

Please write clearly in block capitals.

Centre number

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# GCSE SCIENCE A 2

# H

Higher Tier Unit 6

Wednesday 24 May 2017

Afternoon

Time allowed: 1 hour 30 minutes

## Materials

For this paper you must have:

- a ruler
- a calculator
- the Chemistry Data Sheet and Physics Equations Sheet booklet (enclosed).

## Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

## Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 6(a) should be answered in continuous prose.  
In this question you will be marked on your ability to:
  - use good English
  - organise information clearly
  - use specialist vocabulary where appropriate.

## Advice

- In all calculations, show clearly how you work out your answer.

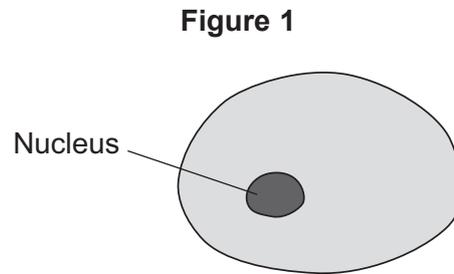
For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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9	
10	
11	
12	
13	
<b>TOTAL</b>	



Answer **all** questions in the spaces provided.

### Biology Questions

1 **Figure 1** shows an animal cell.



1 (a) Describe what is inside the nucleus.

[2 marks]

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1 (b) Give **one** function of the nucleus.

[1 mark]

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3



- 2** Scientists investigated the distribution of one type of lichen growing on the bark of red fir trees and white fir trees.

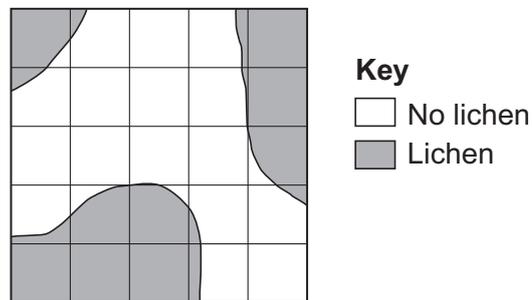
The scientists used a sampling square called a quadrat to estimate the percentage cover of lichen.

Each quadrat was divided into 25 smaller squares.

Only the squares in which the lichen covered more than half the square were counted. This number of squares was then used to calculate the percentage cover of lichen in the whole quadrat.

**Figure 2** shows the lichen growing in one quadrat.

**Figure 2**



- 2 (a)** Count the number of squares in which the lichen covered more than half the square.

Use this number to calculate the percentage cover of lichen in the quadrat shown in **Figure 2**.

**[2 marks]**

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

**Question 2 continues on the next page**

**Turn over ►**



2 (b)

The scientists:

- sampled 20 red fir trees and 20 white fir trees
- measured the percentage cover of lichen three times on the north-east, south-east, south-west and north-west sides of each tree
- calculated the mean percentage cover for each side.

Figure 3 shows the sides of the trees sampled.

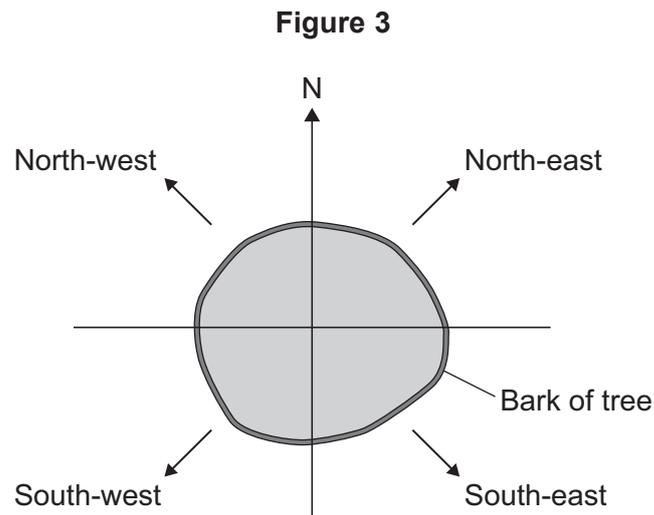
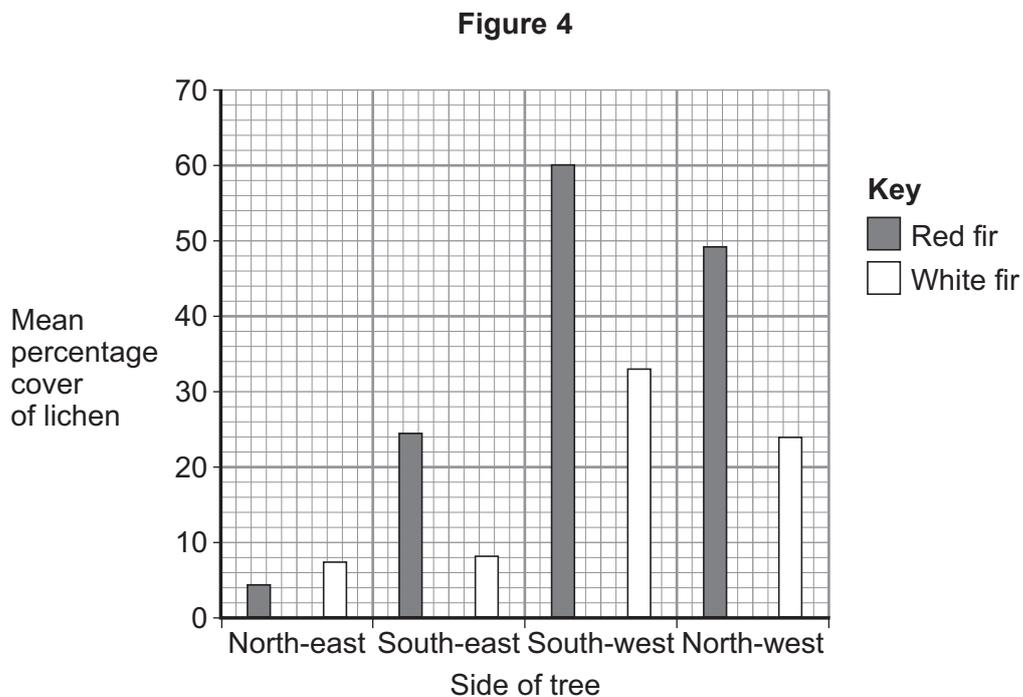


Figure 4 shows the scientists' results.



**2 (b) (i)** Look at **Figure 4**.

Where on the trees was there the most lichen?

[1 mark]

Tick (✓) **one** box.

North side

South side

East side

West side

**2 (b) (ii)** The direction the bark is facing affects the distribution of the lichen growing on the trees.

Give **one** other conclusion that can be made from **Figure 4**.

[1 mark]

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**2 (b) (iii)** Suggest **two** factors that could affect the distribution of the lichen growing on the trees.

[2 marks]

1 \_\_\_\_\_

2 \_\_\_\_\_

6

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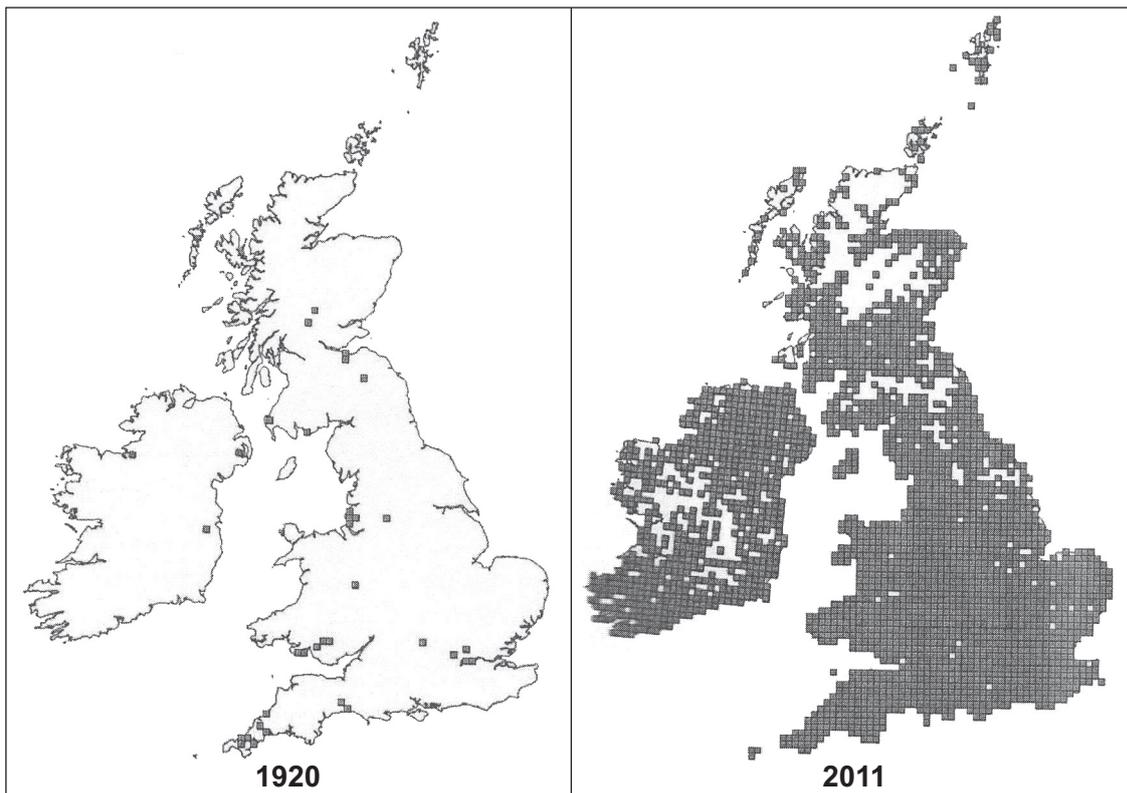
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- 3 Japanese knotweed is an invasive plant species that was brought into Britain from Japan in 1847. Since then, Japanese knotweed has spread widely. It has caused some native British plants to die out.

**Figure 5** shows how Japanese knotweed has spread across the British Isles between 1920 and 2011.

**Figure 5**



Japanese knotweed can survive in conditions where there are high concentrations of sulfur dioxide or high temperatures. In Japan a number of different organisms prevent it from growing out of control.

Japanese knotweed grows strong shoots which can grow through tarmac and concrete. The shoots can grow a metre every month and reach a height of 3 or 4 metres. The plant forms a wide underground network of stems that grow more shoots.

It is very difficult to kill Japanese knotweed. Cutting back new growth takes years to kill the plant. Weed killers can be used, or specialised companies try to dig it all up, but any small stem left in the soil will grow into a new plant.



**3 (a)** What name is given to organisms that can survive in extreme conditions? **[1 mark]**

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**3 (b)** Suggest why native British plants have died out in areas where Japanese knotweed grows. **[2 marks]**

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**3 (c)** Only female Japanese knotweed plants grow in Britain. They are all formed from the original plant.  
What process must have produced all the Japanese knotweed plants in Britain? **[1 mark]**

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**3 (d)** Scientists are investigating the use of an insect from Japan to eat the knotweed and control its growth. Scientists think that the insect will eat only knotweed.  
The insect dies in the winter in Britain, so new insects would have to be brought in each year.  
Give the advantages and disadvantages of using an insect from Japan to control the growth of Japanese knotweed. **[3 marks]**

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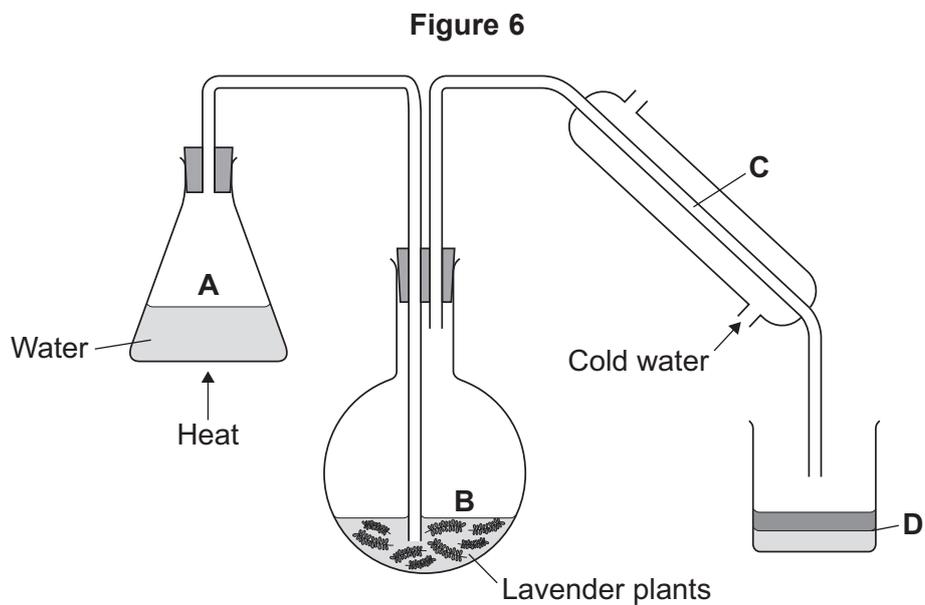


### Chemistry Questions

4 This question is about plant oils.

4 (a) Lavender oil can be separated from lavender plants by steam distillation.

Figure 6 shows the apparatus used in steam distillation.



At **B**, the lavender oils are vaporised.

4 (a) (i) What is produced at **A**?

[1 mark]

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4 (a) (ii) Which process happens at **C**?

[1 mark]

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4 (a) (iii) Describe what happens at **D**.

[1 mark]

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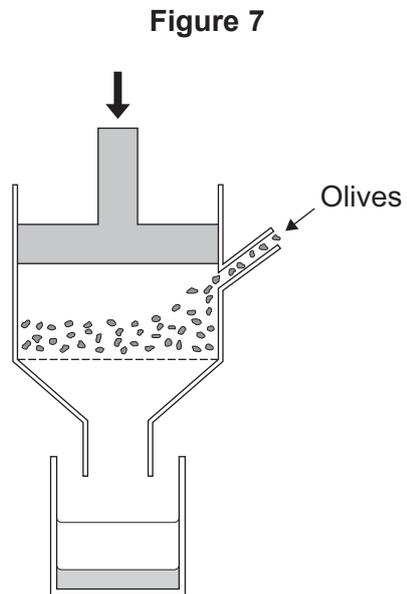


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4 (b) Olive oil is separated by a different method.

Figure 7 shows the apparatus used.



What is the name of this method?

[1 mark]

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Question 4 continues on the next page

Turn over ►



**4 (c)** Evidence suggests that unsaturated oils are healthier to eat than saturated oils.

A student investigated the amount of unsaturation in different samples of olive oil using bromine water.

**4 (c) (i)** What is the colour change when bromine water reacts with an unsaturated oil?

Complete the sentence.

**[1 mark]**

Bromine water changes from \_\_\_\_\_ to colourless.

**4 (c) (ii)** **Figure 8** shows the apparatus the student used.

**Figure 8**

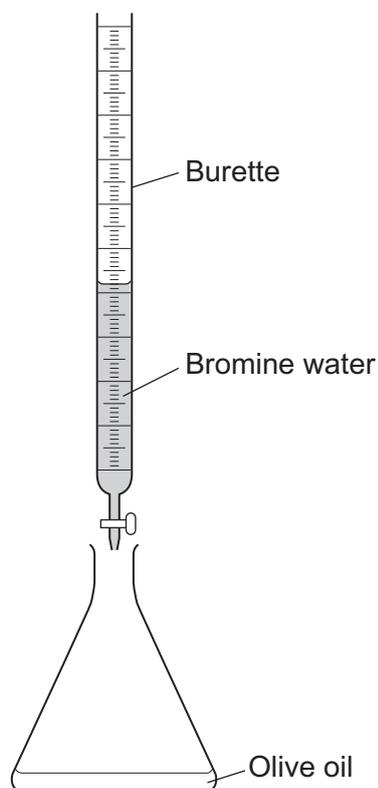


Table 1 shows the student's results.

Table 1

Olive oil sample	Number of drops of bromine water added until olive oil changes colour				
	Test 1	Test 2	Test 3	Test 4	Mean
A	20	21	19	20	20
B	25	14	26	24	25
C	12	15	16	13	14

Describe how the student calculated the mean for olive oil B.

[2 marks]

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4 (c) (iii) The student concluded:

'Olive oil C is the healthiest to use because it is the most unsaturated.'

The student's conclusion is **not** correct.

Explain why.

[2 marks]

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9

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**5** This question is about the Earth and its atmosphere.

**5 (a) (i)** The Earth has existed for about 4.6 billion years.

The gases in the early atmosphere came from intense volcanic activity.

When did this volcanic activity happen?

[1 mark]

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**5 (a) (ii)** On which parts of the Earth's crust are most volcanoes located today?

[1 mark]

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**5 (b) (i)** **Table 2** shows the percentages of carbon dioxide, nitrogen and oxygen in the Earth's early atmosphere and in the atmosphere today.

Complete **Table 2** to show the percentages of nitrogen and oxygen in the atmosphere today.

[1 mark]

**Table 2**

<b>Gas</b>	<b>Percentage (%) of gas in early atmosphere</b>	<b>Percentage (%) of gas in atmosphere today</b>
Carbon dioxide	95	0.04
Nitrogen	3	
Oxygen	1	



**5 (b) (ii)** The percentage of carbon dioxide has decreased from the early atmosphere to the atmosphere today.

Give **two** reasons why.

**[2 marks]**

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5

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**6 (b)** Some cables in the National Grid are placed underground.

Give **one** advantage of using underground cables instead of overhead cables.

**[1 mark]**

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

**6 (c)** Some people who live near overhead cables are concerned about the possible effects on their health.

Suggest what should be done to investigate these concerns.

**[2 marks]**

\_\_\_\_\_  
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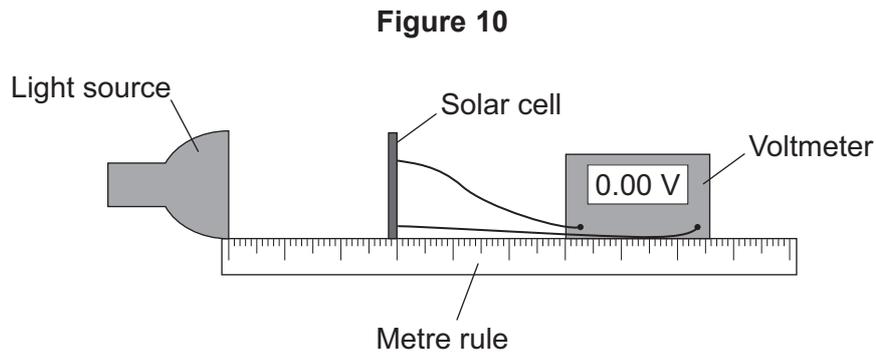


7 Solar cells can be used to generate electricity.

A student made a hypothesis:

'The output voltage from a solar cell increases with the intensity of the light that falls on the solar cell.'

Figure 10 shows the equipment the student used to test her hypothesis.



The student placed the solar cell at different distances from the light source.

For each position of the solar cell the student measured:

- the distance from the light source to the solar cell
- the output voltage.

7 (a) Give **one** control variable in this investigation.

[1 mark]

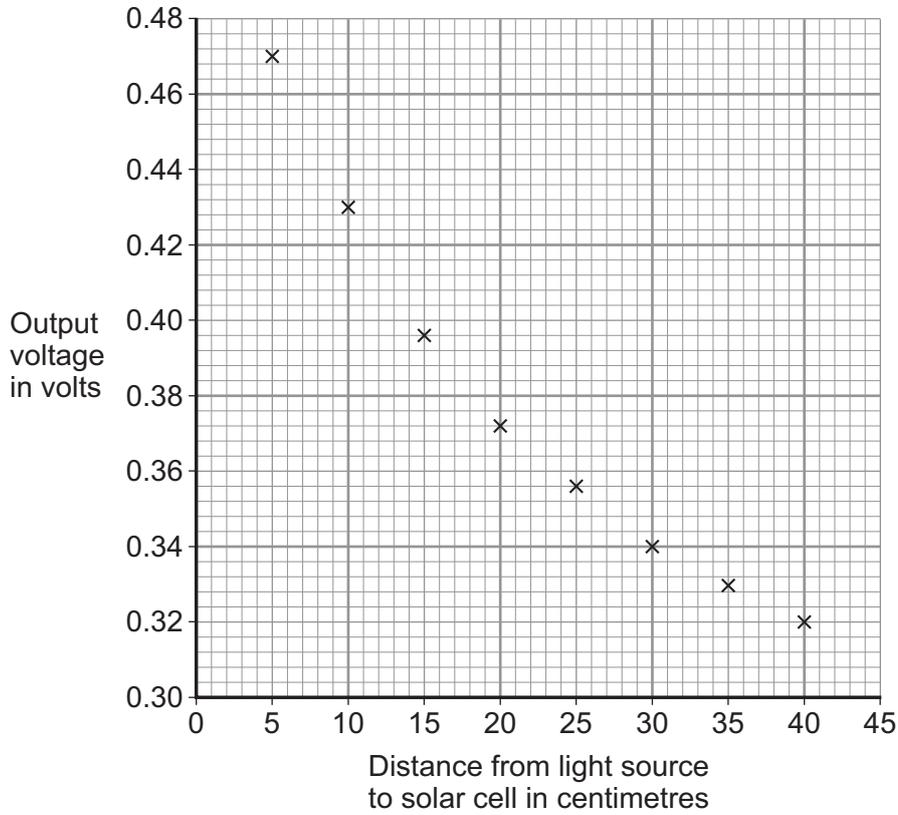
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7 (b) Figure 11 shows the results of the investigation.

Figure 11



7 (b) (i) Draw a line of best fit on the graph in Figure 11.

[1 mark]

7 (b) (ii) Does the graph support the student's hypothesis?

Justify your answer.

[2 marks]

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4

Turn over ►



**Biology Questions**

- 8 (a)** People with Type 1 diabetes do not produce the hormone insulin. These people need to inject themselves with insulin.

Describe how a bacterial cell is genetically engineered to produce human insulin.

**[3 marks]**

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- 8 (b)** Vitamin A deficiency is common in large areas of the world where rice is the main food. Every year about 500 000 children become blind due to vitamin A deficiency.

Scientists have genetically engineered rice plants to produce rice that is rich in a chemical that is converted to vitamin A in the body. The rice is called Golden rice, because the rice grains are gold in colour.

Golden rice could save the sight of many children, but some people think we should **not** grow Golden rice.

Why might some people object to Golden rice being grown?

Suggest **three** reasons.

**[3 marks]**

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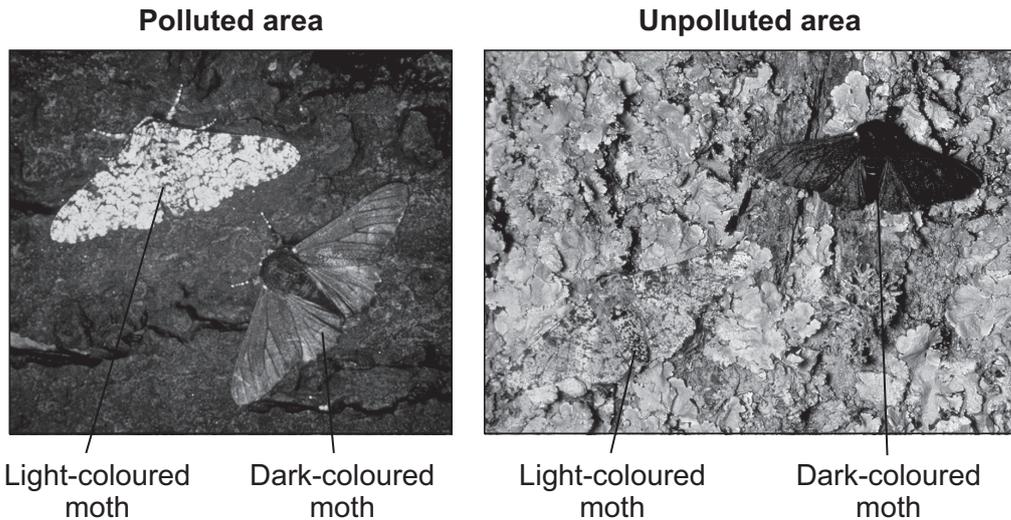
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- 9 There are many peppered moths all over Britain. Birds eat peppered moths.  
Before 1848 there were only light-coloured peppered moths.  
The first dark-coloured peppered moth was seen in 1848.

**Figure 12** shows the two forms of peppered moth on the bark of trees in a polluted area and in an unpolluted area.

**Figure 12**



The dark form of peppered moth was caused by a mutation.

- 9 (a) What is a mutation?

[1 mark]

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- 9 (b) Scientists investigated the effect of predation by birds on the light-coloured and dark-coloured moth populations in an **unpolluted** area.

The scientists:

- surveyed the proportion of the two forms of moth in an unpolluted area where the bark of trees was a light colour
- one evening, released light-coloured and dark-coloured moths onto the trees in the same proportion as was occurring naturally
- counted the number of light-coloured and dark-coloured moths that were alive on the trees 4 hours after dawn the next day.

This investigation was repeated over 6 years.

Turn over ►



The number of moths released each year was in the same proportion as was occurring naturally in the area.

**Table 3** shows the numbers of moths released each year.

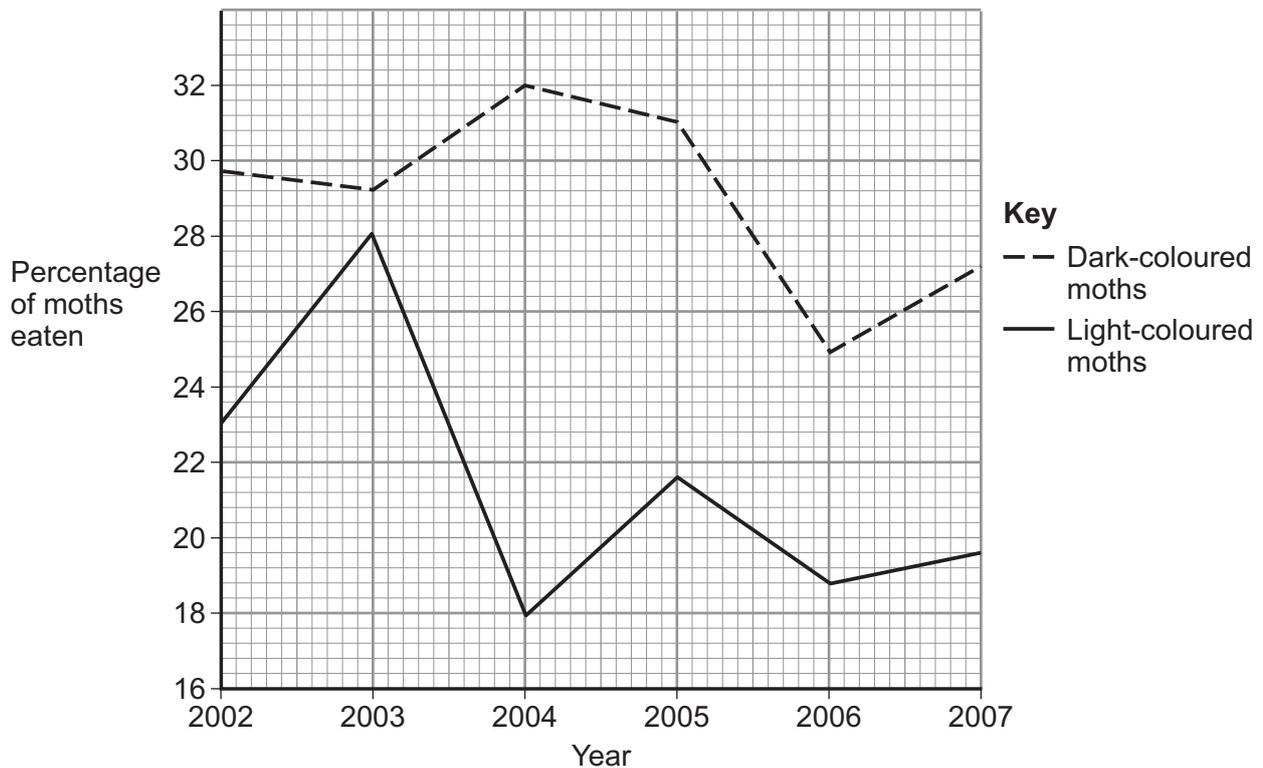
**Table 3**

Year	Number of light-coloured moths released	Number of dark-coloured moths released
2002	706	101
2003	731	82
2004	751	53
2005	763	58
2006	774	34
2007	797	14

The scientists calculated the percentage of each form of moth that was eaten.

**Figure 13** shows the scientists' results.

**Figure 13**



**9 (b) (i)** The percentages determined by the scientists might be inaccurate.

Suggest **one** reason why.

[1 mark]

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**9 (b) (ii)** Use information from **Table 3** and **Figure 13** to calculate how many light-coloured moths survived in 2004.

[2 marks]

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Number of light-coloured moths that survived = \_\_\_\_\_

**9 (b) (iii)** Explain how the data in **Figure 13** and **Table 3** support Darwin's theory of evolution.

[4 marks]

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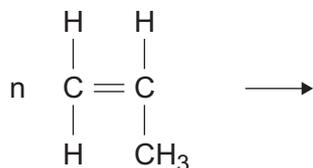


**Chemistry Questions**

**10 (a)** Poly(propene) is produced by polymerising propene.

**10 (a) (i)** Complete the equation for the polymerisation reaction.

**[3 marks]**



**10 (a) (ii)** Propene is produced from naphtha, a fraction from crude oil.

Naphtha contains decane. Decane can be converted into smaller, more useful molecules by cracking.

Complete the chemical equation to show how propene is produced from decane ( $\text{C}_{10}\text{H}_{22}$ ).

**[2 marks]**



**10 (a) (iii)** Describe the conditions needed to crack decane.

**[2 marks]**

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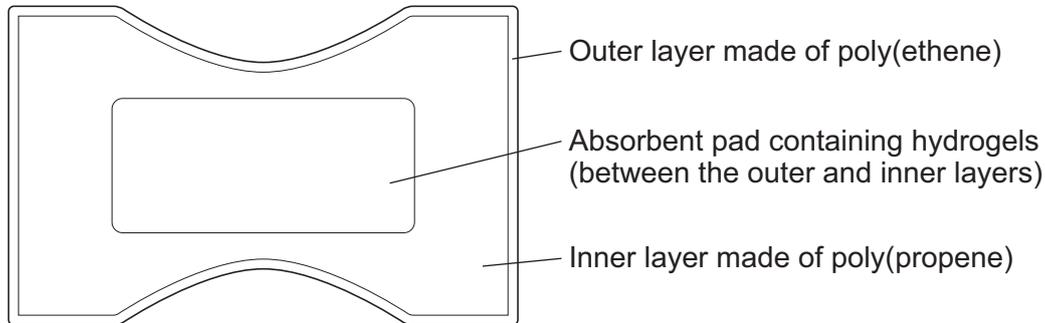
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**10 (b)** Disposable nappies are used to absorb a baby's urine.

**Figure 14** shows the structure of a disposable nappy.

**Figure 14**



18 million tonnes of waste are sent to landfill sites every year. Disposable nappies make up 2% of this waste.

Calculate the mass of disposable nappies sent to landfill each year.

**[1 mark]**

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Mass of disposable nappies = \_\_\_\_\_ tonnes

**10 (c)** Some disposable nappies now use a plastic made from cornstarch as the outer layer rather than poly(ethene).

Explain **two** environmental advantages of using a plastic made from cornstarch rather than poly(ethene).

**[4 marks]**

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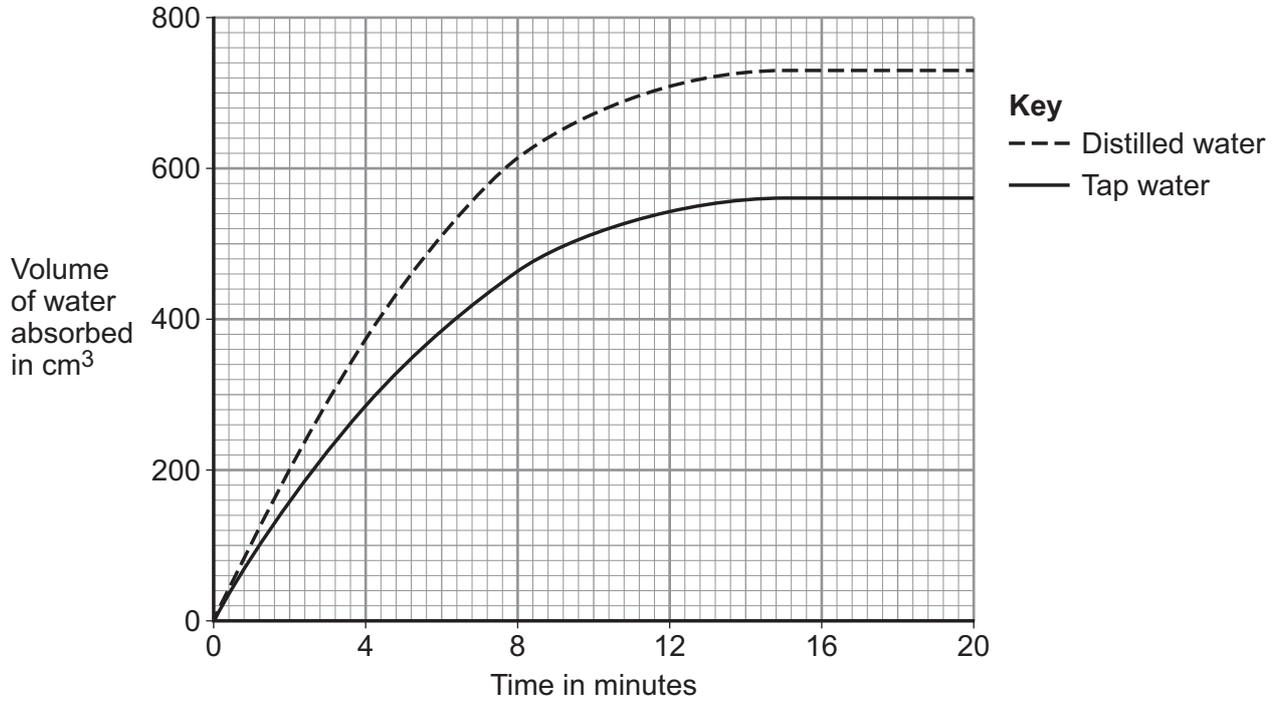


**10 (d)** A student investigated the rate of absorption of distilled water and tap water by one type of hydrogel.

The water was at body temperature.

**Figure 15** shows the student's results.

**Figure 15**



**10 (d) (i)** What **three** conclusions about the **rate** of absorption can you make from these results? **[3 marks]**

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**10 (d) (ii)** Suggest **one** change to the investigation that would make the results more useful to a company making disposable nappies. **[1 mark]**

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**Physics Questions**

**11** Waves can be diffracted.

**11 (a)** What is diffraction?

**[1 mark]**

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**11 (b)** **Figure 16** shows water waves at sea about to pass through a gap in a harbour wall.

As the waves pass into the harbour they are diffracted.

Complete **Figure 16** to show the waves after they have passed into the harbour.

**[2 marks]**

**Figure 16**



**11 (c)** A radio wave has a frequency of 21 000 000 Hz.

The speed of radio waves is 300 000 000 m/s.

Calculate the wavelength of the radio wave.

Use the correct equation from the Physics Equations Sheet.

Give your answer to 2 significant figures.

**[3 marks]**

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Wavelength = \_\_\_\_\_ m

6

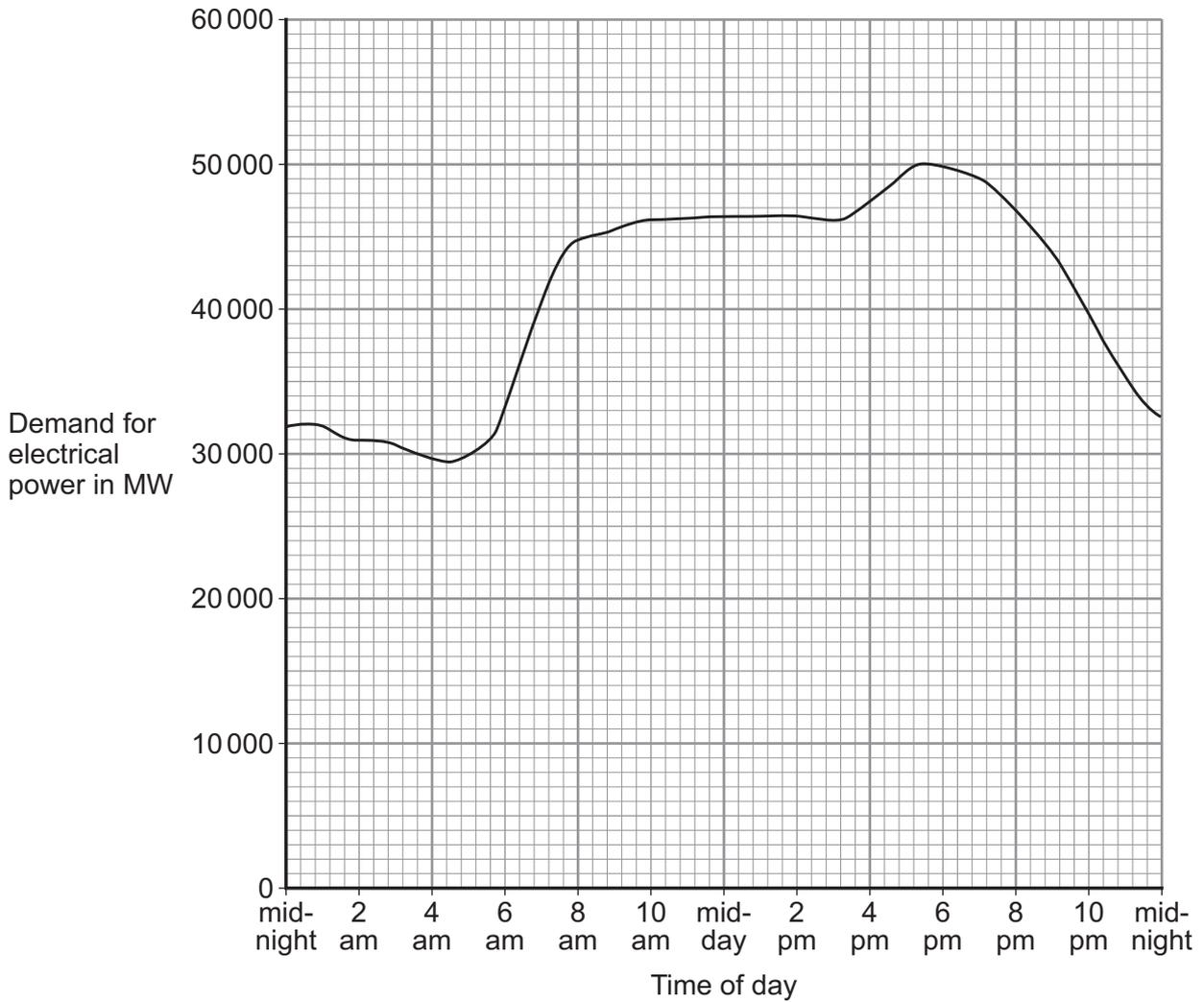
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12 Figure 17 shows the electrical power demand in the UK for one weekday.

Figure 17



12 (a) The graph would be different for a day at the weekend in the UK.

Suggest **one** difference in the graph for a day at the weekend.

Give a reason for your answer.

[1 mark]

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**12 (b)** A pumped storage system can be used to meet a sudden power demand in the UK.

Describe how a pumped storage system works.

**[3 marks]**

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**13 (b)** The spectra from galaxies **B** and **C** provide evidence to support the Big Bang theory.

Explain why the spectrum from galaxy **A** does **not** provide evidence to support the Big Bang theory.

**[2 marks]**

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**END OF QUESTIONS**



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