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 2009

Science in Society SCIS1

Unit 1 Exploring Key Scientific Issues

Wednesday 3 June 2009 1.30 pm to 3.30 pm

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

Time allowed
- 2 hours

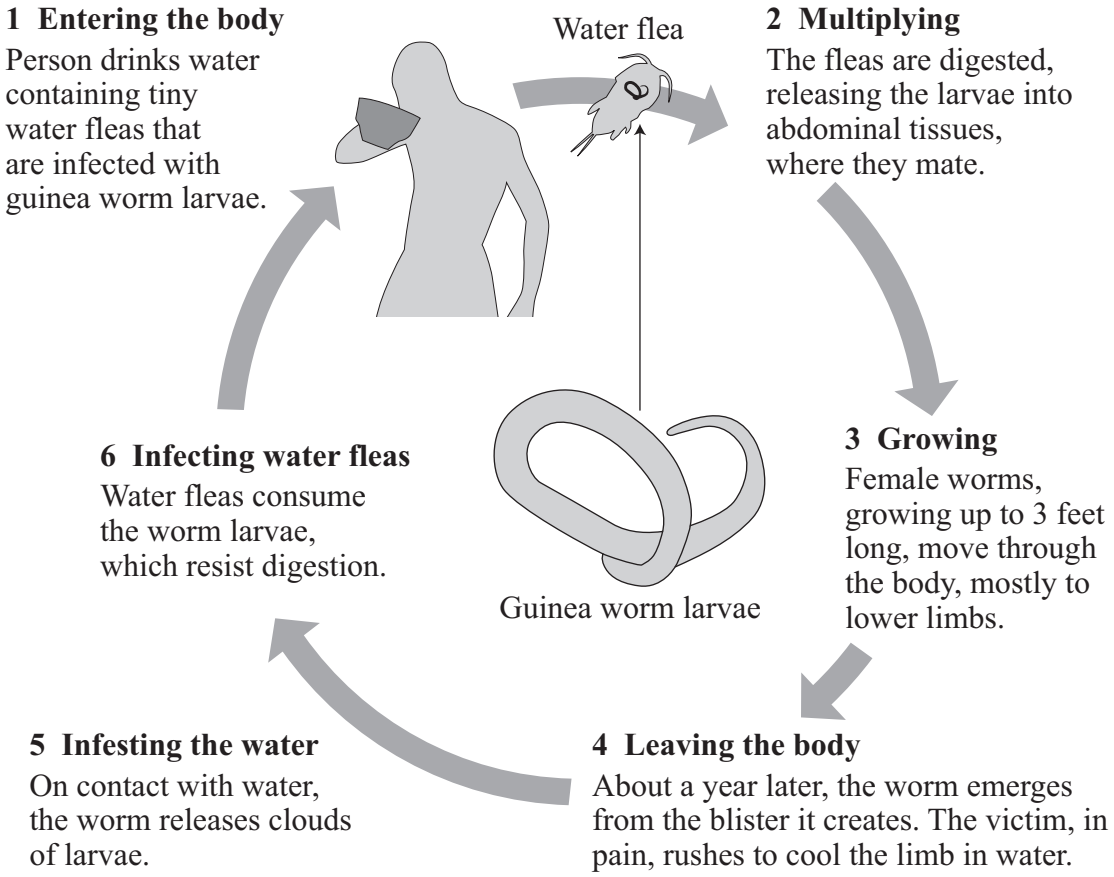
Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- Show all your working.
- Do all rough work in this 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 Guinea worm disease (GWD) is found in Africa and Asia. It is caused by a parasitic worm. This grows inside people for about a year, as shown in **Figure 1**. It then emerges through a very painful blister, usually on the lower limbs. Although the disease is painful, it rarely causes permanent damage.

Figure 1 The life cycle of the guinea worm parasite



In the early 1980s an eradication programme for GWD was started. This was based on using local solutions to prevent the spread of disease.

The programme included

- improved drinking water sources
- monitoring and reporting cases of guinea worm to national and international health authorities
- health education
- filters in domestic water storage containers.

1 (a) (i) How would using filters in water storage containers help prevent the spread of GWD?

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(1 mark)

1 (a) (ii) How would monitoring and reporting cases of GWD to national and international health authorities help prevent the spread of the disease?

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(2 marks)

1 (a) (iii) Developing a new drug to treat GWD was not considered a priority in the eradication programme. Give **three** advantages of improving water supplies and storage compared with the use of drugs.

Advantage 1.....

.....

Advantage 2.....

.....

Advantage 3.....

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(3 marks)

1 (b) **Figure 2** shows the number of GWD cases from 1986 to 2006 for a number of countries affected by the disease. It also shows the Gross Domestic Product (GDP) per capita for those countries.

Figure 2 Data from countries affected by Guinea worm disease

Country	GWD cases estimated 1986	GWD cases reported 1993	GWD cases reported 2006	GDP per capita (in US $) 2006 figures
India	23 000	755	0	3 800
Ghana	170 000	17 918	4 136	2 700
Pakistan	2 400	2	0	2 600
Sudan	60 000	2 984	20 582	2 400
Uganda	162 000	42 852	2	1 900
Nigeria	2 500 000	75 752	16	1 500
Mali	20 400	12 011	329	1 300
Ethiopia	30 800	1 120	3	1 000

Adapted from www.cia.gov

It is claimed that:
"The wealthier a country is, then the better it will be able to reduce GWD."

1 (b) Is this claim justified? Explain your answer using data from **Figure 2**.

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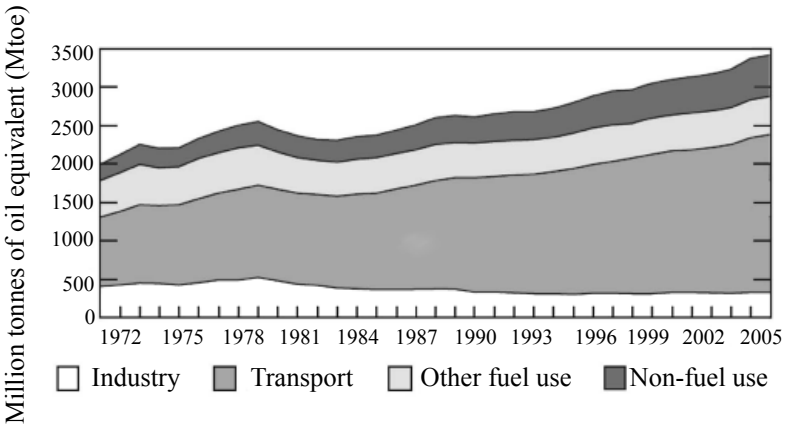
(3 marks)

9

2 **Figure 3** shows how the total amount of oil used for different purposes has risen between 1971 and 2005.

Figure 3 Worldwide use of oil by sector from 1971 to 2005



2 (a) The energy released when oil is burned can be used for transport. What happens to this energy in the end?

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(2 marks)

2 (b) (i) Use **Figure 3** to calculate the percentage increase between 1971 and 2005 in the use of oil for transport.

(2 marks)

2 (b) (ii) Suggest **two** factors that may have led to this increase.

Factor 1.....

.....

Factor 2.....

.....

(2 marks)

Question 2 continues on the next page

2 (c) Predict a possible value for the worldwide consumption of oil in 2035 and state **two** assumptions you have used in your prediction.

Value: .....

Assumption 1: .....

.....

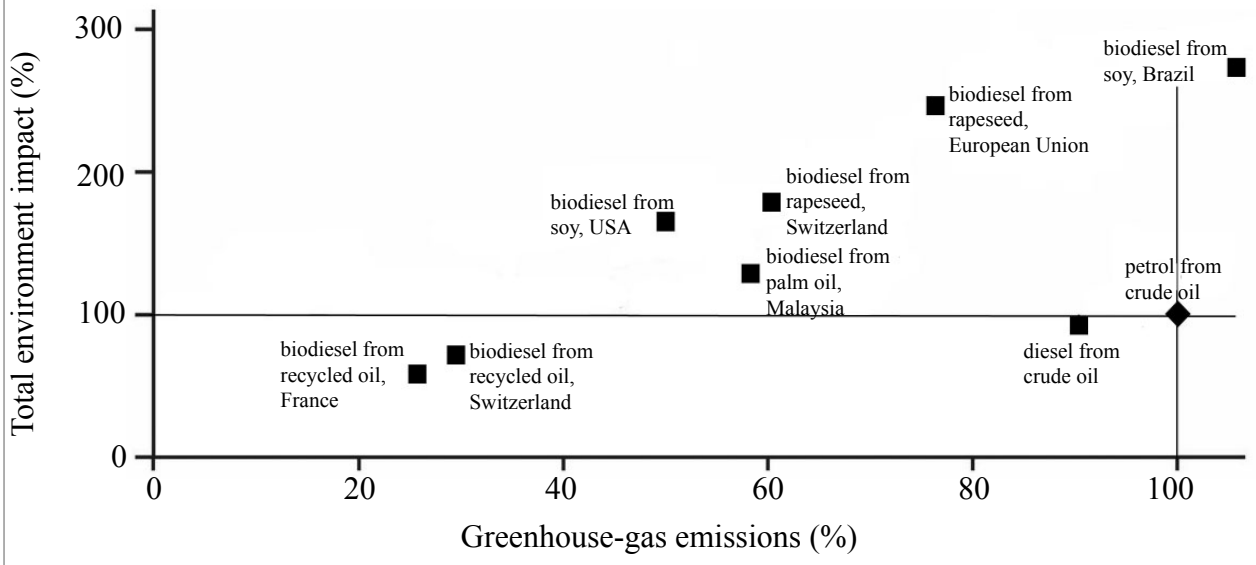
Assumption 2: .....

.....

(2 marks)

2 (d) One possible replacement for oil in transport is diesel produced from biofuels. **Figure 4** shows the results from a comparison of biofuels and fossil fuels. Greenhouse gas emissions are plotted on one axis. The other axis shows the total environmental impact. The total environmental impact of biofuels includes the damage to health, ecosystems and natural resources arising from the growth of crops and the manufacture of fuel.

Figure 4 Total environmental impact and greenhouse gas emissions for biofuels compared to petrol from crude oil



Adapted from *Sciencemag.org* websites

2 (d) (i) Suggest why different biofuels produced from the same plant product might have a different total environmental impact?

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(1 mark)

2 (d) (ii) Write a summary of the data shown in **Figure 4** commenting on the advantages and disadvantages of different biofuels.

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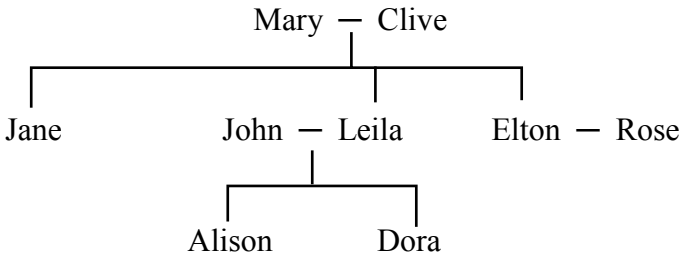
(3 marks)

12

Turn over for the next question

3 Most cases of breast cancer are not linked to any known genes. However about 10% seem to be caused by inheritance of a mutated form of the BRCA1 gene. About 85% of women with the mutated BRCA1 gene go on to develop breast cancer. These women are also likely to develop the cancer at a relatively young age.

Figure 5 The family tree of one family affected by breast cancer



Jane died of breast cancer aged 40. Leila has now been diagnosed with breast cancer. Both her grandmother (on her mother's side) and her grandmother's sister also died of breast cancer. There is no record of breast cancer in Clive's large family. Leila is tested and discovers that she does carry a mutated BRCA1 gene.

3 (a) (i) What is meant by the term gene?

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(1 mark)

3 (a) (ii) How might a mutation in a gene such as BRCA1 occur?

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(1 mark)

3 (a) (iii) How can you account for the fact that Mary has not developed breast cancer?

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(1 mark)

3 (a) (iv) What is the chance of Elton having inherited the mutated BRCA1 gene?

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(1 mark)

3 (b) Elton is also found to carry the mutated gene. Elton and Rose decide to use Pre-implantation Genetic Diagnosis (PGD) to allow them to have children together free of the risk of breast cancer from this gene. This technique involves the creation of embryos by In-vitro Fertilisation (IVF). Only embryos found to be free of the mutated gene are implanted. PGD has only recently been available for the BRCA1 gene.

Suggest **one** option that might have been available to them before PGD?

.....

(1 mark)

Question 3 continues on next page

3 (c) In the UK all procedures such as IVF or PGD have to be licensed by the Human Fertilisation and Embryology Authority (HFEA), a government appointed body.

PGD has been licenced for the prevention of a number of diseases. There are 3 main differences between these diseases and breast cancer caused by the BRCA1 mutation. In breast cancer caused by mutation of the BRCA1 gene:

1 It is not certain that a child, even if she has the mutated gene, will develop breast cancer.
2 The cancer only develops in adults.
3 Treatment is available in some cases.

The HFEA carried out a public consultation about using PGD as a treatment for BRCA1 before it was licensed.

Write a short letter to the HFEA as a response to this consultation. Explain and justify your opinion on whether the use of PGD for BRCA1 mutations should be licensed.

Quality of written communication will be assessed in your answer.

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(6 marks)

11

4 Recent research which studied lice in primates was reported in a newspaper as follows:

Gorillas gave us the itch

Being too lazy to make his own bed condemned mankind to millions of years of the embarrassment and discomfort of lice, research suggests.

Ancestors of modern Man would doubtless have thought they were on to a good thing when they slept in an abandoned gorilla nest 3.3 million years ago.

But while early Man took a kip in the jungle, lice left behind by gorillas crawled on and made themselves at home, suggests a study.

Genetic and fossil analysis of the pubic louse found on humans and the gorilla's louse shows that the lice became separate species about 3.3 million years ago.

This was long after Man and gorillas shared a common ancestor and scientists believe that the most likely explanation for the lice evolving into separate species is as a result of crossing from one host to another.

adapted from The Times

4 (a) Suggest **two** differences between newspaper reports of scientific research and a research paper.

Difference 1 .....

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Difference 2 .....

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(2 marks)

4 (b) Use the newspaper report to identify **one** way in which one species is dependent upon another.

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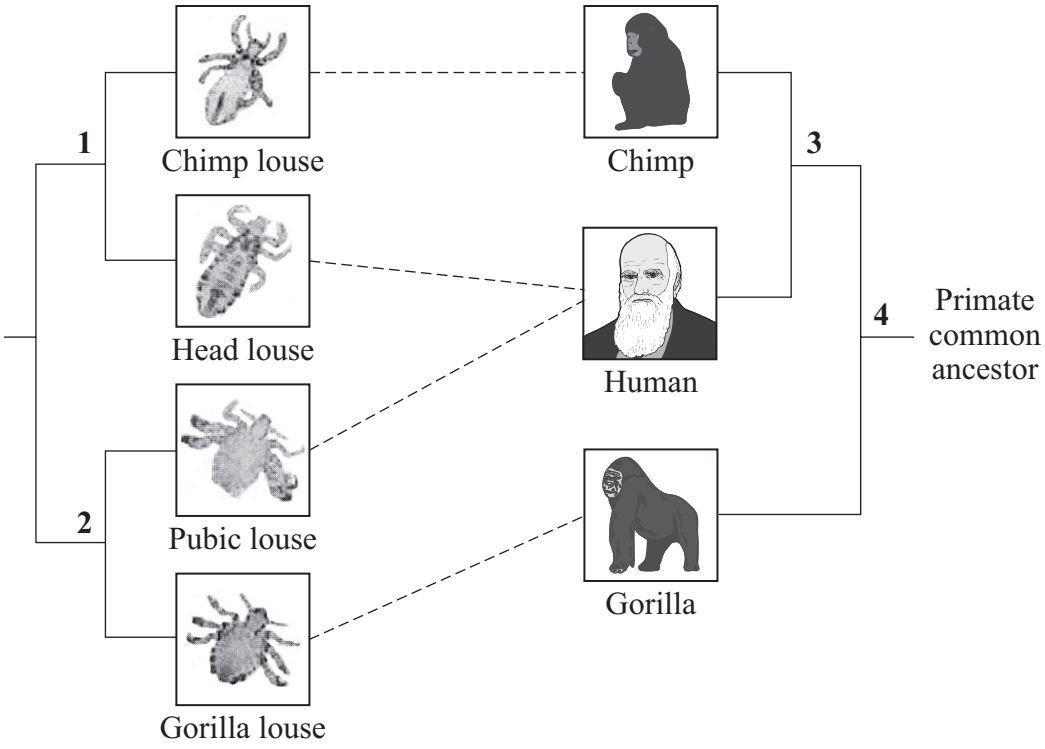
.....

(1 mark)

4 (c) Amongst primates, humans are unique in having two species of parasitic lice - head lice and pubic lice. **Figure 6** shows two evolutionary trees for some species of lice and their primate hosts. Dashed lines between the trees represent host-parasite association.

Figure 6 Evolutionary tree for lice and their hosts



4 (c) Briefly describe how natural selection could lead to the evolution of two different louse species from a single common ancestor.

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(3 marks)

4 (d) Using DNA analysis, scientists can estimate how long ago two species separated from each other. This is known as the divergence date.

A number of studies have estimated the divergence date for some pairs of species shown in **Figure 6**. These values are given in **Figure 7**. The number in brackets represents the minimum and maximum values (range) for each measurement.

Figure 7 Species divergence dates obtained using DNA analysis

Number on Figure 6	Species pairs	Divergence date (and range)/ million years ago
1	Head louse & Chimp louse	6.4 (3.9 – 10.0)
2	Pubic louse & Gorilla louse	3.3 (1.8 - 5.6)
3	Chimp & Human	5.4 (4.3 - 6.5)
4	Gorilla & Common ancestor of Chimp/ Human	6.4 (4.9 - 7.9)

4 (d) (i) Why are the divergence dates given with a range of values?

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.....

(1 mark)

4 (d) (ii) From the divergence data it is likely that the head louse and the chimp louse became separate species 3.1 million years before the pubic louse and the gorilla louse became separate species.

Using the range data given in **Figure 7** calculate values for the shortest and longest possible time between these two pairs of species separating.

shortest time.....

longest time .....

(2 marks)

Question 4 continues on the next page

4 (e) Using the newspaper report on **page 11**, identify an example of the following:

4 (e) (i) a statement which can be supported by the data in **Figure 7**.

.....

(1 mark)

4 (e) (ii) an explanation which involves imagination and conjecture.

.....

(1 mark)

11

5 Mobile phone base stations communicate with mobile phone hand sets using microwaves. This radiation is non-ionising.

5 (a) (i) State **two** differences between non-ionising and ionising radiation

Difference 1 .....

.....

Difference 2 .....

.....

(2 marks)

5 (a) (ii) Give an example of an ionising electromagnetic (em) radiation.

.....

(1 mark)

5 (b) Many people are happy to use mobile phone handsets, but are less willing to have mobile phone masts placed near their houses or places of work.

Suggest why many people have different attitudes to these two risks even though both risks are thought to be low?

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(2 marks)

Question 5 continues on the next page

5 (c) A number of people believe that they have a condition called *electrosensitivity*. When they are exposed to even low levels of microwaves they report a variety of physical symptoms such as severe headaches, nausea, dizziness and high-blood pressure.

In order to investigate whether microwaves from mobile phone masts can cause these symptoms, scientists carried out a *double-blind study*. They exposed 'electrosensitive' and 'non-sensitive' (control) subjects to three conditions:

1 Type A microwave radiation
2 Type B microwave radiation
3 Sham condition – no microwave radiation

Type A and B microwave radiation were similar to radiation patterns given out by different mobile phone masts.

5 (c) (i) What is a double-blind study?

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(2 marks)

5 (c) (ii) Why is it important to use a double-blind study in this case?

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(1 mark)

5 (d) For all subjects, the ability to judge if the microwave transmitter was on or off was approximately 50%.

This is no better than chance.

The researchers recorded the total number of symptoms experienced by participants using a list of 57 possible symptoms (such as headaches, tingling sensations and nausea). The mean values of these results are given in **Figure 8**.

Figure 8 Number of symptoms reported during exposure conditions tests

	'electrosensitive'			**'non-sensitive'**		
Exposure condition	Type A	Type B	Sham	Type A	Type B	Sham
Mean number of symptoms reported	3.0	3.3	3.0	0.33	0.33	0.33

Reproduced with permission from Environmental Health Perspectives.

The objective of the study was given as:

"To determine if electrosensitive and 'non-sensitive' (control) individuals experience more negative health effects when exposed to base station-like signals compared with sham signals."

Use the information above to write a conclusion for the study which addresses the objective and suggests an explanation for the findings.

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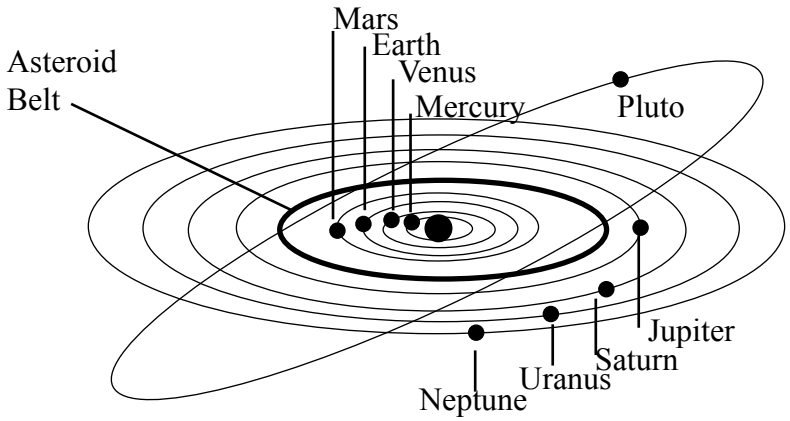
(3 marks)

11

6 In many school science books the solar system is shown using a picture similar to **Figure 9**.

Figure 9 The Solar System



Shortly after the discovery of Neptune some astronomers predicted the existence of a planet further from the Sun than Neptune. This prediction was based on differences between Neptune's observed orbit and that calculated using Newton's Law of Gravity. An extra planet would influence the orbit of Neptune because of gravitational attraction.

In 1930 an American astronomer called Clyde Tombaugh spotted such a planet, which was extremely faint, and much smaller than the astronomers had been expecting. It was named Pluto. It was, however, too small to be responsible for the anomalies in the orbit of Neptune that had been noticed, so some thought another unknown Planet X must exist.

In 1993 the mass of Neptune was recalculated using data from the Voyager fly-by. Using the new, smaller mass for Neptune led to a re-calculation of its orbit which then matched the observed orbit.

The Hubble space telescope has found many more objects orbiting far from the Sun. Some of these objects are similar in size to Pluto. This led to the possibility that they could be named as new planets.

In August 2006 a meeting of the International Astronomical Union voted to change the status of Pluto. It was disqualified as a planet because it is smaller than several other objects that also orbit the Sun but are not regarded as planets. A new and clearer definition of 'planet' was agreed upon. Pluto was renamed a plutoid.

6 (a) What **two** things determine the strength of the force due to gravity between two objects?

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.....

(2 marks)

6 (b) The diagram in **Figure 9** does not accurately reflect the scale of the solar system. Give **two** ways in which it is incorrect.

Way 1 .....

.....

Way 2 .....

.....

(2 marks)

6 (c) Why did astronomers continue to use Newton's Law of Gravity even though it led to predictions of the orbit of Neptune up to 1993 that were different from what was observed?

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(1 mark)

6 (d) From the passage above, identify an example of **one** way in which:

6 (d) (i) a prediction was tested.

.....

(1 mark)

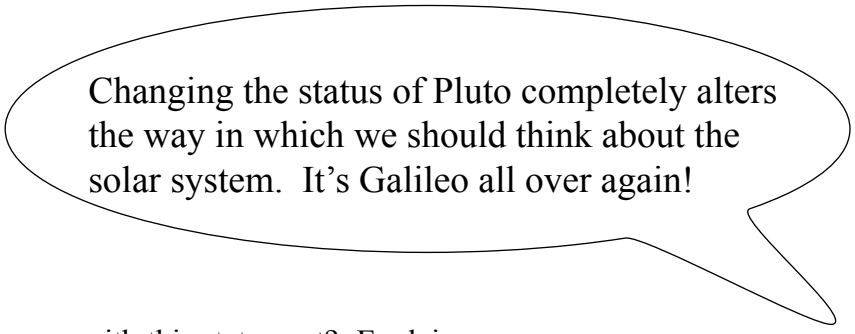
6 (d) (ii) changes in technology have led to an increase in astronomical knowledge.

.....

(1 mark)

Question 6 continues on the next page

6 (e)



Do you agree with this statement? Explain your answer.

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(2 marks)

9

Turn to page 22 for next question

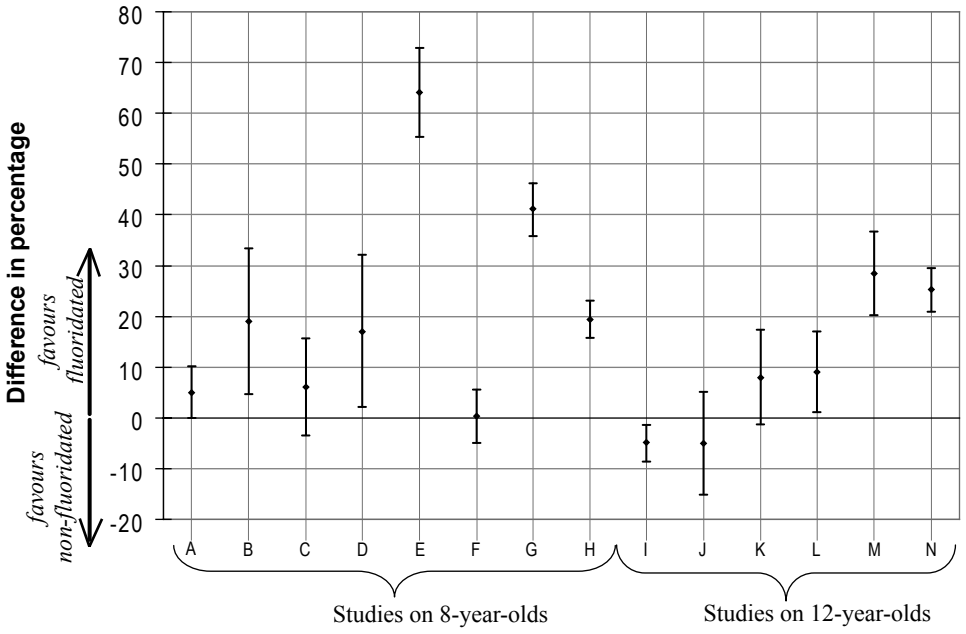
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

7 Tooth decay is a serious health problem in some communities. There is evidence that an increase in the intake of fluoride can reduce the risk of tooth decay, and since the 1950s fluoride has been added to drinking water in many districts, all over the world.

A recent report compared the results of several research projects on the effect of fluoridation of drinking water on dental health. **Figure 10** compares the results for some of these studies, showing the mean difference and the uncertainty in each study.

Figure 10 Difference between fluoridated and non-fluoridated areas in the percentage of children without tooth decay



Adapted from *A systematic review of water fluoridation,* York University (2000)

7 (a) (i) Give the letters of **two** studies of eight year-olds that do not provide clear evidence of any benefit from fluoridation.

Letter 1 .....

Letter 2 .....

(2 marks)

7 (a) (ii) The numbers of children in the different studies range from 176 in study D to 4000 in study H. Use the data in **Figure 10** to explain why it is better to use large numbers of subjects in a research study.

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(2 marks)

7 (a) (iii) Suggest **three** conclusions that can be drawn from the data in **Figure 10** about the impact of fluoridation on the risk of tooth decay.

Conclusion 1: .....

.....

Conclusion 2: .....

.....

Conclusion 3: .....

.....

(3 marks)

7 (b) Researchers also investigate the potential harm caused by fluoride in water. Bone cancer is a rare disease affecting about 1 person in 200 000. One study looked at bone cancer in a sample of 103 children with the cancer and a matched sample of 215 controls.

The amount of fluoride consumed by the children was estimated from both their diets and their tap water intake.

The study found a correlation between the incidence of cancer and level of fluoride intake in the boys but not in the girls in the sample.

Question 7 continues on the next page

7 (b) (i) The study used 'matched controls'. Apart from gender, suggest **two** other factors that might have been matched.

Factor 1.....

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Factor 2.....

.....

(2 marks)

7 (b) (ii) Give **one** possible source of error in this study.

.....

.....

(1 mark)

7 (b) (iii) There has been a series of published papers about the possible correlation between fluoride consumption and bone cancer. About half the papers report a positive correlation. The other half report no correlation.

Why is it so difficult to get clear evidence of whether or not there is a correlation?

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(2 marks)

12

Turn to page 26 for next question

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

8 *Read the two passages below and answer the questions that follow.*

Velcade is a drug which can be used to treat a form of cancer known as multiple myeloma.

The National Institute for Health and Clinical Excellence (NICE) is an independent body which provides health guidance including recommendations about which drugs should be used in the National Health Service (NHS).

Passage 1

Medical apartheid as English cancer patients are denied life-extending drug

Terminal cancer patients accused the Health Secretary of condemning them to death because they are English after the NHS drug rationing body refused to fund a new wonder drug that is available in Scotland.

The treatment, which can extend the lives of sufferers by up to seven years, was approved for patients in Scotland in October 2004 and is routinely available in the rest of Europe.

The leaked ruling, seen by the Daily Mail, which was not due to be made public until next week, reveals that the drug is more clinically effective than chemotherapy but is not regarded as 'cost effective'.

Cancer charities claimed the latest ruling is clear evidence that NICE is refusing to fund treatments that extend the lives of cancer sufferers and give them valuable time with their families and buy them time while a cure is found.

Sufferer, midwife Jacky Pickles condemned the Health Secretary for failing to intervene. She said that after 25 years working in the NHS she will have to give the final years of her life to a Health Service that refuses to save her.

Velcade costs between £9000 and £18,000 for a course of treatment. Each patient requires more than one course of treatment.

Adapted from The Daily Mail, 20th October 2006

Passage 2

Press Release: NICE appraisal of Velcade for the treatment of … multiple myeloma

NICE's expert advisors review all of the evidence on cancer treatments to determine whether they add benefits for patients when compared to other treatments that are already available. The benefits that we assess include whether a drug extends life, and whether a drug improves patients' quality of life.

It is one thing for the newspaper reports to criticise our decision not to recommend the use of this drug, but quite another to unfairly raise patient expectations about the effect of this drug and its availability in other parts of the UK.

Here is a summary of the points raised in the newspaper reports and NICE's response:

Newspaper Reports	NICE position
NICE is not independent.	The committee which makes decisions for NICE is made up of 30 volunteers from the NHS, patient groups, universities and the healthcare industry.
Velcade can extend a person's life by up to seven years.	On average, patients will get a life extension of less than one year compared to other treatments. This is shown by the manufacturer's own research.
The drug is widely available in Scotland.	Velcade is only recommended in Scotland as a last resort when all other licensed treatment options have been tried.

adapted from press release by NICE 20th October 2006

8 (a) (i) Suggest **two** reasons why **Passage 1** highlights a personal story from an individual sufferer rather than simply presenting the results of clinical trials into Velcade's effectiveness?

Reason 1.....

.....

Reason 2.....

.....

(2 marks)

8 (a) (ii) From **Passage 1** identify an example of language being used to influence the reader's opinion.

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.....

(1 mark)

Question 8 continues on the next page

8 (b) (i) What happens when a cancer forms?

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(2 marks)

8 (b) (ii) Before it can be approved for treatment of cancer a drug must be tested on both animals and healthy volunteers. Suggest **two** reasons why both testing stages are required.

Reason 1.....

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Reason 2.....

.....

(2 marks)

8 (c) The NICE committee is made up of 30 volunteers from the NHS, patient groups, universities and the healthcare industry. Give **two** advantages of this.

Advantage 1 .....

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Advantage 2 .....

.....

(2 marks)

8 (d) If you were a member of the NICE committee discuss the factors you would want to consider before you decided to approve, or refuse, the use of a drug such as Velcade.

Quality of written communication will be assessed in the answer.

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(6 marks)

15

END OF QUESTIONS

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