$T = 84 \text{ minutes} * R * \sqrt{R}$ where R is the distance in earth radius units.

from:
http://www-istp.gsfc.nasa.gov/Education/wsynch.html
Earth radius = 6,378.136 Km.

$gmP^3 = a^3$ (newton's version) where: m = mass in units of Earth and Moon
P = Period in lunar months units
a = Distance in moon distance units

From: Exploration of the Universe
by George O. Abell
University of California
Copyright 1975

moon distance = 384,404 Km
Lunar month = 27.322 days
Earth + moon mass = 1.0123 earth masses

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1. Geosync.

$$m(P * P)^{1/3} = a$$

$$\frac{1}{1.0123} * (1/27.3 * 1/27.3)^{1/3} = a$$

$$0.9878\ (0.0366 * 0.0366)^{1/3} = a$$

$$0.9878\ (0.11023509) = a$$

check:

$T = 84 \text{ minutes} * R * \sqrt{R}$

$T = 84 * \frac{42,375}{6378} * \sqrt{\frac{42,375}{6378}}$

$T = 1438.52$ minutes

$T = 23$ hours 58 minutes 31 sec.

Kepler $0.110235 * 384,404\text{Km} = 42,374.8937$

Newton $0.10889 * 384,404\text{Km} = 41,857.9\text{km}$

$T = 1,413.49$ minutes
$T = 23$ hours 32 minutes 13 seconds

---

2. Semi-Sync.

$$(P * P)^{1/3}$$

$$\left(\frac{.5}{27.3} * \frac{.5}{27.3}\right)^{1/3} = a$$

$$(0.0185 * 0.0185)^{1/3} = a$$

$$(0.00033544)^{1/3} = a$$

$$0.06948 = a$$

$$0.06948 * 384,000\text{Km} = 26,681\text{ km}$$

Check:

$T = 84 \text{ minutes} * R * \sqrt{R}$

$T = 84 * \frac{26,681}{6378} * \sqrt{\frac{26,681}{6378}}$

$T = 84 * 4.1832 * \sqrt{4.1832}$

$T = 718.69$
$T = 11$ hours 58 min 41 min.

U.S. Naval Observatory's website: ... in Circular 10,900nm orbits with a 12 hour period.

$T = 84 \text{ minutes} * R * \sqrt{R}$

$84 * 3.165 * \sqrt{3.165}$

472.99 minutes

7.88 hours

7 hours 53 minutes

10,900 nm * 1.852km =

20,186.80

$R = \frac{20,186.80}{6378}$