Inheritance 4

Name: _____

Class: _____

Date: _____

Time: **87 minutes**

Marks: **79 marks**

Comments:

1. This question is about reproduction.

(a) Which **two** statements are true for sexual reproduction in humans?

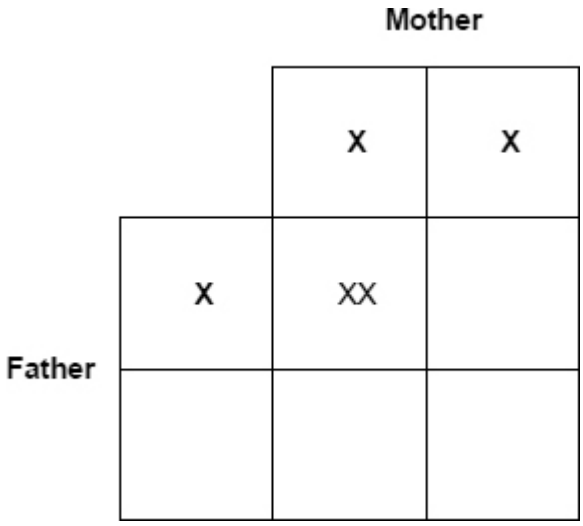
Tick (✓) **two** boxes.

Gametes are formed.	☐
Offspring are clones.	☐
Offspring are genetically identical to parents.	☐
Only one parent is involved.	☐
Sperm and egg fuse.	☐

(2)

(b) Humans reproduce by sexual reproduction.

Complete the diagram below to show the inheritance of sex.



(3)

(c) Draw a ring around the genotype of all male children in the diagram above.

(1)

(d) When children reach puberty, reproductive hormones cause changes in their bodies.

Draw **one** line from each hormone to the change the hormone causes at puberty.

Hormone	**Change the hormone causes at puberty**
Oestrogen	Breasts develop
	Skin turns lighter
Testosterone	Voice becomes deeper
	Wisdom teeth appear

(2)

A woman does **not** want to become pregnant.

She considers two methods of contraception.

(e) Draw **one** line from each method of contraception to how the method prevents pregnancy.

Method of contraception	How the method prevents pregnancy
Condom	Embryos do not implant in the uterus
Oral contraceptive (the pill)	Hormones stop eggs maturing
	Sperm are killed
	Sperm do not reach the egg

(2)

(f) Give **one** advantage and **one** disadvantage of taking oral contraceptives to prevent pregnancy.

Advantage _____

_____

Disadvantage _____

_____

(2)

(Total 12 marks)

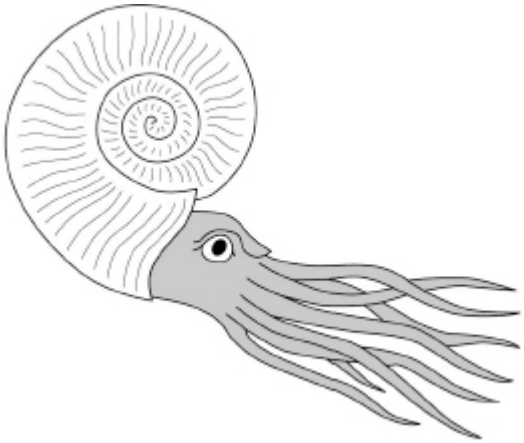
2. Ammonites became extinct millions of years ago.

Figure 1 is a photograph of a fossil ammonite. .

Figure 2 is a drawing of what scientists think a living ammonite looked like.

Figure 1

Figure 2



(a) How was the fossil in **Figure 1** formed?

Tick (✓) **one** box.

The ammonite left traces where it moved. ☐

The ammonite shell was replaced by minerals. ☐

The ammonite was frozen in ice. ☐

(1)

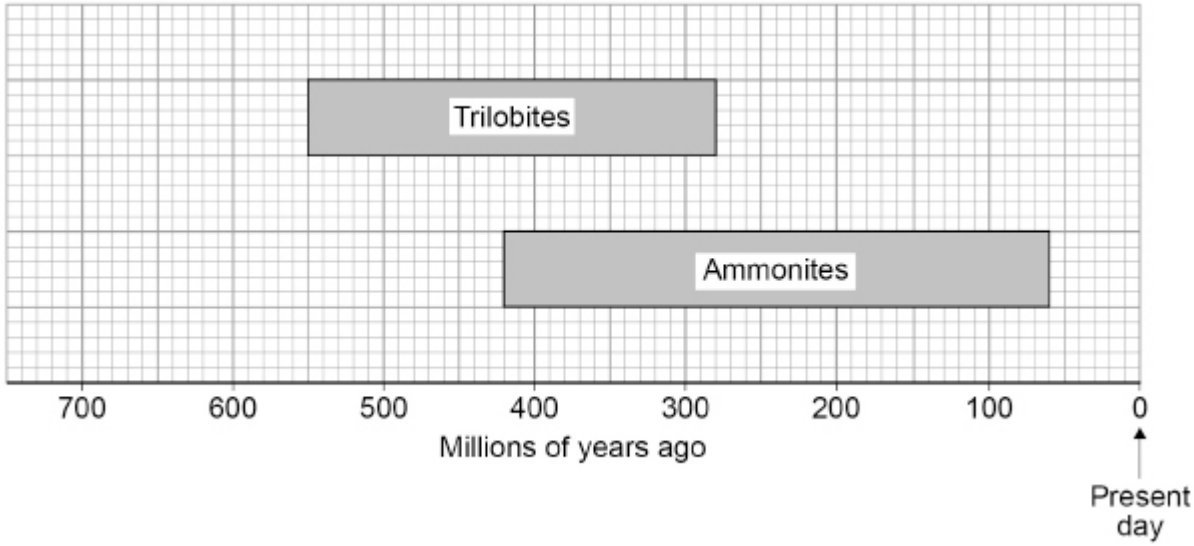
(b) Suggest why scientists are **not** certain what living ammonites looked like.

_____

_____

(1)

The diagram below shows when two different types of organism were alive on Earth.



(c) How many millions of years ago did ammonites become extinct?

Use the diagram above.

_____ million years

(1)

(d) Trilobites lived on Earth for 270 million years.

Calculate how much longer ammonites lived on Earth than trilobites.

Use the diagram above.

_____

_____

_____ million years

(2)

(e) Suggest **two** factors which may have caused ammonites to become extinct.

1. _____

_____

2. _____

_____

(2)

The fossil record provides evidence for the theory of evolution by natural selection.

(f) Which scientist proposed the theory of evolution by natural selection?

Tick (✓) **one** box.

Carl Linnaeus ☐

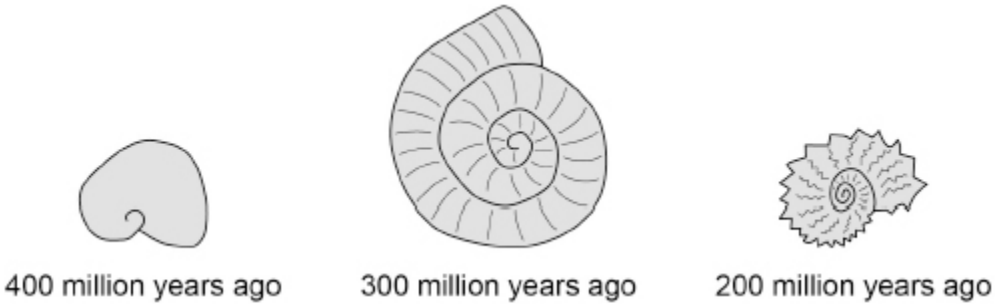
Carl Woese ☐

Charles Darwin ☐

(1)

(g) **Figure 3** shows ammonite fossils from three different time periods.

Figure 3



How do the fossils in **Figure 3** give evidence for the theory of evolution by natural selection?

Tick (✓) **one** box.

All fossils have coiled shells. ☐

More recent fossils are bigger. ☐

Older fossils are more simple. ☐

(1)

(Total 9 marks)

3. This question is about DNA and genes.

(a) Which diagram represents a DNA molecule?

Tick (✓) **one** box.

☐ ☐ ☐

(1)

(b) Describe the structure of a DNA molecule.

_____

_____

(1)

(c) A gene is a small section of DNA on a chromosome.

Complete the sentences.

A gene codes for a particular sequence of _____.

This sequence makes a specific _____.

(2)

(d) What is meant by the term genome?

_____

_____

(1)

(e) The complete human genome is now known.

Which important scientific advance was made using knowledge of the human genome?

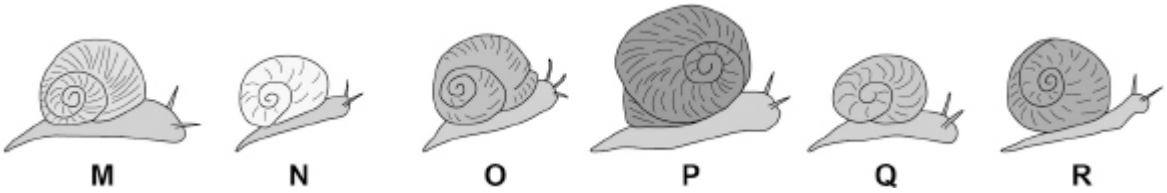
Tick (✓) **one** box.

Discovering antibiotic resistant bacteria	☐
Finding more foods to eat from tropical forests	☐
Tracing how aboriginal people spread across Australia	☐
Working out when the last ice age ended	☐

(1)

A student found six different snails of one species in his garden.

The diagram below shows the snails.



(f) All the snails are different.

What scientific term describes differences in characteristics between individuals of a species?

_____

(1)

(g) A change in DNA has caused snail **P** to be very different from the other five snails.

Suggest why there might be an increasing number of snails similar to snail **P** in each future generation.

_____

_____

_____

_____

(2)

(Total 9 marks)

4. (a) In sexual reproduction, cells divide by meiosis to form gametes.

Which **two** statements are true for cell division by meiosis?

Tick (✓) **two** boxes.

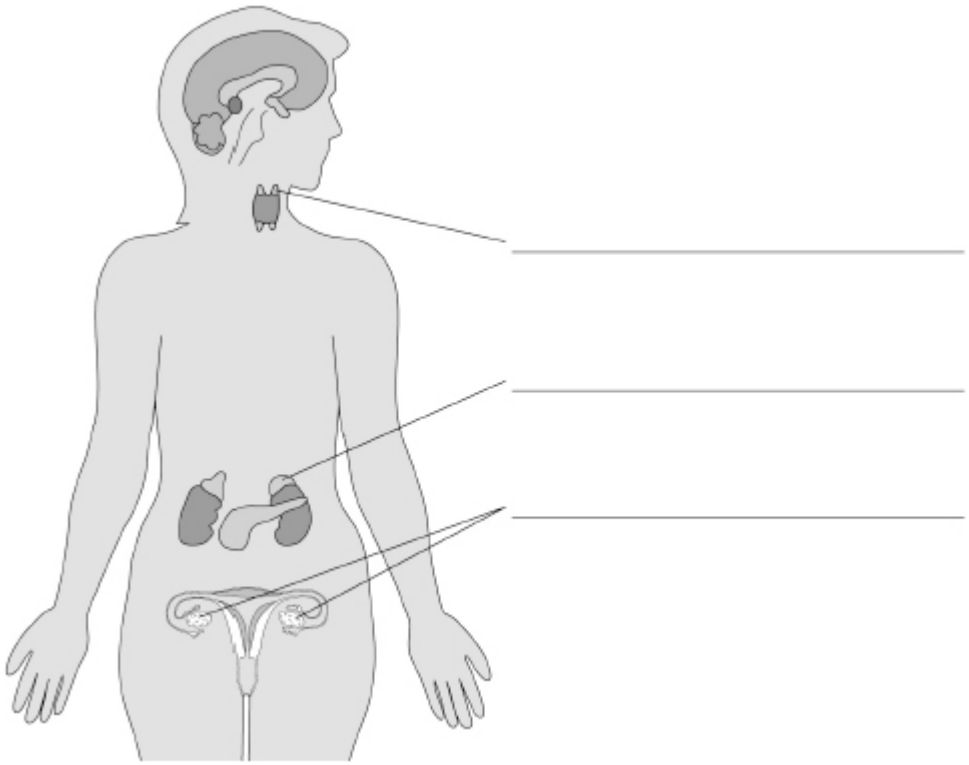
Daughter cells have two sets of chromosomes.	☐
Four daughter cells are formed.	☐
The daughter cells are genetically identical.	☐
The DNA replicates twice.	☐
The parent cell divides twice.	☐

(2)

Hormones are released from endocrine glands.

Each hormone travels in the bloodstream to a target organ.

The diagram below shows the position of endocrine glands in a female.



(b) Label the endocrine glands on the diagram above.

(3)

(c) Complete the table below.

Hormone	**Name of gland which releases hormone**	**Target organ of hormone**
Luteinising hormone (LH)	Pituitary gland	
	Adrenal gland	
Glucagon		

(3)

Millions of geranium plants are sold each year in garden centres.

Geraniums can be reproduced asexually or sexually.

The image below shows a potted geranium plant.

Garden centres usually grow new geranium plants by asexual reproduction.

(d) Suggest **two** advantages for garden centres of growing geraniums by asexual reproduction compared with sexual reproduction.

1. _____

_____

2. _____

_____

(2)

(e) Suggest **two** disadvantages for garden centres of growing geraniums by asexual reproduction compared with sexual reproduction.

1. _____

_____

2. _____

_____

(2)

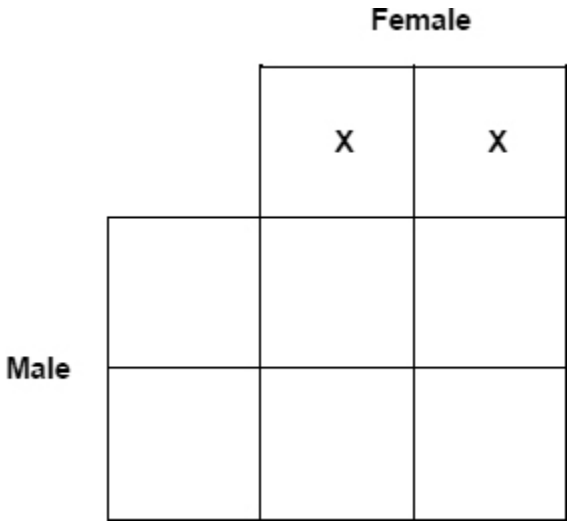
(Total 12 marks)

5. This question is about inheritance.

Humans have 23 pairs of chromosomes in each body cell.

One pair of chromosomes determines sex.

(a) Complete diagram below.



(2)

(b) In some families all children are the same sex.

Give the reason why.

_____

_____

(1)

Cystic fibrosis (CF) is an inherited disorder.

(c) A man and a woman do **not** have CF.

The man and the woman have a child who has CF.

Draw a Punnett square diagram to find the probability that their next child will have CF.

Use the symbols:

T = dominant allele
t = recessive allele

Draw a ring around the genotype of any children with CF.

Probability = _____

(4)

Embryo screening for CF can be done by two methods.

Method 1

- The woman becomes pregnant by sexual intercourse.
- After 10 weeks of pregnancy a fine needle is inserted into the uterus.
- A sample of the fluid surrounding the embryo is taken.
- The DNA of the embryo is tested for CF.

The screening is done free by specialist hospitals for couples who are at risk of having a child with CF.

There is a small risk of miscarriage.

Method 2

- The couple use In Vitro Fertilisation (IVF) to produce a small number of embryos.
- Each embryo is tested for CF.
- One or two embryos without CF are implanted in the woman's uterus.

In 2017 the success rate for having a baby by IVF for women under 35 years was 30%

IVF is a stressful, invasive procedure.

In most UK areas the free public health service does not provide IVF for all women asking for it.

(d) Suggest **three** reasons for choosing **Method 1** instead of **Method 2**.

1. _____

_____

2. _____

_____

3. _____

_____

(3)

(e) Suggest **one** advantage of **Method 2**.

_____

_____

(1)

(Total 11 marks)

6. Scientists believe that the first life on Earth was primitive anaerobic bacteria which first appeared billions of years ago.

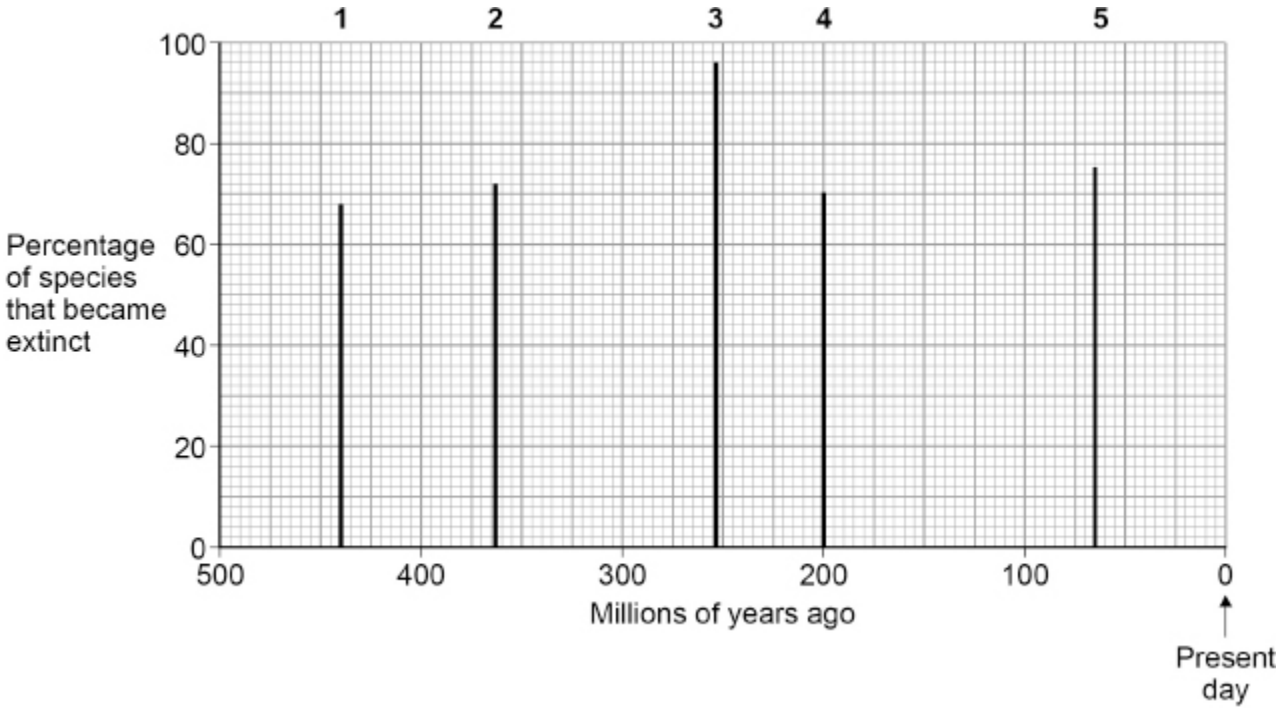
(a) Which domain of the three-domain classification system do these primitive anaerobic bacteria belong to?

_____

(1)

Scientists have identified five periods of mass extinction since the fossil record began.

The graph below shows the timeline of the five mass extinction events.



(b) Ammonites were organisms that first appeared in the oceans 415 million years ago.

Ammonites disappeared in the 5th mass extinction.

Draw a horizontal line on the graph above to show the time period that ammonites existed on Earth.

Label the line 'ammonites'.

(1)

(c) Another type of organism that existed in the oceans was called trilobites.

Trilobites existed from 544 million years ago until 278 million years ago.

How many more years did ammonites exist than trilobites?

_____

_____

_____

_____

_____ years

(2)

(d) There was an increase in the percentage of species which became extinct in the third mass extinction compared to the first mass extinction.

Calculate the percentage increase.

_____

_____

_____

_____

_____

_____

Percentage increase = _____ %

(3)

(Total 7 marks)

7. Animals have adaptations to survive in their environment.

These adaptations may be structural, behavioural or functional.

(a) Draw **one** line from each animal adaptation to the type of adaptation it is.

Animal adaptation	Type of adaptation
 Male palm cockatoos use sticks to beat on hollow branches to attract females.	Structural
 The harmless hornet moth has black and yellow stripes to look like a bee or wasp.	Behavioural
 Sea spiders have automatic muscle contractions that move oxygen around their bodies.	Functional

(2)

Plants also have adaptations.

Orchid plants have adaptations which make them one of the most successful plant groups.

Orchids rely on insects for pollination.

The photograph shows an orchid.

(b) Which **two** features help orchids survive?

Tick (✓) **two** boxes.

Brightly coloured flowers	☐
Large quantities of pollen	☐
No scent	☐
Oval shaped leaves	☐
Small leaves	☐

(2)

Many orchid species grow in tropical rainforest ecosystems.

(c) What name describes the variety of all the different species found in an ecosystem?

Tick (✓) **one** box.

- Biodiversity ☐
- Evolution ☐
- Feeding relationship ☐
- Habitat ☐

(1)

(d) Some species of orchid may become extinct because of deforestation.

Give **one** reason why tropical rainforests are being cut down.

_____

(1)

(e) Give **one** factor that might cause a species of orchid to become extinct.

Do **not** refer to deforestation in your answer.

_____

(1)

Scientists have analysed the entire genetic material of one species of orchid.

(f) What chemical is the genetic material made from?

_____

(1)

(g) What is the name for the entire genetic material of an organism?

_____

(1)

(Total 9 marks)

8. A cat breeder noticed that four kittens from one Siamese cat mother had a new blue colour at the tip of their tails.

(a) What has caused the new colour to appear?

Tick (✓) **one** box.

Fertilisation ☐

Mitosis ☐

Mutation ☐

(1)

(b) The cat breeder wants to use selective breeding so that all new kittens have blue tail tips.

Describe the process of selective breeding the cat breeder could use.

_____

_____

_____

_____

_____

_____

(3)

(c) Suggest **one** reason why the cat breeder wants to have all new kittens with the blue tail tips.

_____

_____

(1)

(d) Siamese cats can suffer from heart defects.

Why might there be more Siamese cats with heart defects amongst the kittens with blue tail tips?

Tick (✓) **one** box.

They are clones	☐
They are formed by mitosis	☐
They are formed by sexual reproduction	☐
They are produced by inbreeding	☐

(1)

With each pregnancy, the cat breeder expected that:

- 50% of the kittens would be male
- 50% of the kittens would be female.

The sex chromosomes in cats are inherited in the same way as in humans.

The sex chromosomes are X and Y.

(e) Give the combination of sex chromosomes present in a male cat and in a female cat.

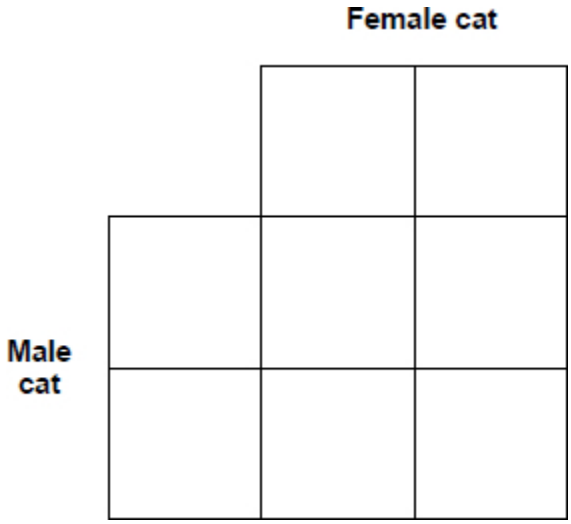
Male cat _____

Female cat _____

(1)

(f) The cat breeder expected 50% male kittens and 50% female kittens.

Complete the Punnett square in the diagram below to show why.



(2)

(g) In the first pregnancy there was one male kitten and three female kittens.

Give the reason why there were **not** two kittens of each sex.

_____

_____

(1)

(Total 10 marks)

1.

(a) gametes are formed

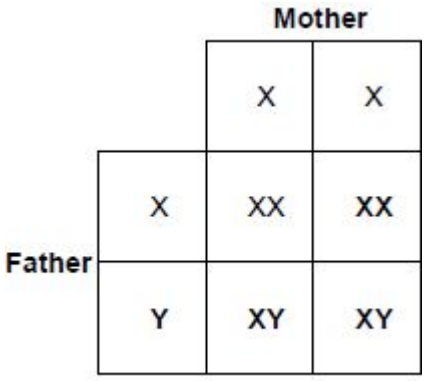
1

sperm and egg fuse

1

(b) Y gamete for father

1



all derivations correct = 2 marks 1 or 2 correct = 1 mark
allow correct derivations from incorrect gamete

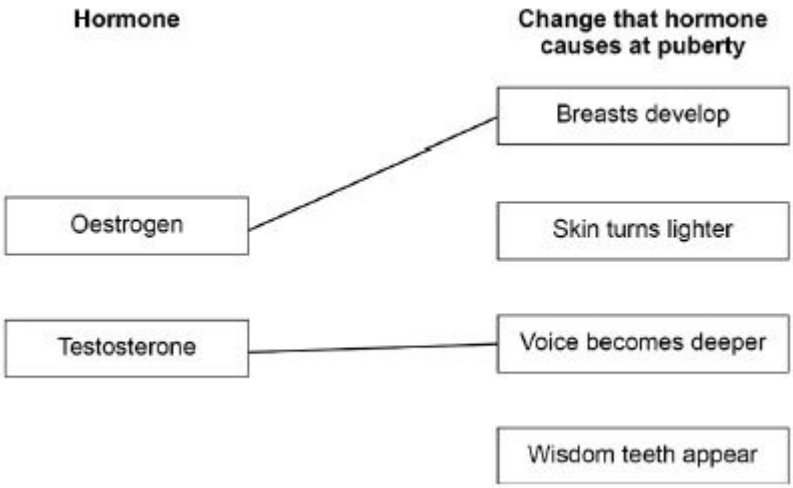
2

(c) rings drawn around all XY

allow one ring drawn around both XY
ignore ring drawn around father's genotype
ecf any letter for Y, except X

1

(d)

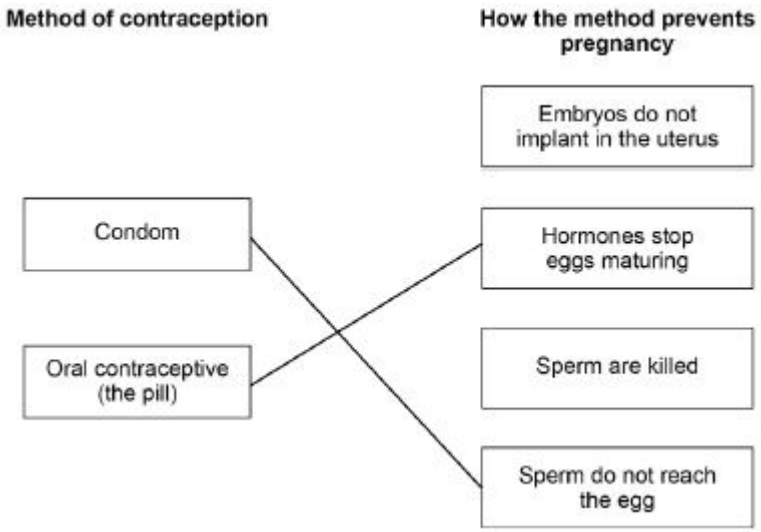


1

If more than one line from a hormone no mark for that hormone

1

(e)



1

If more than one line from a method of contraception no mark for that method

1

(f) advantage –

any **one** from:

- very reliable
- easy to take
- do not have to rely on partner
- helps to treat acne or period pain

ignore you do not get pregnant

1

disadvantage –

any **one** from:

- may cause side effects

allow described eg headaches, nausea, putting on weight

- may affect her fertility later
- have to remember to take it (every day)

allow you have to take it every day

- does not protect against STIs ignore you do not get pregnant

1

[12]

2. (a) the ammonite shell was replaced by minerals

1

(b) any **one** from:

- no living ones around now or during human times

allow there were no humans living then

- all the soft parts have decayed
- the soft parts did not mineralise / fossilise.

1

(c) 60 (million years)

1

(d) (ammonites) 420 - 60 = 360

1

360 - 270 = 90 (million years)

*allow ecf from question **(c)***

1

(e) any **two** from:

ignore pollution

- drought
- ice age / global warming

ignore temperature change unqualified

- volcanic activity

allow earthquake / tsunami

- asteroid / meteor collision
- (new) predators

allow hunted / eaten by other animals

- (new) diseases / pathogens
- competition for food

allow lack of food

- competition for mates

*allow isolation **or** lack of mates*

- lack of habitat **or** habitat change ignore pollution

*if no other mark awarded allow natural disaster **or** climate change **or** catastrophic event for **1** mark*

2

(f) Charles Darwin

1

(g) older fossils are more simple

1

[9]

3. (a)

1

(b) any **one** from:

- 2 strands / chains that are twisted / coiled / spiralled

allow cross links between 2 strands / chains

- double helix
- (long) polymer

allow reference to nucleotides or sugars, phosphates and bases

1

(c)

in this order only

amino acids

1

protein

allow polypeptide

1

(d) all the genetic material (of an organism)

allow DNA / genes for genetic material
ignore chromosomes

1

(e) tracing how aboriginal people spread across Australia

1

(f) variation

ignore genetic/environmental

1

(g) stronger / larger (shell)

1

(so) more likely to (survive and) breed
or
(so) more likely to (survive and) pass on genes

OR

(better) camouflaged (1)

(so) less likely to be eaten and will breed more (1)

1

[9]

4. (a) four daughter cells are formed

1

the parent cell divides twice

1

(b) thyroid (gland)

in this order only

1

adrenal (gland)

1

ovary / ovaries

1

(c)

Hormone	Name of gland which releases hormone	Target organ of hormone
Luteinising hormone (LH)	Pituitary gland	**Ovary**
Adrenaline	Adrenal gland	**Heart / lungs / liver**
Glucagon	**Pancreas**	**Liver / muscle**

1
1
1

(d) only need 1 parent plant

1

will produce (many genetically) identical plants

*allow for **1** mark it is a faster process*

*allow for **1** mark will produce a large number of plants at one time*

ignore clones unqualified

1

(e) any **two** from:

- genetically identical so will all be susceptible to same diseases / pathogens
- no genetic variety for new colours / characteristics to offer customers
- no genetic variety leads to weaker / unhealthy plants (due to lack of evolution)

2

[12]

5. (a) (male gametes) X and Y

1

all offspring correct

		Female	
		X	X
Male	X	XX	XX
	Y	XY	XY

allow correct offspring from incorrect gametes

1

(b) It is (50%) chance if sperm cells which fertilised the egg has X (or Y) chromosome

allow each / every child / baby / pregnancy has a 50% chance of being male or female (so can be all same sex)

1

(c) both parents shown as heterozygous

1

derivation correct to show 1 unaffected, 2 carriers and 1 affected offspring.

		Woman	
		T	t
Man	T	TT	Tt
	t	Tt	tt

allow correct derivation from incorrect gametes

1

tt identified as offspring with CF

1

correct ratio / probability from their derivations of **tt** e.g. 1:3, 1 in 4, 25%, 0.25

1

(d) any **three** from:

- does not need IVF which is stressful / invasive
- higher chance of successful pregnancy as risk of miscarriage is low compared to (30%) success rate of IVF
- the test is freely available

  allow method 2 is not available to all couples who want it

- the test can be carried out even once the mother is pregnant

3

(e) any **one** from:

- child will (definitely) not have CF
- do not need to consider termination
- it is a way to have a child if couples are having fertility problems

1

[11]

6.

(a) archaea

allow archea or archaia as phonetic spelling

1

(b) horizontal line from –415 to –65 (labelled ammonites)

allow -410 to -420 for -415 (to -65)
allow oblique line

1

(c) ammonites = 350 (million years)
and
trilobites = 266 (million years)

allow range 345 to 355

1

84 million (years) or 84 000 000

allow correct calculation from their answer for ammonites

allow answers in standard form

1

(d) 68 and 96

allow +/- half a small square

1

[(96-68) ÷ 68] × 100

1

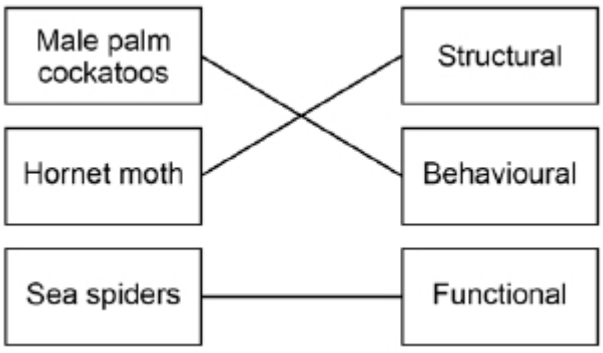
41.17647…
or
41.2
or
41

1

[7]

7.

(a)



additional lines from a box on the left negates the mark for that box

*3 lines correct for **2** marks*

*1 **or** 2 lines correct for **1** mark*

2

(b) brightly coloured flowers

1

large quantities of pollen

1

(c) biodiversity

1

(d) any **one** from:

- to grow crops

  allow farming / biofuels or named crop

- to raise cows
- to build

  *allow houses **or** building materials*

  allow mining

  allow paper / fuel

1

(e) any **one** from:

- (new) disease
- (new) herbivore

  ignore (new) predator

  allow drought / flooding

- climate change **or** global warming **or** ice age
- volcano / earthquake / tsunami / meteor
- lack of pollinators
- (new) competitor

  allow plant collectors

1

(f) DNA

allow deoxyribonucleic acid

1

(g) genome

1

[9]

8. (a) mutation

1

(b) any **three** from:

- choose the cats with the blue tail

  allow choose the cats with the desired characteristic

- breed these cats together
- choose offspring with blue tails and breed these together
- repeat until all cats have blue tails

  allow breed for several generations

3

(c) they are rare / beautiful / expensive

allow description e.g. the breeder will make (more) profit

1

(d) they are produced by inbreeding

1

(e) (male cat) XY **or** YX
(female cat) XX

both required for the mark

allow lower case letters

1

(f)

	(X)	(X)
(X)	XX	XX
(Y)	XY	XY

*allow 2 **or** 3 derivation squares correct for **1** mark*

2

(g) random (if X or Y goes into each sperm)

allow it is a chance event

allow it is only a probability

1

[10]