

Centre Number						Candidate Number				
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
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TOTAL	



General Certificate of Education  
Advanced Subsidiary Examination  
June 2013

# Science in Society

# SCIS1

## Unit 1 Exploring Key Scientific Issues

Wednesday 5th June 2013 1.30 pm to 3.30 pm

<p><b>For this paper you must have:</b></p> <ul style="list-style-type: none"> <li>• a calculator</li> <li>• a ruler.</li> </ul>
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### Time allowed

- 2 hours

### 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.
- Show all your working.
- 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 will be marked on your ability to:
  - use good English
  - organise information clearly
  - use specialist vocabulary where appropriate.



J U N 1 3 S C I S 1 0 1

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

- 1** In the 19th century puerperal (childbed) fever killed many women just after they had given birth. Ignaz Semmelweis collected data about the death rates in two clinics at the Vienna maternity hospital. Clinic 1 was staffed by male doctors and medical students, and Clinic 2 was staffed by female midwives. **Figure 1** shows the births, deaths and death rates in each clinic during 1841–1846.

**Figure 1**  
**Deaths due to puerperal fever at Vienna maternity hospital**

	Clinic 1 (doctors and students)			Clinic 2 (midwives)		
	births	deaths	death rate %	births	deaths	death rate %
1841	3036	237	7.8	2442	86	3.5
1842	3287	518	15.8	2659	202	7.6
1843	3060	274	9.0	2739	164	6.0
1844	3157	260	8.2	2956	68	2.3
1845	3492	241	6.9	3241	66	2.0
1846	4010	459	11.4	3754	105	2.8
Total	20042	1989		17791	691	
Average			9.92			3.88

- 1 (a)** Discuss how the death rates in Clinic 1 and Clinic 2 compare over the six year period.

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(2 marks)

- 1 (b)** One hypothesis about the cause of puerperal fever was:

*“Women felt embarrassed and ashamed when they gave birth in the presence of men. This made them ill.”*

- 1 (b) (i)** Do the data shown in **Figure 1** support this hypothesis? Explain your answer.

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(2 marks)



**1 (b) (ii)** Semmelweis looked at other data and found that:

A	women who gave birth at home, or on the street, were less likely than women in Clinic 1 to contract puerperal fever and die.
B	babies whose mothers had died of puerperal fever were also likely to die, with symptoms the same as their mothers.

Explain whether these findings support or oppose the embarrassment hypothesis.

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*(2 marks)*

**1 (c)** Doctors carried out post-mortems on women who had died from puerperal fever. These doctors often went straight to Clinic 1 to examine women in labour.

In March 1847 a doctor died after being pricked by a scalpel while carrying out a post-mortem of a woman who had died from puerperal fever. His disease showed the same symptoms as puerperal fever.

Semmelweis proposed the hypothesis that puerperal fever was spread by 'cadaverous particles'.

**1 (c) (i)** Suggest what the 'cadaverous particles' might be.

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*(1 mark)*

**1 (c) (ii)** How would Semmelweis' hypothesis explain the difference in death rates in Clinic 1 and Clinic 2?

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*(2 marks)*

**Turn over ▶**



**1 (d)** In May 1847 Semmelweis insisted that all doctors and medical students washed their hands with disinfectant before entering Clinic 1. The average death rate in the clinic dropped to 3%.

After Semmelweis left the Vienna maternity hospital, medical staff stopped the hand-washing procedure. His 'cadaverous particles' hypothesis was not widely accepted until the 1890s.

Suggest why it took a long time for the existence of 'cadaverous particles' to be accepted.

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(2 marks)

<b>11</b>



**2** Cycling can reduce traffic congestion, improve air quality and increase the activity levels and health of cyclists.

**2 (a)** Researchers in the Netherlands carried out a review of previous research which compared the exposure of drivers and cyclists to air pollution.

One of the pollutants studied was carbon monoxide. Car drivers were exposed to concentrations of carbon monoxide between  $1300\mu\text{g}/\text{m}^3$  and  $4800\mu\text{g}/\text{m}^3$ .

**2 (a) (i)** How is carbon monoxide produced by cars?

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(1 mark)

**2 (a) (ii)** What is meant by concentration of a pollutant?

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(1 mark)

**2 (b)** The researchers considered eight studies which examined exposure to air pollution during cycling and car driving in different cities.

The studies measured the concentration of different pollutants for a number of routes and times of day. **Figure 2** shows the ratio (car drivers/cyclists) of pollutant concentrations measured by these studies.

**Figure 2**  
**Comparison of pollutant concentrations to which car drivers and cyclists were exposed**

Pollutant	Ratio of pollutant concentrations car drivers/cyclists		Number of studies considered
	Mean	Range	
Carbon monoxide	1.99	1.18–2.80	2
Diesel soot	1.65	1.60–2.60	4
Ultrafine particles	1.01	0.91–1.06	3
PM <sub>2.5</sub>	1.16	1.06–1.32	4

**2 (b) (i)** Suggest why the studies measured pollutant concentrations at different times of day.

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(1 mark)

Turn over ►



**2 (b) (ii)** In **Figure 2** what does a ratio greater than 1 represent in terms of exposure to a pollutant?

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(1 mark)

**2 (b) (iii)** State **two** conclusions about exposure to a pollutant for car drivers and cyclists which can be drawn from these data.

Conclusion 1 .....

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Conclusion 2 .....

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(2 marks)

**2 (c)** Many people think that the risks of cycling in traffic are greater than the benefits gained.

To investigate this, researchers calculated the relative risks to cyclists and drivers associated with:

- breathing in pollutants
- accidents
- physical activity.

From this, they calculated the corresponding increase or decrease in life expectancy.

The results of their calculations are shown in **Figure 3**.

**Figure 3**  
**Relative risk and mean change in life expectancy on changing to cycling**

Factor	Relative risk (cycling/driving)	Mean change in life expectancy
Breathing in air pollution	1.001–1.053	–21 days
Traffic accidents (journeys under 7.5 km)	0.996–1.010	–7 days
Physical activity	0.500–0.900	+8 months



**2 (c) (i)** Suggest why the risk to cyclists from breathing in pollutants is greater than for car drivers despite the lower concentrations of pollutants (**Figure 2**) they are exposed to.

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(1 mark)

**2 (c) (ii)** A student is thinking about using either a car or a bike to travel to college 6 km away.

Use your knowledge about transport issues, and the data in **Figure 2** and **Figure 3**, to recommend whether they should drive or cycle.

Quality of written communication will be assessed in your answer.

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**3** Asthma affects the airways leading to the lungs, causing wheezing and shortness of breath. The main medications used for asthma are based on a group of substances known as glucocorticoids. These are usually taken using an inhaler.

The effectiveness of the medication varies; some patients who use it show no improvement.

Some researchers think that there is a genetic basis to the response to glucocorticoids in different patients.

**3 (a)** Suggest how the researchers could use family histories to provide evidence of a genetic basis to glucocorticoid response.

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*(2 marks)*

**3 (b)** The researchers used DNA samples taken from patients enrolled on four different clinical trials of asthma medication. They chose patients who were receiving the medication, and not a placebo.

They identified a gene which was associated with response to glucocorticoids in all four groups of patients.

There were two alleles of the gene, called C and T.

**3 (b) (i)** What is meant by a gene?

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*(1 mark)*

**3 (b) (ii)** The T allele contains a small mutation.

What causes mutations in genes?

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*(1 mark)*

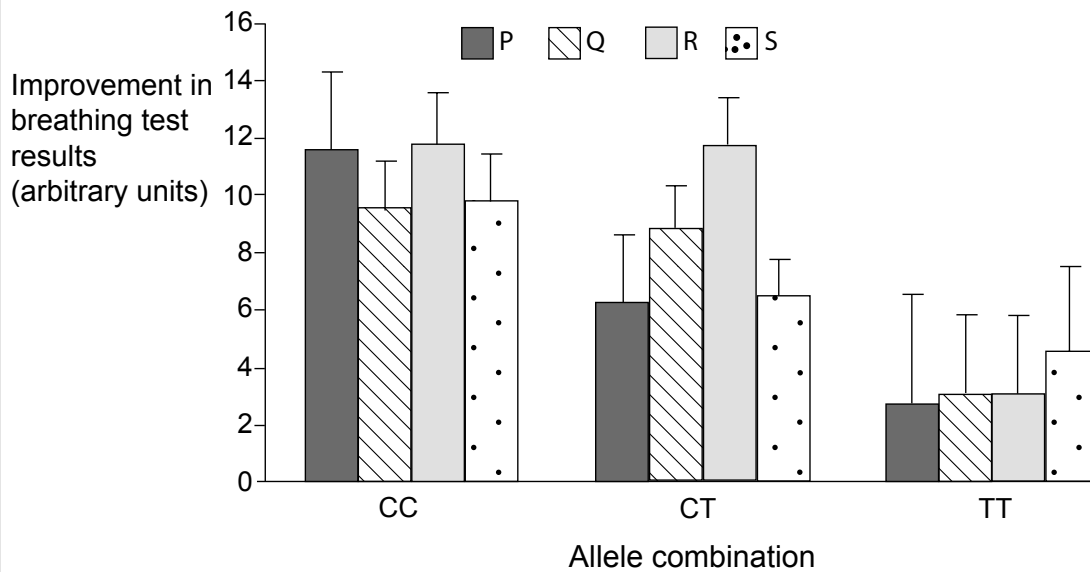




- 3 (c)** To measure the effect of the asthma medication in the clinical trials all the patients took a breathing test. This test measured how strongly they could breathe out in 1 second. In each trial they took the test again after taking the medication for 4–8 weeks.

**Figure 4** shows the mean improvement in the results of the breathing test in four clinical trials, P, Q, R and S. Each trial included patients with each of the possible combinations of the two alleles.

**Figure 4**  
Improvement in breathing test results in four clinical trials



- 3 (c) (i)** Explain why each person has two copies of this gene.

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 (1 mark)

- 3 (c) (ii)** The data are shown with error bars. Why are these useful in interpreting the data?

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 (2 marks)

Turn over ▶



**3 (c) (iii)** Using the data in **Figure 4**, discuss how the information could be used in the future by doctors prescribing asthma medicine to a patient.

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(3 marks)

<b>10</b>



4

Why zebras sport black-and-white stripes is a puzzle that has nagged experts for decades, but now it's finally been solved. Researchers in Sweden have shown that the characteristic markings keep many different species of horsefly at bay.

They say that the stripes, which are unique to each animal, are unappetising to the hungry pests, which have a nasty bite and spread lethal blood diseases. The reason they find the stripes so unattractive is because they reflect light in a certain way. Horseflies, it turns out, prefer the 'flat' light produced by darker coats.

Tests were carried out in a field in Eastern Europe using life-sized models of horses painted white, brown, and with stripes and spots. The models were coated with oil and glue to trap the insects.

'We started off studying horses with black, brown or white coats,' lead researcher Susanne Akesson told the BBC. 'We found that in the black and brown horses, we get horizontally polarised light. From a white coat, you get unpolarised light.'

Akesson explained that horseflies don't like this type of light but surprisingly, in experiments, were found to hate striped coats even more.

She said: 'We were expecting to find that a striped coat, having half of the coat covered with a black surface and half white, would show intermediate attraction to the horseflies, but in fact it was as good as, or even better than, the white surface in terms of attracting few horseflies.'

Dr Akesson acknowledged that there are competing theories about why zebras evolved stripes, such as camouflage against predators, thermoregulation, a way of recognising other herd members and to stimulate grooming, but she argues that they have not been critically tested.

Horseflies, however, can kill - which would provide the necessary *evolutionary pressure* for stripes.

adapted from <http://www.dailymail.co.uk/sciencetech/article-2098731/Zebras-black-white-stripes-horse-flies-bay-claim-researchers.html>

4 (a) The researchers say the stripes are unappetising to horseflies. Suggest what data the scientists collected to support this claim.

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(1 mark)

Turn over ▶



**4 (b)** Scientists are more likely to accept that a factor is a cause of an outcome if they can identify a plausible mechanism to explain an observed correlation.

**4 (b) (i)** Give **one** example of a correlation mentioned in the passage.

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(1 mark)

**4 (b) (ii)** What mechanism is suggested as a possible explanation?

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(1 mark)

**4 (c) (i)** Explain what is meant by the term *evolutionary pressure*.

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(2 marks)

**4 (c) (ii)** Explain how horseflies could have acted as an evolutionary pressure in the evolution of striped zebras from ancestors with dark-coloured coats.

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(3 marks)



**4 (d)** Suggest further research that could be carried out to test the hypothesis that horseflies had a role in the evolution of zebra stripes.

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(2 marks)

10

**Turn over for the next question**

**Turn over ▶**



**5** Researchers wanted to investigate a possible link between drinking fizzy drinks and violence.

They analysed data collected from a sample of school students in Boston, USA. Students aged between 14 and 18 years were asked to fill in a questionnaire which took about 40 minutes to complete.

Some of the questions asked about exposure to violence and violent activity in the previous year. By violent activity the researchers meant that the teenager had ‘got into a physical fight with another child, or pushed, shoved, slapped, hit, punched, kicked, choked or attacked or threatened the other child with a weapon.’

There was also one question asking how many cans of (non-diet) fizzy drinks they drank in the seven days before the questionnaire.

**5 (a) (i)** Suggest **two** reasons why it would be difficult to carry out an experiment to investigate a link between fizzy drinks and violence.

Reason 1 .....

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Reason 2 .....

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*(2 marks)*

**5 (a) (ii)** Suggest why responses to questionnaires, such as the one used by the researchers, may be unreliable.

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*(1 mark)*

**5 (b)** **Figure 5** shows data on the number of cans of drink reported and certain violent activities for the students who answered the fizzy drink question.

**Figure 5**  
**Fizzy drink consumption and other behaviours**

Behaviour shown in the past year	Fizzy drink consumption in past 7 days			
	≤1 can (N=722)	2–4 cans (N=414)	5–7 cans (N=237)	14+ cans (N=245)
Violent towards peers	35.1%	46.1%	54.7%	58.6%
Violent in dating relationship	15.3%	17.6%	25.3%	26.9%
Violent towards other children in family	24.5%	30.3%	38.7%	45.3%



5 (b) (i) State **two** conclusions that can be drawn from the data in **Figure 5**.

Conclusion 1 .....

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Conclusion 2 .....

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(2 marks)

5 (b) (ii) Comment on the definition of violent activity used by the researchers and the effect that this might have on the validity of their findings.

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(2 marks)

5 (c) Newspaper headlines reporting the research included:

<p style="text-align: center;">“Fizzy drink makes kids violent, claims study”</p> <p style="text-align: center;">“Just one can of fizzy drink a day will make teenagers behave more aggressively”</p>
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Discuss whether these headlines accurately represent the link between violence and fizzy drink consumption found in the research.

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(4 marks)



**6** Hepatitis C is an infection of the liver caused by the hepatitis C virus. It is spread by contact with infected blood. There are many different strains of the virus in different regions of the world.

About 1 in 5 people who catch hepatitis C recover due to their natural immune response to the illness.

Many people infected with hepatitis C show no symptoms in the initial stages of the disease so don't seek medical help. Therefore most estimates of the number of people who have hepatitis C are based on blood samples from people being tested for other reasons, eg pregnant women, intravenous drug users or blood donors.

There are an estimated 160 million people infected with hepatitis C worldwide.

**6 (a) (i)** Explain how a virus reproduces.

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*(2 marks)*

**6 (a) (ii)** Describe how the immune system responds to infection.

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*(2 marks)*

**6 (a) (iii)** Considering the sample of people used to estimate the numbers infected with hepatitis C, suggest why 160 million may be an inaccurate estimate.

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*(2 marks)*





**6 (b)** Researchers are working on the development of vaccines against the main strains of the hepatitis C virus. It has been difficult to develop a vaccine because the hepatitis C virus mutates frequently.

The researchers inserted small pieces of DNA from one strain of the hepatitis C virus found in the USA into a strain of the common cold virus. They hoped that the immune system would respond to this combined virus by showing an immune response.

Explain why the fast mutation rate of hepatitis C virus makes it difficult to develop a vaccine for the disease.

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*(2 marks)*

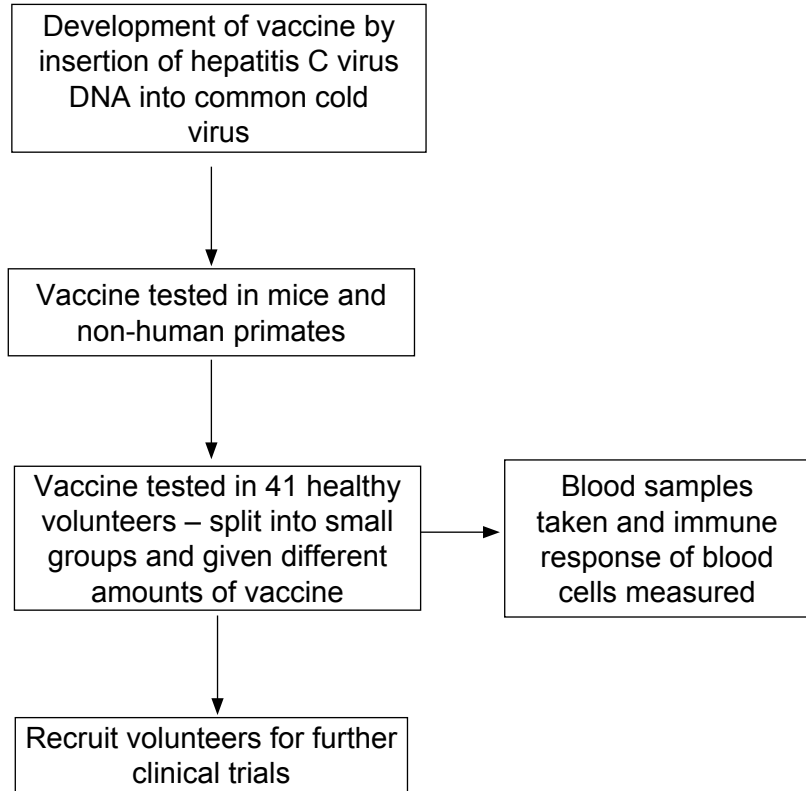
**Question 6 continues on the next page**

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6 (c) **Figure 6** shows an outline of the process that the researchers have used so far to develop and test a vaccine for hepatitis C.

**Figure 6**  
**Stages in the development of a hepatitis C vaccine**



6 (c) (i) Why is it important to test the vaccine initially in healthy volunteers?

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(2 marks)



**6 (c) (ii)** Describe briefly the further clinical trials required before the researchers are able to produce a vaccine against hepatitis C suitable for worldwide distribution.

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(3 marks)

13

**Turn over for the next question**

**Turn over ▶**



**7** In 2011 the UK Government announced the location of eight areas in the UK for new nuclear power plants to be built. They are all near existing nuclear power station sites.

In some of the areas campaigners were strongly opposed to the plans, claiming that the risks of increased radiation dose (irradiation) and environmental contamination were too high. However, some local residents were pleased with the news.

**7 (a) (i)** Explain the difference between irradiation and contamination from nuclear material.

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*(2 marks)*

**7 (a) (ii)** Many people are unwilling to have a nuclear power station near their homes, even though they may take part in activities that have a much larger risk. Suggest **two** possible reasons for this attitude to risk.

Reason 1 .....

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Reason 2 .....

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*(2 marks)*

**7 (a) (iii)** Why might some local residents be pleased with the news of a new nuclear power station near their homes?

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*(1 mark)*



**7 (b)** Leukaemia is a type of cancer. In Great Britain the rate of leukaemia in children aged between 0–14 years is approximately 40 per million children.

Some campaigners suggest that nuclear power plants may cause childhood leukaemia ‘cancer clusters’. These are places where there are more cases of leukaemia than might be expected.

Researchers used the Swiss National Census to carry out a *cohort study* to investigate the incidence of childhood leukaemia at different distances from nuclear power plants in Switzerland.

**7 (b) (i)** What is a cohort study?

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(1 mark)

**7 (b) (ii)** Why was it necessary to use a large sample size for the study into childhood leukaemia?

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(1 mark)

**Question 7 continues on the next page**

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**7 (c)** For each case of leukaemia diagnosed the researchers calculated how far the child's home was from a nuclear facility. The types of facilities they investigated were:

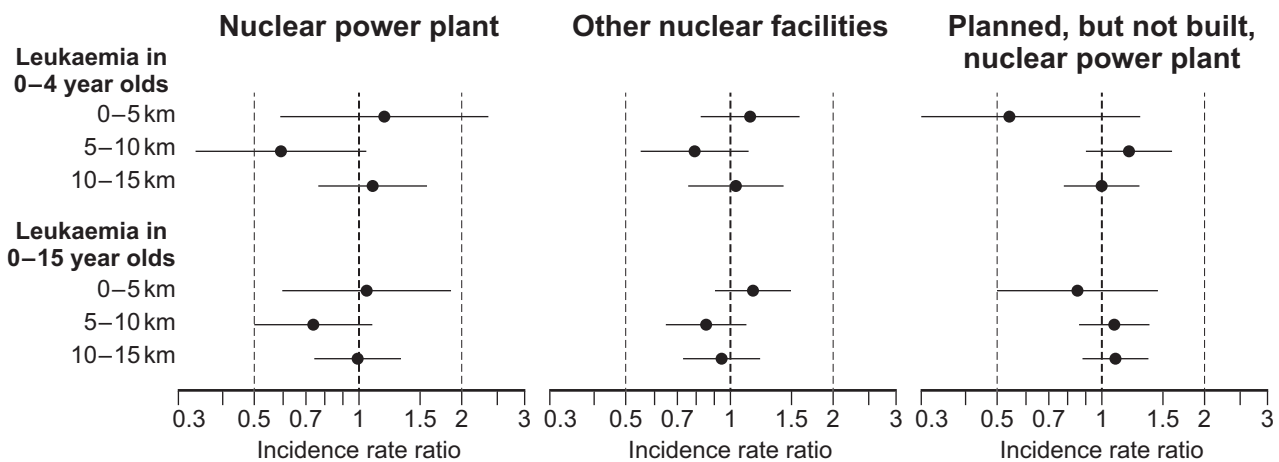
- nuclear power plants
- other nuclear facilities (such as research reactors or nuclear waste storage sites)
- sites where a nuclear power plant was planned, but never built.

The researchers compared the rate of leukaemia at a particular distance from a facility with the rate in children who lived far away. They compared these two rates by calculating a ratio. The results are shown in **Figure 7**.

A ratio greater than 1 means a higher chance of being diagnosed with leukaemia compared with children living far away.

**Figure 7**

**Ratio of rates of leukaemia at different distances from nuclear facilities in Switzerland**



**7 (c) (i)** Do the data in **Figure 7** provide evidence of a link between rate of leukaemia and the distance of a child's home from a nuclear facility? Explain your answer.

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(2 marks)

**7 (c) (ii)** Suggest why the researchers included in their analysis data on the rates of leukaemia in areas where nuclear power plants were planned but not built.

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(2 marks)

<b>11</b>

**Turn over for the next question**

**Turn over ▶**



**8** Passages 1 and 2 are adapted from press releases about space exploration.

Passage 1: European Space Agency

It's not easy to send people into space. Around the world national space agencies and scientists are investigating some of the difficulties that future space explorers may face. By simulating space missions on Earth, scientists hope to be able to understand some of the risks involved in future crewed missions.

In the Mars-500 project six crew members took part in a simulated mission to Mars. They spent 520 days sealed inside a 'spacecraft' and followed the phases that a real mission would involve: flight to Mars, orbiting the planet, landing and exploring the surface and finally a long flight back to Earth. The data from the mission will help mission planners understand some of the psychological stresses involved in long flights.

Passage 2: UK Space Agency

Space is an essential part of all our everyday lives and one of the key enablers of the global economy.

Space has revolutionised telecommunications services, climate and weather forecasting, commerce, environmental management, security, banking, navigation and TV broadcasting.

The UK Space Agency is at the heart of UK efforts to explore space, exploit space-based applications and technology and support our academic and industrial communities. It works to understand better the origins of the Universe, the make-up of our Solar System, and how climate change is affecting our own planet.

**8 (a)** All the crewed space missions currently being planned focus on the International Space Station, the Moon, Mars and asteroids, rather than planets orbiting other stars. Suggest why this might be.

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(1 mark)





**8 (b)** Cosmic rays are present in much greater numbers in space than on Earth. They are particles such as protons and electrons moving at almost the speed of light. They are highly *ionising*. Their effects are rarely included during simulated missions.

**8 (b) (i)** What is meant by ionising?

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(1 mark)

**8 (b) (ii)** Why are the effects of cosmic rays rarely included during simulated missions?

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(1 mark)

**8 (c)** Space agencies regularly send out press releases and hold press conferences to provide information about the progress and findings of actual and simulated missions.

Suggest why it is important to them to publicise their work.

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**Question 8 continues on the next page**

**Turn over ▶**



**8 (d)** The European Space Agency is part of an international group that is planning a crewed mission to Mars.

The UK Space Agency does not fund crewed space exploration. It focuses on supporting the development and use of satellites in space.

Has the UK Space Agency made the right decision?

Explain your viewpoint by discussing the advantages and disadvantages of the funding priorities of the two space agencies.

Quality of written communication will be assessed in your answer.

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**END OF QUESTIONS**

<b>11</b>



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