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

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

.....

.....

..... [2]

(b) The astronomer Johannes Kepler showed that the period T of rotation of a planet about the Sun is related to its mean distance R from the centre of the Sun by the expression

$$\frac{R^3}{T^2} = k$$

where k is a constant.

Use Newton's law to show that, for planets in circular orbits about the Sun of mass M, the constant k is given by

$$k = \frac{GM}{4\pi^2}$$

where G is the gravitational constant. Explain your working.

[4]

(c) A satellite is in a circular orbit about Mars.
The radius of the orbit of the satellite is 4.38×10^6 m. The orbital period is 2.44 hours.

Use the expressions in **(b)** to calculate a value for the mass of Mars.

mass = ... kg [2]

[Total: 8]