Section B

Answer **one** question from this section in the spaces provided.

8(a)   There are approximately about 600 geostationary satellites orbiting around the Earth. The mass of the Earth is 5.9×10^{24} kg and its radius is 6.4×10^6 m.

   (i)   Determine the angular velocity of a geostationary satellite.   [2]

   (ii)   Calculate the radius of the geostationary orbit.   [3]

   (iii)   State one application of geostationary satellites.   [1]

   ....

   (iv)   State one advantage and one disadvantage of using a geostationary orbit for the application stated in (a)(iii).   [2]

   ....

   ....

   ....

(b)   Fig. 8.1 shows a binary star system consists of two stars S_1 and S_2 with masses M_1 and M_2 respectively rotating about a common centre. The centres of the two stars are separated by a distance $R = 1.2 \times 10^{10}$ m.
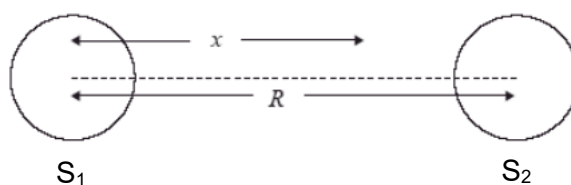

Fig. 8.1

The total gravitational potential due to the stars at any point along a line joining their centres is ϕ. Fig. 8.2 shows how ϕ varies with the distance x from the centre of star S_1. (Values of the potential inside each star are not known.)
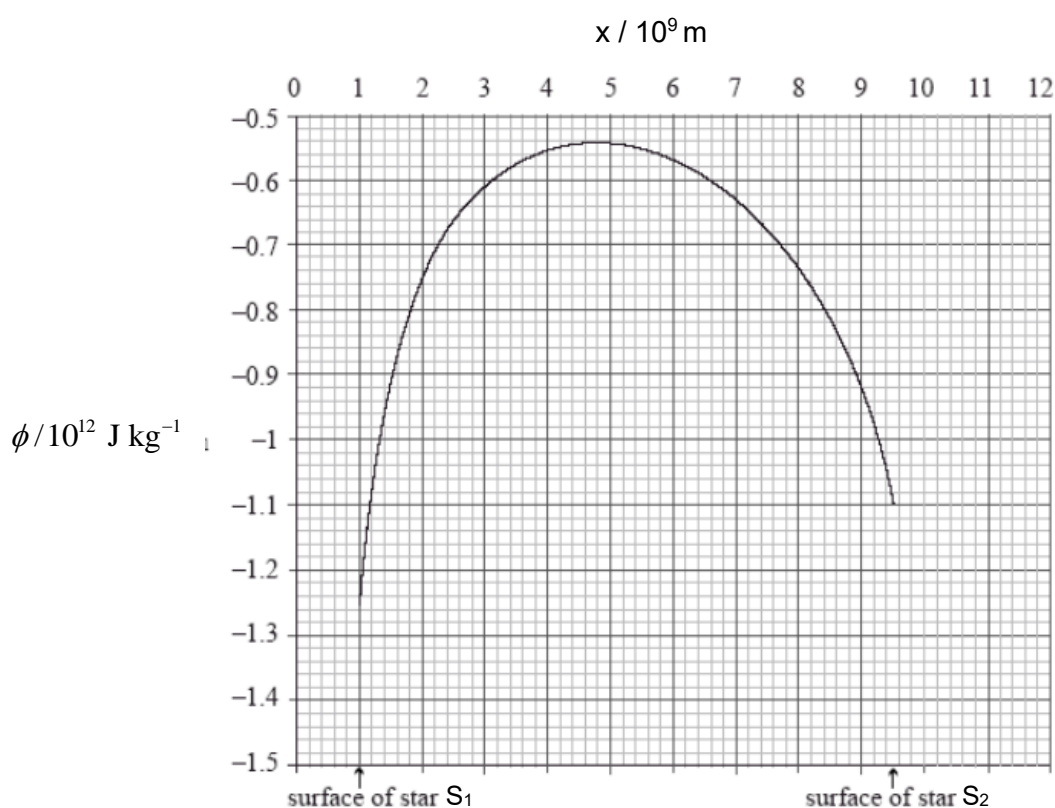

Fig. 8.2

(i)   State the relationship between gravitational potential ϕ and gravitational field strength g.   [2]

        ....

        ....

(ii)   Explain, using Fig. 8.2, whether the gravitational field strength at the surface of star S_1 is greater or less than the gravitational field strength at the surface of star S_2.
[2]

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(iii)   A particle is launched with kinetic energy E_k from the surface of star S_2. The particle arrives at the surface of star S_1. Use Fig. 8.2 to explain whether the kinetic energy of the particle at the surface of star S_1 is less than, equal to, or larger than E_k. [2]

....

....

....

(iv)   Explain the significance of the maximum point on Fig. 8.2.   [1]

....

(v)   Determine the ratio $\dfrac{M_1}{M_2}$.   [3]

$\dfrac{M_1}{M_2}$ = ...

(vi)   Sketch the variation with x of the gravitational field strength g between the surfaces of the two stars. No numerical values are required.   [2]