

QUESTION 6

[Marks: 8]

Jupiter



Io

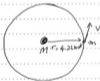
Io is one of the moons that orbit the planet Jupiter.

Io has an orbit radius $r = 4.22 \times 10^8$ m and it completes one orbit every $T = 42.5$ hours.

Use this data to determine the mass M of the planet Jupiter.

Let mass of Io be m .

Let mass of Jupiter be M .



$$T = 42.5 \times 60 \times 60 \text{ s}$$

Gravitational force on Io

$$F_{\text{grav}} = \frac{GMm}{r^2}$$

centripetal acceleration of Io

$$a = \frac{v^2}{r}$$

v is orbital speed of Io

Use $F_{\text{grav}} = ma$

$$\frac{GMm}{r^2} = m \left(\frac{v^2}{r} \right) \Rightarrow v^2 = \frac{GM}{r}$$