Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Q1.

Communication satellites were first proposed in 1945 by the science fiction author Athur C. Clarke. In an article published in the magazine Wireless World he asked whether rocket stations could give worldwide radio coverage.
In the article Clarke states:

"There are an infinite number of possible stable orbits, circular and elpitical, in which a rocket would remain if the initial conditions were correct. A velocity of 8 km s^{-1} applies only to the closest possible orbit, one just outside the atmosphere, and the period of revolution would be about 90 minutes. As the radius of the orbit increases the velocity decreases, since gravity is diminishing and less centrifugal force is needed to balance it."

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(a) State what is meant in the article by the phrase "gravity is diminishing", and criticise the statement that "less centrifugal force is needed to balance (the satellite)".

(3)

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(b) (i) By deriving an appropriate equation, show that the orbital speed of a satellite decreases as the radius of orbit increases.

(3)

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(ii) By deriving an appropriate equation, show that the orbital period of a satellite increases as the orbital speed decreases.

(2)

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(c) The period *T* of a satellite in a circular orbit is given by the equation

$$T = \sqrt{\frac{4\pi^2 r^3}{GM}}$$

Where *r* is the radius of orbit and *M* is the mass of the Earth

Calculate the period of a satellite in an orbit 4.0×10^5 m above the surface of the Earth.

mass of the Earth = 5.98×10^{24} kg

radius of the Earth = 6.36×10^6 m

(2)

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Period of satellite = ...

(d) After a time the radius of a satellite's orbit will start to decrease due to the resisitive forces acting on the satellite from the atmosphere. As this happens the satellite speeds up.

Describe the energy changes occurring as the radius of the orbit decreases.

(2)

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(Total for question = 12 marks)

Q2.

* Describe the similarities and differences between electric and gravitational fields.

(6)

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(Total for question = 6 marks)