K&K Example 7.8

Qualitative description of why spinning objects rotate in an unexpected manner.
Gyroscope

\[ \vec{L} = \vec{L}_0 + \vec{L}_s \]

\[ \frac{d\vec{L}}{dt} = \frac{d\vec{L}_s}{dt} = \vec{I} W \hat{J} \]

\[ J_2 = \frac{\vec{L} W}{I_0 w_s} = \frac{EMg}{Mk^2w_s} \]

\[ J_2 = \frac{gL}{k^2w_s} \]

radius of gyration causing spin
\[ J_z \text{ independent of } \theta \text{ angle} \]

\[ L_{z1} = I_0 w_s \sin \phi \]

\[ \mathbf{T} = \ell w \sin \phi \mathbf{j} \]

\[ \frac{dJ_z}{dt} = \frac{dL_{z1}}{dt} = \ell w \sin \phi \mathbf{j} \]

\[ \int 2d+ = \left| \frac{dL_{z1}}{L_{z1}} \right| = \frac{\ell w \sin \phi}{I_0 w_s \sin \phi} \]

\[ J_2 = \frac{\ell w}{I_0 w_s} = \frac{g \ell}{k^2 w_s} \]

---

Precession of the Equinoxes

Period \( \approx 26,000 \) years

Aquarius

Pisces

Earth at vernal equinox now

600 years from now
K&K Example 7.7

Precession $\Omega$ independent of $\phi$
astrological purposes.

The dates the Sun passes through the 13 astronomical constellations of the ecliptic are listed below, accurate to the year 2002. The dates will increment by one day every 70½ years, and already several have changed. The corresponding tropical and sidereal dates are given as well.

<table>
<thead>
<tr>
<th>Constellation</th>
<th>Tropical date</th>
<th>Sidereal Date Cyril Fagan</th>
<th>IAU Definition Walter Berg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aries</td>
<td>March 21 - April 19</td>
<td>April 15 - May 15</td>
<td>April 19 - May 13 May 17 - May 18</td>
</tr>
<tr>
<td>Taurus</td>
<td>April 20 - May 21</td>
<td>May 16 - June 15</td>
<td>May 14 - May 16 May 19 - June 19</td>
</tr>
<tr>
<td>Gemini</td>
<td>May 22 - June 22</td>
<td>June 16 - July 15</td>
<td>June 20 - July 20</td>
</tr>
<tr>
<td>Cancer</td>
<td>June 23 - July 22</td>
<td>July 16 - August 15</td>
<td>July 21 - August 9</td>
</tr>
<tr>
<td>Leo</td>
<td>July 23 - August 22</td>
<td>August 16 - September 15</td>
<td>August 10 - September 15</td>
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<tr>
<td>Virgo</td>
<td>August 23 - September 23</td>
<td>September 16 - October 15</td>
<td>September 16 - October 30</td>
</tr>
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<td>Libra</td>
<td>September 24 - October 23</td>
<td>October 16 - November 15</td>
<td>October 31 - November 22</td>
</tr>
<tr>
<td>Scorpius</td>
<td>October 24 - November 22</td>
<td>November 16 - December 15</td>
<td>November 23 - November 28</td>
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<td>Ophiuchus</td>
<td>N/A</td>
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<td>Sagittarius</td>
<td>November 23 - December 21</td>
<td>December 16 - January 14</td>
<td>December 18 - January 17</td>
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<td>Capricorn</td>
<td>December 22 - January 20</td>
<td>January 15 - February 14</td>
<td>January 18 - February 15</td>
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<tr>
<td>Aquarius</td>
<td>January 21 - February 19</td>
<td>February 15 - March 14</td>
<td>February 16 - March 11</td>
</tr>
<tr>
<td>Pisces</td>
<td>February 20 - March 20</td>
<td>March 15 - April 14</td>
<td>March 12 - April 18</td>
</tr>
</tbody>
</table>

See also

- Astrology
- The Great Year
- Sidereal time
- Zodiac

References


http://en.wikipedia.org/wiki/Sidereal_astrology
K&K Example 7.9
Precession of the equinoxes - Earth Precesses too
Statics

Rigid Bodies when

\[ \sum \vec{F} = 0 \]
\[ \sum \vec{M} = 0 \]

Surprisingly interesting!

\[ \rightarrow \text{Weight acts on center of mass; use that for torque.} \]

Easy:

[Symmetrical]

\[ \vec{N}_1 = \vec{N}_2 = -\frac{\vec{W}}{2} \]

When centered.
\[ \sum F_x = 0 \]  
\[ \sum F_y = 0 \]

\[ N_1 + N_2 - W = 0 \]

\[ N_2 (d - dw) - N_1 dw = 0 \]

\[ N_2 = \frac{dw}{d - dw} N_1 \]

\[ N_1 + \frac{dw}{d - dw} N_1 = W \]

\[ (\frac{d - dw + dw}{d - dw}) N_1 = W \]

\[ N_1 = \frac{d - dw}{d} W \]

\[ N_1 = (1 - \frac{dw}{d}) W \]
1. \( W + F_2 - F_1 = 0 \)

2. Person end of stick - pivot

\[
F_1 \cdot \cos \theta - W \cdot L \cdot \cos \theta = 0
\]

\[
F_1 = \left( \frac{L}{d} \right) W \quad \text{big l.}
\]

\[
F_2 = F_1 - W
\]

\[
F_2 = \left( \frac{L}{d} \right) W - W = \left( \frac{L}{d} - 1 \right) W
\]

\( F_2 \) as pivot point -

\[
F_2 \cdot \cos \theta - W(L-d) \cdot \cos \theta = 0
\]

\[
F_2 = \left( \frac{L}{d} - 1 \right) W
\]
\[ N_z = \frac{dw}{d-w}, \quad N_1 = \frac{dw}{d+w} \cdot \frac{d}{d} \frac{dw}{d} W \]

\[ N_z = \frac{dw}{d} W \]