

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										



General Certificate of Secondary Education
Higher Tier
June 2012

Science A 2

SCA2HP

Unit 6

H

Friday 15 June 2012 1.30 pm to 3.00 pm

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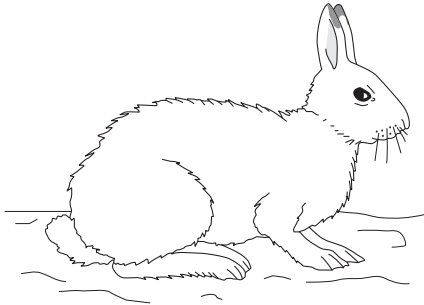
J U N 1 2 S C A 2 H P 0 1

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

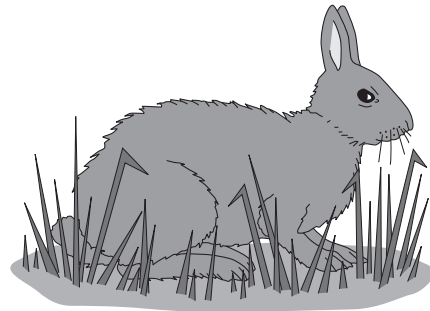
Biology Questions

1 Arctic hares live in very cold conditions.

Arctic hare in winter coat



Arctic hare in summer coat



Explain in detail how each of the following adaptations helps the Arctic hare to survive.

1 (a) The Arctic hare has a white coat in winter and a darker coat in summer:

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(2 marks)

1 (b) The Arctic hare has smaller ears than the European hare:

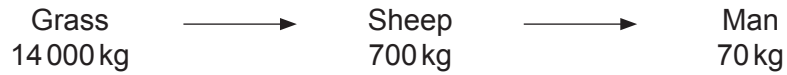
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(2 marks)

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2 The biomass of different organisms in a food chain is shown below.



2 (a) Sketch and label a pyramid of biomass for this food chain.

(2 marks)

2 (b) The amount of biomass decreases along the food chain.

Suggest **two** reasons why.

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(2 marks)

4

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ANSWER IN THE SPACES PROVIDED**

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Chemistry Questions

- 4 Fuel for cars in Brazil contains 75% petrol and 25% ethanol.



Ethanol can be produced by two methods:

- fermentation of sugars
- hydration of ethene obtained from crude oil.

- 4 (a) Write a word equation for the reaction of ethene with steam.

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(1 mark)

- 4 (b) Brazil produces ethanol by fermentation rather than by hydration of ethene.

Suggest **one** reason why.

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(1 mark)



4 (c) The table gives details of the two methods used to make ethanol.

Process 1	Process 2
Fermentation of sugars using yeast	Hydration of ethene with steam
Produces a dilute solution of ethanol after a few days	Produces pure ethanol continuously

Suggest **two** disadvantages of producing ethanol by fermentation compared with hydration.

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(2 marks)

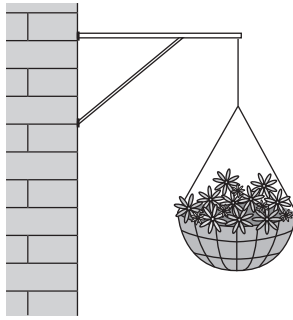
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- 5 Some gardeners add hydrogels and compost to the soil used in hanging baskets.



Scientists investigated how much water different mixtures of soil, compost and hydrogel could hold.

The table shows the scientists' results.

Mixture	Mass of soil in kg	Mass of compost in kg	Mass of hydrogel in g	Water holding capacity as percentage (%) of total mass
Soil	10	0	0	22.96
Soil + compost	10	1	0	24.18
Soil + compost	10	2	0	26.12
Soil + hydrogel	10	0	2	26.09
Soil + hydrogel	10	0	4	27.00
Soil + compost + hydrogel	10	2	2	27.86



5 (a) Describe and compare the effects of adding compost and hydrogels on the water holding capacity of soil.

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(3 marks)

5 (b) Hydrogels are polymers.

Describe what happens to the monomers in the chemical reaction used to produce a polymer.

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(2 marks)

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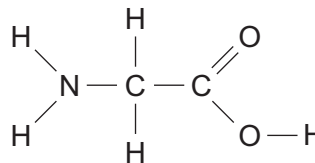
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- 6 Two scientists, Miller and Urey, investigated how simple gases that may have been present in the Earth's early atmosphere led to the formation of chemicals such as glycine. Glycine is found in living organisms.

The displayed (structural) formula of glycine is:



- 6 (a) Name **three** simple gases that could have been present in the Earth's early atmosphere that might combine to form glycine.

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(3 marks)

- 6 (b) Describe the main differences between the Earth's early atmosphere and the atmosphere today.

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(4 marks)



6 (c) Air is a source of some gases used in industrial processes.

Name the process used to separate the gases in air.

Give the reason why this process can be used to separate the gases.

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(2 marks)

9

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Physics Questions

7 (a) Sound and light are different types of waves.

Give **two** similarities and **two** differences between sound waves and light waves.

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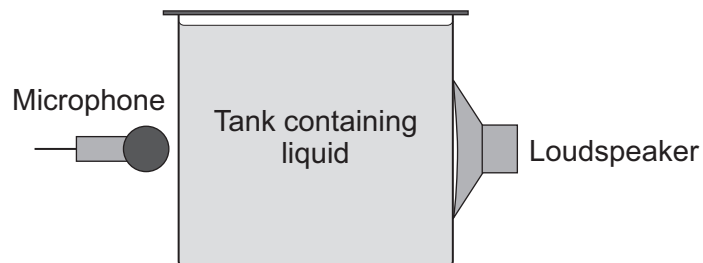
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(4 marks)

7 (b) A student does an experiment to investigate the speed of sound in different liquids.

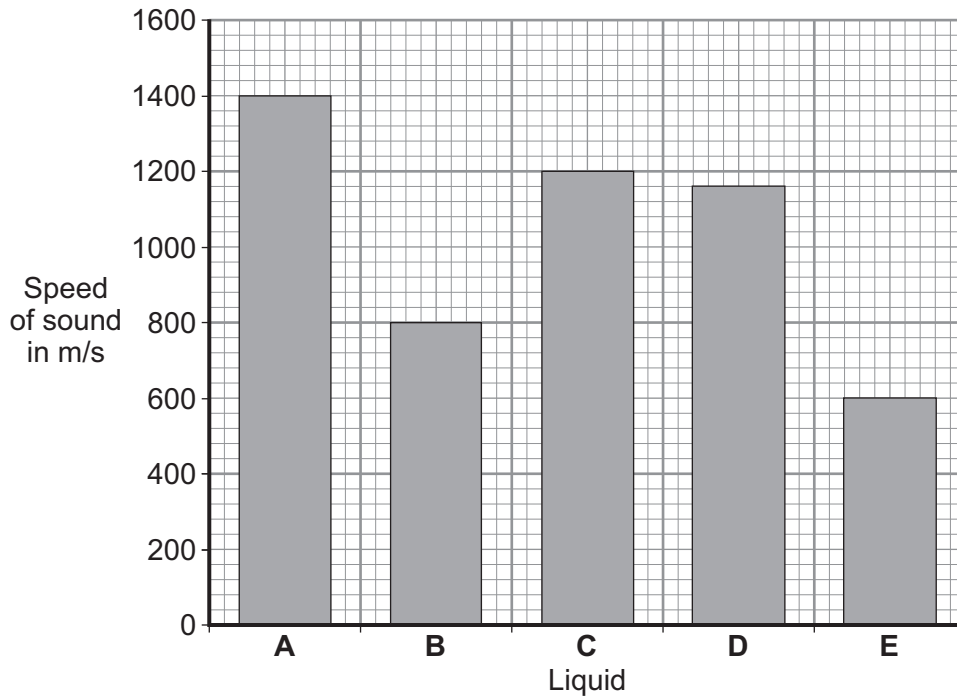
The student uses the apparatus shown.



A loudspeaker makes a sound wave. The sound wave travels through the liquid in the tank. The time it takes to travel this distance is used to calculate the speed of sound.



The bar chart shows the student's results.



7 (b) (i) When a sound wave with a frequency of 4800 hertz passes through one of the liquids, it has a wavelength of 0.25 m.

Calculate the speed of the wave and identify the liquid used.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

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Speed = m/s

The liquid used was

(3 marks)

Question 7 continues on the next page

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- 7 (b) (ii) The student's hypothesis was:
'There is a link between the density of a liquid and the speed of sound in the same liquid.'

Liquid	Density in g/cm ³	Speed of sound in m/s
Ethoxyethane	0.71	985
Ethanol	0.80	1150
Kerosene	0.82	1300
Water	1.00	1500
Mercury	13.50	1450

Use the information in the table to decide whether the student's hypothesis was completely correct or not.

Was the student's hypothesis completely correct?

Draw a ring around your answer. **Yes / No**

Give reasons for your answer.

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(2 marks)



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8 China's economy is growing quickly. To make sure electricity supplies match demand, China is building more coal-fired power stations. These power stations will probably use carbon capture and storage technology.

8 (a) Carbon capture and storage technology reduces carbon dioxide emissions to the atmosphere.

Explain how.

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(2 marks)

8 (b) A lot of people believe that energy resources like falling water should be used instead of energy resources like coal. Hydroelectric power stations generate electricity using the energy of falling water.

A large-scale hydroelectric power station can generate the same amount of electricity as a coal-fired power station.



Biology Questions

9 Gardeners can produce new plants by sexual reproduction or by taking cuttings.



Describe **three** advantages of taking cuttings instead of using sexual reproduction to produce new plants.

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(3 marks)

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10

Approximately a third of UK domestic rubbish is organic matter such as food waste and gardening rubbish.

Many councils have started industrial composting schemes to decompose these wastes. One product of the decomposition is compost (decaying organic matter).

Use this information and your own knowledge to suggest reasons why more councils should be encouraged to start industrial composting schemes.

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(3 marks)

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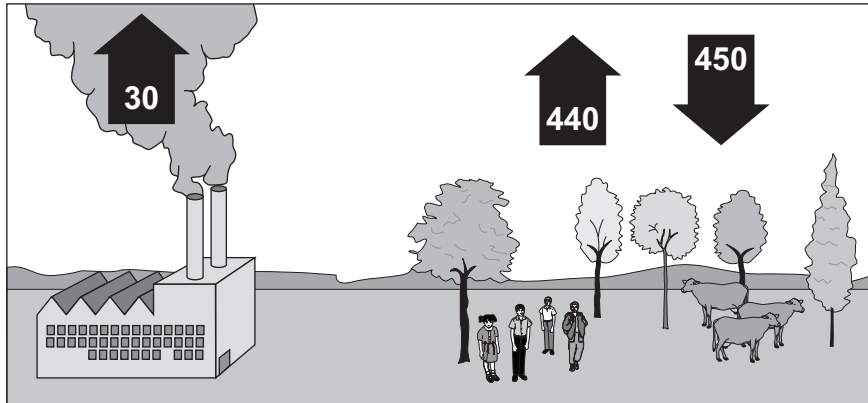
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11

The diagram shows the mass of carbon dioxide released into and removed from the air each year in billions of tonnes.



Describe the processes **shown on the diagram** that exchange carbon dioxide with the air.

Explain the overall effect of these processes on the mass of the carbon dioxide in the air.

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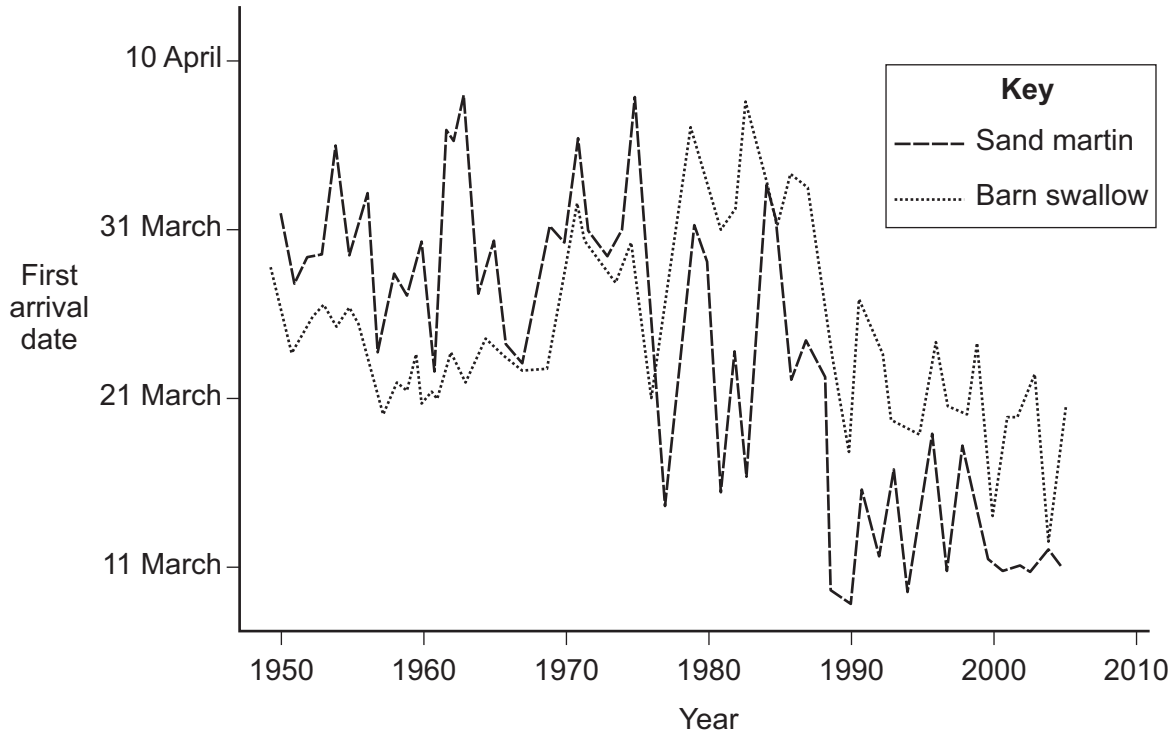
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6



12 Scientists have observed changes in the migration patterns of some species of birds.
 The graph shows the arrival dates in the UK of two species of birds, the Sand martin and the Barn swallow.

Both birds feed on flying insects.



12 (a) Give **two** changes in migratory patterns shown in the data.

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(2 marks)

12 (b) Suggest reasons for the change in the migration pattern of the Sand martin.

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(2 marks)

4

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Chemistry Questions

- 13** Plants such as sunflowers contain oils that can be extracted.



- 13 (a)** The properties of sunflower oil were compared with soybean oil, olive oil and butter (a fat).

The results are given in the table.

Substance	Percentages of types of fat		Smoke point in °C
	Saturated fat %	Unsaturated fat %	
Sunflower oil	11	89	232
Soybean oil	16	84	238
Olive oil	14	86	207
Butter	62	38	130

The smoke point is the temperature at which an oil or fat starts to break down and produce a bluish smoke.

- 13 (a) (i)** Bromine water is used to test for unsaturation.

What would you see when a few drops of bromine water are added to sunflower oil?

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(1 mark)



13 (a) (ii) Suggest which substance in the table would contain the most carbon-carbon double bonds.

Give a reason for your answer.

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(2 marks)

13 (a) (iii) Does the data in the table show that there is a relationship between the types of fat the four substances contain and their smoke points?

Explain your answer.

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(2 marks)

13 (a) (iv) Which of the substances in the table would be best for frying chips?

Give a reason for your answer.

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(1 mark)

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13 (b) Vegetable oils can be hardened.

13 (b) (i) Why are vegetable oils hardened?

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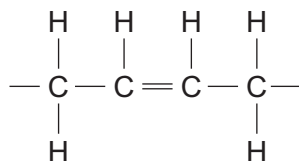
(1 mark)

13 (b) (ii) Describe how vegetable oils are hardened.

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(3 marks)

13 (b) (iii) The diagram shows part of the structure of a molecule of unsaturated vegetable oil.



Draw a diagram to show the structure of the vegetable oil after the oil has been hardened.

(2 marks)

12



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Physics Questions

- 14** Some TV signals are transmitted to a satellite in space and back to Earth. A satellite dish is fixed to a house. The satellite dish receives the TV signal. Microwaves are used for satellite TV transmission.



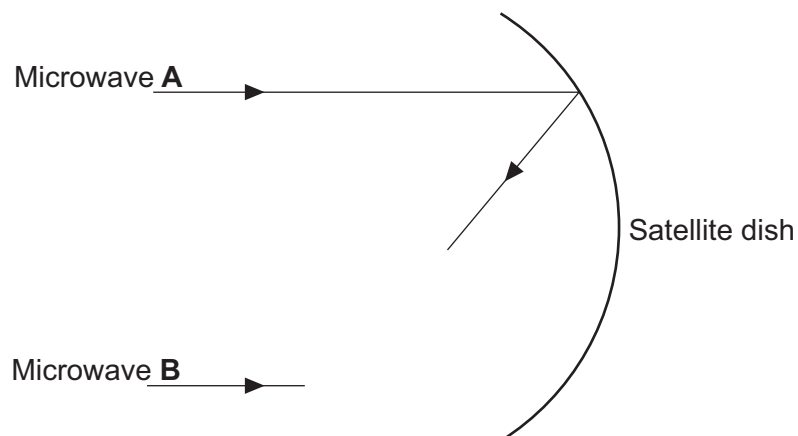
- 14 (a)** Why are microwaves used, rather than radio waves, to transmit TV signals to and from satellites in space?

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(1 mark)

- 14 (b)** The shape of the satellite dish allows microwaves to be focused at the receiver. The diagram shows how microwaves **A** is reflected by the satellite dish.



- 14 (b) (i)** Complete the diagram to show how microwaves **B** is reflected by the satellite dish.

(1 mark)

- 14 (b) (ii)** Draw on the diagram where the receiver should be placed.

For the receiver, use this symbol:

(1 mark)



14 (c) The satellite dish is made of wire mesh.

The size of each hole in the wire mesh is 3 mm. The microwaves that are incident on the dish have a wavelength of 3 cm.

Explain what is meant by diffraction and why microwaves are **not** diffracted by the holes in the wire mesh.

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(4 marks)

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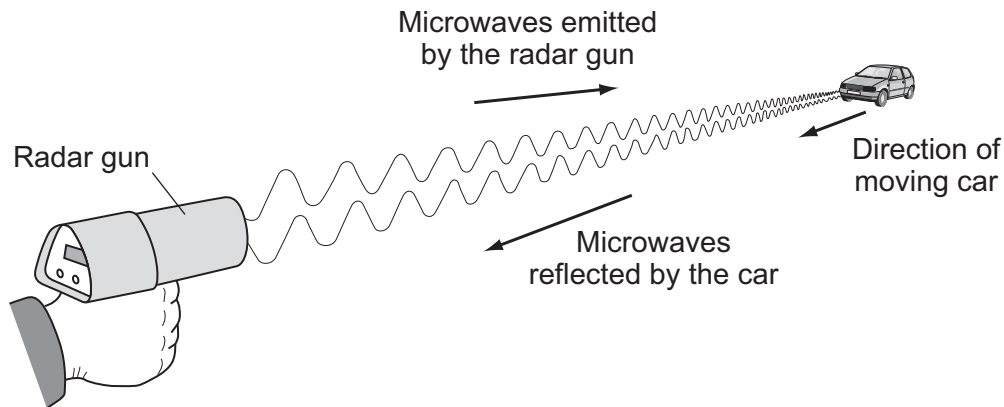


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- 15** A police officer uses a radar gun to check the speed of cars. The radar gun emits a beam of microwaves. The microwaves are reflected by the moving car.



The reflected microwaves have a different frequency to the microwaves that are emitted by the radar gun. This change in frequency can be used to determine the speed of the car as it moves towards the police officer.

- 15 (a)** What is the name given to the observed change in frequency of the microwaves?

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(1 mark)

- 15 (b) (i)** How is the wavelength of the reflected microwaves different from the wavelength of the microwaves emitted by the radar gun?

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(1 mark)

- 15 (b) (ii)** The speed of the microwaves emitted by the radar gun is 300 000 000 m/s.

What is the speed of the reflected microwaves?

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(1 mark)

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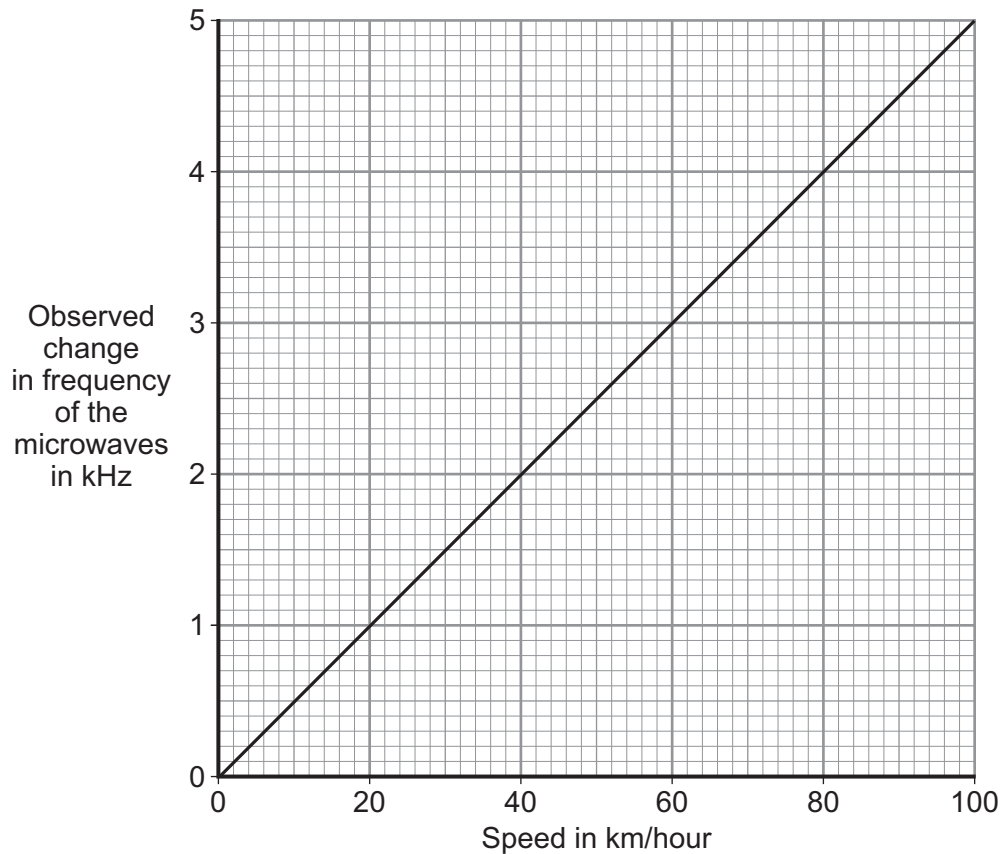
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15 (c) A car is travelling in an area where the speed limit is 70 km/hour.

The frequency of the microwaves emitted by the radar gun is 27 000 000 kHz.
The frequency of the reflected microwaves is 27 000 004 kHz.

The graph shows the relationship between the speed of a car and the observed change in frequency of the microwaves.



15 (c) (i) Is the car exceeding the speed limit?

Use information from the data given and the graph to explain your answer.

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(2 marks)



15 (c) (ii) The police officer determines the speed of a different car.

The frequency of the microwaves emitted by the radar gun is 27 000 000 kHz.
The reflected microwaves have a frequency of 26 999 998 kHz.

What is the speed and direction of this car?

Show clearly how you work out your answer.

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(3 marks)

8

END OF QUESTIONS



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