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

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

.....

.....

.....

.....[2]

(b) A satellite of mass m has a circular orbit of radius r about a planet of mass M. It may be assumed that the planet and the satellite are uniform spheres that are isolated in space.

Show that the linear speed v of the satellite is given by the expression

$$v = \sqrt{\frac{GM}{r}}$$

where G is the gravitational constant.
Explain your working.

[2]

(c) Two moons A and B have circular orbits about a planet, as illustrated in Fig. 1.1.

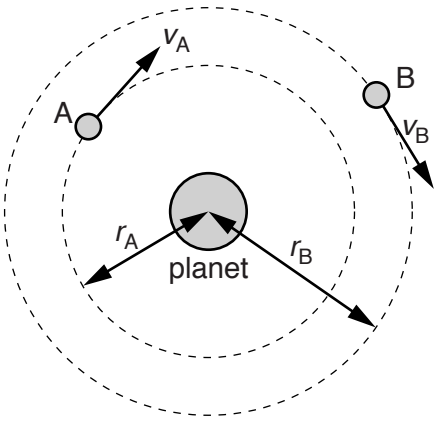

Fig. 1.1 (not to scale)

Moon A has an orbital radius r_A of 1.3×10^8 m, linear speed v_A and orbital period T_A.
Moon B has an orbital radius r_B of 2.2×10^{10} m, linear speed v_B and orbital period T_B.

(i) Determine the ratio

1. $\frac{v_A}{v_B}$,

ratio = ...[2]

2. $\frac{T_A}{T_B}$.

ratio = ...[3]

(ii) The planet spins about its own axis with angular speed $1.7 \times 10^{-4}\,\text{rad}\,\text{s}^{-1}$.
Moon A is always above the same point on the planet's surface.

Determine the orbital period T_B of moon B.

T_B = ...s [2]

[Total: 11]