

1 (a) State Newton's law of gravitation.

.....  
 .....  
 ..... [2]

(b) A binary star consists of star A, of mass  $4.0 \times 10^{30}$  kg, and star B, of mass  $2.0 \times 10^{30}$  kg, separated by a distance of  $3.3 \times 10^{12}$  m. The stars are both in circular orbit around their common centre of gravity X, as shown in Fig. 1.1.

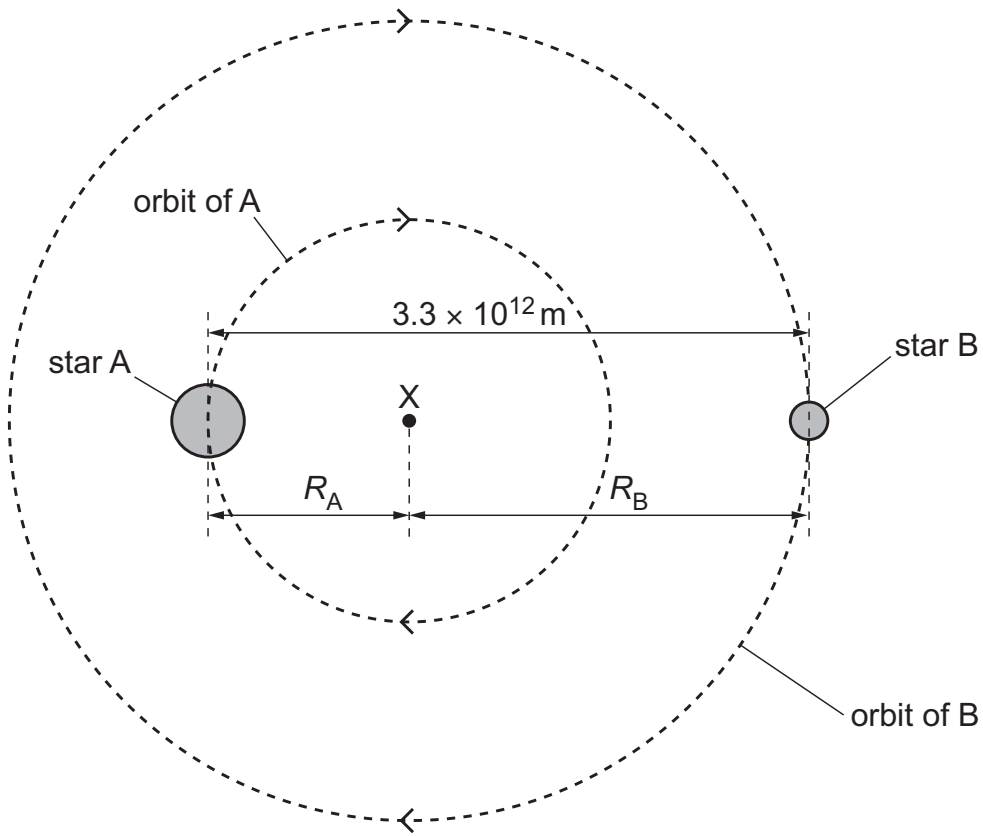


Fig. 1.1

The radius  $R_B$  of the orbit of star B is double the radius  $R_A$  of the orbit of star A.

(i) Use Newton's law of gravitation to calculate the magnitude of the gravitational force exerted by each star on the other.

force = ..... N [2]

(ii) Calculate the centripetal acceleration of star A.

acceleration = .....  $\text{ms}^{-2}$  [1]

(iii) Use your answer in (b)(ii) to determine the period of the orbit of star A.

period = ..... s [3]

(iv) By placing a tick (✓) in each row, complete Table 1.1 to show how the quantities indicated for star B compare with the same quantities for star A.

Table 1.1

|                          | B less than A | B equal to A | B greater than A |
|--------------------------|---------------|--------------|------------------|
| centripetal acceleration |               |              |                  |
| linear speed             |               |              |                  |
| period                   |               |              |                  |

[3]

[Total: 11]