$$\begin{bmatrix} \vec{e1} \\ \vec{e2} \\ \vec{e3} \end{bmatrix} = \begin{bmatrix} \cos(a)\,\hat{i} + \cos(b)\,\hat{j} + \cos(c)\,\hat{k} \\ \cos(d)\,\hat{i} + \cos(e)\,\hat{j} + \cos(f)\,\hat{k} \\ \cos(g)\,\hat{i} + \cos(h)\,\hat{j} + \cos(i)\,\hat{k} \end{bmatrix}$$

$$\vec{e1} = \cos(a)\,\hat{i} + \cos(b)\,\hat{j} + \cos(c)\,\hat{k}$$

$$\vec{e2} = \cos(d)\,\hat{i} + \cos(e)\,\hat{j} + \cos(f)\,\hat{k}$$

$$\vec{e3} = \cos(g)\,\hat{i} + \cos(h)\,\hat{j} + \cos(i)\,\hat{k}$$

$$\begin{bmatrix} \hat{i} \\ \hat{j} \\ \hat{k} \end{bmatrix} = \begin{bmatrix} \cos(a)\,\vec{e1} + \cos(d)\,\vec{e2} + \cos(g)\,\vec{e3} \\ \cos(b)\,\vec{e1} + \cos(e)\,\vec{e2} + \cos(h)\,\vec{e3} \\ \cos(c)\,\vec{e1} + \cos(f)\,\vec{e2} + \cos(i)\,\vec{e3} \end{bmatrix}$$

$$\hat{i} = \cos(a)\,\vec{e1} + \cos(d)\,\vec{e2} + \cos(g)\,\vec{e3}$$

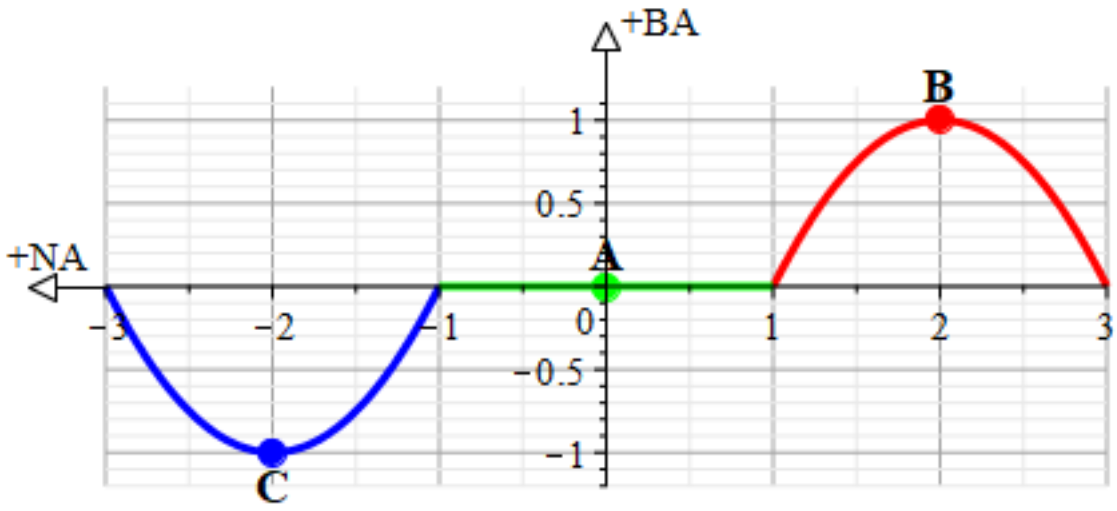
$$\hat{j} = \cos(b)\,\vec{e1} + \cos(e)\,\vec{e2} + \cos(h)\,\vec{e3}$$

$$\hat{k} = \cos(c)\,\vec{e1} + \cos(f)\,\vec{e2} + \cos(i)\,\vec{e3}$$

ΜΕΤΑΣΧΗΜΑΤΙΣΜΟΣ ΣΥΣΤΗΜΑΤΩΝ

```
with(plots):
with(plottools):
with(Student[VectorCalculus]):
with(Physics[Vectors]):
Setup(mathematicalnotation=true):
PL1 := plot([[2+λ, 1-λ^2, λ=-1..1], [-2+λ, -1+λ^2, λ=-1..1], [λ, 0, λ=-1..1]],
    color=[red, blue, green], thickness=[3, 3, 3], title
    ="ΣΥΜΠΛΕΓΜΑ : ΠΑΡΑΒΟΛΕΣ\n ΜΕ ΕΥΘΕΙΑ ΕΝΩΝΟΥΣΑ", titlefont=[arial, bold,
    14], gridlines, scaling=constrained):
PL2 := pointplot([[2, 1], [0, 0], [-2, -1]], color=[red, green, blue], symbol=solidcircle,
    symbolsize=20, gridlines, scaling=constrained):
PL3 := textplot([[2, 1.2, "B"], [0, 0.2, "A"], [-2, -1.2, "C"]], font=[arial, bold, 14]):
display(PL1, PL2, PL3, labels=[x, y]):
```

ΣΥΜΠΛΕΓΜΑ : ΠΑΡΑΒΟΛΕΣ ΜΕ ΕΥΘΕΙΑ ΕΝΩΝΟΥΣΑ



>

Θέμα :

1. Έστω Ελλειπτικός Κώνος με παραμετρικές εξισώσεις :

$[z \cdot a \cdot \cos(\phi), z \cdot b \cdot \sin(\phi), z], z = 0 \,..h, \phi = 0 \,..2 \cdot \mathrm{Pi}$:

Μία τυχαία καμπύλη πάνω στην παράπλευρη επιφάνεια του πιό πάνω κώνου έχει παραμετρικές εξισώσεις :

$[z(t) \cdot a \cdot \cos(\phi(t)), z(t) \cdot b \cdot \sin(\phi(t)), z(t)]$:

Οι παραμετρικές εξισώσεις Ελλειπτικής Κωνοειδούς Έλικας , πάνω στην παράπλευρη επιφάνεια του πιό πάνω κώνου , με βήμα έλικας **c** ,αριθμό στροφών **n** και ύψος έλικας **h** είναι :

Παραμετρικές εξισώσεις Ελλειπτικής *κωνοειδούς* Έλικας :

$$\left[t \cdot a \cdot \cos\left(\frac{2 \cdot \mathrm{Pi}}{c} \cdot t\right), t \cdot b \cdot \sin\left(\frac{2 \cdot \mathrm{Pi}}{c} \cdot t\right), t\right], t = c \,..h$$

Συμβολισμοί :

$a :=$ **Μεγάλος ημιάξονας έλλειψης**
$b :=$ **Μικρός ημιάξονας έλλειψης**
$c :=$ **Βήμα Έλικας**
$n :=$ **Αριθμός στροφών έλικας**
$h := c \cdot n$ **Ύψος Έλικας**

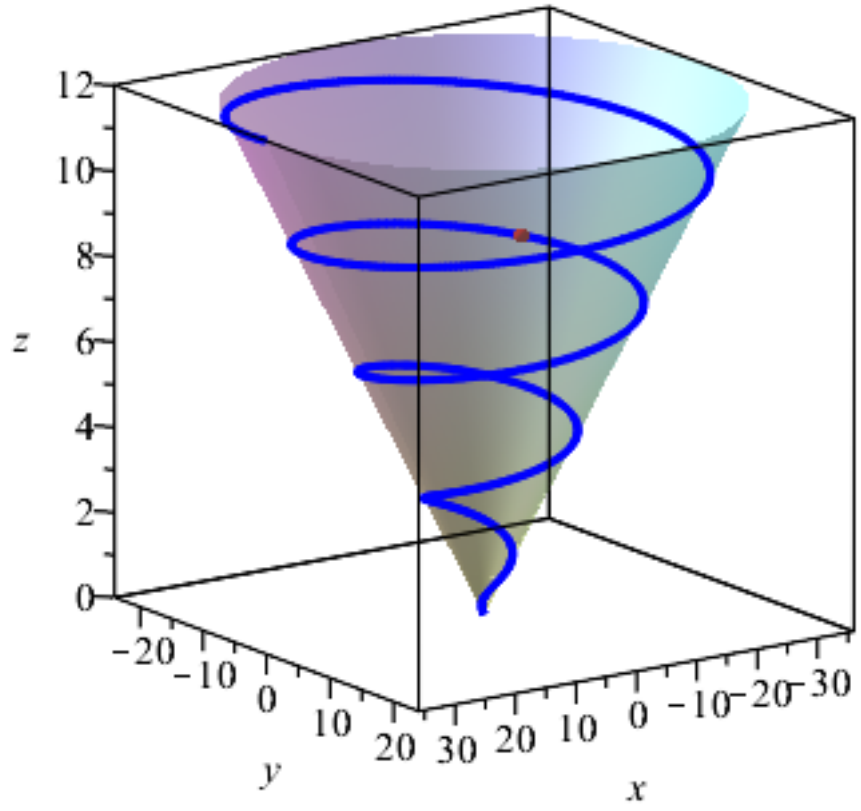
2. Έστω το σύμπλεγμα του σχήματος :

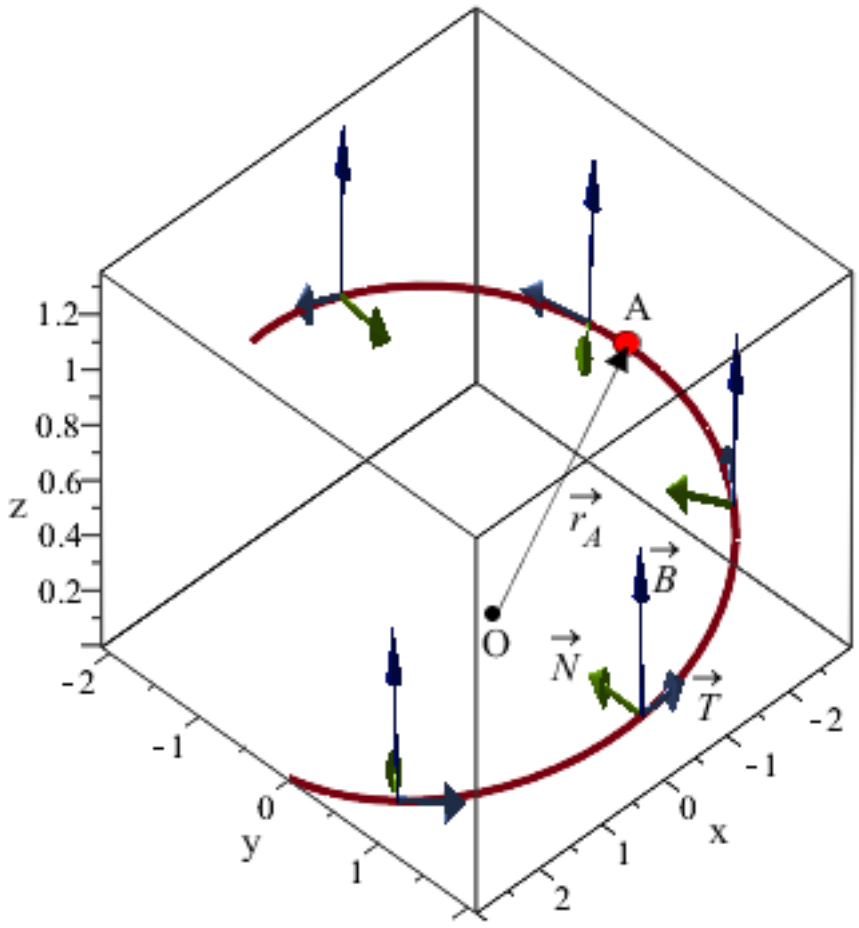
ΝΑ ΒΡΟΥΜΕ ΤΗΝ ΕΞΙΣΩΣΗ ΤΗΣ ΕΠΙΦΑΝΕΙΑΣ ΠΟΥ ΔΙΑΓΡΑΦΕΙ ΤΟ ΣΥΜΠΛΕΓΜΑ

ΟΤΑΝ ΚΙΝΕΙΤΑΙ ΚΑΘΕΤΑ στην εφαπτομένη της ΕΛΛΕΙΠΤΙΚΗΣ ΚΩΝΟΕΙΔΟΥΣ ΕΛΙΚΑΣ .

ΕΛΛΕΙΠΤΙΚΗ ΚΩΝΟΕΙΔΗΣ ΕΛΙΚΑ

ΣΑΒΒΑΣ Π. ΓΑΒΡΙΗΛΙΔΗΣ





```
>
>
> a := 3
```

$$a := 3 \tag{1}$$

```
> b := 2
```

$$b := 2 \tag{2}$$

```
> c := 3
```

$$c := 3 \tag{3}$$

```
> n := 4
```

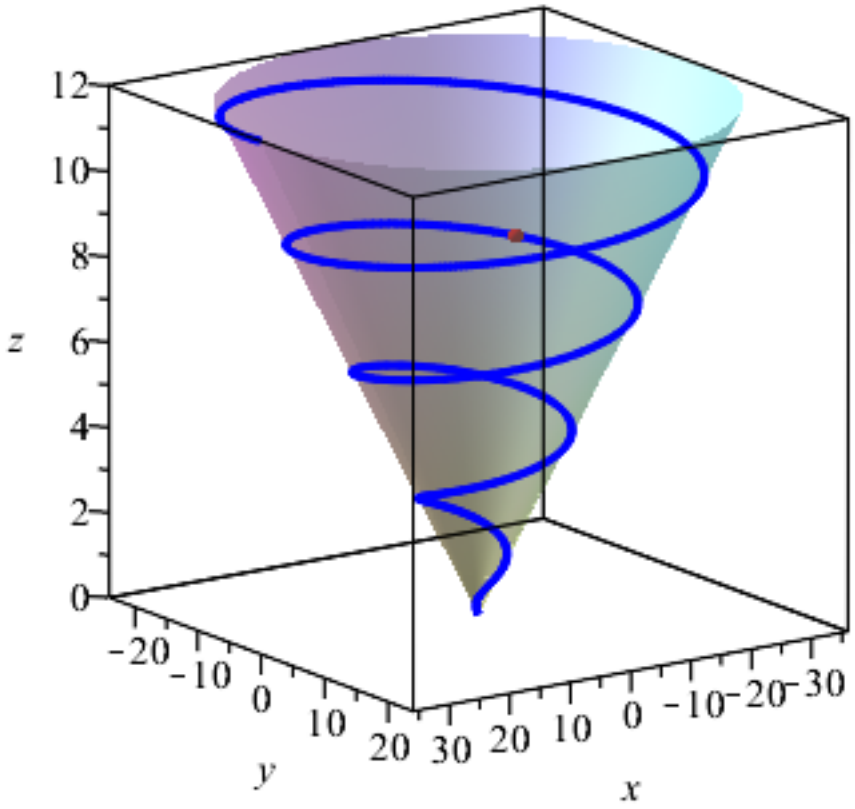
$$n := 4 \tag{4}$$

```
> h := c·n
```

$$h := 12 \tag{5}$$

```
> Helix := ⟨t·a·cos(2·Pi/c·t), t·b·sin(2·Pi/c·t), t⟩ :
> Helix1 := [t·a·cos(2·Pi/c·t), t·b·sin(2·Pi/c·t), t] :
> s1 := spacecurve([t·a·cos(2·Pi/c·t), t·b·sin(2·Pi/c·t), t], t=0..h, color=blue,
      linestyle=1, thickness=3, numpoints=1000, labels=[x, y, z]) :
> s2 := point([5·Pi/2·a·cos(2·Pi/c·5·Pi/2), 5·Pi/2·b·sin(2·Pi/c·5·Pi/2), 5·Pi/2], symbol
      =solidcircle, symbolsize=15, color=red) :
> konos := plot3d([z·a·cos(ϕ), z·b·sin(ϕ), z], z=0..h, ϕ=0..2·Pi, style=surface,
      transparency=0.5) :
> display(s1, s2, konos, scaling=unconstrained, title
      ="ΕΛΛΕΙΠΤΙΚΗ ΚΩΝΟΕΙΔΗΣ ΕΛΙΚΑ\nΣΑΒΒΑΣ Π. ΓΑΒΡΙΗΛΙΔΗΣ", titlefont=[arial,
      bold, 14])
```

ΕΛΛΕΙΠΤΙΚΗ ΚΩΝΟΕΙΔΗΣ ΕΛΙΚΑ
ΣΑΒΒΑΣ Π. ΓΑΒΡΙΗΛΙΔΗΣ



> $TNBFrame(Helix)$

$$\left[\left[-\left(3\left(2\,t\,\pi\sin\left(\frac{2\,\pi\,t}{3}\right)-3\cos\left(\frac{2\,\pi\,t}{3}\right)\right)\right)\Big/\left(-20\,t^2\,\pi^2\cos\left(\frac{2\,\pi\,t}{3}\right)^2+36\,\pi^2\,t^2-60\sin\left(\frac{2\,\pi\,t}{3}\right)t\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)+45\cos\left(\frac{2\,\pi\,t}{3}\right)^2+45\right)^{1/2}\right],\right.$$

$$\left[\left(2\left(2\,t\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)+3\sin\left(\frac{2\,\pi\,t}{3}\right)\right)\right)\Big/\left(-20\,t^2\,\pi^2\cos\left(\frac{2\,\pi\,t}{3}\right)^2+36\,\pi^2\,t^2-60\sin\left(\frac{2\,\pi\,t}{3}\right)t\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)+45\cos\left(\frac{2\,\pi\,t}{3}\right)^2+45\right)^{1/2}\right],$$

$$\left.\left[3\Big/\right.\right.$$

(6)

$$\left(-20\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2 + 36\,\pi^2 t^2 - 60\sin\left(\frac{2\pi t}{3}\right) t\pi\cos\left(\frac{2\pi t}{3}\right) \right.$$

$$\left. + 45\cos\left(\frac{2\pi t}{3}\right)^2 + 45 \right)^{1/2} \Bigg] \Bigg], \Bigg[\Bigg[-\left(16\,\pi^3\cos\left(\frac{2\pi t}{3}\right) t^3 \right.$$

$$\left. + 24\,\pi^2\sin\left(\frac{2\pi t}{3}\right) t^2 + 81\,t\pi\cos\left(\frac{2\pi t}{3}\right) + 135\sin\left(\frac{2\pi t}{3}\right) \right) \Big/$$

$$\left(\left(\left(320\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^2 t^6 - 576\,\pi^6 t^6 \right.\right.\right.$$

$$+ 960\,\pi^5\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right) t^5 + 100\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^4 t^4$$

$$+ 2060\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^2 t^4 + 900\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right) t^3 - 6048\,t^4\pi^4$$

$$+ 7800\,\pi^3\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right) t^3 - 2925\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^4 t^2$$

$$+ 4635\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2 - 4050\,\pi\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right) t - 21240\,\pi^2 t^2$$

$$+ 22950\sin\left(\frac{2\pi t}{3}\right) t\pi\cos\left(\frac{2\pi t}{3}\right) + 2025\cos\left(\frac{2\pi t}{3}\right)^4 - 16200\cos\left(\frac{2\pi t}{3}\right)^2$$

$$\left. - 18225 \right) \Big/ \left(-91125 - 270000\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^6 t^4 + 745200\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^4 t^4 \right.$$

$$- 369360\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^2 t^4 + 607500\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^6 t^2 + 24300\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^4 t^2$$

$$+ 8000\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^6 t^6 - 43200\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^4 t^6 + 77760\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^2 t^6$$

$$+364500\sin\left(\frac{2\pi t}{3}\right)t\pi\cos\left(\frac{2\pi t}{3}\right)+364500\pi\cos\left(\frac{2\pi t}{3}\right)^{5}\sin\left(\frac{2\pi t}{3}\right)t$$

$$+729000\pi\cos\left(\frac{2\pi t}{3}\right)^{3}\sin\left(\frac{2\pi t}{3}\right)t+233280\pi^{5}\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^{5}$$

$$-540000\pi^{3}\cos\left(\frac{2\pi t}{3}\right)^{5}\sin\left(\frac{2\pi t}{3}\right)t^{3}+475200\pi^{3}\cos\left(\frac{2\pi t}{3}\right)^{3}\sin\left(\frac{2\pi t}{3}\right)t^{3}$$

$$+583200\pi^{3}\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^{3}+72000\pi^{5}\cos\left(\frac{2\pi t}{3}\right)^{5}\sin\left(\frac{2\pi t}{3}\right)t^{5}$$

$$-259200\pi^{5}\cos\left(\frac{2\pi t}{3}\right)^{3}\sin\left(\frac{2\pi t}{3}\right)t^{5}-218700\pi^{2}t^{2}-46656\pi^{6}t^{6}-174960t^{4}\pi^{4}$$

$$-91125\cos\left(\frac{2\pi t}{3}\right)^{6}-273375\cos\left(\frac{2\pi t}{3}\right)^{4}-801900t^{2}\pi^{2}\cos\left(\frac{2\pi t}{3}\right)^{2}$$

$$-273375\cos\left(\frac{2\pi t}{3}\right)^{2}\Bigg)\Bigg)^{1/2}\left(-20t^{2}\pi^{2}\cos\left(\frac{2\pi t}{3}\right)^{2}+36\pi^{2}t^{2}\right.$$

$$\left.-60\sin\left(\frac{2\pi t}{3}\right)t\pi\cos\left(\frac{2\pi t}{3}\right)+45\cos\left(\frac{2\pi t}{3}\right)^{2}+45\right)^{3/2}\Bigg],$$

$$\Bigg[-\Bigg(6\left(4\pi^{3}\sin\left(\frac{2\pi t}{3}\right)t^{3}-6\pi^{2}\cos\left(\frac{2\pi t}{3}\right)t^{2}+19t\pi\sin\left(\frac{2\pi t}{3}\right)\right.$$

$$\left.-30\cos\left(\frac{2\pi t}{3}\right)\right)\Bigg)\Big/$$

$$\Bigg(\left(\left(320\pi^{6}\cos\left(\frac{2\pi t}{3}\right)^{2}t^{6}-576\pi^{6}t^{6}\right.\right.$$

$$\left.+960\pi^{5}\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^{5}+100\pi^{4}\cos\left(\frac{2\pi t}{3}\right)^{4}t^{4}\right.$$

$$+2060\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^2 t^4+900\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^3-6048\,t^4\pi^4$$

$$+7800\,\pi^3\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^3-2925\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^4 t^2$$

$$+4635\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2-4050\,\pi\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t-21240\,\pi^2 t^2$$

$$+22950\sin\left(\frac{2\pi t}{3}\right)t\,\pi\cos\left(\frac{2\pi t}{3}\right)+2025\cos\left(\frac{2\pi t}{3}\right)^4-16200\cos\left(\frac{2\pi t}{3}\right)^2$$

$$-18225\Bigg)\Bigg/\Bigg(-91125-270000\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^6 t^4+745200\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^4 t^4$$

$$-369360\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^2 t^4+607500\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^6 t^2+24300\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^4 t^2$$

$$+8000\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^6 t^6-43200\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^4 t^6+77760\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^2 t^6$$

$$+364500\sin\left(\frac{2\pi t}{3}\right)t\,\pi\cos\left(\frac{2\pi t}{3}\right)+364500\,\pi\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right)t$$

$$+729000\,\pi\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t+233280\,\pi^5\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^5$$

$$-540000\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right)t^3+475200\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^3$$

$$+583200\,\pi^3\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^3+72000\,\pi^5\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right)t^5$$

$$-259200\,\pi^5\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^5-218700\,\pi^2 t^2-46656\,\pi^6 t^6-174960\,t^4\pi^4$$

$$-91125\cos\left(\frac{2\pi t}{3}\right)^6-273375\cos\left(\frac{2\pi t}{3}\right)^4-801900\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2$$

$$-273375\cos\left(\frac{2\pi t}{3}\right)^2\Bigg)^{1/2}\Bigg)\left(-20\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2+36\,\pi^2t^2\right.$$

$$\left.-60\sin\left(\frac{2\pi t}{3}\right)t\pi\cos\left(\frac{2\pi t}{3}\right)+45\cos\left(\frac{2\pi t}{3}\right)^2+45\right)^{3/2}\Bigg],$$

$$\left[-\left(10\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)-45\,t\pi\cos\left(\frac{2\pi t}{3}\right)^2+42\,\pi t\right.\right.$$

$$\left.\left.-45\sin\left(\frac{2\pi t}{3}\right)\cos\left(\frac{2\pi t}{3}\right)\right)\right/$$

$$\left(\left(\left(320\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^2t^6-576\,\pi^6t^6\right.\right.\right.$$

$$+960\,\pi^5\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^5+100\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^4t^4$$

$$+2060\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^2t^4+900\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^3-6048\,t^4\pi^4$$

$$+7800\,\pi^3\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^3-2925\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^4t^2$$

$$+4635\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2-4050\,\pi\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t-21240\,\pi^2t^2$$

$$+22950\sin\left(\frac{2\pi t}{3}\right)t\pi\cos\left(\frac{2\pi t}{3}\right)+2025\cos\left(\frac{2\pi t}{3}\right)^4-16200\cos\left(\frac{2\pi t}{3}\right)^2$$

$$\left.-18225\right)\Big/\left(-91125-270000\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^6t^4+745200\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^4t^4\right.$$

$$-369360\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^2 t^4+607500\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^6 t^2+24300\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^4 t^2$$

$$+8000\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^6 t^6-43200\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^4 t^6+77760\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^2 t^6$$

$$+364500\sin\left(\frac{2\pi t}{3}\right) t\,\pi\cos\left(\frac{2\pi t}{3}\right)+364500\,\pi\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right) t$$

$$+729000\,\pi\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right) t+233280\,\pi^5\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right) t^5$$

$$-540000\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right) t^3+475200\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right) t^3$$

$$+583200\,\pi^3\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right) t^3+72000\,\pi^5\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right) t^5$$

$$-259200\,\pi^5\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right) t^5-218700\,\pi^2 t^2-46656\,\pi^6 t^6-174960\,t^4\pi^4$$

$$-91125\cos\left(\frac{2\pi t}{3}\right)^6-273375\cos\left(\frac{2\pi t}{3}\right)^4-801900\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2$$

$$-273375\cos\left(\frac{2\pi t}{3}\right)^2\Bigg)^{1/2}\Bigg)\Bigg(-20\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2+36\,\pi^2 t^2$$

$$-60\sin\left(\frac{2\pi t}{3}\right) t\,\pi\cos\left(\frac{2\pi t}{3}\right)+45\cos\left(\frac{2\pi t}{3}\right)^2+45\Bigg)^{3/2}\Bigg)\Bigg]\Bigg],\left[\left[\right.\right.$$

$$-\Bigg(2\Bigg(20\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^2\sin\left(\frac{2\pi t}{3}\right) t^3-36\,\pi^3\sin\left(\frac{2\pi t}{3}\right) t^3-120\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^3 t^2$$

$$+168\,\pi^2\cos\left(\frac{2\,\pi\,t}{3}\right)t^2-225\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)^2\sin\left(\frac{2\,\pi\,t}{3}\right)t-45\,t\,\pi\sin\left(\frac{2\,\pi\,t}{3}\right)$$

$$+135\cos\left(\frac{2\,\pi\,t}{3}\right)^3+135\cos\left(\frac{2\,\pi\,t}{3}\right)\Bigg)\Bigg)\Bigg/$$

$$\Bigg(\Bigg(\Bigg(320\,\pi^6\cos\left(\frac{2\,\pi\,t}{3}\right)^2t^6-576\,\pi^6\,t^6$$

$$+960\,\pi^5\cos\left(\frac{2\,\pi\,t}{3}\right)\sin\left(\frac{2\,\pi\,t}{3}\right)t^5+100\,\pi^4\cos\left(\frac{2\,\pi\,t}{3}\right)^4t^4$$

$$+2060\,\pi^4\cos\left(\frac{2\,\pi\,t}{3}\right)^2t^4+900\,\pi^3\cos\left(\frac{2\,\pi\,t}{3}\right)^3\sin\left(\frac{2\,\pi\,t}{3}\right)t^3-6048\,t^4\,\pi^4$$

$$+7800\,\pi^3\cos\left(\frac{2\,\pi\,t}{3}\right)\sin\left(\frac{2\,\pi\,t}{3}\right)t^3-2925\,\pi^2\cos\left(\frac{2\,\pi\,t}{3}\right)^4t^2$$

$$+4635\,t^2\,\pi^2\cos\left(\frac{2\,\pi\,t}{3}\right)^2-4050\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)^3\sin\left(\frac{2\,\pi\,t}{3}\right)t-21240\,\pi^2\,t^2$$

$$+22950\sin\left(\frac{2\,\pi\,t}{3}\right)t\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)+2025\cos\left(\frac{2\,\pi\,t}{3}\right)^4-16200\cos\left(\frac{2\,\pi\,t}{3}\right)^2$$

$$-18225\Bigg)\Bigg/\Bigg(-91125-270000\,\pi^4\cos\left(\frac{2\,\pi\,t}{3}\right)^6t^4+745200\,\pi^4\cos\left(\frac{2\,\pi\,t}{3}\right)^4t^4$$

$$-369360\,\pi^4\cos\left(\frac{2\,\pi\,t}{3}\right)^2t^4+607500\,\pi^2\cos\left(\frac{2\,\pi\,t}{3}\right)^6t^2+24300\,\pi^2\cos\left(\frac{2\,\pi\,t}{3}\right)^4t^2$$

$$+8000\,\pi^6\cos\left(\frac{2\,\pi\,t}{3}\right)^6t^6-43200\,\pi^6\cos\left(\frac{2\,\pi\,t}{3}\right)^4t^6+77760\,\pi^6\cos\left(\frac{2\,\pi\,t}{3}\right)^2t^6$$

$$+364500\sin\left(\frac{2\,\pi\,t}{3}\right)t\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)+364500\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)^5\sin\left(\frac{2\,\pi\,t}{3}\right)t$$

$$+729000\,\pi\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t+233280\,\pi^5\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^5$$

$$-540000\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right)t^3+475200\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^3$$

$$+583200\,\pi^3\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^3+72000\,\pi^5\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right)t^5$$

$$-259200\,\pi^5\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^5-218700\,\pi^2t^2-46656\,\pi^6t^6-174960\,t^4\pi^4$$

$$-91125\cos\left(\frac{2\pi t}{3}\right)^6-273375\cos\left(\frac{2\pi t}{3}\right)^4-801900\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2$$

$$-273375\cos\left(\frac{2\pi t}{3}\right)^2\Bigg)\Bigg)^{1/2}\left(400\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^4t^4-1440\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^2t^4\right.$$

$$+2400\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^3+1296\,t^4\pi^4$$

$$-4320\,\pi^3\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^3-5400\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^4t^2$$

$$+5040\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2-5400\,\pi\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t+3240\,\pi^2t^2$$

$$-5400\sin\left(\frac{2\pi t}{3}\right)t\,\pi\cos\left(\frac{2\pi t}{3}\right)+2025\cos\left(\frac{2\pi t}{3}\right)^4+4050\cos\left(\frac{2\pi t}{3}\right)^2$$

$$\left.+2025\right)\Bigg)\Bigg],$$

$$\left[\left(3\left(20\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3t^3-36\,\pi^3\cos\left(\frac{2\pi t}{3}\right)t^3\right.\right.$$

$$+120\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^2\sin\left(\frac{2\pi t}{3}\right)t^2-108\,\pi^2\sin\left(\frac{2\pi t}{3}\right)t^2-225\,\pi\cos\left(\frac{2\pi t}{3}\right)^3t$$

$$+135\,t\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)-135\cos\left(\frac{2\,\pi\,t}{3}\right)^2\sin\left(\frac{2\,\pi\,t}{3}\right)-135\sin\left(\frac{2\,\pi\,t}{3}\right)\Bigg)\Bigg)\Bigg/$$

$$\Bigg(\Bigg(\Bigg(320\,\pi^6\cos\left(\frac{2\,\pi\,t}{3}\right)^2t^6-576\,\pi^6\,t^6$$

$$+960\,\pi^5\cos\left(\frac{2\,\pi\,t}{3}\right)\sin\left(\frac{2\,\pi\,t}{3}\right)t^5+100\,\pi^4\cos\left(\frac{2\,\pi\,t}{3}\right)^4t^4$$

$$+2060\,\pi^4\cos\left(\frac{2\,\pi\,t}{3}\right)^2t^4+900\,\pi^3\cos\left(\frac{2\,\pi\,t}{3}\right)^3\sin\left(\frac{2\,\pi\,t}{3}\right)t^3-6048\,t^4\,\pi^4$$

$$+7800\,\pi^3\cos\left(\frac{2\,\pi\,t}{3}\right)\sin\left(\frac{2\,\pi\,t}{3}\right)t^3-2925\,\pi^2\cos\left(\frac{2\,\pi\,t}{3}\right)^4t^2$$

$$+4635\,t^2\,\pi^2\cos\left(\frac{2\,\pi\,t}{3}\right)^2-4050\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)^3\sin\left(\frac{2\,\pi\,t}{3}\right)t-21240\,\pi^2\,t^2$$

$$+22950\sin\left(\frac{2\,\pi\,t}{3}\right)t\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)+2025\cos\left(\frac{2\,\pi\,t}{3}\right)^4-16200\cos\left(\frac{2\,\pi\,t}{3}\right)^2$$

$$-18225\Bigg)\Bigg/\Bigg(-91125-270000\,\pi^4\cos\left(\frac{2\,\pi\,t}{3}\right)^6t^4+745200\,\pi^4\cos\left(\frac{2\,\pi\,t}{3}\right)^4t^4$$

$$-369360\,\pi^4\cos\left(\frac{2\,\pi\,t}{3}\right)^2t^4+607500\,\pi^2\cos\left(\frac{2\,\pi\,t}{3}\right)^6t^2+24300\,\pi^2\cos\left(\frac{2\,\pi\,t}{3}\right)^4t^2$$

$$+8000\,\pi^6\cos\left(\frac{2\,\pi\,t}{3}\right)^6t^6-43200\,\pi^6\cos\left(\frac{2\,\pi\,t}{3}\right)^4t^6+77760\,\pi^6\cos\left(\frac{2\,\pi\,t}{3}\right)^2t^6$$

$$+364500\sin\left(\frac{2\,\pi\,t}{3}\right)t\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)+364500\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)^5\sin\left(\frac{2\,\pi\,t}{3}\right)t$$

$$+729000\,\pi\cos\left(\frac{2\,\pi\,t}{3}\right)^3\sin\left(\frac{2\,\pi\,t}{3}\right)t+233280\,\pi^5\cos\left(\frac{2\,\pi\,t}{3}\right)\sin\left(\frac{2\,\pi\,t}{3}\right)t^5$$

$$-540000\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right)t^3+475200\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^3$$

$$+583200\,\pi^3\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^3+72000\,\pi^5\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right)t^5$$

$$-259200\,\pi^5\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^5-218700\,\pi^2t^2-46656\,\pi^6t^6-174960\,t^4\pi^4$$

$$-91125\cos\left(\frac{2\pi t}{3}\right)^6-273375\cos\left(\frac{2\pi t}{3}\right)^4-801900\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2$$

$$-273375\cos\left(\frac{2\pi t}{3}\right)^2\Bigg)\Bigg)^{1/2}\left(400\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^4t^4-1440\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^2t^4\right.$$

$$+2400\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^3+1296\,t^4\pi^4$$

$$-4320\,\pi^3\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^3-5400\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^4t^2$$

$$+5040\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2-5400\,\pi\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t+3240\,\pi^2t^2$$

$$-5400\sin\left(\frac{2\pi t}{3}\right)t\,\pi\cos\left(\frac{2\pi t}{3}\right)+2025\cos\left(\frac{2\pi t}{3}\right)^4+4050\cos\left(\frac{2\pi t}{3}\right)^2$$

$$\left.+2025\right)\Bigg)\Bigg],$$

$$\left[-\left(2\left(2\pi^2t^2+9\right)\left(20\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2-36\,\pi^2t^2\right.\right.\right.$$

$$\left.\left.\left.+60\sin\left(\frac{2\pi t}{3}\right)t\,\pi\cos\left(\frac{2\pi t}{3}\right)-45\cos\left(\frac{2\pi t}{3}\right)^2-45\right)\right)\Bigg/$$

$$\left(\left(\left(320\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^2t^6-576\,\pi^6t^6\right.\right.\right.$$

$$+960\,\pi^5\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^5+100\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^4t^4$$

$$+2060\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^2t^4+900\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^3-6048\,t^4\pi^4$$

$$+7800\,\pi^3\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^3-2925\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^4t^2$$

$$+4635\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2-4050\,\pi\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t-21240\,\pi^2t^2$$

$$+22950\sin\left(\frac{2\pi t}{3}\right)t\,\pi\cos\left(\frac{2\pi t}{3}\right)+2025\cos\left(\frac{2\pi t}{3}\right)^4-16200\cos\left(\frac{2\pi t}{3}\right)^2$$

$$-18225\Bigg)\Bigg/\left(-91125-270000\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^6t^4+745200\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^4t^4\right.$$

$$-369360\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^2t^4+607500\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^6t^2+24300\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^4t^2$$

$$+8000\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^6t^6-43200\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^4t^6+77760\,\pi^6\cos\left(\frac{2\pi t}{3}\right)^2t^6$$

$$+364500\sin\left(\frac{2\pi t}{3}\right)t\,\pi\cos\left(\frac{2\pi t}{3}\right)+364500\,\pi\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right)t$$

$$+729000\,\pi\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t+233280\,\pi^5\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^5$$

$$-540000\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right)t^3+475200\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^3$$

$$+583200\,\pi^3\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^3+72000\,\pi^5\cos\left(\frac{2\pi t}{3}\right)^5\sin\left(\frac{2\pi t}{3}\right)t^5$$

$$-259200\,\pi^5\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^5-218700\,\pi^2 t^2-46656\,\pi^6 t^6-174960\,t^4\pi^4$$

$$-91125\cos\left(\frac{2\pi t}{3}\right)^6-273375\cos\left(\frac{2\pi t}{3}\right)^4-801900\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2$$

$$-273375\cos\left(\frac{2\pi t}{3}\right)^2\Bigg)\Bigg)^{1/2}\left(400\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^4t^4-1440\,\pi^4\cos\left(\frac{2\pi t}{3}\right)^2t^4\right.$$

$$+2400\,\pi^3\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t^3+1296\,t^4\pi^4$$

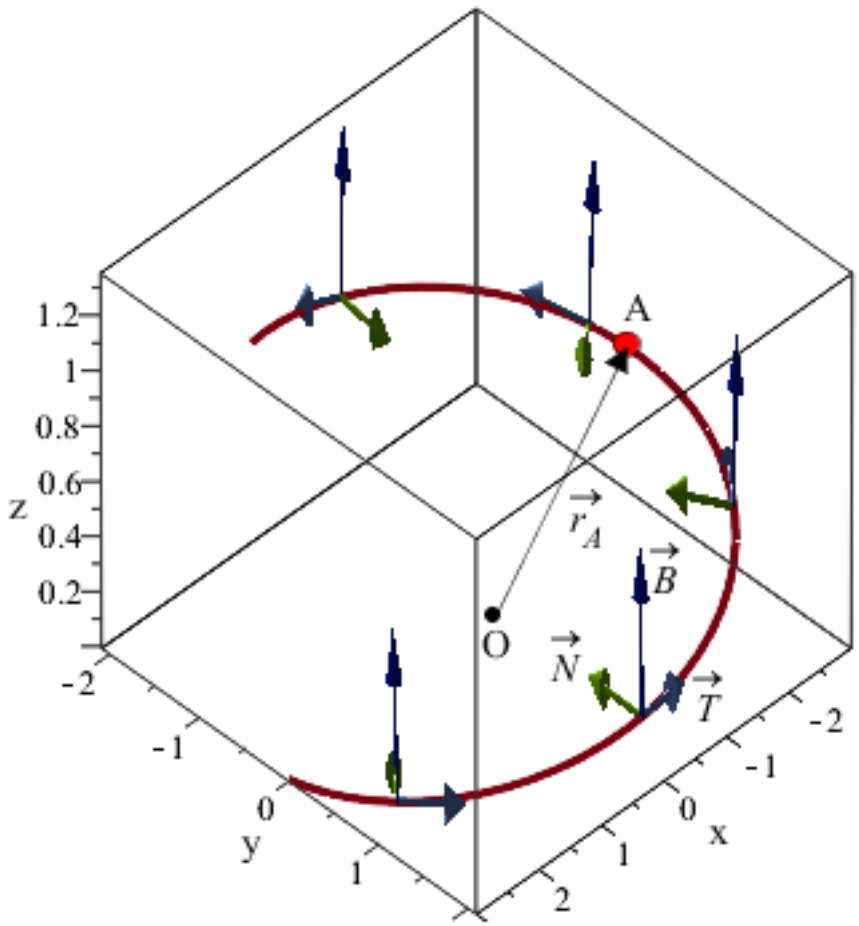
$$-4320\,\pi^3\cos\left(\frac{2\pi t}{3}\right)\sin\left(\frac{2\pi t}{3}\right)t^3-5400\,\pi^2\cos\left(\frac{2\pi t}{3}\right)^4t^2$$

$$+5040\,t^2\pi^2\cos\left(\frac{2\pi t}{3}\right)^2-5400\,\pi\cos\left(\frac{2\pi t}{3}\right)^3\sin\left(\frac{2\pi t}{3}\right)t+3240\,\pi^2t^2$$

$$-5400\sin\left(\frac{2\pi t}{3}\right)t\,\pi\cos\left(\frac{2\pi t}{3}\right)+2025\cos\left(\frac{2\pi t}{3}\right)^4+4050\cos\left(\frac{2\pi t}{3}\right)^2$$

$$\left.+2025\right)\Bigg)\Bigg]$$

```
> rA_ := simplify(t·a·cos(2·Pi/c·t)·_i + t·b·sin(2·Pi/c·t)·_j + t·_k):
> TA_ := simplify(TNBFrame(Helix)[1][1]·_i + TNBFrame(Helix)[1][2]·_j
      + TNBFrame(Helix)[1][3]·_k):
> NA_ := simplify(TNBFrame(Helix)[2][1]·_i + TNBFrame(Helix)[2][2]·_j
      + TNBFrame(Helix)[2][3]·_k):
> BA_ := simplify(TNBFrame(Helix)[3][1]·_i + TNBFrame(Helix)[3][2]·_j
      + TNBFrame(Helix)[3][3]·_k):
>
```



1. ΝΑ ΒΡΟΥΜΕ ΤΗΝ ΕΞΙΣΩΣΗ ΤΗΣ ΠΡΑΣΙΝΗΣ ΕΥΘΕΙΑΣ , $\vec{L}=L\cdot\vec{N}$ ΜΗΚΟΥΣ=L ,
ΣΤΟ ΣΗΜΕΙΟ Α ΤΗΣ ΕΛΙΚΑΣ s1: $\left[\frac{5\cdot Pi}{2}\cdot a\cdot\cos\left(\frac{2\cdot Pi}{c}\cdot\frac{5\cdot Pi}{2}\right),\frac{5\cdot Pi}{2}\cdot b\cdot\sin\left(\frac{2\cdot Pi}{c}\cdot\frac{5\cdot Pi}{2}\right),\frac{5\cdot Pi}{2}\right]$

```
> rL_ := rA_ + TA_·0 + NA_·L·λ + BA_·0 :
> X1 := subs(L = 1, Component(rL_, 1)) :
> Y1 := subs(L = 1, Component(rL_, 2)) :
> Z1 := subs(L = 1, Component(rL_, 3)) :
>
```

2. ΝΑ ΒΡΟΥΜΕ ΤΗΝ ΕΞΙΣΩΣΗ ΤΗΣ ΜΠΛΕ ΠΑΡΑΒΟΛΗΣ , $\left[-2+\lambda,-1+\lambda^2,\lambda=-1..1\right]$,
ΣΤΟ ΣΗΜΕΙΟ Α ΤΗΣ ΕΛΙΚΑΣ s1: $\left[\frac{5\cdot Pi}{2}\cdot a\cdot\cos\left(\frac{2\cdot Pi}{c}\cdot\frac{5\cdot Pi}{2}\right),\frac{5\cdot Pi}{2}\cdot b\cdot\sin\left(\frac{2\cdot Pi}{c}\cdot\frac{5\cdot Pi}{2}\right),\frac{5\cdot Pi}{2}\right]$

```
> rp1_ := rA_ + TA_·0 + NA_·(-2 + λ)·(-1) + BA_·(-1 + λ^2) :
> X2 := Component(rp1_, 1) :
> Y2 := Component(rp1_, 2) :
> Z2 := Component(rp1_, 3) :
>
```

3. ΝΑ ΒΡΟΥΜΕ ΤΗΝ ΕΞΙΣΩΣΗ ΤΗΣ ΚΟΚΚΙΝΗΣ ΠΑΡΑΒΟΛΗΣ , $\left[2+\lambda,1-\lambda^2,\lambda=-1..1\right]$,
ΣΤΟ ΣΗΜΕΙΟ Α ΤΗΣ ΕΛΙΚΑΣ s1: $\left[\frac{5\cdot Pi}{2}\cdot a\cdot\cos\left(\frac{2\cdot Pi}{c}\cdot\frac{5\cdot Pi}{2}\right),\frac{5\cdot Pi}{2}\cdot b\cdot\sin\left(\frac{2\cdot Pi}{c}\cdot\frac{5\cdot Pi}{2}\right),\frac{5\cdot Pi}{2}\right]$

```
> rp2_ := rA_ + TA_·0 + NA_·(2 + λ)·(-1) + BA_·(1 - λ^2) :
```

```
> X3 := Component(rp2_, 1):
> Y3 := Component(rp2_, 2):
> Z3 := Component(rp2_, 3):
>
>
>
```

4. ΝΑ ΒΡΟΥΜΕ ΤΙΣ ΣΥΝΤΕΤΑΓΜΕΝΕΣ ΤΟΥ ΣΗΜΕΙΟΥ Β .

```
> rB_ := rA_ + TA_·0 + NA_·(-2) + BA_·(+1):
> XB := Component(rB_, 1):
> YB := Component(rB_, 2):
> ZB := Component(rB_, 3):
>
```

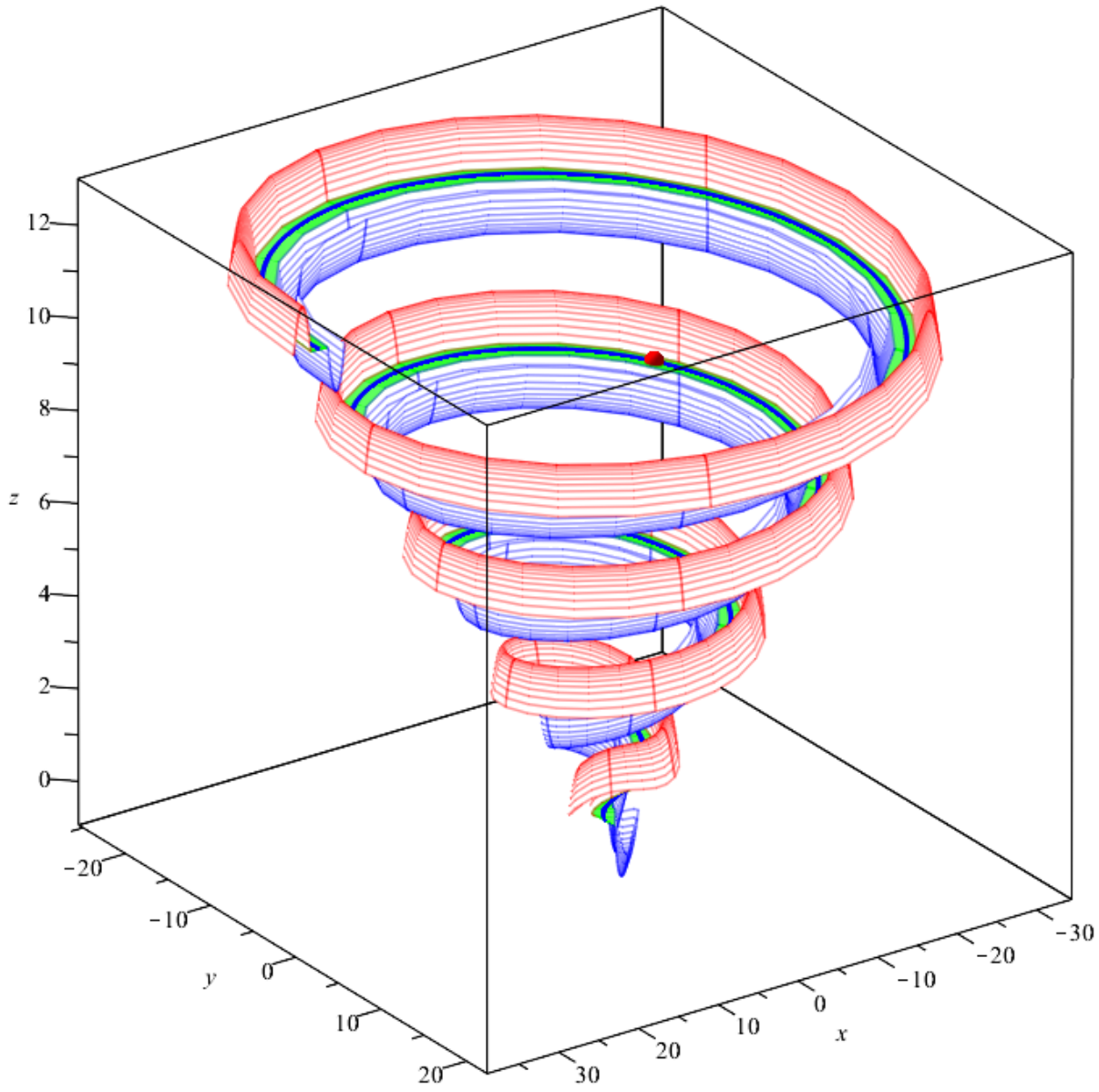
5. ΝΑ ΒΡΟΥΜΕ ΤΙΣ ΣΥΝΤΕΤΑΓΜΕΝΕΣ ΤΟΥ ΣΗΜΕΙΟΥ C .

```
>
> rC_ := rA_ + TA_·0 + NA_·(+2) + BA_·(-1):
> XC := Component(rC_, 1):
> YC := Component(rC_, 2):
> ZC := Component(rC_, 3):
>
>
```

ΠΑΡΟΥΣΙΑΣΗ

```
>
> p1 := plot3d([X1, Y1, Z1], λ=-1..1, t=0..h, color=green, numpoints=10000, style
      =hidden):
> p2 := plot3d([X2, Y2, Z2], λ=-1..1, t=0..h, color=blue, numpoints=10000, style
      =hidden):
> p3 := plot3d([X3, Y3, Z3], λ=-1..1, t=0..h, color=red, numpoints=10000, style
      =hidden):
> display(s1, s2, p1, p2, p3, scaling=unconstrained, orientation=[55, 65, 0], title
      ="ΕΠΙΦΑΝΕΙΑ ΔΙΑΓΡΑΦΟΜΕΝΗ \nΑΠΟ ΤΟ ΣΥΜΠΛΕΓΜΑ\nΣΑΒΒΑΣ Π.
      ΓΑΒΡΙΗΛΙΔΗΣ", titlefont=[arial, 14, bold]):
```

ΕΠΙΦΑΝΕΙΑ ΔΙΑΓΡΑΦΟΜΕΝΗ
ΑΠΟ ΤΟ ΣΥΜΠΛΕΓΜΑ
ΣΑΒΒΑΣ Π. ΓΑΒΡΙΗΛΙΔΗΣ




```
> p1A := animate(plot3d, [[X1, Y1, Z1], λ=-1..1, t=0..C, color=green, numpoints=10000,
      style=hidden], C=0..h, frames=20):
> p2A := animate(plot3d, [[X2, Y2, Z2], λ=-1..1, t=0..C, color=blue, numpoints=10000,
      style=hidden], C=0..h, frames=20):
> p3A := animate(plot3d, [[X3, Y3, Z3], λ=-1..1, t=0..C, color=red, numpoints=10000,
      style=hidden], C=0..h, frames=20):
> pointA := animate(pointplot3d, [Helix1, symbol=solidcircle, symbolsize=10, color
      =green], t=0..h, frames=20, trace=10):
> pointB := animate(pointplot3d, [[XB, YB, ZB], symbol=solidcircle, symbolsize=10, color
      =red], t=0..h, frames=20, trace=10):
> pointC := animate(pointplot3d, [[XC, YC, ZC], symbol=solidcircle, symbolsize=10, color
      =blue], t=0..h, frames=20, trace=10):
>
> display(s1, s2, p1A, p2A, p3A, pointA, pointB, pointC, konos, scaling=unconstrained,
      orientation=[55, 65, 0], title
```

= "ANIMATION\nΤΟ ΣΥΣΤΗΜΑ FRENET-SERRET ΚΙΝΕΙΤΑΙ\nΣΑΒΒΑΣ Π. ΓΑΒΡΙΗΛΙΔΗΣ", *titlefont* = [*arial*, *bold*, 12]) :