

2 The International Space Station (ISS) orbits the Earth at a height of 4.1×10^5 m above the Earth's surface. The radius of the Earth is 6.37×10^6 m.

- (a)** Both the ISS and the astronauts inside it are in free fall. Explain why this makes the astronauts feel weightless

.....
.....[1]

- (b) (i)** Calculate the value of the gravitational field strength g at the height of the ISS above the Earth.

$$g = \dots\dots\dots \text{N kg}^{-1} \text{ [2]}$$

- (ii)** State the value of the centripetal acceleration of ISS at this height.

$$a_c = \dots\dots\dots \text{m s}^{-2} \text{ [1]}$$

- (iii)** The speed of the ISS in its orbit is 7.7 km s^{-1} . Show that the period of the ISS in its orbit is 92 minutes.

[2]

- (iv)** The ISS is in a low Earth orbit. Suggest an advantage of this orbit as compared to higher orbits.

.....
.....[1]

- (c) The ISS has arrays of solar cells on its wings. These solar cells charge batteries which power the ISS. The wings always face the Sun.

7% of the energy of the sunlight incident on the cells is stored in the batteries. The total area of the cells facing the solar radiation is 2500 m^2 . The intensity of solar radiation at the orbit of the ISS is 1.4 kW m^{-2} outside of the Earth's shadow and zero inside it. The ISS passes through the Earth's shadow for 35 minutes during each orbit.

By reference to **(b)(iii)**, calculate the average power delivered to the batteries during one orbit.

average power =W [3]