

**Section A**

Answer **all** the questions in the spaces provided.

- 1 (a) State Newton's law of gravitation.

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

- (b) Some of the planets in the Solar System have several moons (satellites) that have circular orbits about the planet.

The planet and each of its moons may be considered to be point masses.

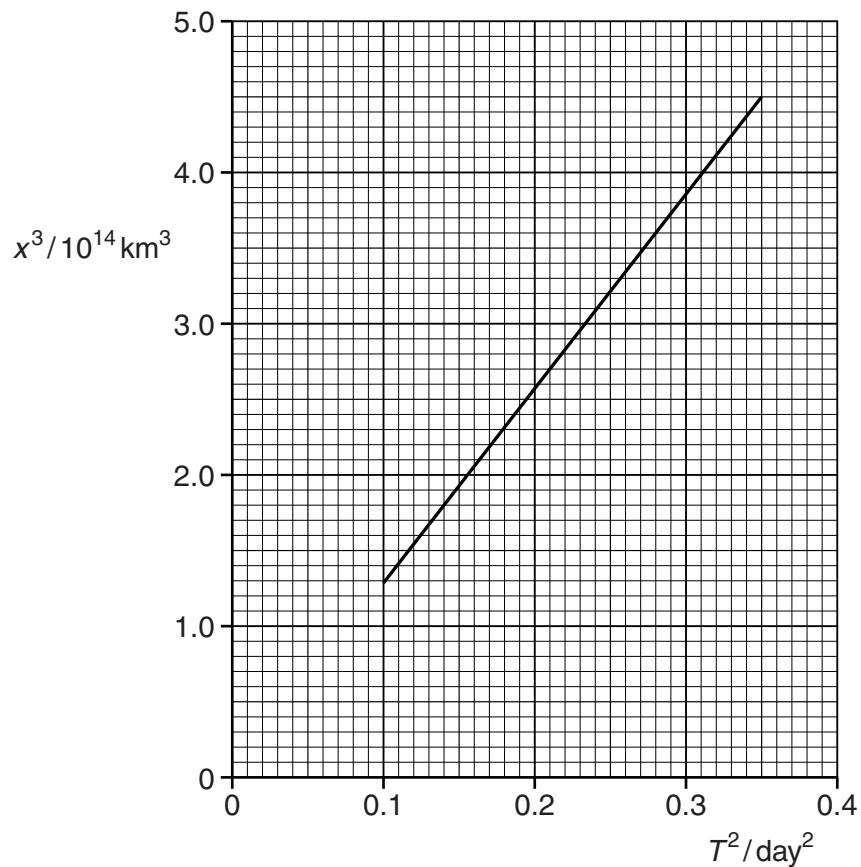
Show that the radius  $x$  of a moon's orbit is related to the period  $T$  of the orbit by the expression

$$GM = \frac{4\pi^2 x^3}{T^2}$$

where  $G$  is the gravitational constant and  $M$  is the mass of the planet. Explain your working.

[3]

- (c) The planet Neptune has eight moons, each in a circular orbit of radius  $x$  and period  $T$ . The variation with  $T^2$  of  $x^3$  for some of the moons is shown in Fig. 1.1.



**Fig. 1.1**

Use Fig. 1.1 and the expression in (b) to determine the mass of Neptune.

$$\text{mass} = \dots \text{ kg} \quad [4]$$