(*Note that $w=v^{\alpha}$*)

In[ ]:= $$\text{Solve}\left[l^2 w^2 + w^4 \tau^2 + 2\, l\, w^3 \tau \,\text{Cos}\left[\frac{\pi\alpha}{2}\right] - m^2 == 0,\ w\right]$$

Out[ ]= $$\left\{\left\{w \to -\frac{l\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]}{2\tau} - \frac{1}{2}\sqrt{\left(-\frac{2\,l^2}{3\tau^2} + \frac{l^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2}{\tau^2} + \right.}\right.\right.$$

$$\left(2^{1/3}\left(l^4 - 12\, m^2 \tau^2\right)\right) \Big/ \left(3\tau^2\left(2\, l^6 + 72\, l^2 m^2 \tau^2 - 108\, l^2 m^2 \tau^2 \,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2 + \right.\right.$$

$$\left.\left.\sqrt{-4\left(l^4 - 12\, m^2\tau^2\right)^3 + \left(2\, l^6 + 72\, l^2 m^2 \tau^2 - 108\, l^2 m^2 \tau^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2\right)^2}\right)^{1/3}\right) +$$

$$\frac{1}{3\times 2^{1/3}\tau^2}\left(2\, l^6 + 72\, l^2 m^2 \tau^2 - 108\, l^2 m^2 \tau^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2 + \right.$$

$$\left.\sqrt{-4\left(l^4 - 12\, m^2\tau^2\right)^3 + \left(2\, l^6 + 72\, l^2 m^2 \tau^2 - 108\, l^2 m^2 \tau^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2\right)^2}\right)^{1/3} -$$

$$\frac{1}{2}\sqrt{\left(-\frac{4\,l^2}{3\tau^2} + \frac{2\,l^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2}{\tau^2} - \left(2^{1/3}\left(l^4 - 12\, m^2\tau^2\right)\right) \Big/ \right.}$$

$$\left(3\tau^2\left(2\, l^6 + 72\, l^2 m^2 \tau^2 - 108\, l^2 m^2 \tau^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2 + \right.\right.$$

$$\left.\left.\sqrt{-4\left(l^4 - 12\, m^2\tau^2\right)^3 + \left(2\, l^6 + 72\, l^2 m^2 \tau^2 - 108\, l^2 m^2 \tau^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2\right)^2}\right)^{1/3}\right) -$$

$$\frac{1}{3\times 2^{1/3}\tau^2}\left(2\, l^6 + 72\, l^2 m^2 \tau^2 - 108\, l^2 m^2 \tau^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2 + \right.$$

$$\left.\sqrt{-4\left(l^4 - 12\, m^2\tau^2\right)^3 + \left(2\, l^6 + 72\, l^2 m^2 \tau^2 - 108\, l^2 m^2 \tau^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2\right)^2}\right)^{1/3} -$$

$$\left(\frac{8\,l^3\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]}{\tau^3} - \frac{8\,l^3\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^3}{\tau^3}\right) \Big/ \left(4\sqrt{\left(-\frac{2\,l^2}{3\tau^2} + \frac{l^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2}{\tau^2} + \right.}\right.$$

$$\left(2^{1/3}\left(l^4 - 12\, m^2\tau^2\right)\right) \Big/ \left(3\tau^2\left(2\, l^6 + 72\, l^2 m^2 \tau^2 - 108\, l^2 m^2 \tau^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2 + \right.\right.$$

$$\left.\left.\sqrt{-4\left(l^4 - 12\, m^2\tau^2\right)^3 + \left(2\, l^6 + 72\, l^2 m^2 \tau^2 - 108\, l^2 m^2 \tau^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2\right)^2}\right)^{1/3}\right) +$$

$$\frac{1}{3\times 2^{1/3}\tau^2}\left(2\, l^6 + 72\, l^2 m^2 \tau^2 - 108\, l^2 m^2 \tau^2\,\text{Cos}\left[\frac{\pi\alpha}{2}\right]^2 + \right.$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Big)^{1/3}\Big)\Big)\Big)\Big\},$$

$$\Big\{w\to-\frac{l\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]}{2\,\tau}-\frac{1}{2}\sqrt{\Big(-\frac{2\,l^2}{3\,\tau^2}+\frac{l^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2}{\tau^2}+\left(2^{1/3}\,\left(l^4-12\,m^2\,\tau^2\right)\right)\Big/}$$

$$\Big(3\,\tau^2\,\Big(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Big)^{1/3}\Big)+$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\Big(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Big)^{1/3}\Big)+$$

$$\frac{1}{2}\sqrt{\Big(-\frac{4\,l^2}{3\,\tau^2}+\frac{2\,l^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2}{\tau^2}-\left(2^{1/3}\,\left(l^4-12\,m^2\,\tau^2\right)\right)\Big/}$$

$$\Big(3\,\tau^2\,\Big(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Big)^{1/3}\Big)-$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\Big(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Big)^{1/3}-$$

$$\left(\frac{8\,l^3\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]}{\tau^3}-\frac{8\,l^3\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^3}{\tau^3}\right)\Big/\Big(4\sqrt{\Big(-\frac{2\,l^2}{3\,\tau^2}+\frac{l^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2}{\tau^2}+}$$

$$\left(2^{1/3}\,\left(l^4-12\,m^2\,\tau^2\right)\right)\Big/\Big(3\,\tau^2\,\Big(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Big)^{1/3}\Big)+$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\Big(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Big)^{1/3}\Big)\Big)\Big)\Big\},$$

$$\Big\{w \to -\frac{1\,\mathrm{Cos}\big[\frac{\pi\alpha}{2}\big]}{2\,\tau} + \frac{1}{2}\sqrt{\Bigg(-\frac{2\,1^2}{3\,\tau^2} + \frac{1^2\,\mathrm{Cos}\big[\frac{\pi\alpha}{2}\big]^2}{\tau^2} + \Big(2^{1/3}\,\big(1^4 - 12\,m^2\,\tau^2\big)\Big)\Big/}$$

$$\Bigg(3\,\tau^2\,\Bigg(2\,1^6 + 72\,1^2\,m^2\,\tau^2 - 108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2 +$$

$$\sqrt{-4\,\big(1^4 - 12\,m^2\,\tau^2\big)^3 + \Big(2\,1^6 + 72\,1^2\,m^2\,\tau^2 - 108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\Big)^2}\;\Bigg)^{1/3}\Bigg) +$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\Bigg(2\,1^6 + 72\,1^2\,m^2\,\tau^2 - 108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2 +$$

$$\sqrt{-4\,\big(1^4 - 12\,m^2\,\tau^2\big)^3 + \Big(2\,1^6 + 72\,1^2\,m^2\,\tau^2 - 108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\Big)^2}\;\Bigg)^{1/3}\Bigg) -$$

$$\frac{1}{2}\sqrt{\Bigg(-\frac{4\,1^2}{3\,\tau^2} + \frac{2\,1^2\,\mathrm{Cos}\big[\frac{\pi\alpha}{2}\big]^2}{\tau^2} - \Big(2^{1/3}\,\big(1^4 - 12\,m^2\,\tau^2\big)\Big)\Big/}$$

$$\Bigg(3\,\tau^2\,\Bigg(2\,1^6 + 72\,1^2\,m^2\,\tau^2 - 108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2 +$$

$$\sqrt{-4\,\big(1^4 - 12\,m^2\,\tau^2\big)^3 + \Big(2\,1^6 + 72\,1^2\,m^2\,\tau^2 - 108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\Big)^2}\;\Bigg)^{1/3}\Bigg) -$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\Bigg(2\,1^6 + 72\,1^2\,m^2\,\tau^2 - 108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2 +$$

$$\sqrt{-4\,\big(1^4 - 12\,m^2\,\tau^2\big)^3 + \Big(2\,1^6 + 72\,1^2\,m^2\,\tau^2 - 108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\Big)^2}\;\Bigg)^{1/3} +$$

$$\Bigg(\frac{8\,1^3\,\mathrm{Cos}\big[\frac{\pi\alpha}{2}\big]}{\tau^3} - \frac{8\,1^3\,\mathrm{Cos}\big[\frac{\pi\alpha}{2}\big]^3}{\tau^3}\Bigg)\Bigg/\Bigg(4\,\sqrt{\Bigg(-\frac{2\,1^2}{3\,\tau^2} + \frac{1^2\,\mathrm{Cos}\big[\frac{\pi\alpha}{2}\big]^2}{\tau^2} +}$$

$$\Big(2^{1/3}\,\big(1^4 - 12\,m^2\,\tau^2\big)\Big)\Big/\Bigg(3\,\tau^2\,\Bigg(2\,1^6 + 72\,1^2\,m^2\,\tau^2 - 108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2 +$$

$$\sqrt{-4\,\big(1^4 - 12\,m^2\,\tau^2\big)^3 + \Big(2\,1^6 + 72\,1^2\,m^2\,\tau^2 - 108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\Big)^2}\;\Bigg)^{1/3}\Bigg) +$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\Bigg(2\,1^6 + 72\,1^2\,m^2\,\tau^2 - 108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2 +$$

$$\sqrt{-4\,\big(1^4 - 12\,m^2\,\tau^2\big)^3 + \Big(2\,1^6 + 72\,1^2\,m^2\,\tau^2 - 108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\Big)^2}\;\Bigg)^{1/3}\Bigg)\Bigg)\Bigg)\Bigg)\Big\},$$

$$\Big\{w \to -\frac{1\,\mathrm{Cos}\big[\frac{\pi\alpha}{2}\big]}{2\,\tau} + \frac{1}{2}\sqrt{\Bigg(-\frac{2\,1^2}{3\,\tau^2} + \frac{1^2\,\mathrm{Cos}\big[\frac{\pi\alpha}{2}\big]^2}{\tau^2} + \Big(2^{1/3}\,\big(1^4 - 12\,m^2\,\tau^2\big)\Big)\Big/}$$

$$\Bigg(3\,\tau^2\,\Bigg(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2+$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\right)^2}\;\Bigg)^{1/3}\Bigg)+$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\Bigg(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2+$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\right)^2}\;\Bigg)^{1/3}\Bigg)+$$

$$\frac{1}{2}\sqrt{\Bigg(-\frac{4\,l^2}{3\,\tau^2}+\frac{2\,l^2\,\mathrm{Cos}\big[\frac{\pi\,\alpha}{2}\big]^2}{\tau^2}-\left(2^{1/3}\,\left(l^4-12\,m^2\,\tau^2\right)\right)\Big/}$$

$$\Bigg(3\,\tau^2\,\Bigg(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2+$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\right)^2}\;\Bigg)^{1/3}\Bigg)-$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\Bigg(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2+$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\right)^2}\;\Bigg)^{1/3}+$$

$$\left(\frac{8\,l^3\,\mathrm{Cos}\big[\frac{\pi\,\alpha}{2}\big]}{\tau^3}-\frac{8\,l^3\,\mathrm{Cos}\big[\frac{\pi\,\alpha}{2}\big]^3}{\tau^3}\right)\Bigg/\Bigg(4\sqrt{\Bigg(-\frac{2\,l^2}{3\,\tau^2}+\frac{l^2\,\mathrm{Cos}\big[\frac{\pi\,\alpha}{2}\big]^2}{\tau^2}+}$$

$$\left(2^{1/3}\,\left(l^4-12\,m^2\,\tau^2\right)\right)\Big/\Bigg(3\,\tau^2\,\Bigg(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2+$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\right)^2}\;\Bigg)^{1/3}\Bigg)+$$

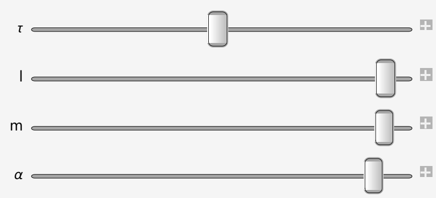
$$\frac{1}{3\times 2^{1/3}\,\tau^2}\Bigg(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2+$$

$$\sqrt{-4\,\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\right)^2}\;\Bigg)^{1/3}\Bigg)\Bigg)\Bigg)\Bigg)\}\}$$

(*Only Fourth root is positive for different l, m, τ and α *)

In[ ]:=
$$\text{Manipulate}\Big[\text{NSolve}\Big[l^2 w^2 + w^4 \tau^2 + 2\, l\, w^3\, \tau\, \text{Cos}\Big[\frac{\pi\,\alpha}{2}\Big] - m^2 == 0,\ w\Big],$$
$$\{\tau, 0, 5\}, \{l, 0, 10\}, \{m, 0, 10\}, \{\alpha, 0, 1\}\Big]$$

Out[ ]=




```
{{w → -0.987783}, {w → -0.342489 - 4.07426 i},
 {w → -0.342489 + 4.07426 i}, {w → 0.949358}}
```

(*Expression for g(τ) in terms of l, m, α and τ*)

In[5]:= g[l_, m_, α_, τ_] :=

$$\Big\{\text{ArcCos}\Big[-\frac{1}{m}\, l\, \text{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]\ \bigg(-\frac{l\, \text{Cos}\big[\frac{\pi\alpha}{2}\big]}{2\,\tau} + \frac{1}{2}\sqrt{\bigg(-\frac{2\, l^2}{3\,\tau^2} + \frac{l^2\, \text{Cos}\big[\frac{\pi\alpha}{2}\big]^2}{\tau^2} + \big(2^{1/3}\,(l^4 - 12\, m^2\, \tau^2)\big)\Big/}$$

$$\bigg(3\,\tau^2\ \bigg(2\, l^6 + 72\, l^2\, m^2\, \tau^2 - 108\, l^2\, m^2\, \tau^2\, \text{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2 +$$

$$\sqrt{-4\,(l^4 - 12\, m^2\, \tau^2)^3 + \Big(2\, l^6 + 72\, l^2\, m^2\, \tau^2 - 108\, l^2\, m^2\, \tau^2\, \text{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\Big)^2}\ \bigg)^{1/3}\bigg) +$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\bigg(2\, l^6 + 72\, l^2\, m^2\, \tau^2 - 108\, l^2\, m^2\, \tau^2\, \text{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2 +$$

$$\sqrt{-4\,(l^4 - 12\, m^2\, \tau^2)^3 + \Big(2\, l^6 + 72\, l^2\, m^2\, \tau^2 - 108\, l^2\, m^2\, \tau^2\, \text{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\Big)^2}\ \bigg)^{1/3}\bigg) +$$

$$\frac{1}{2}\sqrt{\bigg(-\frac{4\, l^2}{3\,\tau^2} + \frac{2\, l^2\, \text{Cos}\big[\frac{\pi\alpha}{2}\big]^2}{\tau^2} - \big(2^{1/3}\,(l^4 - 12\, m^2\, \tau^2)\big)\Big/\bigg(3\,\tau^2}$$

$$\bigg(2\, l^6 + 72\, l^2\, m^2\, \tau^2 - 108\, l^2\, m^2\, \tau^2\, \text{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2 +$$

$$\sqrt{-4\,(l^4 - 12\, m^2\, \tau^2)^3 + \Big(2\, l^6 + 72\, l^2\, m^2\, \tau^2 - 108\, l^2\, m^2\, \tau^2\, \text{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2\Big)^2}\ \bigg)^{1/3}\bigg) -$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\bigg(2\, l^6 + 72\, l^2\, m^2\, \tau^2 - 108\, l^2\, m^2\, \tau^2\, \text{Cos}\Big[\frac{\pi\,\alpha}{2}\Big]^2 +$$

$$\sqrt{-4\left(1^4-12\,m^2\,\tau^2\right)^3+\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Bigg)^{1/3}\;+$$

$$\left(\frac{8\,1^3\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]}{\tau^3}-\frac{8\,1^3\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^3}{\tau^3}\right)\Bigg/\;\Bigg(4\sqrt{\Bigg(-\frac{2\,1^2}{3\,\tau^2}+\frac{1^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2}{\tau^2}\;+}$$

$$\left(2^{1/3}\left(1^4-12\,m^2\,\tau^2\right)\right)\Big/\;\Bigg(3\,\tau^2\,\Bigg(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+$$

$$\sqrt{-4\left(1^4-12\,m^2\,\tau^2\right)^3+\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Bigg)^{1/3}$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\Bigg(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+$$

$$\sqrt{-4\left(1^4-12\,m^2\,\tau^2\right)^3+\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Bigg)^{1/3}\Bigg)\Bigg)\Bigg)$$

$$\frac{1}{m}\,\tau\,\Bigg(-\frac{1\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]}{2\,\tau}+\frac{1}{2}\sqrt{\Bigg(-\frac{2\,1^2}{3\,\tau^2}+\frac{1^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2}{\tau^2}+\left(2^{1/3}\left(1^4-12\,m^2\,\tau^2\right)\right)\Big/}$$

$$\Bigg(3\,\tau^2\,\Bigg(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+$$

$$\sqrt{-4\left(1^4-12\,m^2\,\tau^2\right)^3+\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Bigg)^{1/3}\Bigg)+$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\Bigg(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+$$

$$\sqrt{-4\left(1^4-12\,m^2\,\tau^2\right)^3+\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Bigg)^{1/3}\Bigg)+$$

$$\frac{1}{2}\sqrt{\Bigg(-\frac{4\,1^2}{3\,\tau^2}+\frac{2\,1^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2}{\tau^2}-\left(2^{1/3}\left(1^4-12\,m^2\,\tau^2\right)\right)\Big/\;\Bigg(3\,\tau^2}$$

$$\Bigg(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+$$

$$\sqrt{-4\left(1^4-12\,m^2\,\tau^2\right)^3+\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\;\Bigg)^{1/3}\Bigg)-$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\Bigg(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+$$

$$\sqrt{-4\left(1^4-12\,m^2\,\tau^2\right)^3+\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\Bigg)^{1/3}+$$

$$\left(\frac{8\,1^3\,\mathrm{Cos}\left[\frac{\pi\alpha}{2}\right]}{\tau^3}-\frac{8\,1^3\,\mathrm{Cos}\left[\frac{\pi\alpha}{2}\right]^3}{\tau^3}\right)\Bigg/\left(4\sqrt{\left(-\frac{2\,1^2}{3\,\tau^2}+\frac{1^2\,\mathrm{Cos}\left[\frac{\pi\alpha}{2}\right]^2}{\tau^2}+\right.}\right.$$

$$\left(2^{1/3}\left(1^4-12\,m^2\,\tau^2\right)\right)\Big/\left(3\,\tau^2\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+\right.\right.$$

$$\sqrt{-4\left(1^4-12\,m^2\,\tau^2\right)^3+\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\Bigg)^{1/3}$$

$$\frac{1}{3\times2^{1/3}\,\tau^2}\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+\right.$$

$$\sqrt{-4\left(1^4-12\,m^2\,\tau^2\right)^3+\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\Bigg)^{1/3}\Bigg)\Bigg)\Bigg)$$

$$\mathrm{Cos}[\pi\,\alpha]\Big]\left(-\frac{1\,\mathrm{Cos}\left[\frac{\pi\alpha}{2}\right]}{2\,\tau}+\frac{1}{2}\sqrt{\left(-\frac{2\,1^2}{3\,\tau^2}+\frac{1^2\,\mathrm{Cos}\left[\frac{\pi\alpha}{2}\right]^2}{\tau^2}+\left(2^{1/3}\left(1^4-12\,m^2\,\tau^2\right)\right)\Big/\right.}\right.$$

$$\left(3\,\tau^2\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+\right.\right.$$

$$\sqrt{-4\left(1^4-12\,m^2\,\tau^2\right)^3+\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\Bigg)^{1/3}\Bigg)+$$

$$\frac{1}{3\times2^{1/3}\,\tau^2}\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+\right.$$

$$\sqrt{-4\left(1^4-12\,m^2\,\tau^2\right)^3+\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\Bigg)^{1/3}\Bigg)+$$

$$\frac{1}{2}\sqrt{\left(-\frac{4\,1^2}{3\,\tau^2}+\frac{2\,1^2\,\mathrm{Cos}\left[\frac{\pi\alpha}{2}\right]^2}{\tau^2}-\left(2^{1/3}\left(1^4-12\,m^2\,\tau^2\right)\right)\Big/\right.}$$

$$\left(3\,\tau^2\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+\right.\right.$$

$$\sqrt{-4\left(1^4-12\,m^2\,\tau^2\right)^3+\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\Bigg)^{1/3}\Bigg)-$$

$$\frac{1}{3\times2^{1/3}\,\tau^2}\left(2\,1^6+72\,1^2\,m^2\,\tau^2-108\,1^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+\right.$$

$$\sqrt{-4\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\,\Bigg)^{1/3}+$$

$$\left(\frac{8\,l^3\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]}{\tau^3}-\frac{8\,l^3\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^3}{\tau^3}\right)\Bigg/\left(4\sqrt{\left(-\frac{2\,l^2}{3\,\tau^2}+\frac{l^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2}{\tau^2}+\right.}\right.$$

$$\left(2^{1/3}\left(l^4-12\,m^2\,\tau^2\right)\right)\Bigg/\left(3\,\tau^2\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+\right.\right.$$

$$\left.\left.\sqrt{-4\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2\right)^2}\right)^{1/3}\right)+$$

$$\frac{1}{3\times 2^{1/3}\,\tau^2}\left(2\,l^6+72\,l^2\,m^2\,\tau^2-108\,l^2\,m^2\,\tau^2\,\mathrm{Cos}\left[\frac{\pi\,\alpha}{2}\right]^2+\sqrt{-4\left(l^4-12\,m^2\,\tau^2\right)^3+\left(2\,l^6+\right.}\right.$$

(*If we have to find out the root where g(τ) intersect with τ then suppose if we fix l= 0.9, m=3, α=0.2 then if we want to find the intersection point of τ near 1 then, *)

In[7]:= **FindRoot[g[0.9, 3, 0.2, τ] - τ, {τ, 1}]**

Out[7]= {τ → 1.75459}