

- 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.

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

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

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