



GCSE

3400U20-1

**TUESDAY, 17 MAY 2022 – MORNING**

**BIOLOGY – Unit 2:**  
**Variation, Homeostasis and Micro-organisms**

**FOUNDATION TIER**

**1 hour 45 minutes plus your additional time allowance**

**Surname** \_\_\_\_\_

**First name(s)** \_\_\_\_\_

**Centre Number** \_\_\_\_\_

**Candidate Number** 0 \_\_\_\_\_



## **ADDITIONAL MATERIALS**

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

## **ITEMS INCLUDED WITH QUESTION PAPER**

A separate Diagram Booklet.

**The Diagram Booklet MUST be handed in to the invigilators and sent for marking.**

## **INSTRUCTIONS TO CANDIDATES**

Use black ink, black ball-point pen or your usual method.

Write your name, centre number and candidate number in the spaces provided on the front cover.

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

(Turn over)

| <b>For Examiner's use only</b> |                     |                     |
|--------------------------------|---------------------|---------------------|
| <b>Question</b>                | <b>Maximum Mark</b> | <b>Mark Awarded</b> |
| <b>1.</b>                      | <b>10</b>           |                     |
| <b>2.</b>                      | <b>8</b>            |                     |
| <b>3.</b>                      | <b>10</b>           |                     |
| <b>4.</b>                      | <b>8</b>            |                     |
| <b>5.</b>                      | <b>12</b>           |                     |
| <b>6.</b>                      | <b>12</b>           |                     |
| <b>7.</b>                      | <b>9</b>            |                     |
| <b>8.</b>                      | <b>11</b>           |                     |
| <b>Total</b>                   | <b>80</b>           |                     |

Answer ALL questions.

1 Cystic fibrosis (CF) is an inherited condition caused by a DNA mutation.

(a) COMPLETE THE SENTENCES by selecting your answers from the words below. [3 marks]

radiation    increase    random  
prevent    regular

A mutation is a \_\_\_\_\_

change in DNA.

Ionising \_\_\_\_\_ can

\_\_\_\_\_ the rate of

mutations.



- 1 (b) In the family tree in IMAGE 1.1, some people have CF.
- (i) Calculate the PERCENTAGE OF PEOPLE in this family tree who have CF. [2 marks]

Percentage = \_\_\_\_\_ %

- (ii) State how many males and females in this family tree have CF. [1 mark]

Males = \_\_\_\_\_

Females = \_\_\_\_\_



1 (b)(iii)

In the whole population of the UK,

- 0.01% of people have CF
- The ratio of males to females is 1 : 1

From your answers to (i) and (ii) on page 4, give TWO ways in which this family is different from the whole population of the UK:  
[2 marks]

I. \_\_\_\_\_

\_\_\_\_\_

II. \_\_\_\_\_

\_\_\_\_\_



1 (c) CF affects the lungs.

In a treatment, patients with CF are given DNA which does not have the CF mutation.

Complete the following sentences by underlining the correct word. [2 marks]

(i) The treatment is called:

**chemotherapy**

**gene therapy**

**physiotherapy**

(ii) The DNA is given to the patient by:

**injection**

**infusion**

**inhalation**

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| 10 |



**2 IMAGES 2.1A and 2.1B show the hazel dormouse (*Muscardinus avellanarius*) in winter and summer.**

- **Dormice are nocturnal (active only at night).**
- **In summer, they live high up in trees and bushes, eating berries and insects.**
- **In winter, they hibernate (being completely inactive) and keep warm in nests at ground level.**
- **Between the years 2000 and 2020 the dormouse population in the UK decreased and it became an endangered species in some areas.**
- **In 2000, as part of a local action plan, 1 000 dormice were released into an area and their numbers later increased to 1 050.**

**Use the information to answer the following questions.**



**2 (a) State ONE way in which the dormouse BODY STRUCTURE is adapted to: [3 marks]**

**(i) survive in low temperatures;**

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**(ii) climb in branches of trees;**

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**(iii) look for food at night.**

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**(b) State ONE way in which the BEHAVIOUR of the dormouse helps it to survive in its environment. [1 mark]**

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2 (c) Using the information, complete the table below by writing true or false for each statement. [4 marks]

| Statement about the hazel dormouse                           | True or false |
|--|---------------|
| Its habitat is woodland.                                     | true          |
| It eats only plants.   | _____         |
| The species became extinct in the UK in 2020.                | _____         |
| It does not hunt for food in daylight.                       | _____         |
| As a result of a local action plan, numbers increased by 5%. | _____         |
| It belongs to the genus Muscardinus.                         | _____         |

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(Turn over)



3 (a) **COMPLETE THE SENTENCE** by selecting your answers from the words below. [2 marks]

**brain**

**muscles**

**spinal cord**

**nerves**

**The central nervous system consists of the**

---

**and the**

---



**3 (b) IMAGE 3.1 shows a section through the human eye.**

**(i) Identify parts A and B on IMAGE 3.1.  
[2 marks]**

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

**B** \_\_\_\_\_

**(ii) Using some labels from IMAGE 3.1, COMPLETE TABLE 3.2 by stating the parts of the eye which match the functions.  
[3 marks]**

**TABLE 3.2**

| <b>Part of the eye</b> | <b>Function</b>                            |
|------------------------|--|
| _____                  | <b>changes shape to focus light</b>        |
| _____                  | <b>prevents reflection of light</b>        |
| _____                  | <b>carries nerve impulses to the brain</b> |

**(Turn over)**



3 (b)(iii)

Joanna leaves a dark room and goes out into bright sunlight.



Explain how parts **C** and **D** in **IMAGE 3.1** change in order to control how much light enters her eyes when she goes into bright sunlight. [3 marks]

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**4 (b) Explain why the tissue type of the patient and the donor kidney must be tested before a transplant operation is carried out. [2 marks]**

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| <b>8</b> |



**5 (a) COMPLETE THE FOLLOWING description of Type 2 diabetes by filling in the missing words. [3 marks]**

**In Type 2 diabetes, body cells do not respond to the hormone**

---

**which is produced by the**

---

**and so the level of**

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**in the blood becomes too high.**



**5 (b) Researchers in Spain stated the following hypothesis.**

**‘Drinking coffee reduces the risk of having Type 2 diabetes, high blood pressure and obesity.’**

- **Scientists working for a large chain of coffee shops carried out an investigation to test this hypothesis.**
- **They used 2 000 volunteers, 1 000 of whom drank coffee every day and the other 1 000 who never drank coffee.**
- **They recorded the number of volunteers from each group who had Type 2 diabetes, had high blood pressure or were obese.**

**The results of the investigation are shown in TABLE 5.1.**

- (i) Complete the bar chart in GRAPH 5.2 by:  
[4 marks]**
- I. adding a scale for numbers of volunteers.**
  - II. drawing bars of the results for high blood pressure and obesity.**
  - III. labelling your bars.**



**5 (b)(ii)**

**The scientists concluded that the hypothesis was only partly supported. Give the reasons for this conclusion. [2 marks]**

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**(iii) State ONE way in which the scientists should have ensured that the investigation was a fair test. [1 mark]**

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**5 (b)(iv)**

**A doctor said that she did not have confidence in the results because the investigation was biased. [1 mark]**

**Give ONE reason to support this point of view.**

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**(c) In 2019 the cost to NHS Wales of medical treatments for Type 2 diabetes was £500 million.**

**Suggest ONE lifestyle change which individuals can make to reduce the risk of developing Type 2 diabetes. [1 mark]**

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| <b>12</b> |



- 6 **Limpets (*Patella vulgata*) are animals without backbones which live on rocky seashores, feeding on plants.**

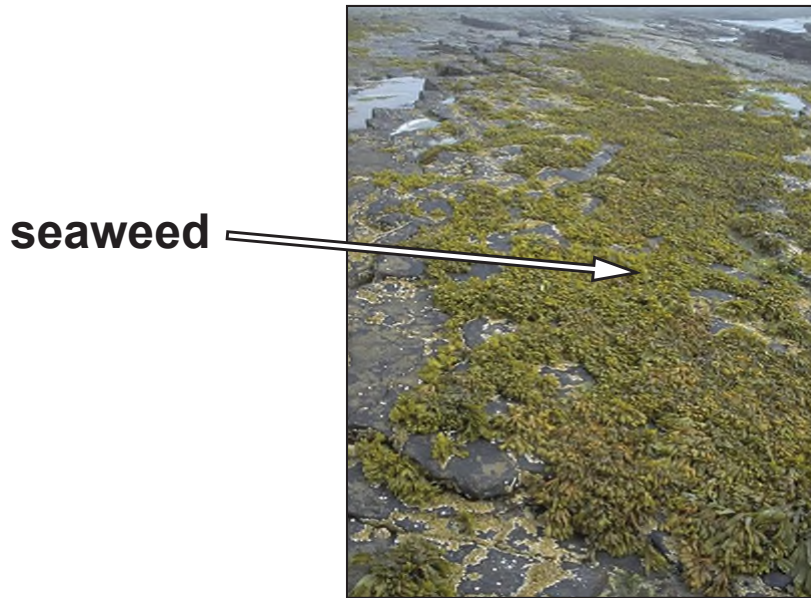


**Photograph of limpets**

- (a) **State the scientific term for animals which do not have backbones. [1 mark]**
-



6 (b) Students investigated the density of limpets (number per m<sup>2</sup>) on two rocky shores in Anglesey. One shore was sheltered and one was exposed to heavy wave action.



A sheltered shore



An exposed shore

(Turn over)



**6 (b) (continued)**

**Students' method:**

- **Select a section on each shore of 300 m<sup>2</sup>.**
- **Place quadrats, each of area 1 m<sup>2</sup>, at 10 random co-ordinates in each of the two shore sections and collect data.**
- **Compare the data for the two shores.**

**(i) TABLE 6.1 shows one part of the students' risk assessment for the investigation.**

**COMPLETE TABLE 6.1. [1 mark]**

**(ii) Describe in detail the techniques the students should use to PLACE THEIR QUADRATS AT RANDOM and COLLECT DATA. [3 marks]**

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**6 (b) (continued)**

**The results of the investigation are shown in TABLES 6.2 AND 6.3.**

**(iii) Complete TABLE 6.3 FOR THE SHELTERED SHORE by calculating: [3 marks]**

- I. The mean number of limpets per m<sup>2</sup>.**
- II. The estimated total number of limpets in the 300 m<sup>2</sup> section of the shore.**

**Space for working**



6 (b)(iv) I.

From these results, state what the students could conclude about the density of limpets when they compared the two shores. [1 mark]

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II. Suggest an explanation for this observation. [1 mark]

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6 (b)(v)

State which of the quadrats (1 – 10) from the exposed shore shown in TABLE 6.2 had an anomalous result and describe what should have been done to take account of this.  
[2 marks]

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**7 Biological control is used to reduce the numbers of a pest population through the introduction of another species. It has been used with varying success since the 19th century.**

**(a)(i) State TWO advantages of this method of control. [2 marks]**

**Advantage 1**

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**Advantage 2**

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7 (a)(ii)

State TWO disadvantages of this method of control. [2 marks]

Disadvantage 1

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Disadvantage 2

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- 7 (b) The whitefly (***Trialeurodes vaporariorum***) is a pest which damages greenhouse crops such as tomatoes. Whitefly numbers can be reduced by using the biological control agent ***Encarsia formosa***.

### **Encarsia formosa FACT FILE**

- ***E. formosa*** is a tiny wasp that lays eggs inside developing whitefly.
- When the eggs hatch, the young wasps kill the developing whitefly from the inside.
- Optimal conditions for ***E. formosa*** are temperatures over 20 °C.
- When daytime temperatures are less than 17 °C, ***E. formosa*** activity is significantly reduced, making it less effective.



7 (b) (continued)

**GRAPH 7.1** shows the number of whiteflies in a greenhouse containing tomato plants.

***E. formosa*** were introduced on day 7.

- (i) I. The use of ***E. formosa*** to reduce the number of whiteflies is considered to be successful when there are 20 or fewer whiteflies per plant. Use **GRAPH 7.1** to determine how many days it took for the number of whiteflies to fall to 20 following the introduction of ***E. formosa***. [2 marks]

\_\_\_\_\_ days

- II. Suggest a reason why it took this long for the number to fall to 20. [1 mark]

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(Turn over)



7 (b)(ii)

**Suggest ONE reason why this method of pest control would not be effective to use if whiteflies damaged wheat crops grown in Wales. [1 mark]**

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**(iii) An alternative approach to reducing pest numbers is to use pesticide. State why it is not appropriate to use pesticide along with *E. formosa*. [1 mark]**

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8 Hair length in cats is controlled by a pair of alleles. The allele for short hair (**H**) is dominant to the allele for long hair (**h**).



(a) State what is meant by the terms:

(i) allele; [1 mark]

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(ii) dominant; [1 mark]

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8 (a)(iii)  
recessive. [1 mark]

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(b)(i) A cat breeder crossed a homozygous short-haired cat with a long-haired cat. **COMPLETE THE PUNNETT SQUARE** to show the predicted genotypes of the offspring. Use the letters **H** and **h** for the alleles. [2 marks]

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|----------------|--|--|
| <b>Gametes</b> |  |  |
|                |  |  |
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(ii) State the **phenotype** of the offspring in the F1 generation. [1 mark]

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(Turn over)



8 (b)(iii)

**COMPLETE THE PUNNETT SQUARE** to show the possible genotypes of the offspring if two of the F1 offspring were crossed.  
[2 marks]

|                |  |  |
|----------------|--|--|
| <b>Gametes</b> |  |  |
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|                |  |  |

(iv) Using the results from (b)(iii), state how many kittens would be predicted to be short-haired in a litter of 8 kittens. [1 mark]

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(Turn over)



8 (b)(v)

The cat breeder wanted to determine whether one of the short-haired cats was homozygous or heterozygous. She decided to breed the short-haired cat with a long-haired cat. Predict the phenotypes of the offspring you would expect if the short-haired cat was:

I. Homozygous [1 mark]

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II. Heterozygous [1 mark]

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**END OF PAPER**

**(Turn over)**



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GCSE

3400U20-1

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**BIOLOGY – Unit 2:  
Variation, Homeostasis and Micro-organisms**

**FOUNDATION TIER**

**The Diagram Booklet MUST be handed in  
to the invigilators and sent for marking.**

# Diagram Booklet

Surname \_\_\_\_\_

First name(s) \_\_\_\_\_

Centre Number \_\_\_\_\_

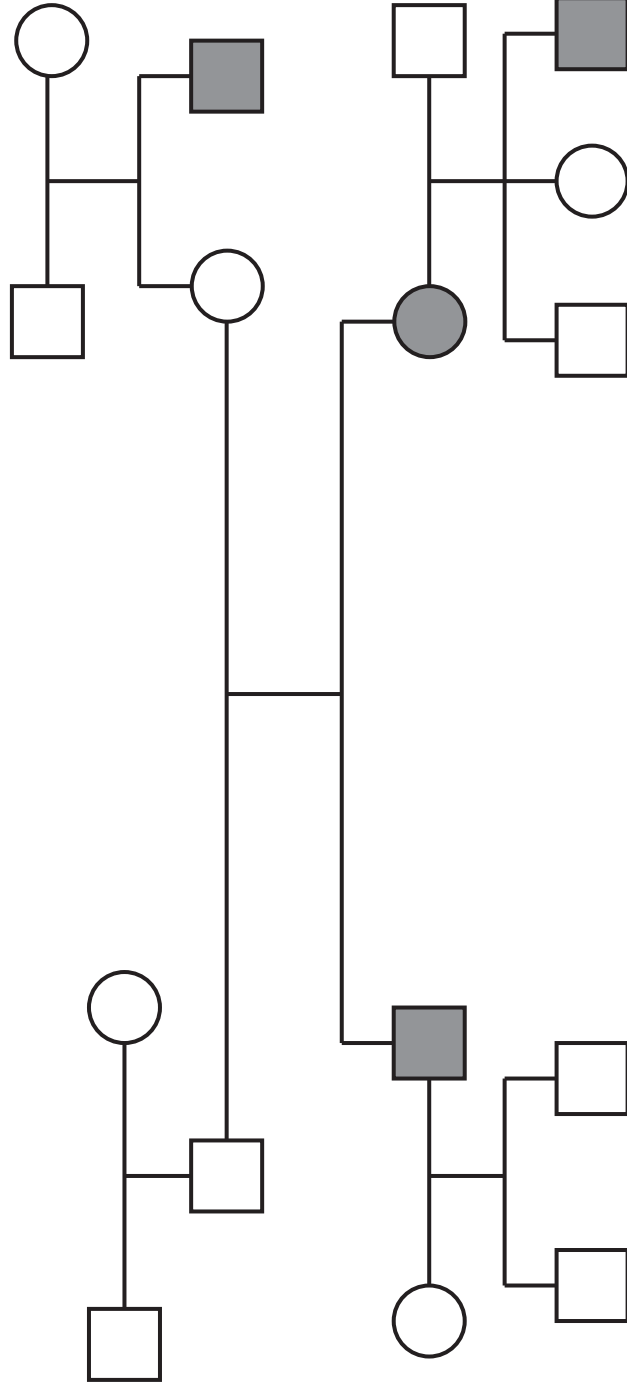
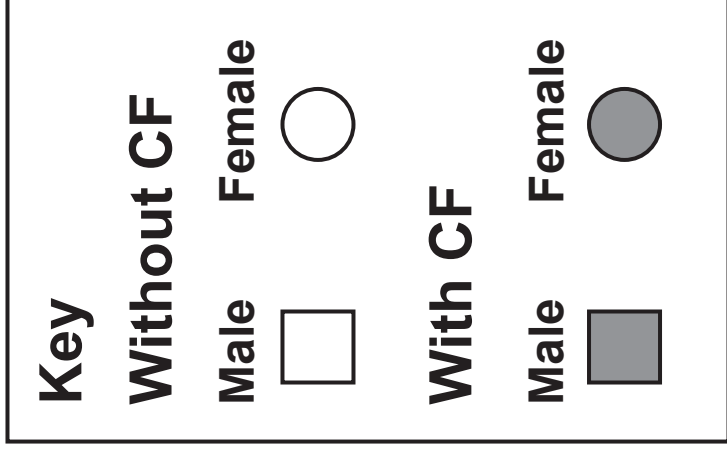
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**IMAGE 1.1**

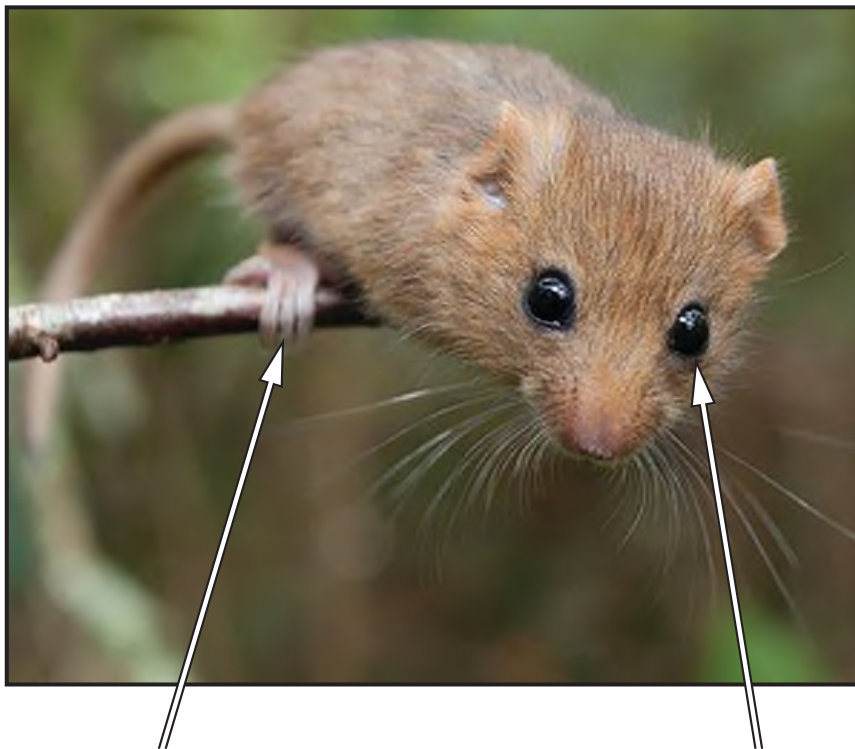


**IMAGE 2.1A** winter



**thick fur covering the body and long tail**

**IMAGE 2.1B** summer



**grasping feet with claws**

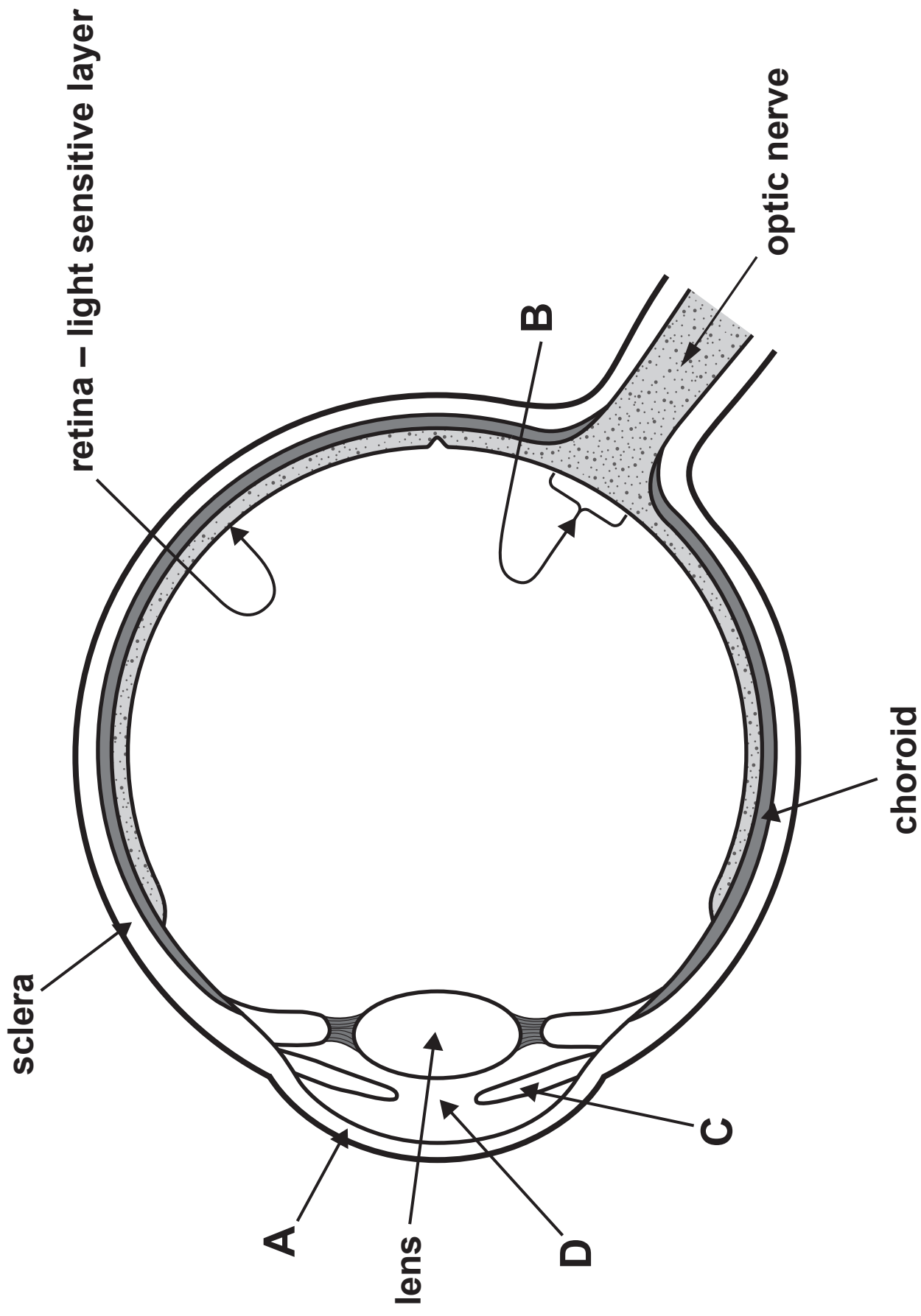
**large eyes for seeing in dim light**



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**IMAGE 3.1**



**TABLE 4.1**

| <b>Fact file – Treatment of Kidney Failure</b>           |   |   |
|--|---|---|
|  | <b>Dialysis</b>   | <b>Transplant</b>                                     |
| <b>Percentage of patients surviving after five years</b> | <b>35</b>   | <b>97</b>   |
| <b>Waiting time for treatment</b>                        | <b>2–3 weeks</b>  | <b>3–4 years</b>                                      |
| <b>Usual time spent in hospital</b>                      | <b>3 days every week for life</b>                         | <b>one 5-day stay for an operation</b>                |
| <b>Procedure</b>   | <b>needles inserted into blood vessels</b>                | <b>major surgery</b>                                  |
| <b>Drugs</b>   | <b>anti-rejection drugs not required</b>                  | <b>anti-rejection drugs needed for life</b>           |
| <b>Diet</b>  | <b>special low-salt foods and restricted fluid intake</b> | <b>normal balanced diet and normal fluid intake</b>   |
| <b>Employment and sports</b>                             | <b>very limited choice</b>                                | <b>most types of jobs and many sports can be done</b> |



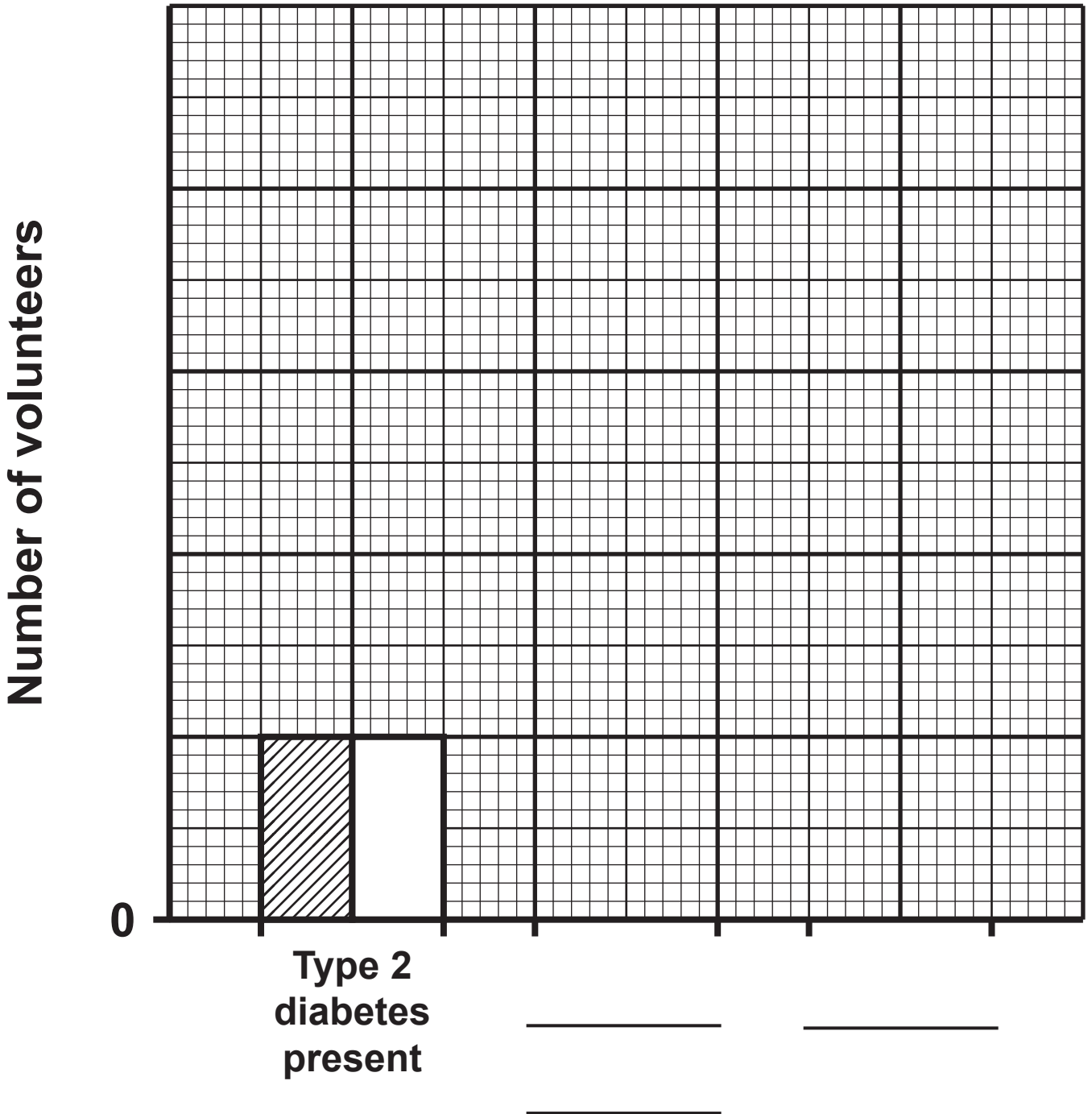
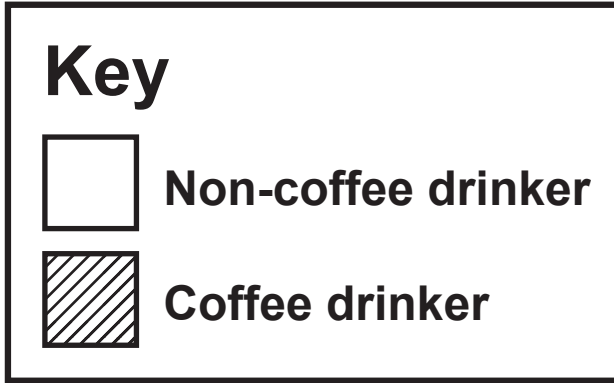
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**TABLE 5.1**

| <b>Condition</b>           | <b>Number of volunteers with the condition</b> |                            |
|----------------------------|--|----------------------------|
|                            | <b>Coffee drinkers</b>                         | <b>Non-coffee drinkers</b> |
| <b>Type 2 diabetes</b>     | <b>100</b>                                     | <b>100</b>                 |
| <b>High blood pressure</b> | <b>280</b>                                     | <b>420</b>                 |
| <b>Obesity</b>             | <b>340</b>                                     | <b>460</b>                 |

GRAPH 5.2





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**TABLE 6.1**

| <b>Hazard</b>                   | <b>Risk</b> | <b>Control measure</b> |
|---------------------------------|-------------|------------------------|
| <b>Sharp edges<br/>on rocks</b> |             |                        |
|                                 |             |                        |
|                                 |             |                        |
|                                 |             |                        |
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**TABLE 6.2**

Number of limpets on exposed shore:

| Quadrat number    | 1  | 2  | 3  | 4  | 5 | 6  | 7  | 8  | 9  | 10 | Mean number per m <sup>2</sup> | Estimated total number in the 300 m <sup>2</sup> section of shore |
|-------------------|----|----|----|----|---|----|----|----|----|----|--------------------------------|---|
| Number of limpets | 26 | 21 | 22 | 18 | 5 | 21 | 17 | 23 | 19 | 26 | 19.8                           | 5940  |

**TABLE 6.3**

Number of limpets on sheltered shore:

| Quadrat number    | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | Mean number per m <sup>2</sup> | Estimated total number in the 300 m <sup>2</sup> section of shore |
|-------------------|----|----|----|----|----|----|----|----|----|----|--------------------------------|---|
| Number of limpets | 30 | 22 | 26 | 31 | 28 | 25 | 23 | 19 | 31 | 26 |                                |   |



GRAPH 7.1

