Centre Number						Candidate Number				
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Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
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8	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
June 2012

Science in Society SCIS1

Unit 1 Exploring Key Scientific Issues

Wednesday 30 May 2012 9.00 am to 11.00 am

For this paper you must have:
- a calculator
- a ruler.

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.

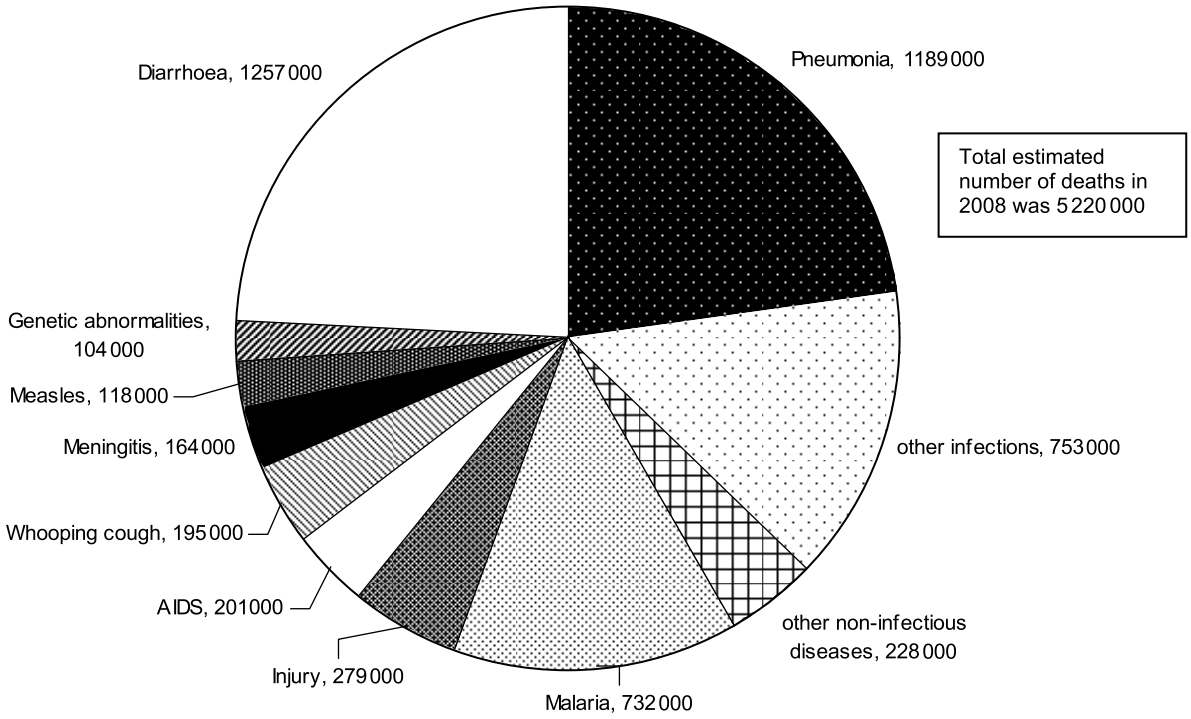
Answer **all** questions in the spaces provided.

1 In September 2000 World Leaders at the United Nations (UN) agreed a number of targets which became known as the Millennium Development Goals. Each country said that it would work together with others to achieve the targets by 2015.

One Millennium Development Goal is for countries to achieve a two-thirds reduction in the number of deaths of children aged 5 or under compared with the figure in 1990. Each year researchers produce reports showing the change in the estimated number of deaths over time.

Figure 1 shows the causes and estimated numbers of deaths of children between 1 month and 5 years worldwide. The numbers shown are for 2008.

Figure 1
Worldwide deaths of children between 1 month and 5 years old



Source: Adapted from The Lancet Vol 375, Issue 9730, Black et al (2010)

1 (a) (i) Name **two** causes of death shown in **Figure 1** which are not infectious diseases.

Cause 1 .....

Cause 2 .....

(1 mark)

1 (a) (ii) Choose **one** example of an infectious disease shown in **Figure 1**, and describe and explain how its spread could be prevented.

Disease: .....

Prevention method (and why this works): .....

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(2 marks)

1 (a) (iii) Scientists have not yet succeeded in creating a vaccine against HIV, the cause of AIDS. Give **one** reason for this.

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(1 mark)

1 (b) Diarrhoea may occur during viral or bacterial infections. In babies and children it can lead to dehydration very quickly. **Figure 2** shows the estimated number of children dying from diarrhoea in four countries.

Figure 2
Number of child deaths due to diarrhoea in four countries in 2008

Country	Estimated number of deaths due to diarrhoea	Population (approx)
India	237 482	1 173 108 000
Nigeria	201 368	152 217 000
Norway	6	4 676 000
UK	4	62 348 000

1 (b) (i) There are many more deaths from diarrhoea in countries in the developing world, such as Nigeria, than in the UK. Suggest why this might be the case.

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(1 mark)

1 (b) (ii) India and Nigeria have a similar numbers of deaths. Using the data in **Figure 2** suggest why policy makers may recommend focussing more on reducing the incidence of diarrhoea in Nigeria.

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(2 marks)

1 (c) In 1990 there were an estimated 12.4 million deaths of all children under 5 years worldwide. In 2010 the corresponding number of deaths was 7.7 million.

1 (c) (i) Suggest **one** reason why it is difficult for researchers to collect accurate data on childhood deaths in some countries.

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(1 mark)

1 (c) (ii) Discuss whether you think that the Millennium Development Goal of a two-thirds reduction in deaths will be met by 2015.

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(2 marks)

1 (d) The data gathering and report writing for the 2008 data shown in **Figure 1** was funded by the Bill and Melinda Gates Foundation, an organisation which aims to enhance healthcare and reduce poverty. The authors of the report wrote:

"The sponsors of the study had no role in study design, data collection, analysis and interpretation or writing of the report."

Why was this information included in the report?

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(1 mark)

11

2 Appendicitis is a painful medical condition. It is treated as a medical emergency and usually results in surgery to remove the appendix.

The reason why appendicitis occurs is not fully understood but it is usually thought to be caused by blockage or infection in the appendix.

2 (a) Researchers in Canada have proposed a hypothesis that air quality on a given day may be a factor in developing appendicitis shortly afterwards. The researchers make the following statements:

A	Incidence of appendicitis increased in industrialised nations in the 19th and early 20th Centuries, and then decreased later in the 20th Century.
B	In the UK there was a 36% drop in the incidence of appendicitis between 1975 and 1994 after legislation was passed in 1956 and 1968 to improve air quality.

2 (a) (i) Choose one of the statements and explain how it supports the researchers' hypothesis.

Statement: .....

Explanation: .....

.....

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(1 mark)

2 (a) (ii) Other researchers are less certain of the link. Suggest an argument that they could use to challenge the use of either statement A or B to support the hypothesis.

Statement: .....

Argument: .....

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(1 mark)

Question 2 continues on the next page

2 (b) The researchers investigated appendicitis in one city for nearly 8 years. There were 5191 cases of appendicitis in that time. Patients were identified using hospital admission databases.

For each patient they compared

- the air pollution on the day on which a patient was admitted into hospital, with the air pollution on the same day of the week before they were admitted into hospital.
- the average air pollution 5 days prior to the appendicitis occurring, and a similar period the week before that.

In this way, each patient acted as both the case and the control for the research.

2 (b) (i) Why is it important for the researchers to have a control in the study?

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(1 mark)

2 (b) (ii) Give **one** advantage of using the same patient as both the case and the control.

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(1 mark)

2 (c) The researchers calculated the odds ratio for the risk of appendicitis. An odds ratio greater than 1 means that a case of appendicitis was more likely if there was an increase in air pollutants on the day, or in the 5 days before the attack.

Figure 3 shows their value for each odds ratio. The figures in brackets are the minimum and maximum likely values.

Figure 3
The odds ratio for the risk of appendicitis associated with increases in pollutants

		Odds Ratio (minimum-maximum)		
		Age range		
Pollutant	**Time interval**	**18-34 (618 patients)**	**35-64 (630 patients)**	**>64 (121 patients)**
ozone	same day	1.04 (0.85–1.27)	0.87 (0.71–1.07)	0.93 (0.58–1.50)
	5-day average	1.39 (1.06–1.81)	1.29 (0.99–1.68)	1.10 (0.62–1.96)
sulfur dioxide	same day	0.99 (0.79–1.23)	1.37 (1.10–1.70)	0.96 (0.59–1.57)
	5-day average	1.03 (0.73–1.46)	1.47 (1.04–2.07)	2.03 (0.98–4.23)

Source: Adapted from Canadian Medical Association Journal, Kaplan et al (2009)

2 (c) (i) State **three** possible conclusions that could be drawn from the data given in **Figure 3**.

Conclusion 1 .....

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Conclusion 2 .....

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Conclusion 3 .....

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(3 marks)

2 (c) (ii) What would make these researchers, and other scientists, more confident that there is a correlation between daily air pollution and risk of appendicitis?

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(2 marks)

2 (c) (iii) What would make scientists more confident that air pollution is a cause of appendicitis?

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(1 mark)

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Turn over for the next question

3 In caves in Mexico there are a number of populations of small fish called Cave Mollies. In one of these cave systems, a religious ceremony is carried out once a year by the local people. As part of the ceremony plant roots are thrown into the water.

The plant roots contain a *chemical compound* called rotenone. The rotenone anaesthetises the fish, which causes them to stop swimming. The fish are then collected for food.

3 (a) Explain what is meant by the term chemical compound.

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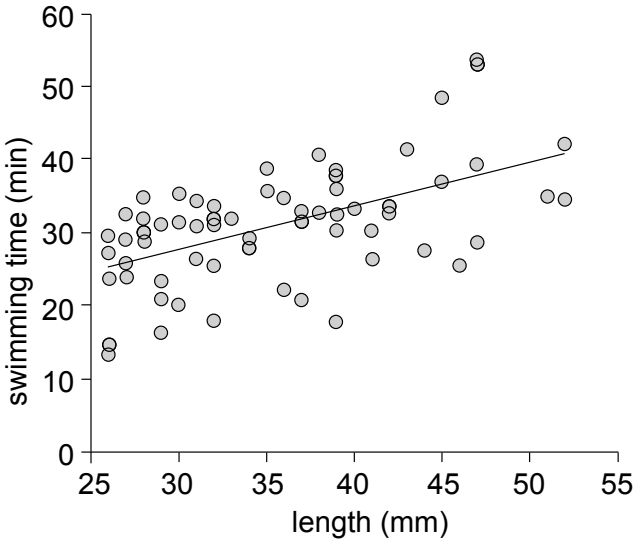
(1 mark)

3 (b) Researchers investigated how the religious festival has affected the population of fish in the cave system. Before the ceremony, they collected fish from 2 areas in the cave system near the ceremony and 2 areas away from the ceremony. In total 64 fish were collected.

The researchers prepared a solution of known concentration of rotenone from the plant root.

The length of each fish was measured before it was put into a tank on its own. 5ml of the solution was added to the tank at 2 minute intervals over 1 hour. **Figure 4** shows the relationship between the length of each fish and how long it took before it stopped swimming.

Figure 4
Swimming time as a function of fish length during exposure to rotenone



3 (b) (i) Give **one** advantage of using a rotenone solution of known concentration, rather than pieces of root.

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(1 mark)

3 (b) (ii) Describe the relationship between swimming time and fish length shown in **Figure 4**.

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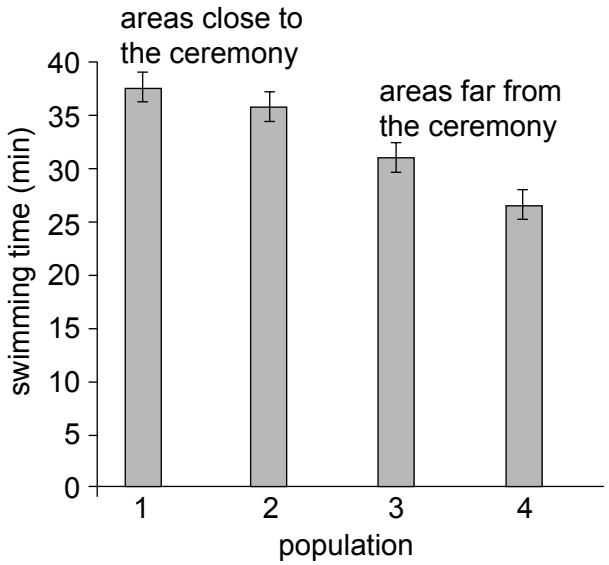
(2 marks)

3 (c) **Figure 5** shows the average time it took fish from the different collection areas to stop swimming.

- *Areas 1 and 2* were near where the ceremony took place, and the fish populations have previously been exposed to the rotenone.
- *Areas 3 and 4* were in parts of the caves far from the ceremony, and the fish populations there have not been previously exposed to rotenone.

The layout of the caves means that the fish populations in each of the four areas are separate and isolated from the others.

Figure 5
Swimming time of fish from each area during exposure to rotenone



3 (c) (i) The data in **Figure 5** are shown with error bars. Explain why these are useful in interpreting the data.

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(1 mark)

Turn over ▶

3 (c) (ii) Do the data in **Figure 5** show a relationship between the location of the fish and swimming time? Explain your answer.

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(2 marks)

3 (d) The researchers came to the conclusion that the religious ceremony is an example of human-induced evolution in populations of cave fish that have been exposed to rotenone.

Suggest **one** way in which natural selection, and human behaviour, could have led to a change in the population of the fish over time.

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(3 marks)

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Source for Figure 4 and Figure 5 on previous page: Adapted from 'An Indigenous Religious Ritual Selects for Resistance to A Toxicant in A Livebearing Fish', Tobler et al, Biology Letters, Royal Society Publishing (September 2010)

4 Cystic Fibrosis is a recessive genetic disease. It is caused by a mutation in the gene coding for a protein that regulates movement of substances across cell membranes. The disease causes the lungs and digestive system to become clogged with thick, sticky mucus. This leads to frequent infections. Currently there is no known cure for the disease. The *median life expectancy* of someone with Cystic Fibrosis is 35.

4 (a) (i) Give **one** cause of genetic mutation.

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(1 mark)

4 (a) (ii) Explain what is meant by the term median life expectancy.

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(2 marks)

4 (b) About 1 person in 25 in the UK is thought to be a carrier for Cystic Fibrosis. Adults can be screened for the cystic fibrosis gene using a mouthwash test to obtain cheek cells for genetic analysis.

4 (b) (i) Explain why carriers show no symptoms of Cystic Fibrosis?

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(2 marks)

4 (b) (ii) If a man and a woman, both of whom are carriers, have a child, what is the likelihood the child would have Cystic Fibrosis? Explain your answer.

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(2 marks)

4 (c) Researchers investigated whether the incidence of Cystic Fibrosis in Italy has changed over the past decade. They compared the numbers of babies born and diagnosed in two similar regions of Italy where the carrier screening policy is different.

Western region: testing offered only to couples with a history of Cystic Fibrosis in the family, and those undergoing IVF treatment

Eastern region: testing offered to anyone who wants it for a small fee.

Not all parents in the Eastern region chose to be screened for Cystic Fibrosis. Apart from cost considerations, suggest why this might be.

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(2 marks)

Source for Figure 6 and Figure 7 (opposite): Adapted from 'Association between Carrier Screening and Incidence of Cystic Fibrosis', Castellani et al, The Lancet, Elsevier Publishing (2009)

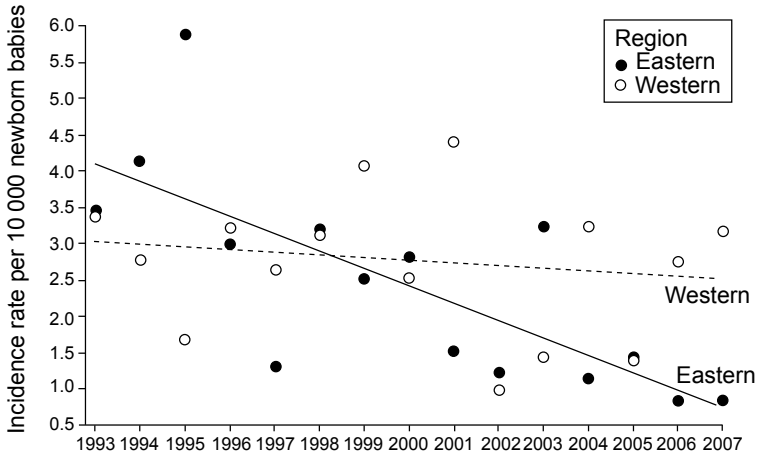
4 (d) **Figure 6** shows the number of tests carried out in each region between 1993 and 2007, and the results of the tests.

Figure 6
Test results for Cystic Fibrosis carrier screening

	Western Region	Eastern Region
Total number of tests	2559	87025
One of couple is a carrier	314	3650
Both of couple are carriers	9	82

Figure 7 shows the number of babies born with Cystic Fibrosis per 10000 babies born in the two regions. The lines show the line of best fit for each data set.

Figure 7
Incidence of Cystic Fibrosis in babies born in two similar regions of Italy



4 (d) Use the data from **Figures 6 and 7** to write a conclusion about the effect of the different screening policies on the incidence of Cystic Fibrosis.

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(3 marks)

5 A placebo is something given to a patient which is not believed to have any physical effect on the condition they are suffering from. Sometimes, however, getting a placebo leads to improvement. This is known as the placebo effect.

5 (a) Describe how a clinical trial of a new treatment can be designed to minimise the placebo effect on the results.

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(2 marks)

5 (b) A research study aimed to investigate the placebo effect in the use of the painkiller morphine. Patients who had undergone an operation were split into two groups:

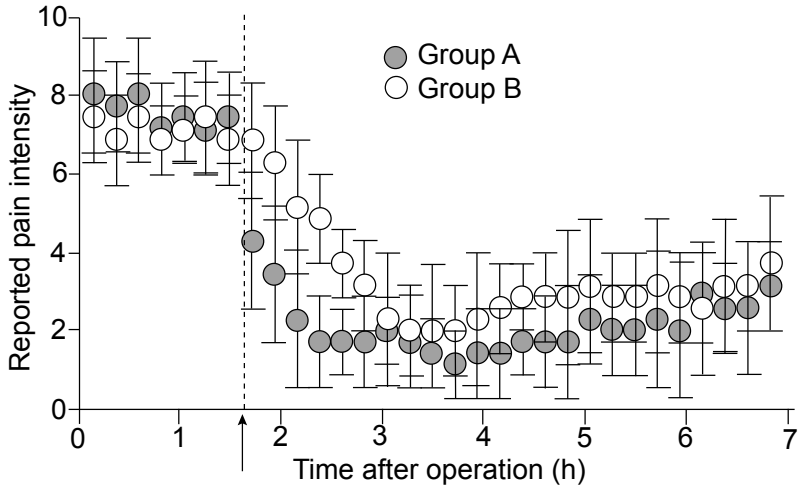
Group A: were told that they would get morphine, and when it would be given

Group B: were told that they **might not** get morphine, but **were** actually given morphine at the same time as group A

Morphine could be given to patients in group B without them being aware of it because the patients all had intravenous drips.

After the operation patients were asked to say how bad their pain was on a scale of 1-10, where 1 was no pain and 10 was unbearable pain. **Figure 8** shows the results for patients in each group. During the experiment **both** groups of patients were given morphine at the same time as shown by the arrow and dotted line.

Figure 8
Reported pain intensity with time after operation.



Source: Adapted from 'Overt versus Covert Treatment for Pain, Anxiety and Parkinson's Disease', Colloca et al, The Lancet, Elsevier Publishing (2004)

5 (b) (i) Using the data in **Figure 8** compare the effect of morphine on reported pain intensity for Group A and Group B.

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(2 marks)

5 (b) (ii) Do the data in **Figure 8** provide evidence that morphine only works as a painkiller when patients know that they are receiving it? Explain your answer.

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(1 mark)

5 (c) Doctors sometimes suggest placebo treatments to their patients.

Doctors in the USA were questioned about their use of placebo treatments with patients. **Figure 9** shows a number of these placebo treatments, and the percentage of doctors who had suggested them to their patients.

Figure 9
Typical placebo treatments

Placebo treatment	**Percentage of doctors suggesting the treatment**
over-the-counter painkillers for symptoms unrelated to pain	41%
vitamins	38%
sedatives	13%
antibiotics (for a viral disease)	13%

5 (c) (i) Why might a doctor suggest a placebo treatment to a patient?

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(1 mark)

5 (c) (ii) Health officials are concerned about the use of antibiotics as a placebo treatment. Using your knowledge of infectious diseases, explain why they are concerned.

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(2 marks)

5 (d) Amongst the doctors in the survey many recommended the placebo treatment by saying:

"This is a medicine which is not typically used for your condition, but which may benefit you."

Do you think that it is acceptable for doctors to recommend placebo treatments to patients?

You should include both medical and ethical issues in your answer.

The quality of written communication will be assessed in your answer.

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(6 marks)

14

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Radiographers work mainly in hospitals. Much of their work uses *ionising radiation* to:

- create images
- diagnose disease
- treat disease.

The nature of their work means that they are exposed to higher levels of radiation than the general public.

In the US the recommended *radiation dose limit* for radiographers has decreased over time, as shown in **Figure 10**.

Figure 10
Recommended radiation dose limits for radiographers in the US since 1902

Year	Exposure (mSv)
1902	3000
mid 1920s	700
1934	300
1949	150
1957	50
1999 (in UK)	20

In the UK all hospitals must have a radiation safety policy. One such policy contains the following information:

Staff doses

- The hospital will ensure that ionising radiation doses received by staff are kept *as low as reasonably practicable*. The use of personal radiation monitors and/or environmental monitoring will measure exposures to ionising radiation for all staff.

6 (a) (i) Name one type of ionising radiation used in hospitals to create images.

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(1 mark)

6 (a) (ii) Explain how ionising radiation is used to treat disease.

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(1 mark)

6 (a) (iii) Explain why the radiation dose depends on the type of radiation used, as well as the activity of the source.

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(2 marks)

6 (b) (i) Suggest why recommended exposure limits have decreased over time, as shown in **Figure 10**.

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(1 mark)

6 (b) (ii) Name **two** ways in which radiation doses for medical staff may be kept *as low as reasonably practicable*.

Way 1 .....

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Way 2 .....

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(2 marks)

6 (b) (iii) The radiation dose limit set by the UK Health and Safety Executive for the general public is 1mSv. Why is it not set at 0 mSv?

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(1 mark)

6 (b) (iv) Why is it acceptable for radiographers to have a higher radiation dose limit than the general public?

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(2 marks)

10

7 Meteorites that land on Earth are thought to have been formed at around the same time as the planets and other bodies orbiting the Sun.

7 (a) Give **one** way in which the orbit of meteorites differs from that of planets.

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(1 mark)

7 (b) Geophysicists measured the proportion of two lead (Pb) isotopes in a meteorite to find out how old it is.

Suggest why scientists are interested in knowing the age of meteorites.

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(1 mark)

7 (c) The two lead isotopes are produced by the decay of uranium isotopes. The decay characteristics of two uranium (U) isotopes are shown in **Figure 11.**

Figure 11
Decay characteristics of two uranium isotopes

Decay	Half-life (approximate)
U-238 → Pb-207	704 million years
U-235 → Pb-206	4470 million years

7 (c) (i) What is the difference in atomic structure between the isotopes U-238 and U-235?

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(1 mark)

7 (c) (ii) Explain what is meant by radioactive decay.

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(1 mark)

7 (c) (iii) How long would it take for the amount of U-238 in a meteorite to have reduced to ¼ of the original amount? Show your working.

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(2 marks)

7 (c) (iv) Comment on how much the amount of U-235 would have reduced in the time you calculated in question 7(c)(iii). No calculation is required.

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(1 mark)

7 (c) (v) Explain why the ratio of Pb-207 to Pb-206 in the meteorite is different now, compared with when it was first formed.

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(2 marks)

7 (d) The geophysicists also measured the age of the meteorite by looking at the decay of a radioactive isotope of aluminium. **Figure 12** gives the age for the meteorite that they found.

Figure 12
Calculated age of a North West Africa meteorite

isotope(s) used	age of meteorite (million years)
Uranium isotopes	4568.20
Aluminium isotope	4568.14

What is the advantage of using two different methods to measure the age of the meteorite?

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(1 mark)

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8 Read the passage below about healthy eating and answer the questions that follow.

SIMPLY EATING YOUR FIVE A DAY WILL NOT PROTECT YOU AGAINST CANCER

It has been a part of healthy living for decades: eat more fruit and vegetables to beat cancer. Now, scientists have found that the anti-carcinogenic properties of such a diet are weak at best.

In one of the largest and longest studies into the link between diet and the killer disease, scientists surveyed the fruit and vegetable consumption of almost 400,000 men and women in 10 European countries including the UK over almost nine years, during which they developed 30,000 cancers.

They found that eating an extra 200 g of fruit and vegetables each day, equivalent to two servings, reduced the incidence of cancer by about 4 per cent.

The World Health Organisation in 1990 recommended five servings of fruit and vegetables a day. At this time it was suggested that potential reductions in cancer risk were as high as 50 per cent.

Is the 5-a-day recommendation now history? No. There is still good evidence that fruit and vegetables protect against heart disease and stroke. In the same population of men and women there was a 30 per cent lower incidence of heart disease and stroke among those eating five servings a day compared with those eating less than one and a half servings.

The over-emphasis on fruit and vegetables may also have come from the way the early research was conducted. These were mostly case control studies which rely on people's memories of what they ate, and depend on people volunteering to be controls. These volunteers are likely to have a strong interest in health.

Later in the 1990s, case control studies were replaced by *prospective studies* in which participants were asked about what they were eating at the time, and followed to see who developed cancer in the ensuing years. Results from these studies were consistently less impressive than the earlier ones.

It remains possible that specific foods have preventive effects against specific cancers, and that the overall effect of a diet high in fruit and vegetables is greater in younger people. Many foods including blueberries, broccoli and strawberries are also said to have anti-cancer properties.

Dr Rachel Thompson, science programme manager for the World Cancer Research Fund, said: "This study suggests that if we all ate an extra two portions of fruits and vegetables a day (about 150 g), about 2.5 per cent of cancers could be prevented. Given the fact that there are many types of cancer where there is no evidence eating fruits and vegetables affects risk, it is not surprising that the overall percentage is quite low. But for the UK, this works out at about 7,000 cases a year... a significant number."

Source: Adapted from The Independent, Jeremy Laurance, 7 April 2010.

8 (a) What changes in the body lead to the formation of a cancerous tumour?

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(2 marks)

8 (b) From the passage identify an example of potential bias in research.

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(1 mark)

8 (c) (i) Why is it important to have a large sample size when studying diet and cancer incidence?

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(2 marks)

8 (c) (ii) With the help of the passage explain what is meant by a prospective study.

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(2 marks)

Question 8 continues on the next page

8 (d) Do you think that the government should continue to publicise the 5-a-day healthy eating campaign?

Use the information from the passage, ideas about risk, and your own knowledge to support your answer.

The quality of written communication will be assessed in your answer.

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(6 marks)

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END OF QUESTIONS