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Surname										
Other Names										
Candidate Signature										



General Certificate of Secondary Education
Higher Tier
January 2013

Science A 2

Unit 6

Thursday 17 January 2013 1.30 pm to 3.00 pm

SCA2HP

H

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 5(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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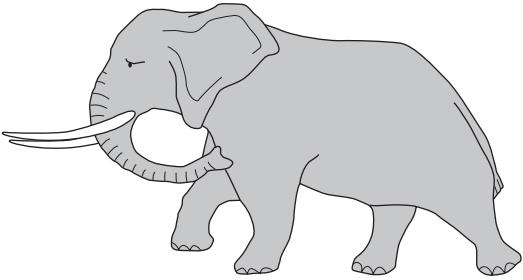
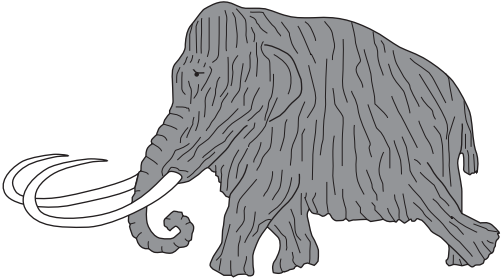
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SCA2HP

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

Biology Questions

- 1** The table gives some information about the African elephant and the woolly mammoth.

African elephant	Woolly mammoth
	
Mass of male: 6000 kg	Mass of male: 8000 kg
Habitat: near the equator	Habitat: northern Europe
An endangered species	Extinct

- 1 (a)** Use information from the table to help you to answer the following questions.
- 1 (a) (i)** The diagrams show that both animals have tusks. Tusks help animals to compete.

Suggest **two** things animals may compete for.

1

2

(2 marks)



- 1 (a) (ii)** The woolly mammoth was adapted to survive during the ice age.

Use information from the table to suggest **two** ways the woolly mammoth was adapted to survive in the cold.

Adaptation 1:

How this helped the woolly mammoth survive:

.....

.....

Adaptation 2:

How this helped the woolly mammoth survive:

.....

.....

(4 marks)

- 1 (b)** Darwin's theory of evolution says that elephants developed a trunk because animals with a longer nose had an advantage over animals with a shorter nose.

The elephants with a longer nose survived to breed and pass on the gene for a longer nose to their offspring.

- 1 (b) (i)** Name the process by which evolution happens.

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(1 mark)

- 1 (b) (ii)** Describe how Lamarck's theory would explain how elephants developed a trunk.

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(2 marks)



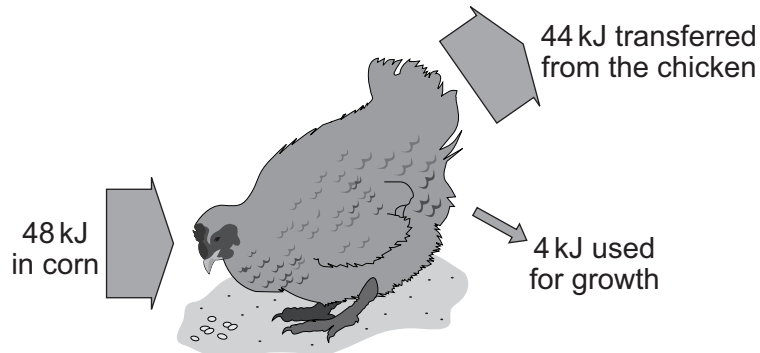
2 A food chain is shown below.

corn → chicken → human

2 (a) What energy transfer takes place when corn plants photosynthesise?

..... energy $\xrightarrow{\text{Photosynthesis}}$ energy
(1 mark)

2 (b) The diagram shows what happens to the energy in the corn eaten by the chicken.



2 (b) (i) What percentage of the energy in the corn eaten by the chicken is used for growth?

.....
.....

Percentage of energy eaten that is used for growth =
(2 marks)

2 (b) (ii) Give **three** ways the rest of the energy is transferred from the chicken.

1

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2

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3

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(3 marks)



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Chemistry Questions

3 Ethene is an alkene.

3 (a) The general formula of alkenes is C_nH_{2n}

An ethene molecule has two carbon atoms.

What is the molecular formula of ethene?

.....

(1 mark)

3 (b) Ethene is produced in industry from hydrocarbons.

3 (b) (i) Use words from the box to complete the sentence.

bromine

catalyst

fuel

polymer

steam

Hydrocarbons are obtained from the fractional distillation of crude oil.

To produce ethene, the hydrocarbons are vaporised.

The vapours are then passed over a hot or mixed with

..... and heated to a very high temperature.

(2 marks)

3 (b) (ii) Complete the following sentence.

The industrial process used to make ethene is called

(1 mark)



- 3 (c)** 8 billion plastic bags are used each year in the UK.

Most plastic bags are made from poly(ethene), but some modern plastic bags are made from polylactic acid (PLA).

PLA is a polymer made from cornstarch.

Cornstarch comes from maize, a plant crop.

- 3 (c) (i)** PLA causes fewer problems with waste disposal compared with poly(ethene).

Explain why.

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(2 marks)

- 3 (c) (ii)** PLA and poly(ethene) are made from different raw materials.

Besides waste disposal, suggest **one** other environmental advantage of using PLA rather than poly(ethene) to make plastic bags.

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(1 mark)

- 3 (c) (iii)** Suggest **one** disadvantage of using cornstarch to make PLA.

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(1 mark)

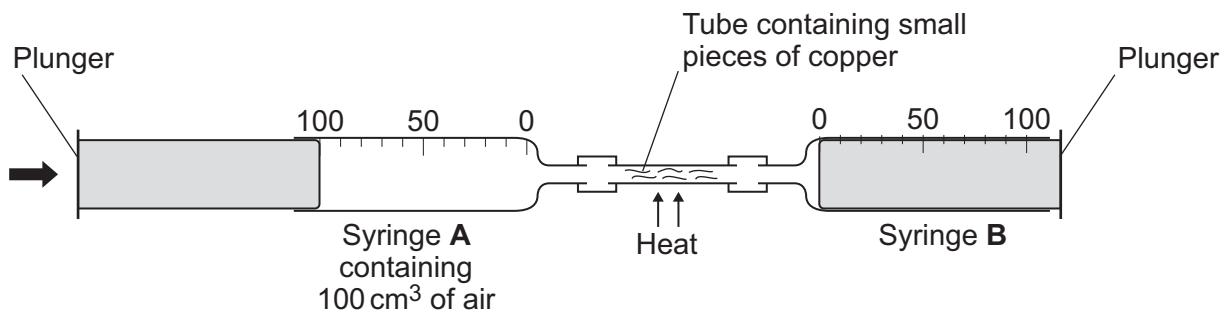
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- 4 The diagram shows the apparatus used to investigate the percentages of gases in the air.



100 cm³ of air was measured using Syringe A.

The air was passed over the heated copper by pushing the plungers backwards and forwards. The air was passed over the heated copper until the volume of air did not change.

A black solid formed on the copper when the air was passed over the copper.

- 4 (a) (i) Which gas in the air reacted with the copper?

.....
(1 mark)

- 4 (a) (ii) What volume of this gas would you expect to react with copper in the investigation?

..... cm³
(1 mark)

- 4 (a) (iii) Write a word equation for the reaction occurring between copper and the gas.

..... + →
(1 mark)

- 4 (b) (i) What is the main gas remaining in the apparatus at the end of the investigation?

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(1 mark)

- 4 (b) (ii) Name **one** other gas which will also be present at the end of the investigation.

.....
(1 mark)



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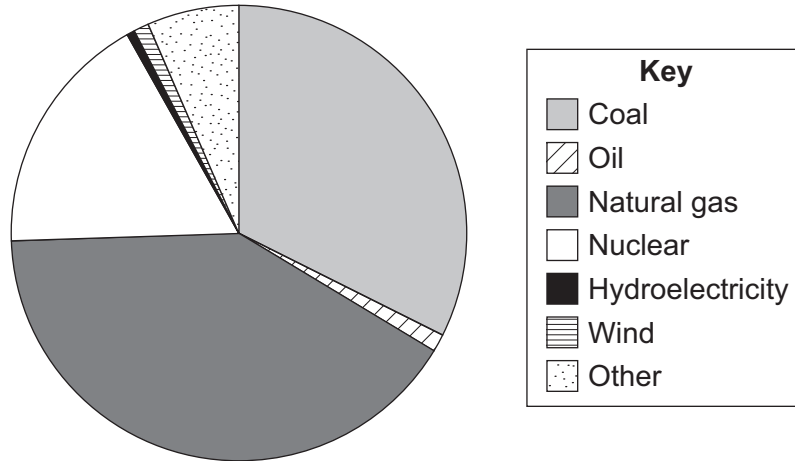
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Physics Questions

- 5 (a)** The pie chart shows how the electricity generated in the UK is produced using different energy resources.



- 5 (a) (i)** Which energy resource is used to generate approximately one third of the UK's electricity?

.....
(1 mark)

- 5 (a) (ii)** Name **two** energy resources that could be part of the 'Other' energy resources used to generate electricity in the UK.

1

2

(2 marks)



9

- 6** Periscopes are used in submarines to see above the surface of the sea when the submarine is below the surface of the water. A periscope can be made using plane mirrors.

- 6 (a)** Describe the image produced in a plane mirror.

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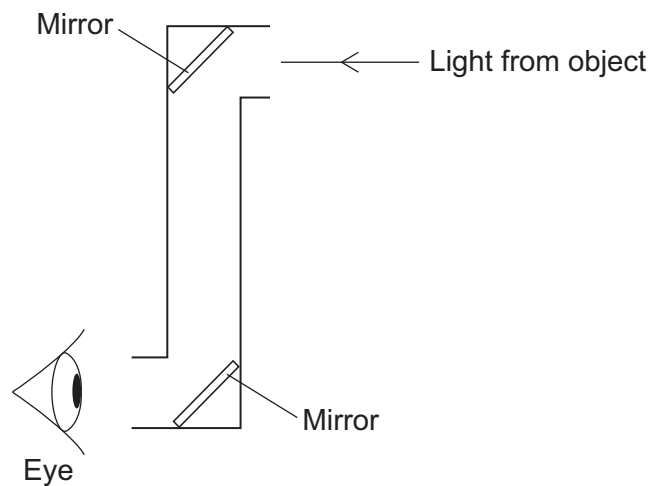
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(3 marks)

- 6 (b)** A periscope has two plane mirrors that reflect light so that objects can be viewed by people in the submarine.



Complete the ray diagram to show how light from the object reaches the eye.

(3 marks)



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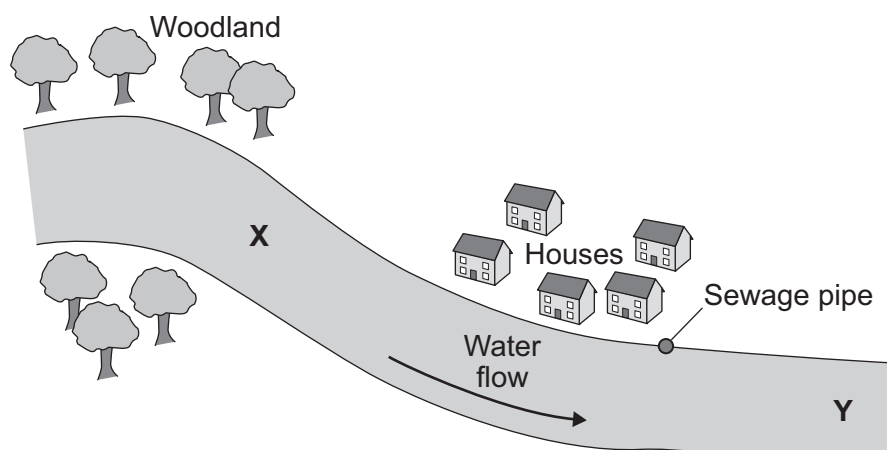
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Biology Questions

- 7 Scientists investigated the water quality at points **X** and **Y** in a river. The scientists sampled the invertebrate animals living at these points.



The table shows their results.

Invertebrate	Level of oxygen needed for survival	Number of invertebrates sampled	
		Point X	Point Y
Dragonfly nymph	Medium – high	5	0
Freshwater louse	Medium – low	5	6
Freshwater shrimp	Medium – high	14	0
Mayfly nymph	High	11	0
Red-tailed maggot	Low	0	14
Stonefly nymph	High	12	0
Tubifex worm	Low	0	15
Water boatman beetle	Medium – high	12	0



7 (a) Use evidence from the table to compare the water quality at points **X** and **Y**.

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(3 marks)

7 (b) The table shows the oxygen level needed for survival of different invertebrates.

Name **one** other non-living environmental factor that could also be measured.

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(1 mark)

7 (c) Other organisms can be used to indicate levels of pollution.

What organisms can be used to indicate the concentration of sulfur dioxide in the air?

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(1 mark)

5

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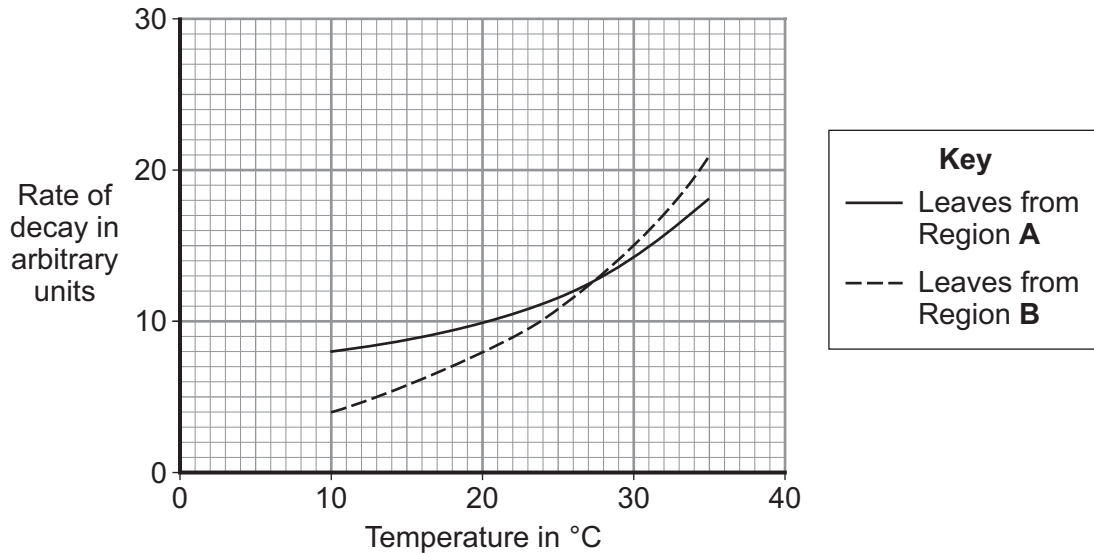


- 8 Scientists collected leaves that had fallen from beech trees in two different parts of the UK, Region **A** and Region **B**.

Equal masses of leaves from the two regions were put in incubators at different temperatures. All other conditions were the same.

The leaves decayed in the incubators. The rate of decay of the leaves was measured.

The results are shown in the graph.



Give **two** conclusions you can make from the data and suggest a reason for each conclusion.

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(4 marks)



- 9** *Bacillus thuringiensis* (Bt) is a soil bacterium. It produces a poison that kills several different species of insect that feed on cotton plants.

Over 90 % of the cotton plants grown in Australia, the USA and China today are genetically modified to produce the Bt poison, resulting in less crop damage.

A cotton plant



- 9 (a)** Explain in detail how cotton plants can be genetically modified to produce the Bt poison.

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(4 marks)

- 9 (b)** Many environmentalists do not think we should grow genetically modified cotton plants. Suggest **two** reasons why.

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(2 marks)

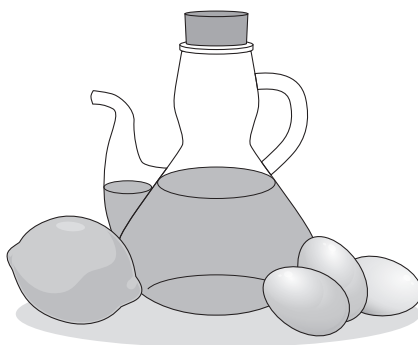


Chemistry Questions

10 Mayonnaise is an emulsion.

A mayonnaise recipe includes:

- 3 egg yolks
- 400 cm^3 vegetable oil
- 40 cm^3 lemon juice (lemon juice dissolved in water).



10 (a) 400 cm^3 vegetable oil was poured into a beaker containing 40 cm^3 lemon juice.

Describe and explain what you would see in the beaker after a few minutes.

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(2 marks)



- 10 (b)** The egg yolks were added to the vegetable oil and lemon juice mixture and stirred vigorously.
This produced an emulsion.

State **two** properties of the emulsion that are different from those of the vegetable oil and lemon juice that the emulsion was made from.

.....

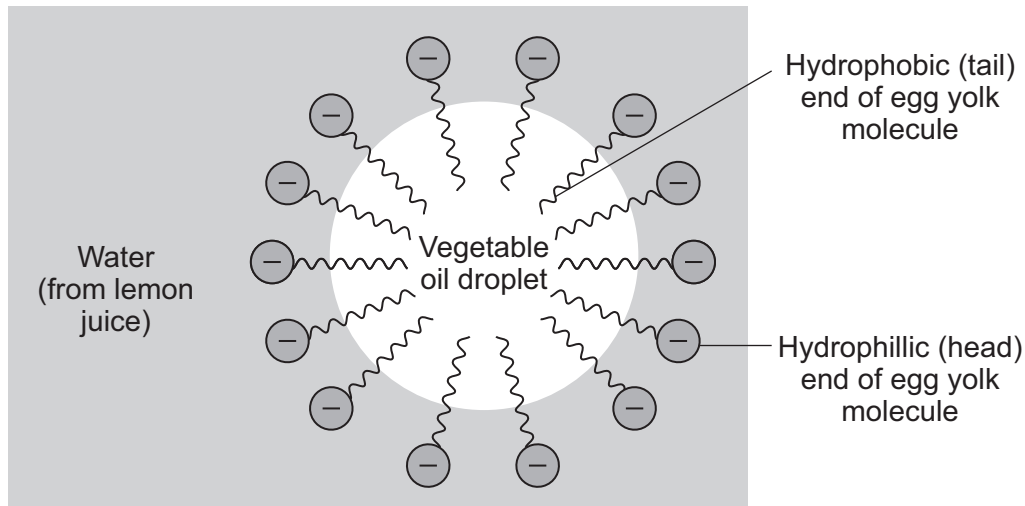
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(2 marks)

- 10 (c)** The diagram below shows a simple model of how an emulsion is formed when egg yolks are stirred with a mixture of vegetable oil and lemon juice.



Use the diagram to help you explain how the molecules in the egg yolk are able to produce a stable emulsion between the vegetable oil and lemon juice.

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(3 marks)

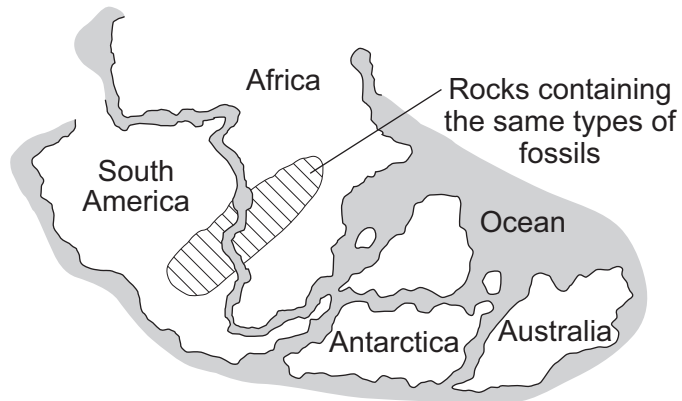


- 11** In 1915, two different theories were suggested to explain the following observation:
'In South America and Africa many animal fossils are exactly the same.'

Theory 1

Wegener's theory of continental drift.

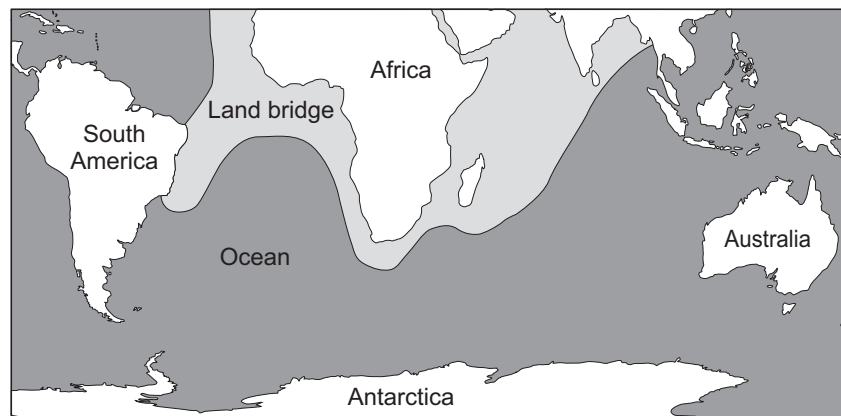
- Continents were once joined together.
- The continents then split and slowly drifted apart.



Theory 2

Other scientists' land bridge theory.

- South America and Africa had once been joined by a land bridge.
- The continents were in fixed positions and could not move.



- 11 (a)** Describe **two** pieces of evidence that Wegener could use to support his theory (Theory 1).

Use the diagrams to help you to answer this question.

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(2 marks)

- 11 (b)** Which piece of evidence could the other scientists use to support the land bridge theory (Theory 2)?

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(1 mark)



11 (c)

In 1912, Captain Scott led a scientific expedition to Antarctica.

The scientists collected many fossils in Antarctica.

One fossil the scientists collected was *Glossopteris*, a tree-like plant.

Glossopteris fossils had already been found in Australia and Africa.

The work of the scientists on Scott's expedition could have provided evidence for Wegener's theory, rather than the theory proposed by the other scientists.

Explain why.



Glossopteris



Fossil of part of
Glossopteris
(not to scale)

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(4 marks)

11 (d)

In 1962, scientists produced the theory of plate tectonics.

The theory of plate tectonics supported Wegener's theory that continents move.

Describe and explain what causes tectonic plates to move.

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(3 marks)

10

Turn over ►



Physics Questions

- 12** A householder wants to reduce his electricity bill by installing a system that uses a renewable energy resource to generate electricity.

The renewable energy systems for generating electricity the householder is considering are:

- a wind turbine
- solar cells.

- 12 (a)** Suggest which of these systems for generating electricity has the lower maintenance cost.

Give a reason for your answer.

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(1 mark)

- 12 (b)** Using a renewable energy system may save money in the long term.

Suggest a reason why.

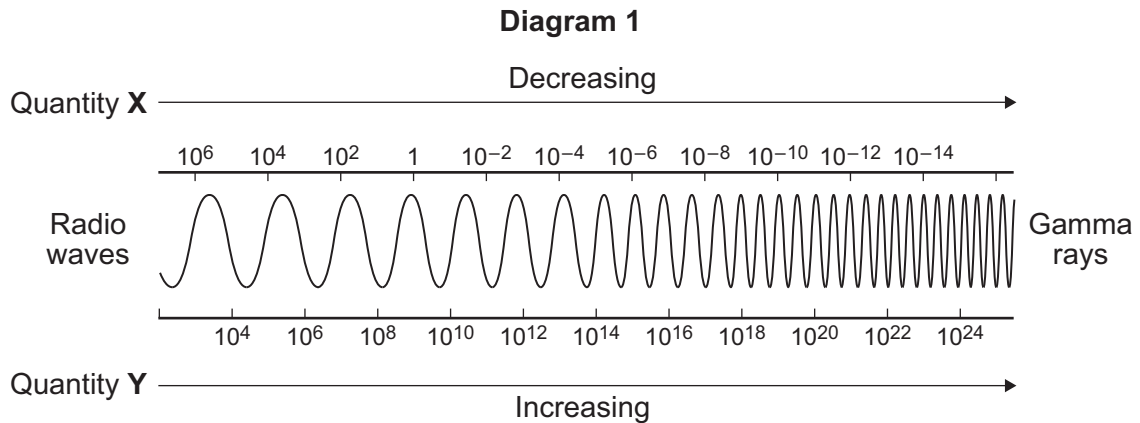
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(1 mark)



- 13** The electromagnetic spectrum is shown in **Diagram 1**.



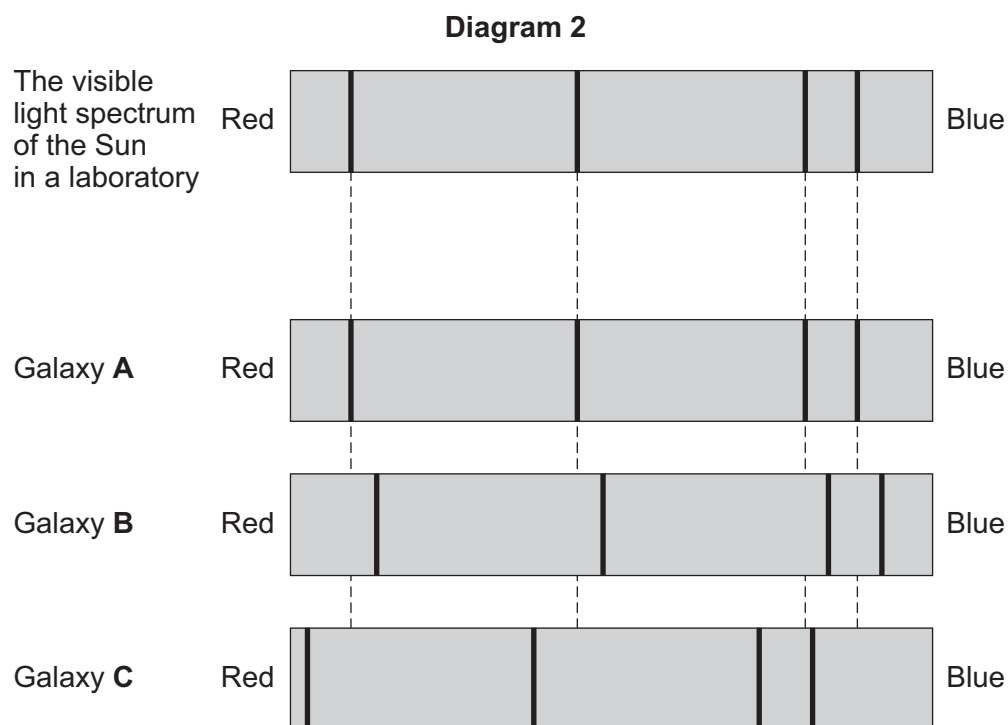
- 13 (a)** Name quantities **X** and **Y**, and state the units they are measured in.

Quantity **X**: Unit for Quantity **X**:

Quantity **Y**: Unit for Quantity **Y**:
(3 marks)

- 13 (b)** The visible part of the electromagnetic spectrum from stars includes dark lines. These lines are at specific wavelengths.

Diagram 2 shows the visible light spectra for three galaxies, **A**, **B** and **C**, compared to the visible light spectrum of the Sun as seen in a laboratory.



- 13 (b) (i)** Using evidence from the spectra, what conclusions can be made about the movement of galaxies **A**, **B** and **C** relative to the Earth?

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(3 marks)

- 13 (b) (ii)** Compare the speed of galaxy **B** with the speed of galaxy **C** relative to the observer.

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(1 mark)

- 13 (b) (iii)** Explain why it is **not** valid to make conclusions about all galaxies in the Universe from these spectra.

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(2 marks)

9

END OF QUESTIONS



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