

7 (a) State what is meant by *angular velocity*.

.....
.....

[1]

(b) A binary star system consists of two stars S_1 and S_2 , each in a circular orbit about a point P, as shown in Fig. 7.1. The two stars rotate with the same angular velocity ω .

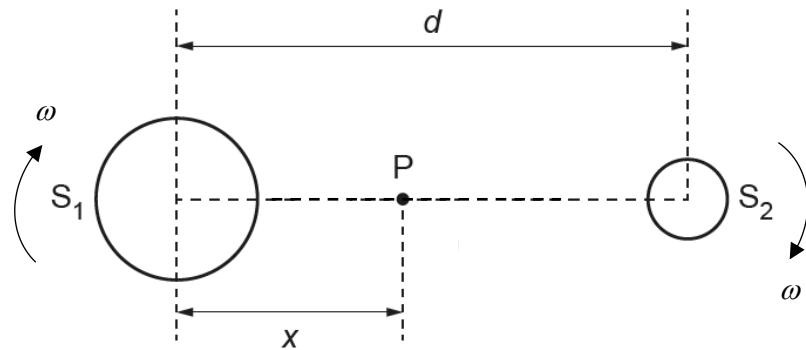


Fig. 7.1

The separation d of the centres of S_1 and S_2 is 1.8×10^{12} m. Point P is at a distance x from the centre of star S_1 . The period of rotation of the stars is 44.2 years.

(i) Calculate ω .

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

- (ii) Show that the ratio of the masses of the stars is given by

$$\frac{\text{mass of } S_1}{\text{mass of } S_2} = \frac{d - x}{x}$$

[2]

(iii) The ratio in (ii) is 1.5. Determine the mass of S_1 .

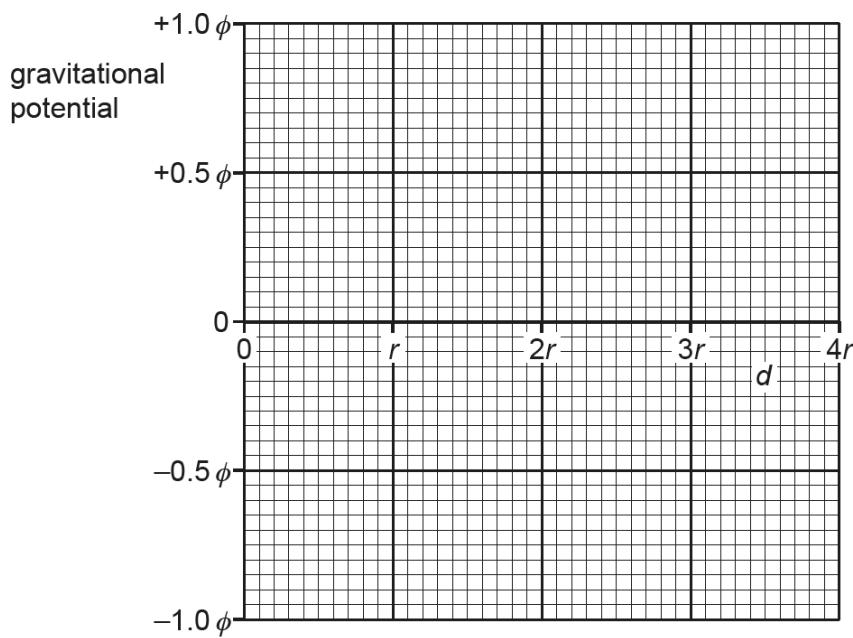
mass of S_1 = kg [4]

- (c) (i) Define *gravitational potential* at a point.

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

- (ii) An isolated solid sphere of radius r may be assumed to have its mass M concentrated at its centre. The magnitude of the gravitational potential at the surface of the sphere is ϕ .

On Fig. 7.2, show the variation of the gravitational potential with distance d from the centre of the sphere for values of d from r to $4r$.



[2]

Fig. 7.2

Section B

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