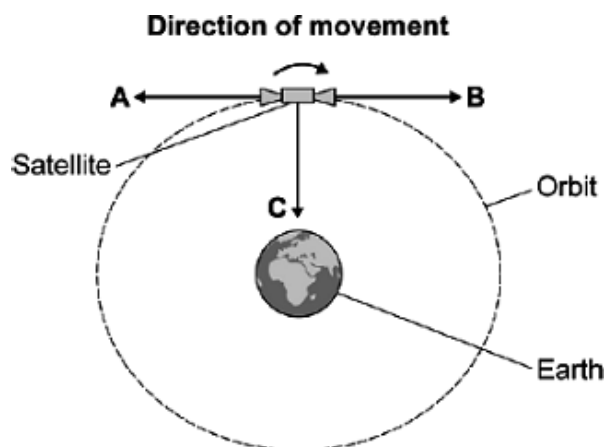**Q1.**   (a)   The diagram shows a satellite moving in a circular orbit above the Earth.

A centripetal force acts on the satellite, causing it to accelerate.

Direction of movement

(i)   Use a word from the box to complete the sentence.

friction	gravity	tension

The centripetal force on the satellite is provided by ....

(1)

(ii)   In what direction does the satellite accelerate, **A**, **B** or **C**?

....

(1)

(iii)   When the satellite accelerates in a circular orbit its speed does not change.

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

When the satellite accelerates there is a change in its

| direction. |
| distance from the Earth. |
| kinetic energy. |

(1)

(b)   The electrical systems on the satellite can be powered by rechargeable batteries.

One fully charged 4 volt battery stores 216 000 coulombs of charge.

Calculate the energy, in joules, available from one fully charged battery.

....

....

....
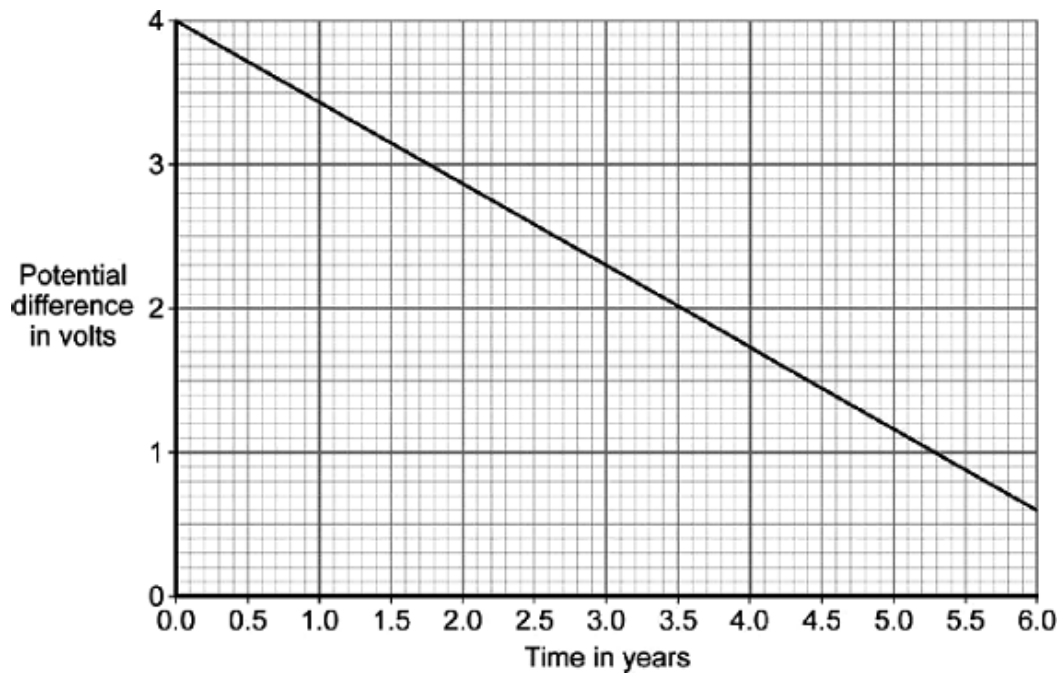
Energy available = ... J

(2)

(c) Batteries to be used on a satellite must not discharge by more than 15% when left unused for three years.

Scientists test new types of battery by charging them to 4 volts and then storing them at 37 °C for several years. The potential difference of the battery is measured every month.

The graph shows the data obtained for one type of battery.

(i) Use the graph to calculate the time taken, in years, for the potential difference of this battery to drop by 15%.

....

....

....

Time taken = ... years

(2)

(ii) Use your answer from (c)(i) to explain whether this battery is suitable for use on a satellite.

....

....

(1)

(d)   There are now thousands of satellites in orbit around the Earth. A student used the Internet to find information about three of them.

The table shows the information found by the student.

Satellite	Height of the orbit above the Earth in kilometres	Orbital speed in kilometres per hour
K	705	27 500
L	20 200	13 900
M	35 800	11 100

A student concluded that the greater the height of the satellite the slower the orbital speed.

Any conclusion drawn from the data in the table might not be valid for **all** satellites.

Suggest reasons why.

....

....

....

....

....

....
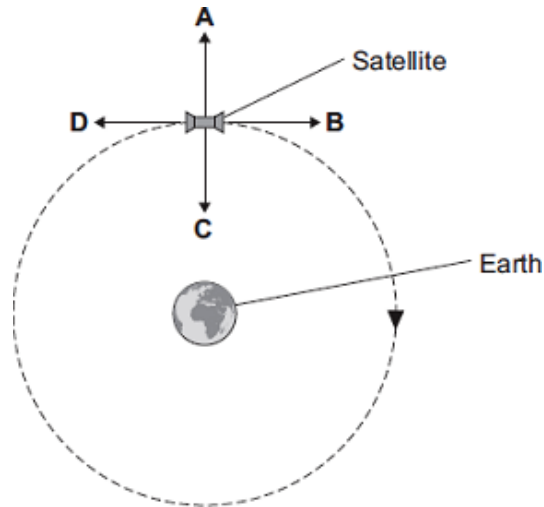
(3)
(Total 11 marks)

Q2.   The diagram shows a satellite moving in a circular orbit around the Earth.

There is a centripetal force acting on the satellite.

(a)   Which arrow, **A**, **B**, **C** or **D**, shows the direction of the centripetal force?

(1)

(b)   Draw a ring around the correct answer to complete each sentence.

The speed of the satellite increases. For the satellite to stay in the same orbit

the centripetal force on the satellite must

| decrease. |
| stay the same. |
| increase. |

The radius of the orbit increases. For the satellite to stay at the same speed

the centripetal force on the satellite must

| decrease. |
| stay the same. |
| increase. |

(2)

(c)   A satellite in a geostationary orbit always stays above the same point on the surface of the Earth.

These satellites:

•   are used for communications

•   are in a fixed orbit at 36 000 km above the surface of the Earth

•   complete one orbit in 24 hours.

The table shows three geostationary satellites, **E**, **F** and **G**, and their masses.

Satellite	Mass of satellite in kg	Launch date
E	1200	1978
F	1500	1984
G	3500	2011

(i)   Describe a pattern shown in the table.

....

....

(1)

(ii)   Which satellite has the greatest centripetal force acting on it?

Give a reason for your answer.

....

....

....

(2)

(iii) Mass is the only thing that affects the force acting on a geostationary satellite.

Explain why.

....

....

....

....

(2)
(Total 8 marks)