Answer **all** the questions in the spaces provided.

**1** A binary star consists of two stars A and B that orbit one another, as illustrated in Fig. 1.1.

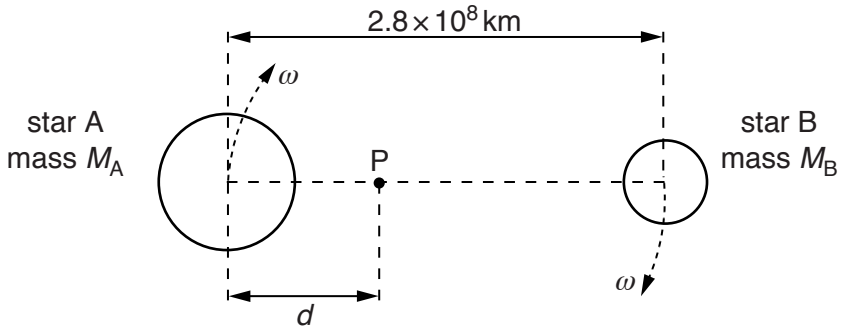


**Fig. 1.1**

The stars are in circular orbits with the centres of both orbits at point P, a distance $d$ from the centre of star A.

**(a) (i)** Explain why the centripetal force acting on both stars has the same magnitude.

.....

.....

..... [2]

**(ii)** The period of the orbit of the stars about point P is 4.0 years.

Calculate the angular speed $\omega$ of the stars.

$\omega$ = ..... rad s$^{-1}$ [2]

**(b)** The separation of the centres of the stars is $2.8 \times 10^8$ km.
The mass of star A is $M_A$. The mass of star B is $M_B$.
The ratio $\frac{M_A}{M_B}$ is 3.0.

**(i)** Determine the distance $d$.

$d$ = ..... km [3]

**(ii)** Use your answers in **(a)(ii)** and **(b)(i)** to determine the mass $M_B$ of star B.
Explain your working.

$M_B$ = ..... kg [3]

[Total: 10]