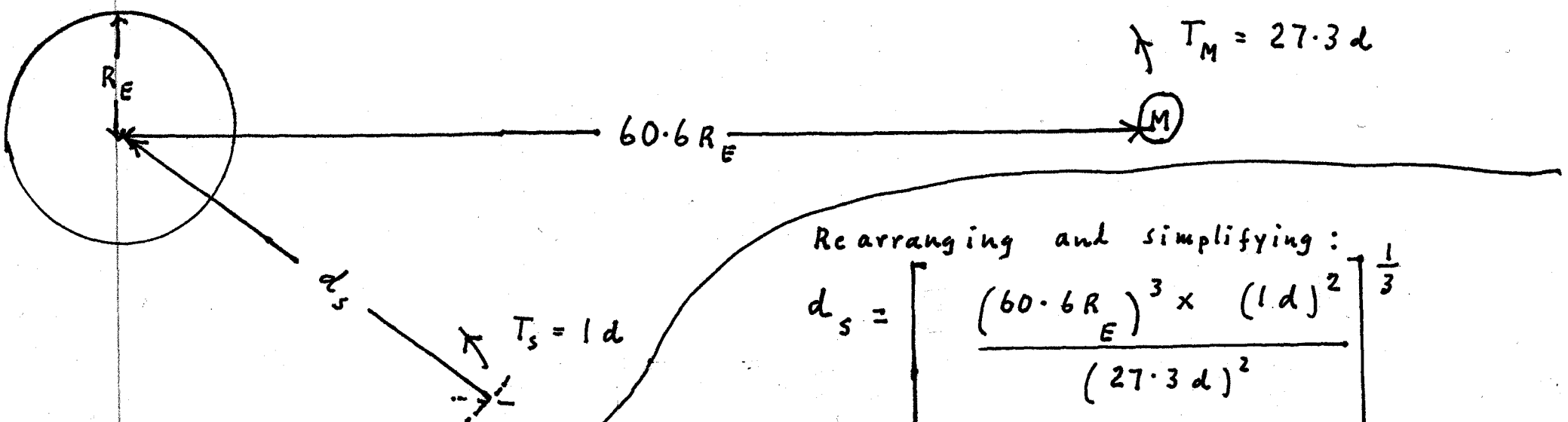
Calculating the distance of a geostationary / geosynchronous satellite from the centre of the Earth

Treat the Earth as the primary, with the Moon and the artificial Earth satellite as secondaries.

Using $T_M = 27{\cdot}3\ d$, $d_M = 60{\cdot}6\ R_E$; $T_s = 1\ d$, $d_s = ?$



Using Kepler III and taking care with the units:

"$\dfrac{T_M^2}{d_M^3} = \dfrac{T_s^2}{d_s^3}$"

Substituting:

$$\frac{(27{\cdot}3\ d)^2}{(60{\cdot}6 R_E)^3} = \frac{(1\ d)^2}{d_s^3}$$

Rearranging and simplifying:

$$d_s = \left[\frac{(60{\cdot}6 R_E)^3 \times (1\ d)^2}{(27{\cdot}3\ d)^2} \right]^{\frac{1}{3}}$$

$$= \left[\frac{2{\cdot}2 \times 10^5 R_E^3 \times 1\ d^2}{745\ d^2} \right]^{\frac{1}{3}}$$

Note that "d^2" has been eliminated

$$= \left[296\ R_E^3 \right]^{\frac{1}{3}}$$

$$= 6{\cdot}6\ R_E$$ (T. A. S. R. accuracy)

DF
2011, May 2