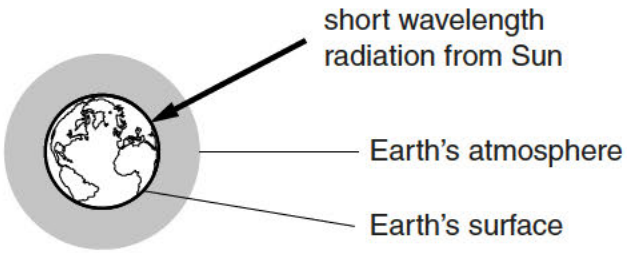
1 Scientists are worried about greenhouse gases.

Look at the simple diagram of the Earth and its atmosphere.



(a) The greenhouse effect helps keep the Earth warm.

Explain how the greenhouse effect warms the Earth.

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

(b) Three main greenhouse gases are water vapour, carbon dioxide and methane.

These gases can be man-made or produced naturally.

(i) Complete the table showing a possible natural cause for **each** gas.

Greenhouse gas	Man-made cause	Natural cause
water vapour	burning fuels	
carbon dioxide	burning fuels	
methane	producing fuels	

[2]

(ii) A lot of scientists think that global warming is mostly caused by human activities.
A few scientists think that global warming is mostly a natural cycle.

Suggest a reason why some scientists think it is mostly a natural cycle.

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

(iii) Each greenhouse gas gives a different contribution to the greenhouse effect.

Look at the information about each gas.

Greenhouse gas	Percentage of gas in atmosphere	How long it lasts	Global warming potential (GWP) over a few years	Contribution to the greenhouse effect
water vapour	0.01% to ~4%	A few days		36% to 66%
carbon dioxide	0.30%	100 years	1	10% to 26%
methane	0.06%	11 to 12 years	21 times more than carbon dioxide	4% to 9%

The global warming potential (GWP) for water vapour has not been calculated.

Use data from the table to suggest why scientists do not calculate the GWP for water vapour.

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

(c) Methane has a GWP that is 21 times more than carbon dioxide, but contributes less than carbon dioxide to the greenhouse effect.

Suggest why.

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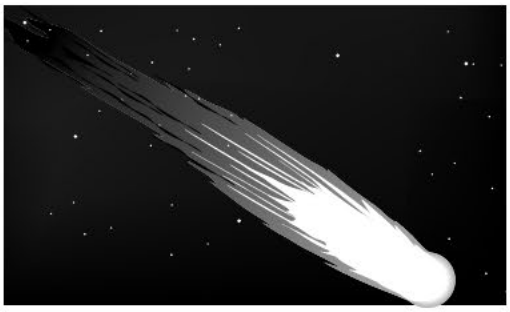
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2 Comets orbit the Sun and are made of dust and ice.

(a) Some comets take hundreds of years to complete one orbit.

Look at the picture.



(i) We can only see a comet for a very small part of its orbit.

In which part of its orbit can the comet be seen?

Explain why.

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

(ii) The speed of a comet changes during its orbit.

Describe the shape of its orbit.

Explain how and why the speed changes during the orbit.

You may use a diagram in your answer.

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..... **[3]**

(b) Asteroids also orbit the Sun.

Some asteroids pass close to Earth.
These are called Near Earth Objects (NEOs).

(i) Explain why it is difficult for scientists to observe these NEOs.

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

(ii) One day, scientists may discover an asteroid on a collision course with the Earth.

One method to protect the Earth would be to use a long-range missile which explodes at the asteroid.

Explain the advantages and disadvantages of using this method to protect the Earth.

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[Total: 9]

3 Real rockets can carry satellites into space and put them in orbit around Earth.

Two types of satellite orbit are

- low polar orbit
- geostationary orbit.

(a) TV satellites are in geostationary orbit.

What is meant by a geostationary orbit and why is this orbit chosen for satellites transmitting TV signals?

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..... **[3]**

(b) Low polar satellites can be used to take aerial photographs of storm clouds.

These photographs can be updated about every 90 minutes.

(i) Explain why this satellite cannot take photographs of these storm clouds more often than this.

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

(ii) A **low polar** satellite travels at a different speed to a **geostationary** satellite.

Compare the speeds of the two satellites and explain this difference using ideas about forces.

No calculations are required in your answer.

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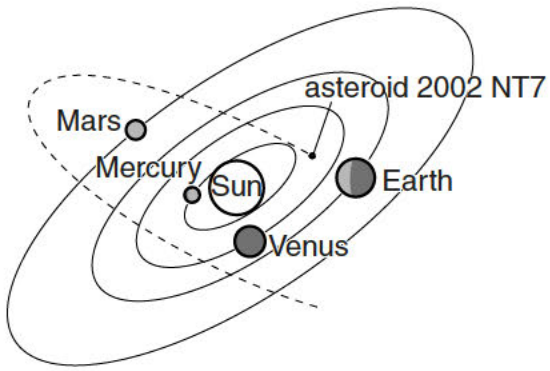
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[Total: 7]

4 The asteroid named 2002 NT7 is a Near Earth Object (NEO) with a diameter of 2 km.



Asteroid 2002 NT7 has a low probability of colliding with the Earth in the year 2019.

Explain why most asteroids are not normally a threat, and discuss the possible actions needed to manage the threat of asteroid 2002 NT7.

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

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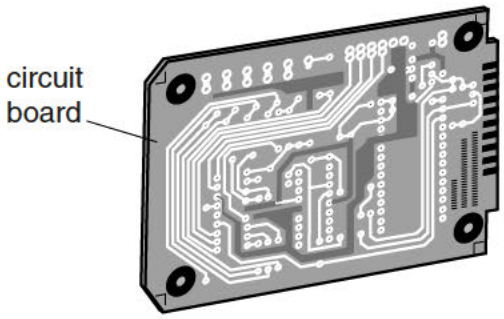
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[Total: 6]

5 A microchip manufacturer has been asked to make electronic components for a new communications satellite.



The manufacturer must make these components as small and as light as possible.

Write about the difficulties for the manufacturer in making very small components for the satellite.

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

[Total: 2]

6 Our understanding of the Solar System has developed over centuries.

Astronomer	Dates	
Ptolemy	87 to 150 AD	He believed the **Earth** was the centre of the Universe.
Copernicus	1473 to 1543 AD	He believed the **Sun** was the centre of the Solar System.
Galileo	1564 to 1642 AD	He showed that Copernicus' model was right and that Ptolemy's was wrong.

(a) (i) What did Copernicus do to develop his theory?

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

(ii) How was Galileo able to support Copernicus' theory?

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(iii) Why were Copernicus' and Galileo's ideas **controversial** at the time?

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

(b) The Big Bang Theory, developed in 1949, states that the Universe began with an 'explosion'. This made the Universe expand.

What can we conclude about the movement of galaxies from the Big Bang Theory?

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

(c) The Big Bang Theory has been accepted by many scientists.

The theory might be changed by future scientists.

Explain why.

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..... [1]

[Total: 6]

7 Stars are part of the Universe.

(a) The **end** of the 'life cycle' **of a star** depends on its mass.

Put the life cycle stages from this list into the correct **order** for a large star.

black hole

red supergiant

supernova

order

large star

[1]

(b) The brightest supergiant stars in our galaxy have very high surface temperatures and appear blue in colour.

Using powerful telescopes these 'super bright' stars can be observed in galaxies other than our own.

Observations of the radiation emitted by these stars can help to accurately calculate the distance to these other galaxies, and provides more evidence for the age of the Universe.

Explain the value of more than one team of scientists investigating these blue supergiants.

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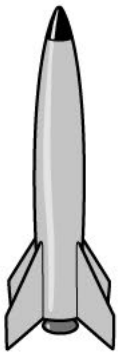
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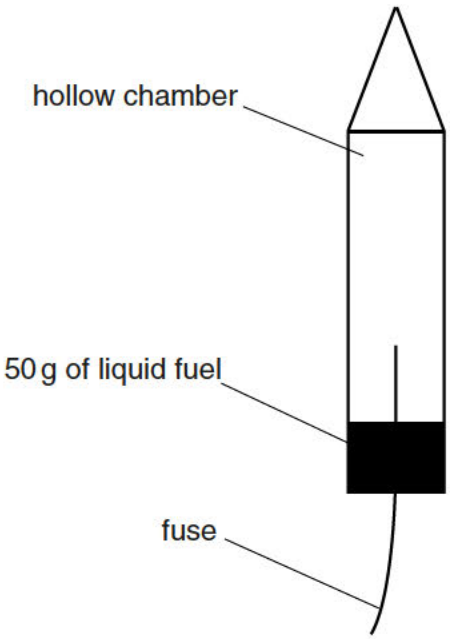
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[Total: 3]

8 Rockets use hot gases to make them move.



Look at the diagram of a simple rocket.



Denise lights the fuse of the rocket. The 50 g of fuel in the rocket ignites.

A very fast chemical reaction takes place which creates a large amount of hot gas.

The gas fills the hollow chamber.

(a) The hot gas produces a high pressure inside the rocket.

Explain how the particles in the hot gas produce a high pressure in the rocket, making it move.

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

(b) Denise re-launches the same rocket.

This time, the rocket contains 100 g of the same type of fuel.

The rocket lifts off and reaches a greater height than before.

Suggest why using more fuel produces a greater force and acceleration on the rocket.

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

(c) Rockets carry satellites into space.

These satellites can have different types of orbit around the Earth.

One type is a low polar orbit.

Another type is a geostationary orbit, which has an orbital period of 24 hours.

Describe and explain the differences in orbits, periods and speeds between geostationary orbits and low polar orbits.



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

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..... **[6]**

(d) A rocket was sent to Mars.

The rocket carried a vehicle called the Mars Rover.



The Mars Rover has a mass of 185 kg.

Its wheels are designed to carry a total weight of up to 1800 N.

The gravitational field strength (g) on Mars is 3.8 N/kg.

This means a mass of 1 kg on Mars weighs 3.8 N.

(i) Calculate the weight of the Rover vehicle on Mars.

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answer ..... N **[2]**

(ii) Look at the table showing how gravitational field strength varies.

Place	Gravitational field strength in N/kg
Moon	1.6
Earth	10.0
Mars	3.8

Scientists are happy for the Rover to be used on the Moon or Mars.

They are very careful when using the Rover on Earth.

Use the data and information about the Rover to explain why.

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[Total: 13]