

1. (U10-3.31)(a) A lunar sidereal month is 27.3 Earth days.

$$27.3 \text{ days} \cdot \frac{24 \text{ hours}}{1 \text{ days}} = 655.2 \text{ hours}$$

So, 655.2 hours to go  $360^\circ$  around Earth.

$$\frac{360^\circ}{655.2 \text{ hours}} = 0.54^\circ \text{ per hour}$$

$$\text{To go } 0.5^\circ, \frac{0.5^\circ}{0.54^\circ \text{ per hour}} = 0.925925 \text{ hours}$$

(b) In 12 hours, the Moon moves

$$\frac{0.54^\circ}{1 \text{ hour}} \cdot 12 \text{ hours} = 6.48^\circ$$

Yes,  $6.48^\circ$  is observable.

2. (U10-3.43) (a) The number of total eclipses would increase because many partial eclipses would become total eclipses, while all total eclipses would stay total eclipses.

(b) Total eclipses would never happen as the Moon's diameter would no longer be large enough to cover the Sun.

3. (U10-4.46)

$$\text{Moon Mass} = M_M = 7.35 \times 10^{22} \text{ Kg}$$

$$\text{Earth Mass} = M_E = 5.98 \times 10^{24} \text{ Kg}$$

$$\text{Distance } R = 384,400 \text{ Km} = 3.844 \times 10^8 \text{ m}$$

$$G = 6.67 \times 10^{-11} \text{ m}^3 \text{ Kg}^{-1} \text{ s}^{-2}$$

$$F = \frac{G \cdot M_E \cdot M_M}{R^2} = \frac{(6.67 \times 10^{-11}) (5.98 \times 10^{24}) (7.35 \times 10^{22})}{(3.844 \times 10^8)^2}$$

$$= 1.984878 \times 10^{20} \text{ Newtons}$$

→ The force exerted by Moon on Earth would be equal & opposite the force exerted by Earth on Moon.

→ The force between Sun & Earth is

$$3.53 \times 10^{22} \text{ N}, \text{ so } \sim 178 \text{ times that}$$

of the Earth & Moon.

4) (U10-4.55)

Spacecraft orbited 111 km above Moon's surface.

$$\text{Use } P^2 = \frac{4\pi^2 r^3}{G (M_{\text{Moon}} + M_{\text{Spacecraft}})} \leftarrow \text{Moon Mass} \gg \text{Spacecraft Mass}$$

$$= \frac{4\pi^2 \cdot \left[ \frac{3476}{2} + 111 \right]^3}{G \cdot M_{\text{Moon}}}$$

$$= \frac{4\pi^2 \cdot (1.849 \times 10^3 \text{ km})^3}{4.90245 \times 10^{12}}$$

$$= \frac{4\pi^2 \cdot (1.849 \times 10^6 \text{ m})^3}{4.90245 \times 10^{12}}$$

$$= 50987269 \text{ s}^2$$

$$P = 7,140 \text{ s} = 1.98 \text{ hours}$$