

Name:

Date:

P8 - Test 3
SPACE PHYSICS
Intermediate

GCSE

PHYSICS

AQA - Triple Science

Mark

Grade

Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

Instructions

- Answer all questions
- Answer questions in the space provided
- All working must be shown

Information

- The marks for the questions are shown in brackets

1.

(a) Which one of the following types of electromagnetic wave has the highest frequency?

Tick **one** box.

Gamma rays

Infrared

Microwaves

Ultraviolet

(1)

(b) What makes microwaves suitable for sending communications to a satellite in space?

(1)

(c) Scientists have detected short bursts of radio waves emitted from a distant galaxy. The scientists think that the radio waves may have been emitted from a neutron star. What event leads to a neutron star forming?

(1)

(d) Some of the radio waves from the distant galaxy have a frequency of 1.2 gigahertz (GHz).

Which of the following is the same as 1.2 GHz?

Tick **one** box.

1.2×10^3 Hz

1.2×10^6 Hz

1.2×10^9 Hz

1.2×10^{12} Hz

(1)

(e) Radio waves travel through space at a speed of 3.0×10^8 m/s

Calculate the wavelength of the 1.2 GHz radio waves emitted from the distant galaxy.

Wavelength = _____ m

(3)

(f) When radio waves are absorbed by an aerial they may create an alternating current in an electrical circuit.

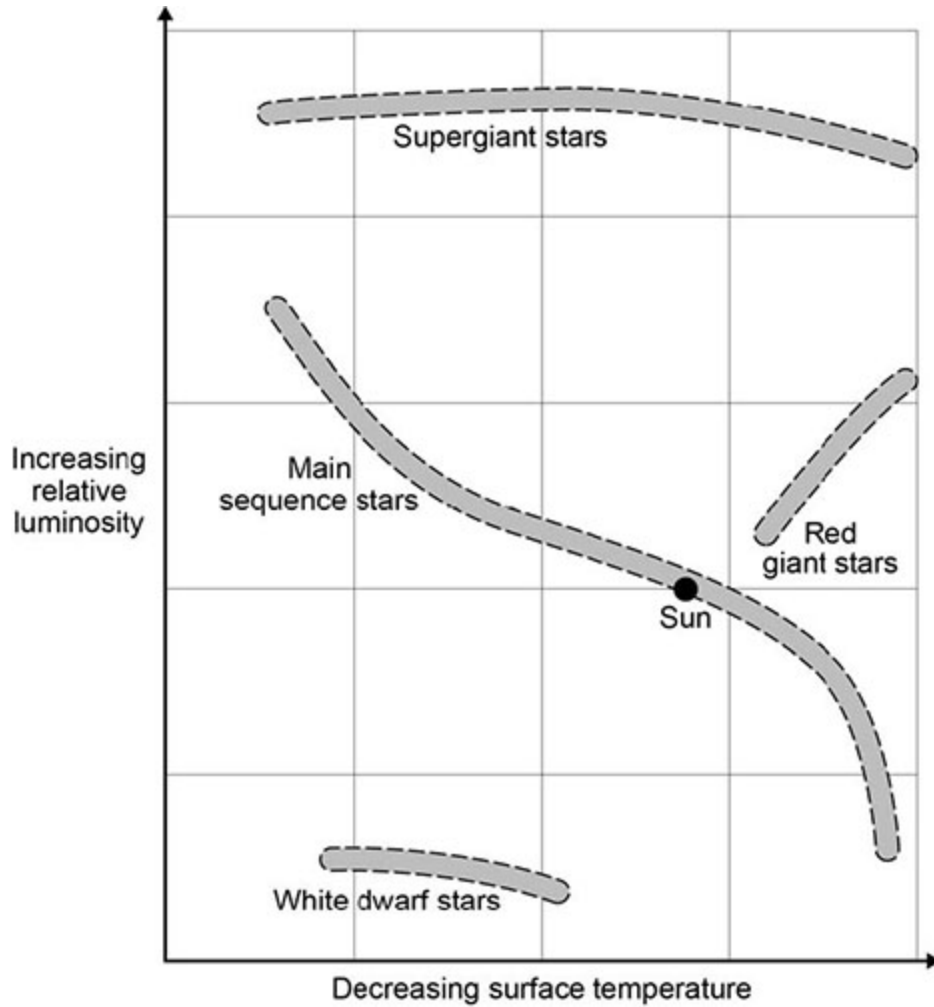
If an alternating current is created what frequency would it have?

(1)

The diagram shows four groups of stars.

The surface temperature and relative luminosity determine which group a star is in.

A star with a relative luminosity of 1 emits the same amount of energy every second as the Sun.



(g) The Sun is in the group of main sequence stars. These stars are stable.

Explain why a star remains stable.

(2)

(h) At different points in their lifecycle stars change from one group to another.

Describe what will happen to the Sun between it leaving the main sequence group and becoming a white dwarf.

Use information from the diagram.

(4)

(Total 8 marks)

2.

In 1929, the astronomer Edwin Hubble observed that the light from galaxies moving away from the Earth had longer wavelengths than expected.

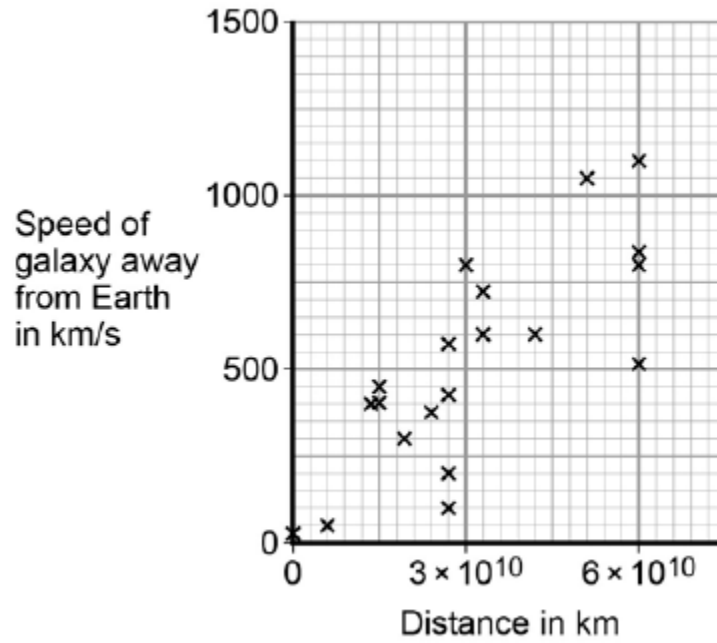
(a) What name is given to this effect?

(1)

- (b) From his observations, Hubble was able to calculate the speed of a galaxy and the distance of the galaxy from the Earth.

Figure 1 shows the results of Hubble's calculations.

Figure 1



What relationship between the speed of a galaxy and the distance is suggested by Hubble's results?

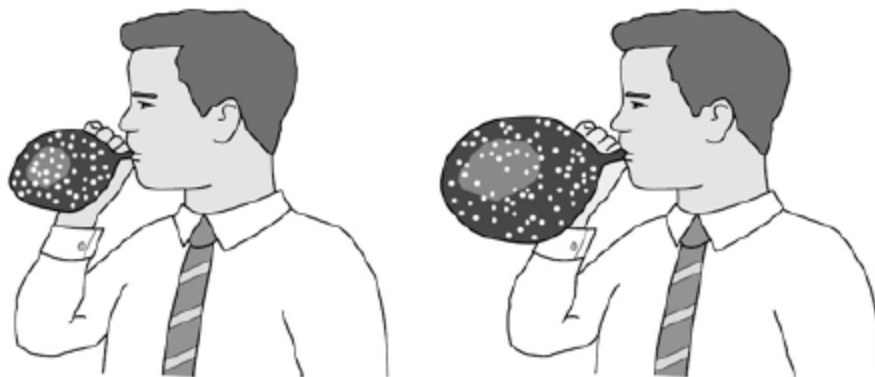
(1)

The observations made by Hubble support the idea that the Universe is expanding. This means that galaxies are continually moving away from each other and from the Earth.

Figure 2 shows a student using a balloon to model the idea of an expanding Universe.

Some dots, which represent galaxies, were marked on the balloon. The balloon was then inflated.

Figure 2



(c) Give **one** strength and **one** weakness of this model in representing the idea of an expanding Universe.

Strength _____

Weakness _____

(2)

In the 1950s there were two main theories to explain how the Universe began.

Theory 1

The Universe has always existed, it is continually expanding. New galaxies are formed as older galaxies die out.

Theory 2

The Universe began from a very small region that was extremely hot and dense. The Universe has been expanding ever since.

(d) In what way do the observations made by Hubble support both Theory 1 and Theory 2?

(1)

- (e) Most scientists now believe that Theory 2 is correct.
Suggest what is likely to have caused scientists to start thinking Theory 1 is wrong.

(1)

(Total 6 marks)

3.

The early Universe contained only the lightest element.

- (a) Use the correct answer from the box to complete the sentence.

hydrogen	iron	uranium
-----------------	-------------	----------------

The early Universe contained only _____ .

(1)

- (b) Use the correct answer from the box to complete the sentence.

main sequence star	protostar	supernova
---------------------------	------------------	------------------

The heaviest elements are formed only in a _____ .

(1)

- (c) Use the correct answer from the box to complete the sentence.

red giant	red super giant	white dwarf
------------------	------------------------	--------------------

Only a star much bigger than the Sun can become a _____ .

(1)

(d) The Universe now contains a large variety of different elements.

Describe how this happened.

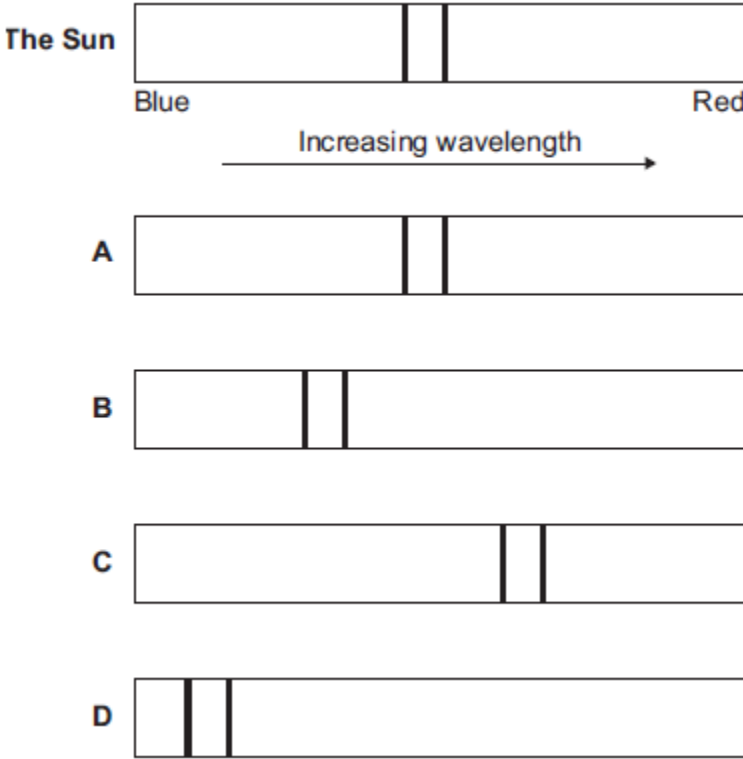
(4)
(Total 7 marks)

4.

Scientists can use the visible light spectrum from distant stars to determine whether the stars are moving.

The visible light spectrum from stars includes dark lines at specific wavelengths.

(a) The diagram shows the visible light spectrum from the Sun and from four other stars, **A**, **B**, **C** and **D**.



(i) Which star, **A**, **B**, **C** or **D**, is moving away from the Earth?

(1)

(ii) How does the speed of star **B** compare with the speed of star **D**?

Tick (✓) **one** box.

	Tick (✓)
The speed of star B is greater than the speed of star D .	<input type="checkbox"/>
The speed of star B is less than the speed of star D .	<input type="checkbox"/>
The speed of star B is the same as the speed of star D .	<input type="checkbox"/>

(1)

- (b) A radio wave is emitted by a star.
The radio wave has a wavelength of 1500 m and a frequency of 200 000 Hz.

Calculate the speed of this radio wave.

Choose the correct unit from the list below.

m m/s m/s²

Speed = _____ unit _____

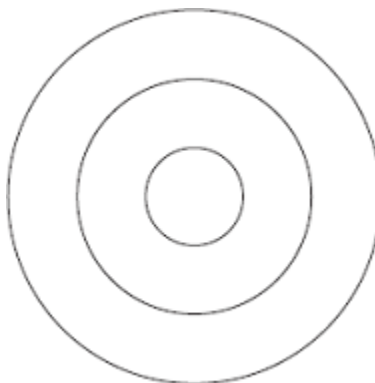
(3)
(Total 5 marks)

5.

A teacher demonstrates the production of circular waves in a ripple tank.

Diagram 1 shows the waves at an instant in time.

Diagram 1



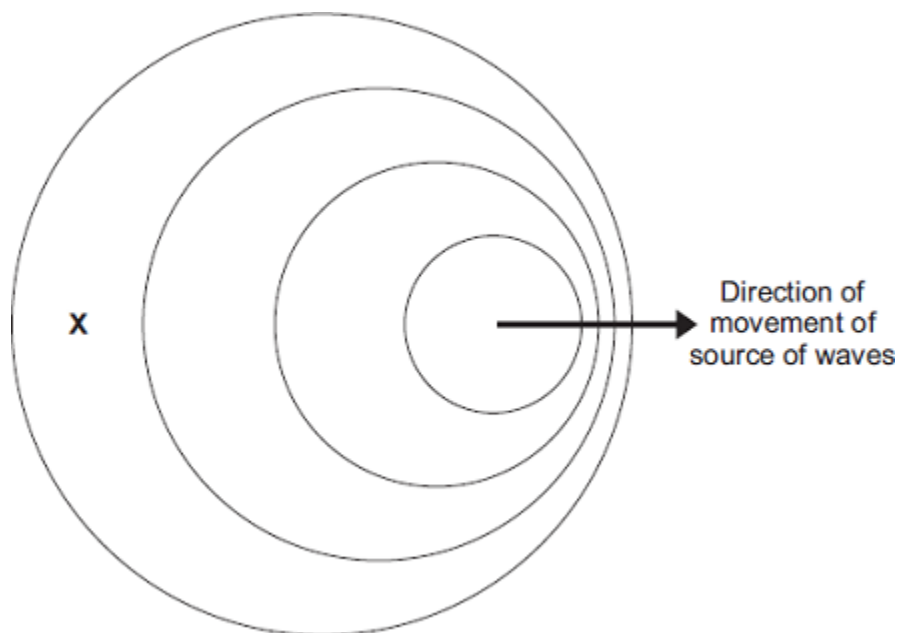
- (a) Show on **Diagram 1** the wavelength of the waves.

(1)

- (b) The teacher moves the source of the waves across the ripple tank.

Diagram 2 shows the waves at an instant in time.

Diagram 2
(Actual size)



- (i) Use the correct answer from the box to complete each sentence.

decreased	increased	stayed the same
-----------	-----------	-----------------

In **Diagram 2**, the observed wavelength of the waves at **X**

has _____ .

In **Diagram 2**, the frequency of the waves at **X**

has _____ .

(2)

- (ii) Take measurements from **Diagram 2** to determine the wavelength of the waves received at **X**.

Give the unit.

Wavelength = _____

(3)

- (c) The teacher uses the waves in the ripple tank to model the changes in the wavelengths of light observed from distant galaxies.

When observed from the Earth, there is an increase in the wavelength of light from distant galaxies.

- (i) State the name of this effect.

(1)

- (ii) What does this increase in wavelength tell us about the movement of most galaxies?

(1)

- (iii) Explain how this observation supports the Big Bang theory of the formation of the Universe.

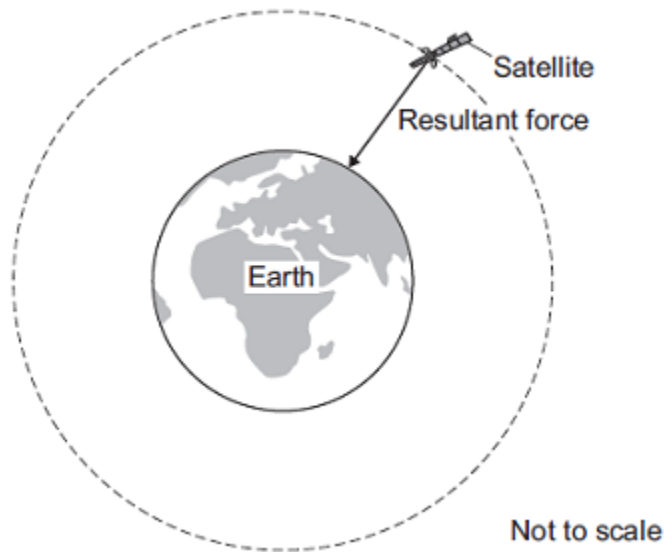
(4)

- (iv) State **one** other piece of evidence that supports the Big Bang theory of the formation of the Universe.

(1)

(Total 13 marks)

6. Man-made satellites can orbit the Earth, as shown in the figure below.



The satellite experiences a resultant force directed towards the centre of the orbit.

The resultant force is called the centripetal force

(a) What provides the centripetal force on the satellite?

(1)

(b) State **two** factors that determine the size of the centripetal force on the satellite.

1. _____

2. _____

(2)

(c) The table below gives data for five different satellites orbiting the Earth.

Satellite	Average height above Earth's surface in kilometres	Time taken to orbit Earth once in minutes	Mass of satellite in kilograms
A	370	93	419 000
B	697	99	280
C	827	103	630
D	5 900	228	400
E	35 800	1440	2 030

(i) State the relationship, if any, between the height of the satellite above the Earth's surface and the time taken for the satellite to orbit the Earth once.

(1)

(ii) State the relationship, if any, between the time taken for the satellite to orbit the Earth once and the satellite's mass.

(1)

(d) Over 300 years ago, the famous scientist Isaac Newton proposed, with a 'thought experiment', the idea of satellites.

Newton suggested that if an object was fired at the right speed from the top of a high mountain, it would circle the Earth.

Why did many people accept Isaac Newton's idea as being possible?

Tick (✓) **one** box.

Isaac Newton was a respected scientist who had made new discoveries before.

Isaac Newton went to university.

It was a new idea that nobody else had thought of before.

(1)

(Total 6 marks)

7.

Stars go through a life cycle. About 90 % of all stars are in the 'main sequence' period of the life cycle.

(a) Stars are stable during the 'main sequence' period of the life cycle.

Why?

(1)

(b) The table gives an estimated time for the number of years that three stars, X, Y and Z, will be in the 'main sequence' period of their life cycle.

Star	Relative mass of the star compared to the Sun	Estimated 'main sequence' period in millions of years
X	0.1	4 000 000
Y	1.0	9 000
Z	40.0	200

(i) This data suggests that there is a pattern linking the mass of a star and the number of years the star is in the 'main sequence' period of its life cycle.

What is the pattern suggested by the data?

(1)

(ii) Scientists cannot give the exact number of years a star will be in the 'main sequence' period.

Suggest why.

(1)

(iii) Nuclear fusion is the process by which energy is released in stars.

Which **one** of the following can be concluded from the data in the table?

Draw a ring around the correct answer in the box to complete the sentence.

The rate of nuclear fusion in a large star is

faster than
the same as
slower than

 in a small star.

Explain the reason for your answer.

(3)

(c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Describe what happens to a star **much bigger** than the Sun, once the star reaches the end of the 'main sequence' period of its life cycle.

Your answer should include the names of the stages the star passes through.

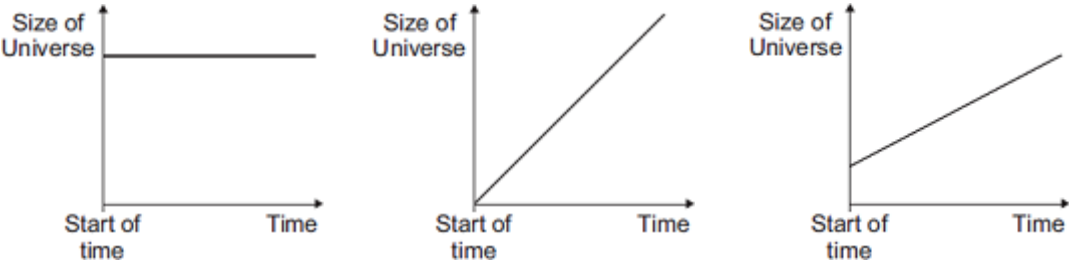
(6)

(Total 12 marks)

8.

The 'big bang' theory is one theory explaining the origin of the Universe.

(a) The graphs X, Y and Z, show how the size of the Universe may have changed with time.



Which graph would the 'big bang' theory suggest is correct?

Write your answer, X, Y or Z, in the box.

Explain the reason for your answer.

(3)

(b) In 1948, an alternative to the 'big bang' theory, called the 'steady state' theory, was developed.

The 'steady state' theory suggested that the Universe, although expanding, has always existed without a beginning in time.

(i) Complete the following sentence by drawing a ring around the correct line in the box.

The measurement of red-shift in the light from distant galaxies provides evidence

to support

<p>only the 'big bang' theory.</p> <p>only the 'steady state' theory.</p> <p>both the 'big bang' and 'steady state' theories.</p>

(1)

(ii) In 1965, scientists rejected the 'steady state' theory in favour of the 'big bang' theory.

Suggest what might cause scientists to stop supporting one theory and to start supporting an alternative theory.

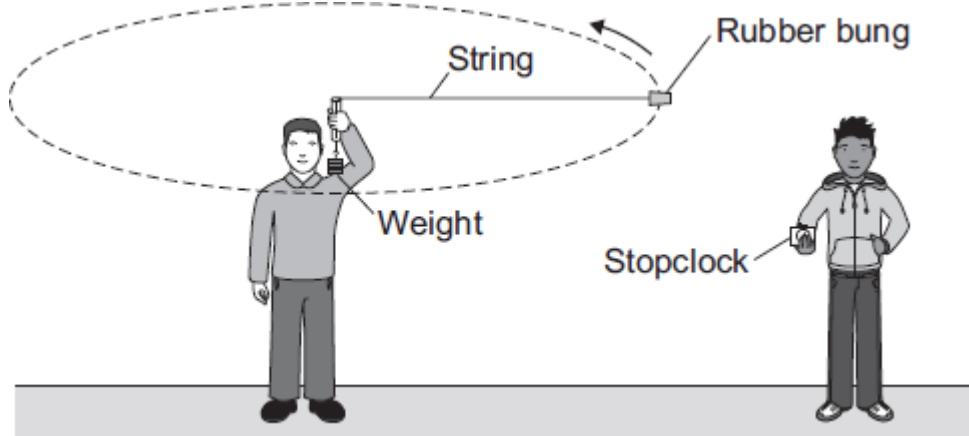
(1)

(Total 5 marks)

9.

Objects moving in a circle experience a force called **centripetal** force, which acts to the centre of the circle.

The diagram shows the apparatus used by two students to find out how the centripetal force acting on an object affects the speed of the object.



(a) (i) In which direction does the centripetal force act on the rubber bung?

(1)

(ii) In this investigation, what provides the centripetal force?

(1)

(b) One student swung the rubber bung around in a circle at constant speed. The second student timed how long it took the rubber bung to complete 10 rotations. The students then calculated the speed of the rubber bung, using the radius of the circle and the time to complete one rotation. The students repeated this for several different values of centripetal force.

(i) During the investigation, the radius of the circle and the mass of the rubber bung were not changed.

Explain why.

(2)

(ii) One of the variables in this investigation was the time taken by the rubber bung to complete 10 rotations.

Which **two** words can be used to describe this variable?

Draw a ring around each of your **two** answers.

continuous **control** **dependent** **independent**

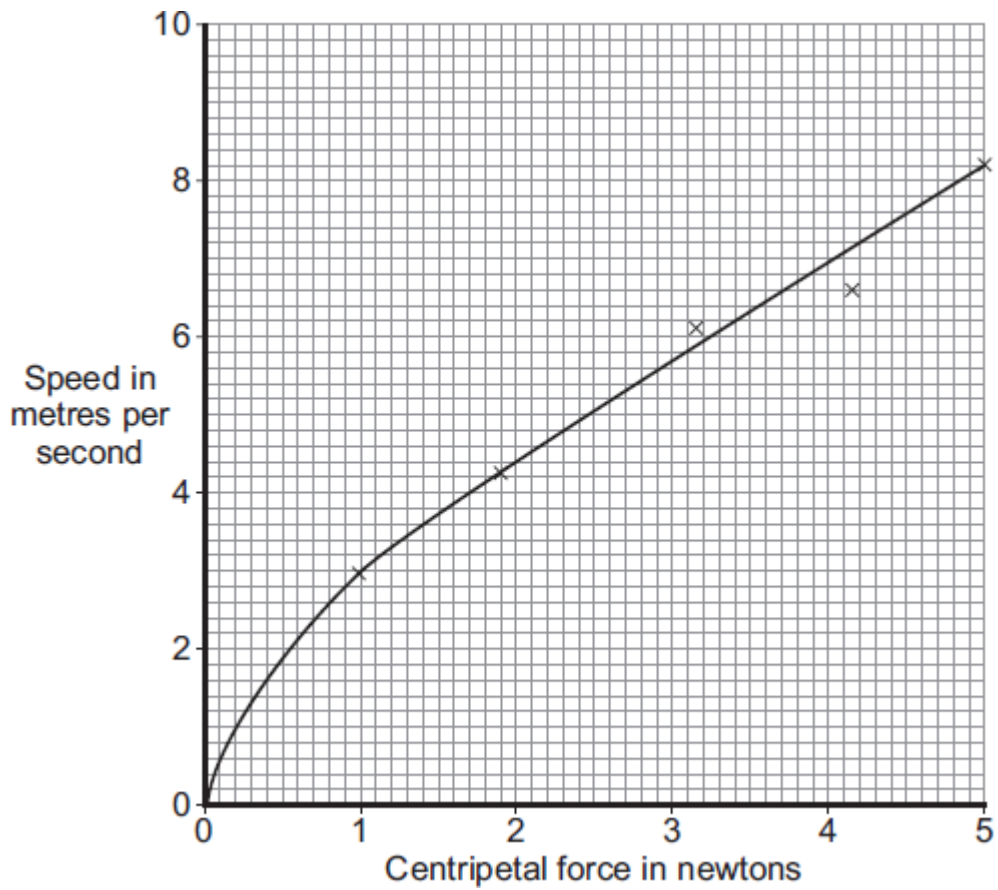
(1)

(iii) The students timed 10 rotations of the rubber bung, rather than just one rotation.

Suggest why.

(1)

(c) The graph shows the students' data.

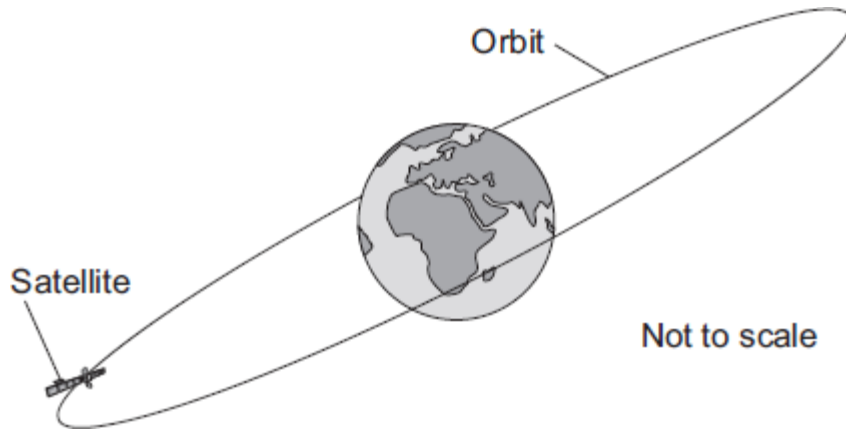


There is a relationship between the speed of an object moving in a circle and the centripetal force acting on the object.

What conclusion about this relationship can the students make from their data?

(1)

- (d) The diagram shows a satellite in a circular orbit above the Earth. The satellite is part of the global positioning system (GPS). The satellite orbits the Earth **twice** every 24 hours.



- (i) What provides the centripetal force needed to keep the satellite in its orbit around the Earth?

(1)

- (ii) Is this satellite in a geostationary orbit?

Draw a ring around your answer. **Yes** **No**

Give a reason for your answer.

(1)

(Total 9 marks)