2 A binary star consists of two stars A and B. The two stars may be considered to be isolated in space. The centres of the two stars are separated by a constant distance, as illustrated in Fig. 2.1.

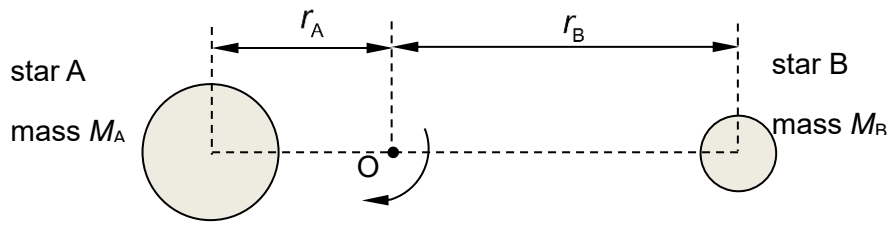

Fig. 2.1

Star A of mass M_A has a larger mass than star B of mass M_B such that $M_A = 4M_B$.

The stars are in circular orbits about each other such that the centre of their orbits is at a fixed point O. The radius of orbit of star A and star B are r_A and r_B respectively.

The period of each orbit is T.

(a) Explain why the two stars must always be directly opposite as they move in the circular orbit.

……..

……..

……..

…… [2]

(b) Show that $\frac{r_B}{r_A} = 4$. Explain your working.

[2]

(c) If the period T is 104 days and the separation of the centres of the stars is 1.1×10^{11} m,

(i) calculate the angular velocity of star A, and

angular velocity = …… rad s^{-1} [1]

(ii) determine the mass of each star.

mass M_A of star A = …… kg

mass M_B of star B = …… kg [3]

[Total:8]

[Turn over