

Section A

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

- 1 (a) State what is meant by a *gravitational field*.

.....
.....
.....

[2]

- (b) In the Solar System, the planets may be assumed to be in circular orbits about the Sun. Data for the radii of the orbits of the Earth and Jupiter about the Sun are given in Fig. 1.1.

	radius of orbit /km
Earth	1.50×10^8
Jupiter	7.78×10^8

Fig. 1.1

- (i) State Newton's law of gravitation.

.....
.....
.....
.....

[3]

- (ii) Use Newton's law to determine the ratio

$$\frac{\text{gravitational field strength due to the Sun at orbit of Earth}}{\text{gravitational field strength due to the Sun at orbit of Jupiter}}$$

$$\text{ratio} = \dots \quad [3]$$

(c) The orbital period of the Earth about the Sun is T .

(i) Use ideas about circular motion to show that the mass M of the Sun is given by

$$M = \frac{4\pi^2 R^3}{GT^2}$$

where R is the radius of the Earth's orbit about the Sun and G is the gravitational constant.

Explain your working.

[3]

(ii) The orbital period T of the Earth about the Sun is 3.16×10^7 s.

The radius of the Earth's orbit is given in Fig. 1.1.

Use the expression in (i) to determine the mass of the Sun.

mass = kg [2]