Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3430UD0-1

S19-3430UD0-1

SCIENCE (Double Award)

Unit 4 – BIOLOGY 2
HIGHER TIER

TUESDAY, 14 MAY 2019 – AFTERNOON

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**7**	
3.	**4**	
4.	**11**	
5.	**6**	
6.	**9**	
7.	**6**	
8.	**9**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

If you run out of space, use the additional pages at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **7** is a quality of extended response (QER) question where your writing skills will be assessed.

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Answer **all** *questions*

1. *(a)* State what is meant by the following terms:

(i) gene; [1]

.....

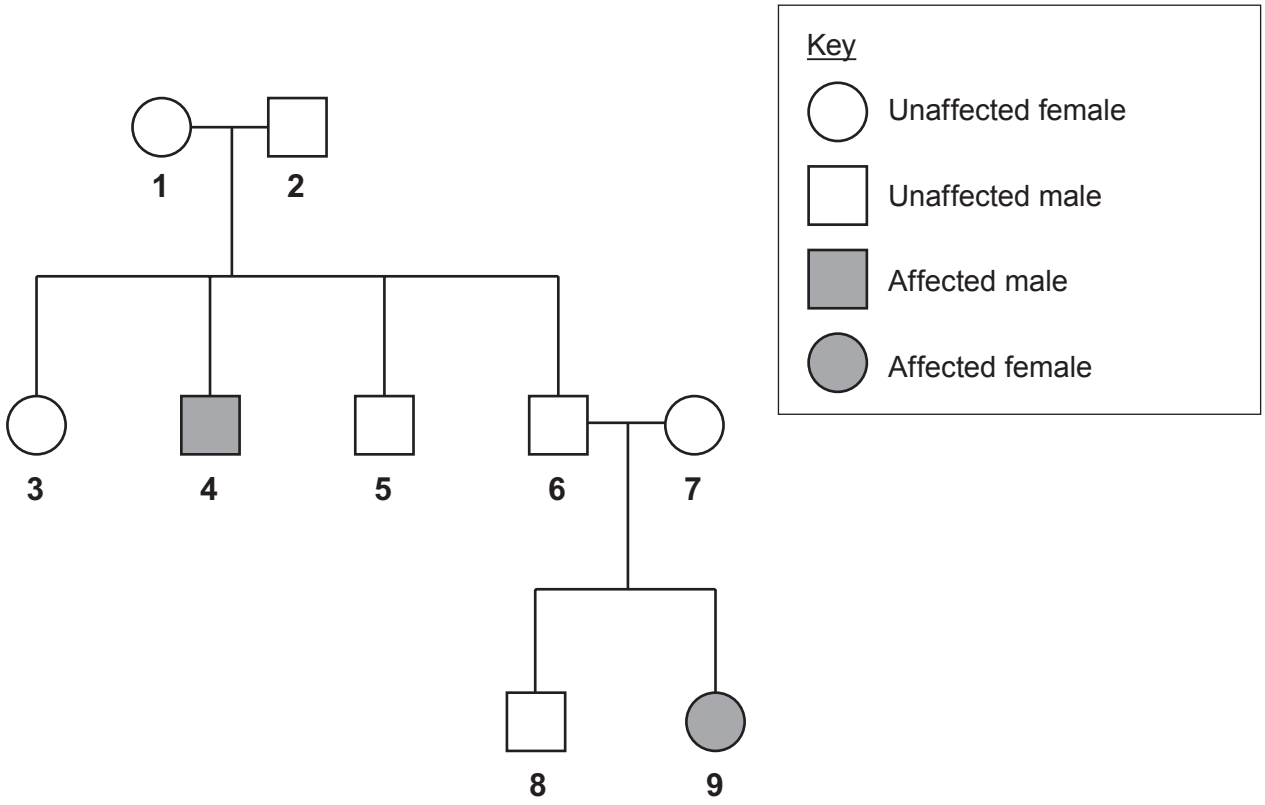
.....

(ii) allele. [1]

.....

.....

(b) Cystic fibrosis is an inherited condition. The allele that causes this condition is recessive. The family tree below shows how cystic fibrosis is passed on in families.



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(i) Use letters **N** and **n** to complete the Punnett square to show how parents **1** and **2** could produce offspring number **4**. [2]

Gametes		

(ii) State the genotype of individual **9**. Explain your answer. [2]

.....

.....

(iii) State the possible genotypes of individual **5**. [1]

.....

(c) Our understanding of how characteristics are inherited comes from the principles proposed by Gregor Mendel in the 19th century. In his experiments on pea plants *(Pisum sativum)* Mendel studied characteristics controlled by a single gene. State why this is not representative of most phenotypes. [1]

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8

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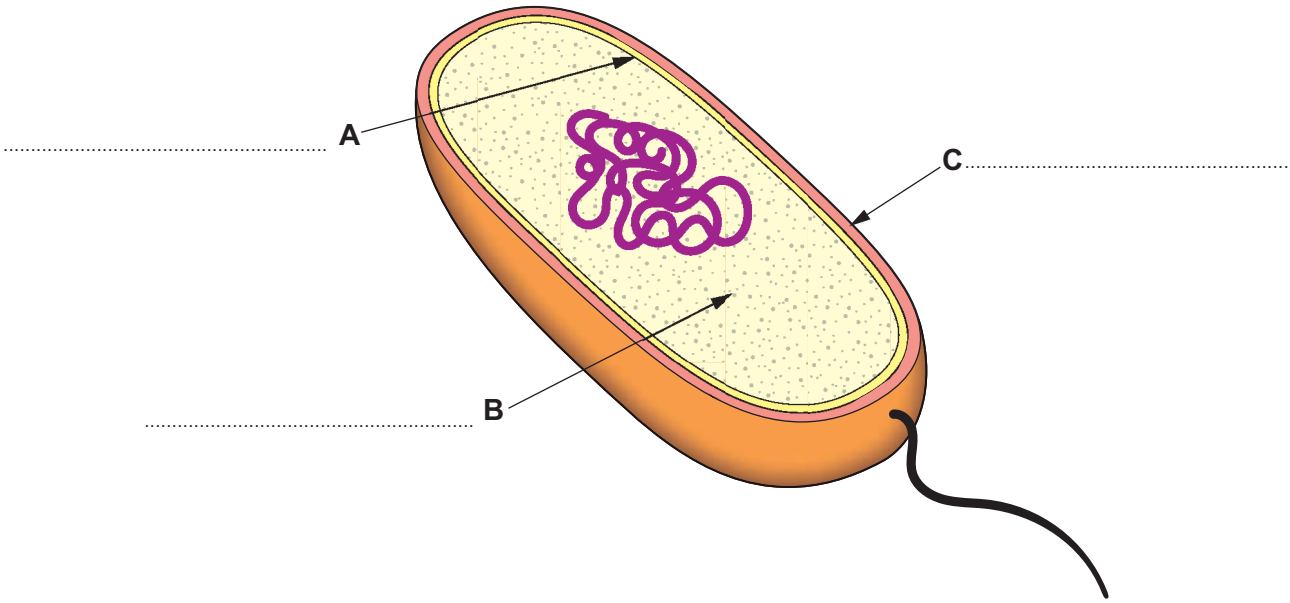
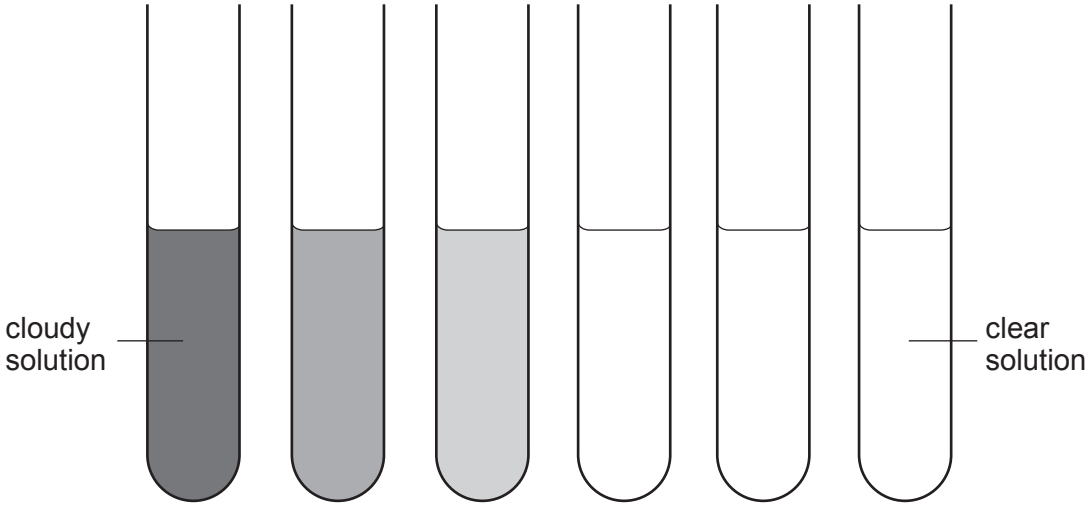
2. The diagram shows a bacterial cell.



(a) Label structures **A**, **B** and **C** on the diagram above. [3]

(b) Carys wanted to investigate the effect of an antibiotic on bacterial growth. She set up the experiment shown below with test tubes containing increasing concentrations of an antibiotic and inoculated each test tube with a fixed volume of nutrient broth containing a known concentration of bacteria.

The tubes were incubated at 25 °C for two days. The cloudier the solution becomes the more bacteria present. A clear sample means there is no bacterial growth.



Tube number	1	2	3	4	5	6
Concentration of antibiotic (μg/cm^3)	0.25	0.50	1.00	2.00	4.00	8.00

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(i) Explain the result observed in tubes **4–6**. [1]

.....

.....

(ii) Suggest the minimum concentration of antibiotic that would be effective against the bacterium. [1]

minimum concentration = ... $\mu g/cm^3$

(iii) Suggest how Carys could improve her experiment so that she could obtain a more accurate value for the minimum concentration of antibiotic needed to be effective against the bacterium. [2]

.....

.....

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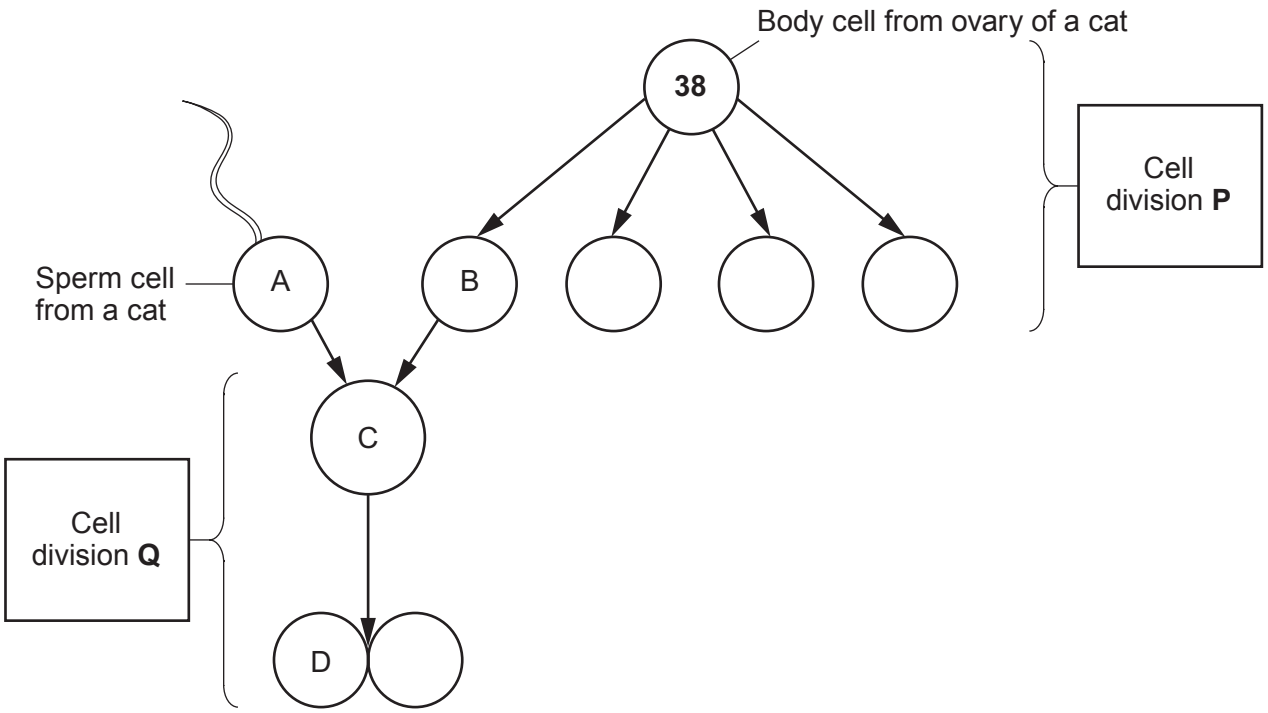
3. The diagram shows the two types of cell division occurring in a **cat** and the process of fertilisation. The number of chromosomes in a body cell from the ovary of a cat is also shown.



(i) State the type of cell division occurring at points: [1]

P .....

Q .....

(ii) State the number of chromosomes in the following cells: [2]

A .....

B .....

C .....

D .....

(iii) Apart from chromosome number, state **one** *other* difference, between the daughter cells produced by cell division **P** and cell division **Q**. [1]

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4

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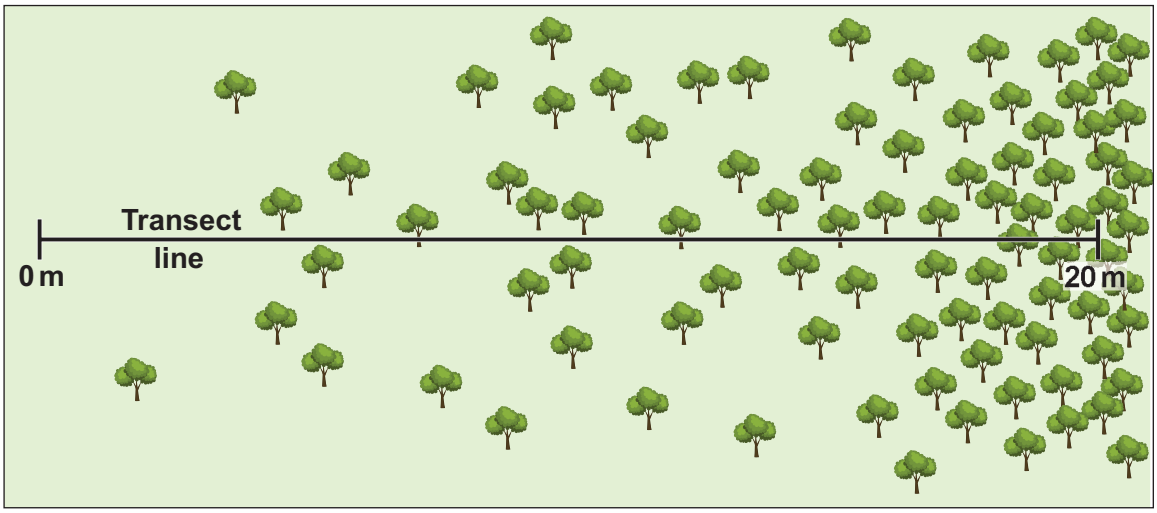
4. Rhys wanted to investigate the abundance and distribution of four plant species as he moved from the edge of a woodland towards the centre. He laid down a tape measure to form a transect. Using a 0.25 m^2 quadrat he sampled every five metres along the transect line, estimating the percentage area cover of each species. The diagram shows the area of woodland that was investigated.



His results are shown in the table.

Species	Percentage cover at each distance along transect (m)				
	0	5	10	15	20
Primrose *(Primula vulgaris)*	40	35	35	25	5
Dog's Mercury *(Mercurialis perennis)*	50	35	15	10	5
Bluebell *(Hyacinthoides non-scripta)*	0	5	10	25	80
Wood Anemone *(Anemone nemorosa)*	5	20	40	35	10

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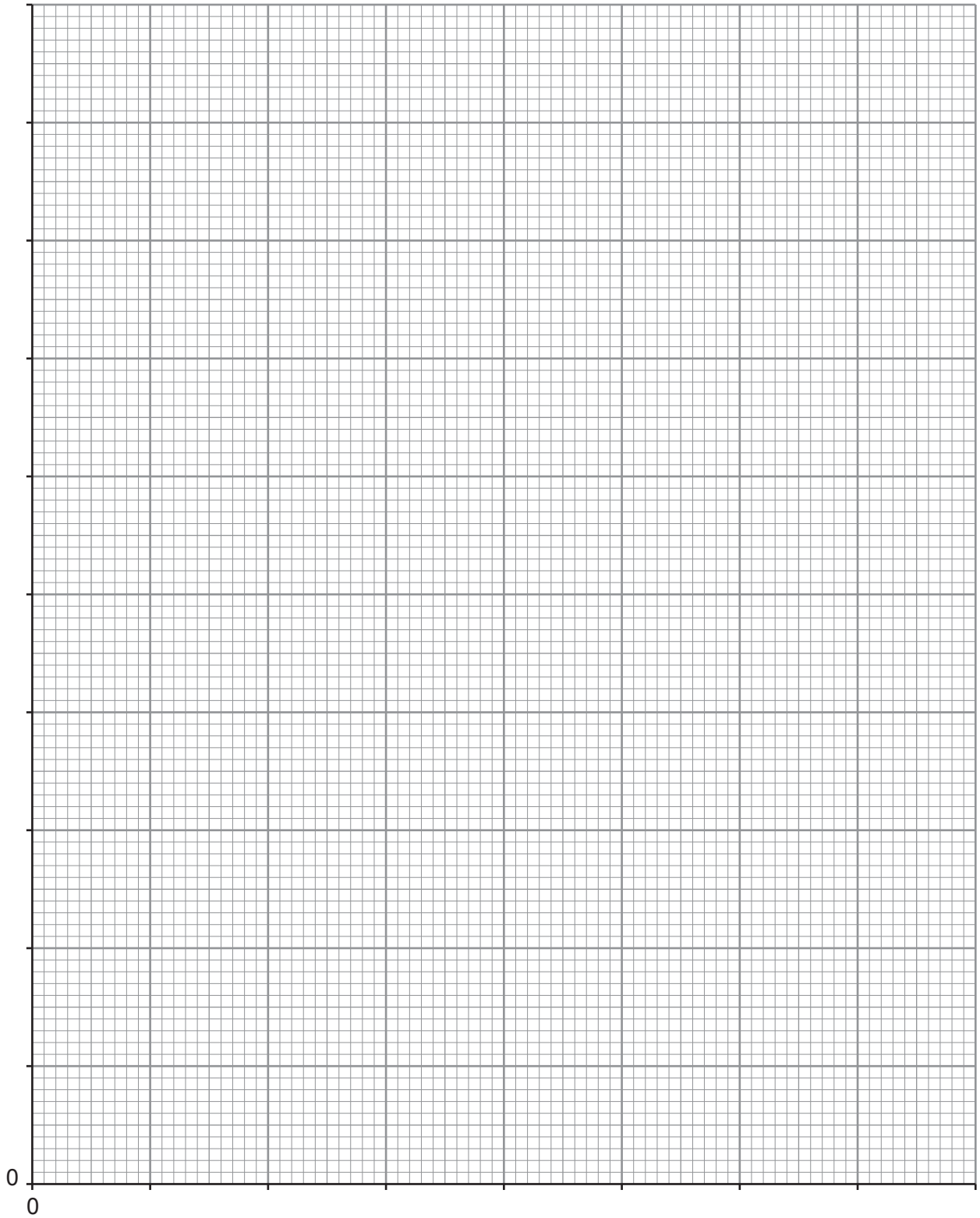
(a) **Draw a line graph** of the results for both Dog's Mercury and Bluebell on the grid below. Label each line. [4]



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(b) (i) State the term used to refer to competition between two different species. [1]

.....

(ii) Describe the results for Dog's Mercury and Bluebell. Suggest an explanation for your answer. [2]

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(c) (i) Jim suggested to Rhys that he should have carried out random sampling. State why it would be unsuitable to use a random sampling method in this investigation. [1]

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.....

.....

(ii) Suggest **one** improvement Rhys could make to his method. [1]

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(d) Biodiversity is a measure of the variety of different species and the number of individuals within those species in an area. State **two** reasons why it is important that biodiversity is maintained. [2]

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5. Thalidomide is a medical drug that caused unexpected damage to foetuses in the 1950s and 1960s. It was used for easing morning sickness in pregnant women, although it had not been fully tested.

As a result of the damage to foetuses, the drug was banned. Drug testing was also made more thorough.

Thalidomide has since been used as a treatment for bone cancer. However, its use is heavily regulated to prevent a repeat of the problems it caused last century.

With thalidomide came the widespread recognition that differences in sensitivity to drugs between species required consideration. Many scientists report that animals are good predictors of how humans will respond to drugs and that current testing procedures would have identified the dangers of thalidomide and the side effects would have been avoided.

Despite this, there is evidence that animal tests cannot predict how humans will respond to a drug. In 1990, six different drugs were trialled in humans and in animals. The results showed that animals and humans had 22 common side effects (true positives). There were 48 side effects in animals which did not occur in humans (false positives). There were also 20 side effects in humans that did not occur in animals (false negatives).

(a) The sensitivity of the animal tests is calculated using the formula:

$$\text{Sensitivity} = \frac{TP}{TP + FN} \times 100$$

TP = true positives

FN = false negatives

Calculate the sensitivity of the animal tests in the trial carried out in 1990. [2]

Sensitivity = ... %

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(b) Use **only** the information in the passage to answer the following questions.

(i) Evaluate the arguments **for** and **against** the use of animals in drug testing. [2]

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(ii) State how the thalidomide problem has had **one** positive outcome on the development of new drugs. [1]

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.....

(iii) State why the ban on thalidomide was removed. [1]

.....

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6. Negative feedback mechanisms maintain optimum conditions inside the body.

(a) (i) State what is meant by the term *negative feedback*. [2]

.....

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.....

(ii) State **three** factors that are controlled within the body to maintain optimum conditions. [2]

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(b) Hypoglycaemia is a condition which occurs when blood glucose levels fall to a dangerously low concentration. The normal blood glucose range is between 4.0 and 7.5 mmol/l.

(i) Suggest **two** reasons which could cause the blood glucose level in a person with insulin dependent diabetes to fall below 4.0 mmol/l. [2]

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(ii) Explain why a glucagon injection may be used to treat severe hypoglycaemia. [3]

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7. Warfarin is an anticoagulant and has been used as a poison to control the rat population since the 1950s. Rats die from internal bleeding a few days after eating poisoned bait. In 1960, warfarin resistant rats were found in Montgomeryshire. In the years that followed, studies found that the area where rats resistant to warfarin were detected was expanding at a rate of approximately 5 km/year.

Use your knowledge of natural selection to explain how resistance to warfarin developed and spread. [6 QER]

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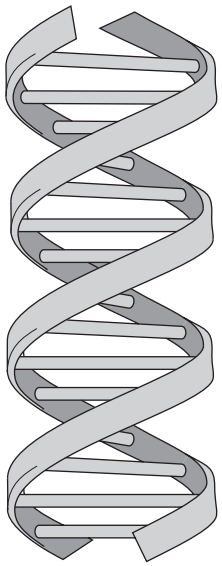
8. DNA is made of two long chains of alternating molecules of sugar and phosphate connected by bases. The chains are twisted to form a double helix as shown in the diagram.



(a) A sample of DNA was analysed and found to contain 27% thymine.

(i) Name the complementary base to thymine. [1]

.....

(ii) Calculate the percentage of **cytosine** that would be present in this sample. [2]

Cytosine = ... %

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(b) (i) Explain how the sequence of bases on DNA determines the structure of a protein. [3]

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The sequence of bases on a small section of DNA is shown below.

TGA CTG GTC AAC

This section of DNA can undergo two different mutations.

Mutation 1 **TGA CAG CTC AAC**

Mutation 2 **TGA CTG GTC ATC**

(ii) Using the information and your own knowledge conclude why mutation 1 may affect an organism more than mutation 2. [3]

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END OF PAPER

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