

Centre Number						Candidate Number				
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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8	
TOTAL	



General Certificate of Education
Advanced Subsidiary Examination
June 2010

Science in Society

SCIS1

Unit 1 Exploring Key Scientific Issues

Friday 28 May 2010 9.00 am to 11.00 am

<p>For this paper you must have:</p> <ul style="list-style-type: none"> • a calculator • a ruler.
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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 0 S C I S 1 0 1

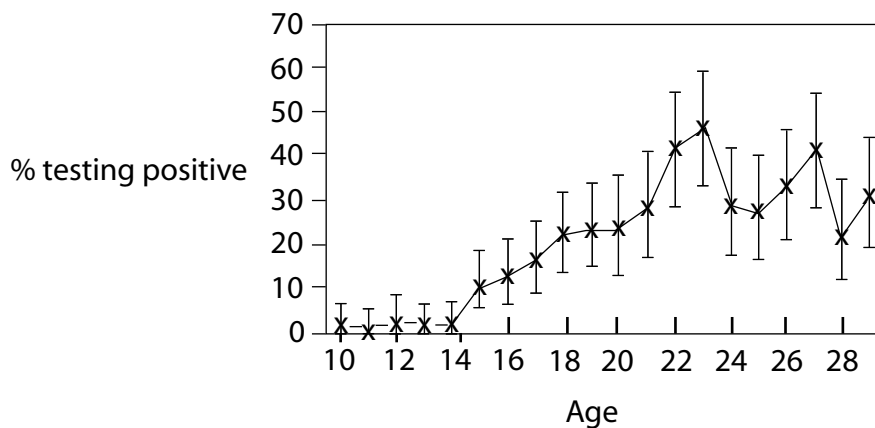
Answer **all** questions in the spaces provided.

- 1 (a)** Cervical cancer is a very common cancer amongst women worldwide, causing approximately 270 000 deaths annually.

Scientists have been investigating the link between cervical cancer and a group of viruses known as human papillomavirus (HPV). There are over 100 different HPVs which infect the skin and lining of body cavities. Some are spread by sexual activity. About 40 HPVs infect the genital area. Most cases of infection do not have any symptoms, and clear up within a year or so.

Around 30% of young women are infected by at least one type of HPV within 2 years of becoming sexually active. **Figure 1** shows the percentage of young women in England testing positive for HPV antibodies in their blood. This is an indicator that they have had at least one type of HPV infection at some time.

Figure 1
Percentage of young women in England testing positive for HPV antibodies



- 1 (a) (i)** What are antibodies?

.....

 (1 mark)

- 1 (a) (ii)** Explain why the presence of antibodies indicates a previous infection.

.....

 (2 marks)



1 (a) (iii) Using **Figure 1**, summarise the relationship between testing positive for HPV antibodies and age.

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(3 marks)

1 (b) Having a HPV infection does not mean that a woman will develop cervical cancer. However, almost all cases of cervical cancer are caused by long-lasting infection by a few types of HPV. Two particular HPVs – type 16 and type 18 – cause more than 65% of all cervical cancers in Europe.

Scientists have developed a vaccine against type 16 and type 18 HPVs. This protects women against infection and lowers their risk of developing cervical cancer later in life.

The vaccine provides most protection if it is given before a young woman has become infected by HPVs.

1 (b) (i) Explain briefly how vaccination works.

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(3 marks)

1 (b) (ii) Suggest a suitable age range for the vaccine to be given. Justify your answer using the information in **Figure 1**.

Age range:

Reason:

(2 marks)



- 2 (a) In Colombia 74% of the population lives in urban areas. Transport is an important part of urban life, but it can contribute to air pollution and ill health. Air quality rules limit the allowed concentrations of a number of different pollutants. **Figure 2** gives the air quality standards in Colombia for a number of pollutants.

Figure 2
Allowed concentrations of measured pollutants in Colombia

Pollutant	Maximum allowed concentration	
Sulfur Dioxide (SO ₂)	100 µg/m ³	average of all daily samples must be below this
Carbon Monoxide (CO)	15 mg/m ³	only one sample in an 8-hour period may exceed this
Nitrogen Oxides (NO _x)	100 µg/m ³	no single sample may exceed this

- 2 (a) (i) Describe the chemical reaction that takes place when a fuel burns in a car engine. You may use words, an equation, or a diagram.

.....

 (2 marks)

- 2 (a) (ii) Choose **one** pollutant in **Figure 2** and explain how it may be produced in a car engine.

Pollutant:.....
Produced:

.....
 (2 marks)

- 2 (a) (iii) The concentration of carbon monoxide is measured in mg/m³. Explain what concentration means.

.....

 (1 mark)



2 (a) (iv) Suggest **two** reasons why it is better to record several daily samples when measuring air pollution rather than a single measurement.

Reason 1:

.....

Reason 2:

.....

(2 marks)

2 (b) Bogota is the capital city of Colombia. In the 1990s the local government in Bogota wanted to improve the overall quality of life, including air quality, in the city.

Amongst the measures that were introduced were:

- 1. improvements in public transport such as buses
- 2. allowing people to drive their car into the city centre on only 2 days each week.

2 (b) (i) Explain how the increased use of buses improves the air quality in the city centre.

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(2 marks)

Question 2 continues on the next page

Turn over ▶



2 (b) (ii) By only allowing any particular car into the city on two days of the week, the local government restricts the freedom of people in Bogota.

Is it ethical for local government to restrict the freedom of individuals in this way?
Explain why you think this.

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(4 marks)

13



- 3 (a)** Down's syndrome is a genetic disease. It affects the physical characteristics of a child and delays their mental development.

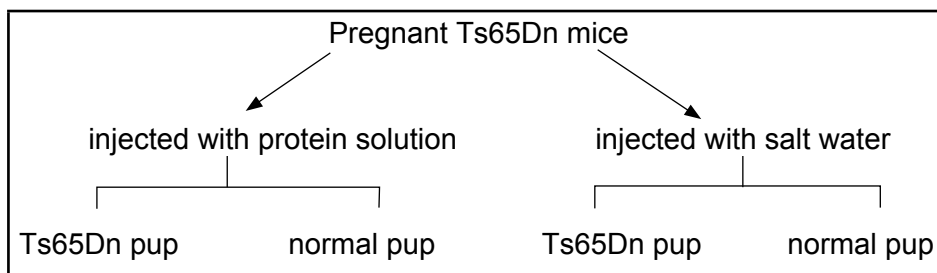
Some researchers have been investigating ways of treating Down's syndrome during pregnancy, before a baby is born. They have been using mice which have a Down's-like condition, called Ts65Dn mice. The mice have similar developmental delays to those seen in humans with Down's syndrome.

The researchers injected a protein solution into pregnant Ts65Dn mice to see if they could reduce the developmental delays that would normally be seen in baby mice (pups) that inherit the condition.

A sample of pregnant Ts65Dn mice were given an injection into the space around the organs in the abdomen. The injection was either a protein solution or salt water.

Figure 3 summarises the experimental design and shows the possible outcomes. Some pups born to Ts65Dn mothers will be normal. It is not obvious at birth if a pup has the Down's-like Ts65Dn condition, or is normal.

Figure 3
Experimental conditions and mice used in the experiment



After birth, all pups were weighed. The researchers then measured the development of each pup using 8 different tests. They did this every day from day 5 until the pups were 21 days old. Those doing the tests did not know which pups came from protein treated mothers. They also did not know if the pup was a Ts65Dn mouse, or a normal mouse, until the end of the experiment.

- 3 (a) (i)** Explain why the researchers used a salt water injection as well as the protein treatment injection.

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(2 marks)

Question 3 continues on the next page

Turn over ▶



- 3 (a) (ii) Give **two** ways in which the researchers designed the experiment to make it a 'blind trial'.

Method 1:

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Method 2:

.....

(2 marks)

- 3 (b) After these tests had been completed, each pup's genotype was determined to see if it was a Ts65Dn mouse or a normal mouse. The researchers then compared the development of Ts65Dn pups with normal mice from untreated mothers. **Figure 4** summarises their findings, including the number of pups in each group.

Figure 4
Summary of results from developmental tests in Ts65Dn pups

Pups	Average development compared with normal mice
Ts65Dn from untreated mothers (14 mice)	Delayed in 8 out of 8 tests
Ts65Dn from protein treated mothers (6 mice)	Delayed in 3 out of 8 tests

Have the researchers produced good evidence that the protein treatment can reduce the developmental delays associated with the Ts65Dn condition? Explain your answer.

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(2 marks)



3 (c) (i) Suggest **two** reasons why mice are used to test possible treatments for diseases that affect people?

Reason 1:

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Reason 2:

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(2 marks)

3 (c) (ii) Give **two** examples of questions that further research might address before this treatment could be developed into a treatment for pregnant women at risk of Down's babies?

Question 1:

.....

Question 2 :

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(2 marks)

3 (d) In the research paper the experimenters state:

"...food and water were available at all times.... The mice received humane animal care in compliance with the National Institutes of Health guidelines for care and use of experimental animals."

Why is this good practice from a scientific point of view?

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(2 marks)

12

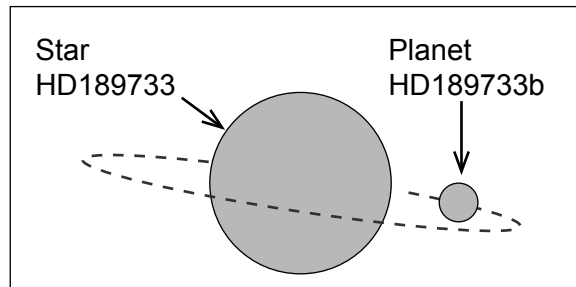
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- 4 (a) Over 330 planets orbiting distant stars have so far been found. These are known as extra-solar planets. Astronomers investigate them by observing the radiation coming directly from the star, or reflected from the orbiting planets.

Planet HD 189733b is a Jupiter-sized planet orbiting a star 63 light years away. It orbits the star once every 2.2 days. The planet has been observed using both the Hubble and the Spitzer space telescopes. **Figure 5** shows the orientation of the orbit as seen from these telescopes.

Figure 5
HD 189733b and its star



An international team of astronomers has used a special camera on board the Hubble space telescope to study the infrared radiation emitted by the planet. The planet goes behind the star every 2.2 days so the astronomers were able to compare the radiation from the star alone with the radiation from the star and planet combined. This allowed them to calculate the radiation emitted by the planet.

- 4 (a) (i) State **one** difference between infrared radiation and visible light.

.....

 (1 mark)

- 4 (a) (ii) A light year is the distance light travels in one year. Why do astronomers use this measure of distance?

.....

 (1 mark)

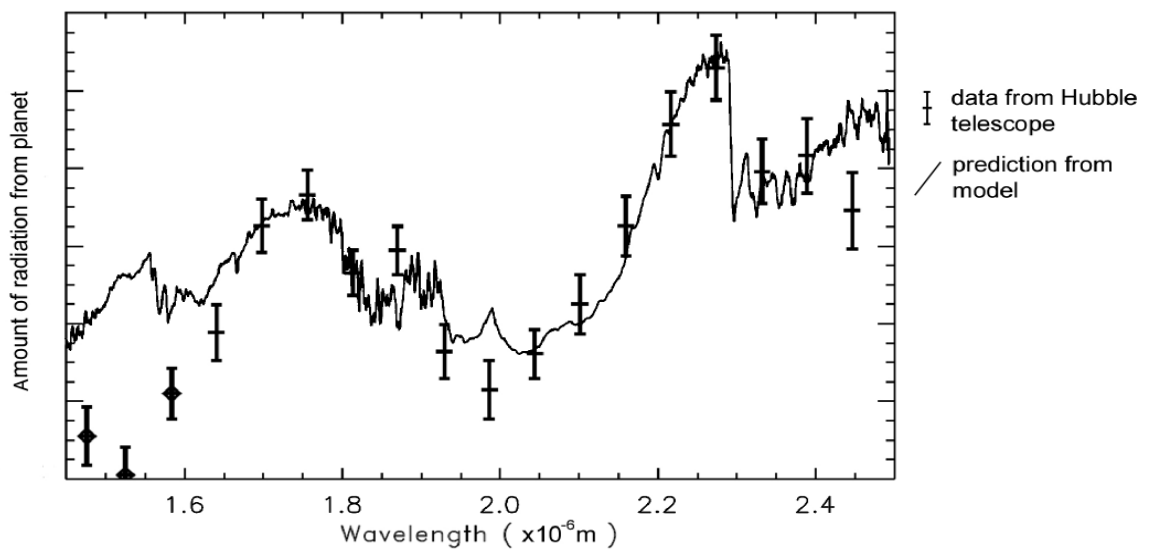


- 4 (b) The gases in the atmosphere of the planet affect the amount of infrared radiation of different wavelengths which reaches the Earth. Astronomers are particularly interested in evidence of the presence of carbon dioxide and oxygen.

To determine which gases might be present in the atmosphere of HD 189733b, the astronomers used a computer model to simulate the pattern of radiation wavelengths that they would expect to see for different combinations of gases. Their final model included water, carbon monoxide, methane and carbon dioxide.

Figure 6 shows the pattern of wavelengths of infrared radiation measured by the Hubble camera (points and bars) and the pattern predicted by the model (solid line).

Figure 6
Observed radiation from planet compared to predictions from model



- 4 (b) (i) How well does the prediction from the computer model match all the observed data shown in Figure 6? Explain your answer.

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(3 marks)

Question 4 continues on the next page

Turn over ▶



4 (b) (ii) Suggest **two** reasons why astronomers find computer models a valuable tool for this research.

Reason 1:.....

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Reason 2:.....

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(2 marks)

4 (b) (iii) Why are astronomers particularly interested in detecting the presence of carbon dioxide and oxygen in the atmosphere of extra-solar planets?

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(4 marks)

11



5 (a) The European Prospective Investigation into Cancer and Nutrition (EPIC) is a *cohort study*. Three features of the study are:

- it has been running since 1992
- it has over half a million participants
- it involves 10 European countries.

5 (a) (i) What is meant by a cohort study?

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(2 marks)

5 (a) (ii) Explain why each of the three features above makes the EPIC study a useful research tool.

Running since 1992:

.....

Half a million participants:

.....

10 European countries

.....

(3 marks)

5 (b) For many years the body mass index (BMI) has been used as a measurement of obesity in adults. It is below 18 for underweight people and over 40 for very obese people. A group of researchers published some results of an EPIC study to investigate how weight affects the relative risk of death within a 10 year period.

The researchers measured the BMI, waist circumference and waist-to-hip ratio of 359 387 participants and then followed their progress for 10 years. In that time 14 723 of the participants died.

What percentage of participants died during the period of the research?

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1 mark)

Question 5 continues on the next page

Turn over ▶



- 5 (c) After taking into account factors such as age, smoking, physical activity and alcohol consumption, the researchers compared the risk of death for different values of BMI with that for 'ideal' BMI values.

Taking the relative risk as 1 for values of BMI between 23.5 and 25, they found that the relative risk increased at both higher and lower values of BMI.

- 5 (c) (i) Suggest **one** reason why the researchers took other factors into account when calculating the relative risk of death for different values of BMI.

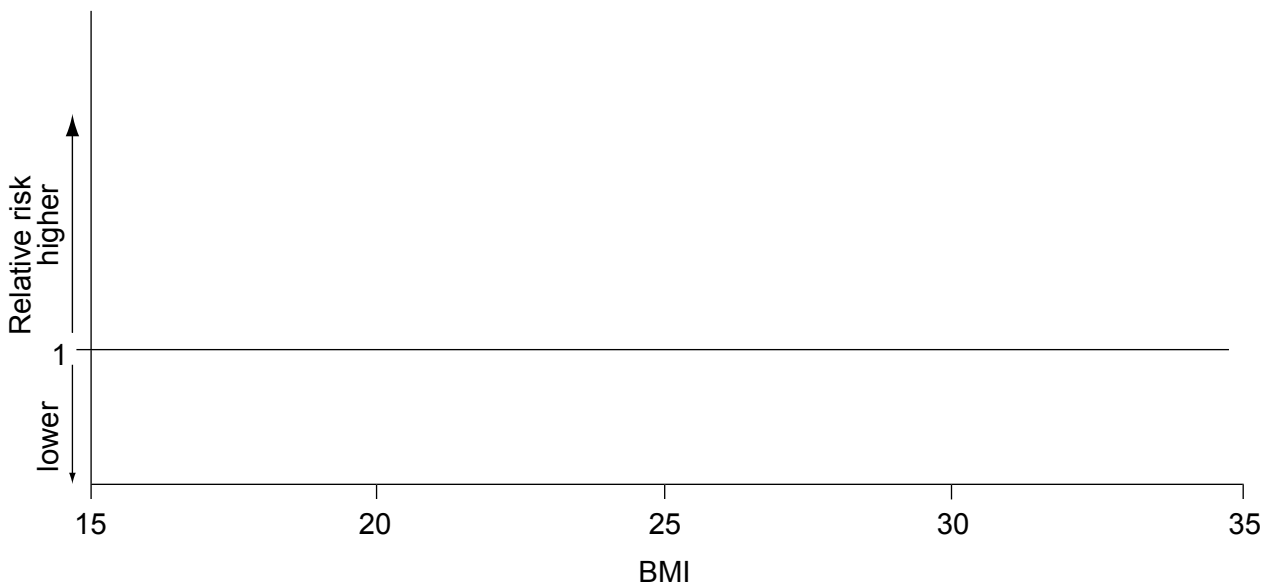
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(1 mark)

- 5 (c) (ii) Using the axes below **sketch a graph** to show the relationship between relative risk of death and BMI.

Figure 7
Relationship between BMI and relative risk of death



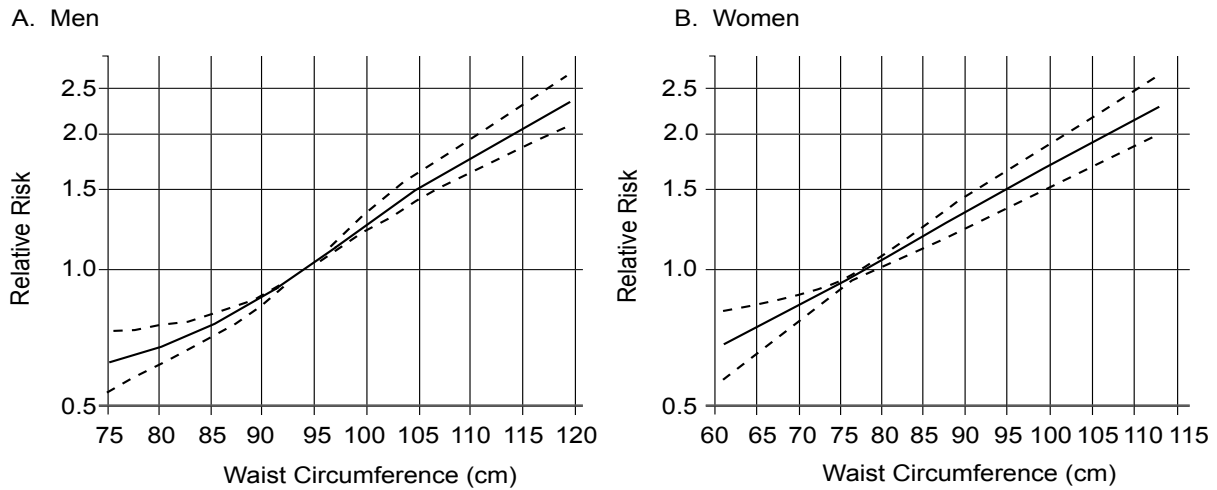
(2 marks)



- 5 (d) For some people waist circumference or waist-to-hip ratio is a better indicator than BMI of their likely health outcomes.

Figure 8 shows how the relative risk of death for men and women varied with waist circumference for the same values of BMI. The dotted lines represent the estimated extent of the uncertainty in the data.

Figure 8
Relative risk of death for different waist circumferences, for men and women



- 5 (d) (i) What is the best estimate of the value of waist circumference that corresponds to double the risk of death for **men**? What is the range within which we can be confident that this best estimate lies?

Value:

Range: (2 marks)

- 5 (d) (ii) Suggest **one** reason why the researchers analysed the data from men and women separately.

.....
 (1 mark)



- 6 (a) A number of companies are advertising 'stem cell therapies' direct to consumers via the internet. Following one such advertisement the Multiple Sclerosis (MS) Society issued the following press release:

MS Society warning over 'stem cell' treatments

The MS Society is aware that a company ... is approaching people with MS and is seeking payments in exchange for injections of stem cells.

There is no scientific evidence as yet to support a stem cell treatment in humans to repair MS damage. Some types of stem cell treatment may be hazardous. While there is legitimate stem cell research underway across the world, there is absolutely no evidence to support a treatment of this kind.

The company does not have EU or US approval to conduct a clinical trial of stem cells for MS. Anyone agreeing to participate in those areas will not have the legal protections that apply to an individual participating in clinical trials that have regulatory approval in the US or EU.

The company website does not contain satisfactory information about results analysis, legal responsibility for safety, or insurance against harm and negligence.

The website contains the following disclaimer: "The treatments are experimental biological therapies which are not currently US FDA approved and are not to be construed as a treatment or cure for any degenerative disease, illness, condition or injury."

Adapted from MS Society press release.

A number of clinical trials have been carried out using stem cells from both embryos and adults to treat different diseases.

- 6 (a) (i) What is the main difference between embryo-derived and adult-derived stem cells?

.....

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(1 mark)

- 6 (a) (ii) Why are some people opposed to the use of embryo-derived stem cells for research?

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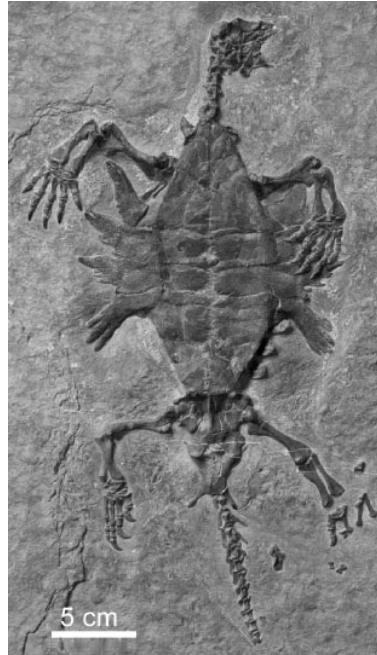
(2 marks)



- 7 (a) A 'transitional fossil' is a fossil which shows evidence of body structures intermediate between two major groups of organisms. When Charles Darwin published *On the Origin of Species* in 1859 there was little evidence in the fossil record of these transitional fossils, and they were often called 'missing links'. A lack of transitional fossils made it difficult to show evolutionary change.

Recently three turtle fossils found in China have been identified as transitional fossils. They have been dated as 220 million years old. **Figure 9** shows one of the fossils.

Figure 9
Fossil of half-shelled turtle found in Guizhou province of China



Palaeontologists have used these fossils to provide evidence about the evolution of turtle shells. There are two hypotheses about the development of the shell. The first is that the shell developed from bony plates on the skin and later fused to the backbone and ribs. The second is that the shell formed from below as extensions of the backbone and ribs.

The three Chinese fossils have a complete lower shell protecting the belly, but an incomplete upper shell. This supports the second hypothesis.

There were fossils of marine animals in the rocks where the Chinese fossils were found. It is likely that the three turtles were aquatic animals. The lower shell may have protected them from predators below as they swam.



7 (a) From the passage on **page 18** identify an example of:

7 (a) (i) data

.....
(1 mark)

7 (a) (ii) a suggested explanation of data

.....
(1 mark)

7 (a) (iii) how data can be used to rule out alternative explanations

.....
(1 mark)

7 (a) (iv) imagination being used in the research.

.....
(1 mark)

7 (b) There are 'missing links' in the fossil record. This is sometimes used to claim that there is insufficient evidence for evolution by natural selection.

However, biologists still accept the theory of evolution by natural selection.
Give **two** reasons for this.

Reason 1:
.....

Reason 2:
.....

(2 marks)

6

Turn over for the next question

Turn over ▶



8 Read the following two passages about storage of nuclear waste.

Passage 1

Government invites communities for ‘no commitment’ discussions on hosting geological disposal facility for radioactive waste

Communities interested in finding out more about hosting an underground disposal facility for radioactive waste were invited today to open no-commitment discussions with the Government.

An independent Committee on Radioactive Waste Management (CoRWM) has carried out a consultation on the best long-term option for protecting the public and the environment. It recommends that a geological disposal facility will provide a permanent solution for our higher activity radioactive waste. Some of this waste is currently in storage but most will be produced over the next century as nuclear facilities are decommissioned.

It is likely to take several decades before any such facility is operational. The Secretary of State for Environment, Food and Rural Affairs said:

“Construction and operation of a geological disposal facility will be a multi-billion pound high technology project that will provide skilled employment for hundreds of people over many decades. It will contribute greatly to the local economy.”

Adapted from a Department for Environment, Food and Rural Affairs press release.

Passage 2

The waste to be managed

Radioactive material that is no longer useful can be divided into three groups:

High level waste (HLW):

This is waste whose temperature may rise significantly while it is stored. It is produced as a by-product of the reprocessing of used nuclear fuel. It starts out as a highly radioactive liquid containing many isotopes such as caesium-137 or plutonium-239. By 2015 most HLW will have been converted into solid form. This treated solid waste will be stored in 150 litre stainless steel containers. They will be stored for at least 50 years before being transported to a final disposal site.

Intermediate level waste (ILW):

This is also produced during the reprocessing of used fuel, and from general operations and maintenance of nuclear sites. As nuclear sites are decommissioned (closed) and cleaned up, more ILW will be produced.

Low level waste (LLW):

This is radioactive waste with a low radioactive content. It forms the biggest proportion of radioactive waste material. It comes from hospitals and research labs, as well as the nuclear industry.



Passage 2 (continued)

Voluntarism and Partnership

A voluntary approach to choosing a suitable location for a geological disposal facility is thought to be the most appropriate way to go. During the early stages of the process, local communities will be asked to register their interest without commitment. The opinions of the wider surrounding area as well as immediate village/town will also need to be taken into account.

Right of Withdrawal (RoW)

To develop and maintain confidence a community has the right of withdrawal until a late stage of the process. Up to the time when underground operations and construction are due to begin, if a community wished to withdraw its involvement, then the process would stop.

Adapted from "Managing Radioactive Waste Safely" published by Department for Environment, Food and Rural Affairs (DEFRA).

8 (a) (i) Why is high level waste (HLW) initially stored for 50 years?

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.....
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.....

(2 marks)

8 (a) (ii) Why is it beneficial to turn the HLW into a solid before storing it?

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(2 marks)

8 (b) At the present time, the large amount of low level waste (LLW) that is produced in the UK is compacted (squashed) and then buried in a landfill site in one place.

8 (b) (i) Suggest **two** disadvantages of this.

Disadvantage 1:

Disadvantage 2:

(2 marks)

Question 8 continues on the next page

Turn over ▶



8 (b) (ii) Give **one** reason why LLW is not incinerated in the same way that domestic waste can be.

.....
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(1 mark)

8 (c) Give **two** reasons why the Government would like communities to volunteer to have a geological disposal unit built near them.

Reason 1:.....

.....

Reason 2:.....

.....

(2 marks)

8 (d) Hollerton Borough Council would like to volunteer to investigate whether the geological disposal facility could be built on some disused council land. The land is about 4 miles away from the small town of Hollerton. There are about 10 000 people living in the town.

Write a newspaper article which explains the scientific issues involved in the disposal of nuclear waste. You should also lay out the potential risks and benefits of having the geological disposal facility built in the local area.

Your article should include a suitable headline which is eye-catching and summarises the main theme of the article.

Quality of written communication will be assessed in your answer.



There are no questions printed on this page

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