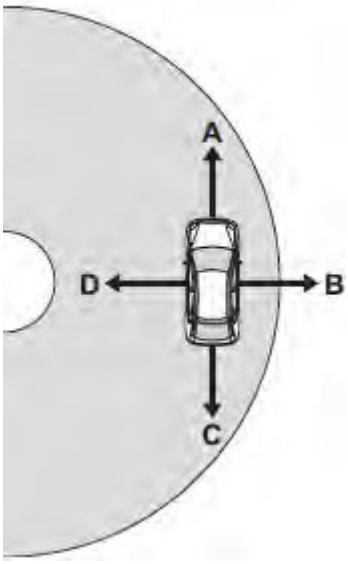
Q1.(a) **Figure 1** shows a car travelling around a bend in the road. The car is travelling at a constant speed.

Figure 1



There is a resultant force acting on the car. This resultant force is called the centripetal force.

(i) In which direction, **A**, **B**, **C** or **D**, does the centripetal force act on the car?

Tick (✓) **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

(ii) State the name of the force that provides the centripetal force.

.....

(1)

(iii) State **two** factors that affect the size of the centripetal force acting on the car.

1 .....

2 .....

(2)

(b) **Figure 2** shows a racing car.

Figure 2



© braverabbit/iStock/Thinkstock

The racing car should not roll over when racing.

State **two** features of the car that make it difficult for the car to roll over.

1.....

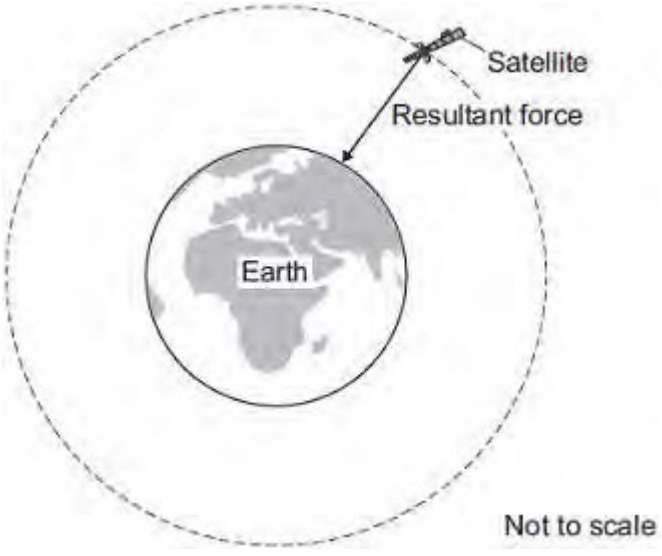
.....

2.....

.....

(2)
(Total 6 marks)

Q2. 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.

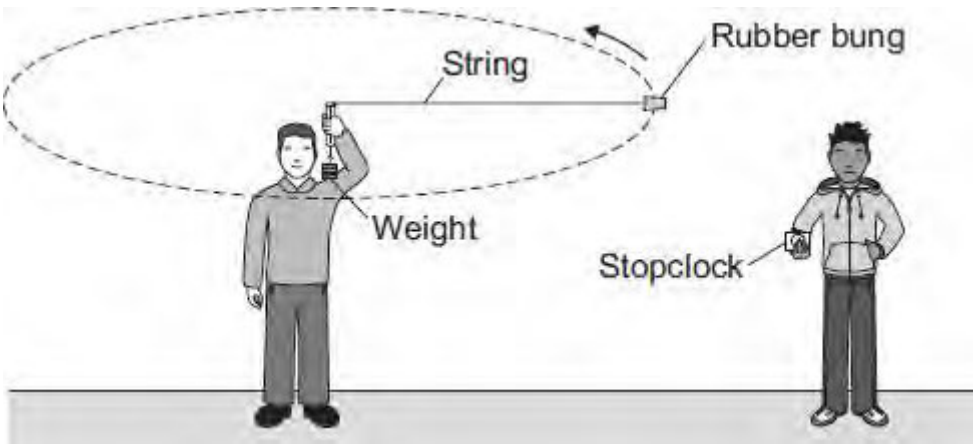
Isaac Newton was a respected scientist who had made new discoveries before. ☐

Isaac Newton went to university. ☐

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

(1)
(Total 6 marks)

Q3. 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.

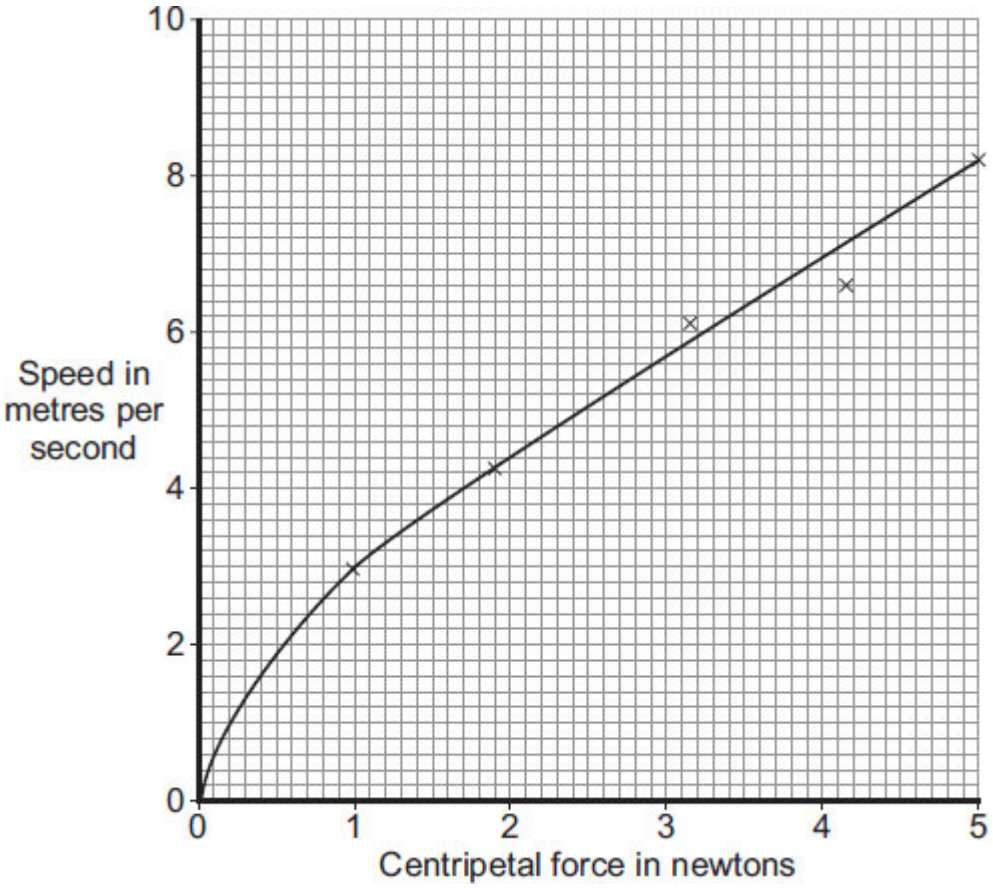
Suggest why.

.....

.....

(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.

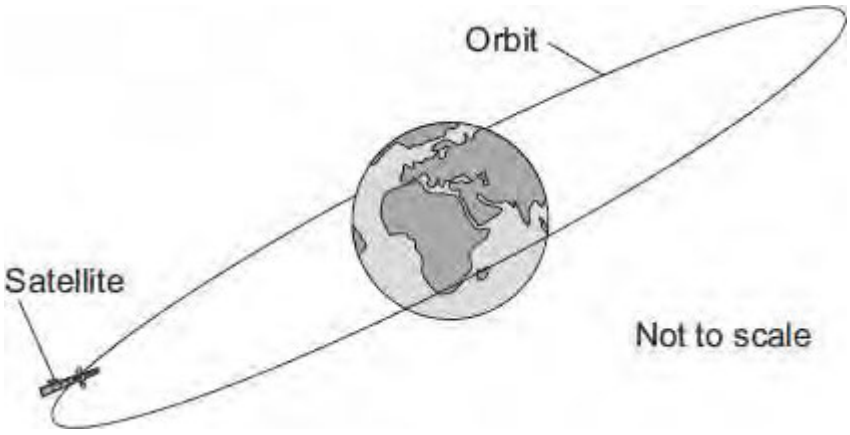
What conclusion about this relationship can the students make from their data?

.....

.....

(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**

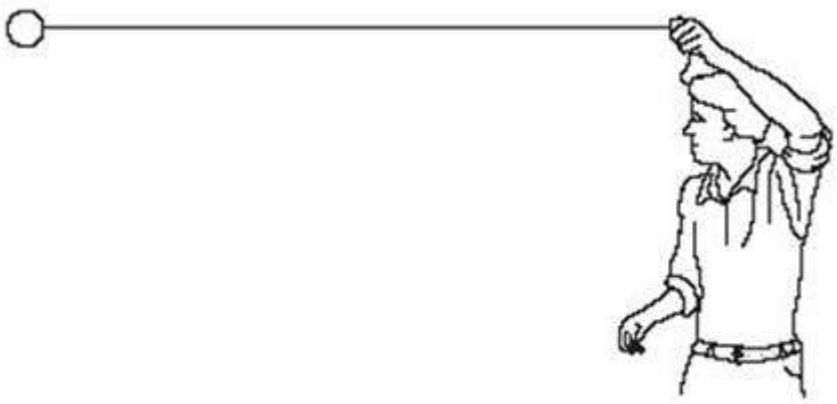
Give a reason for your answer.

.....

.....

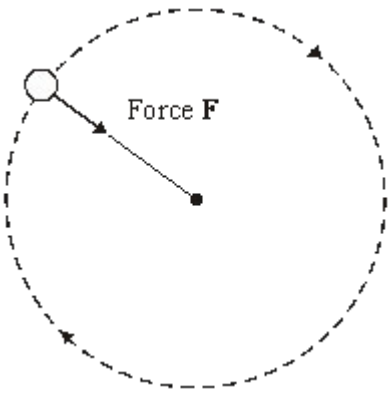
(1)
(Total 9 marks)

Q4. (a) A student has fastened a ball to a piece of string and is swinging it round in a horizontal circle.



(i) The diagram below shows an overhead view of the movement of the ball.

Add an arrow, from the centre of the ball, to show the direction in which the ball would move if the string broke at this instant.



(1)

(ii) Complete the table to show how force **F** changes if the student changes what he is doing. In each case, all the other factors stay the same.

If the student	Force F needs to
uses a ball with a greater mass	.....
swings the ball at a greater speed	
	.....

swings the ball with a shorter piece of string	.....

(3)

(b) The Moon orbits the Earth in a circular path. Use words from the box to complete the **three** spaces in the sentence.

direction	**resistance**	**speed**	**velocity**

You may use each word once, more than once or not at all.

The Moon's ..... is constant but its ..... changes

because its ..... changes.

(2)

(c) When any object moves in a circular, or nearly circular, path a force must act towards the centre of the circle.

(i) What word is used to describe this force?

.....

(1)

(ii) The Moon orbits the Earth. What provides the force towards the Earth?

.....

(1)

(iii) In an atom, name the particles which are moving in circular paths around the nucleus.

.....

(1)

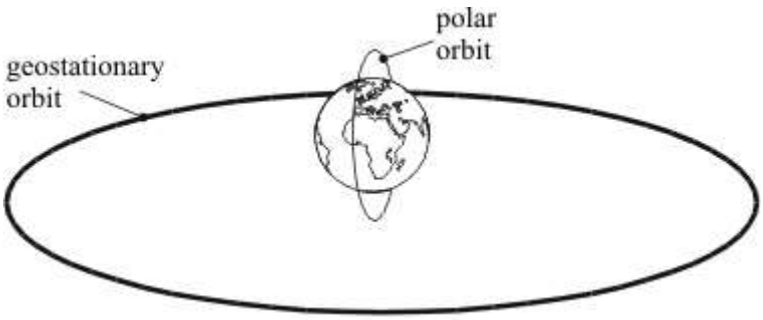
(iv) In the case of an atom, what word describes the forces which keep these particles moving in circular paths around the nucleus?

.....

(1)

(Total 10 marks)

Q5. The diagram below shows the orbits for two types of satellite, a polar orbit and a geostationary orbit.



A satellite in stable Earth orbit moves at a constant speed in a circular orbit because there is a single force acting on it.

(i) What is the direction of this force?

.....

(1)

(ii) What is the cause of this force?

.....

(1)

(iii) What is the effect of this force on the **velocity** of the satellite?

.....

(1)

(iv) In which of the orbits shown above would this force be bigger?
Explain the reason for your answer.

.....

.....

(2)

(v) Explain why the kinetic energy of the satellite remains constant.

.....

.....

.....

(2)
(Total 7 marks)