WJEC (Wales) Biology GCSE Topic 2.3 DNA and Inheritance Questions by Topic

1.

(a) (i) Which part of a living cell contains chromosomes? [1]

.....

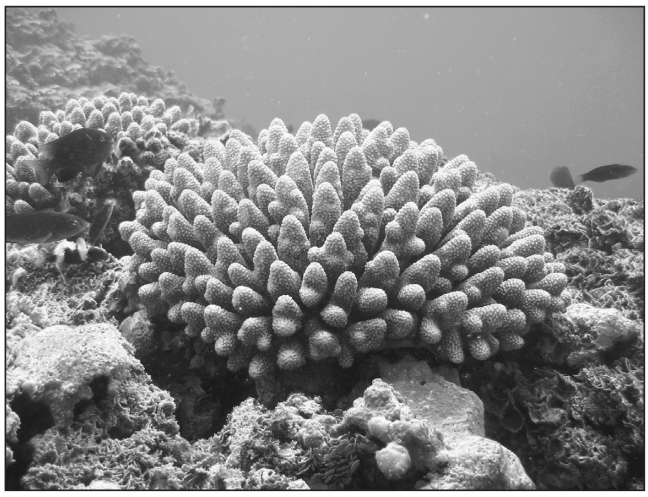
(iii) What is the scientific term used for sex cells such as sperm and eggs? [1]

.....

2.

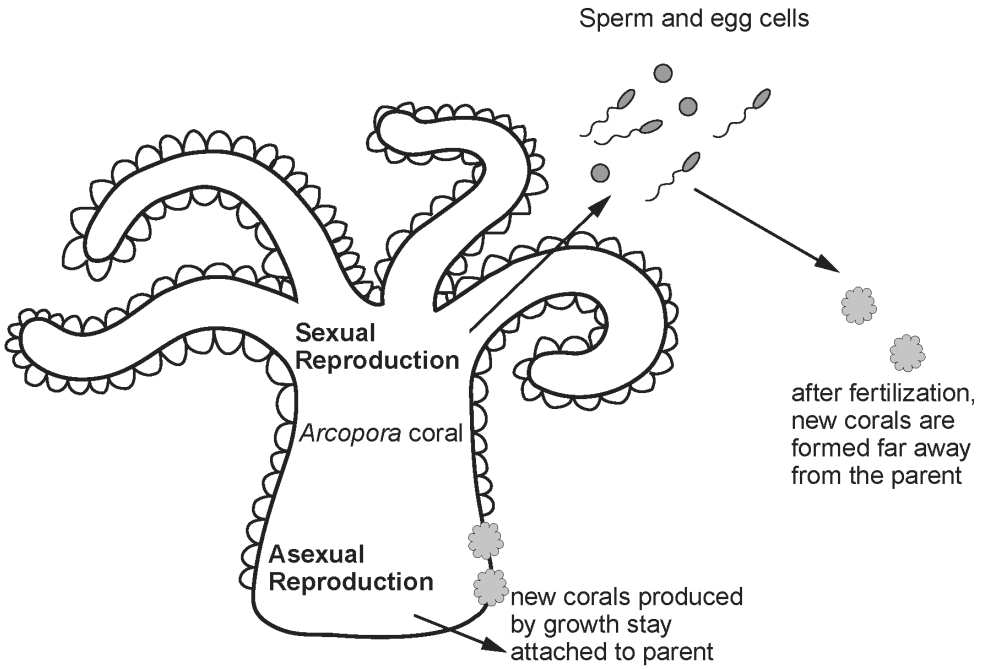
This question is about simple sea animals called corals.

Arcopora is a bushy coral which can grow into large colonies forming huge coral reefs.



Arcopora coral

Arcopora can reproduce by sexual and asexual reproduction as shown in the diagram below.



Use this information and your own knowledge to answer the following questions.

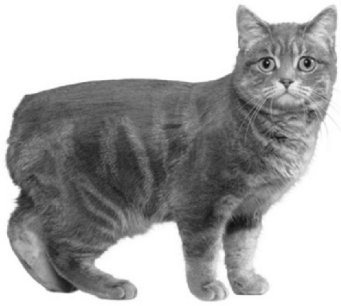
(b) (i) State the scientific term for the sex cells (sperm and egg cells) produced during sexual reproduction. [1]

.....

(c) (i) Suggest a reason why large coral reefs of *Arcopora* result from **asexual** reproduction. [1]

3. Manx cats have no tails. This condition arose as a mutation sometime in the 1700 or 1800s. The mutation produced a dominant allele that resulted in the lack of a tail.

Manx cat



(a) What is meant by the term *dominant allele*? [1]

.....

.....

(b) The allele for no tail can be represented by the letter **B**. Cats that lack the **B** allele have normal length tails.

In the following cross two **heterozygous** Manx cats are mated together.

(i) Complete the information below by writing in the genotype of both parents.
You must select a **suitable** letter to represent the allele for a normal length tail. [1]

Phenotype of parents Manx **x** Manx

Genotype of parents ....

(ii) Complete the Punnett square below to show this cross. [2]

Gametes		

(iii) The dominant allele **B** is lethal in the homozygous condition. The kittens die before birth. How many kittens out of a litter of 8 would be expected to survive in the above cross? [1]

.....

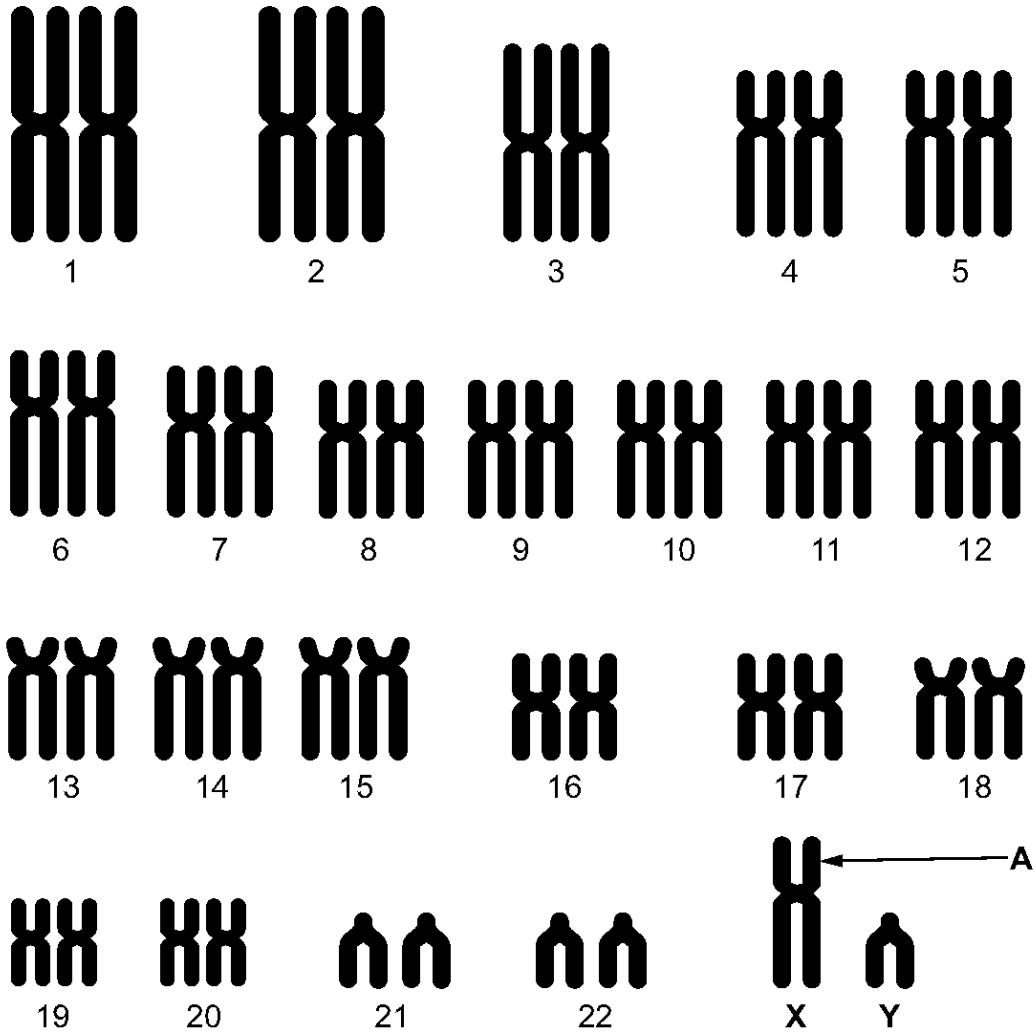
(c) A breeder of Manx cats wants to ensure that **all** kittens survive.

Give the phenotypes and genotypes of the two cats she would have to mate in order to do this. [2]

Phenotype of parents ..... **x** .....

Genotype of parents ..... **x** .....

4. The drawing shows the chromosomes from a human cell.



(a) How does the drawing show that the cell is not a gamete? [1]

.....

(b) Point A on the X chromosome shows the position of an allele. Give the reason why a male cannot be heterozygous for this allele. [1]

.....

.....

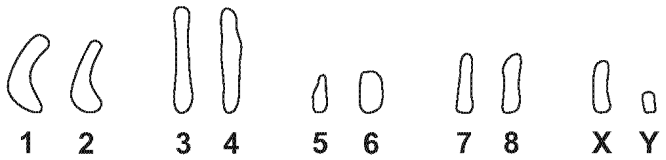
(c) Describe how genes are arranged on a chromosome. [1]

.....

.....

3

5. The diagram below shows all the chromosomes in a body cell of an animal.



(a) (i) How many chromosomes are shown? [1]

.....

(ii) What evidence in the diagram shows that the cell comes from a male animal? [1]

.....

(iii) State the number of chromosomes in a sperm cell (male gamete) from this animal. [1]

(b) Use words from the list below to complete the following sentences. [3]

allele **wall** **protein** **DNA** **nucleus**

(i) Chromosomes are found inside a cell in a structure called the

..... .

(ii) Chromosomes contain genes, which are made of a chemical called

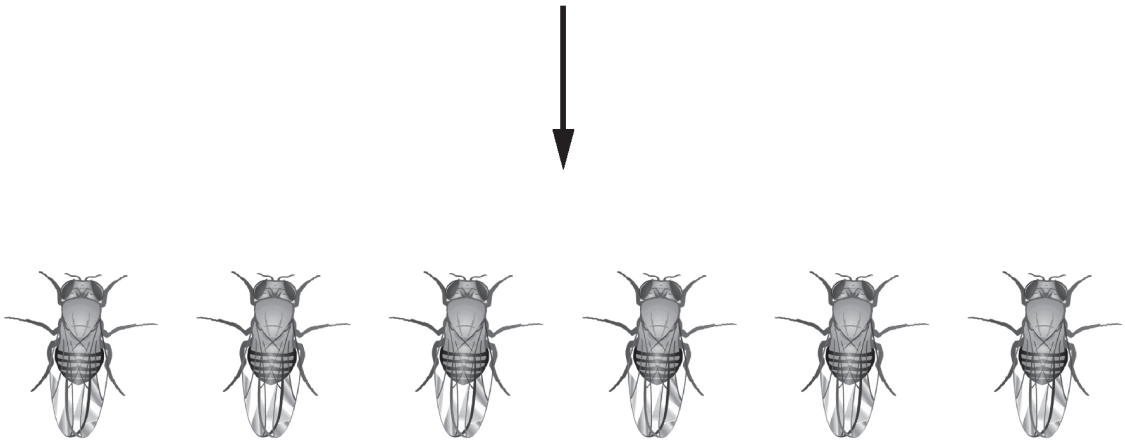
..... .

(iii) A gene codes for the order of amino acids that make up a particular

..... .

6. A grey-bodied fruit fly was mated with a black-bodied fruit fly. All the F1 offspring were grey-bodied.

Grey-bodied fly × Black-bodied fly



All the F1 offspring are grey-bodied

(a) Using the letters **A** and **a** to represent the alleles for the two different body colours, complete the Punnett square below to show the offspring produced from the mating between the grey-bodied and black-bodied fruit flies. [2]

	Gametes		
F1			

(b) (i) Complete the Punnett square below to show the offspring produced when two of the F1 offspring are selfed (bred together). [2]

	Gametes		
F2			

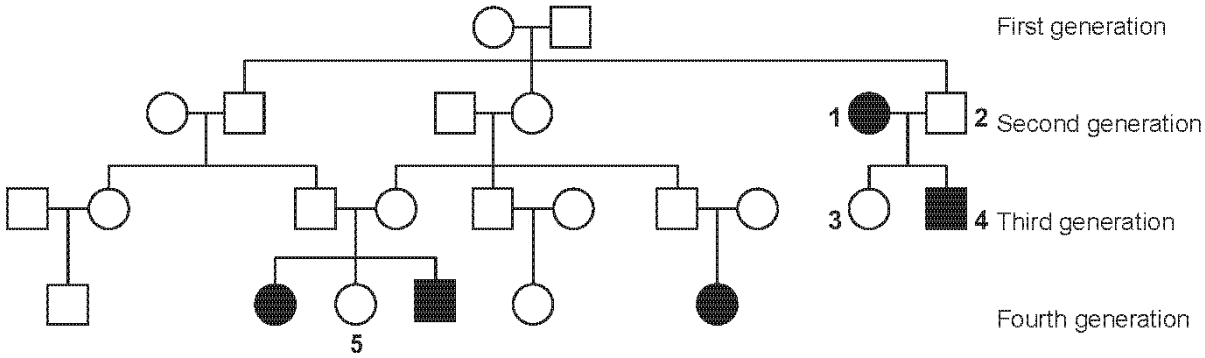
(ii) What is the ratio of the different phenotypes in the F2 offspring? [1]

..... : .....

7.

Cystic fibrosis is a hereditary disease that affects around 1 in every 2 500 babies born in the UK. It affects several organs in the body including the lungs and pancreas. The disease is caused by a recessive allele (**n**).

The family tree below shows the history of the inheritance of cystic fibrosis.



Female

Male

Female with cystic fibrosis

Male with cystic fibrosis

(a) (i) State the genotype of person number **2**. ..... [1]

(ii) Explain your answer. [2]

.....

.....

.....

(b) (i) State the genotype of person number **3**. ..... [1]

(ii) Explain your answer. [2]

.....

.....

.....

(c) What is the probability of person number **5** being homozygous dominant? [1]
Place a circle around the correct answer.

25% 50% 75% 100%

7

8.

In mice the allele for black colour **(B)** is dominant over the allele for white colour **(b)**. Two heterozygous black mice are mated together. They produce a litter of 8 young mice.

(a) (i) Which of the following results would you expect in the litter? [1]

Underline the correct answer.

A 4 black and 4 white

B 6 black and 2 white

C all black

D 2 black and 6 white

(ii) Complete the Punnett square below to help explain your answer to part *(a)*(i). [2]

Gametes		

Images: ©Emilia Stasiak/Shutterstock

(b) The sex of mice is determined by which sex chromosomes are present.

(i) State the sex chromosomes present in the body cells of [1]

I the father, ...

II the mother. .....

(ii) Complete the Punnett square below to show the expected sex chromosomes of the offspring in the litter. [2]

Gametes		

6

9.

Phenylketonuria (PKU) is an inherited disease caused by a recessive allele. PKU results in damage to the nervous system in the early years of life.

Key – **N** represents the allele for **not** having PKU

n represents the allele for having PKU

A couple, neither of whom suffer from PKU, have a child who is found to have PKU.

(a) (i) State the genotype of: [1]

I. the mother .....

II. the father .....

(ii) Complete the Punnett square below to show the possible genotypes of the children produced by this couple. [2]

Gametes		

(iii) Place a circle in the Punnett square around the genotype of a child suffering from PKU. [1]

(iv) From your Punnett square, what is the probability of a child **not** having PKU? [1]

.....

10. Mrs Hughes is a well known breeder of both yellow and black Labrador dogs. The allele for black coat (**B**) is dominant to the allele for yellow coat (**b**). Mrs Hughes finds it easier to sell black Labrador puppies because they are more popular. She does however produce yellow Labrador puppies when there is a demand for them.

Mrs Hughes has recently bought a black Labrador dog because it has many of the features which judges look for in dog shows, but she does not know its genotype.

(a) State the meaning of the term *genotype*. [1]

.....

.....

(b) (i) Mrs Hughes wants to breed from the black Labrador she has just bought but needs to know its genotype. How could she find out its genotype? Give a full explanation of the cross she could carry out and the expected results. [3]

.....

.....

.....

.....

.....

(ii) Complete the Punnett squares below to show the **possible** results of this cross. [2]

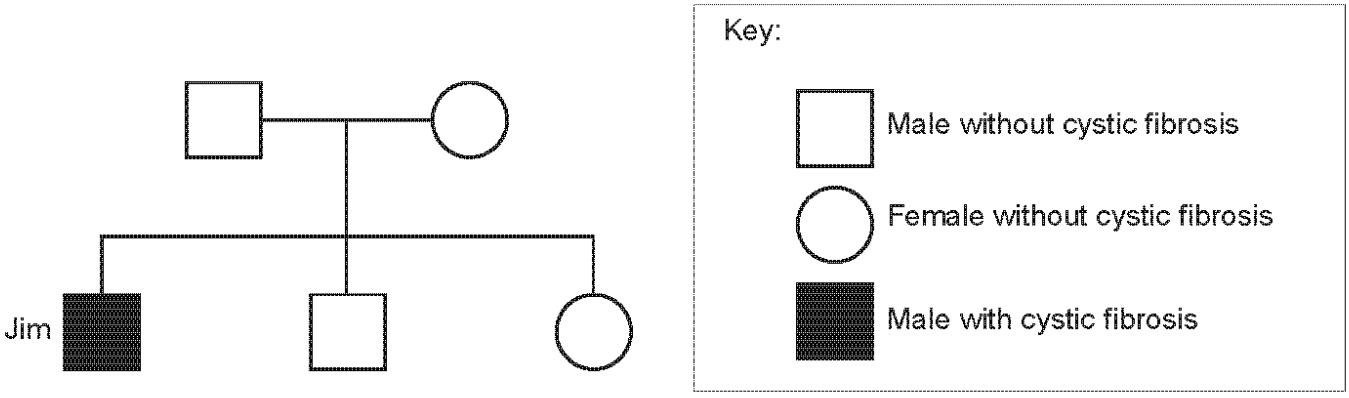
Gametes		

Gametes		

6

11. This question is about the disease cystic fibrosis.

(b) Look at the family tree below.



Use information in the family tree above, and your own knowledge, to choose the correct letter to complete the following statements.

(i) Jim inherited cystic fibrosis: [1]

A **only** from his father
B **only** from his mother
C from his father **and** his mother

.....

(ii) Jim's parents are: [1]

A heterozygous for cystic fibrosis
B homozygous dominant for cystic fibrosis
C homozygous recessive for cystic fibrosis

.....

(iii) Jim is: [1]

A heterozygous for cystic fibrosis
B homozygous dominant for cystic fibrosis
C homozygous recessive for cystic fibrosis

.....

(iv) Jim's parents are expecting another child. The probability that the child will have cystic fibrosis is:

[1]

A 25%
B 50%
C 75%

.....

(v) In the human population, cystic fibrosis affects: [1]

A **only** males
B **only** females
C males **and** females

.....

8

12. *(a)* State the meaning of the term heterozygous. [1]

.....

.....

.....

(b) Two tomato plants, both with purple stems, were crossed. The seeds were collected and sown in soil in a greenhouse. When large enough the plants were examined and the colour of the stems was recorded. The cross was carried out five times and the results are shown in the table below.

cross number	number of plants with purple stems	number of plants with green stems
1	616	209
2	746	251
3	409	139
4	892	292
5	534	181
approximate ratio of purple stemmed to green stemmed plants	..... :	

(i) **Complete the table above** to show the **approximate ratio** of purple stemmed plants to green stemmed plants. The ratio must be presented in **whole numbers**. [1]

(ii) **Complete the Punnett square below** to show how the approximate ratio of purple stemmed to green stemmed plants, shown opposite, is obtained. You must choose a letter to represent the allele for purple stems and for green stems.

I. Letter to represent: [1]

allele for purple stem colour = ...

allele for green stem colour = ...

II. Punnett square [2]

gametes		

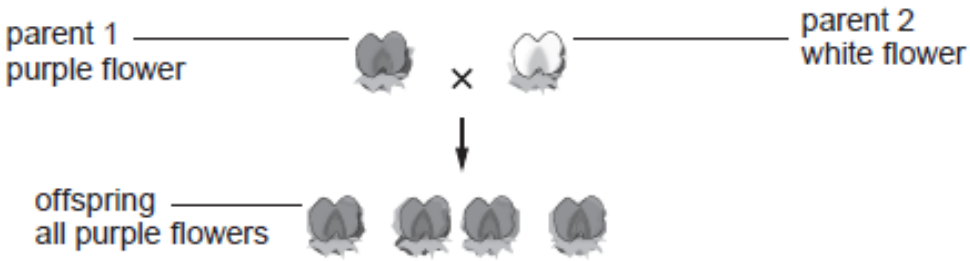
(iii) A heterozygous purple stemmed plant was crossed with a green stemmed plant. Give the probability of the appearance of green stemmed plants in the offspring. [1]

.....

13.

(b) Alan crossed two pea plants *(Pisum sativum)*.

- Parent 1 had purple flowers.
- Parent 2 had white flowers.
- All the offspring had purple flowers, as shown below.



Flower colour in pea plants is controlled by one gene. The gene has two alleles, **D** and **d**.

(i) Underline the correct answer to complete the following sentences.

I. The genotype of parent 1 is **DD** / **Dd** / **dd** [1]

II. The genotype of parent 2 is **DD** / **Dd** / **dd** [1]

(ii) State the phenotype of the offspring. [1]

.....

(iii) The offspring are heterozygous.

State the meaning of the term *heterozygous*. [2]

.....

.....

.....

14. A high level of blood cholesterol increases the risk of heart disease. One cause of high blood cholesterol is the inherited condition known as FH (familial hypercholesterolaemia).

FH is caused by a dominant allele (**B**). The recessive form of this allele (**b**) results in low levels of cholesterol (non-FH).

(a) State the meaning of the terms:

(i) allele; [1]

.....

.....

(ii) recessive. [1]

.....

.....

.....

(b) (i) Complete the Punnett square below to show the possible genotypes of the children produced by parents both of whom are heterozygous for FH.

Use the letters **B** and **b**. [2]

Gametes		

(ii) What is the probability of two heterozygous parents producing a child with FH? [1]

.....

(iii) What is the phenotypic ratio of the children produced?

..... FH : ..... non-FH

15. In mice the allele for black eye colour (**B**) is dominant over the allele for red eye colour (**b**).

(a) What is the phenotype of each of the following mice? [1]

Mouse 1 **BB** .....

Mouse 2 **Bb** .....

Mouse 3 **bB** .....

Mouse 4 **bb** .....

(b) (i) If mouse 1 and mouse 4 were mated together and had 12 offspring, how many of these would you expect to have black eyes?

Number with black eyes ..... [1]

(ii) Complete the Punnett square below to help explain your answer. [1]

Gametes		

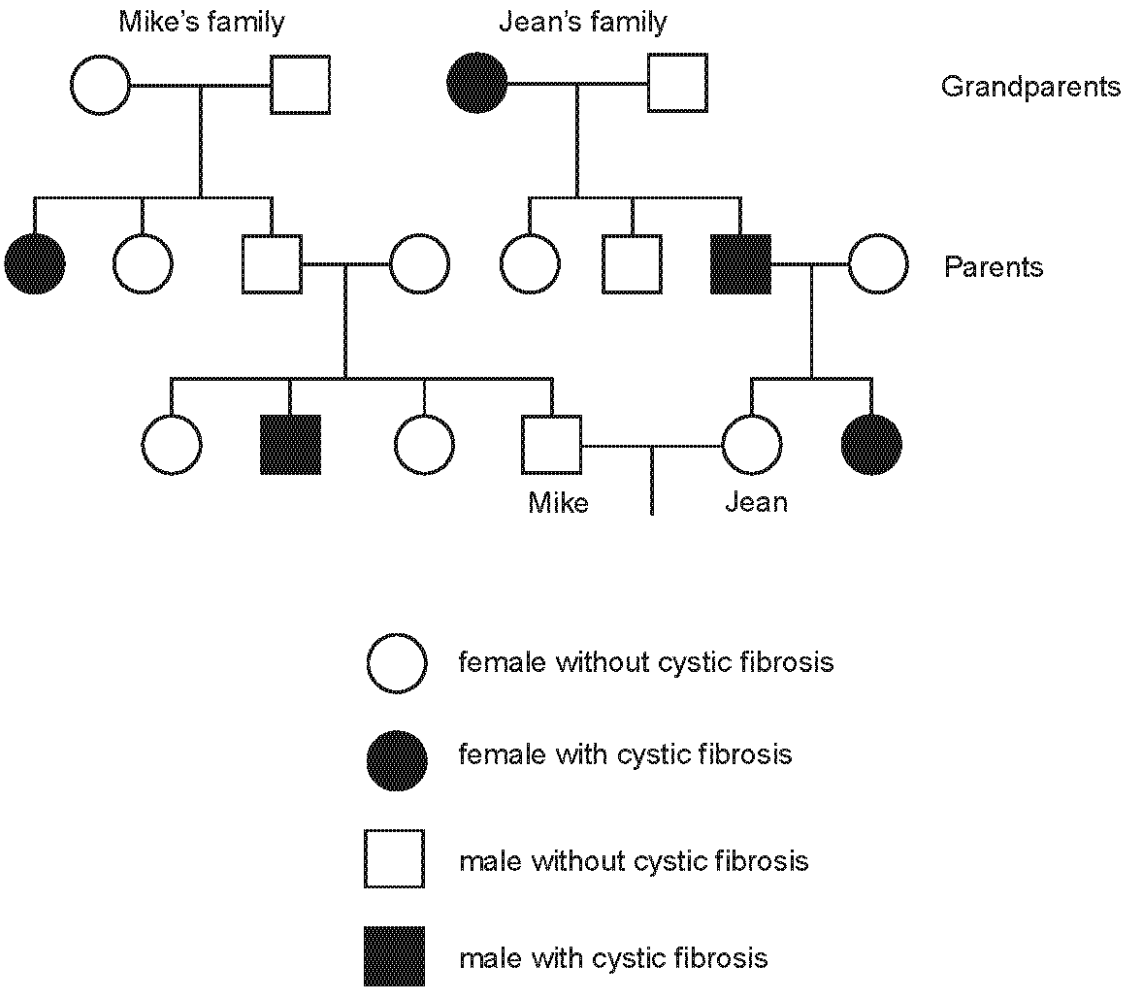
(c) (i) If mouse 2 and mouse 4 were mated together and had 50 offspring over several litters, how many of their offspring would you expect to have red eyes?

Number with red eyes ..... [1]

(ii) Complete the Punnett square below to help explain your answer. [1]

Gametes		

16. The patterns of inheritance of cystic fibrosis in two families is shown as a family tree below.



Cystic fibrosis results from a homozygous pair of recessive alleles. People who are heterozygous for cystic fibrosis have one normal allele and one cystic fibrosis allele. They are carriers of cystic fibrosis but do not suffer from it.

(a) In the family trees shown, if **N** = the normal allele and **n** = the allele for cystic fibrosis, what is the genotype of: [2]

(i) Mike's grandfather; .....

(ii) Jean? .....

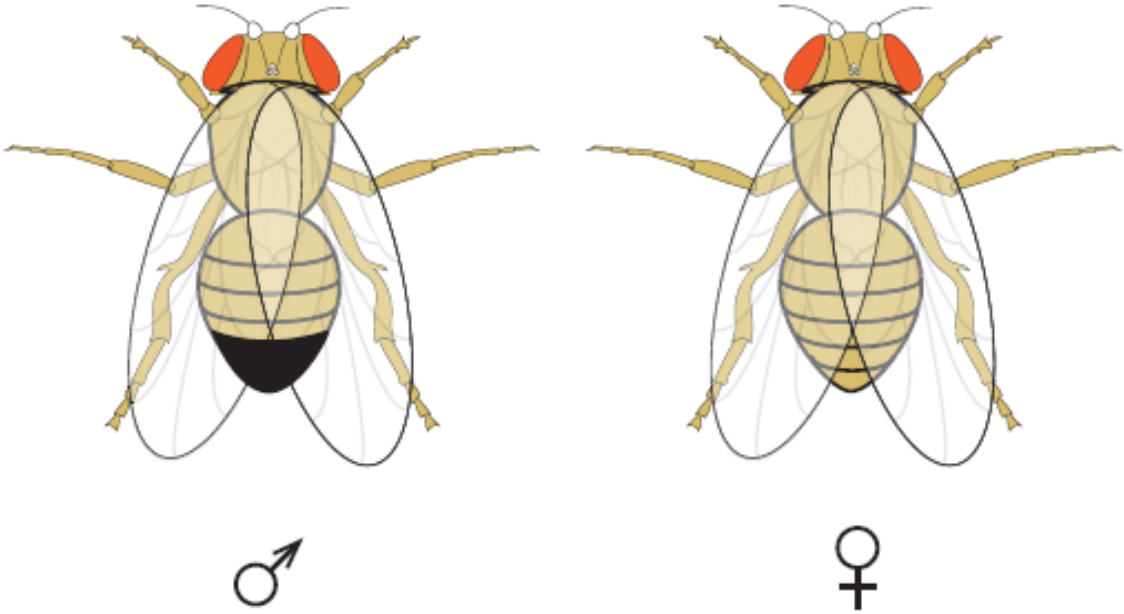
(b) What is the percentage chance that Mike is a carrier of cystic fibrosis? [1]

.....

17. A class of year 11 students decided to carry out some genetics investigations on the fruit fly *Drosophila melanogaster*. Fruit flies are easily kept in school laboratories and are a good species for genetics investigations because they:

- have a short generation time (a very short time to develop from egg to adult and reproduce)
- are easy to maintain
- males (♂) and females (♀) are easy to identify
- they produce between 200 and 500 offspring per mating

The students were asked to draw a sketch of a male and a female fruit fly. A sketch is shown below.



(a) Suggest an advantage to the students, of the fruit fly:

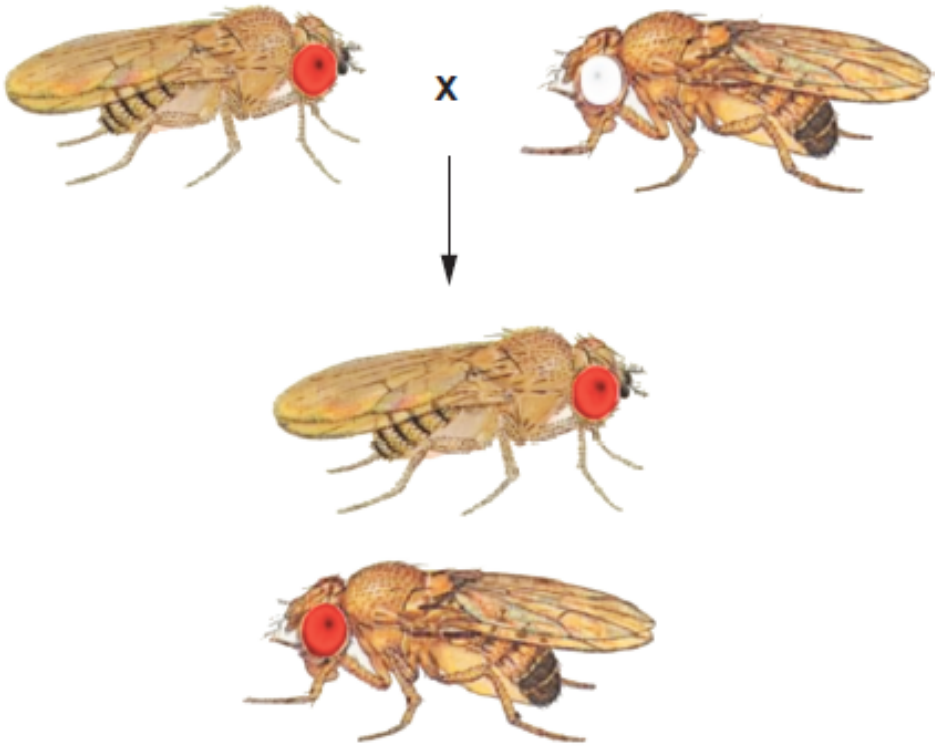
(i) having a short generation time; [1]

.....

(ii) producing large numbers of offspring. [1]

.....

(b) The students were asked to cross a red-eyed fly and a white-eyed fly. One of each of these flies was placed in a specimen tube with some nutrients. The diagram below shows the phenotype of both the flies in this cross and some of the offspring.



All F1 offspring have red eyes

(i) **Label one** of the **male** flies in the diagram above. [1]

(ii) Show this cross in the Punnett square below. Use the letters **R** to represent the allele for red eye colour and the letter **r** to represent the alleles for white eye colour. [2]

	Gametes		
F1			

(c) The students then decided to self the F1 generation. There were 8 groups of students. When they examined the F2 generation they obtained the following results.

Group number	Number of offspring in F2 generation	Number of flies with red eyes	Number of flies with white eyes	Approximate ratio of red-eyed to white-eyed flies
1	214	156	58	.....
2	139	108	31	.....
3	0	0	0	No ratio
4	276	206	70	.....
5	319	244	75	.....
6	39	28	11	.....
7	217	55	162	1 : 3
8	312	235	77	.....

(i) **Complete the table** by writing in the **approximate** ratio of red to white eyed flies for all the remaining groups. Use whole numbers only. [1]

(ii) The students in group number 3 followed the method correctly. Suggest a reason for their result. [1]

.....

(iii) Suggest an explanation for the anomalous result obtained by group number 7. [1]

.....

.....

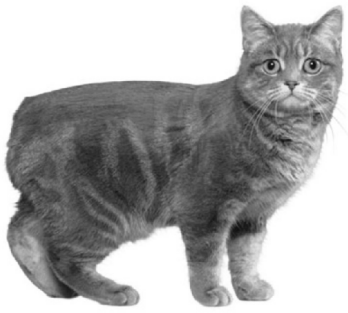
(iv) Complete the Punnett square below to show the expected result when the F1 were selfed. [2]

F2

Gametes		

18. Manx cats have no tails. This condition arose as a mutation sometime in the 1700 or 1800s. The mutation produced a dominant allele that resulted in the lack of a tail.

Manx cat



(a) What is meant by the term *dominant allele*? [1]

.....

.....

(b) The allele for no tail can be represented by the letter **B**. Cats that lack the **B** allele have normal length tails.

In the following cross two **heterozygous** Manx cats are mated together.

(i) Complete the information below by writing in the genotype of both parents.
You must select a **suitable** letter to represent the allele for a normal length tail. [1]

Phenotype of parents Manx **x** Manx

Genotype of parents ....

(ii) Complete the Punnett square below to show this cross. [2]

Gametes		

(iii) The dominant allele **B** is lethal in the homozygous condition. The kittens die before birth. How many kittens out of a litter of 8 would be expected to survive in the above cross? [1]

.....

(c) A breeder of Manx cats wants to ensure that **all** kittens survive.

Give the phenotypes and genotypes of the two cats she would have to mate in order to do this. [2]

Phenotype of parents ..... **x** .....

Genotype of parents ..... **x** .....

19.

(a) (i) Gregor Mendel crossed purple flowered pea plants with white flowered pea plants. All the **F1** generation were purple flowered. Show this cross by completing the Punnett square below.
Use the letter **D** to represent the purple allele and the letter **d** to represent the white allele. [2]

	Gametes		
F1			

(ii) When Mendel selfed the **F1** generation he obtained a ratio of 3 purple : 1 white flowered pea plants in the **F2** generation. In the space below construct and complete a Punnett square to show this cross. [2]

(b) Mendel's experiments on genetics were carried out with garden peas *(Pisum sativum)*. In each of his experiments he used thousands of pea plants.
State the importance of the use of such a large number of plants. [1]

.....

(c) Mendel published his work on the genetics of pea plants in 1866. The significance of his work was not recognised until it was replicated in the early 1900s. Why is it important for scientists to replicate the work of other scientists? [1]

.....

20. *(a)* A human body cell has 46 chromosomes.
How many chromosomes are present in:

(i) a sperm cell; .....

(ii) a fertilised egg cell? ..... [2]

(b) Gavin and Tracy are expecting their second baby. Their first baby is female.
What is the chance that their second baby will also be female?
Circle the correct answer.

0% 25% 50% 100% [1]

3

21. *(a)* Use words from the list below to complete the following sentences about chromosomes. [3]

nucleus **cytoplasm** **circle** **gene** **protein** **membrane**

Chromosomes are found in the ..... of a cell. Sections of DNA form units of inheritance. Each unit is called a ..... . Each unit is a code for the production of one ..... .

(b) The table below gives the number of chromosomes in the **body** cells of some animals.

animal	number of chromosomes in body cells
human	46
meerkat	36
kangaroo	16
fruit fly	8
mosquito	6

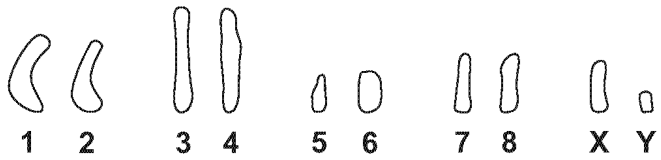
The diagram below shows the chromosomes from an **egg cell** in one of the animals in the table above.

(i) I How many chromosomes are shown in the diagram above? ..... [1]

II State the animal from which this egg cell was taken. Give a reason for your answer. [2]

.....

22. The diagram below shows all the chromosomes in a body cell of an animal.



(a) (i) How many chromosomes are shown? [1]

(b) Use words from the list below to complete the following sentences. [3]

allele **wall** **protein** **DNA** **nucleus**

(i) Chromosomes are found inside a cell in a structure called the

..... .

(ii) Chromosomes contain genes, which are made of a chemical called

..... .

(iii) A gene codes for the order of amino acids that make up a particular

..... .

23. *(a)* Complete the following sentences about genes. [2]

(i) Genes are found in the nucleus of a cell on paired structures called

..... .

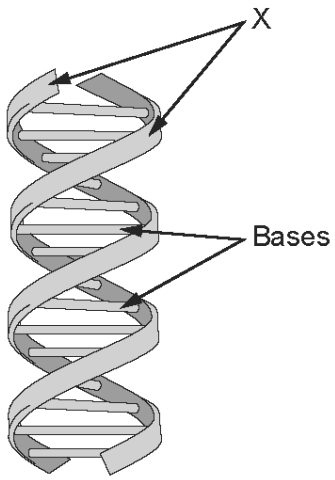
(ii) Genes are sections of a long molecule called ..... .

24.

(a) Which part of a plant cell contains DNA? Underline your answer. [1]

vacuole nucleus cytoplasm cell membrane

(b) The diagram below shows a small section of DNA.



Use the information in the diagram above and your own knowledge to answer the following questions. Underline the correct answer for **each** question.

(i) Which molecules make up the two strands labelled **X**? [1]

sugar and protein

phosphate and protein

sugar and phosphate

phosphate and salt

(ii) There are four bases A, G, T and C. How are they paired in DNA? [1]

A with T and G with C

A with G and C with T

A with C and G with T

A with A, C with C, T with T and G with G

(iii) What term is used to describe the structure of DNA? [1]

double coil

double helix

double spiral

single helix

(c) Complete the sentence below. [1]

The order of the bases A, G, T and C in DNA forms a code which controls how

..... are linked together to form different .....

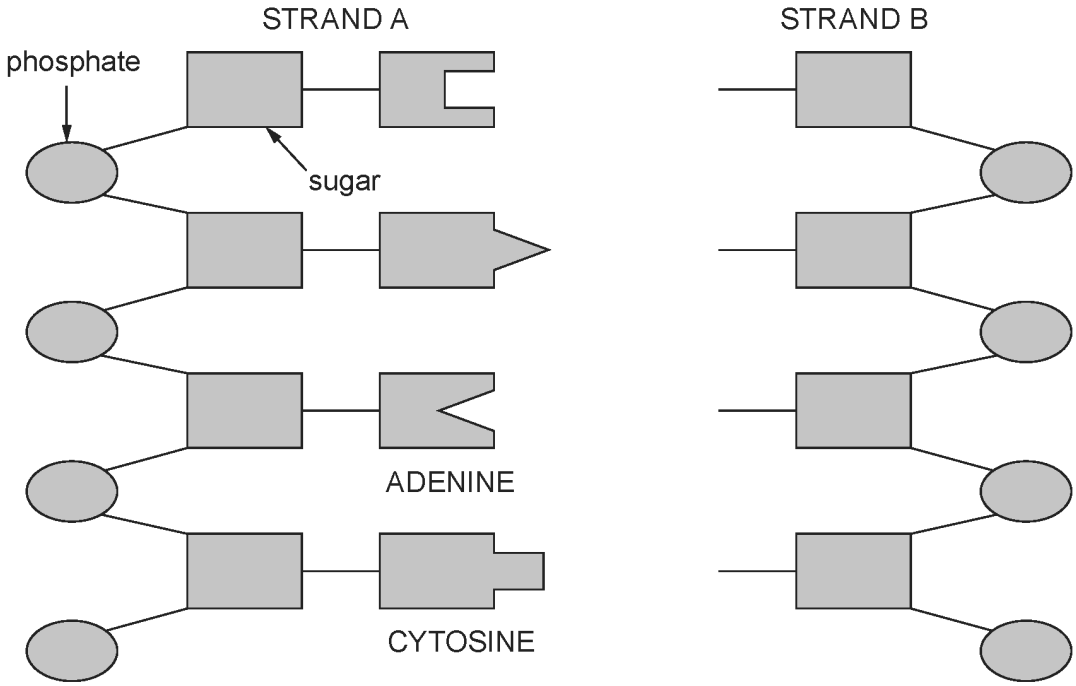
5

25. A DNA molecule consists of two coiled strands. When cells divide, the two strands in the DNA separate. The bases of each strand pair with complementary bases to make new DNA.

(a) Complete the diagram below to show the sequence of complementary bases that would appear in this DNA molecule by:

(i) drawing the shapes of the **four** missing complementary bases in strand B; [2]

(ii) labelling **each** of them with their correct **names**. [2]



(b) Describe how a section of DNA can control the formation of a protein. [2]

.....

.....

.....

.....

26. *(b)* A section of a single strand of DNA has the following sequence of bases:

A T C T G T A C A G

(i) What will be the complementary sequence of bases to that shown above? [1]

.....

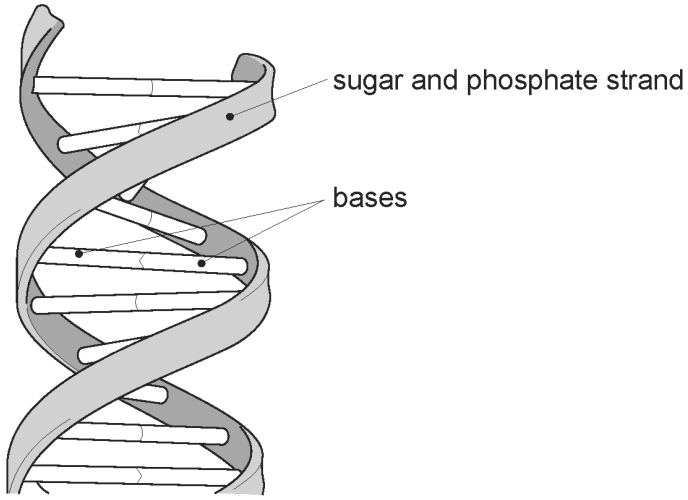
(ii) State the maximum number of amino acids that could be coded by the sequence shown. [1]

.....

27.

(a) The diagram below shows DNA.

Bases A, C, T and G join two strands of sugar and phosphate molecules.

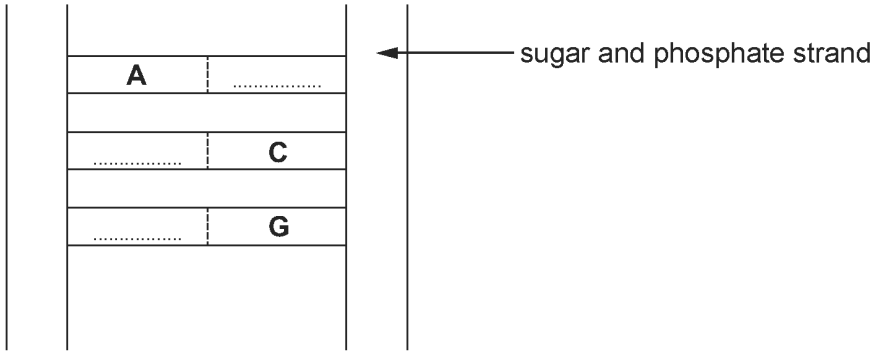


(i) What name is given to the shape of DNA? [1]

Underline your answer

double spiral **double fold** **double helix** **double coil**

(ii) The diagram below shows a very small section of DNA. [2]
Complete the diagram by adding the missing bases.



(b) Use some of the words below to complete the sentence. [1]

salts **amino acids** **minerals** **proteins**

The bases in DNA form a code which is important in building .....

from ..... .

4

28. The diagrams below show part of a DNA molecule with a small section in detail.

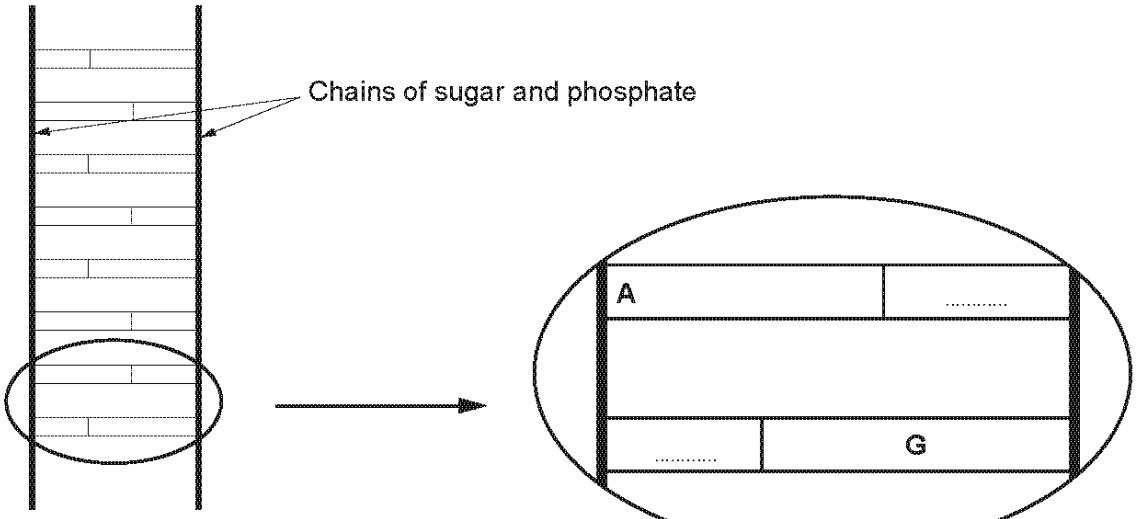


Diagram **1** Diagram **2**

(a) Molecules known as **A**, **T**, **C** and **G** join the chains of sugar and phosphate as shown in the diagrams.

(i) What is the general name for these molecules? [1]
Underline your answer.

bases acids proteins

(ii) Fill in the two missing letters on the dotted lines in Diagram **2**. [1]

(b) (i) Which part of a living cell contains DNA? [1]

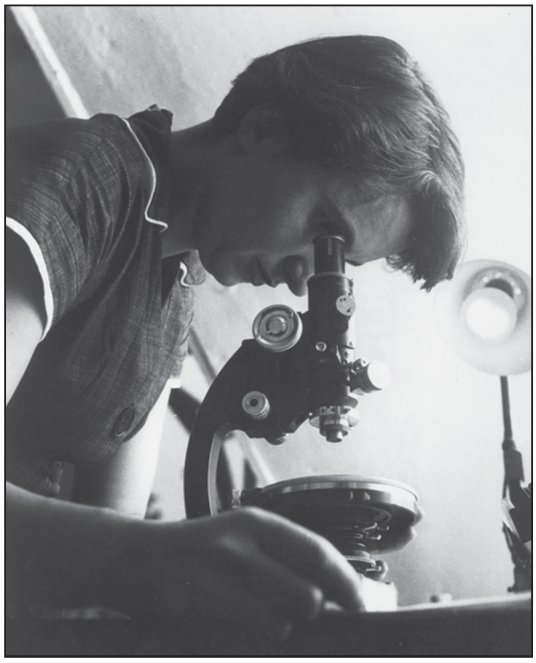
.....

(ii) The diagrams show DNA as a ladder-like structure.
How is the **shape** different in a living cell? [1]

.....

4

29. *(a)* The photograph below shows a scientist who worked on the structure of DNA in the 1950s.



Rosalind Franklin

How was the structure of DNA discovered?
Choose one of the following statements to answer the question. [1]

A by one scientist using a number of different techniques

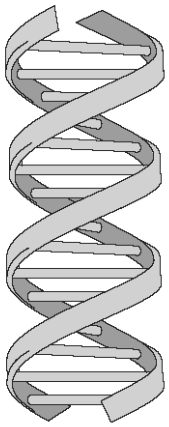
B by many scientists using a number of different techniques

C by many scientists using the same technique

D by one scientist using one technique

Letter .....

The diagram below shows part of a DNA molecule.



DNA

(b) Complete the sentences about DNA using some of the words below. [3]

phosphate bases amino acids helix sugar

DNA is made up of two long chains of alternating ..... and ..... molecules which are joined by the ..... A, T, C and G. DNA is twisted to form a double ..... .

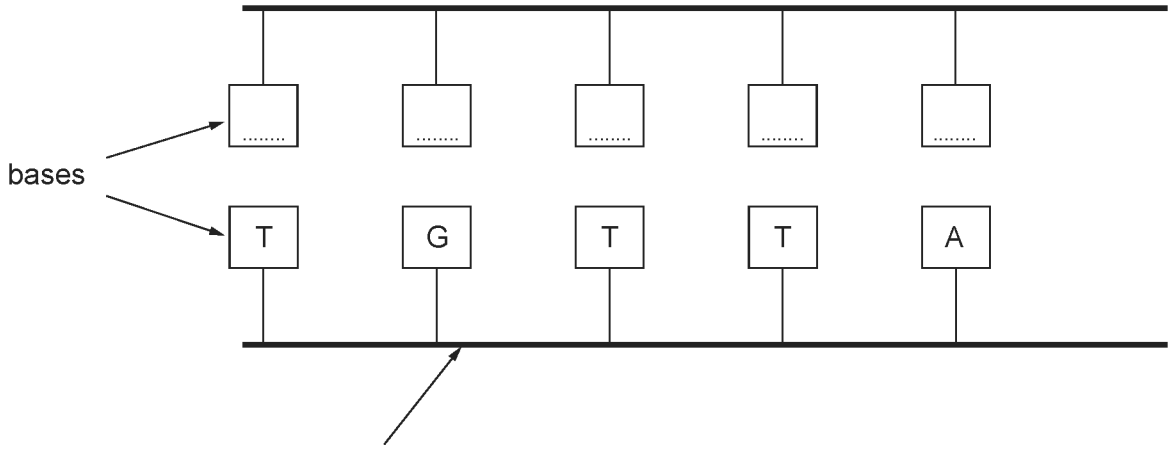
(c) Why is the order of the molecules A, T, C and G in DNA important in the production of proteins? [1]

.....

.....

5

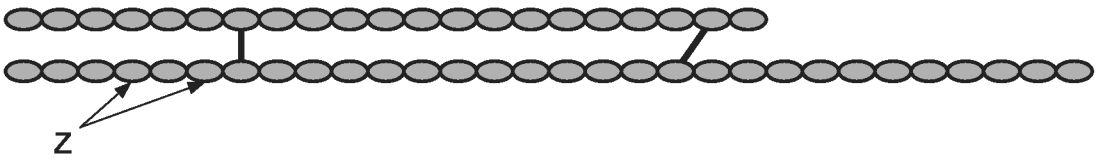
30. *(a)* The diagram below shows a small section of DNA.



(i) Five bases are shown on one strand of the DNA. Fill in the **five** missing letters for the bases on the other strand. [2]

(ii) Complete the label on the diagram by writing the missing word on the dotted line. [1]

(b) Insulin is a protein. The structure of insulin is shown below.



(i) Underline the name of the small molecules labelled **Z** which make up the protein. [1]

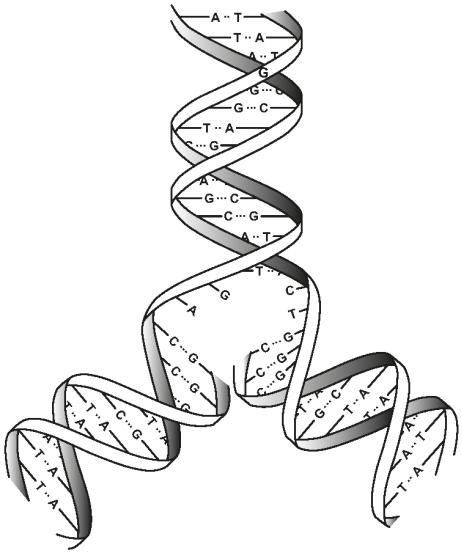
amino acids **fatty acids** **mineral salts**

(ii) Why are the bases in DNA important in building proteins from these small molecules? [2]

.....

.....

31. The diagram shows part of a molecule of DNA during the process of cell division.



(a) In which part of a human cell would DNA be found? [1]

.....

(b) In DNA the ratio of adenine to thymine is always 1:1 and the ratio of guanine to cytosine is always 1:1. Use the information from the diagram to give a reason for these observations. [1]

.....

32. The DNA molecule is a double helix with each strand linked by a series of bases.

There are four different bases in DNA.

(a) The table shows the percentage of each base found in a sample of DNA taken from a rat *(Rattus rattus)*.

Complete the table to give the names of the two missing bases. [1]

Percentage of base	Name of base
28.6	adenine
21.4	guanine
28.6	.....
21.4	.....

(b) A DNA molecule contains 1000 base pairs. 30% of the bases are guanine. Calculate how many adenine bases are contained in this DNA molecule.
Show your working. [2]

answer = ...

33. Describe the structure and function of DNA (Diagrams will not be credited). [6 QER]

34. *(a)* In DNA there is a genetic code which determines the order in which certain chemicals are linked together to form proteins.

(i) Name the **four** bases which make up the genetic code in DNA. [2]

....

(ii) Name the types of chemicals which are linked together to form proteins. [1]

35. The relative masses of bases in DNA, in three different animals, are shown in the table.

	mass of base /a.u.			
source of DNA	adenine	guanine	thymine	cytosine
human	30.9	19.9	29.4	19.8
salmon	29.7	20.8	29.1	20.4
sheep	29.3	21.4	28.3	21.0

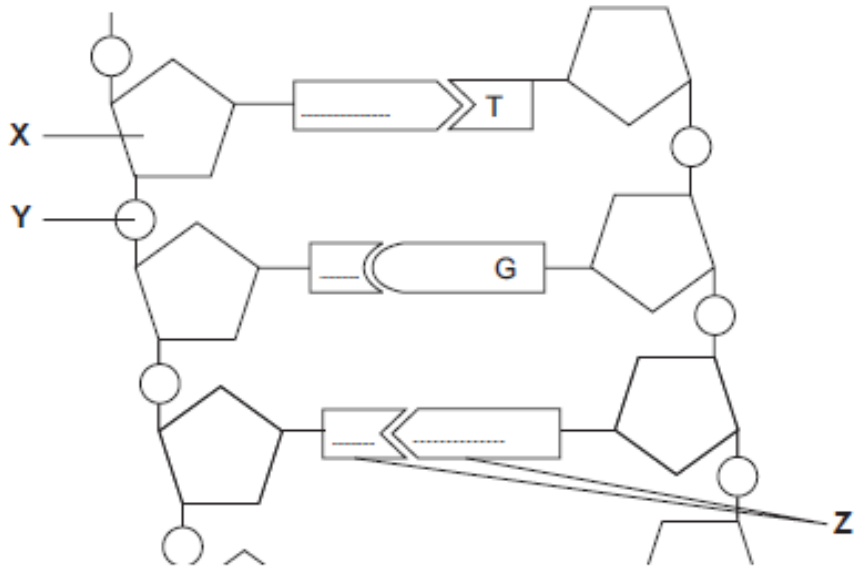
(a) How do the data above give evidence for base pairing? [2]

.....

.....

.....

36. *(a)* The diagram below shows a small section of DNA.



(i) Which one of the following pairs of substances correctly describes labels **X** and **Y** on the diagram?

Underline your answer [1]

salt and sugar

sugar and phosphate

acid and phosphate

salt and acid

(ii) The structures labelled **Z** are bases.

Complete the letter names for the **four** missing bases on the diagram. [2]

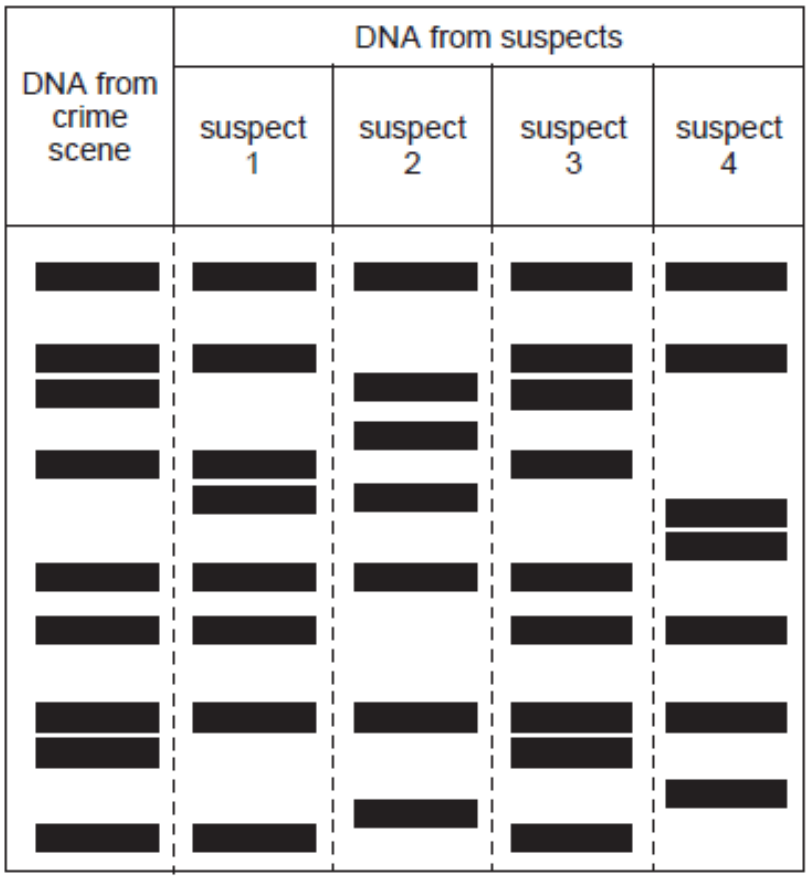
(iii) State why the order of the bases in DNA is important in the production of proteins. [2]

.....

.....

(b) Apart from identical twins, no two persons have identical DNA. Samples of DNA can be analysed to produce DNA profiles which can be used to identify individuals in criminal investigations.

The diagram below shows five DNA profiles.



(i) From the diagram, identify the suspect whose DNA was found at the crime scene. Give a reason for your answer. [1]

Suspect .....

Reason .....

(ii) Apart from criminal investigations, state **one** *other* use of DNA profiling. [1]

.....

(iii) After DNA profiles have been used in investigations they are often retained for future reference. Suggest **one** reason why some people may object to their DNA profiles being retained by the police. [1]

.....

37. Outline the basic structure of DNA and explain the meaning and importance of the genetic code in the production of proteins. An account of protein synthesis is not required.

DO NOT USE DIAGRAMS. [6 QWC]

6

38. A high level of blood cholesterol increases the risk of heart disease. One cause of high blood cholesterol is the inherited condition known as FH (familial hypercholesterolaemia).

FH is caused by a dominant allele (**B**). The recessive form of this allele (**b**) results in low levels of cholesterol (non-FH).

(a) State the meaning of the terms:

(i) allele; [1]

39.

(a) Explain what is meant by the term *genetic profiling.* [1]

.....

.....

(b) State **two** uses of genetic profiling. [2]

(i) .....

.....

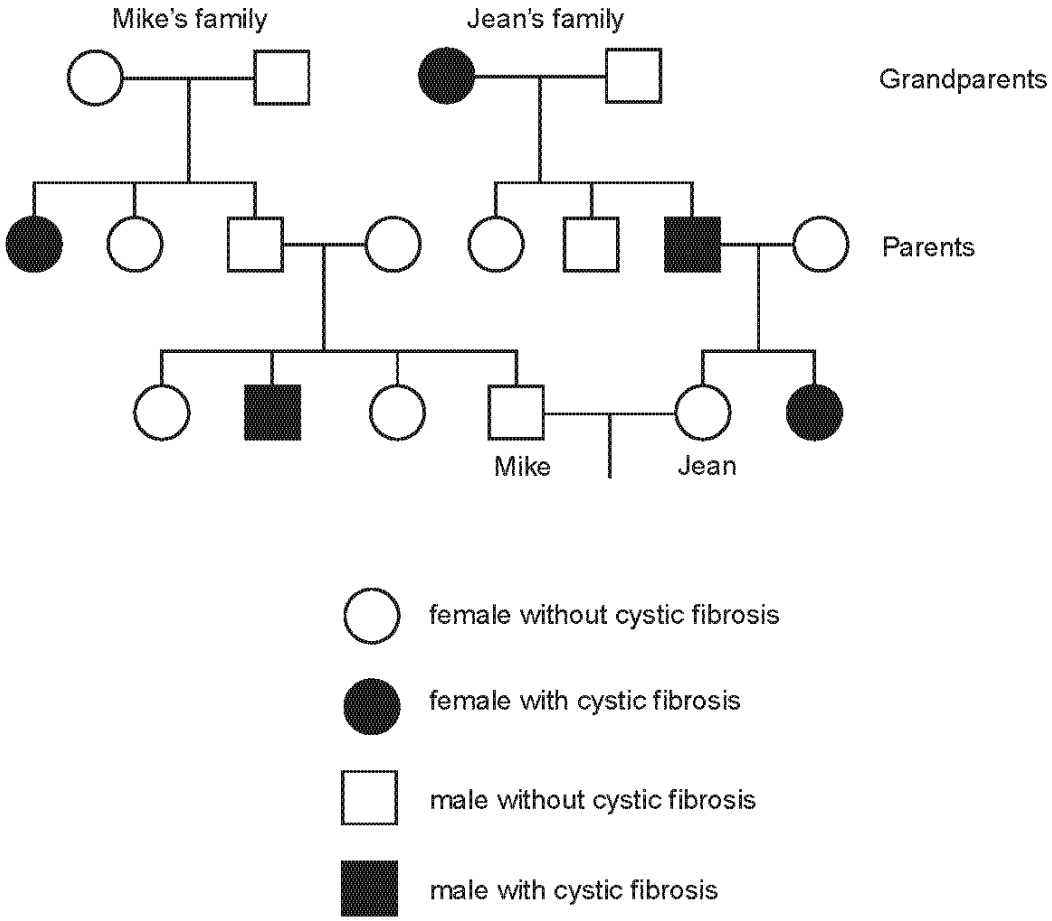
(ii) .....

.....

3

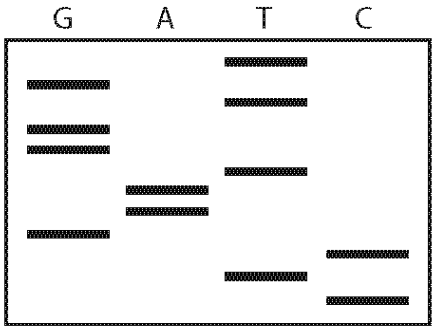
40.

The patterns of inheritance of cystic fibrosis in two families is shown as a family tree below.

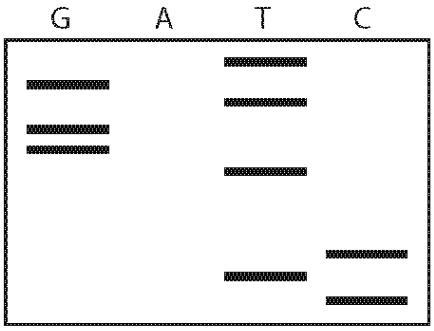


Cystic fibrosis results from a homozygous pair of recessive alleles. People who are heterozygous for cystic fibrosis have one normal allele and one cystic fibrosis allele. They are carriers of cystic fibrosis but do not suffer from it.

(c) Chromosomes from Mike and Jean's developing baby and from Mike were examined. A genetic analysis of the alleles present was carried out. The results are shown below as a sequence of bars.



Genetic analysis of Mike's alleles



Genetic analysis of Mike and Jean's developing baby's alleles

(i) What term is used for this sequence of bars? [1]

.....

(ii) Cystic fibrosis is caused by a change in protein made in the cells.
Explain why the protein made in the cells of the developing baby is different from the protein being made in Mike's cells. [2]

.....

41. In the 1850s it was thought that there were two species of elephants living on Earth. In the 1950s some scientists suggested that three species of elephants existed. These were:

1. *Elephas indicus*, the Indian elephant
2. *Loxodonta africana*, the African plains elephant
3. *Loxodonta cyclotis*, the African forest elephant

In 2011, an analysis of the chemical structure of chromosomes of African, Indian and fossil elephants was carried out. This provided evidence that African and Indian elephants had a common ancestor 2.5 million years ago and confirmed that three species of elephants exist today.

(a) Name: [2]

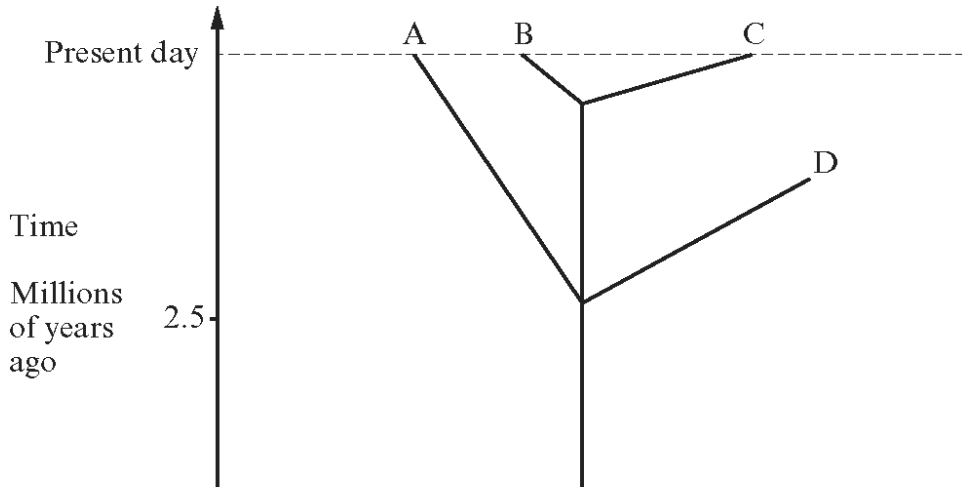
(i) the chemical in the chromosomes that was analysed;

.....

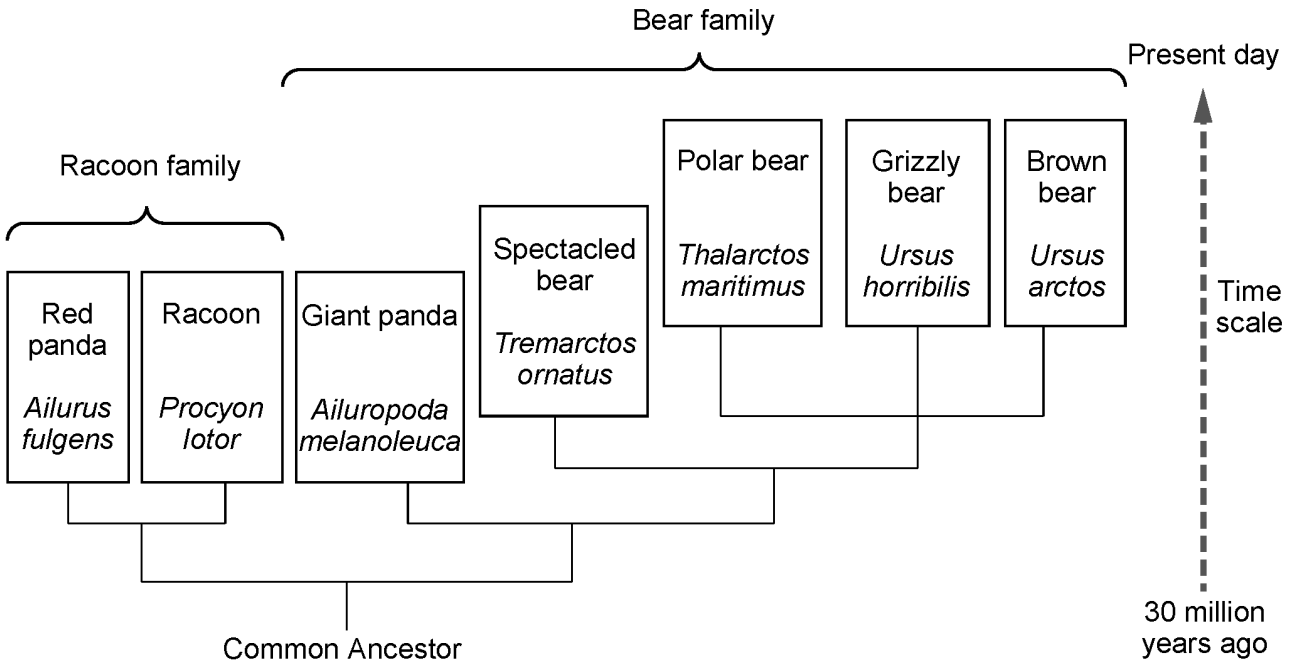
(ii) the units made of this chemical which make up chromosomes.

.....

The diagram below is a simplified family tree showing the evolution of elephants and their ancestors. Each letter represents a species.



42. The diagram shows a suggested simplified evolutionary history for bears, racoons and pandas.



(ii) Name the technique that would be used to analyse DNA samples from these animals. [1]

.....

43. In 2013 specimens of sea snails (molluscs) were collected from a deep sea trench near the north of Scotland. They were sent to a scientist at the National Museum of Wales, Cardiff, for identification.

Most of the specimens were known as *Volutopsius norwegicus* but one showed some differences in appearance to the known specimens and also showed some similarities.

It was concluded that the unknown specimen belonged to the same genus as the known specimens. The scientist reported that the differences might be due to:

EITHER

A – the sea snail's development under different environmental conditions

OR

B – natural selection from a group of snails showing continuous variation

(b) Name the technique that could be used to confirm the scientist's conclusions. [1]

.....

44. *Plasmodium falciparum* is a single-celled organism which causes malaria when it is in human blood.

Chloroquine is a medication which kills *Plasmodium falciparum*.

In the early 20th century a lot of chloroquine was used throughout Africa and was very successful. By the 1980s *Plasmodium falciparum* showed widespread resistance to chloroquine.

The mutation which caused resistance was originally very rare in the population.

(a) (i) Name the chemical that had become mutated. [1]

.....