

- 4 A distant star S of mass M and its planet P of mass $0.12M$ orbit in circular orbits about a fixed point O with angular velocity ω as shown in Fig. 4.1.

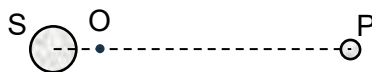


Fig. 4.1

- (a) (i) On Fig 4.1, draw circles that represent the orbits of star S and planet P. [1]

- (ii) Explain why the centripetal forces acting on star S and planet P are equal in magnitude.

.....

.....

.....

..... [2]

- (iii) Show that the ratio of the radius r_S , of the orbit of star S to the radius r_P of the orbit of planet P is

$$\frac{r_S}{r_P} = 0.12.$$

[1]

(b) The period of star S is 1500 days and its speed is 70 m s^{-1} . Determine

(i) the angular velocity ω of star S,

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

(ii) the radius r_S of the orbit of star S,

$$r_S = \dots\dots\dots \text{ m} \quad [1]$$

(iii) the separation between the centers of star S and planet P,

$$\text{separation} = \dots\dots\dots \text{ m} \quad [1]$$

(iv) the mass M .

$$M = \dots\dots\dots \text{ kg} \quad [2]$$

- (c) The plane of orbits of star S and planet P is parallel to the line of sight from Earth.

On the axes of Fig. 4.2, sketch the variation with time t of the apparent speed v of star S as viewed from the Earth.

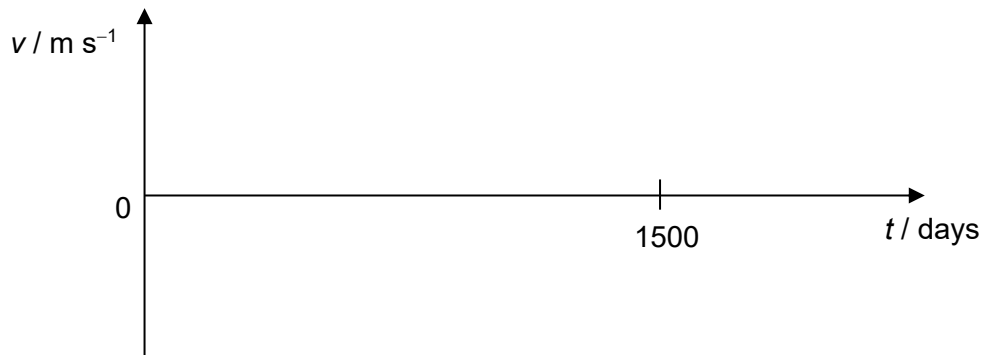


Fig. 4.2

[1]