

FOR OFFICIAL USE

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C

KU	PS

Total Marks

**0300/402**

NATIONAL  
QUALIFICATIONS  
2004

WEDNESDAY, 19 MAY  
10.50 AM – 12.20 PM

**BIOLOGY**  
STANDARD GRADE  
Credit Level

**Fill in these boxes and read what is printed below.**

Full name of centre

Town

Forename(s)

Surname

Date of birth

Day Month Year

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Scottish candidate number

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Number of seat

- 1 All questions should be attempted.
- 2 The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, and must be written clearly and legibly in ink.
- 3 Rough work, if any should be necessary, as well as the fair copy, is to be written in this book. Additional spaces for answers and for rough work will be found at the end of the book. Rough work should be scored through when the fair copy has been written.
- 4 Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.



Marks

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1. The table contains information about five species of bat.

<i>Species</i>	<i>Wingspan (cm)</i>	<i>Roosting place</i>	<i>Flight</i>
Pipistrelle bat	19–25	Trees and buildings	Fast and erratic
Leisler's bat	25–33	Trees and buildings	Fast and straight
Lesser Horseshoe bat	19–25	Buildings only	Fast and agile
Bechstein's bat	25–33	Trees and buildings	Slow and fluttering
Daubenton's bat	19–25	Trees and buildings	Fast and straight

Use the information from the table to complete the boxes of the paired statement key below.

1 Wingspan 19–25 cm .....

Wingspan 25–33 cm ..... go to 3

2 Roosts in  ..... Lesser Horseshoe bat

Roosts in trees and buildings ..... go to 4

3 Slow and fluttering flight .....

Fast and straight flight .....

4  ..... Pipistrelle bat

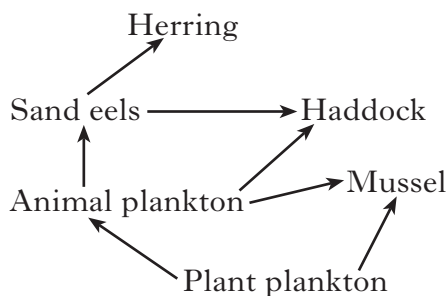
..... Daubenton's bat

3

Marks

KU	PS
1	
1	
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2	

2. The diagram shows part of a food web from the sea.



(a) Cod are fish that feed on young herring and sand eels.

Complete the food web to show the relationship of the cod to the other organisms in the food web.

1

(b) Over fishing has led to a decrease in the numbers of haddock in the food web.

(i) Explain why the population of animal plankton may **increase** if the haddock numbers are reduced.

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1

(ii) Explain why the population of animal plankton may **stay the same** if the haddock numbers are reduced.

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1

(c) Underline **one** word in each pair to make the following sentences correct.

{ Producers }  
{ Consumers } have the greatest biomass in a food chain. At each stage

in the food chain, the biomass is { greater }  
{ smaller } than the stage before.

The reason for this is that energy is { gained }  
{ lost } from each stage.

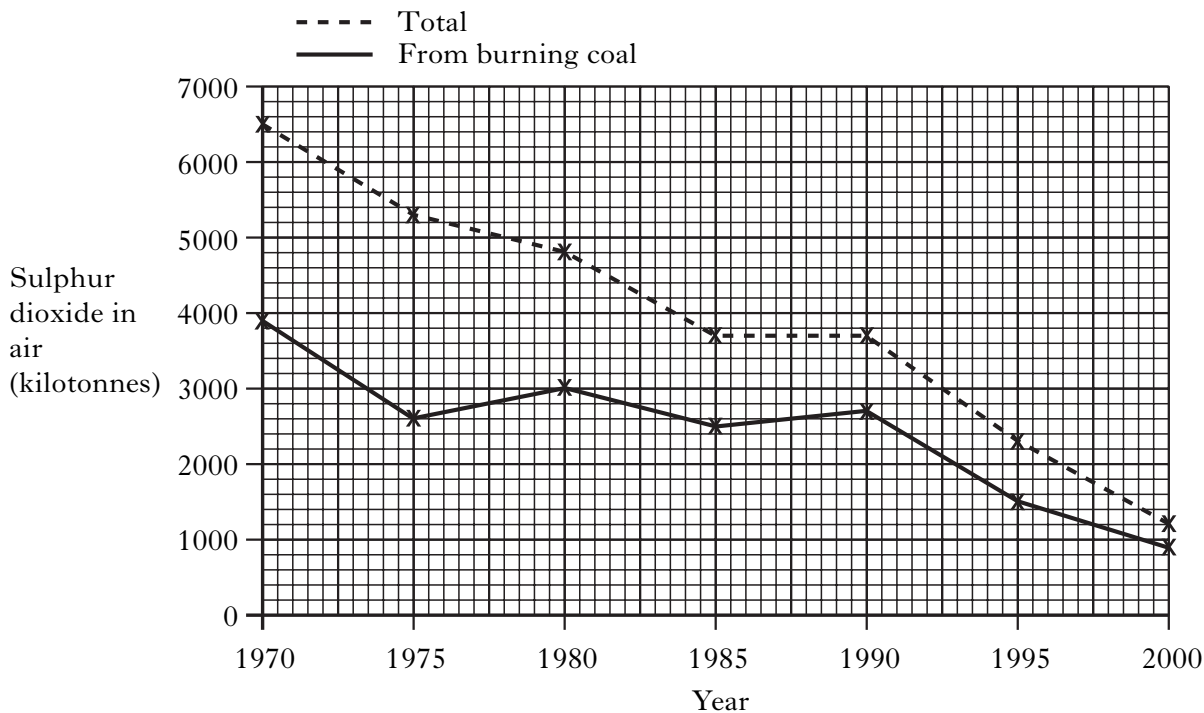
2

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3. The graph gives information about levels of sulphur dioxide in the air.



(a) The graph shows an overall reduction in the total level of sulphur dioxide in the air.

(i) During which 5 year period was there no reduction in the total level of sulphur dioxide in the air?

From \_\_\_\_\_ to \_\_\_\_\_

1

(ii) During which 5 year period was there the greatest decrease in the total level of sulphur dioxide in the air?

*Space for calculation*

From \_\_\_\_\_ to \_\_\_\_\_

1

(iii) In 1970, 3900 kilotonnes of sulphur dioxide were produced from burning coal. What percentage of the total is this?

*Space for calculation*

\_\_\_\_\_ %

1

3. (a) (continued)

(iv) Underline the correct option in the following sentence.

Between 1970 and 2000 the proportion of sulphur dioxide in the

air which came from burning coal  $\left\{ \begin{array}{l} \text{increased} \\ \text{decreased} \\ \text{stayed the same} \end{array} \right\}$ .

(b) Sulphur dioxide levels in the air could be reduced by switching from coal-fired power stations to nuclear power stations.

Give one **disadvantage** of using nuclear power.

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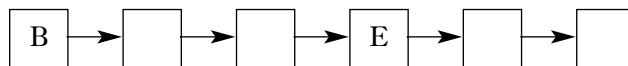
Marks 

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5. (a) The following statements refer to the stages that occur after pollination.

- A Fertilisation takes place.
- B A pollen tube grows out from a pollen grain.
- C The ovule forms a seed and the ovary forms a fruit.
- D The pollen tube grows down through the stigma.
- E The male gamete moves towards the ovule.
- F The pollen tube grows through the ovary wall.

Use the letters of the statements to complete the sequence of stages.



2

(b) Plants can reproduce by sexual and asexual means.

Draw lines to link each method of reproduction with the advantages that each method provides.

<i>Method of reproduction</i>	<i>Advantage</i>
Sexual	Offspring obtains food and water from parent
Asexual	Seeds are dispersed
	Greater variation among offspring
	Pollination is not required

2

(c) The plants in a clone have been produced by asexual reproduction.

Give **one** other piece of information about the members of a clone.

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<b>3</b>	
<b>1</b>	
<b>1</b>	

6. (a) Complete the following table about the three major food groups.

<i>Type of food</i>	<i>Chemical elements present</i>	<i>Example of digestive enzyme</i>	<i>Product(s) of digestion</i>
Carbohydrates	1 carbon 2 hydrogen 3 oxygen		
Fats	1 2 3	lipase	1 fatty acids 2 glycerol
	1 carbon 2 hydrogen 3 oxygen 4 nitrogen		

(b) The villi which line the small intestine each contain a lacteal and blood capillaries.

Give a brief description of the function of each of these structures.

Lacteal

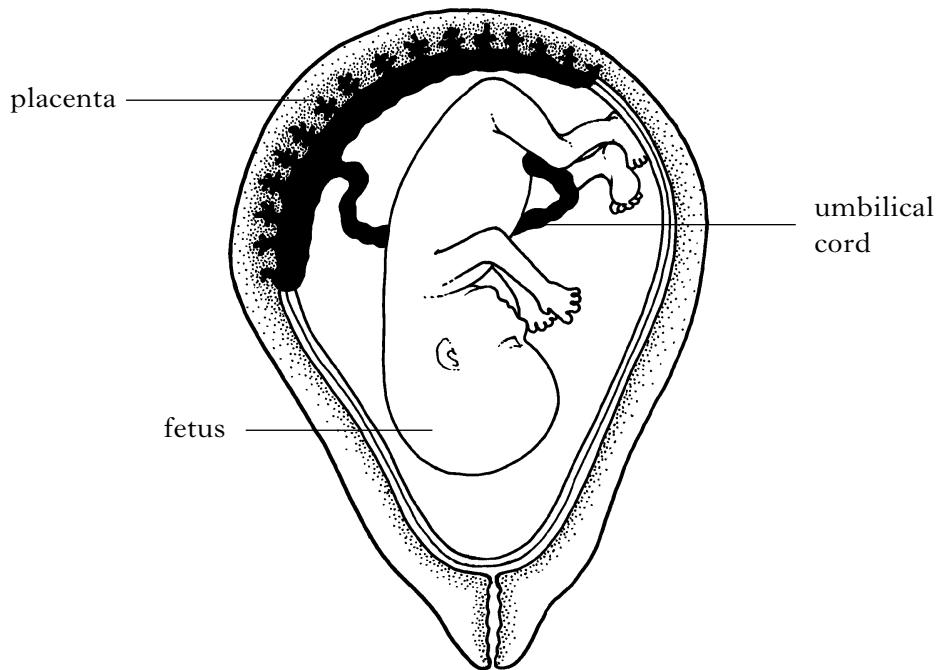
Blood capillaries



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7. The diagram shows a developing human fetus.



Complete the following table by putting a tick in the correct column to indicate the main direction of exchange for each of the following materials.

The first one has been done for you.

<i>Material</i>	<i>Direction of exchange</i>		
	<i>Mother to fetus</i>	<i>Fetus to mother</i>	<i>No exchange</i>
glucose	✓		
amino acids			
blood			
oxygen			
urea			
carbon dioxide			

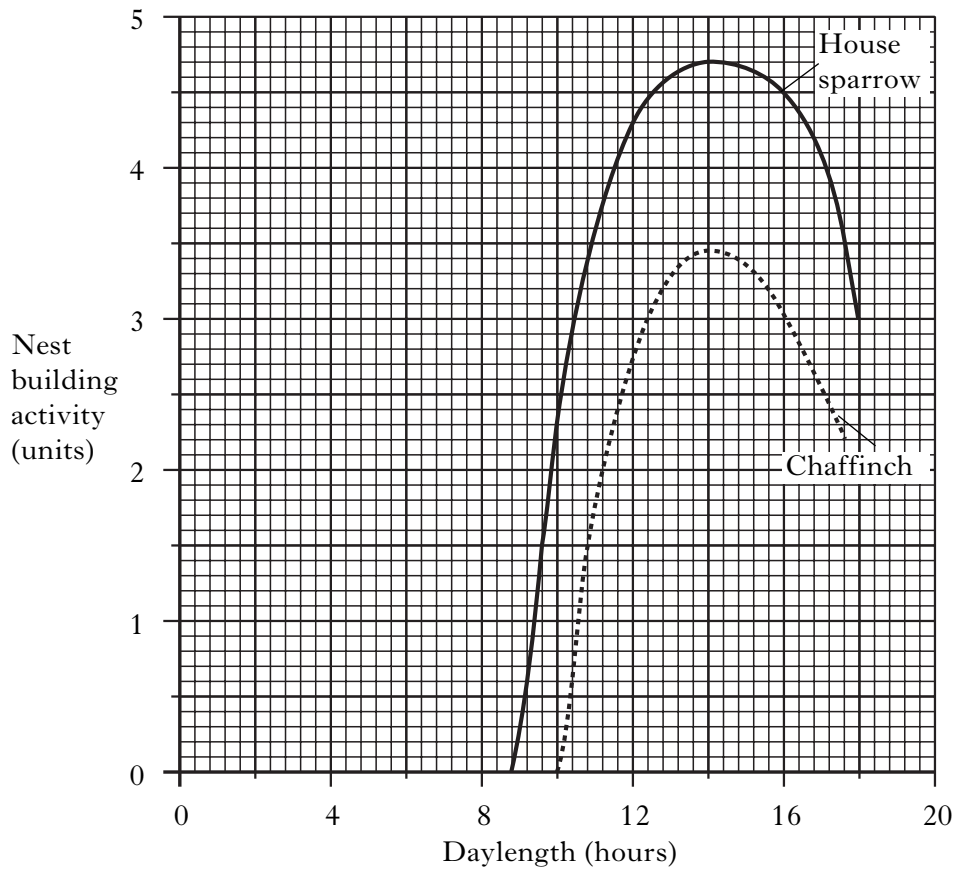
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8. The graph shows the relationship between daylength (hours of light in a 24 hour period) and the nest building activity of chaffinches and house sparrows.



- (a) Using data from the graph, describe the relationship between nest building activity and daylength for the chaffinch.

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3

- (b) House sparrows begin nesting activity earlier than chaffinches. Suggest a benefit to the survival of house sparrows.

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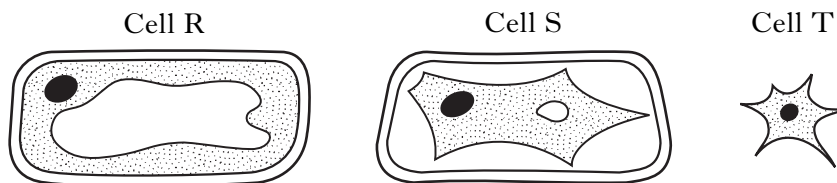
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1	

9. Plant cells and animal cells were left in water or 10% sucrose solution for 10 minutes. The cells were then examined under the microscope. The appearance of three individual cells is shown below.



- (a) Which **two** of the cells had been placed in 10% sucrose solution?

Cell \_\_\_\_\_ and Cell \_\_\_\_\_

1

- (b) The change in the cells was caused by the movement of water into or out of the cells.

What is the name of this process?

\_\_\_\_\_

1

- (c) With reference to the cells placed in water, what is meant by the term “concentration gradient”?

\_\_\_\_\_

\_\_\_\_\_

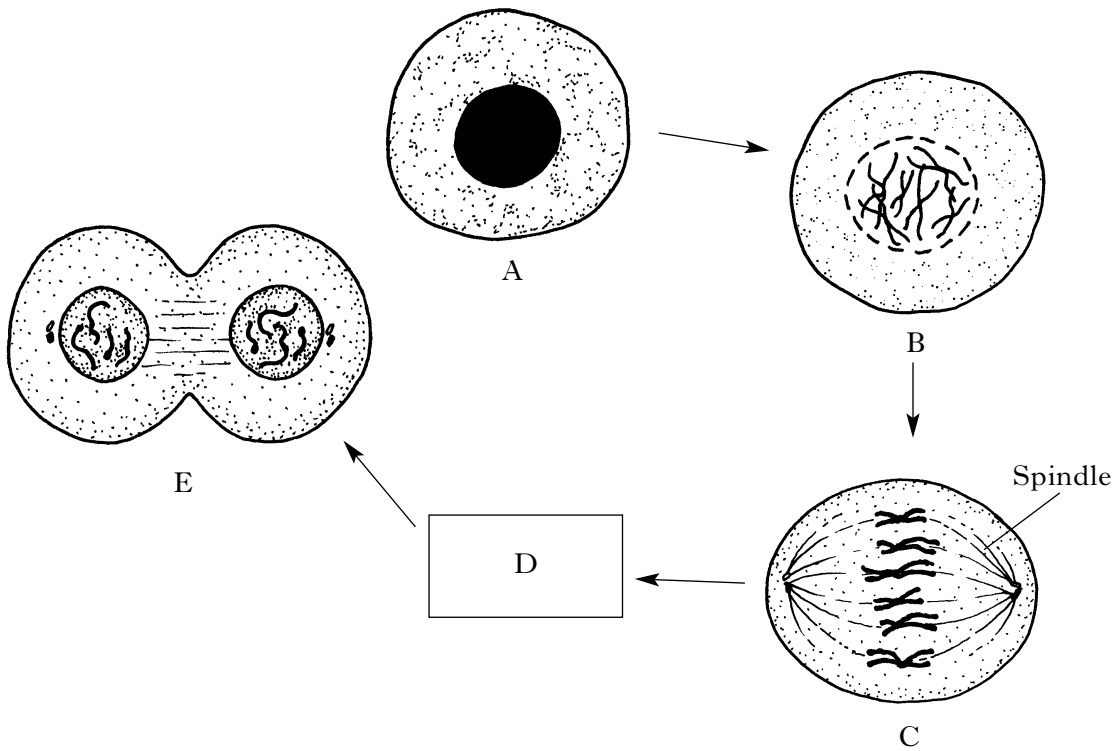
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1	

10. The diagram represents some of the stages of cell division.



Describe what happens in stages C and D.

C \_\_\_\_\_  
 \_\_\_\_\_

1

D \_\_\_\_\_  
 \_\_\_\_\_

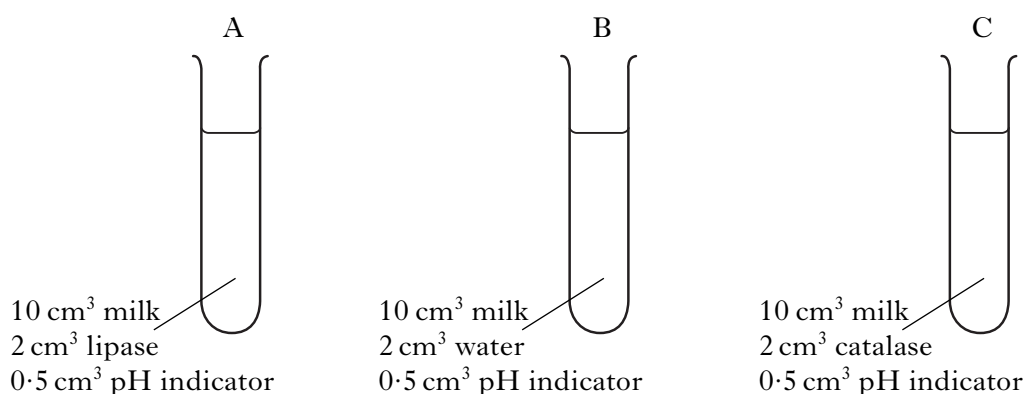
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11. The activity of the enzymes lipase and catalase was investigated.

Three test tubes were set up.



The colour of the pH indicator was noted at the start and after 20 minutes.

The results are shown in the table below.

<i>Test tube</i>	<i>Colour of pH indicator</i>	
	<i>At start</i>	<i>After 20 minutes</i>
A	green	orange
B	green	green
C	green	green

(a) In tube A, the pH indicator colour change was due to the production of fatty acids as the lipase reacted with the fat in the milk.

Explain why there was no change in tube C.

---



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1

(b) What term is used to describe tube B which contained water instead of an enzyme?

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1

(c) Name **two** variables, not already shown, which would have to be kept the same when this investigation was set up.

1 \_\_\_\_\_

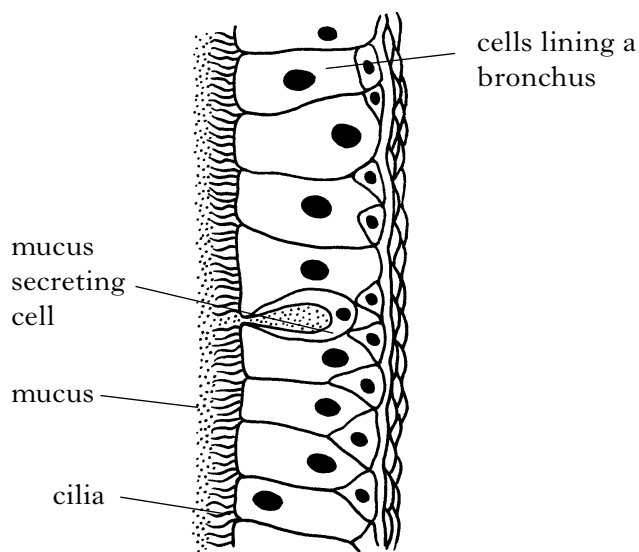
2 \_\_\_\_\_

2

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KU	PS
2	
1	

12. The diagram represents part of the breathing system in humans.



(a) Describe how the mucus and cilia help to protect the lungs from damage and infection.

Mucus

Cilia

(b) Which of the following are involved in **breathing out** during deep breathing in humans?

- 1 Diaphragm contracts
- 2 Diaphragm relaxes
- 3 Muscles between the ribs contract
- 4 Muscles between the ribs relax
- 5 Rib cage moves up and out
- 6 Rib cage moves down and in

Tick the correct box.

1, 3 and 5 correct

1, 4 and 5 correct

2, 3 and 6 correct

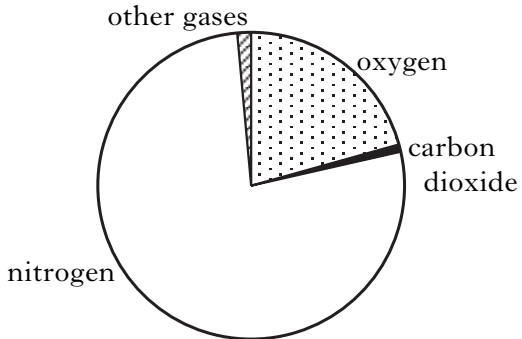
2, 4 and 6 correct

Marks

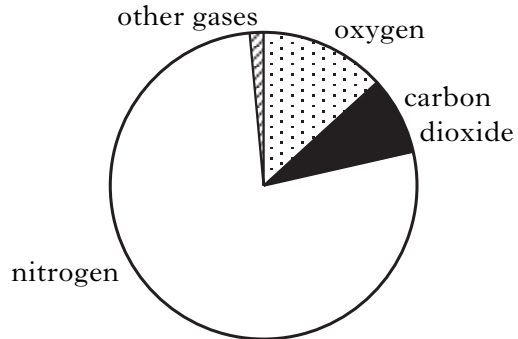
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**12. (continued)**

(c) The pie charts below show the composition of fresh air and breathed air.



**Chart A**



**Chart B**

(i) Indicate which chart refers to breathed air and give a reason for your choice.

The chart that refers to breathed air is

Reason

1

(ii) Which named gas appears not to be involved in gas exchange in the lungs?

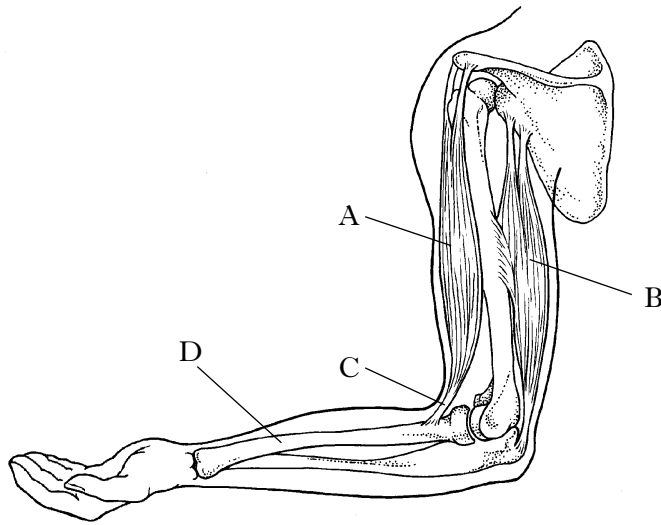
1

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1	
1	

13. The diagram shows some of the structures in a human arm.



(a) Name the type of structures labelled A, B and C.

A and B \_\_\_\_\_

C \_\_\_\_\_

(b) Which structure contracts to bend the arm?

Letter \_\_\_\_\_

(c) Which of the following are composed of living cells?

*Tick the correct box.*

Structures A and B only

Structures A, B and C only

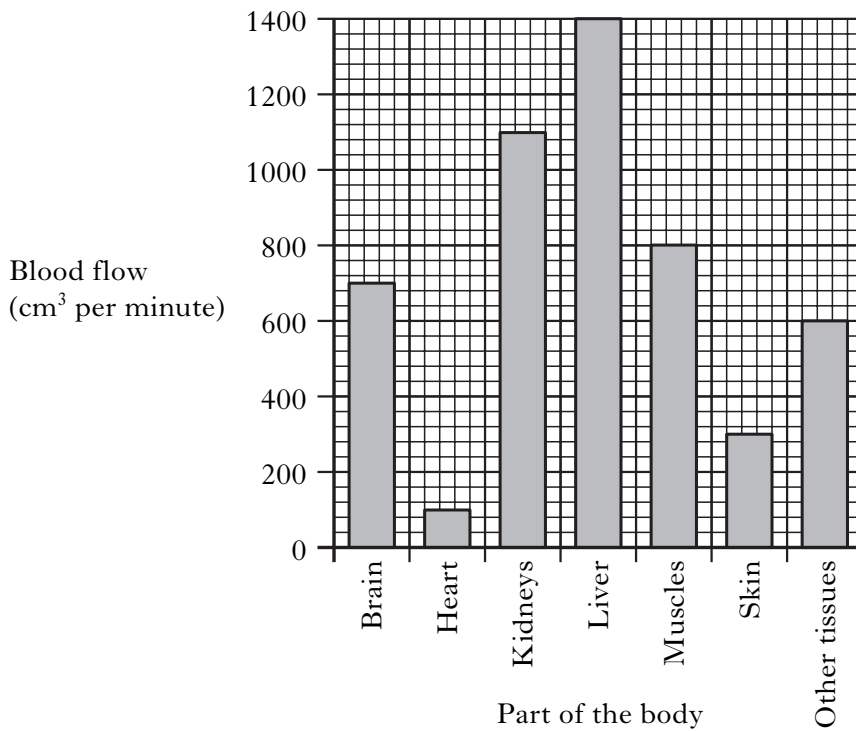
Structures A, B and D only

Structures A, B, C and D



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14. The bar chart shows the blood flow to parts of the body when a person is sitting still.



- (a) What is the total blood flow per minute?

*Space for calculation*

Total \_\_\_\_\_ cm<sup>3</sup>

1

- (b) Express the flow of blood to the liver, the brain and the heart as a simple whole number ratio.

*Space for calculation*

\_\_\_\_\_ : \_\_\_\_\_ : \_\_\_\_\_  
liver      brain      heart

1

- (c) During exercise the blood flow to the muscles increases to 1200 cm<sup>3</sup> per minute.

Calculate the percentage increase in blood flow to the muscles.

*Space for calculation*

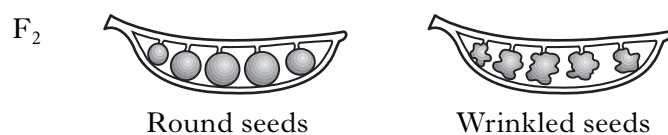
\_\_\_\_\_ %

1

Marks

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1	
2	

15. (a) True breeding pea plants were bred to produce two generations, as shown below.



- (i) Round seeds and wrinkled seeds are caused by two forms of the same gene.

What term describes different forms of the same gene?

\_\_\_\_\_

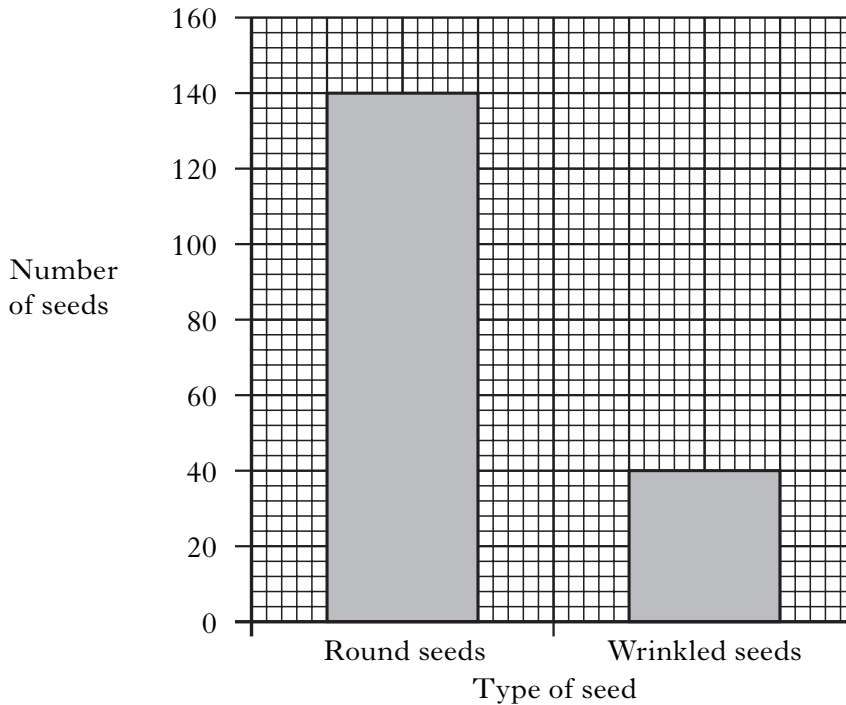
- (ii) Using the letter **R** for round seeds and **r** for wrinkled seeds, complete the following table.

<i>Plant</i>	<i>Genotype</i>
Parent with round seeds	
All F <sub>1</sub>	
F <sub>2</sub> with wrinkled seeds	

Marks	KU	PS
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15. (a) (continued)

(iii) The seeds from the F<sub>2</sub> were counted and the results are shown in the bar chart.



What is the simple whole number ratio of round to wrinkled seeds?

*Space for calculation*

\_\_\_\_\_ : \_\_\_\_\_  
round      wrinkled

1

(b) In order to improve a certain characteristic, particular pea plants are chosen to breed.

(i) What is the name given to this procedure?

\_\_\_\_\_

1

(ii) Suggest a characteristic of pea plants which a plant breeder might wish to improve.

\_\_\_\_\_

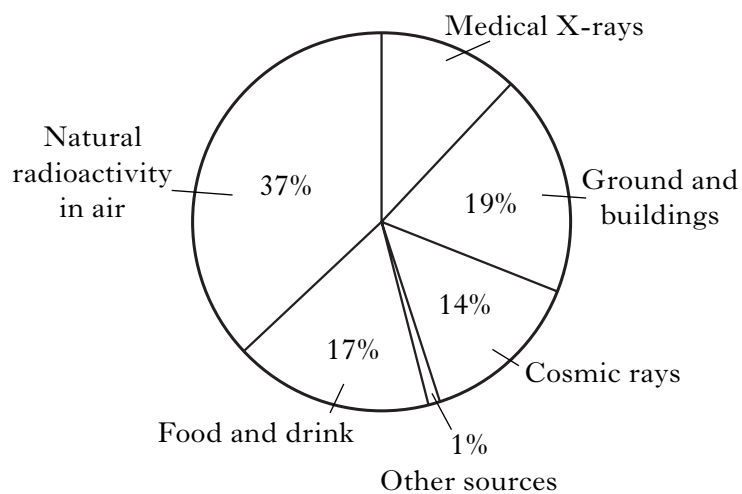
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16. (a) Exposure to radiation can cause mutation.  
The pie chart shows the contribution of various sources of radiation to the total exposure.



- (i) Which source of radiation contributes most to the total exposure?

\_\_\_\_\_

1

- (ii) What percentage of the total exposure comes from X-rays?  
*Space for calculation*

\_\_\_\_\_ %

1

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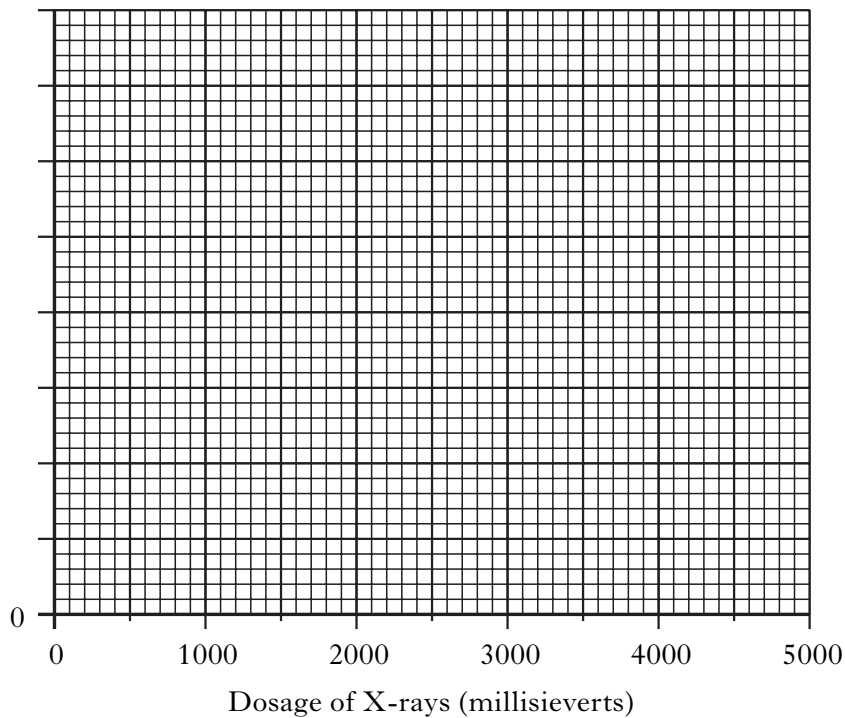
KU	PS
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16. (continued)

- (b) The table shows the occurrence of chromosome mutations in *Drosophila* fruit flies when exposed to different doses of radiation.

Dosage of X-rays (millisieverts)	Chromosome mutations (%)
1000	1.0
2000	1.9
2500	2.6
3000	3.1
4000	4.2
4500	4.6
5000	5.3

- (i) On the grid below, complete the y-axis and plot a line graph of the results.  
(An additional grid, if needed, will be found on page 27.)



- (ii) What is the relationship between the dosage of X-rays and chromosome mutations?

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2

1


Marks

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17. Read the following passage and answer the questions based on it.

Midges are blood-feeding insects similar to mosquitoes but much smaller. There are about 40 species found in Scotland. One species, *Culicoides impunctatus* (or the 'Highland biting midge'), is best known for biting people.

Midges inhabit all areas of the world except the poles, New Zealand and Patagonia (where the habitat is too dry). In the UK, their numbers are greatest in parts of Western Scotland and the Highlands where they thrive in the damp acidic soil. The colder winters on the East coast often result in frozen soil which kills the overwintering larvae.

In late summer, eggs are laid on the soil surface. They hatch into thread-like larvae which live a few centimetres below the soil surface and feed on decaying plant and animal matter. Flying adults begin to emerge the following May, triggered by lengthening days and warmer temperatures. These adults lay eggs that develop quickly to give a second emergence of adult midges in August.

Midges are unable to fly in very wet or windy weather or in temperatures below 7 °C. In such poor conditions they might only survive a few days. In more favourable conditions they may live for two weeks.

All midges feed on plant nectar. Only females feed on blood as they require the blood proteins and fats to develop their eggs.

Different species of midge specialise in feeding on different hosts. The Highland biting midge feeds on large mammals, including cattle, horses, deer, and of course, people. The host is detected by a combination of smells, heat, carbon dioxide, movement and colour. Differences amongst people in these factors partly explain why midges bite some more than others.

Biting midges and mosquitoes obtain blood in different ways. Mosquitoes insert their mouth-parts directly into a blood capillary. Midges use their jaws to cut a hole in the skin, creating a pool of blood from which they feed.

(a) Give **two** reasons why midges do not exist in some parts of the world.

1 \_\_\_\_\_

2 \_\_\_\_\_

1

(b) What do the midge larvae feed on?

\_\_\_\_\_

1

(c) What is the maximum time an adult midge can live for?

\_\_\_\_\_

1

<i>Marks</i>	KU	PS
<b>1</b>		
<b>1</b>		
<b>1</b>		

**17. (continued)**

(d) Name **two** types of food that an adult female midge might eat.

1 \_\_\_\_\_

2 \_\_\_\_\_

(e) Suggest why the Highland biting midge might not bite mice.

\_\_\_\_\_

\_\_\_\_\_

(f) Describe **two** differences, mentioned in the passage, between midges and mosquitoes.

1 \_\_\_\_\_

2 \_\_\_\_\_

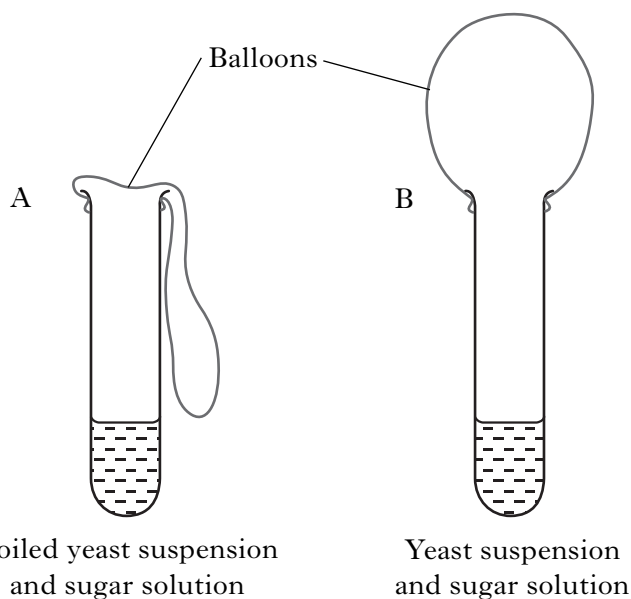
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Marks

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1	
1	

**18.** An investigation into fermentation was carried out at 20 °C.

A deflated balloon was attached to the top of each tube at the start. The appearance of the balloons after several hours is shown below.



(a) What substance produced in tube B caused the balloon to inflate?

\_\_\_\_\_

1

(b) The balloon on the tube with the boiled yeast suspension did not inflate. Explain this result.

\_\_\_\_\_

\_\_\_\_\_

1

(c) How would the appearance of the balloon on tube B differ if the investigation had been carried out at 15 °C?

\_\_\_\_\_

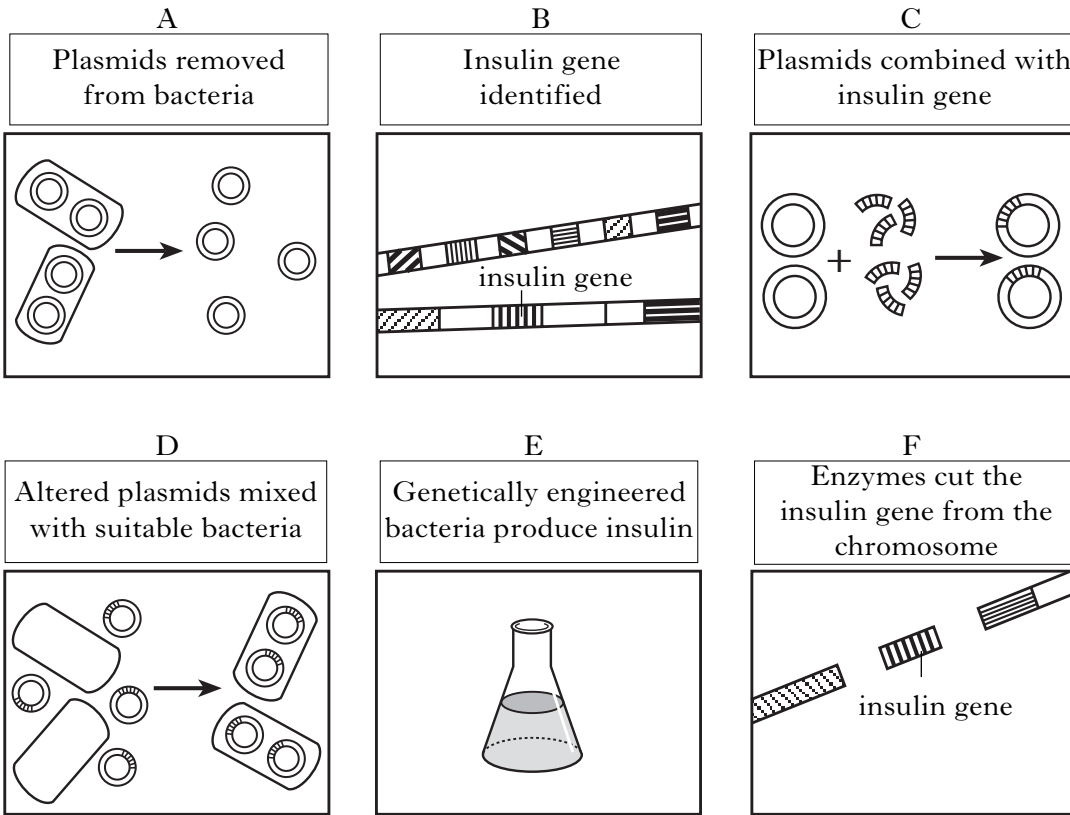
1



Marks

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1	
1	
1	

19. The diagrams show the production of insulin by genetic engineering. They are not in the correct order.



(a) Use the letters to put the diagrams in the correct sequence. The first and last have been done for you.

B
 
 
 
 
E

(b) Explain why there is an ever-increasing need for insulin produced by genetic engineering.

\_\_\_\_\_

\_\_\_\_\_

(c) Before biotechnology was used to produce insulin, it was obtained from the pancreas of animals such as pigs. Give **one** advantage of producing insulin by genetic engineering.

\_\_\_\_\_

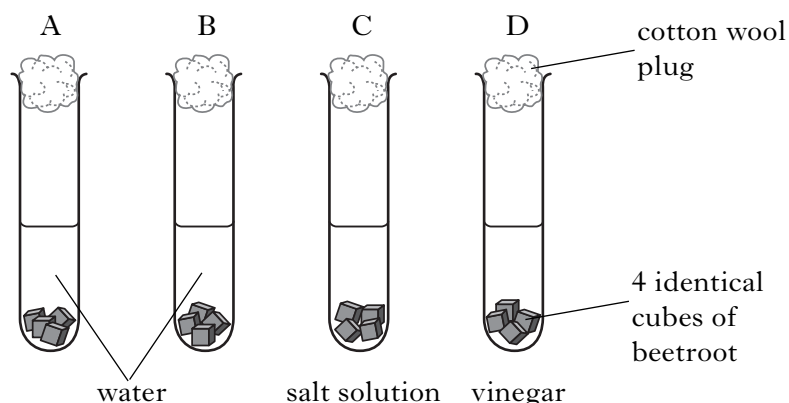
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20. Four test tubes were set up to investigate decay of beetroot as shown below.



Test tube A was incubated at 5 °C and tubes B, C and D were incubated at 30 °C. After 48 hours, the appearance of the solutions was recorded. Any cloudiness in the solution was due to the growth of micro-organisms.

The results are shown in the table.

<i>Test tube</i>	A	B	C	D
<i>Appearance</i>	Clear	Cloudy	Slightly cloudy	Clear

(a) (i) In which test tube would the beetroot show most decay if left for two weeks?

Test tube \_\_\_\_\_

1

(ii) From the results, suggest **two** methods of preventing decay in beetroot.

1 \_\_\_\_\_

2 \_\_\_\_\_

1

(iii) Suggest why cotton wool plugs were used in the experiment.

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

1

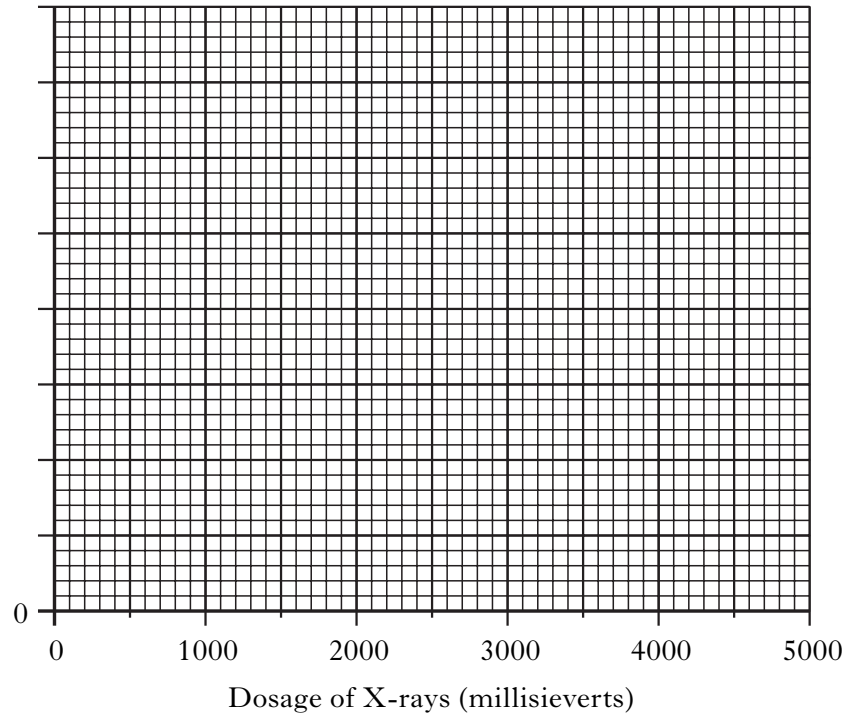
(b) Name a type of micro-organism responsible for decay.

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

1

[END OF QUESTION PAPER]

ADDITIONAL GRAPH PAPER FOR QUESTION 16(b)(i)



**[Turn over**

SPACE FOR ANSWERS  
AND FOR ROUGH WORKING