Section A

For Examiner's Use

Answer **all** the questions in the spaces provided.

1 **(a)** The Earth may be considered to be a uniform sphere of radius 6.38×10^3 km, with its mass concentrated at its centre.

(i) Define *gravitational field strength*.

.....

..... [1]

(ii) By considering the gravitational field strength at the surface of the Earth, show that the mass of the Earth is 5.99×10^{24} kg.

[2]

(b) The Global Positioning System (GPS) is a navigation system that can be used anywhere on Earth. It uses a number of satellites that orbit the Earth in circular orbits at a distance of 2.22×10^4 km above its surface.

(i) Use data from **(a)** to calculate the angular speed of a GPS satellite in its orbit.

angular speed = ... rad s^{-1} [3]

(ii) Use your answer in **(i)** to show that the satellites are not in geostationary orbits.

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[3]

(c) The planes of the orbits of the GPS satellites in **(b)** are inclined at an angle of 55° to the Equator.

Suggest why the satellites are not in equatorial orbits.

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..... [1]