

Twenty First Century Science

PILOT Examination Questions

GCSE Science June 2004

**Air quality, You and your genes, Earth in the Universe
(Higher Tier)**

Please note:

- These questions are not Sample Assessment Materials (SAMs) for the new OCR specification (for Sept 2006).
- The style of question varies from that used for the new specifications.
- For up to date SAMs see the OCR website:
www.gcse-science.com
- These questions are provided for classroom use by teachers, to develop students' understanding of Ideas about Science.
- Some of the material covered in these questions is no longer part of the GCSE Science specification. Please check the specification document before using these questions.

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Answer **all** the questions.

- 1 These power stations use different fuels in the production of electricity.



A



B

- (a) Power station **A** burns natural gas.

Natural gas contains methane.

Methane contains **only** carbon atoms and hydrogen atoms.

- (i) What is the name given to chemicals that contain only carbon atoms and hydrogen atoms?

..... [1]

- (ii) When natural gas is burned, two main products are given off.

Write down these **two** products.

1

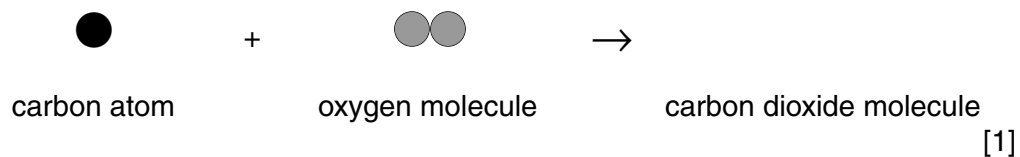
2 [2]

- (b) Power station **B** burns coal.

Coal contains mostly carbon. It burns in plenty of air to form carbon dioxide, which enters the atmosphere.

- (i) The atomic diagram shows the reaction between carbon and oxygen.

Finish this diagram to show what is produced.



(ii) Some carbon dioxide is removed from the atmosphere.

Describe **two** ways that carbon dioxide is removed from the atmosphere.

1

.....

2

.....[2]

(c) Burning coal or natural gas can also produce sulfur dioxide as a pollutant.

Scientists in both of the power stations shown have taken steps to reduce this sulfur dioxide pollution.

(i) State **one** way to reduce sulfur dioxide pollution caused by a coal burning power station.

.....[1]

(ii) State a **different** way to reduce sulfur dioxide pollution caused by a natural gas burning power station.

.....[1]

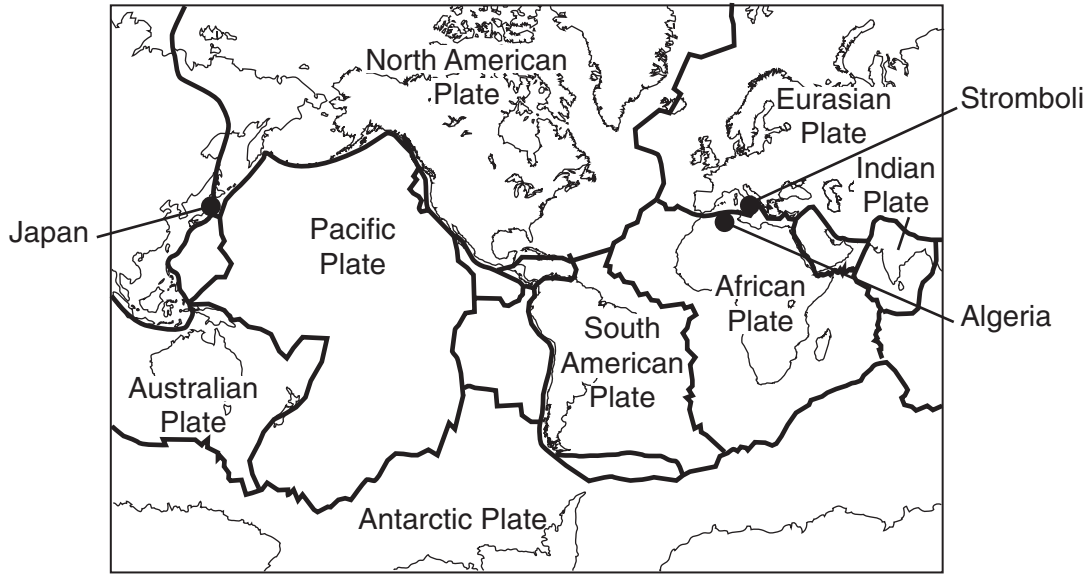
(iii) The government has agreed to reduce all air pollution from power stations.

Suggest how this can be done.

.....[1]

[Total: 9]

- 2 This question is about earthquakes.
The map shows some of the tectonic plates that cover the surface of the Earth.



source: BBC website

- (a) In May 2003, there were earthquakes in Algeria and Japan.

Explain why earthquakes are likely to occur in Algeria and Japan.

Use the information shown on the map to help you.

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.....[2]

- (b) The earthquakes in Algeria and Japan were of similar strengths. The earthquake in Japan caused little damage to buildings. The earthquake in Algeria killed more than 2000 people and left over 10 000 people homeless. A newspaper article reporting the earthquake in Algeria said:

Why did so many die?



Northern Algeria's slums and luxury villas are now piles of rubble. Local residents blamed illegal property deals for the poor construction. The initial shock turned to anger, with victims turning on developers. "Why is it that the new buildings have collapsed and the old ones are still standing?" asked one man, surveying a pile of flattened buildings. Many people are believed to be still buried in the rubble. Entire areas of housing crumbled like houses of cards. When the quake struck, families were gathering at home for dinner, or to watch the UEFA Cup football final on the television.

based on a report in The Times 24th May 2003

- (i) Explain why so many people died in this earthquake in Algeria.

.....[1]

- (ii) Suggest ways in which the government in Algeria could help to prevent future earthquakes causing so much damage.

.....

[3]

- (c) In December 2002 the volcano, Stromboli, on an island near Italy erupted. A burst of gas from the tiny volcanic island sent a mass of rock into the sea, causing a tidal wave. Stromboli is shown on the map.

Use your ideas about energy to explain what causes a volcano to erupt.

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.....[3]

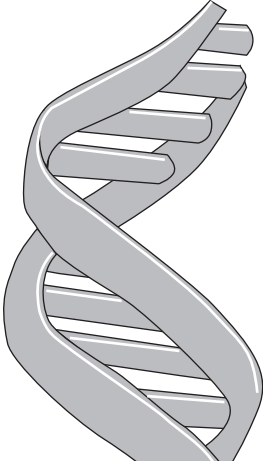
[Total: 9]

3 Read this newspaper article about DNA.

Using DNA.

1953

Francis Crick and James Watson worked out that the structure of DNA was a double helix.



1996

Bones in Russia were identified by genetic testing as being from the murdered Tsar Nicholas.

1985

DNA fingerprinting was invented by Alex Jeffreys at Leicester University.

1999

Genetic tests prove President Clinton is not the father of Danny Williams, as claimed.

The newspaper story also suggests how DNA could be used in the future.

2010

DNA samples used to make up a picture of what a criminal looks like.



2015

DNA records of every person kept on a Government database available to police and medical research organisations.

Some people agree with these possible future uses of DNA. Other people disagree.

Suggest **two** reasons why people might agree and **two** reasons why people might disagree.

Reasons for agreeing

1

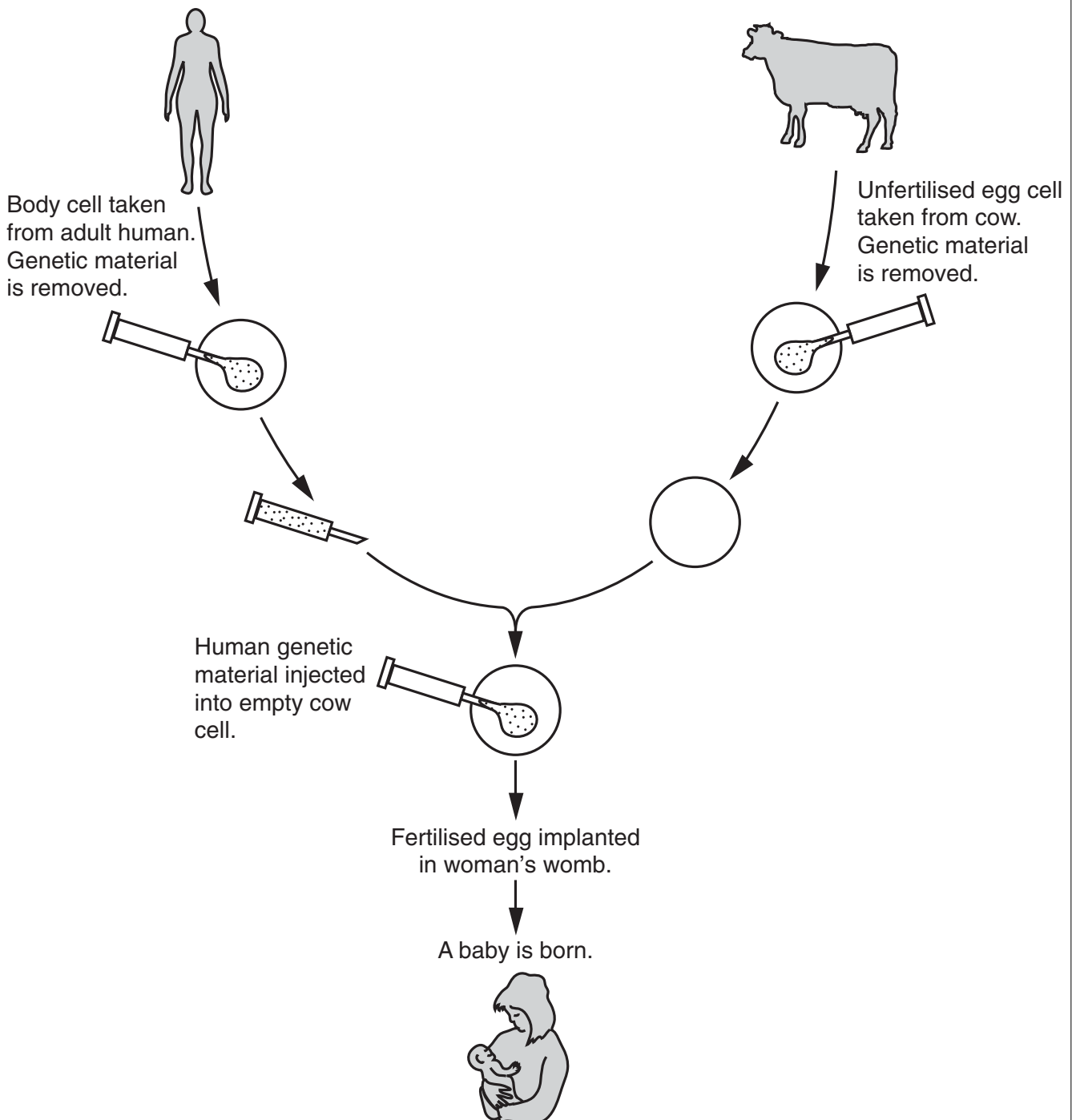
2

Reasons for disagreeing

1

2

- 4 Scientists think it may be possible to produce a human from a cow's egg.



(a) The baby produced would not have cow characteristics. It would have human characteristics.

Explain why.

.....
.....
.....
.....[2]

(b) This method uses cow eggs instead of human eggs.

Write down **two** advantages of using cow eggs instead of human eggs.

1
.....
2
.....
.....[2]

[Total: 4]

- 5 Read this newspaper story about gene therapy.

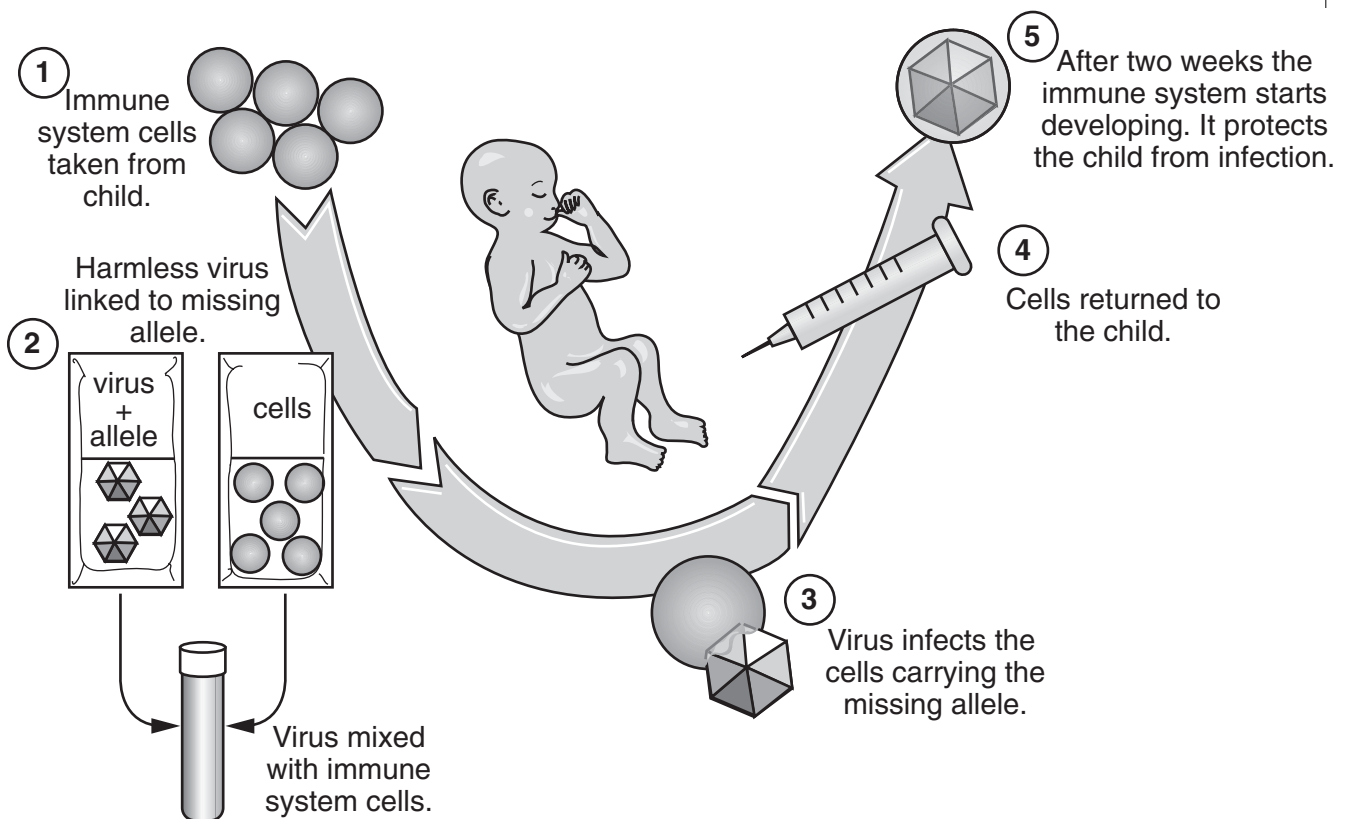
Scientific Success.

A boy born with a deadly genetic disorder has been cured by gene therapy!
The boy lacked an allele essential to the development of his immune system.
It looked as if he would have to spend the rest of his life inside a plastic bubble.

- (a) Explain how living inside a plastic bubble would protect him.

.....
.....[1]

- (b) The diagram shows how gene therapy cured the boy.



- (i) After this treatment, the boy's immune system worked.

Use your ideas about gene therapy to explain why.



One mark will be for writing in sentences with correct spelling, punctuation and grammar.

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.....
.....
.....
.....
.....[2+1]

- (ii) This treatment was successful for the boy. It will not stop the genetic disorder being passed to his children.

Explain why.

.....
.....[1]

[Total: 5]

6 This question is about nitrogen dioxide, NO₂, and petrol engine cars.

- (a) Nitrogen dioxide is formed at high temperatures.
The temperature inside car petrol engines is high enough for this reaction to take place.
Nitrogen dioxide is formed from gases found in the atmosphere.

Describe the steps in the formation of nitrogen dioxide.

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.....
.....
.....[2]

- (b) The amount of nitrogen dioxide emitted by cars has decreased over the last 20 years.

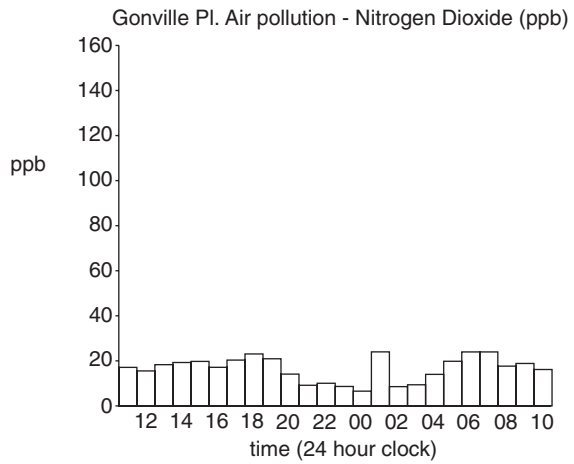
State **two** technological developments that have helped to achieve this.

1
.....
2
.....[2]

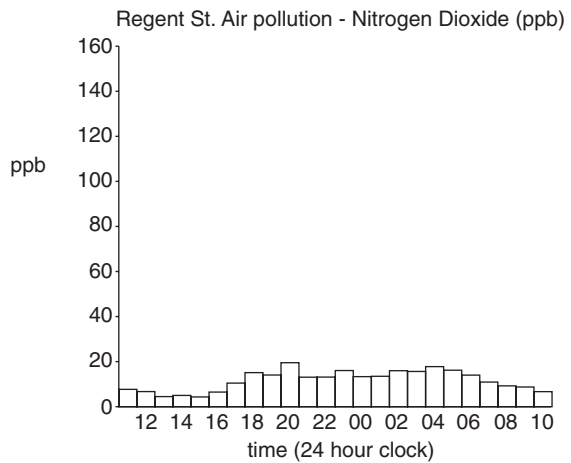
- (c) The charts below show information about air pollution caused by nitrogen dioxide. They show the results for three different sites in Cambridge. The sites are normally very busy with traffic.

The graphs show the level of nitrogen dioxide in parts per billion (ppb) in each street on the same day in August 2003.

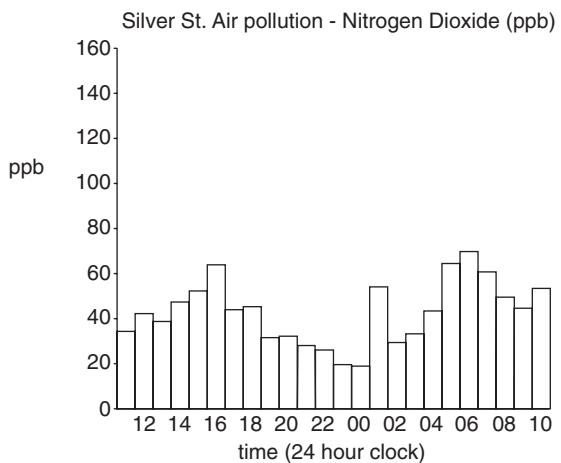
Gonville Place



Regent Street



Silver Street



- (i) It has been suggested that there may be a correlation between nitrogen dioxide concentrations and volume of traffic at these sites.

What other data would you need to show that there is a correlation?

.....
.....[1]

- (ii) Additional data shows that there is a correlation between nitrogen dioxide levels and volume of traffic.

What other data would you need to show that petrol engines are the major **cause** of pollution by nitrogen dioxide?

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.....
.....[2]

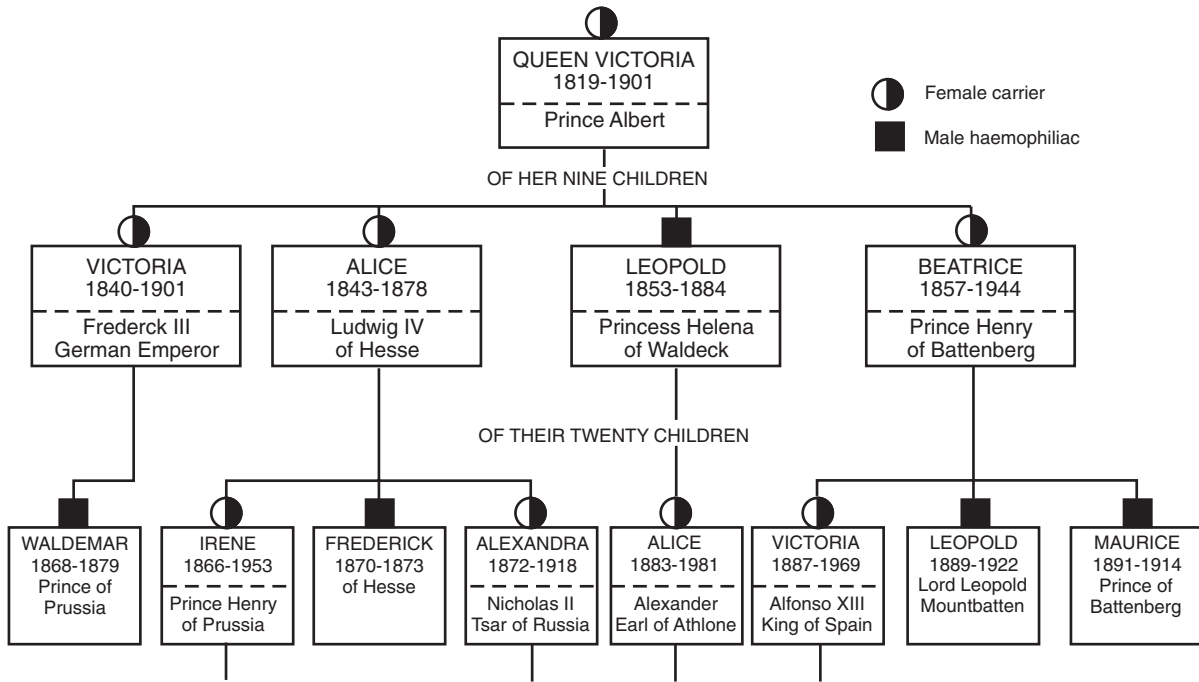
[Total: 7]

7 Queen Victoria had the allele responsible for haemophilia. She was a carrier of haemophilia.

(a) Explain what is meant by a *carrier*.

.....
[1]

(b) Look at the diagram of Queen Victoria's family tree.
 It shows only her descendants who either had haemophilia or were carriers.



The table shows the life span of some male haemophiliacs from Queen Victoria's family tree.

name	life span in years
Leopold	31
Waldemar	11
Frederick	3
Leopold	33
Maurice	23

(i) Calculate the average life span of the male haemophiliacs shown in the table.

You **must** show your working.

Average = years [2]

(ii) The average life span of female carriers in Queen Victoria's family tree was 66 years.

Suggest why the average life span of the male haemophiliacs was less.

.....
.....
.....[2]

(c) Haemophilia is a genetic disorder.

It is possible to find out very early in a pregnancy whether the baby has haemophilia. Following a positive result of this test, some people may decide to terminate the pregnancy.

Other people may decide to continue with the pregnancy.

Write down **two** arguments to support **each** decision.

To terminate the pregnancy

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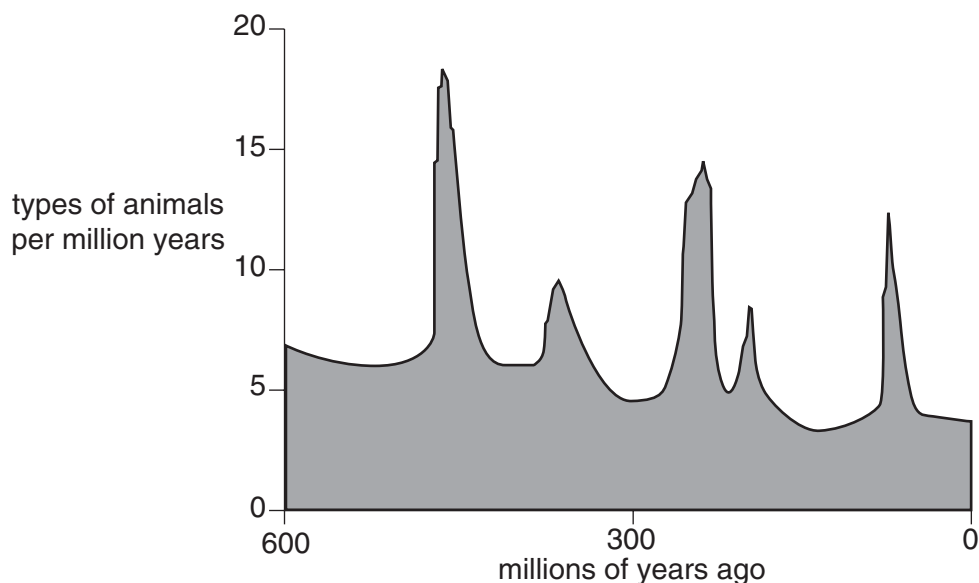
To continue with the pregnancy

.....
.....
.....
.....[4]

[Total: 9]

8 This question is about the possible effects of an asteroid hitting the Earth.

(a) The graph shows the rate at which types of animals have become extinct over the past 600 million years.



The data comes from fossil records, which show that sometimes there are sudden changes in the fossil evidence.

This shows that many species have become extinct at the same time. This is called a **mass extinction**.

A student makes these notes about the extinction of the dinosaurs.

65 million years ago:

- dinosaurs died out
- so did flying reptiles and marine reptiles.

Rocks from 65 million years ago show unusually high amounts of iridium.

Iridium is not found in the Earth's crust.

Iridium is found in asteroids and in material from volcanoes.

Discuss whether an asteroid hitting the Earth caused the extinction of the dinosaurs.

Use your ideas about asteroid collisions and the student's notes to help you with your answer.



One mark will be for a clear, ordered answer.

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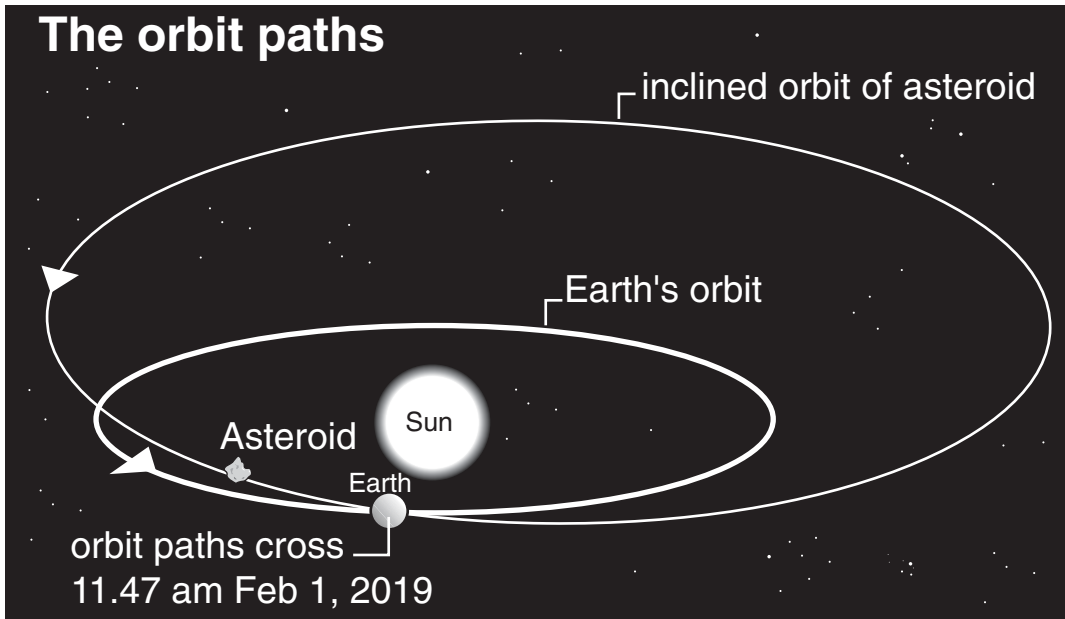
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.....[3+1]

Turn over for the rest of question 8

- (b) On 9th July 2002, an asteroid identified as 2002 NT7 was observed in orbit around the Sun.



News reports warned that the asteroid was scheduled to crash into the Earth at 11.47am on 1st February 2019. After several weeks, scientists reported that the asteroid would miss the Earth.

- (i) Suggest why it took several weeks for the scientists to confirm that there was no danger.

.....
.....
.....[2]

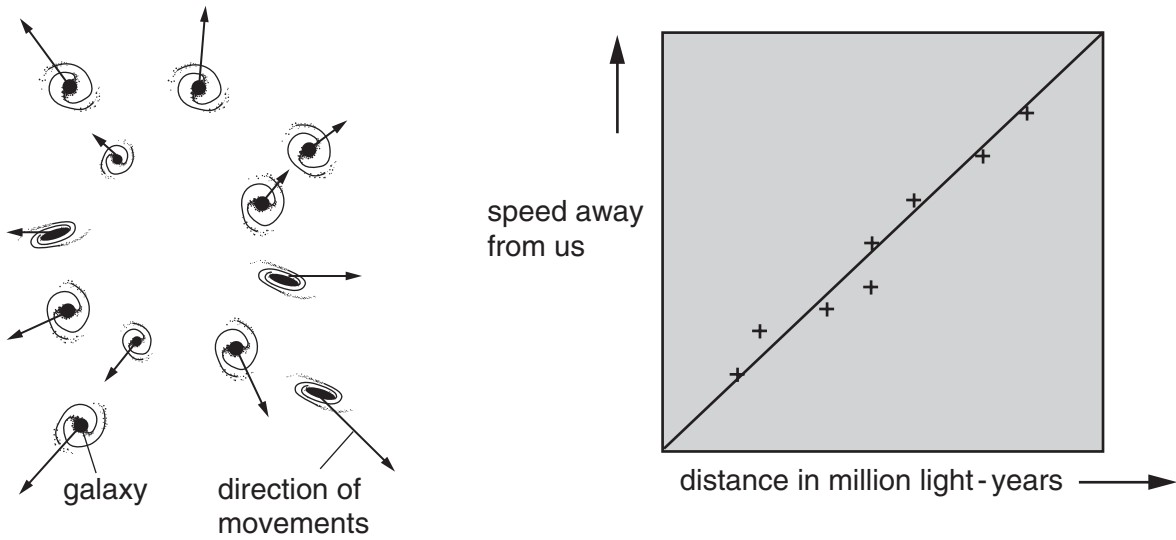
- (ii) Suggest and explain **two** possible consequences for life on Earth of an asteroid impacting on the Earth.

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.....[2]

[Total: 8]

9 This question is about ideas about the possible origins and future of the Universe.

(a) A student reads about Edwin Hubble's observations of moving galaxies. The student draws these diagrams to understand what is observed.



Use the diagrams to help you explain what Hubble observed and how this supports the idea of a 'big bang' start to the Universe.

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.....[3]

(b) It has been suggested that eventually the Universe will collapse in a 'big crunch'.

Explain why this might happen.

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.....[2]

[Total: 5]

END OF QUESTION PAPER