Section A

For Examiner's Use

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

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

.....

.....

.....[2]

(b) A star and a planet are isolated in space. The planet orbits the star in a circular orbit of radius *R*, as illustrated in Fig. 1.1.

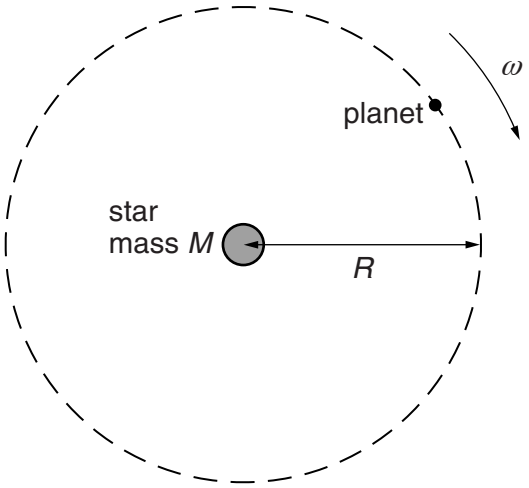

Fig. 1.1

The angular speed of the planet about the star is ω.
By considering the circular motion of the planet about the star of mass *M*, show that ω and *R* are related by the expression

$$R^3\omega^2 = GM$$

where *G* is the gravitational constant. Explain your working.

[3]

(c) The Earth orbits the Sun in a circular orbit of radius 1.5×10^8 km. The mass of the Sun is 2.0×10^{30} kg.
A distant star is found to have a planet that has a circular orbit about the star. The radius of the orbit is 6.0×10^8 km and the period of the orbit is 2.0 years.

Use the expression in **(b)** to calculate the mass of the star.

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mass = ... kg [3]