

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Secondary Education
Higher Tier
June 2013

Science A 2

SCA2HP

Unit 6

H

Thursday 13 June 2013 9.00 am to 10.30 am

For this paper you must have:

- a ruler
 - the Chemistry Data Sheet and Physics Equations Sheet Booklet (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 2(b)(ii) 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
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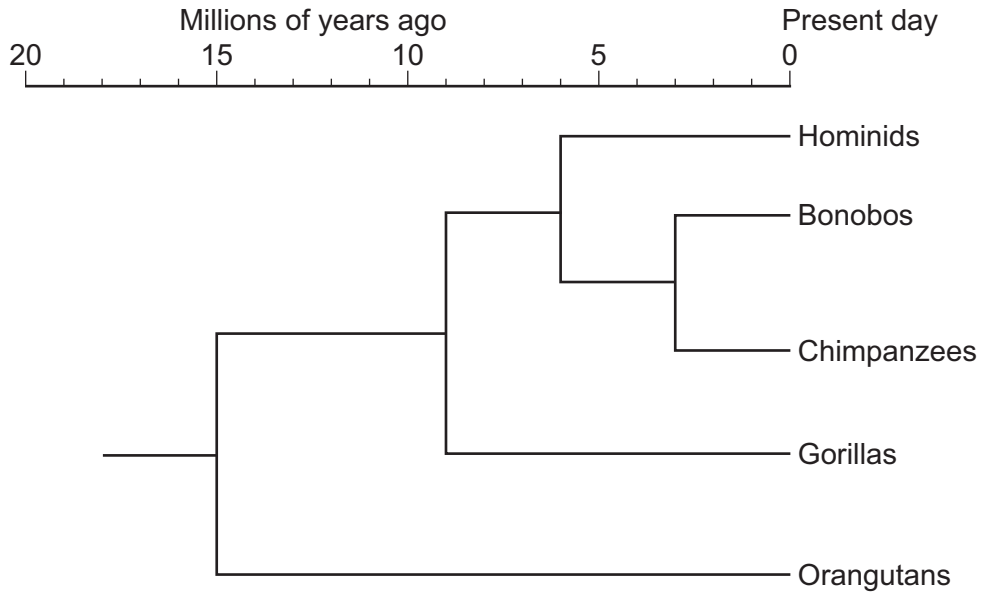


J U N 1 3 S C A 2 H P 0 1

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

Biology Questions

1 The diagram shows an evolutionary tree for the great apes.



1 (a) (i) How many years after gorillas did hominids evolve?

..... millions of years
(1 mark)

1 (a) (ii) Which animal in the diagram is the most distant relative of chimpanzees?

.....
(1 mark)

1 (b) Charles Darwin is well known for his theory of evolution.

1 (b) (i) Complete the sentence.

Darwin's theory states that evolution happens by a process called

.....
(1 mark)



1 (b) (ii) When Darwin's theory was first published people did not accept the idea.

People did not accept the idea because the theory challenged the belief that God made all the animals and plants that live on Earth.

Give **one** other reason why his theory was not accepted **by scientists** at the time.

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(1 mark)

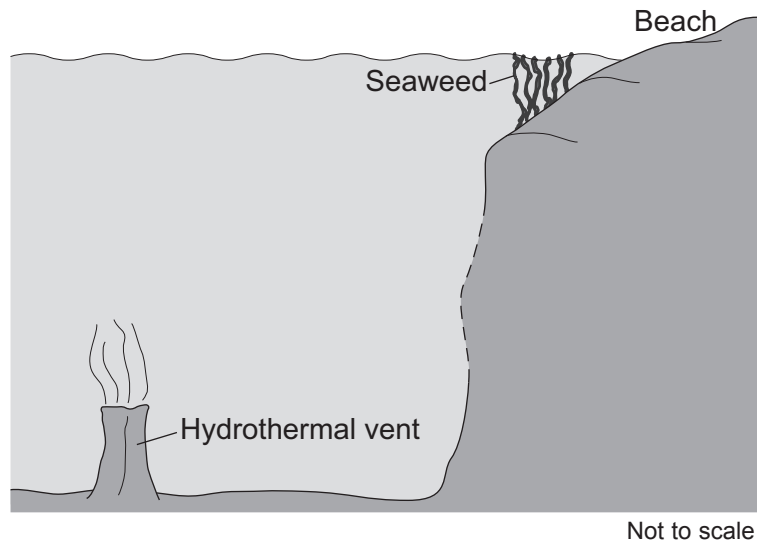
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- 2** There are areas in deep seas where there are hot water springs called hydrothermal vents.



Volcanic activity creates an environment of very hot, acidic water.

No light reaches the deep seabed.

The environment is very extreme but many different organisms can live there.

- 2 (a)** Complete the following sentence.

Organisms that can survive in extreme conditions are called

..... (1 mark)

- 2 (b)** In the hydrothermal vents bacteria absorb toxic chemicals from the hot water. The bacteria use the chemicals to produce carbohydrates for the rest of the food chain.

The bacteria are eaten by limpets, which are eaten by crabs.

- 2 (b) (i)** Draw and label a pyramid of biomass for this community.

(2 marks)



Chemistry Questions

3 A scientist investigated how much water hydrogel pellets absorb.

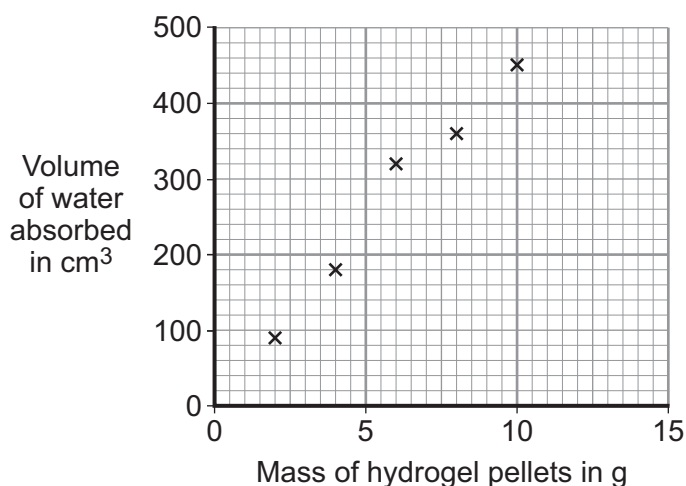
The scientist:

- measured 500 cm³ of water into a beaker
- added 2 g of hydrogel pellets
- left the hydrogel pellets in the water overnight.

The next day, the scientist calculated the volume of water that had been absorbed by the hydrogel pellets.

The scientist repeated the investigation with different masses of hydrogel pellets.

The scientist plotted the results.



3 (a) (i) Draw a line of best fit on the graph.

(1 mark)

3 (a) (ii) Which result should be taken again?

Mass of hydrogel pellets: g Volume of water: cm³

Why did you choose this result to retest?

.....

.....

(2 marks)



3 (b) Describe the relationship between the mass of hydrogel pellets used and the volume of water absorbed.

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(1 mark)

3 (c) Give one control variable in the investigation.

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(1 mark)

3 (d) Disposable nappies for babies have a pad containing hydrogel pellets.
Suggest and explain why hydrogel pads are used in disposable nappies.

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(2 marks)

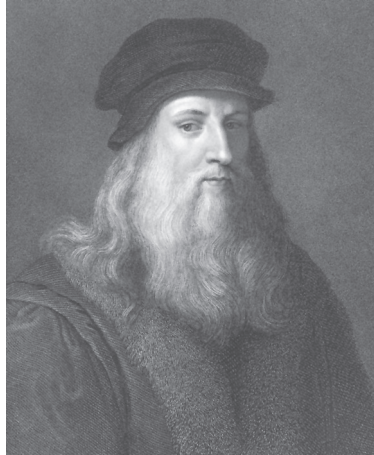
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4 Leonardo da Vinci was a famous Italian artist, scientist and engineer. He lived from 1452 to 1519.



He had little education and did not go to university. When he was 14 years old he started to work with an artist to learn how to paint.

Leonardo da Vinci made his own paints. He mixed coloured powders with linseed oil (a vegetable oil). He added water to the linseed oil and powder mixture to make an emulsion.

4 (a) Paints are used in the form of emulsions.

Suggest **two** reasons why.

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(2 marks)

4 (b) Scientists in the fifteenth century observed sea shells in rock layers in mountains. Some scientists said this was because of the Great Flood described in the Bible. Leonardo da Vinci said it was because at different times the seabed was raised. Leonardo da Vinci's theory is similar to the tectonic plate theory scientists use today.

4 (b) (i) Most scientists in the fifteenth century ignored Leonardo da Vinci's scientific work.

Suggest why.

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(1 mark)



4 (b) (ii) What are tectonic plates?

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(2 marks)

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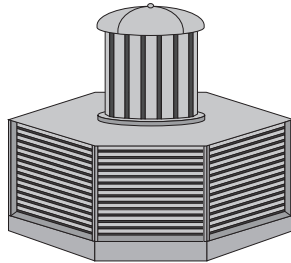
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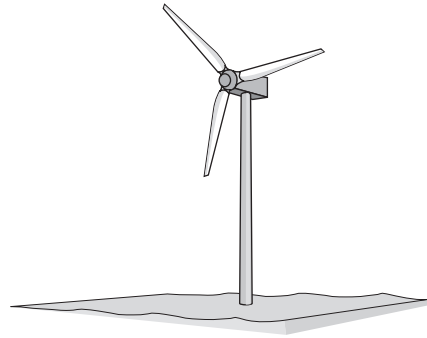
Physics Questions

5 A community of people living on an island are considering buying wind turbines to supply their electricity. The community have looked at two types of wind turbine.

Vertical Axis Wind Turbine



Horizontal Axis Wind Turbine



Not to scale

The community looked at information about the two different types of wind turbine.

- **Vertical axis wind turbines** start to rotate at wind speeds of 1.5 m/s.
- Vertical axis wind turbines are powered by wind coming from any direction.
- The power output at 12 m/s is 1 MW.
- The wind turbines continue to generate electricity until the wind speed reaches 40 m/s.

- **Horizontal axis wind turbines** start to rotate at wind speeds of 3.6 m/s.
- Horizontal axis wind turbines turn to point into the wind.
- The power output at 12 m/s is 1 MW.
- At very high wind speeds, above 20 m/s, the wind turbines stop working automatically to avoid damage.

5 (a) The community decide that vertical axis wind turbines would be better.

Use the information given to suggest why.

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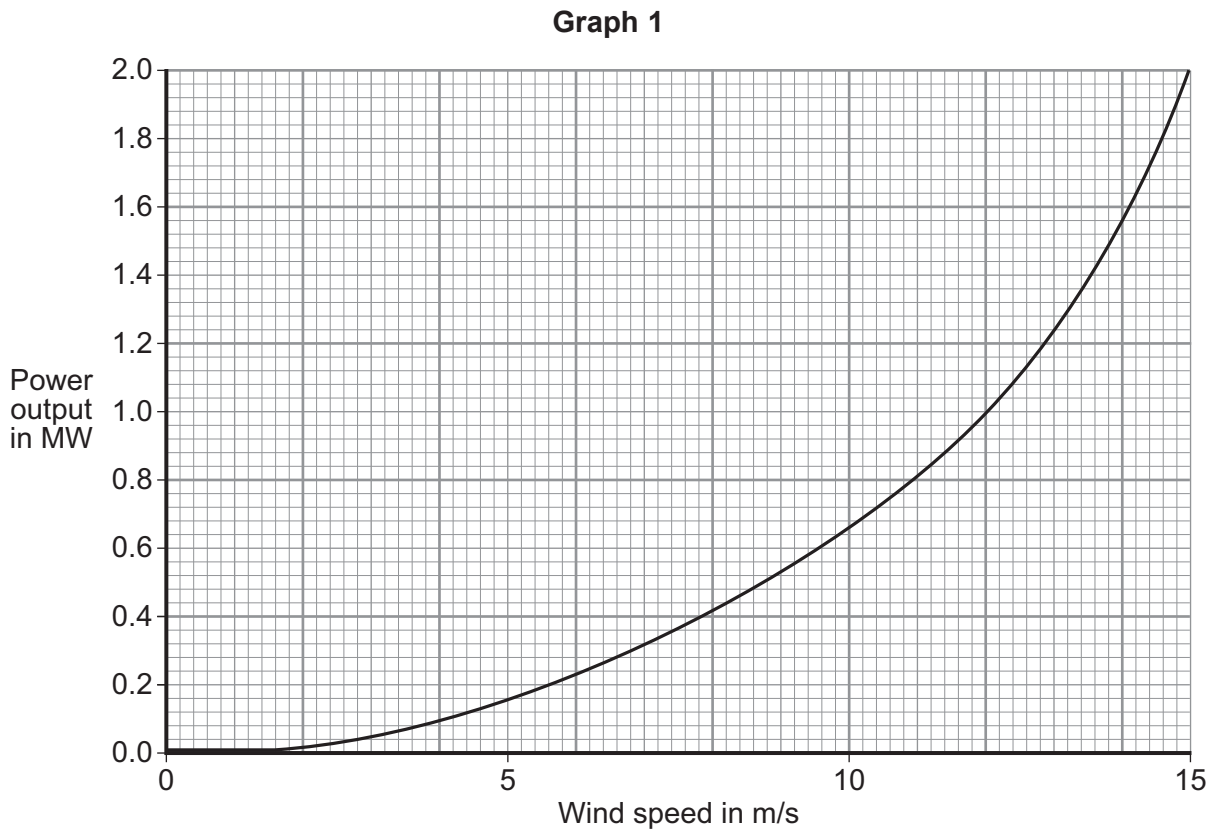
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(3 marks)



5 (b) **Graph 1** shows how the power output varies with wind speed for a vertical axis wind turbine.



Describe how the power output of this wind turbine varies with wind speed for the range of wind speeds shown.

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(2 marks)

Question 5 continues on the next page

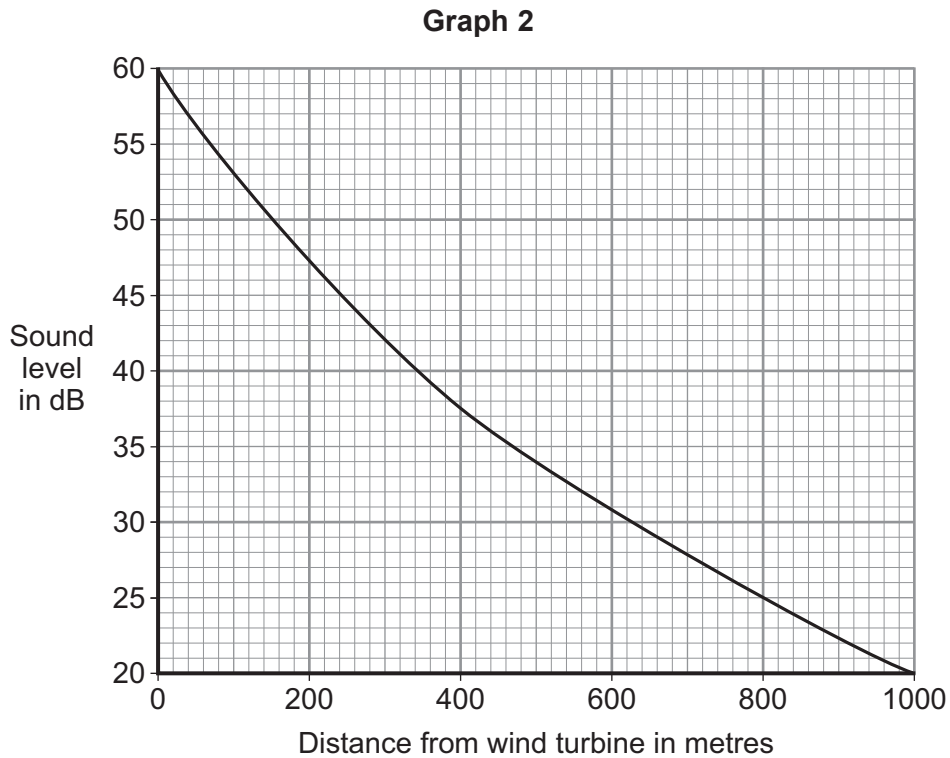
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- 5 (c)** Some local people do not want the wind turbines. These people say the wind turbines are too noisy.

Graph 2 shows how the sound level detected changes with distance from a wind turbine.

Sound level is measured in decibels, dB.



The sound level of a normal conversation is 50 dB.

- 5 (c) (i)** How far from the wind turbine would a person need to stand to detect a sound level of 50 dB?

Distance = metres
(1 mark)



5 (c) (ii) The graph shows that 1000m away you can still hear the noise the wind turbines produce.

A sound level of 30dB is the same as a person whispering in another person's ear. The nearest house to the wind turbine is 1000m away.

Some people do not want the wind turbines because of the noise the wind turbines produce.

Are these people justified in not wanting wind turbines?

Give reasons for your answer.

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(2 marks)

5 (d) On the mainland, wind turbines are connected to the National Grid.

Electricity is transmitted through the power lines of the National Grid at very high voltages and low currents.

State why.

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(1 mark)

9

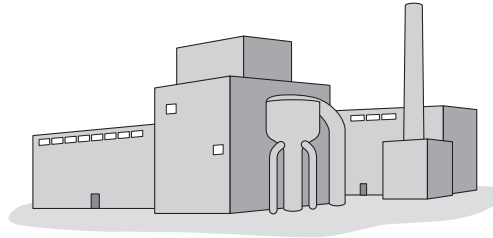
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6 A company has planning permission to build a biofuel power station on the edge of a city.

A local newspaper publishes a picture of the proposed power station.



6 (a) Give **one** example of a biofuel the power station could use.

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(1 mark)

6 (b) Explain how the energy stored in the biofuel is used in the power station to generate electricity.

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(4 marks)



6 (c) The power station will be connected to the National Grid using underground cables **not** overhead power lines.

Give **one** advantage and **one** disadvantage of using underground cables.

Advantage

.....

Disadvantage

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(2 marks)

7

Turn over for the next question

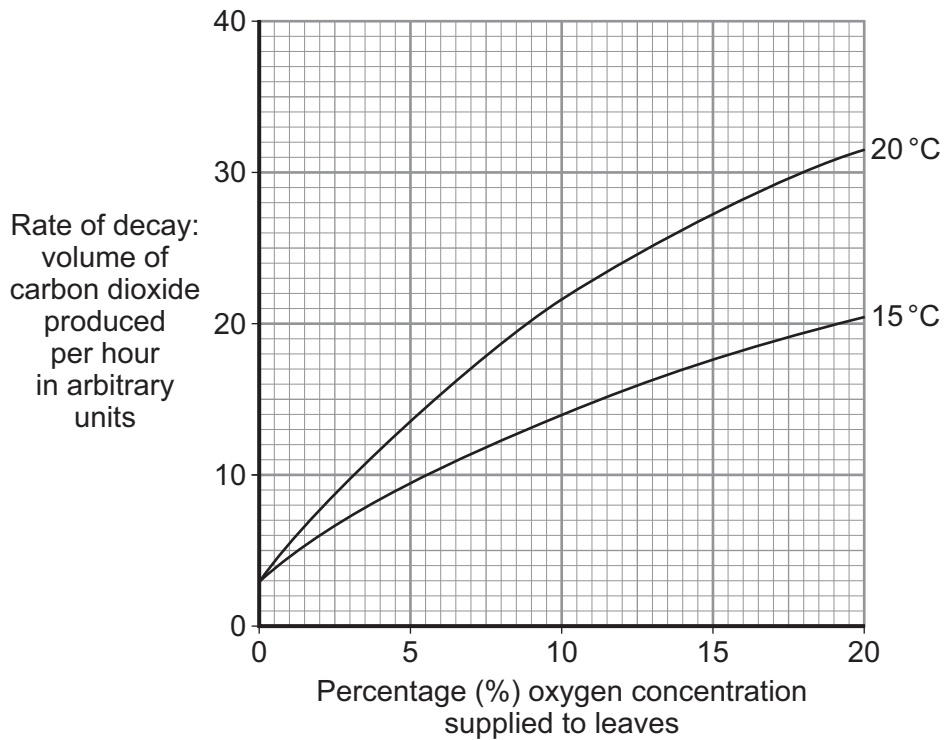
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Biology Questions

7 A scientist investigated the effect of oxygen concentration and temperature on the rate of decay of leaves in a container.

The scientist's results are shown in the graph.



7 (a) The rate of decay is measured as the volume of carbon dioxide produced per hour.

Explain why carbon dioxide is produced during the process of decay.

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(3 marks)



7 (b) Give **two** conclusions that can be made from the results shown in the graph.

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(2 marks)

7 (c) Materials are constantly recycled within a community. Some communities are stable.

What is meant by a *stable community*?

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(1 mark)

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Turn over for the next question

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8 Kittens are usually produced by sexual reproduction.



8 (a) Explain how sexual reproduction produces variety in the offspring.

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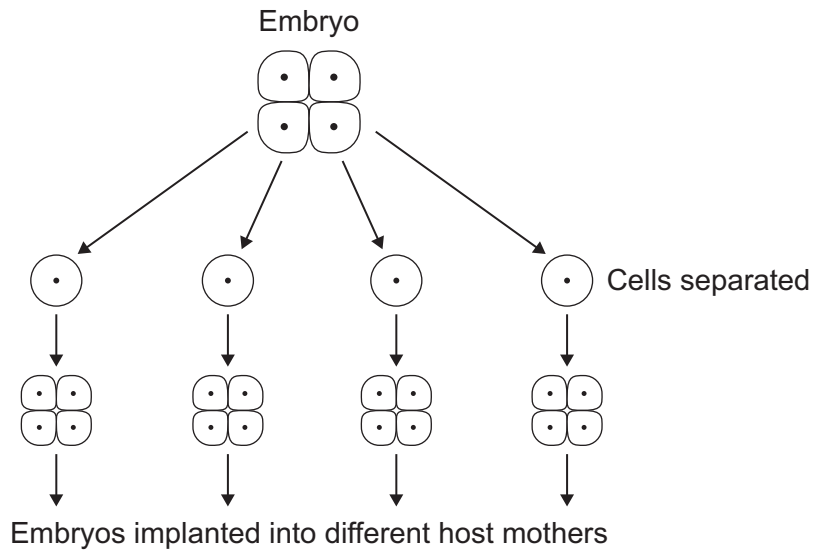
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(4 marks)



8 (b) Identical kittens (clones) can be produced using the technique shown in the diagram.



8 (b) (i) What is this technique called?

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(1 mark)

8 (b) (ii) The same technique could be used to produce human babies.

Suggest one ethical reason why many people would disagree with cloning humans.

Do **not** write about religious beliefs in your answer.

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(1 mark)

Turn over for the next question

6

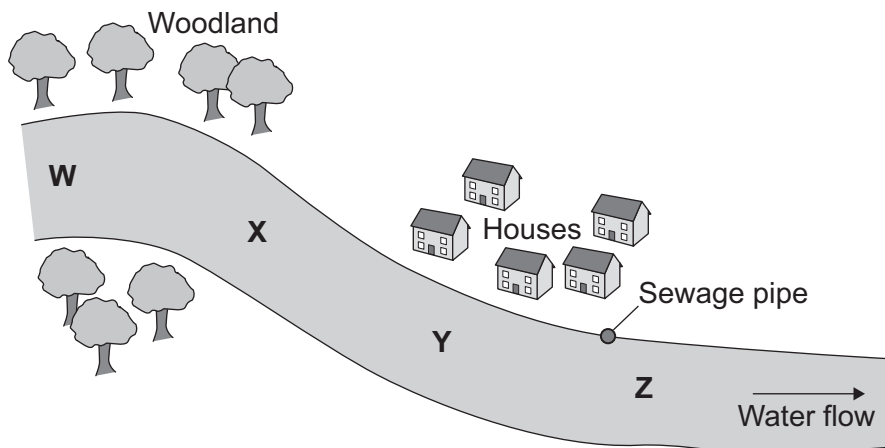
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- 9 Two groups of students, **Group 1** and **Group 2**, were monitoring the oxygen concentration in a river.

They measured the oxygen concentration of the water at points **W**, **X**, **Y** and **Z**. The measurements were taken on the same day, but the two groups used different oxygen sensors.

The sensors for both groups were working properly.



The results for the two groups are shown in the table.

Sampling position	Concentration of oxygen in arbitrary units			
	W	X	Y	Z
Group 1	9.4	9.3	9.4	8.5
Group 2	9	9	9	9

- 9 (a) The results of **Group 2** did not show any difference in the concentration of oxygen at the four different sampling positions. The results of **Group 1** did show differences.

Suggest why.

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(1 mark)



9 (b) The results of **Group 1** show the lowest concentration of oxygen was at sampling position **Z**.

Suggest why.

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(3 marks)

9 (c) The students also counted the number of different invertebrates living in the river at points **W, X, Y and Z**.

The results are shown in the table.

Invertebrate	Sampling position			
	W	X	Y	Z
Stonefly larva	4	5	4	0
Water snail	16	15	16	10
Bloodworm	0	0	0	25
Freshwater louse	6	5	7	5

From these results, which invertebrate is **not** suitable as an indicator of oxygen concentration in water?

.....

Give a reason for your choice.

.....

.....

(1 mark)

5

Turn over ►



Chemistry Questions

10 The atmosphere of Mars is different from the atmosphere of Earth.

10 (a) (i) What is the percentage of nitrogen in the Earth's atmosphere today?

.....
(1 mark)

10 (a) (ii) **Table 1** shows the percentages of gases in the atmosphere of Mars.

Table 1

Gas	Percentage of gases in the atmosphere of Mars (%)
Carbon dioxide	95
Nitrogen	3
Oxygen	0.13

Earth's early atmosphere may have been like the atmosphere on Mars.

Describe how and why the percentages of carbon dioxide and oxygen in the Earth's atmosphere have changed.

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(5 marks)



- 10 (b)** Table 2 shows the mean surface temperature and percentage of water vapour in the atmosphere of three planets.

Table 2

	Earth	Mars	Venus
Mean surface temperature in °C	20	-23	460
Percentage (%) of water vapour in atmosphere	0.4	0.002	0.0002

Suggest why Venus and Mars do **not** have oceans.

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(2 marks)

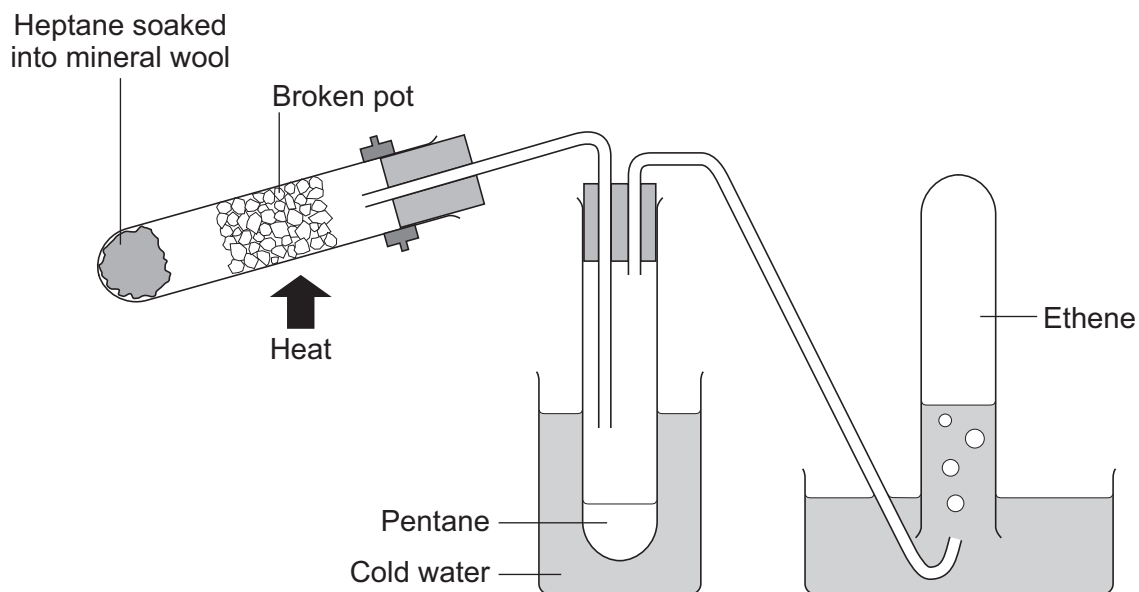
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Turn over for the next question

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11 In the laboratory, ethene can be made using the apparatus shown.



11 (a) (i) Complete the symbol equation for this reaction.



(1 mark)

11 (a) (ii) Explain how you can tell pentane has a higher boiling point than ethene.

Use information from the diagram.

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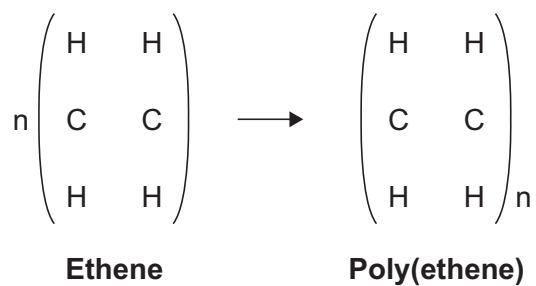
(1 mark)



11 (b) Ethene molecules are polymerised to form poly(ethene).

Complete the displayed (structural) formula of ethene and poly(ethene) in the equation to show this reaction.

Draw lines to represent each bond.



(3 marks)

5

Turn over for the next question

Turn over ►



12 Potatoes can be cooked in different ways.

Boiled potatoes



Chips



12 (a) Boiled potatoes are cooked in boiling water for 15 minutes.
Chips are cooked in vegetable oil for 7 minutes.

The time taken to cook chips in oil is different from the time taken to cook potatoes in boiling water.

Explain why the time taken is different.

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(2 marks)

12 (b) (i) Vegetable oils contain unsaturated fats.

What does *unsaturated* mean?

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(1 mark)



12 (b) (ii) Describe a test for unsaturation.

What result would you expect to see if a vegetable oil containing unsaturated fat was tested using the method you have described?

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(2 marks)

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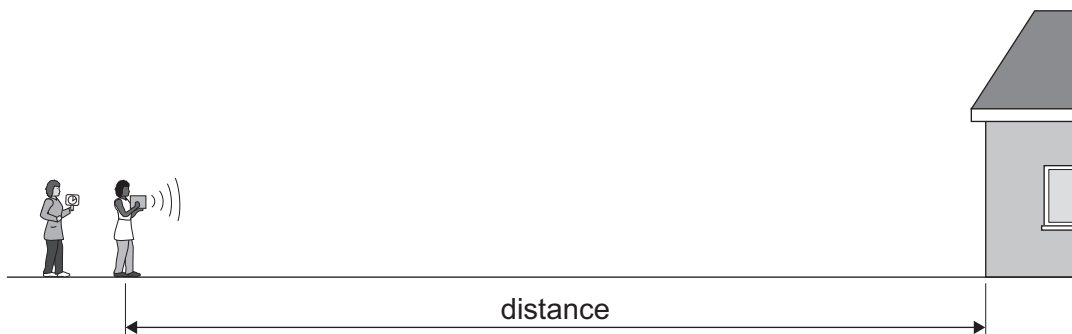
Physics Questions

13 Two students investigated the reflection of sound waves from a building.

One student used a signal generator connected to a loudspeaker to produce a short, high-pitched sound wave.

The second student used a stop clock to measure the time taken for the sound wave to return to the students.

The students repeated the experiment at different distances from the building.



13 (a) (i) What name is given to reflected sounds?

.....
(1 mark)

13 (a) (ii) Sound is a longitudinal wave.

How is a longitudinal wave different from a transverse wave?

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(2 marks)



13 (b) The students' results are shown in the table.

	Trial 1	Trial 2	Trial 3
Time in seconds	0.40	0.59	0.92
Distance in metres	50.0	100.0	150.0

13 (b) (i) What was probably the biggest source of error in the students' investigation?

Give a reason for your answer.

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(2 marks)

13 (b) (ii) The signal generator was set at a frequency of 1.2 kHz.

The speed of sound in air, when the students did the investigation, was 340 m/s.

Calculate the wavelength of the sound wave generated by the speaker.

Use the correct equation from the Physics Equations Sheet.

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Wavelength = m

(3 marks)

8

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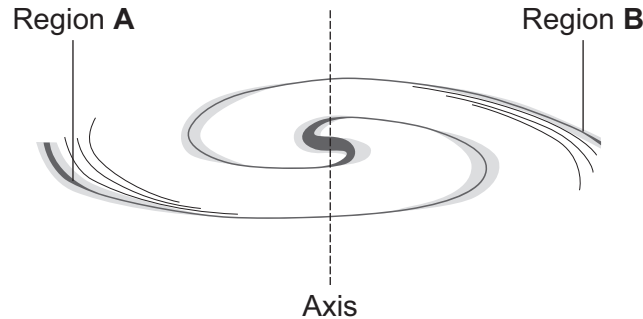
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14 Spiral galaxies rotate about an axis through their centre.

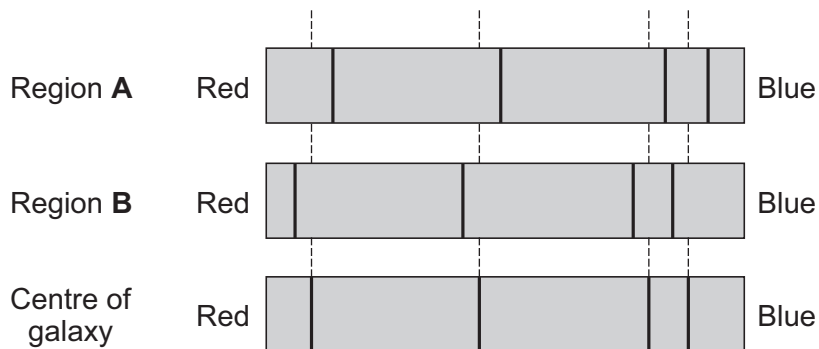
Astronomers use the light emitted by stars in these galaxies to investigate their rotation.

The diagram shows a rotating spiral galaxy.



The visible part of the electromagnetic spectrum from a star includes dark lines. These lines are at specific wavelengths.

Light from the two different regions and the centre (of the galaxy) is analysed and the dark spectral lines are as shown.



14 (a) Explain how astronomers would use these spectra to identify the direction the galaxy is rotating.

State the direction the galaxy is rotating.

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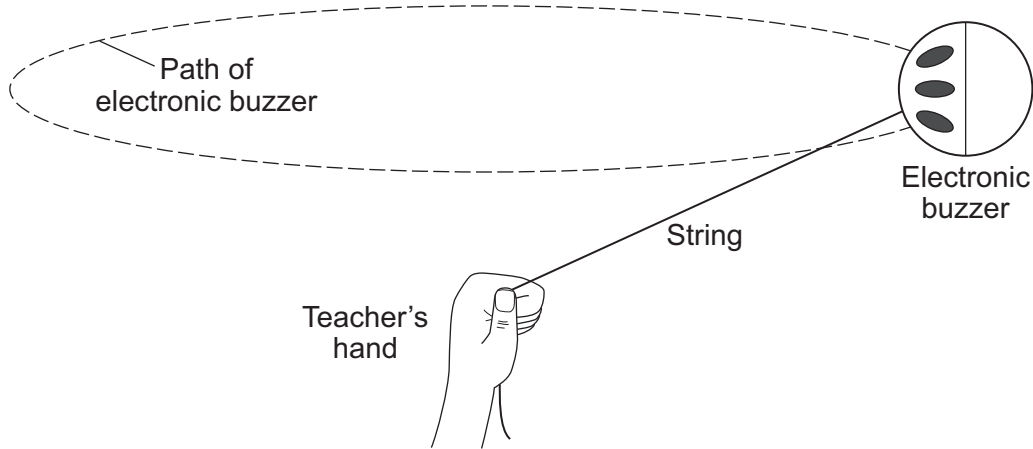
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(3 marks)



14 (b) A teacher models the rotation of the galaxy for his physics class by whirling an electronic buzzer around his head.



When the electronic buzzer is stationary, it produces a sound with a constant pitch.

14 (b) (i) What determines the pitch of a sound?

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(1 mark)

14 (b) (ii) When the buzzer is rotated, the pitch people hear changes.

Describe how the pitch people hear changes and name the observed effect.

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(2 marks)

6

END OF QUESTIONS



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Question 12: Parsley Potatoes, Potato Frites © Thinkstock

