Answer **all** the questions.

1 Not everyone agrees about the age of the Earth. Read this story of how ideas changed and then answer the questions.

How old is the Earth?

James Ussher was Archbishop of Armagh.

In 1645, he followed family histories in the Bible back in time.

He calculated that the Universe was created in the year 4004 BC, on October 23.

By the late 1700s, it was known that rocks eroded.

James Hutton, a Scottish farmer, noticed that Hadrian's Wall had not been eroded very much.

It was made from stone and had been there for over 1000 years.

He said that the Earth must be older than Ussher suggested.

By 1897, many people were studying science.

William Thompson suggested that the Earth had once been a ball of molten rock.

He said that it was cooling down gradually by conduction and radiation.

He worked out that it must be between 24 million and 400 million years old.

Radioactivity was discovered in 1896.

In 1905, Ernest Rutherford used radioactive decay of minerals to work out the age of the Earth. He said it was 500 million years old.

Today scientists estimate the age of the Earth as being much older.

(a) Ussher's announcement that the Universe was created in 4004 BC was not challenged by many people in Britain in 1645.

Suggest why.

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..... [2]

(b) James Hutton thought that Hadrian's Wall showed that the Earth must be much more than 5 000 years old.

Explain why.

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..... [2]

(c) William Thompson did not know about radioactive decay. Radioactive decay releases heat energy.

Explain why Thompson's cooling model gave too low a value for the age of the Earth.

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(d) The information in the question describes how estimates about the age of the Earth have changed.

Use your ideas about how science theories are developed to explain how this happened.

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[Total: 9]

(a) What is the best current estimate for the age of the Earth?

Put a (ring) around the correct answer.

6 000 years **500 million years** **4 500 million years** **4 500 billion years** [1]

(b) **(i)** What data did Ussher use for saying that the Universe was created in 4004 BC?

.....

..... [1]

(ii) Ussher's announcement that the Universe was created in 4004 BC was not challenged by many people in Britain in 1645.

Suggest why.

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..... [2]

(c) James Hutton thought that Hadrian's Wall showed that the Earth must be much more than 5 000 years old.

Explain why.

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..... [2]

(d) The information in the question describes how estimates about the age of the Earth have changed.

Use your ideas about how science theories are developed to explain how this happened.

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

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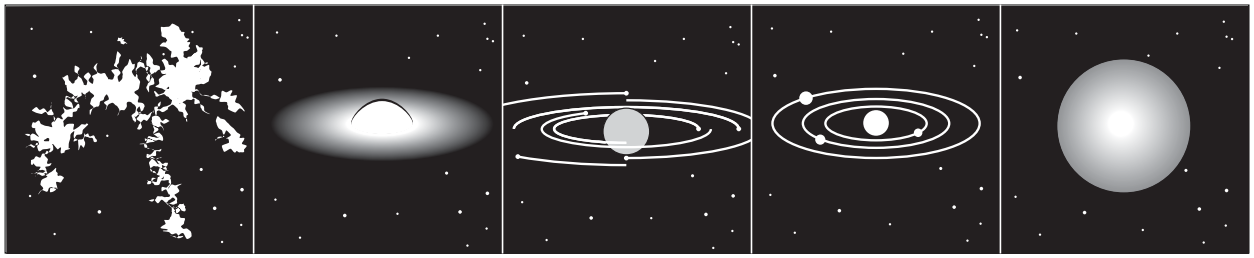
[Total: 10]

END OF QUESTION PAPER

6 **(a)** The diagrams show some of the stages in the life of the Sun and solar system.



Use the diagrams to help you tell the life story of the Sun.

One mark will be for a clear, ordered answer.

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..... [5+1]

(b) Betelgeuse, a bright star in the constellation Orion, is 600 light years away from Earth.

People say that when we look at a star we are **looking back in time**.

Use Betelgeuse as an example to explain what this means.

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..... [2]

(c) The Milky Way is one of many galaxies in the Universe. Astronomers have observed that the galaxies are moving.

Describe this movement **and** explain what this suggests about the beginning of the Universe.

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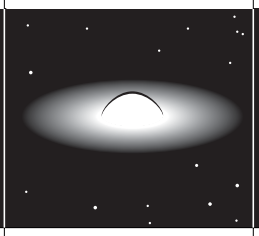
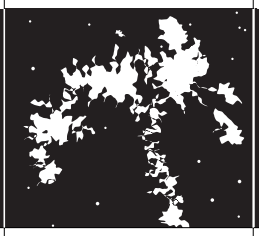
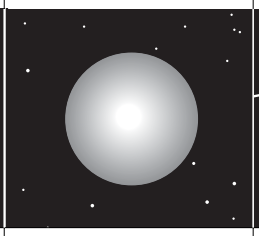
[Total: 11]

3 **(a)** The diagrams show some of the stages in the life of the Sun and the Solar System. They are in the wrong order.

A	B	C	D	E
				
The planets orbit the Sun. Some debris remains.	The cloud begins to form a denser centre, which heats up as it contracts.	A cloud of dust and gases.	The Sun runs out of fuel, forming a red giant.	Remaining dust swirling round begins to form planets.

Fill in the boxes to show the right order.

The first one has been done for you.

C				

[3]

(b) The Solar System has different types of bodies in orbit around the Sun. Planets are one type.

(i) Write down the names of **two** other types of bodies that are orbiting the Sun.

1. .....

2. ..... [2]

(ii) Put a (ring) around the name of the force that keeps a planet in orbit around the Sun.

electrical **friction** **gravity** **magnetism** [1]

(c) The Sun is just one star in the Milky Way galaxy. The next nearest visible star, Alpha Centauri, is about 4 light years away.

What is a **light year**?

..... [2]

(d) The Milky Way is one of many galaxies in the Universe. It looks as though the galaxies are **moving away from us**.

Explain what this suggests about the beginning of the Universe.

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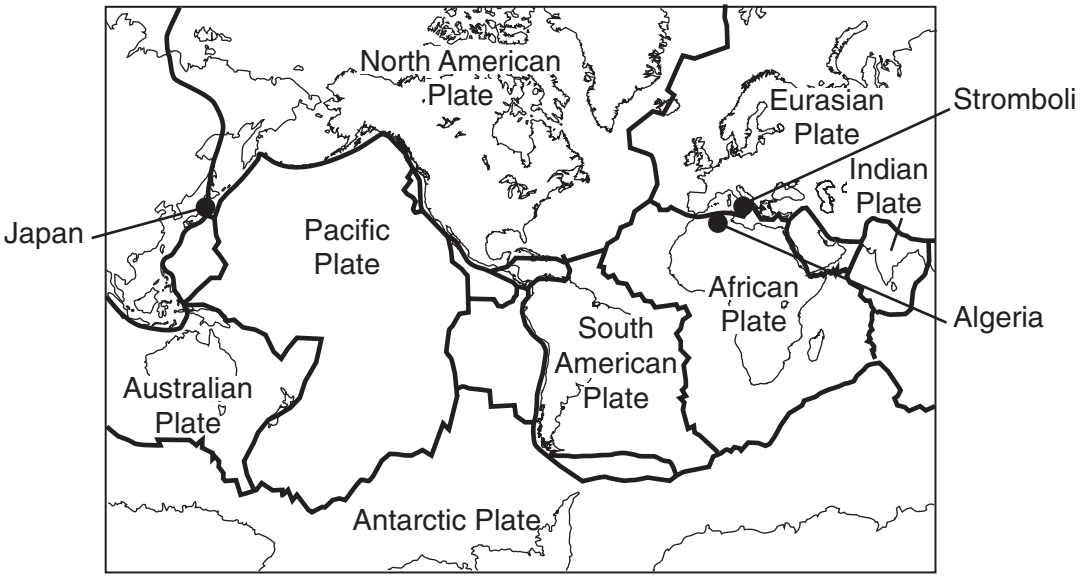
[Total: 10]

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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(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.

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(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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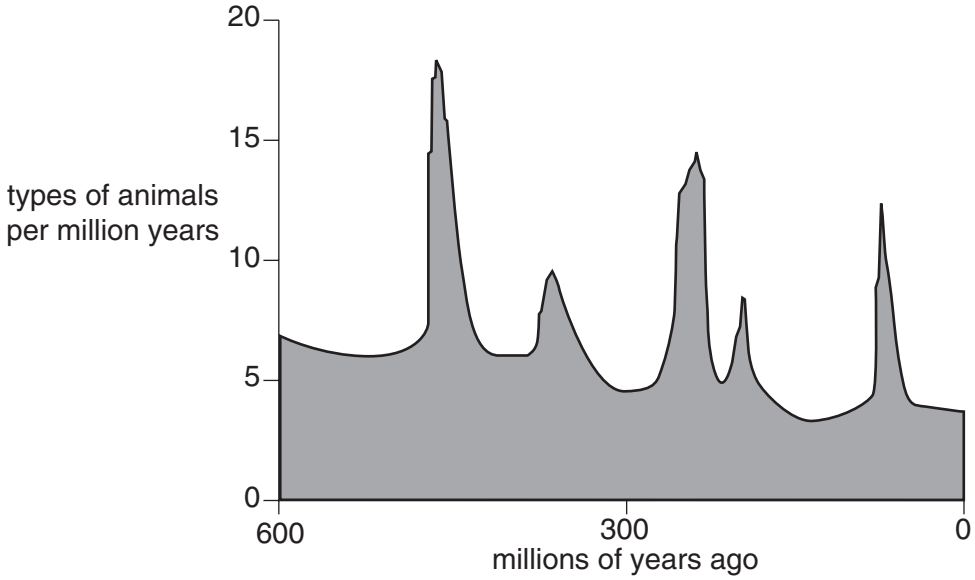
[Total: 9]

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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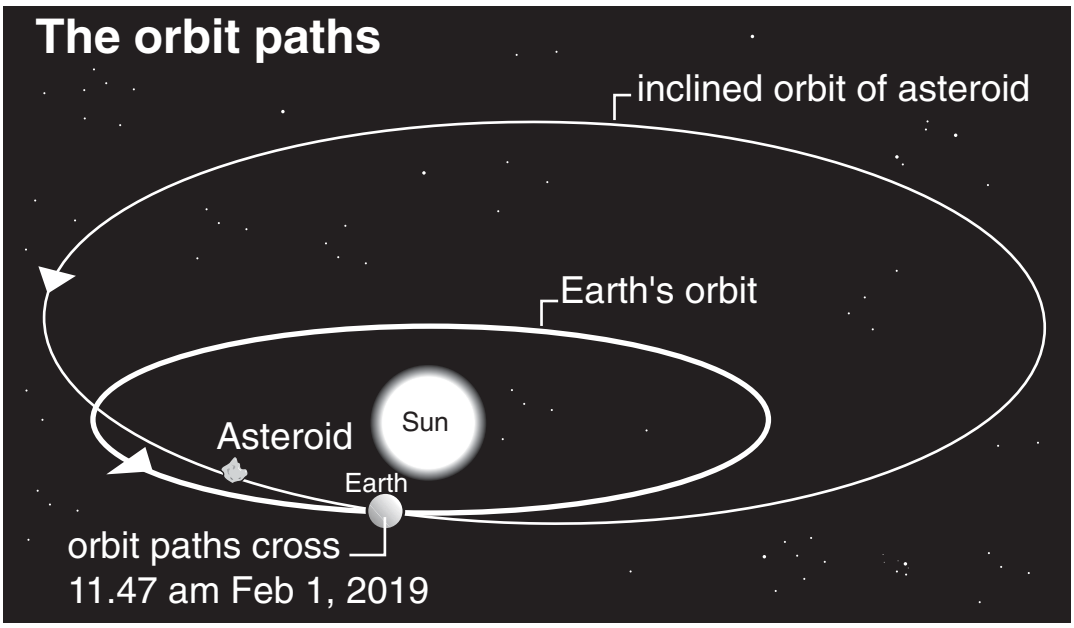
Turn over for the rest of question 8

(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.

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

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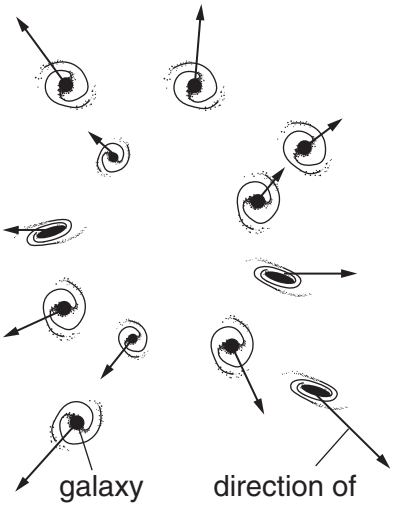
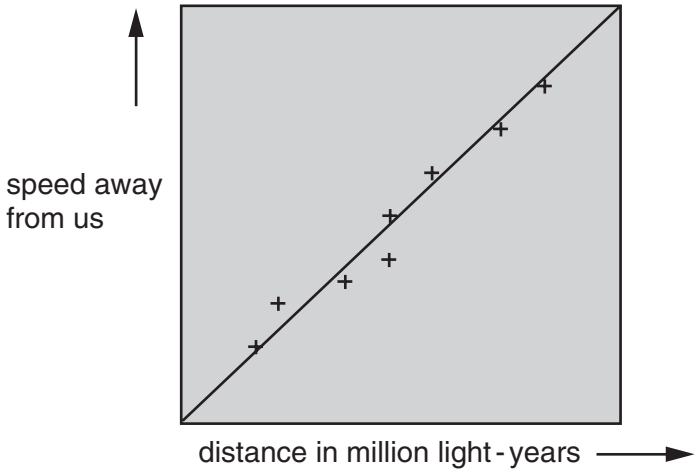
[Total: 8]

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

Explain why this might happen.

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[Total: 5]

END OF QUESTION PAPER