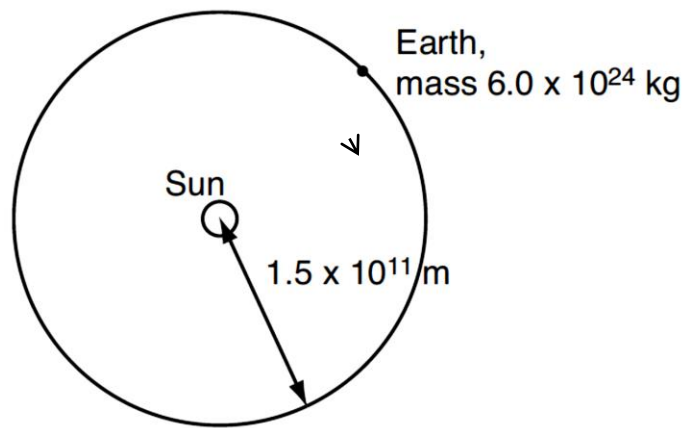


**3**

The orbit of the Earth, mass  $6.0 \times 10^{24}$  kg, may be assumed to be a circle of radius  $1.5 \times 10^{11}$  m with the Sun at its centre, as illustrated in Fig. 3.1.



**Fig. 3.1**

**(a)**

**(i)**

Show that the time taken for one orbit is  $3.15 \times 10^7$  s.

**(ii)**

Calculate the magnitude of the angular velocity of the Earth about the Sun.

angular velocity = .....  $\text{rad s}^{-1}$   
[2]

**(b)**

**(i)**

Hence, or otherwise, calculate the magnitude of the gravitational force on the Sun due to the Earth.

gravitational force = ..... N  
[3]

**(ii)**

Draw an arrow on Fig. 3.1 and label it S to represent the gravitational force on the Sun.  
[1]

**(iii)**

Calculate the mass of the Sun.

mass of the Sun = ..... kg  
[2]

(c)

(i)

Calculate the orbital speed of the Earth.

orbital speed = .....  $\text{km s}^{-1}$   
[2]

(ii)  
Hence, deduce the total energy of the Earth.

total energy = ..... J  
[3]

**(d)**

Sketch on Fig. 3.1 a possible subsequent path of the Earth if the Sun were to disappear and label the path E.  
[1]