

- 3 A system comprising the star Musica and its exoplanet Arion can be considered as isolated in space. The centres of the two bodies are separated by a constant distance d , as illustrated in Fig. 3.1.

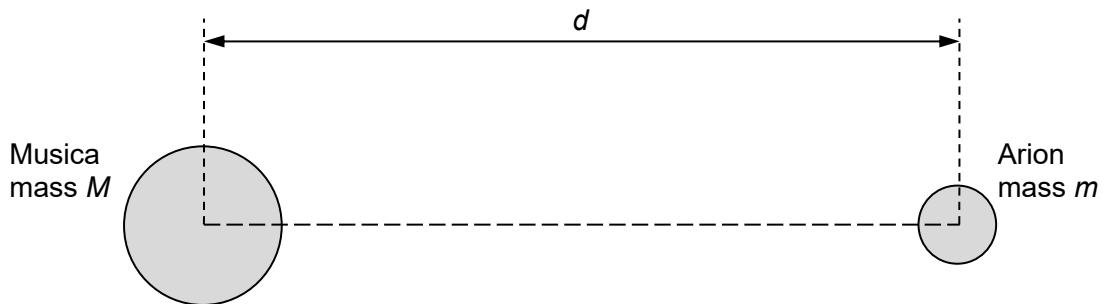


Fig. 3.1

Musica, of mass M , has a larger mass than Arion of mass m , such that $\frac{M}{m} = 240$.

The two bodies are in circular orbits about each other such that the centre of their orbits is at a fixed point.

Over a period of time equal to T of the orbits, the positions of the bodies are shown in Fig. 3.2.

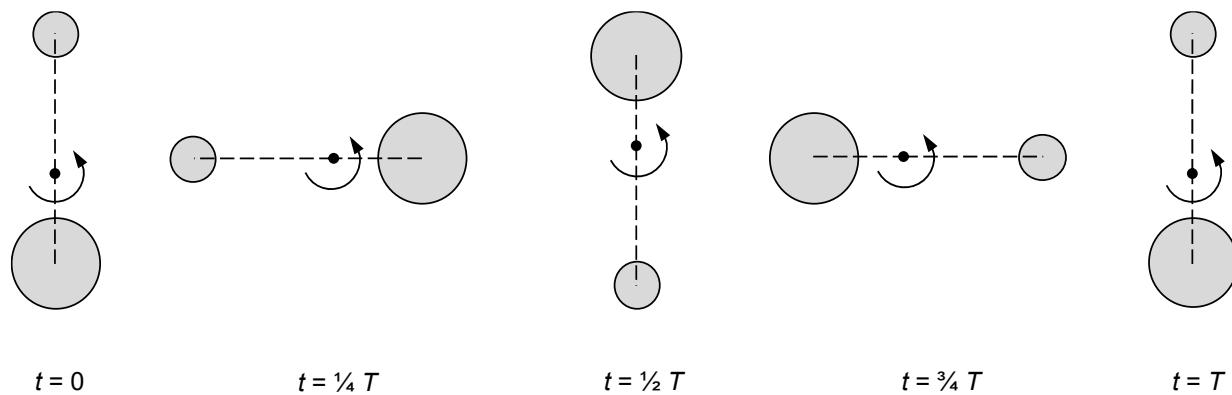


Fig. 3.2

The period T of each orbit is 2.7 years.

The separation d of the centres of Musica and Arion is 3.9×10^{11} m.

- (a) (i) Explain why the centripetal forces acting on Musica and Arion are equal in magnitude.

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[2]

- (ii) Determine the radius of the orbit of Musica. Explain your working.

$$\text{radius} = \dots \text{m} \quad [3]$$

- (b) Use your answers in (a) to determine the mass of Musica.

$$\text{mass} = \dots \text{kg} \quad [3]$$

[Total: 8]