

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Secondary Education
Higher Tier
June 2015

Science A 2

Unit 6

Friday 12 June 2015 1.30 pm to 3.00 pm

For this paper you must have:

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

Time allowed

- 1 hour 30 minutes

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 4(b) 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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11	
12	
13	
TOTAL	



J U N 1 5 S C A 2 H P O 1

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SCA2HP

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

Biology Questions

- 1 (a)** Living organisms can be used as indicators of pollution.

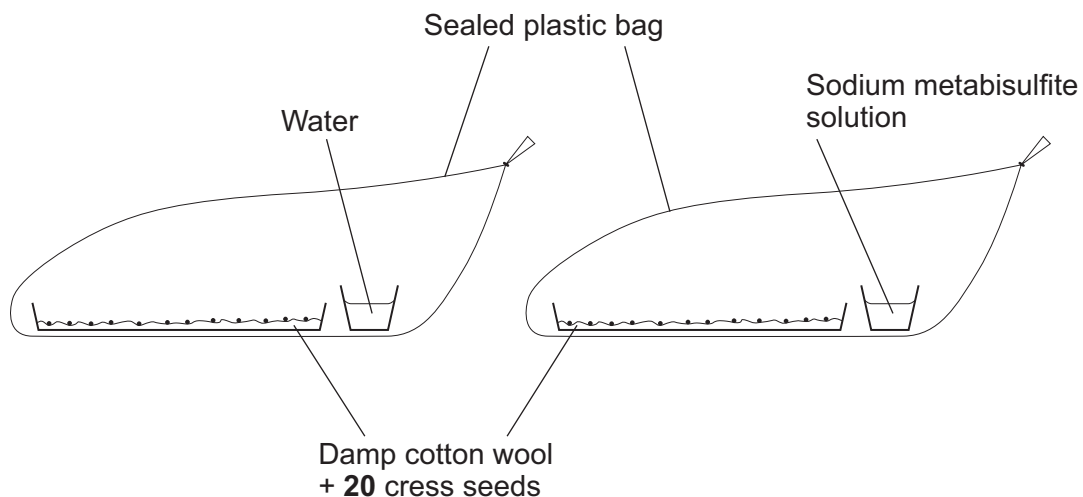
Name **one** type of organism that can be used to indicate the concentration of sulfur dioxide in the atmosphere.

[1 mark]

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- 1 (b)** **Figure 1** shows an investigation to find out if sulfur dioxide gas affects the growth of cress seeds.

Figure 1



Sodium metabisulfite solution gives off sulfur dioxide gas.

Both bags were left in a warm laboratory for several days. The number of seeds that grew in each bag was counted.

What was the dependent variable in this investigation?

[1 mark]

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- 1 (c)** The investigation was carried out five times.

Table 1 shows the five sets of results.

Table 1

	Number of seeds that grew					Mean
Bag containing water	15	17	15	16	17	16
Bag containing sodium metabisulfite solution	5	9	8	5	8	7

- 1 (c) (i)** The mean percentage of seeds that grew in the bag containing water was 80%.

Calculate the mean percentage of seeds that grew in the bag containing sodium metabisulfite solution.

[1 mark]

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 %

- 1 (c) (ii)** Give **one** conclusion you can make from these results.

[1 mark]

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4

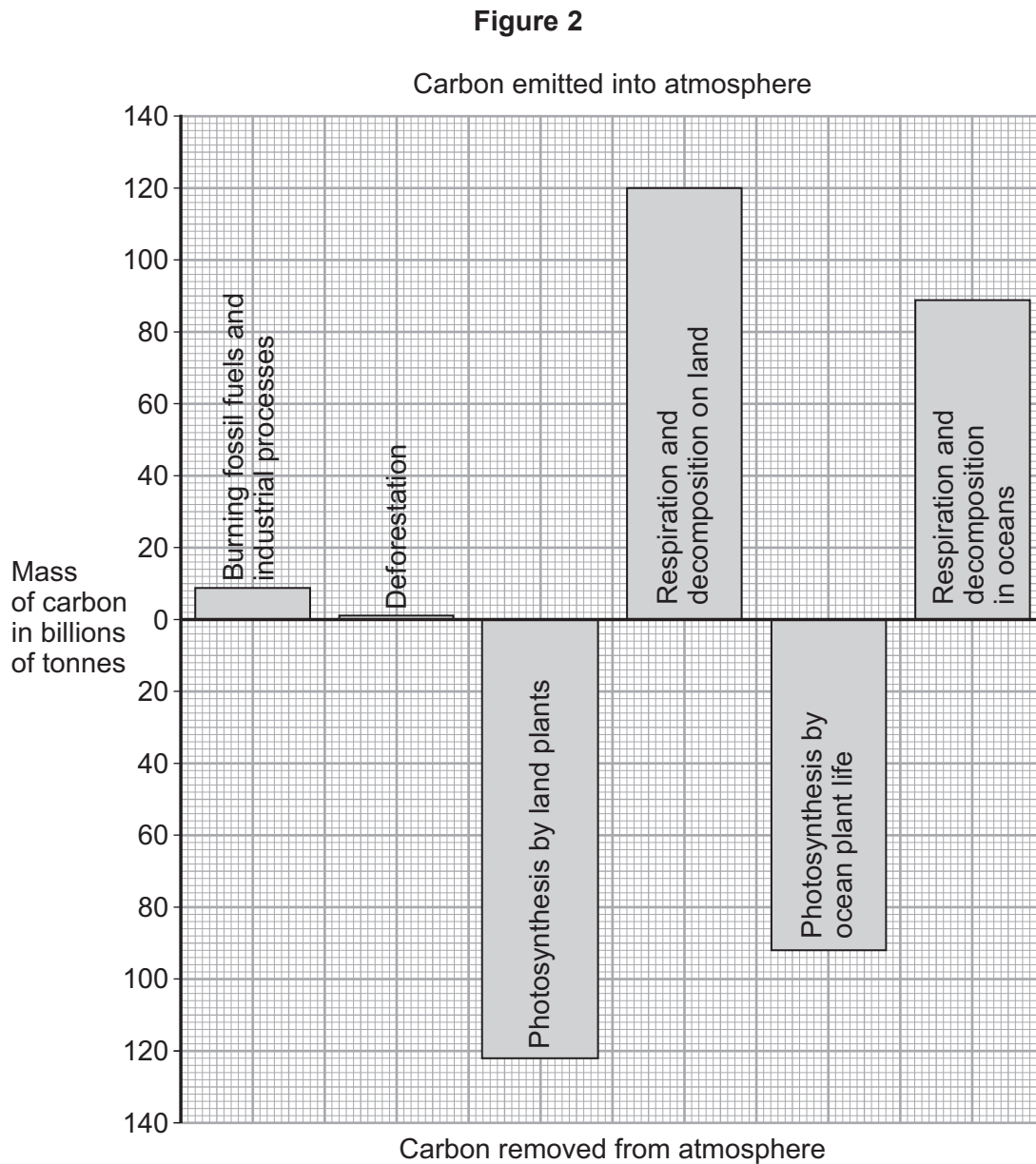
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- 2 The amount of carbon in the atmosphere is increasing.

Figure 2 shows the mass of carbon in billions of tonnes involved in some processes in the carbon cycle each year.



- 2 (a) (i) Use information from **Figure 2** to calculate the total mass of carbon removed from the atmosphere each year.

[2 marks]

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.....

..... billions of tonnes



- 2 (a) (ii)** The mass of carbon in the atmosphere is increasing by 5 billion tonnes each year.

One tonne of carbon is equivalent to 3.67 tonnes of carbon dioxide.

Calculate the increase in the mass of carbon dioxide in the atmosphere each year.

[1 mark]

.....

 billion tonnes

- 2 (b) (i)** Many scientists think the burning of fuels is the main cause of the increasing amount of carbon dioxide in the atmosphere. Other scientists disagree.

Use information from **Figure 2** to suggest why some scientists do **not** think that burning fuels is the main cause of the increase in carbon dioxide in the atmosphere.

[1 mark]

.....

- 2 (b) (ii)** Some scientists think we should eat less meat and eat more food from plants.

Suggest how eating less meat and eating more food from plants could reduce the amount of carbon dioxide in the atmosphere.

[2 marks]

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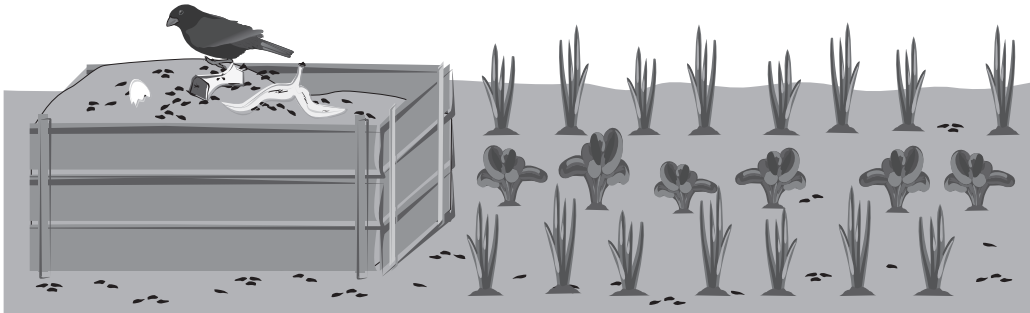


- 3** A chef built a compost heap to recycle his vegetable and fruit peelings.

The compost heap soon had many earthworms living in it. The earthworms burrowed through the compost heap and ate the vegetable and fruit peelings. Blackbirds visited the compost heap and ate some of the earthworms.

Figure 3 shows the compost heap in the chef's vegetable garden.

Figure 3



- 3 (a)** Suggest **two** reasons why having a compost heap is useful to the chef.

[2 marks]

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- 3 (b)** The chef covered the compost heap with a plastic sheet. The plastic sheet stopped the birds eating the earthworms and also helped the decay process.

Suggest how the earthworms **and** the plastic sheet helped to speed up the process of decay.

[3 marks]

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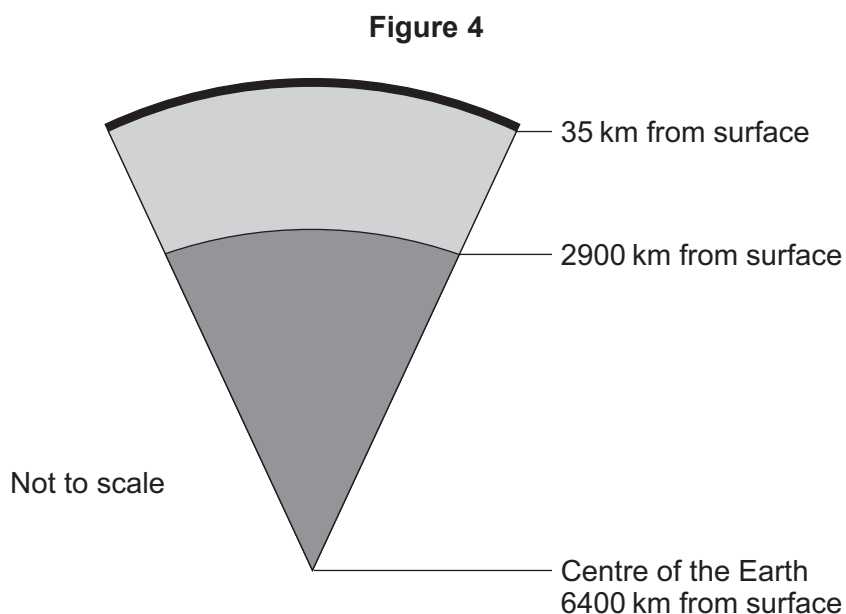
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Chemistry Questions

- 4 (a) The Earth is made up of layers.

Figure 4 represents a section through the layers of the Earth.



Complete **Table 2** to show the names of the layers of the Earth and the thickness of the layers.

[3 marks]

Table 2

Name of layer	Thickness in km
	35
Mantle	
	3500

Question 4 continues on the next page

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4 (b) In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

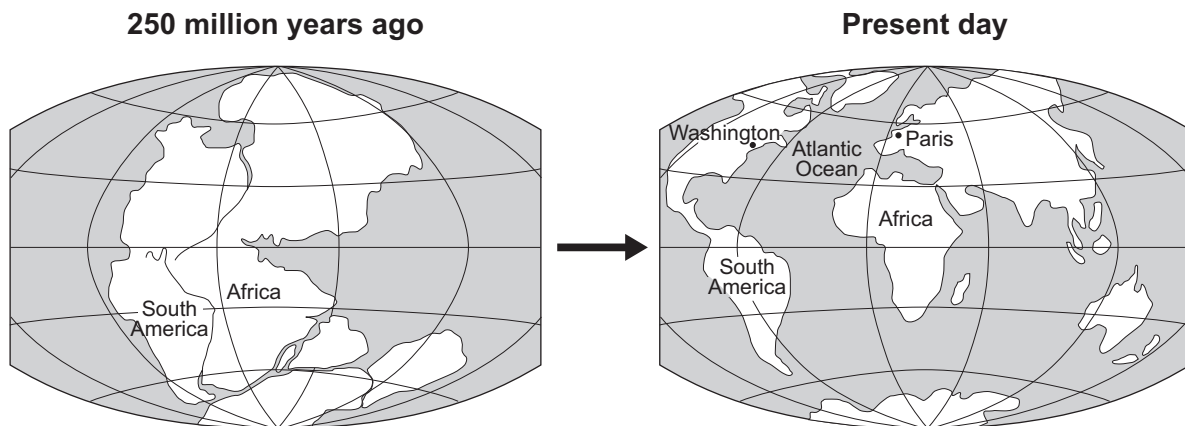
The Earth's surface has changed in the last 250 million years.

In 1912, Alfred Wegener observed that:

- the shapes of the coastlines of Africa and South America fitted together
- Paris and Washington were moving apart by a few centimetres each year.

Wegener suggested that the Earth's surface had changed as shown in **Figure 5**.

Figure 5



The tectonic plate theory is now used to explain the processes that caused the changes.

Describe the changes shown in **Figure 5** and describe the processes that caused these changes.

[6 marks]

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Extra space

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9

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5 This question is about ethanol. The boiling point of ethanol is 78 °C.

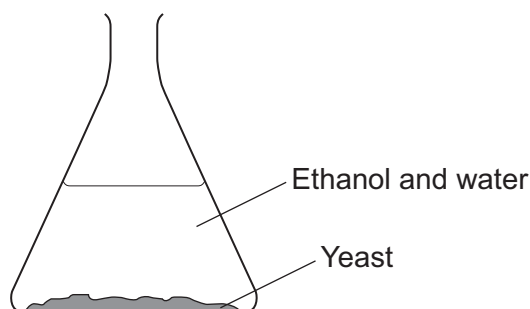
Ethanol can be produced by fermentation of sugar with yeast.

A student:

- put yeast and water in a conical flask
- added sugar to the yeast and water
- left the mixture for a few days to ferment.

Figure 6 shows the conical flask after the mixture had fermented to produce ethanol and carbon dioxide.

Figure 6



5 (a) Write the word equation for the reaction taking place to produce ethanol.

[1 mark]

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5 (b) (i) Suggest how the student could separate yeast from the mixture of ethanol and water.

[1 mark]

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5 (b) (ii) Suggest how the student could separate ethanol from the mixture of ethanol and water.

[1 mark]

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- 5 (c)** In industry ethanol can be produced by fermentation of sugar or by hydration of ethene.

Table 3 gives details of the two processes.

Table 3

Ethanol produced by fermentation	Ethanol produced by hydration
Raw material is sugar cane	Raw material is crude oil
Sugar solution and yeast left to ferment	Ethene and steam heated with a catalyst
15% solution of ethanol produced	100% ethanol produced
Reaction vessel has to be emptied and refilled	Process runs continuously

Compare the two processes and give **one** advantage and **one** disadvantage of producing ethanol by fermentation rather than by hydration.

[2 marks]

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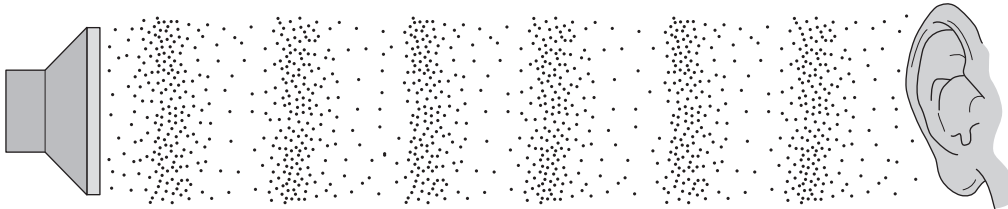


Physics Questions

6 A sound wave is an example of a longitudinal wave.

6 (a) **Figure 7** shows the air particles in a sound wave as the wave travels from a loudspeaker to an ear.

Figure 7



Write a letter **R** on **Figure 7** to show an area of rarefaction.

[1 mark]

6 (b) Complete the sentence about longitudinal waves.

[1 mark]

The vibrations of the air particles are to the direction of energy transfer.

6 (c) A stationary car horn emits a sound wave of frequency 400 Hz.

The wavelength of the wave is 0.85 m.

Calculate the speed of sound.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Speed of sound = m/s

Question 6 continues on the next page

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- 6 (d) (i)** The same car sounding its horn passes a person standing on the pavement. As the car moves towards the person the frequency the person hears seems to change.

State the name given to this effect.

[1 mark]

.....

- 6 (d) (ii)** **Table 4** shows the frequency of sound the person hears as the car moves at different speeds towards and away from him.

Table 4

Movement of the car	Speed of the car in m/s	Frequency the person hears in Hz
Towards the person	10	412
Towards the person	20	424
Away from the person	10	388
Away from the person	20	376

The actual frequency of the sound wave emitted by the horn is 400 Hz.

Use the information in **Table 4** to make **two** conclusions about the frequency the person hears.

[2 marks]

Conclusion 1

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Conclusion 2

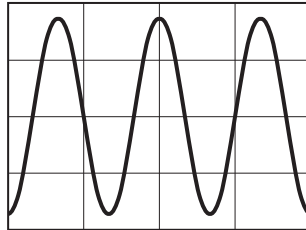
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- 6 (d) (iii)** The person on the pavement has a microphone connected to a cathode ray oscilloscope (CRO).

Figure 8 shows the trace on the CRO of the sound wave detected from the horn when the car is stationary.

Figure 8



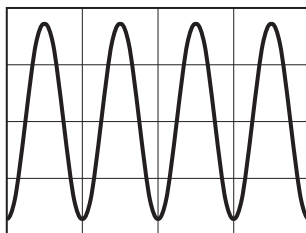
How many complete sound waves are shown in **Figure 8**?

[1 mark]

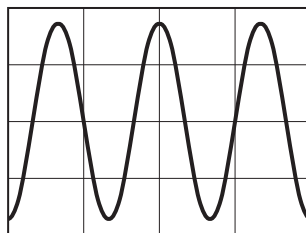
- 6 (d) (iv)** The car then moves away from the person at a steady speed.

Figure 9 shows three possible CRO traces for the sound wave now detected.

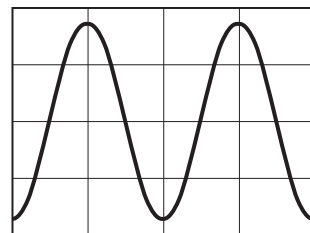
Figure 9



A



B



C

Which trace, **A**, **B** or **C**, would be seen on the CRO

as the car moves away?

[1 mark]

9

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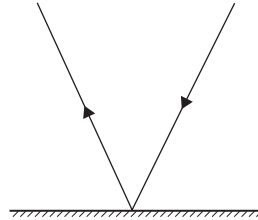
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- 7 Light rays can be reflected and refracted.

Figure 10 shows how a plane mirror reflects a ray of light.

Figure 10



- 7 (a) (i) What is the relationship between the angle of incidence and the angle of reflection for the ray of light?

[1 mark]

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- 7 (a) (ii) The image in a plane mirror is upright.

Complete the sentence to give **one** other property of the image produced in a plane mirror.

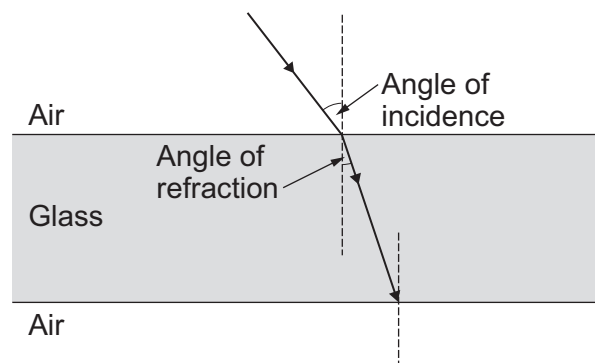
[1 mark]

The image produced in a plane mirror is

- 7 (b) Light is refracted when passing from air into glass.

Figure 11 shows a ray of light as it passes from air into a glass block.

Figure 11



- 7 (b) (i) Draw a line on **Figure 11** to show the path of the ray as it leaves the glass block.

[1 mark]



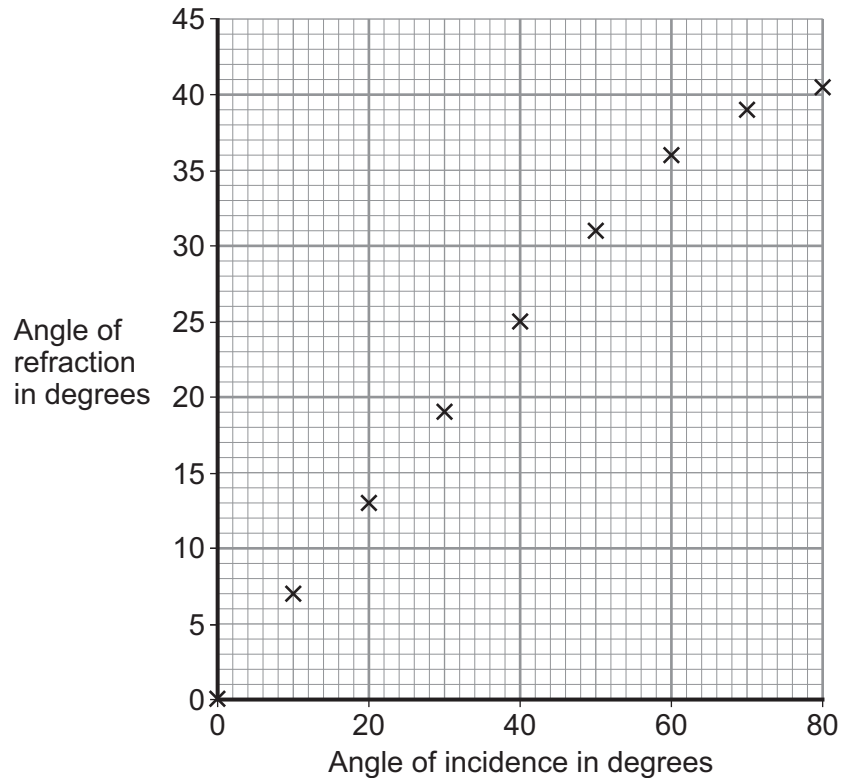
7 (b) (ii) Name the dashed lines drawn at 90° to the glass in **Figure 11**.

[1 mark]

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7 (c) A student investigated the relationship between the angle of incidence and the angle of refraction as light passes from air into glass. Her results are shown in **Figure 12**.

Figure 12



7 (c) (i) Draw a line of best fit on **Figure 12**.

[1 mark]

7 (c) (ii) Use **Figure 12** to describe the relationship between the angle of incidence and the angle of refraction.

[2 marks]

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Biology Questions

- 8** Tigers are large, striped animals that feed on deer. Tigers live and hunt in grassland and forest areas of Asia.

Figure 13 shows a tiger.

Figure 13



- 8 (a)** The ancestor of the tiger did not have stripes.

Use your knowledge of Darwin's theory of evolution to suggest how the tiger evolved to have stripes.

[4 marks]

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8 (b) Lamarck had a different theory to explain evolution.

Describe how Lamarck would have explained how the tiger evolved to have stripes.

[2 marks]

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6

9 The Arctic flounder is a fish that can survive in extremely cold waters.

In the 1990s scientists transferred genes from the Arctic flounder into tomatoes to create a frost-resistant tomato. The tomatoes were never grown commercially, partly because of public concern.

9 (a) What is the name of the technique in which genes are transferred from one organism into the cells of another organism?

[1 mark]

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9 (b) Describe the advantages **and** disadvantages of using this technique to produce crop plants such as frost-resistant tomatoes.

[3 marks]

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Turn over for the next question

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10 Some species of wolf are endangered and are at risk of becoming extinct.

Figure 14 shows a Red wolf. The Red wolf is an endangered species.

Figure 14



Red wolves are only in season (fertile) once a year.

Scientists have developed a method that could be used to protect Red wolves from becoming extinct.

Sperm from a male Red wolf can be used to fertilise eggs from a female Red wolf. The embryos produced can then be frozen.

Later, when female wolves are in season and able to support a pregnancy, the embryos are implanted into their wombs.

All the Red wolf cubs produced would be different from their biological parents and different from each other.

10 (a) (i) Explain why the Red wolf cubs would be different from their biological parents and different from each other.

[3 marks]

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- 10 (a) (ii)** Name a method that could be used to produce Red wolf cubs that are different from both parents but identical to each other.

[1 mark]

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- 10 (a) (iii)** In the long-term it would be better to produce Red wolves that are different from each other.

Suggest why.

[1 mark]

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5

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Chemistry Questions

11 **Table 5** shows information about the fractions obtained when crude oil is distilled.

Table 5

Fraction	Supply from distillation as percentage (%) of crude oil input	Demand by consumers as percentage (%) of crude oil input	Number of carbon atoms in hydrocarbon chain
LPG	2	6	$C_1 - C_4$
Petrol	14	27	$C_5 - C_{10}$
Kerosene	13	8	$C_{11} - C_{15}$
Diesel	21	21	$C_{16} - C_{19}$

11 (a) Some petrol is produced by cracking.

11 (a) (i) Why is it necessary to produce some petrol by cracking?

[1 mark]

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11 (a) (ii) Which fraction is the most suitable to be cracked to produce petrol?

[1 mark]

Draw a ring around the correct answer.

diesel**kerosene****LPG**

11 (a) (iii) Give **two** reasons why the fraction you chose in part (a)(ii) is cracked to produce petrol.
[2 marks]

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11 (b) Describe the process used to crack hydrocarbons.

[2 marks]

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6

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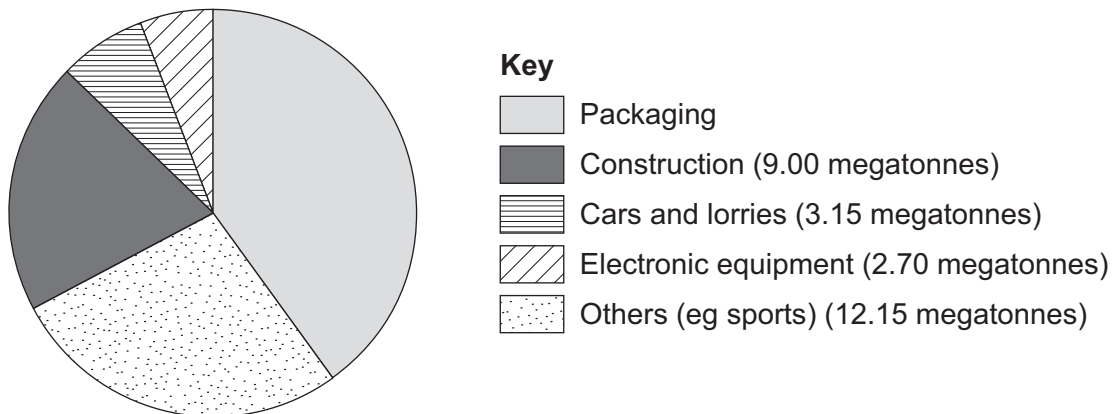
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12 Polymers have many important uses. Each year 45 megatonnes of polymers are used.

The pie chart in **Figure 15** shows the mass in megatonnes of polymers used in different ways.

Figure 15



12 (a) What percentage of polymers is used in packaging?

[2 marks]

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Percentage of polymers used in packaging = %

12 (b) (i) Poly(ethene) is often used for packaging. Poly(ethene) is made from ethene.

Ethene is an alkene with the chemical formula C_2H_4

Draw the displayed structure for ethene.

[1 mark]



12 (b) (ii) Poly(ethene) is formed from ethene in a polymerisation reaction.

Describe, in terms of molecules, what happens in a polymerisation reaction.

[3 marks]

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12 (c) Most plastic bags are made from poly(ethene). Some plastic bags are now made using a polymer produced from cornstarch.

Evaluate the use of plastic bags made from a polymer produced from cornstarch instead of poly(ethene).

[4 marks]

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Physics Questions

13 Nuclear fuels and fossil fuels are non-renewable energy sources.

13 (a) Power stations generate electrical power.

Describe the similarities and differences between generating power using nuclear fuels and using fossil fuels.

[4 marks]

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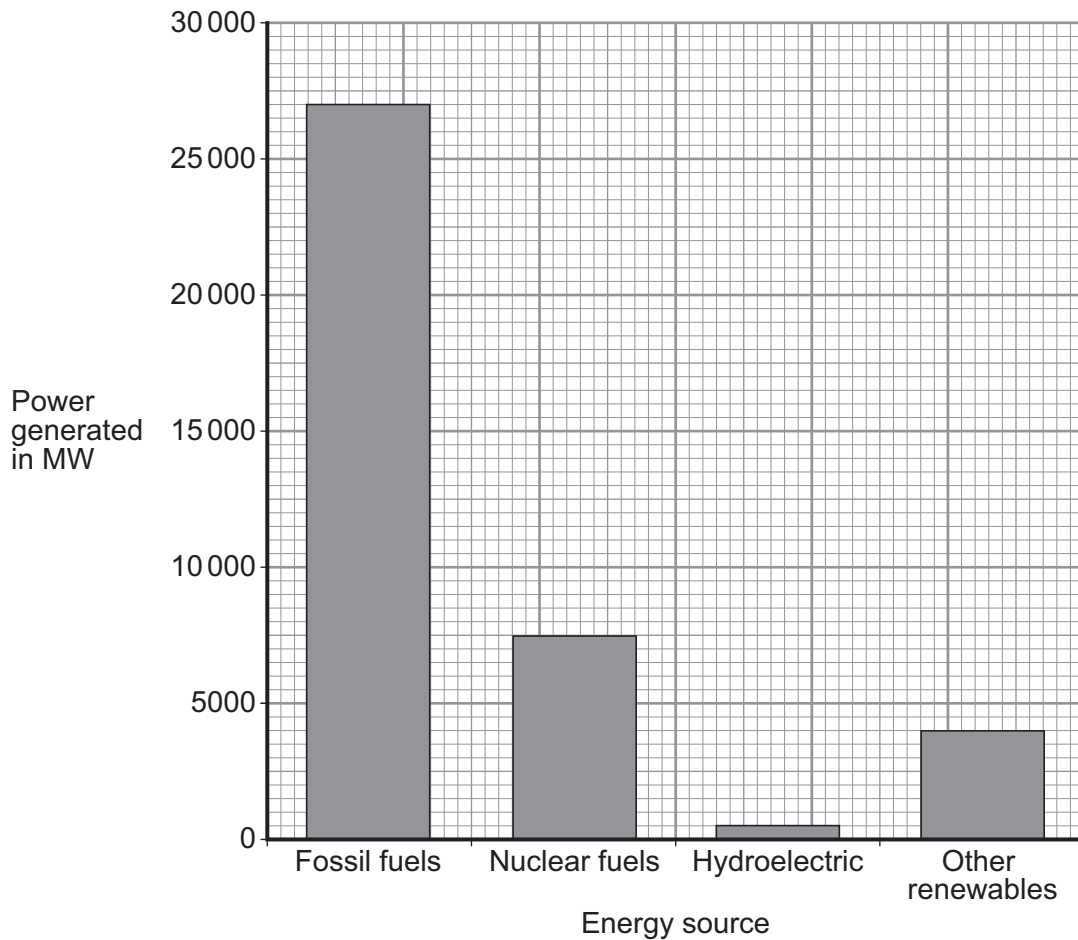
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13 (b) Figure 16 shows the power generated using different energy sources in the UK.

Figure 16



13 (b) (i) Nuclear fuels are less readily available, and more expensive, than fossil fuels.

Suggest **two** other reasons why nuclear fuels are used **less** than fossil fuels to generate power.

[2 marks]

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- 13 (b) (ii)** Suggest **two** reasons why the proportion of power generated using fossil fuels might decrease in the future.

[2 marks]

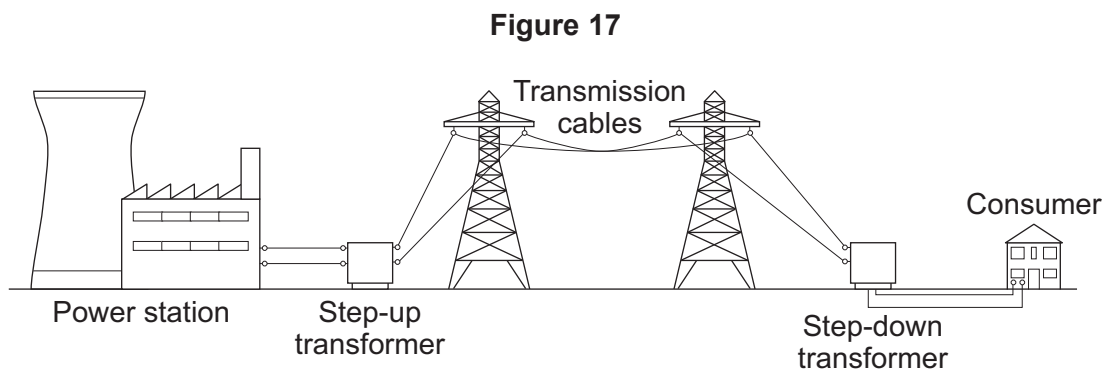
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- 13 (c)** **Figure 17** shows how power is distributed from a power station and transmitted along the National Grid.



Explain why step-up transformers are included in the National Grid.

[3 marks]

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- 13 (d)** Shale gas is natural gas trapped in rocks. The shale gas can be extracted by a process called fracking. The shale gas can then be used as a fuel.

Part of a news report on fracking is shown below.

Fracking is a process used to extract shale gas from difficult-to-reach places. Fracking will provide more shale gas, so gas prices may go down. If shale gas was used in power stations, less carbon dioxide would be produced than if coal was used in power stations.

Many possible fracking sites are close to built-up areas. Some local people are opposed to fracking. A lot of water needs to be transported to the fracking site. The process of fracking uses chemicals known to cause cancer and these chemicals may escape and contaminate the water supply. Some local people also worry that fracking may cause small earth tremors. These people say fracking is discouraging energy companies from investing money in renewable sources of energy.

Use information from the news report and your own knowledge to suggest, with reasons, why some local people are opposed to fracking.

[3 marks]

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14

END OF QUESTIONS



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Question 10, Figure 14: Photograph of Red wolf © Thinkstock.

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