Koide formula

$$Q = \frac{m_1 + m_2 + m_3}{\left(\sqrt{m_1} + \sqrt{m_2} + \sqrt{m_3}\right)^2}$$

0.666661

m_1 = **0.510998946**
m_2 = **105.6583745**
m_3 = **1776.86**

0.510999

105.658

1776.86

$$\text{QK[n\_] :=} \frac{\text{Sum}[m_i, \{i, 1, n\}]}{\left(\text{Sum}\left[\sqrt{m_i}, \{i, 1, n\}\right]\right)^2}$$

$$\text{AngleQK[n\_] :=} \frac{1}{3\left(\frac{\text{Sum}[m_i,\{i,1,n\}]}{\left(\text{Sum}\left[\sqrt{m_i},\{i,1,n\}\right]\right)^2}\right)}$$

$$\text{nAngleQK[n\_] :=} \frac{1}{n\left(\frac{\text{Sum}[m_i,\{i,1,n\}]}{\left(\text{Sum}\left[\sqrt{m_i},\{i,1,n\}\right]\right)^2}\right)}$$

(***Does it need the replacement 3 → n when in arbitrary n case? ***)

AngleQK[n_] = $\frac{1}{3Q}$ = square of the cosine of angle b/w sqrt mass vector and unit vector

QK[1]
QK[2]
QK[3]

1.

0.878412

0.666661

```
(1/2) Sqrt[3] // N
ArcCos[1]
ArcCos[Sqrt[3]/2]
1/(ArcCos[2/3]/π) // N
Cos[π/4] // N
```

0.866025

0

$\frac{\pi}{6}$

3.73524

0.707107

So QK[2] $\approx \frac{\sqrt{3}}{2} = \mathrm{Cos}\left[\frac{\pi}{6}\right]$, and QK[3] $\approx \frac{2}{3}$

```
ArcCos[QK[1]]
ArcCos[QK[2]]
ArcCos[QK[3]]
ArcCos[AngleQK[1]]
ArcCos[AngleQK[2]]
ArcCos[AngleQK[3]]
```

0.

0.498267

0.841077

1.23096

1.18157

1.04719

Notice thatArcCos[AngleQK[1]] > ArcCos[AngleQK[2]] > ArcCos[AngleQK[3]] > 1 ,
seems to be going to 1

Hypothesis :
ArcCos[AngleQK[n]] → 1, for increasing n

Per the Koide formula this means that the vector $\{\sqrt{m_1}, \sqrt{m_2}, \sqrt{m_3}, \ldots\}$ moves closer to the unit vector {1, 1, 1, ...} as n increases
Test this below and find a speculative m_4 ,

Take
ArcCos[AngleQK[4]] ≈ 1 very nearly, then

AngleQK[4] ≈ Cos[1]

$$\frac{\left(53.1467+\sqrt{m_4}\right)^2}{3\,(1883.03+m_4)} \approx \text{Cos}[1]$$

Gives reasonable solution $\{m_4 \to 28\,568.2\}$

Use this to get m_5 (altough now on 2 nd appx, so sacifice accuracy even more)

Gives solution $\{m_5 \to 512\,118.\}$

Seems to exhibit exponential growth

Cos[1] // N

0.540302

AngleQK[4]

$$\frac{\left(53.1467+\sqrt{m_4}\right)^2}{3\,\left(1883.03+m_4\right)}$$

$$\textbf{Solve}\left[\frac{\left(53.146685078685636\grave{}+\sqrt{m_4}\right)^2}{3\,\left(1883.029373446\grave{}+m_4\right)}-\text{Cos}[1]==0,\ m_4\right]$$

$\{\{m_4 \to 4.70523\},\ \{m_4 \to 28\,568.2\}\}$

m_4 = 28568.217767728336`

28 568.2

AngleQK[5]

$$\frac{\left(222.168+\sqrt{m_5}\right)^2}{3\,\left(30\,451.2+m_5\right)}$$

$$\textbf{Solve}\left[\frac{\left(222.1680380721117\grave{}+\sqrt{m_5}\right)^2}{3\,\left(30451.247141174335\grave{}+m_5\right)}-\text{Cos}[1]==0,\ m_5\right]$$

$\{\{m_5 \to 0.\},\ \{m_5 \to 512\,118.\}\}$

m_5 = 512118.13383695995`

512 118.

```
AngleQK[6]
```

$$\frac{\left(937.792+\sqrt{m_6}\right)^2}{3\,\left(542\,569.+m_6\right)}$$

```
Solve[(937.7923346390743` + Sqrt[m6])^2/(3 (542569.3809781343` + m6)) - Cos[1] == 0, m6]
```

$$\left\{\left\{m_6\to 0.\right\},\ \left\{m_6\to 9.12474\times 10^6\right\}\right\}$$

```
nAngleQK[4]
```

$$\frac{\left(53.1467+\sqrt{m_4}\right)^2}{4\,\left(1883.03+m_4\right)}$$

```
Solve[nAngleQK[4] - Cos[1] == 0, m4]
```

$$\{\{m_4\to 190.196\},\ \{m_4\to 6044.39\}\}$$

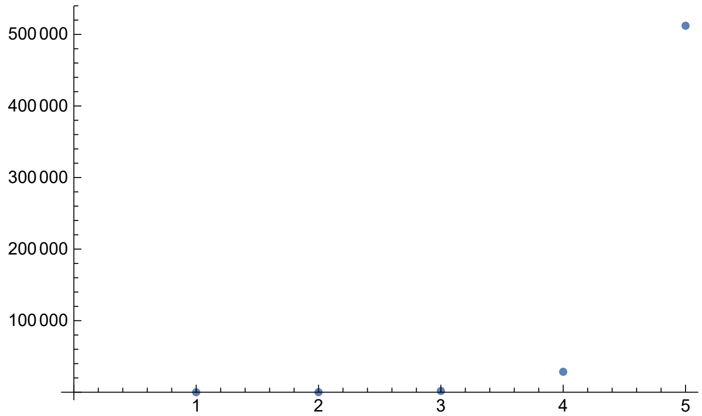
```
nAngleQK[5] /. m4 → 6044.386001745425`
```

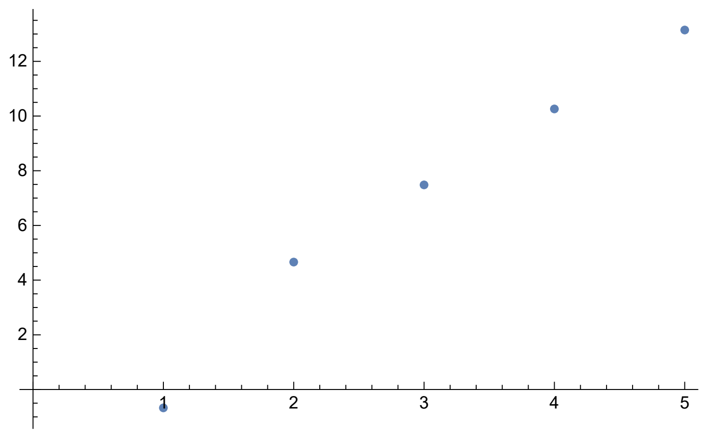
$$\frac{\left(130.892+\sqrt{m_5}\right)^2}{5\,\left(7927.42+m_5\right)}$$

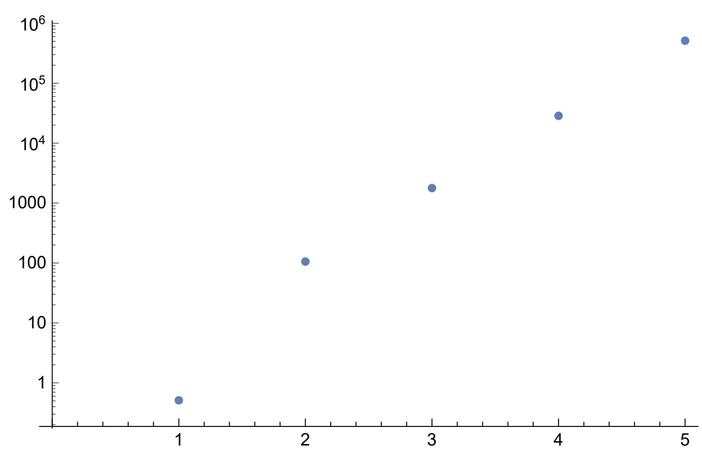
```
Solve[(130.89233448587385` + Sqrt[m5])^2/(5 (7927.4153751914255` + m5)) - Cos[1] == 0, m5]
```

$$\{\{m_5\to 346.459\},\ \{m_5\to 18\,290.1\}\}$$

```
ListPlot[Table[m_i, {i, 1, 5}]]
ListPlot[Table[Log[m_i], {i, 1, 5}]]
ListLogPlot[Table[m_i, {i, 1, 5}]]
```








```
FindFit[Table[m_i, {i, 1, 5}], a Exp[b + c x ], {a, b, c}, x]
FindFit[Table[m_i, {i, 1, 5}], a x Exp[b + c x], {a, b, c}, x]
```

{a → 0.183656, b → 0.413264, c → 2.88555}

{a → 0.127524, b → 0.285914, c → 2.66208}

```
Fit[Table[Log[m_i], {i, 1, 5}], {1, x}, x]
Fit[Table[Log[m_i], {i, 1, 5}], {x}, x]
```

$-2.99501 + 3.32352\, x$

$2.5067\, x$

```
Fit[Table[Log[m_i], {i, 1, 5}], {1, x}, x]
Fit[Table[Log[m_i], {i, 1, 4}], {x}, x]
```

$-2.99501 + 3.32352\, x$

$2.40457\, x$

```
Fit[Table[Log[m_i], {i, 1, 3}], {1, x}, x]
Fit[Table[Log[m_i], {i, 1, 3}], {x}, x]
```

$-4.33018 + 4.077\, x$

$2.2212\, x$