

Name: \_\_\_\_\_

# Inheritance, Variation and Evolution part 6 AQA Triple Biology

Class: \_\_\_\_\_

Date: \_\_\_\_\_

---

Time: **87 minutes**

Marks: **83 marks**

Comments:

---

1.

Some people keep rabbits as pets.

Figure 1 shows two types of rabbit.

Figure 1



**Himalayan rabbit**  
has black patches



**White rabbit**  
has no black patches

The fur colour pattern in the Himalayan rabbit is caused by a dominant allele.

(a) What is a dominant allele?

Tick (✓) **one** box.

An allele expressed only if a rabbit has two copies of the allele

An allele expressed only if it is inherited from the male rabbit

An allele expressed when a rabbit has only one copy of the allele

(1)

In parts (b) and (c), use the following symbols:

**H** = dominant allele for Himalayan fur pattern

**h** = recessive allele for white fur.

(b) What is the genotype of a white rabbit?

Tick (✓) **one** box.

**HH**

**Hh**

**hh**

(1)

A male Himalayan rabbit was crossed with a female Himalayan rabbit.

The male rabbit and the female rabbit each had the heterozygous genotype **Hh**.

Some of the offspring were Himalayan rabbits and some of the offspring were white rabbits.

(c) Complete the Punnett square diagram in **Figure 2**.

You should show:

- the male gametes
- the offspring genotypes.

**Figure 2**

		<b>Female</b>	
		<b>H</b>	<b>h</b>
<b>Male</b>		Hh	

(3)

(d) Some of the offspring in **Figure 2** are homozygous and some are heterozygous.

Draw a ring around the genotype of **one homozygous** offspring in **Figure 2**.

(1)

(e) Four offspring were born.

How many of the four offspring would you expect to be Himalayan rabbits?

Use **Figure 2**.

Tick (✓) **one** box.

1

2

3

4

(1)

(f) Inheritance of sex in rabbits is the same as inheritance of sex in humans.

A female rabbit has two X chromosomes in each body cell.

How many X chromosomes does a male rabbit have in each body cell?

Tick (✓) **one** box.

0       1       2

(1)

(g) Some of the offspring in **Figure 2** would be male and some of the offspring would be female.

How many of the four offspring in part (e) would you predict to be female?

---

(1)

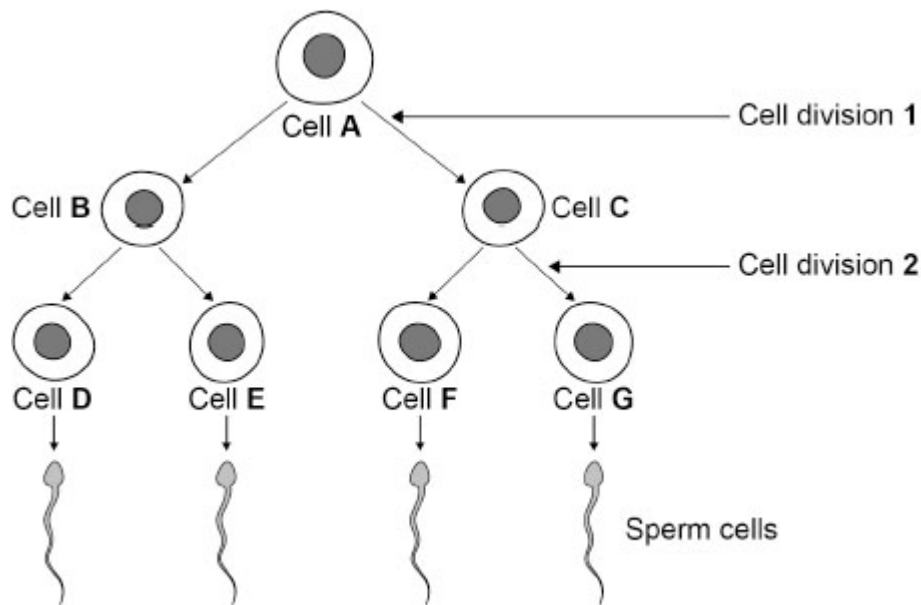
(Total 9 marks)

2.

New cells are produced by cell division.

**Figure 1** shows sperm formation in a human.

**Figure 1**



(a) Where in the body are sperm cells produced?

---

(1)

(b) How many chromosomes are there in cell **A** and in cell **D**?

Choose answers from the box.

23	24	46	92
----	----	----	----

Cell **A** \_\_\_\_\_

Cell **D** \_\_\_\_\_

(2)

(c) Complete the sentence.

Choose the answer from the box.

differentiation	evolution	fertilisation
-----------------	-----------	---------------

A sperm cell joins with an egg cell in a process called \_\_\_\_\_.

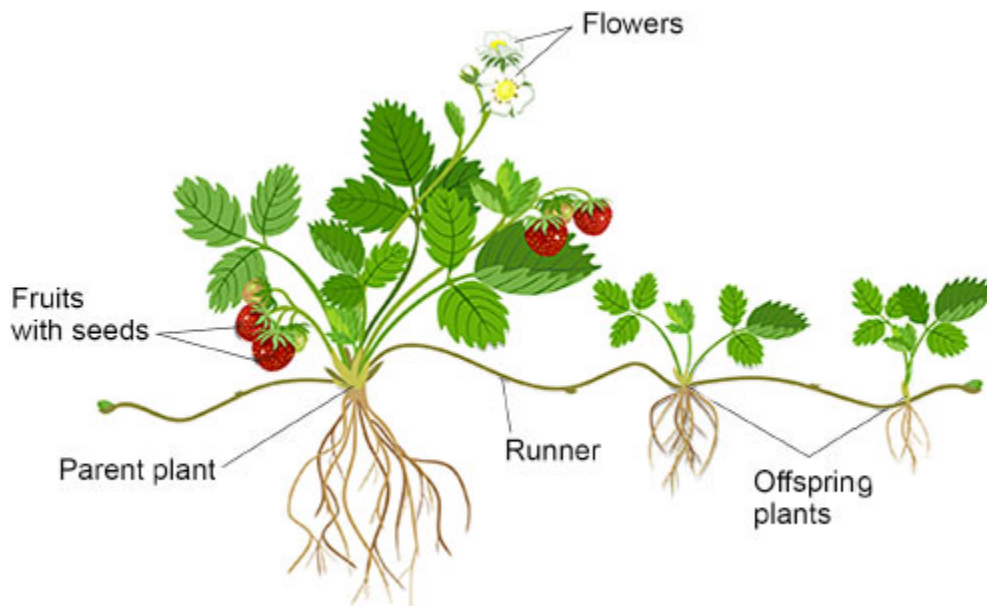
(1)

Strawberry plants can reproduce both sexually and asexually.

**Figure 2** shows a strawberry plant reproducing:

- sexually, using flowers, fruits and seeds
- asexually, using horizontal stems called runners.

**Figure 2**



(d) Meiosis produces gametes.

What is the name of the male gamete in a flower?

Tick (✓) **one** box.

Embryo

Ovum

Pollen

(1)

(e) Which process produces new cells in runners?

Tick (✓) **one** box.

Binary fission

Evolution

Mitosis

(1)

- (f) Substances used for growth pass through the runners from the parent plant to the offspring plants.

Which **two** substances pass through the runners?

Tick (✓) **two** boxes.

Carbon dioxide	<input type="checkbox"/>
DNA	<input type="checkbox"/>
Insulin	<input type="checkbox"/>
Sugar	<input type="checkbox"/>
Water	<input type="checkbox"/>

(2)

Sexual reproduction and asexual reproduction each have different advantages for the strawberry plant.

- (g) Give **one** advantage of reproducing **sexually**.

---

---

(1)

- (h) Give **one** advantage of reproducing **asexually**.

---

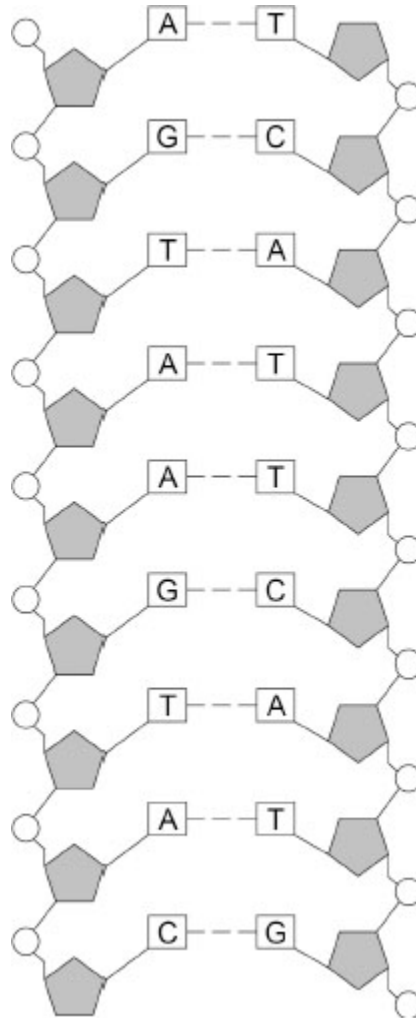
---

(1)

(Total 10 marks)

3. **Figure 1** shows part of a DNA molecule.

**Figure 1**



The letters **A**, **C**, **G** and **T** in **Figure 1** represent four different compounds.

(a) What are **A**, **C**, **G** and **T** called?

Tick (✓) **one** box.

Bases

Fatty acids

Sugars

(1)

- (b) The section of DNA shown in **Figure 1** contains the following sequence of these compounds:

**A G T A A G T A C**

A sequence of three compounds codes for one amino acid.

How many amino acids would this section of DNA code for?

---

**(1)**

- (c) Sometimes a change occurs in the sequence of the compounds **A**, **C**, **G** and **T** in the DNA.

What name is given to a change in DNA?

Tick (✓) **one** box.

Differentiation

Mutation

Natural selection

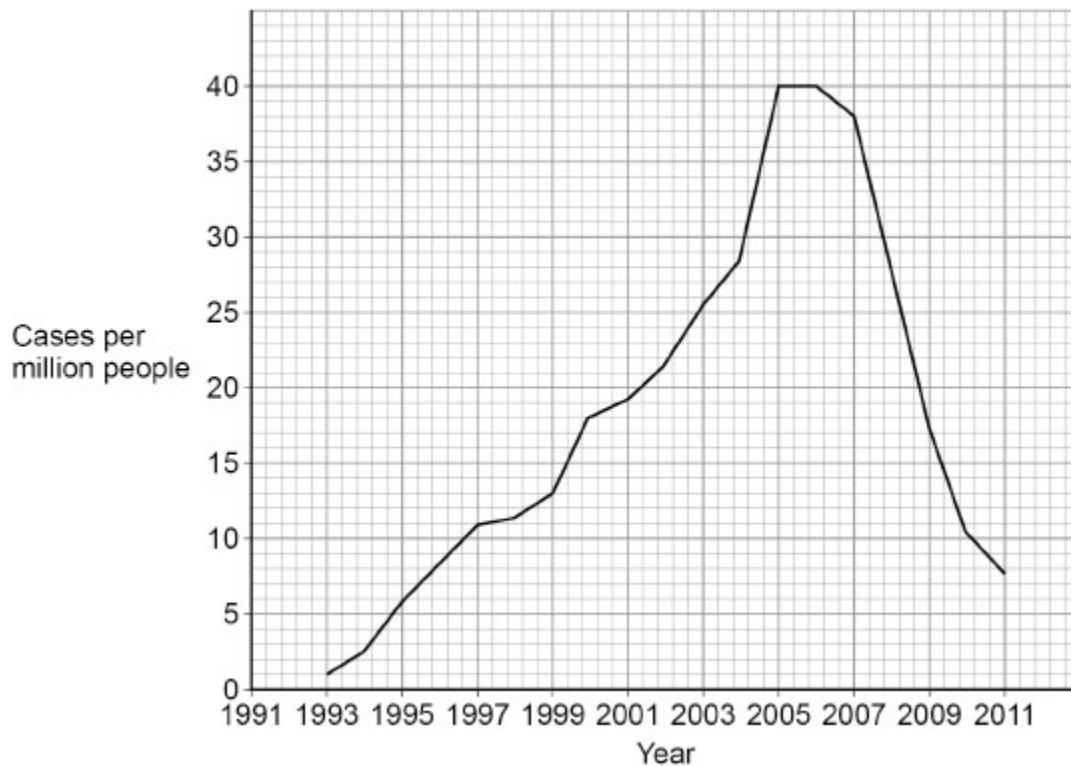
**(1)**

Changes in the DNA of a bacterial pathogen can produce new strains of the pathogen.

Many people have been infected with a bacterial pathogen called MRSA.

**Figure 2** shows how many cases of MRSA occurred in one country from 1993 to 2011.

**Figure 2**



- (d) Calculate the mean rate of increase in MRSA cases per year in the 12 years from 1993 to 2005.

---

---

---

---

---

Mean rate of increase = \_\_\_\_\_ cases per million people per year

**(3)**

(e) Most antibiotics will **not** kill MRSA bacteria.

Which word describes bacteria that are **not** killed by antibiotics?

Tick (✓) **one** box.

- Immune
- Powerful
- Resistant

(1)

(f) **Figure 2** shows that the number of cases of MRSA decreased after 2006.

Suggest **one** reason for this decrease.

---

---

(1)

(Total 8 marks)

4.

Ichthyosaurs are reptiles that lived in the sea millions of years ago.

The figure below shows the fossilised remains of an ichthyosaur.



(a) Suggest how the fossil in the figure above was formed after the ichthyosaur died.

---

---

---

---

(2)

(b) The length of the image of the ichthyosaur in the figure above is 120 mm.

The real length of the ichthyosaur was 17 times longer than the image in the figure above.

Calculate the real length of the ichthyosaur.

Give your answer in metres.

---

---

---

---

Real length of ichthyosaur = \_\_\_\_\_ metres

(3)

(c) The table below gives the classification of the ichthyosaur in the figure above.

Classification group	Name
Kingdom	Animalia
	Chordata
Class	Reptilia
Order	Ichthyosauria
	Ichthyosauridae
Genus	Ichthyosaurus
Species	intermedius

Complete the table above.

Choose answers from the box.

<b>Community</b>	<b>Family</b>	<b>Mammal</b>	<b>Phylum</b>	<b>Population</b>
------------------	---------------	---------------	---------------	-------------------

(2)

(d) Ichthyosaurs were predators.

Ichthyosaurs are now extinct.

Scientists think that extinction of the ichthyosaurs was caused by increased competition with other predators for food.

Suggest **two other** possible causes of extinction of the ichthyosaurs.

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

(2)

(Total 9 marks)

5.

Human growth hormone (hGH) is made by the pituitary gland.

(a) Name **one other** hormone made by the pituitary gland.

\_\_\_\_\_

(1)

(b) hGH is a protein.

A child with a deficiency of hGH can be given injections of hGH.

What would happen to the hGH if it was given as a tablet that was swallowed?

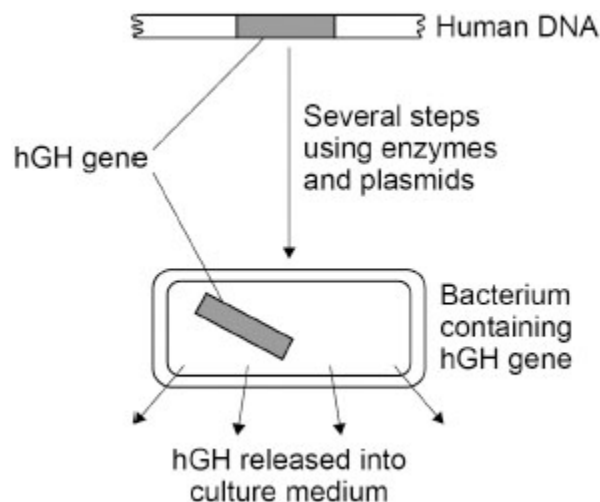
\_\_\_\_\_

\_\_\_\_\_

(1)

Scientists can use genetic engineering to make hGH.

The figure below shows a summary of the process.



(c) Describe how scientists can transfer the gene for hGH from human cells to bacterial cells.

Use information from the figure above.

---

---

---

---

---

---

---

---

---

---

**(4)**

(d) Growth hormone (GH) can be extracted from the urine of farm animals.

It is better to use hGH made by genetic engineering than to use GH from the urine of farm animals.

Suggest **two** reasons why.

Do **not** refer to ethical reasons or religious beliefs in your answer

1 \_\_\_\_\_

---

2 \_\_\_\_\_

---

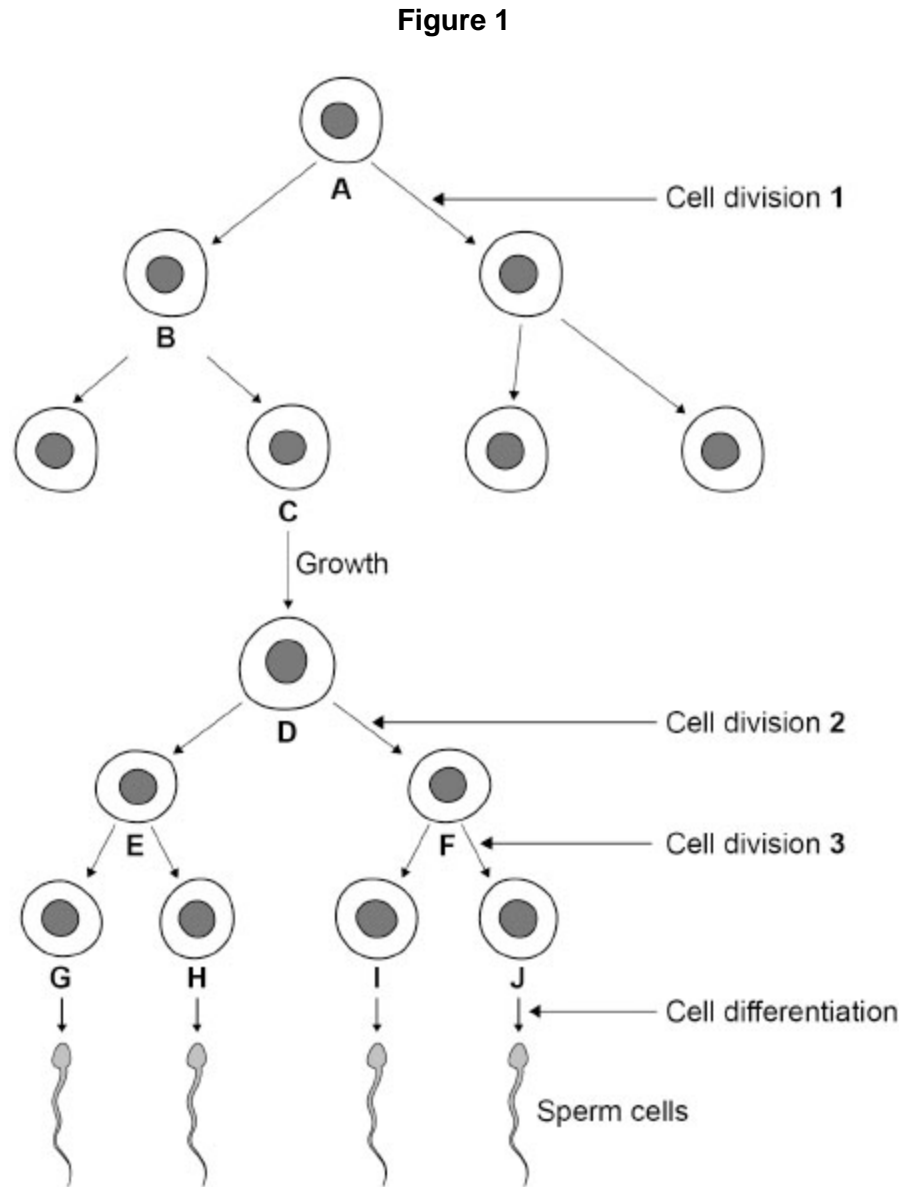
**(2)**

**(Total 8 marks)**

6.

New cells are produced by cell division.

Figure 1 shows sperm formation in a human.



(a) Which cell division in **Figure 1** represents mitosis?

Tick (✓) **one** box.

Cell division 1

Cell division 2

Cell division 3

(1)

(b) Which two cells in **Figure 1** are genetically identical?

Tick (✓) **one** box.

**A and C**

**B and I**

**F and J**

**G and H**

(1)

(c) How many chromosomes are there in cell **J** in **Figure 1**?

---

(1)

(d) How many of the cells **C, D, E, F, G, H, I** and **J** contain a Y chromosome?

Use **Figure 1**.

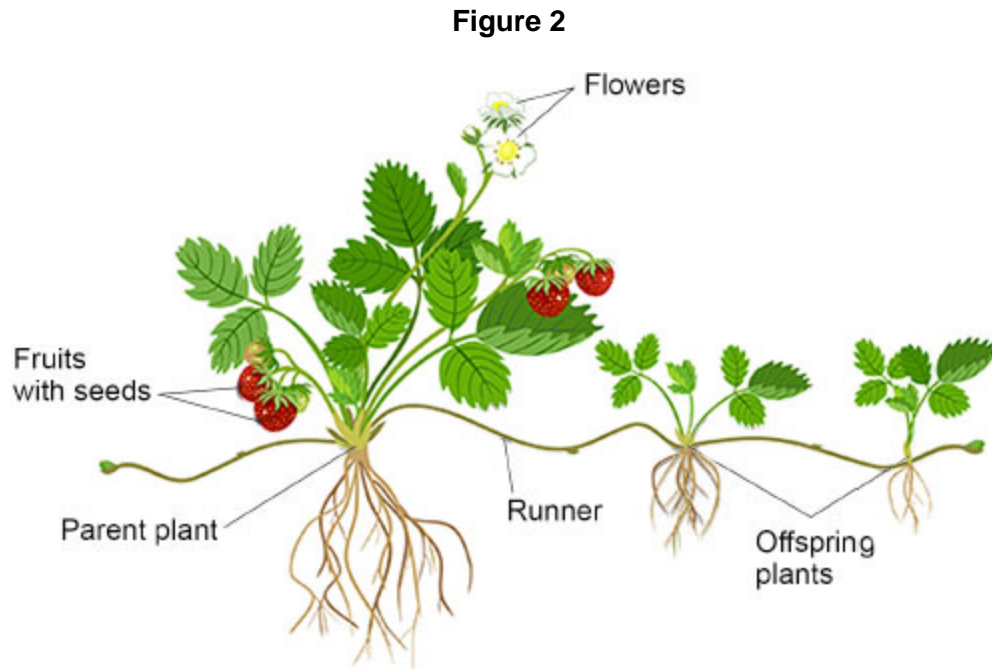
---

(1)

Strawberry plants can reproduce both sexually and asexually.

**Figure 2** shows a strawberry plant reproducing:

- sexually using flowers, fruits and seeds
- asexually using horizontal stems called runners.



(e) Explain why the offspring produced using runners are genetically identical.

---

---

---

---

(2)

(f) Explain why the offspring produced using flowers, fruits and seeds are **not** genetically identical.

---

---

---

---

(2)

(g) Describe **two** advantages of **asexual** reproduction for the survival of strawberry plants.

1 \_\_\_\_\_  
\_\_\_\_\_

2 \_\_\_\_\_  
\_\_\_\_\_

**(2)**

(h) Describe **two** advantages of **sexual** reproduction for the survival of strawberry plants.

1 \_\_\_\_\_  
\_\_\_\_\_

2 \_\_\_\_\_  
\_\_\_\_\_

**(2)**

**(Total 12 marks)**

7.

Some people keep rabbits as pets.

Figure 1 shows two types of rabbit.

Figure 1



**Himalayan rabbit**  
has black patches



**White rabbit**  
has no black patches

The Himalayan fur pattern is controlled by a dominant allele.

A heterozygous male Himalayan rabbit was crossed many times with each of two female Himalayan rabbits, **A** and **B**.

The results of the two types of cross were different.

- Crosses with female **A**: **all** of the 210 offspring were Himalayan rabbits.
- Crosses with female **B**: **some** of the 240 offspring were Himalayan rabbits and **some** were white rabbits.

In parts (a) and (b), use the following symbols to represent alleles:

**H** = dominant allele for Himalayan fur

**h** = recessive allele for white fur.

(a) What is the genotype of female Himalayan rabbit **A**?

Give the reason for your answer.

Genotype \_\_\_\_\_

Reason \_\_\_\_\_

\_\_\_\_\_

(2)

- (b) Determine the probability that one of the offspring from a cross with female Himalayan rabbit **B** will be white.

You should:

- draw a Punnett square diagram
- use the symbols **H** and **h**
- identify the phenotype of each offspring genotype.

Probability of offspring being white = \_\_\_\_\_

(4)

Adult Himalayan rabbits have:

- white fur over most of the body
- black fur on the nose, ears and feet.

The black colour is caused by production of a substance called melanin.

**Figure 2** shows how melanin is made from another substance called tyrosine.

**Figure 2**



(c) White rabbits have one base change in the gene that codes for the enzyme tyrosinase.

Explain how a change of one base in the DNA of the gene coding for tyrosinase could stop the tyrosinase working.

---

---

---

---

---

---

---

---

(4)

For the first four weeks of life, Himalayan rabbits produce white fur over the whole body.

The black areas of fur start to develop after four weeks.

In the first four weeks, young rabbits stay in the nest with their mother.

A rabbit's body temperature is 39 °C.

The tyrosinase in Himalayan rabbits is:

- most active between 15 °C and 25 °C
- **not** active above 35 °C.

(d) The fur on the nose, ears and feet of Himalayan rabbits is white for the first four weeks of life.

Explain what causes the fur to be white in the first four weeks of life.

---

---

---

---

(2)

(e) From the age of four weeks, young rabbits move from the nest to the outside environment.

Explain why a Himalayan rabbit develops black nose, ears and feet from the age of four weeks.

---

---

---

---

---

---

---

**(3)**

(f) Melanin is also produced in human skin.

Melanin absorbs ultraviolet (UV) radiation from sunlight and prevents the radiation reaching deep into the skin.

UV radiation is a type of ionising radiation.

Explain the advantage of producing melanin in human skin when exposed to bright sunlight.

---

---

---

---

---

**(2)**

**(Total 17 marks)**

8.

Carl Linnaeus invented a classification system that places organisms into groups.

(a) What is the name of the largest classification group in Linnaeus's system?

Tick (✓) **one** box.

Family

Kingdom

Order

(1)

(b) Linnaeus gave each species a binomial name.

Which **two** classification groups form the binomial name?

Tick (✓) **two** boxes.

Class

Genus

Order

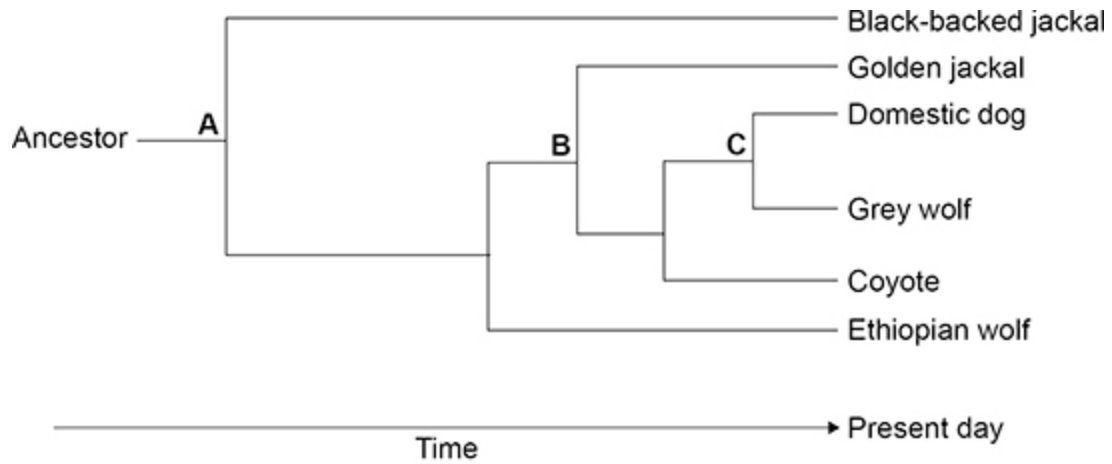
Phylum

Species

(2)

Scientists think that the animals in **Figure 2** all evolved from an ancestor that lived about 6 million years ago.

The figure below shows how the animals may have evolved.



**Key**

- A** 6 million years ago
- B** 3 million years ago
- C** 32 thousand years ago

(c) What was the **most recent** time that the domestic dog and the golden jackal shared a common ancestor?

Tick (✓) **one** box.

- 32 thousand years ago
- 3 million years ago
- 6 million years ago

(1)

(d) Which present-day animal in above figure is the **most distant** relative of the domestic dog?

---

(1)

Scientists think the grey wolf and the domestic dog had a common ancestor.

The common ancestor:

- lived about 32 thousand years ago
- is now extinct.

(e) Give **two** possible causes of extinction.

1 \_\_\_\_\_  
\_\_\_\_\_  
2 \_\_\_\_\_  
\_\_\_\_\_

(2)

(f) 32 thousand years ago, humans hunted other animals for food.

Wolves also hunted other animals for food.

Suggest **one** reason why wolves began to follow groups of humans.

\_\_\_\_\_  
\_\_\_\_\_

(1)

(g) Some wolves are more aggressive than other wolves.

Describe how selective breeding of wolves could produce a domestic animal that is less aggressive than the wolf.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

(2)

(Total 10 marks)

## Mark schemes

1.

(a) an allele expressed when a rabbit has only one copy of the allele

1

(b) **hh**

1

(c)

	<b>H</b>	<b>h</b>
<b>H</b>	Hh	Hh
<b>h</b>	Hh	hh

male gametes correct

1

all three offspring genotypes correctly derived from gametes

*allow 1 mark for 2 correct*

2

(d) (on **Figure 2**)

ring drawn around **HH** and / or **hh**

1

(e) 3

*answer must be consistent with genotypes in question (c) if given*

*allow 3 if question (c) is not answered*

1

(f) 1

1

(g) 2 / two

*allow half / ½ (of them)*

*ignore ratios*

1

[9]

2.

(a) testis / testes / testicle(s)

1

(b) **A = 46**

1

**D = 23**

*if no other mark awarded allow 1 mark for **A = 92 and D = 46***

1

(c) fertilisation

1

- (d) pollen 1
- (e) mitosis 1
- (f) sugar 1
- water 1
- (g) any **one** from:
- produces (genetic) variation (in offspring)
    - allow offspring are not (genetically) identical*
    - allow description of an advantage of variation*
    - eg not all killed by one pathogen / disease*
  - (seeds / fruits) can be dispersed (to new areas)
  - many seeds / offspring produced
  - offspring not competing (for light / water / ions)
  - can survive in a new environment
  - enables evolution
- 1
- (h) any **one** from:
- fast
  - many offspring produced
  - (genetically) identical offspring
    - allow they are clones*
  - only one parent needed
  - offspring less vulnerable (as attached to parent)
  - offspring receive water from parent
    - allow offspring receive named example of nutrient from parent*
  - can out-compete other species
  - can colonise local area
  - less energy is needed
    - allow pollinators / bees not required*

1  
[10]

- 3.** (a) bases 1
- (b) 3 / three 1
- (c) mutation 1

- (d) *figures from graph*  
40 and 1

1

*correct equation*

$$\frac{40 - 1}{12}$$

allow  $\frac{39}{12}$

1

*correct answer*

3.25 (cases per million people per year)

1

- (e) resistant

1

- (f) any **one** from:

- discovery of a new antibiotic / drug / treatment
- vaccination
- isolation of patients

*allow social distancing*

- better / improved education about MRSA
- better hygiene

*allow increased awareness of MRSA*  
*allow examples such as more / better hand washing (in hospitals)*

1

**[8]**

**4.**

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

- (ichthyosaur died and) is buried in sediment / sand / mud / silt
  - (only) soft parts decayed / eaten
- or**
- bones were not decayed / eaten

- bone(s) / remains replaced by minerals

*allow skeleton or hard parts for bones throughout*

*ignore compression*

*ignore reference to oxygen*

*do not accept (ichthyosaur died and) is buried in rock(s)*

*allow mineralisation of bones*

*allow bone(s) left imprint in mud / sand / sediment (that then hardened to rock)*

*ignore bones turned to stone / rock*

2

- (b)  $120 \times 17$   
*allow conversion to metres at any stage* 1
- 2040 (mm) 1
- 2.04 (metres)  
*allow correct conversion of incorrectly calculated length* 1
- (c) phylum 1
- family  
*in this order only* 1
- (d) any **two** from:
- ice age
  - global warming  
*if neither of these, allow climate change for 1 mark*  
*ignore weather*
  - volcanic activity
  - asteroid collision  
*if neither of these, allow catastrophic event **or** natural disaster for 1 mark*
  - new predators  
*allow named example*  
*allow hunters*
  - (new) disease / pathogen  
*allow named example*
  - competition for mates  
*allow lack of mates*  
*ignore competition unqualified*
  - lack of habitat **or** habitat change  
*ignore environment change*  
*allow competition between **ichthyosaurs** for food*  
*ignore isolation*  
*ignore pollution*  
*ignore lack of food*

2

[9]

5.

(a) ADH **or** antidiuretic hormone

*allow other correct pituitary hormone eg FSH / LH / TSH*

*ignore functions of hormones*

1

(b) any **one** from:

- (it would) be digested to amino acids
- (it would) be digested by protease
- (it would) be digested (by enzymes) in the stomach
- (it would) be digested (by enzymes) in the small intestine
- (it would) be digested so (hGH is) not absorbed

*allow 'broken down' for digested throughout*

1

(c) isolate (hGH) gene from human DNA / chromosome

*allow cut (hGH) gene from human DNA / chromosome*

1

join (hGH) gene to (cut) plasmid

1

put plasmid (containing gene) into bacteria

1

*enzyme used at a suitable stage:*

to cut (hGH) gene from human  
DNA

**or**

to insert / join (hGH) gene to plasmid

*allow reference to named enzyme used in genetic engineering*

*allow to insert / join (hGH) gene to bacterial DNA*

1

(d) any **two** from:

- (hGH) easier to isolate / purify / extract
- made in larger quantities  
*ignore reference to speed of production*
- no / less chance of immune reaction  
*allow no / less chance of rejection*  
*ignore reference to side effects*
- no / less chance of passing on disease / pathogens (from animals to humans)  
**or**  
no / less chance of infection (of humans)  
*allow named (animal) disease eg BSE*
- no / less chance of containing antibiotics / urea / drugs
- it is the specific human hormone so may be more effective (in human body)  
*allow animal GH may not be the correct shape*  
*ignore ethical / religious reasons*  
*ignore reference to cost*  
*allow converse if clearly referring to GH*

2

**[8]**

**6.**

(a) cell division 1

1

(b) **A and C**

1

(c) 23  
**or**  
twenty three

*do **not** accept 23 pairs*

1

(d) 5 / five  
**or**  
6 / six

*ignore reference to letters*

1

(e) (only) mitosis

*do **not** accept meiosis / meitosis / metosis*

1

(so) **all** cells receive a copy of every allele / gene

*allow (so) **all** cells receive a copy of every chromosome*

**or**

*(so) **all** cells receive a copy of all the DNA*

**or**

*(so) **all** cells receive a full set of chromosomes*

1

(f) gametes are produced by meiosis

1

(so) offspring have unique / different / random combinations of alleles / genes / chromosomes from each parent / gamete

*allow (so) gametes fuse creating unique / different / random combinations of alleles / genes / chromosomes in offspring*

1

(g) any **two** from:

- faster than sexual
- many offspring produced to colonise local area  
**or**  
many offspring produced to out-compete other species
- genetically identical offspring so well adapted to current conditions / environment
- only one parent needed so no need for pollinators / bees
- offspring receive water **and** sugars / minerals / ions / salts from parent
- less energy / materials required as no need to produce gametes / flowers / seeds / fruits

2

(h) any **two** from:

- new combinations of alleles gives genetic variation  
**or**  
genetic variation gives selective advantage  
*allow genetic variation provides the opportunity for evolution*  
*allow genetic variation enables species to adapt to new / changed environments*
- seeds dispersed to new / wider area so less vulnerable to habitat loss  
**or**  
seeds dispersed to new / wider area so not competing with (parent / offspring) plants for space / water / minerals
- larger number of offspring produced so will increase the population quickly  
*allow larger number of offspring produced will improve survival of the species*

2

[12]

7.

(a) *genotype*  
**HH**

*allow homozygous dominant*

1

*reason*

all offspring have (at least one) **H**

**or**

female **A** gives **H** to every offspring

**or**

none of the offspring are white so female **A** does not have a **h**

*MP2 is dependent on MP1*

1

(b) gametes correct for both parents:

**H + h**

1

correct derivation of offspring genotypes:

**HH + Hh + Hh + hh**

*allow correct derivation from incorrect gametes*

1

correct phenotype for each genotype:

**HH + Hh = Himalayan**

**and hh = white**

*allow correct phenotypes for stated genotypes*

1

probability correct for offspring genotypes,  
eg 0.25 / ¼ / 25% / 1 in 4

*allow 1:3*

*do not accept 1 in 3 / 1:4 / 3:1*

*do not accept 0 / 100%*

1

(c) gives different set of 3 bases

*allow gives a different triplet ignore codon*

1

codes for a different amino acid

1

(which) alters shape of the (enzyme's) active site

*allow the (enzyme's) active site is no longer complementary (to tyrosine / substrate)*

1

(so) tyrosine / substrate no longer fits

*allow cannot form enzyme-substrate complexes*

1

(d) temperature inside mother's body is greater than 35 °C

**or**

temperature inside nest is greater than 35 °C

*allow mother's body temperature is 39 °C*

1

(so) tyrosinase / enzyme does not work

*allow tyrosinase / enzyme is inactive*

*do not accept tyrosinase / enzyme is denatured*

1

(e) outside environment is cooler  
*allow outside environment is less than 35 °C* 1

rabbit loses heat from ears / nose / feet / extremities  
**or**  
temperature of ears / nose / feet / extremities drops (more than rest of body) 1

(so) tyrosinase is (more) active 1

(f) stops (UV / ionising) radiation  
causing mutation (in skin cells)  
*allow UV / ionising radiation can cause mutation (in skin cells)* 1

(which can) lead to (skin) cancer  
*allow description of cancer eg tumours **or** uncontrolled cell division* 1

[17]

**8.** (a) kingdom 1

(b) genus 1

species 1

(c) 3 million years ago 1

(d) black-backed jackal  
*ignore jackal*  
*do **not** accept golden jackal* 1

- (e) any **two** from:
- drought
  - ice age
  - global warming
    - if none of these awarded, allow 1 mark for climate change*
    - ignore weather*
  - volcanic activity
  - asteroid collision
    - if neither of these, allow catastrophic event or natural disaster for 1 mark*
  - (new) predators
    - allow named example*
    - allow hunters*
  - (new) disease / pathogen
    - allow named example*
  - competition for food
    - allow lack of food*
  - competition for mates
    - allow lack of mates*
    - ignore competition unqualified*
  - lack of habitat or habitat change
    - ignore environment change*
    - ignore isolation*
    - ignore pollution*

2

- (f) any **one** from:
- wolves ate humans
  - wolves get left-over food from humans
  - humans gave food to wolves

1

- (g) breed the least / less aggressive wolves

1

breed (least / less aggressive) offspring

*ignore repeat breeding of the original pair(s)*

1

**[10]**