7 **(a)** There are quantitative and qualitive aspects of gravitational field that are analogous to those of electric field. Complete the table in Fig. 7.1 below to show these analogous aspects.

Analogy	
Gravitational Field	Electric Field
Mass	
Newton's Law of Gravitation	
	Electric Field Strength is in the direction of decreasing Electric Potential

Fig 7.1

[3]

(b) In an imagined universe, Earth has a larger sibling Areth with which it forms a double planet system, and the two orbit about each other. Earth has a mass of 5.97×10^{24} kg and a radius of 6370 km. Areth has the same mean density as Earth but is 20% bigger in radius. They are separated by a distance of 96600 km.

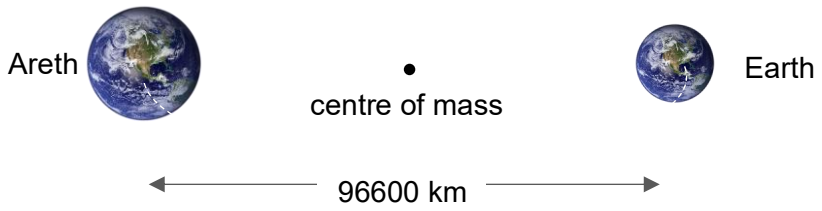

Fig. 7.2

(i) Show that the magnitude of the force that Earth and Areth exert on each other is 4.40×10^{23} N.

[2]

(ii) Using Newton's Laws of Motion, explain why the two planets orbit about the centre of mass of the double planet system.

.....

.....

.....

.....[2]

(iii) By considering the centripetal forces on the two planets, show that

$$\frac{\text{radius of Earth's orbit}}{\text{radius of Areth's orbit}} = 1.73$$

[1]

(iv) Determine the orbital period, in days, of the double planet system.

period = ... days [4]

(c) P is a point on the surface of Earth that lies on the line joining the centres of Earth and Areth, as shown in Fig. 7.3.

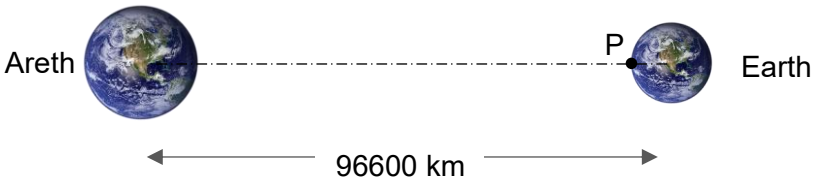

Fig. 7.3

(i) State the value of the gravitational field strength at P due to Earth only.

field strength = ... N kg^{-1} [1]

(ii) Using the values given in **(b)**, calculate the gravitational field strength at P due to Areth only.

field strength = ... N kg^{-1} [3]

(iii) Hence determine the gravitational force on a man of mass 80.0 kg standing at point P.

force = ... N [2]

(iv) When the man in **(iii)** steps on a weighing scale, the reading produced is greater than the value determined in **(iii)**.

Suggest a reason for this.

.....

.....

.....

.....[2]

[Total: 20]