

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Secondary Education  
Higher Tier  
January 2012

## Science A 2

## SCA2HP

### Unit 6

# H

Wednesday 18 January 2012 9.00 am to 10.30 am

**For this paper you must have:**

- a ruler
  - the Chemistry Data Sheet (enclosed)
  - the Physics Equations Sheet (enclosed).
- You may use a calculator.

**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	
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11	
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13	
14	
TOTAL	



J A N 1 2 S C A 2 H P 0 1

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

**Biology Questions**

**1** The star-nosed mole is almost blind, but is a very successful predator.

The star-nosed mole tunnels underground to find its prey.



Very small eyes hidden in thick fur

Tentacles around nose that are very sensitive to touch

Strong front limbs

**1 (a)** Use information from the photograph to suggest how each of the following adaptations helps the star-nosed mole to survive.

**1 (a) (i)** Very small eyes hidden in thick fur: .....  
.....  
(1 mark)

**1 (a) (ii)** Strong front limbs: .....  
.....  
(1 mark)

**1 (a) (iii)** Tentacles around nose that are very sensitive to touch: .....  
.....  
(1 mark)



**1 (b)** In a community, star-nosed moles feed on small invertebrates. The small invertebrates feed on plants.

**1 (b) (i)** Draw and label a pyramid of biomass for the three organisms in the community.

(2 marks)

**1 (b) (ii)** What is the source of energy for this community of organisms?

.....  
(1 mark)

6

**Turn over for the next question**

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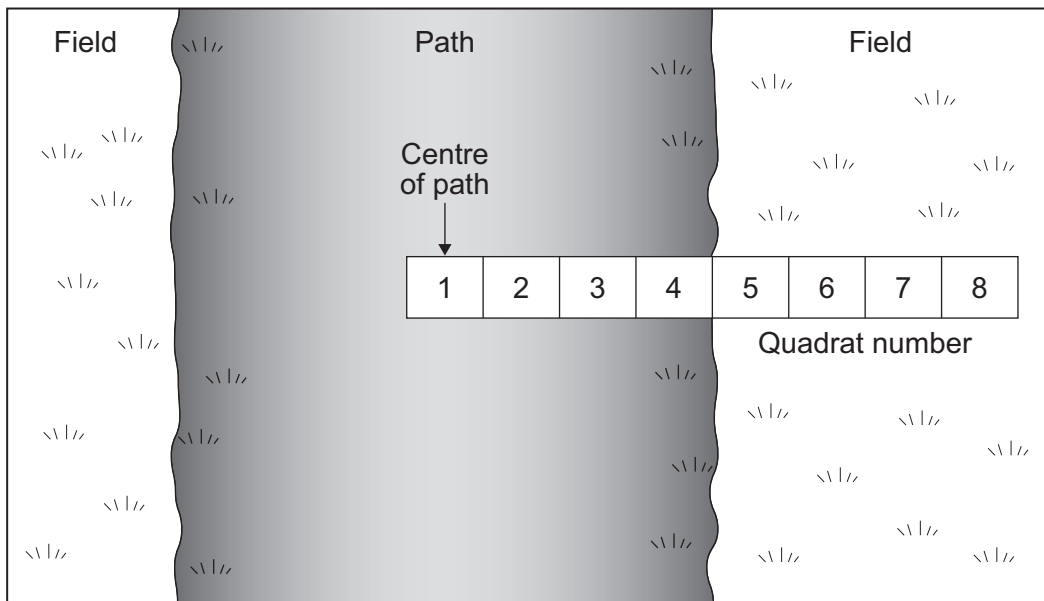


2 Greater plantain and Ribwort plantain are two types of plant.

Students investigated the distribution of these two plants across a path.

The students wanted to find out how the two plants were affected when people walked along the path. The students used a grid called a quadrat.

The diagram shows where the students put the quadrats.

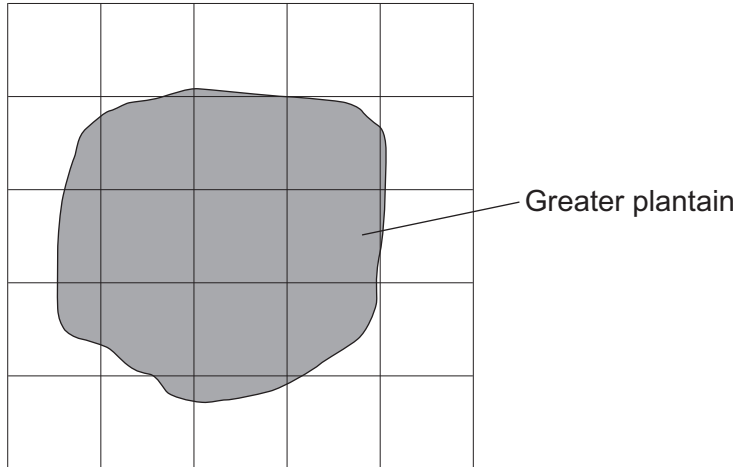


Each quadrat was divided into 25 smaller squares.

The students used the squares to estimate the percentage cover of each type of plantain within the quadrat.



2 (a) Estimate the percentage of the quadrat covered by Greater plantain.



.....  
 .....

Percentage = .....  
 (2 marks)

2 (b) The results are shown in the table.

	Mean percentage cover							
Quadrat number	1	2	3	4	5	6	7	8
Greater plantain	31	28	28	19	3	2	1	1
Ribwort plantain	3	4	6	29	29	37	40	39

2 (b) (i) Use information from the table to describe the distributions of Greater plantain and Ribwort plantain.

.....  
 .....

(2 marks)

Question 2 continues on the next page

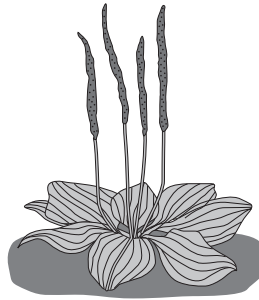
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2 (b) (ii) The drawings show the two types of plantain.



Ribwort plantain



Greater plantain

Use information from the drawings to suggest why there is the difference in the distribution of the two types of plantains you described in part (b)(i).

.....  
.....  
.....  
.....

(2 marks)

2 (c) The students decided to investigate the distribution of these two types of plantain in two areas of the school grounds.

- Area 1 – the school football pitch.
- Area 2 – grass in an area where nobody walks.

Predict what the students would find out.

Give the reason for your prediction.

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(2 marks)



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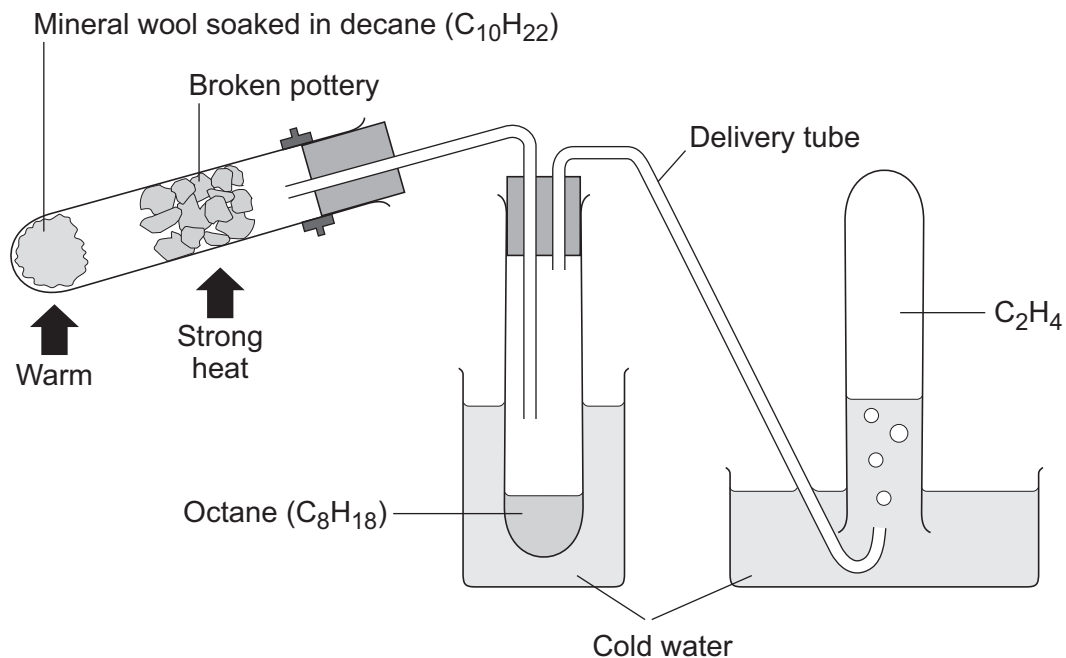


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### Chemistry Questions

3 Hydrocarbons are cracked to produce smaller molecules.

3 (a) The diagram shows an experiment to demonstrate cracking.



Describe the process of cracking shown in the diagram.

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(4 marks)

3 (b) (i) What is the name of the alkene with the formula  $C_2H_4$ ?

.....

(1 mark)



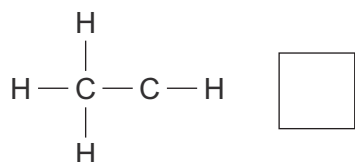
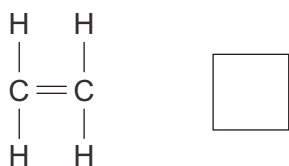
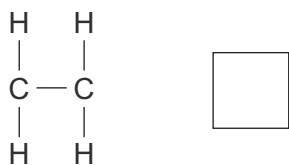


3 (b) (ii) What is the general formula of the alkenes?

.....  
(1 mark)

3 (b) (iii) What is the displayed (structural) formula of the alkene  $C_2H_4$ ?

Tick (✓) **one** box.



(1 mark)

7

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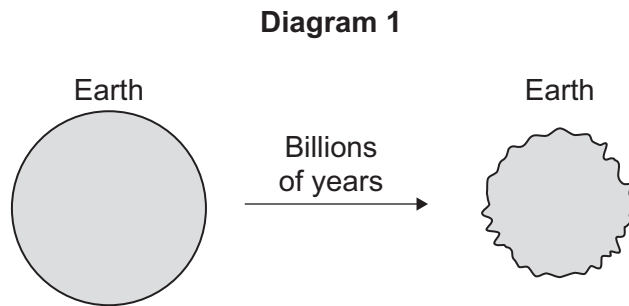
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4 The surface of the Earth has changed slowly over billions of years.

4 (a) **Diagram 1** shows one theory of how mountains are formed.



4 (a) (i) Describe this theory of mountain formation.

.....  
.....  
(1 mark)

4 (a) (ii) Most scientists accepted this theory of mountain formation until about 60 years ago.

Suggest why most scientists accepted this theory.

.....  
.....  
(1 mark)

**Question 4 continues on the next page**

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4 (b) **Diagram 2** shows the positions of the continents 250 million years ago.

**Diagram 2**



**Diagram 3** shows the positions of the continents today.

**Diagram 3**





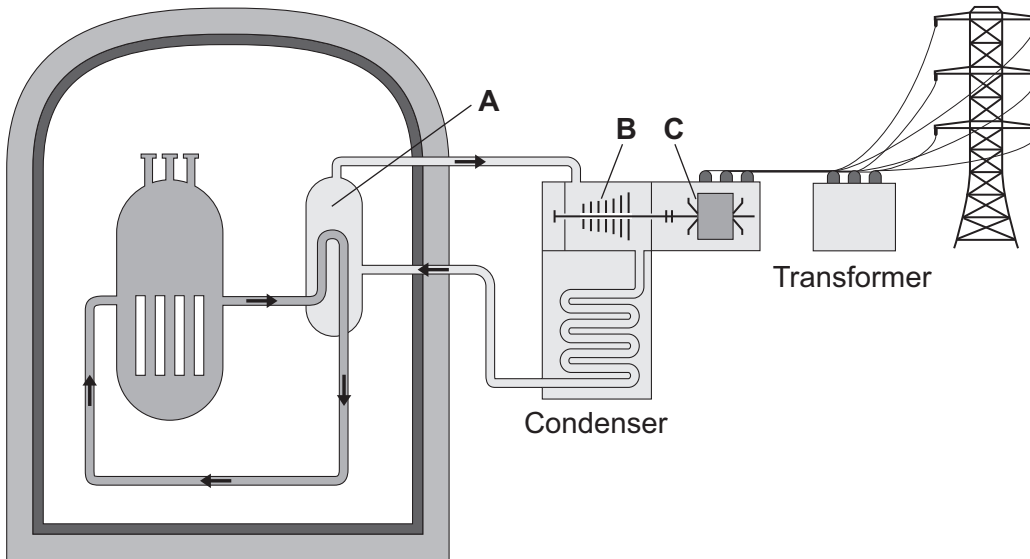
**Physics Questions**

**5** A nuclear power station generates electricity using nuclear fuel.

**5 (a)** Name **one** nuclear fuel that is used.

.....  
(1 mark)

**5 (b)** The diagram below shows a nuclear power station.



Name the parts of a nuclear power station labelled **A**, **B** and **C** on the diagram.

**A** .....

**B** .....

**C** .....

(3 marks)

**5 (c)** The transformer changes the voltage of the electricity generated by the power station.

**5 (c) (i)** What type of transformer is shown in the diagram?

.....  
(1 mark)



**5 (c) (ii)** Changing the voltage increases the efficiency of the power transmission.

Explain how.

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.....  
.....  
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(2 marks)

**5 (d)** A country generates 80 % of its electricity using fossil fuel power stations.

The country's government is considering replacing all of its fossil fuel power stations with nuclear power stations.

Suggest **two** factors that the country's government will have to consider in making a decision.

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(2 marks)

9

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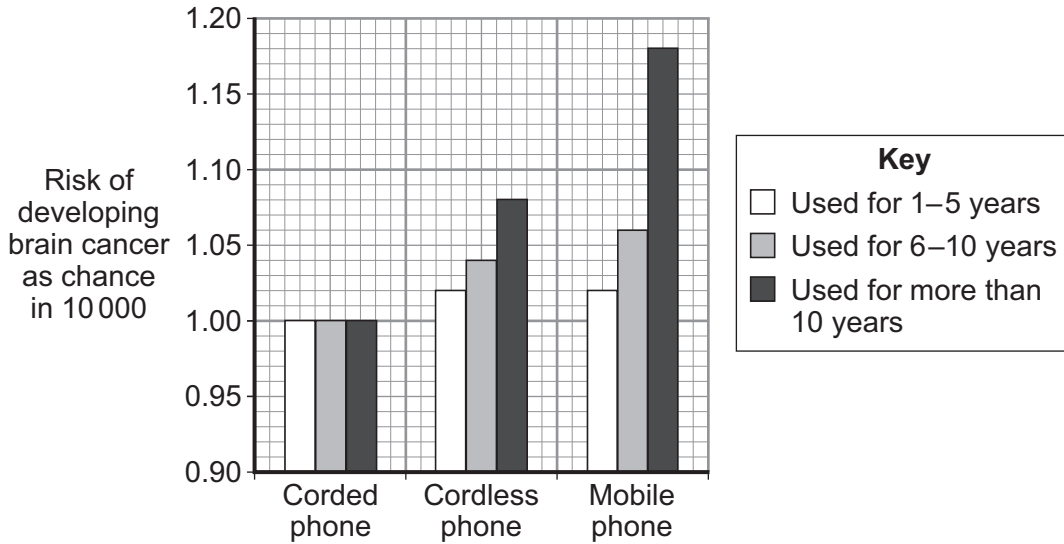
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**6** Scientists investigated whether the use of different kinds of phone increased the risk of getting brain cancer.

The scientists compared a group of people who used only corded phones with other groups who used either cordless phones or mobile phones.

The bar chart shows the average results of the investigation.



**6 (a)** The bar chart does not show individual results from the investigation.

Why are individual results important when considering how useful the data is?

.....  
 .....

(1 mark)

**6 (b)** There are several other factors which will affect the results of the investigation.

Give **two** factors that the scientists could include in their investigation to give more valid results.

Factor 1 .....

Factor 2 .....

(2 marks)





**6 (c)** Give **two** conclusions that can be made from the results of the investigation.

Conclusion 1 .....

.....

Conclusion 2 .....

.....

(2 marks)

**6 (d)** A student looked at the results and said:  
'I am going to stop using my mobile phone so that I will have no chance of getting a brain tumour'.

Is the student's statement supported by the data?

Give the reason for your answer.

.....

.....

(1 mark)

6

**Turn over for the next question**

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**Biology Questions**

**7** A woman decided to clone her pet cat before the cat died.

**7 (a)** What is a clone?

.....  
.....

(1 mark)

**7 (b)** Adult cell cloning can be used to clone the pet cat.

Describe in detail the main stages in adult cell cloning.

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(4 marks)

**7 (c)** Producing a clone of a human is against the law in the UK.

Suggest **two** reasons why.

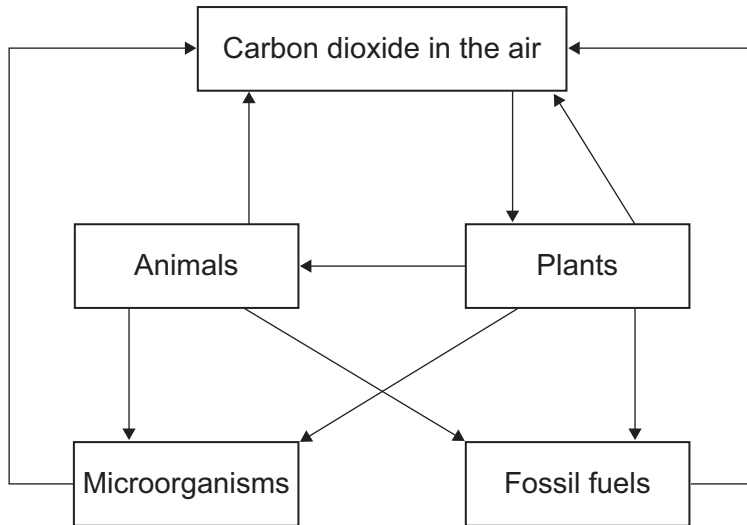
1 .....  
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2 .....  
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(2 marks)

7



8 The diagram shows part of the carbon cycle.



Use the information in the diagram and your own knowledge to describe in detail how carbon is cycled between living organisms and the air.

Your answer should include the names of any processes involved.

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(6 marks)

6
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Turn over ►



- 9 Head lice live on people’s heads and feed on their blood.  
Head lice cause itching and people may develop open wounds from scratching.



A poisonous chemical has been used to kill head lice for many years.  
Recently, the chemical has not been as successful at killing head lice. Many head lice  
now survive treatment with the chemical.

Explain in terms of **natural selection** why most head lice are no longer killed by the  
chemical.

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(3 marks)

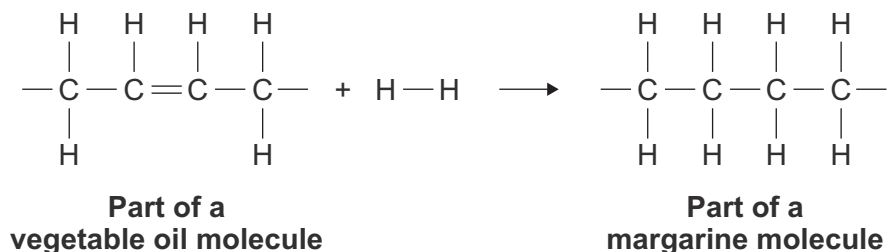
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## Chemistry Questions

10 Margarine can be produced from vegetable oil.

10 (a) The equation represents the reaction for the production of one type of margarine.



10 (a) (i) Name the type of reaction shown in the equation.

.....  
(1 mark)

10 (a) (ii) Give the **two** conditions needed for the reaction.

1 .....

2 .....

(2 marks)

10 (b) The modified fat used to make margarine is solid at room temperature.

Give **one** advantage of this property.

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.....  
(1 mark)

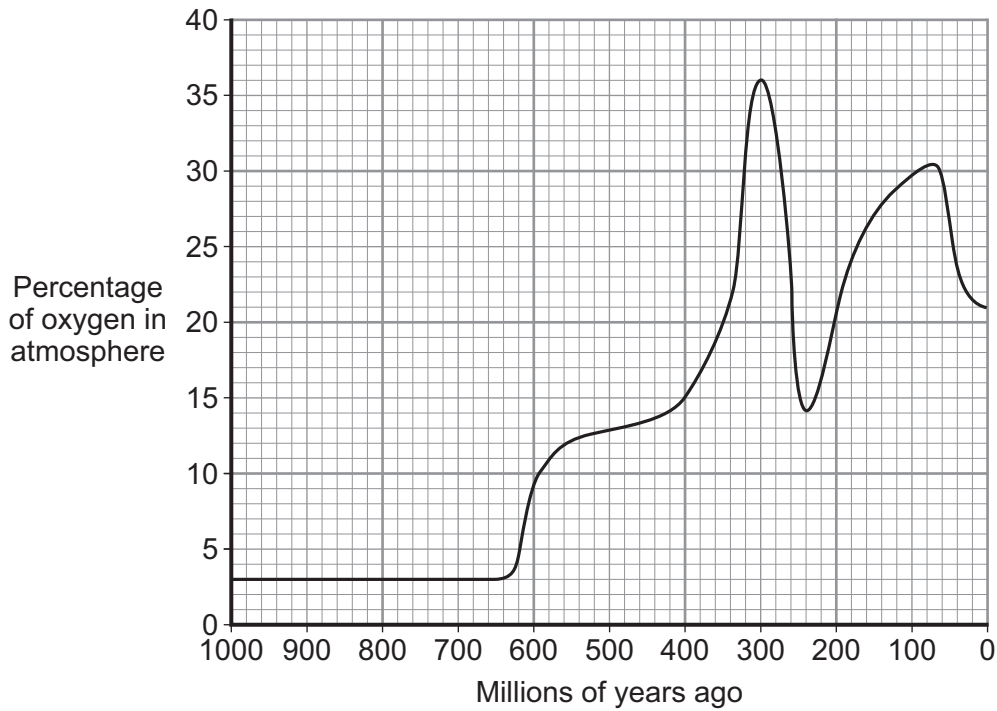
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- 11 The graph shows changes in the percentage of oxygen in the Earth's atmosphere over the last thousand million years.



- 11 (a) (i) The percentage of oxygen in the atmosphere changed between 700 million years ago and 300 million years ago.

How many more times greater was the percentage of oxygen in the atmosphere 300 million years ago compared with 700 million years ago?

.....

.....

Answer = ..... times greater  
(1 mark)



**11 (a) (ii)** The percentage of oxygen in the atmosphere changed between 700 million years ago and 300 million years ago.

Explain why.

.....

.....

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.....

(2 marks)

**11 (a) (iii)** Suggest an explanation for the change in the percentage of oxygen in the atmosphere between 300 and 250 million years ago.

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(2 marks)

**Question 11 continues on the next page**

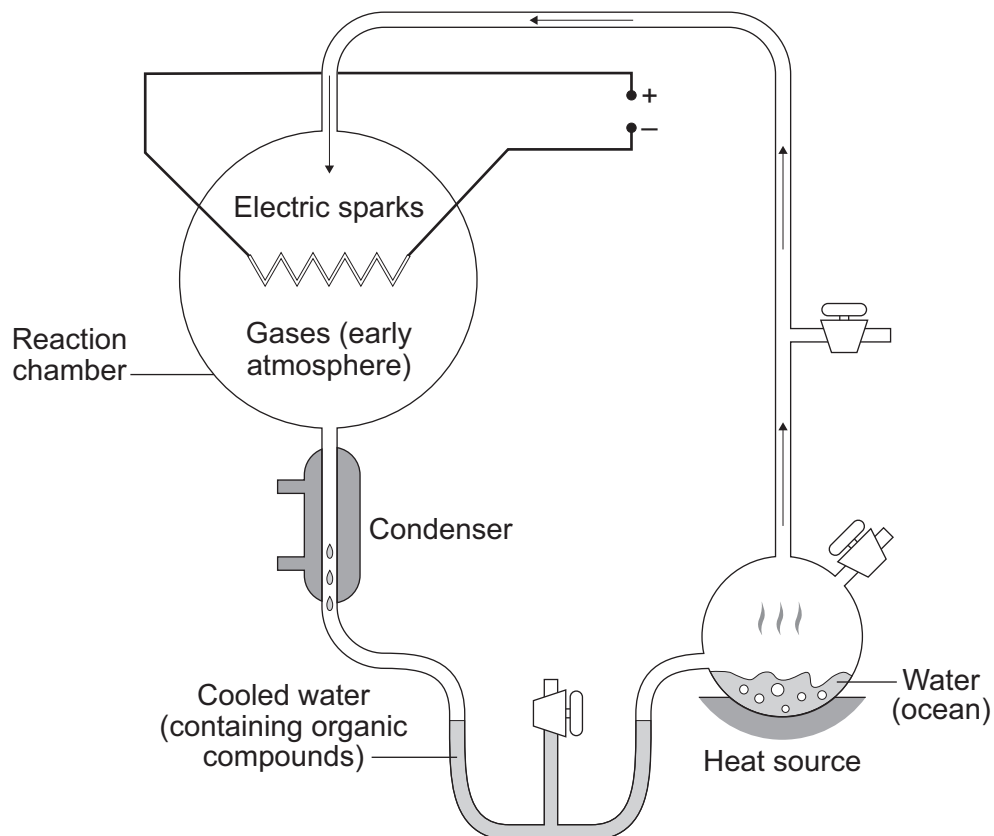
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11 (b)

One theory for the origin of life on Earth is the *chemosynthesis theory*. This theory states that life on Earth began when more and more complex organic molecules and structures were synthesised. After a long time, these molecules and structures became living organisms.

Two scientists, Miller and Urey, used the apparatus below to investigate the development of life on Earth. The gases in the reaction chamber were water vapour, methane and hydrogen.



When electric sparks were produced in the reaction chamber a mixture of organic compounds was produced. These organic compounds can be combined to make proteins.

Does the Miller–Urey experiment support the *chemosynthesis theory* for the origin of life?

Explain your answer.

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(2 marks)

7





12

Ethanol can be produced on a large scale in two ways.

- By hydrating ethene with steam using a catalyst.
- By growing sugar cane, then fermenting the sugar solution using yeast.

Evaluate the effect on the environment of these two methods of producing ethanol.

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(4 marks)

4

**Turn over for the next question**

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**Physics Questions**

**13** Electromagnetic waves behave differently in different situations.

**13 (a)** Complete the table to give the name of the wave property which matches each behaviour.

Description of wave property	Name of wave property
A wave is incident on an object and travels back along its original path	
A wave changes direction when the wave travels from one material into another	
A wave spreads out after passing an obstacle	

(3 marks)

**13 (b)** What is the correct range of wavelengths of electromagnetic waves?

Tick (✓) **one** box.

Range of wavelengths	Tick (✓)
10 m to 1000 m	
$10^{-15}$ m to $10^4$ m	
$10^{-4}$ m to $10^{15}$ m	

(1 mark)

**13 (c)** Electromagnetic waves travel at a speed of  $3 \times 10^8$  m/s in a vacuum. Microwave radiation has a wavelength of 2 cm.

Calculate the frequency of microwave radiation.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

.....

Frequency = ..... hertz  
(2 marks)

6
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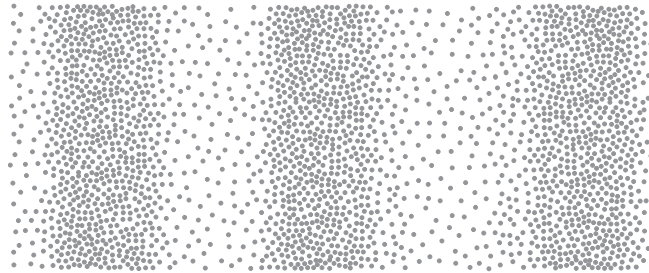


**14** Sound waves cause oscillations in the air. Sound waves are longitudinal.

**14 (a)** In which direction are the oscillations of the particles compared to the direction of transfer of energy?

.....  
(1 mark)

**14 (b)** The diagram shows the disturbance of air molecules in the path of a sound wave at one point in time.



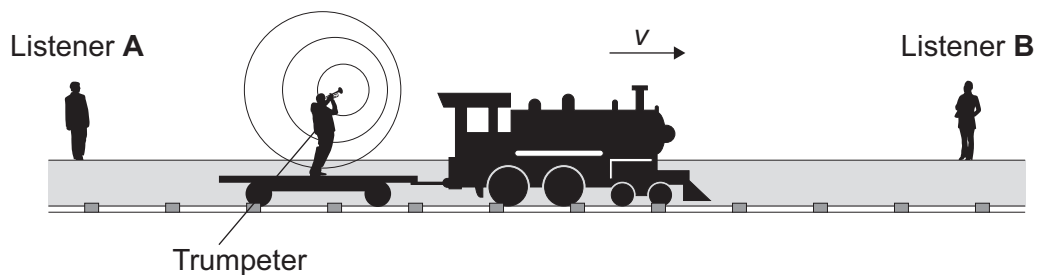
**14 (b) (i)** Label the diagram with the letter **R**, in an area of rarefaction.

(1 mark)

**14 (b) (ii)** Label the diagram to show one complete wavelength.

(1 mark)

**14 (c)** Scientists investigated how wave properties change when the source of waves is moving relative to stationary observers.



A trumpeter stands on a moving train blowing his trumpet. **Listener A** is behind the train and **Listener B** is in front of the train and they both hear different notes being played.

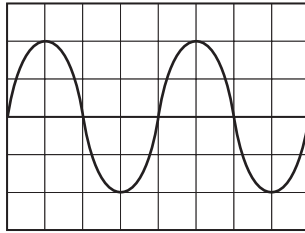
**14 (c) (i)** What is the name of this effect?

.....  
(1 mark)



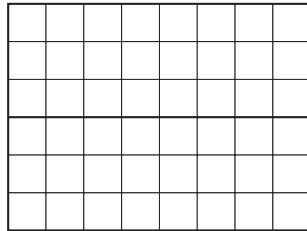
**14 (c) (ii)** The trumpeter plays a note with a constant frequency.

The diagram shows an oscilloscope trace of the note.

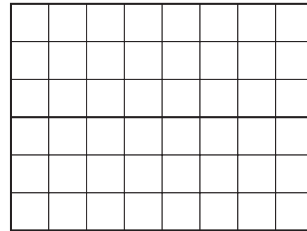


On the grids below, draw the oscilloscope trace for the note at the positions of Listener **A** and Listener **B**.

**Listener A**



**Listener B**



(3 marks)

**14 (d)** Observations of *red-shift* of light from distant galaxies provide evidence for the big bang theory.

**14 (d) (i)** What does *red-shift* mean?

.....  
.....

(1 mark)

**Question 14 continues on the next page**

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14 (d) (ii) **Diagram 1** shows an analysis of light from the Sun.

**Diagram 1**



**Diagram 2** shows an analysis of light from a nearby galaxy.

**Diagram 2**



What conclusion can be made about the movement of the nearby galaxy?

.....  
.....

(1 mark)

9

**END OF QUESTIONS**



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