each of the following questions, draw a ring around the correct answer to complete the sentence.

(a) A gene is a small section of cellulose.  DNA.  protein.

X and X.
(b) The sex chromosomes in the human male are \(X\) and \(Y\). \(X\) and \(Y\). (1)

(c) (i) Most human body cells contain \(23\) chromosomes. \(46\) chromosomes. \(92\) chromosomes. (1)

(ii) The number of chromosomes in a human gamete (sex cell) is the same number as half the number in body cells. twice the number. (1)

(d) Gametes are produced by fertilisation. meiosis. mitosis. (1)

(Total 5 marks)

Q51.
In each question, draw a ring around the correct answer to complete the sentence.

(a) Our understanding of how genes are inherited is mostly because of the work of Darwin. Lamarck. Mendel. (1)

(b) A scientist investigated inheritance in pea plants.
The scientist crossed tall pea plants with short pea plants. Diagram 1 shows the results.

Diagram 1
Some tall offspring
Some short offspring

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

T = allele for tall
  t = allele for short

(i) The 1st cross in Diagram 1 produced 120 offspring. All of these offspring were tall.

This shows that plant 1 contained the alleles

TT.
Tt.
tt.

(ii) Plant 3 is tall because of the environment.
(c) **Diagram 2** gives more information about the cross between plant 3 and plant 4.

![Diagram 2](image)

This cross produced some tall offspring and some short offspring.

The ratio of tall to short offspring in **Diagram 2** is

1:1.
2:1.
3:1.

(1)

(d) Two short plants were crossed. This cross produced 100 offspring.

The expected offspring would be

- 100 short plants.
- 50 tall plants and 50 short plants.
- 75 tall plants and 25 short plants.

(Total 5 marks)

**Q52.**

The photograph shows a fossil footprint. The fossil was found in a rock at the bottom of a shallow river.

Scientists believe this is the footprint of a dinosaur. The dinosaur was alive 110 million years ago.
(a) (i) Suggest how the fossil shown in the photograph was formed.

_________________________________________________________________

_________________________________________________________________

(1)

(ii) Fossils may also be formed by other methods.

Describe one other method of forming a fossil.

_________________________________________________________________

_________________________________________________________________

(1)

(b) Dinosaurs are now extinct.

Give two factors that can cause extinction.

1. ___________________________________________________________________

_________________________________________________________________

2. ___________________________________________________________________

_________________________________________________________________

(2)

(c) How can fossils give evidence for evolution?

_________________________________________________________________

_________________________________________________________________

(1)

(d) Scientists are uncertain about how life began on Earth.

Why?

_________________________________________________________________

_________________________________________________________________

(1)

(Total 6 marks)
Q53.
(a) Complete the sentences about evolution.
   Draw a ring around the correct answer to complete each sentence.

   (i) Darwin suggested the theory of evolution by [ ]
       artificial
       natural
       asexual

   (ii) Darwin’s theory of evolution says that all species of living things have [ ]
       evolved from
       artificial
       complex
       simple

   (iii) Most scientists believe that life first developed about [ ]
       three billion
       three million
       three thousand

(b) Darwin’s theory of evolution was only slowly accepted by other people.
   Give two reasons why.
   1 _________________________________________________________________
   2 _________________________________________________________________

(c) Diagram 1 shows one model of the relationship between some animals.

   Diagram 1

   Whale  Cow  Hippopotamus  Pig  Camel
(i) Complete the sentence.

The model shown in Diagram 1 is an evolutionary _____________________.

(1)

(ii) Which two of the animals in Diagram 1 are most closely related?

________________________ and _____________________________

(1)

(iii) Diagram 2 shows a more recent model of the relationship between the animals.

Diagram 2

Whale → Cow → Hippopotamus → Camel → Pig

Suggest one reason why scientists have changed the model of the relationships between the animals shown in the diagram.

Draw a ring around the correct answer.

more powerful computers new evidence from fossils new species discovered

(1)

(Total 8 marks)

Q54.

In sexual reproduction, an egg fuses with a sperm.

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

An egg and a sperm fuse together in the process of cloning. fertilisation. mitosis.

(1)

(ii) Egg cells and sperm cells each contain the structures given in the box.

chromosome gene nucleus

(1)
List these three structures in size order, starting with the smallest.

1. ____________________________________________________________ (smallest)
2. ____________________________________________________________
3. ____________________________________________________________ (largest)

(iii) The egg and the sperm contain genetic material.

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

The genetic material is made of

- carbohydrate.
- DNA.
- protein.

(b) The diagram below shows the inheritance of X and Y chromosomes.

(i) Draw a tick (✓) on the part of the diagram that shows a sperm cell.

(ii) What is the chance of having a female child?

Give the reason for your answer.

______________________________________________________________  
______________________________________________________________  
______________________________________________________________  
______________________________________________________________  
______________________________________________________________  

(Total 7 marks)

Q55.

Figure 1 shows a fossil of a sea animal called a Plesiosaur.
The Plesiosaur was alive about 135 million years ago.
(a) How can fossils give evidence for evolution?

Tick (✔) one box.

- Newer fossils are simpler than older fossils.
- Fossils show change over time.
- All fossils show the bones of animals.

(b) Plesiosaurs lived in the sea. There was mud at the bottom of the sea.

Suggest how the fossil shown in Figure 1 may have been formed after the animal died.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(3)

(c) Figure 2 shows what scientists think a living Plesiosaur may have looked like.

Figure 2
Scientists think that the Plesiosaur had smooth skin, with no scales. The scientists cannot be certain what the skin of a Plesiosaur was like. Suggest why.

___________________________________________________________________
___________________________________________________________________

(d) Plesiosaurs are now extinct.

Give two possible reasons why.

1. _________________________________________________________________
___________________________________________________________________

2. _________________________________________________________________
___________________________________________________________________

(Question 56. Total 7 marks)
Millions of years ago

Key
Each point plotted on the graph shows the estimate for one human.

(a) (i) As humans evolved, their brain volume changed.

What has happened to human brain volume over the past 4 million years?
________________________________________________________________________________________
________________________________________________________________________________________

(ii) Why is the evidence for estimated brain volume for *Homo sapiens* stronger than the evidence for *Australopithecus afarensis*?
________________________________________________________________________________________
________________________________________________________________________________________

(b) In a book, the brain volume of a different species, *Australopithecus africanus*, is stated to be about 600 cm$^3$.

Use evidence from the graphic above to estimate when *Australopithecus africanus* lived on Earth.

Estimate = _________________ million years ago

(c) Scientists believe that modern humans evolved by natural selection from *Australopithecus afarensis*.

(i) Complete the following sentence.

In the nineteenth century, the scientist who suggested the theory of evolution by natural selection was Charles ____________________________ .
(ii) In the nineteenth century, many people did not accept this scientist's theory.

Give one reason why.

________________________________________________________________________
________________________________________________________________________

(1)
(Total 5 marks)

Q57.

Sexual reproduction in humans involves the joining together of an egg cell and a sperm cell.

The sex of an embryo is decided by the chromosomes they inherit from their mother and father.

(a) Where in the cell are the chromosomes?

Tick one box.

- Cell membrane
- Cytoplasm
- Nucleus
- Ribosomes

(1)

(b) Draw one line from each type of cell to the number of chromosomes in the cell.

<table>
<thead>
<tr>
<th>Type of cell</th>
<th>Number of chromosomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sperm cell</td>
<td>26</td>
</tr>
<tr>
<td>Embryo cell</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>69</td>
</tr>
</tbody>
</table>

(2)
(c) A man and a woman decide to have a child.

Complete the genetic diagram in the figure below.

```
            Parent
          |     |
          X   X

            Parent
          |     |
          X   XX

            Y
```

(2)

(d) On the figure above, circle a male child.

(1)

(e) What is the chance of the man and woman having a boy?

Tick one box.

1 in 2

1 in 3

1 in 4

1 in 8

(1)

(Total 7 marks)

Q58.

(a) Some antibiotics work by destroying the cell membranes of bacteria.

Suggest why these antibiotics may have side effects in the animals that are given these antibiotics.

___________________________________________________________________

(1)

(b) Each arrow on the figure below shows the date of discovery of each new type of antibiotic.

```
```

In which 10 year period were most new types of antibiotic discovered?

___________________________________________________________________
(c) The figure above shows 22 new types of antibiotic. These were discovered before 2010.

Determine the percentage of types of antibiotic that have been discovered between 1980 and 2010.

Use information from the figure above.

Give your answer to 2 significant figures.

___________________________________________________________________

____________________________________________

_______________________

____________________ %

(2)

(d) Bacteria can evolve rapidly.

Many bacteria can develop into new strains which are resistant to antibiotics.

Complete the table below to show if each action is more likely or less likely to help bacteria to become antibiotic resistant.

Put a tick in each row.

<table>
<thead>
<tr>
<th>Action</th>
<th>More likely</th>
<th>Less likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take painkillers for headache</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washing with antiseptic hand gel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adding antibiotics to food for cows</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Giving antibiotics for colds and flu</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stopping antibiotics as soon as you feel better</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Total 8 marks)

Q59.

Genetic disorder E is a condition caused by a change in the chromosomes.

(a) Figure 1 shows the chromosomes from one cell of a person with genetic disorder E.
(i) How do you know this person is female?

Use information from Figure 1.

______________________________________________________________
______________________________________________________________

(1)

(ii) Describe how the chromosomes shown in Figure 1 are different from the chromosomes from a person who does not have genetic disorder E.

______________________________________________________________
______________________________________________________________
______________________________________________________________

(2)

(b) As a woman gets older, the chance of her having a baby with genetic disorder E increases.

Figure 2 shows this.
(i) The chance of a 35-year-old woman having a baby with genetic disorder E is 2 per 1000 births.

What is the chance of a 40-year-old woman having a baby with genetic disorder E?

_____________________ per 1000 births

(1)

(ii) A 40-year-old woman is more likely than a 35-year-old woman to have a baby with genetic disorder E.

How many times more likely?

_________________________ times

(1)

(c) A 41-year-old woman wants to have a baby. A 41-year-old woman has an increased chance of having a baby with genetic disorder E.

Doctors can screen embryos for genetic disorder E.

The table gives some information about two methods of embryo screening.

<table>
<thead>
<tr>
<th><strong>Method 1</strong></th>
<th><strong>Method 2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The woman is given hormones to cause the release of a few eggs. The eggs are taken from her body in a minor operation. The eggs are fertilised in a glass</td>
<td>1. The woman gets pregnant in the</td>
</tr>
</tbody>
</table>
Use information from the table to give two advantages and one disadvantage of Method 1 compared with Method 2 for detecting genetic disorder E.

Advantages of Method 1:

1. ____________________________________________________________
   _____________________________________________________________________

2. _________________________________________________________________
   _____________________________________________________________________

Disadvantage of Method 1:

   _____________________________________________________________________
   _____________________________________________________________________

 Q60.

A person’s characteristics can be due to:

• environmental causes
• genetic causes
• both environmental and genetic causes.

(a) Complete Table 1.

Put a tick to show what each characteristic is due to.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Characteristic due to</th>
</tr>
</thead>
<tbody>
<tr>
<td>dish.</td>
<td>normal way.</td>
</tr>
<tr>
<td>2. One cell is taken from each embryo when the embryo is 3 days old.</td>
<td>2. Cells are taken when the embryo is 10 weeks old.</td>
</tr>
<tr>
<td>3. Cells are screened for genetic disorder E.</td>
<td>3. Cells are screened for genetic disorder E.</td>
</tr>
<tr>
<td>4. An unaffected embryo is placed in the woman’s uterus. Embryos that are not used are destroyed or used in medical research.</td>
<td>4. An unaffected fetus is allowed to develop. If the fetus has genetic disorder E, the woman can choose to have an abortion.</td>
</tr>
<tr>
<td>5. This method costs about £6000.</td>
<td>5. This method costs about £600.</td>
</tr>
</tbody>
</table>

(Total 8 marks)
<table>
<thead>
<tr>
<th>Key term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genotype</td>
<td>The set of alleles for a characteristic</td>
</tr>
<tr>
<td></td>
<td>The genus of an organism</td>
</tr>
<tr>
<td></td>
<td>The inheritance of chromosomes</td>
</tr>
<tr>
<td>Phenotype</td>
<td>The mutation of genes</td>
</tr>
<tr>
<td></td>
<td>The physical characteristic of an organism</td>
</tr>
</tbody>
</table>

(c) Farmers use selective breeding to control the characteristics in cows. Table 2 shows the stages of selective breeding in cows.

Complete Table 2 to show the correct order of the stages.

The first stage has been numbered for you.

Table 2

<table>
<thead>
<tr>
<th>Stage in selective breeding</th>
<th>Order of stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows are bred over many generations</td>
<td></td>
</tr>
<tr>
<td>Parents are bred together</td>
<td></td>
</tr>
<tr>
<td>Cows with the desired characteristics are chosen</td>
<td>1</td>
</tr>
<tr>
<td>Calves with the most desired characteristics are bred together</td>
<td></td>
</tr>
</tbody>
</table>

(d) Farmers selectively breed cows for many different reasons.

Suggest two characteristics that cows may be bred for.
Do **not** suggest coat colour.

1. ______________________________________________________________________
_____________________________________________________________________

2. ______________________________________________________________________
_____________________________________________________________________

(e) Selective breeding can lead to problems.

Suggest how problems caused by selective breeding in cows can have negative financial effects for the farmer.

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

(2)

(Total 11 marks)
Q1.  
(a) only genetic causes  
any one from:
- pattern of scales
- number of fins
- eye colour

only environmental causes:
- scar

both genetic and environmental causes:
- length

(b) 
\[
\begin{array}{c|c|c}
 & B & b \\
\hline
b & b & bb \\
\hline
b & Bb & bb \\
\end{array}
\]

allow 2 correct for 1 mark

(c) any bb circled

(d) 0.5

allow ecf from 04.2

(e) \((260,000 / 2 =) 130,000\)

allow ecf from 04.4

(f) mutation

allow change in diet / hormones / DNA

---

Q2.  
(a) (i) 3

(ii) Q

(iii) 1

(b) from fossils / bones
allow artefacts / named artefacts / drawings / evidence of fires

(c) Darwin

Q3.
(i) clones

accept other positive indications

(ii) same genes / alleles / DNA

accept same genetics / genetic information do not accept same chromosomes

grown in same (environmental) conditions or correct eg – same amount of water / same temperature / same amount of light

Q4.
(a) one from each parent / one from egg and one from sperm

donot accept egg and sperm join / fertilisation unqualified

(b) (i) nn

accept a ring around printed nn

(ii) Nn Nn

Q5.

dominant

recessive

genes

gametes

environmental

Q6.
extinct (NOT fossils)
fossils
Q7.
(a) mud
  decayed
  skeleton
  rock

(b) idea that living things have changed (over time)
  do not allow ‘dating’
  do not credit ‘evolved’
  allow ‘compare the skeleton’

Q8.
fossils
  gains 1 mark

but
extinct
  gains 2 marks

fossils
rocks/coal
  each for 1 mark

Q9.
(a) (i) any one from
  mutations
  discontinuous variation

(ii) gene
  accept any clear indication such as a tick

(b) any one from
gamma radiation
  accept radiation
X-rays
ultra violet rays
chemicals
accept mutagens
chance

(c) zebras breed (to produce)
fertile offspring
do not accept mating

Q10.
(a) fertilisation
credit conception

(b) (i) sperm
do not accept offensive answers or those in the vernacular
testes or testicles

(ii) ovum or ova or eggs
do not accept ovules
ovary

Q11.
(a) (i) testis

ovary

(b) fertilisation or fertilise(d) / (ing)
accept fusion
do not credit conception or intercourse

(c) (i) the same, identical
do not credit very similar make clear
their genetic material is the same
do not credit the same number of chromosomes or genes

(ii) the same, identical
make clear their genetic material is the same
do not credit the same number of chromosomes or genes
Q12.

(a) agilisaurus / camarasaurus / ornitholestes

(b) eorapter

allow lagosuchus

(c) lagusuchus (it) walks on hind limbs / two limbs / alamosaurus has longer neck / lagusuchus has back legs longer than front but alamosaurus has the reverse

(d) (i) alamosaurus

(ii) increased

(e) from hard parts / bones / imprints
e.g. footprints / parts replaced by other materials / conditions for decay absent or example

buried is neutral

(f) simple

billion

Q13.

(a) breed (together)

accept have same number of chromosomes

do not accept have the same number of genes

to produce fertile offspring

(b) male or testes

accept dog

testes or male

accept testis

do not accept testicles

ovary or ovaries

gametes
fertilisation

do not accept conception

fetus or zygote or embryo

do not accept baby or puppy

(c) genetic information or genes or chromosomes or DNA

do not accept characteristics by itself

(comes) from two parents

accept from both parents

Q14.

(a) (i) gametes correct

allow by implication from line diagram

only need on X from female

offspring genotype correctly derived

on suitable diagram

\[
\begin{array}{ccc}
| & X & X \\
\hline
| & XX & XX \\
X & & \\
| & XY & XY \\
\gamma & & \\
\end{array}
\]

or

\[
\begin{array}{ccc}
| & X \\
\hline
| & XX \\
X & & \\
| & XY \\
\gamma & & \\
\end{array}
\]

(ii) 1:1 or 50% or ½ or 0.5 or 1 in 2

or 1 out of 2 or 50 : 50

do not accept 50/50

accept 'equal' (probability)

(b) Y chromosome needed for male child

only male has the Y or wives had only X (chromosomes)
or sex determined by the sperm
Q15.
(a) clearly labelled ‘y’
mark the offspring in two horizontal rows
1 mark for each fully correct row
allow transferred error if parent 2 is incorrect

<table>
<thead>
<tr>
<th>XX</th>
<th>XX</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>XY</th>
<th>XY</th>
</tr>
</thead>
</table>

accept YX

(b) parent 1
accept XX

(c) 50:50
or equal or even
or
1:1 or 50%
accept 1/2 or 2/4

Q16.
(a) genes/DNA

<table>
<thead>
<tr>
<th>female/girl/woman/</th>
<th>male/boy/man/</th>
</tr>
</thead>
</table>

both required in the correct place for this last mark

do not accept homo/heterogametic, homo/heterozygous

(b) parents correct
n.b if parents are wrong, candidates can score a maximum of 3 marks

gametes correct
allow just 1 mark for female

combinations correct

correct analysis of the 50:50 ratio of what is written
Q17.
(a) remains of an organism or bone / shell / hard part of an organism / impression

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

(b) (i) D

(ii) B

(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

(c) C = ‘widest’ thickest / wider thicker column or more fossils
    (of type C found)
    allow biggest / er

(d) members of the groups have similar physical structures
    extra box ticked – cancel

Q18.
(a) protection / defence
    ignore insulation or rolls into a ball
    ignore camouflage

    from predators / from being attacked / from being eaten

(b) looks like snake / looks scary

    deters predators or has large eyes to spot predator or camouflage or warning colouration from predator or prey
    allow two separate adaptations for 2 marks
(c) (i) natural selection
(ii) Darwin
(iii) simple life forms
(d) believe that God created all organisms or humans there from the beginning

Q19.

eggs
accept gamete once
ovaries
sperms
accept gamete once
testes
sexual
gametes
allow egg and sperm once
fertilisation
asexual

Q20.

(a) (i) 56
accept 54 – 58
(ii) increased
reasonable qualification eg slowly then more quickly or to 174 / 176 or by 138 / 140

(b) any two from:
• no immunity or antibodies ineffective
   accept no resistance
• no vaccines or humans not immunised
• idea of large scale contact or large scale travel
  do not accept passed on
  ignore no cure

Q21.
(a) X (no mark)
   X is more visible or Y is more camouflaged

(b) (i) so camouflage not changed or so not easier to see

(ii) 25

   7

(iii) any one from:
   • eaten (by birds) / died
   • mixed in with large number of unmarked moths
   • moved away

(c) (i) DNA

(ii) the gene / allele for being dark / dominant

Q22.
in the correct order
DNA

23

XX

XY

recessive
Q23.  
(a) any two from:
- streamlined / shape reduces friction / long and thin / smooth surface OWTTE
- fins / flippers / tail / paddle
  *do not* accept ‘arms’ or ‘legs’
- structures that push against water  

(b) (i) any two from:
- fossil has hind limb / legs / feet
  *it = minke*
  *accept any valid comparison*
- fossil has more ribs / bones
- fossil has teeth
- fossil has curved spine  

(ii) billion  
give evidence for  

1 2 1 1 1

Q24.  
(a) fossils / teeth / bones / skeleton / foot prints
  *allow cave drawings*
  *do not* accept scientists have seen them  

(b) only (some) bones remain / soft parts have decayed
  *accept ‘no-one has ever seen one’*
  *allow no photos, no pictures, no drawings*

(c) any two from:
- hunted by human  
- (new) predator
  *allow more predators*
- (new) competitor
• (new) disease
• environment changed / named environmental change
  allow natural disaster
• prey extinct / loss of food supply
  ignore not enough food

Q25.
(a) characteristics
(b) genes
(c) chromosomes
(d) mitosis
(e) asexual

Q26.
(a) sexual reproduction
(b) any three from:
  • coat colour inherited / controlled by genes
  • it has horse and zebra features
  • gets gametes from both parents
  • genes / DNA / chromosomes / genetic information in gametes
  • zorse receives genes / DNA / chromosomes / genetic information from parents

Q27.
(a) 2 and 3
(b) cell P has an X chromosome; cell R has a Y chromosome
(c) any two from:
• (formed from) different egg / 2 eggs
• (formed from) different sperm / 2 sperm
• have different genes / alleles / chromosomes / DNA
  allow genetics

(d) (i) stem cells
    1
(ii) the cells divide
     1
    the cells differentiate
     1
(iii) (medical) research / named eg growing organs
     or
    medical / patient treatment
    allow (embryo) cloning
    do not allow designer babies / more babies
    1
(iv) any one from:
  • ethical / moral / religious objections
    ignore cruel / not natural / playing God
  • potential harm to embryo
    allow deformed
    ignore harm to mother
    1

Q28.
(a) genes
  1
  chromosomes
  1
(b) (i) higher yield
    1
    less use of pesticides
    1
(ii) any two from:
  • uncertain about effects on health
  • fewer bees
  • might breed with wild plant
  • seeds only from one manufacturer
  2
Q29.
(a) lemur(s)  
(b) gorilla(s)  
\textit{in either order}  
chimpanzee(s)  
accept chimps  
(c) (i) (Charles) Darwin  
accept (Alfred) Wallace  
if first name given it must be correct  
(ii) variation  
\textit{in this order}  
environment  
allow phonetic spellings  
survive  
generation

Q30.
(a) (i) circle  
\textit{mark independently}  
unshaded  
\textit{could be in body of script}  
(ii) (Harriet) dd  
\textit{in first box}  
DD  
if another letter is chosen it must be used throughout and upper or lower case must be clear  
Dd

(b) (i) to check for the D allele.
(ii) any one from:

- may harm / kill foetus / embryo / baby / mother
- allow could affect the baby
- immoral / unethical / religion
- ignore playing God
- ignore references to unnatural
- ignore wrong unqualified
- ignore expense / prejudice unqualified
- ignore lack of permission
- ignore results are unreliable

Q31.
(a) sexual

(b) chromosome

(c) (i) any two from:

- genetic-engineering can produce fast-growing food animals
- genetic engineering can be used to clone animals in danger of extinction
- using GM animals can reduce the number of animals used in medical research

(ii) GM animals might escape and breed with wild animals

animals have the right to be free from genetic modification

Q32.
(a) (i) sex cells

(ii) chromosomes

(b) (i) two

(ii) recessive

(c) (i) cell membrane

allow membrane
(ii) cytoplasm

(d) (i) A

(ii) B

Q33.
(a) (i) dominant
   *allow clear indication*

(ii) recessive
   *allow clear indication*

(b) (i) aa
   *extra ring drawn cancels the mark*

(ii) Aa
   *extra ring drawn cancels the mark*

(c) 3 purple : 1 yellow
   *extra box ticked cancels the mark*

Q34.
(a) chromosomes

(b) (i) has XY / Y
   *allow female would be XX / has no Y*

(ii) The strands are in pairs

(iii) nucleus

Q35.
(a) warmer / dryer
   *allow greenhouse effect / global warming*
   *ignore wind*

(b) (i) genes / alleles / chromosomes / DNA / genetic material / genetics
allow inheritance
allow nutrition / food / metabolism / growth rate
ignore environment

(ii) natural selection / evolution
allow survival of the fittest

Q36.
(a) (i) any one from:
   • A
   • C
(ii) any one from:
   • B
   • D

(b) (i) pig A
(ii) a gamete

(c) XY or YX
   XY
   XY or YX
   in this order only

Q37.
(a) (i) 23
(ii) nucleus / 'the head'
   allow phonetic spelling

(b) (i) X and X
(ii) X and Y

(c) 150 million / 150,000,000 / half (of them) / 50% / 1 in 2
Q38.
(a) asexual
(b) mitosis
(c) genes

[3]

Q39.
(a) insects don’t eat / damage crop
   allow idea of insects carrying plant disease
   allow idea of insects carrying plant disease
(b) (i) 60
   lower (yield)
   accept ‘higher’ if answer clearly refers to wheat with
   transferred gene
   allow yield is only 52 or goes down to 52
   by 8 (arbitrary units)
   accept ecf from (b)(i) for 2 marks
   (ii) lower (yield)
   accept bigger crop / more wheat
   ignore grows better
   (iii) grow / use wheat without insect poison (gene)
   higher yield (in fields)
   accept bigger crop / more wheat
   ignore grows better
   (c) ignore unnatural / unethical / against religion unqualified
   (concerned about)
   accept specific examples given
   effect on populations of (wild) flowers / insects
   ignore harms the environment
   effect of eating GM crops on human health
   allow harmful to humans if eaten

[8]

Q40.
(a) (i) recessive allele
(ii) carriers
(b) (i) 6

allow nn

(ii) 1 in 4 / 0.25 / \(\frac{1}{4}\) / 25% / 1:3

do not accept ‘3:1’ / 1:4 / 1 in 3 / 25

(c) advantage:
detect CF qualified – eg at early stage / before becoming pregnant or (only) healthy children produced

allow ‘after only 3 days’
allow reduces health care costs

disadvantage:
some embryos are destroyed / may damage embryo

allow increased risk of miscarriage
ignore not natural
ignore cost

Q41.
(a) Relevant organelle found in cells such as nucleus, mitochondria

(b) Linnaeus

(c) Kingdom

(d) *Homo Sapiens*

ignore underlining, italics or not, capitals or not

(e) Any one from:

• to know which species are closely related or study evolution
• to monitor biodiversity
• to identify different organisms such as two different species

Q42.
(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
Q43.  

(a) (i) | Feature | Mitosis only | Meiosis only |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Produces new cells during growth and repair</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Produces gametes (sex cells)</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Produces genetically identical cells</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

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

(ii) (a man) testis / testes  
accept testicle(s)  

(a woman) ovary / ovaries  
*do not* accept 'ova' / ovule

Q44.
Q45.

(a) sexual reproduction

(b) (i) genes
(ii) gametes

(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
   less time before having a calf when no milk produced

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

Q46.

(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

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

or

from a long time ago / many years ago
if number, > 1000 years
ignore hundreds

(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

(b) (i) 18 to 30
allow 30 to 18
allow 12
ignore units

(ii) small sample
allow only 49 shells / not representative / not enough evidence
allow not all fossils found

(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
Q47.
(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

Q48.
(a) genes
1

   chromosomes
1

(b) (i) higher yield
1

   less use of pesticides
1

(ii) any **two** from:
- uncertain about effects on health
- fewer bees
- might breed with wild plant
- seeds only from one manufacturer
2

Q49.
(a) (i) any **two** from:
- trapped / held (since sticky)
- engulfed / covered by resin
  *allow engulfed / covered by amber*
- prevented decay.

(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.

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

(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

Q50.
(a) DNA

(b) X and Y

(c) (i) 46 chromosomes

(ii) half the number

(d) meiosis
Q51.
(a) Mendel

(b) (i) TT

(ii) a dominant allele

(c) 1 : 1

(d) 100 short plants

[5]

Q52.
(a) (i) animal walking on soft material or suitably named material

or

further detail – eg dries out / buried / hardens / turns to rock
do not allow general descriptions of how fossils are formed
or reference to bones not decaying

(ii) any one from:

• (from) bones / shells / hard parts or from parts that do not decay / rot or are preserved
  ignore imprint / impression

• animal trapped in resin / amber / ice / peat
  allow frozen

• infiltration with minerals / named

(b) any two from:

examples of physical factors such as flooding, volcanic activity (allow volcanoes) asteroid collision, drought, ice age / temperature change
  accept 2 physical factors or 2 biological factors or one of each for full marks
  ignore pollution

examples of biological factors such as predators (allow hunters), disease / named pathogen, competition lack of food / mates, cyclical nature of speciation / isolation / lack of habitat or habitat change
  If no other answers given allow natural disaster / climate change / weather change / catastrophic event / environmental change for 1 mark

(c) older fossils simpler

to gain the mark there must be implication of change
change (with time)
  ignore evolve
  ignore extinction

(d) insufficient / no evidence / no remains or fossils survive
  ignore no people were there
  allow no proof

Q53.
(a) (i) natural

(ii) simple

(iii) three billion

(b) any two from:
  • reference to religion
  • insufficient evidence / couldn’t prove it / no proof
    ignore no evidence
  • mechanism of inheritance / variation not known
    allow genes / DNA not known about
  • reference to other theories
  • reference to Darwin’s status

(c) (i) tree

(ii) hippopotamus and pig
    both required, either order
    allow hippo

(iii) new evidence from fossils

Q54.
(a) (i) fertilisation

(ii) in sequence:
    accept 1 next to gene, 2 next to chromosome and 3 next to nucleus in box
1 gene
2 chromosome
3 nucleus

allow 1 mark for smallest or largest in correct position

(iii) DNA

(b) (i) On diagram:

tick drawn next to X and / or Y from Parent 1

tick(s) must be totally outside grid squares

allow ticks around “parent”

extra ticks elsewhere cancel

(ii) 0.5 / ½ / 50% / 1:1 / 50:50 / 1 in 2

allow 2/4 / 2 in 4 / 2 out of 4 / ‘even(s)’ / ‘fifty – fifty’

do not allow 1:2 or ‘50 / 50’ or ‘50 – 50’

2 (out of 4) boxes are XX

or

half of the sperm contain an X-chromosome

allow XY is male and 2 (out of 4) boxes are XY

Q55.

(a) fossils show change over time.

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

soft parts decay / are eaten

or

bones / hard parts / shell do not decay

minerals enter bones / parts are replaced by minerals / mineralisation

accept turns to rock

allow ‘is an impression’ / ‘imprint’ / ‘cast’

(c) skin is soft / skin not preserved / not fossilised / skin decays

accept not enough / no evidence / no-one has seen one

allow ‘this fossil is only bones’

(d) any two examples of:

accept 2 physical factors or 2 biological factors or one of each for full marks

physical factors such as volcanic activity (allow volcanoes) / earthquakes /
asteroid (collision) / ice age / temperature change

ignore pollution

and / or

biological factors such as predators / disease / named pathogen / competition / lack of food / mates / cyclical nature of speciation / isolation / lack of habitat or habitat change

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

Q56.

(a) (i) (volume) increases (with time)

ignore numbers

(ii) there is more evidence / specimens / results (for Homo sapiens)

allow examples of this, eg more / better fossils

allow converse if clearly referring to Australopithecus

ignore reference to being 'more recent'

(b) 2.5 – 3.15 (million years ago)

accept any number in range

(c) (i) Darwin

(ii) any one from:

• they believed in other theories
  allow they believed that God made all life

• insufficient evidence
  ignore 'no evidence'

• no proof
  allow not enough proof

• genes / mechanism of inheritance not known / discovered

Q57.

(a) Nucleus

(b) Type of cell

Number of chromosomes
(c)  

```
X  X  
X  XX  XX  
Y  XY  XY  
```

*all three correct for 2 marks*
*one or two correct for 1 mark*
*allow XY or YX in correct places*

(d)  

```
X  X  
X  XX  XX  
Y  X Y  X Y  
```

*either circled*

(e) 1 in 2

Q58.

(a) animal cells also have cell membrane

(b) 1945–1955

*allow 1946–1956*

*or 1947–1957*
(c) \( \frac{2}{22} = 9.09 \)  
allow 9.09 (%) or 9 (%) with no working shown for 1 mark

9.1 (%)  
allow 9.1 (%) with no working shown for 2 marks

(d)

<table>
<thead>
<tr>
<th>More likely</th>
<th>Less likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

allow 3 marks for 4 correct
allow 2 marks for 3 correct
allow 1 mark for 2 correct

more than one tick in a row negates a mark

Q59.

(a) (i) (female) has XX / only X’s / no Y  
allow has X chromosomes
ignore ref to genes / cells

(ii) extra chromosome / has 47 chromosomes / one set has 3 copies
ignore reference to chromosome numbers other than 47 or no. 18

no. 18

(b) (i) 14  
allow in range of 13.5 to 14.5

(ii) 7  
allow in range of 6.75 to 7.25
accept ecf from 5bi

(c) Advantages:
any two from:
• more than 1 embryo (so more chance of success)
allow method 2 may cause a miscarriage
• tested at 3 days cf 10 weeks or tested earlier
  tested when only 3 days old
• tested before pregnancy
• no termination / abortion
• spare embryos have a potential use.

Disadvantages:
any one from:
• needs an operation
  accept described hazard of operation
• (spare) embryos / human life destroyed / harmed
  must be comparative
• higher cost
• embryos might not implant / might not develop.

Q60.
(a)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Environmental</th>
<th>Genetic</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye colour</td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>A scar</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>

(b) Key term       Definition

Genotype
- The set of alleles for a characteristic
- The genus of an organism
- The inheritance of chromosomes

Phenotype
- The mutation of genes
- The physical characteristics of an organism

extra lines from the left negate the mark

(c)

<table>
<thead>
<tr>
<th>Stage in selective breeding</th>
<th>Order of stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows are bred over many generations</td>
<td>4</td>
</tr>
<tr>
<td>Parents are bred together</td>
<td>2</td>
</tr>
<tr>
<td>Cows with the desired characteristics are chosen</td>
<td>1</td>
</tr>
<tr>
<td>Calves with the most desired</td>
<td>3</td>
</tr>
</tbody>
</table>
characteristics are bred together

all 3 correct for 2 marks
1 or 2 correct for 1 mark

max. 2

(d) beef / meat
allow hardiness, disease resistance

milk yield

(e) higher veterinary costs

less income from sale of (milk and meat) products

[11]