Question 1:

```
In[•]:= a[t_] = 2 + 2 Cos[t]
```

$$\text{Out[•]= } 2 + 2\,\text{Cos}[t]$$

```
In[•]:= b[t_] = 2 + 2 Sin[t]
```

$$\text{Out[•]= } 2 + 2\,\text{Sin}[t]$$

```
In[•]:= c[t_] = 2 - Cos[t / 2]
```

$$\text{Out[•]= } 2 - \text{Cos}\left[\frac{t}{2}\right]$$

```
In[•]:= d[t_] = 2 - Sin[t / 2]
```

$$\text{Out[•]= } 2 - \text{Sin}\left[\frac{t}{2}\right]$$

```
In[•]:= e[t_] = 1 + Cos[t] / 12
```

$$\text{Out[•]= } 1 + \frac{\text{Cos}[t]}{12}$$

```
In[•]:= f[t_] = 3 + Sin[t] / 12
```

$$\text{Out[•]= } 3 + \frac{\text{Sin}[t]}{12}$$

```
In[•]:= g[t_] = 3 + Cos[t] / 12
```

$$\text{Out[•]= } 3 + \frac{\text{Cos}[t]}{12}$$

```
In[•]:= h[t_] = 2 + Sin[t] / 8
```

$$\text{Out[•]= } 2 + \frac{\text{Sin}[t]}{8}$$

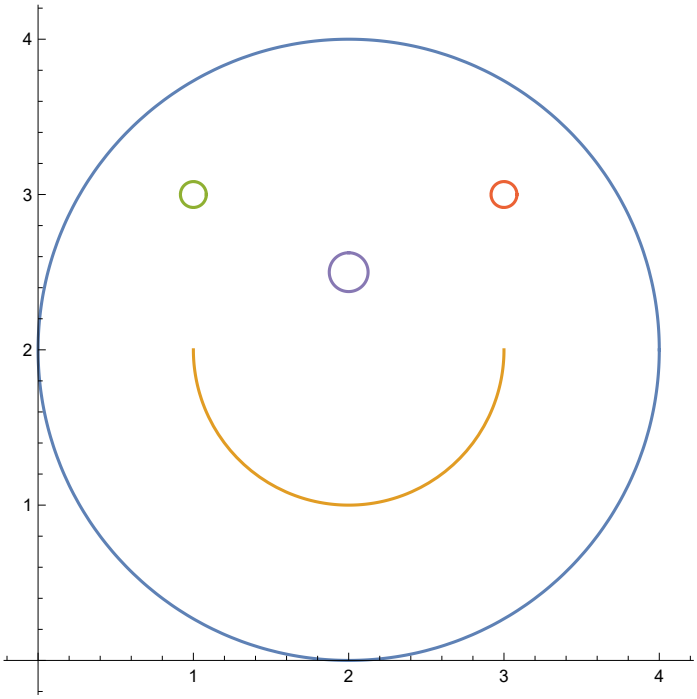
```
In[•]:= i[t_] = 2.5 + Cos[t] / 8
```

$$\text{Out[•]= } 2.5 + \frac{\text{Cos}[t]}{8}$$

Note: h[t] and i[t] are the extra nose I gave him for fun.

In[ ]:=
```
ParametricPlot[
 {{a[t], b[t]}, {c[t], d[t]}, {e[t], f[t]}, {g[t], f[t]}, {h[t], i[t]}}, {t, 0, 2 π}]
```

Out[ ]=



In[ ]:=
```
Clear[a, b, c, d, e, f, g, h, i]
```

Question 2:

In[ ]:=
```
x[t_] = Sin[π * t]
```

Out[ ]=
```
Sin[π t]
```

In[ ]:=
```
y[t_] = t^2 + t
```

Out[ ]=
```
t + t^2
```

In[ ]:=
```
x[1]
```

Out[ ]=
```
0
```

In[ ]:=
```
y[1]
```

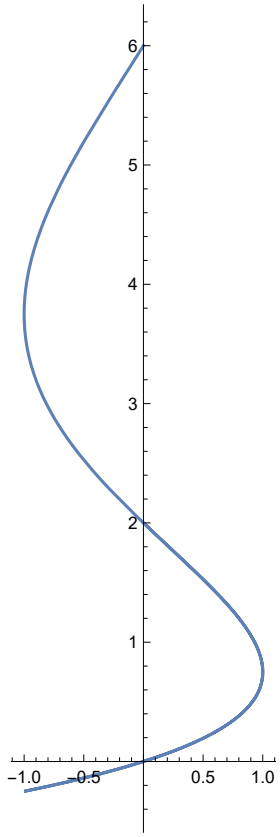
Out[ ]=
```
2
```

In[ ]:=
```
m[t_] = y'[t] / x'[t]
```

Out[ ]=
$$\frac{(1 + 2\,t)\ \text{Sec}[\pi\,t]}{\pi}$$

In[•]:=
```
p1 = ParametricPlot[{x[t], y[t]}, {t, -2, 2}]
```

Out[•]=



In[•]:=
```
m[1]
```

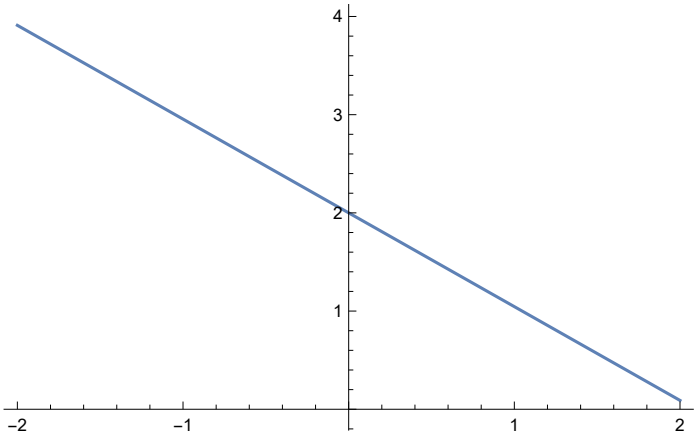
Out[•]= $-\frac{3}{\pi}$

In[•]:=
```
Solve[y - y[1] == -3/π (x - x[1]), y]
```

Out[•]= $\left\{\left\{y \to \frac{2\pi - 3x}{\pi}\right\}\right\}$

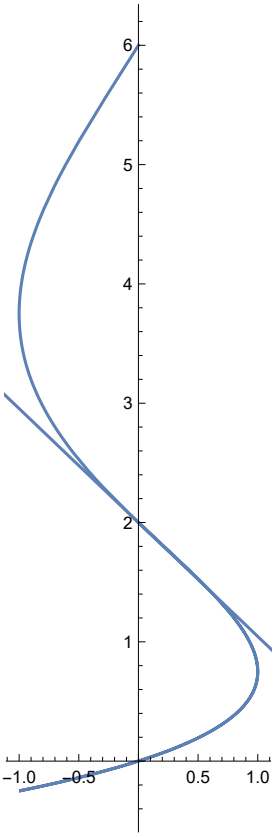
In[ ]:= `p2 = Plot[(2 π - 3 x)/π, {x, -2, 2}]`

Out[ ]=



In[ ]:= `Show[p1, p2]`

Out[ ]=



In[ ]:= `Clear[x, y, m]`

Question 3:

In[•]:= `x[t_] = Cos[t] + Log[Tan[1/2 * t]]`

Out[•]= $\text{Cos}[t] + \text{Log}\left[\text{Tan}\left[\frac{t}{2}\right]\right]$

In[•]:= `x[π / 4]`

Out[•]= $\frac{1}{\sqrt{2}} + \text{Log}\left[\text{Tan}\left[\frac{\pi}{8}\right]\right]$

In[•]:= `y[t_] = Sin[t]`

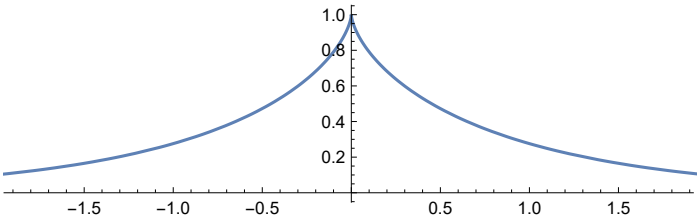
Out[•]= `Sin[t]`

In[•]:= `y[π / 2]`

Out[•]= `1`

In[•]:= `ParametricPlot[{x[t], y[t]}, {t, 0, 2 π}]`

Out[•]=



In[•]:= `L[t_] = ∫_(π/4)^(3 π/4) √((x'[t])^2 + (y'[t])^2) 𝕕t`

Out[•]= `Log[2]`

In[•]:= `N[%]`

Out[•]= `0.693147`

In[46]:= `Clear[x, y, L]`

Question 4:

In[•]:= `r[θ_] = Abs[Tan[θ]]^Abs[Cot[θ]]`

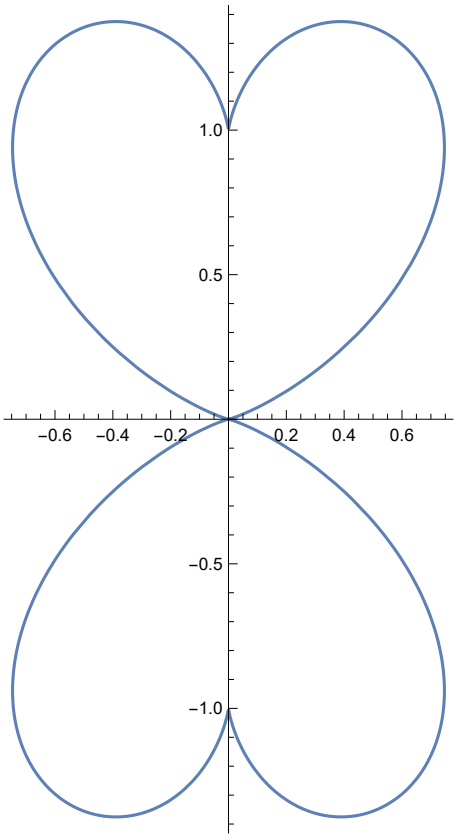
Out[•]= $\text{Abs}[\text{Tan}[\theta]]^{\text{Abs}[\text{Cot}[\theta]]}$

In[ ]:=
```
PolarPlot[r[θ], {θ, -π, π}]
```

General: $0.000128228^{7798.59}$ is too small to represent as a normalized machine number; precision may be lost.

General: $0.000128228^{7798.59}$ is too small to represent as a normalized machine number; precision may be lost.

Out[ ]=



In[ ]:=
```
Clear[r]
```

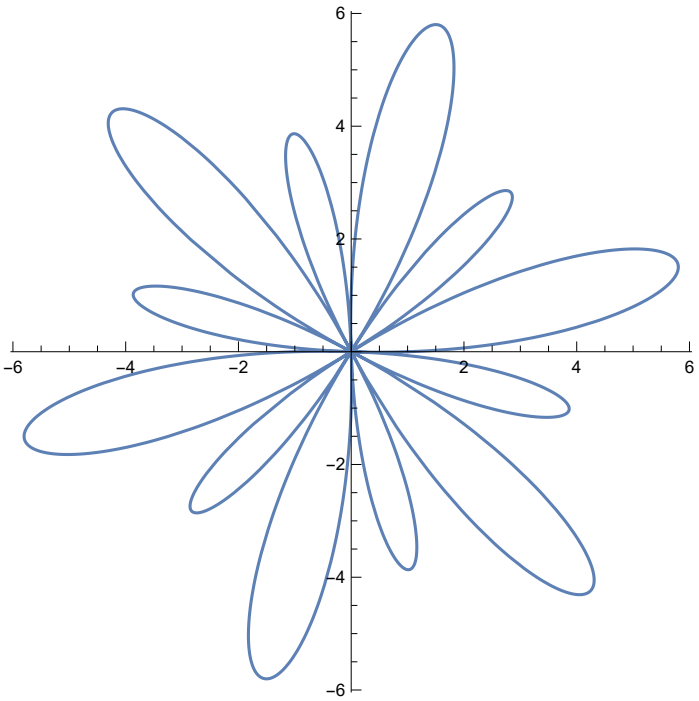
Question 5:

In[ ]:=
```
r[θ_] = 1 + 5 Sin[6 * θ]
```

Out[ ]=
```
1 + 5 Sin[6 θ]
```

In[ ]:=
```
PolarPlot[r[θ], {θ, 0, 2 π}]
```

Out[ ]=



In[ ]:=
```
A[θ_] = 1 / 2 * ∫_0^(2 π) (r[θ])^2 dθ
```

Out[ ]=
$$\frac{27\,\pi}{2}$$

In[ ]:=
```
Clear[r, A]
```

Question 6:

In[ ]:=
```
p1 = Normal[Series[x * Exp[1]^-x, {x, -1, 10}]]
```

Out[ ]=
$$-e + 2\,e\,(1+x) - \frac{3}{2}\,e\,(1+x)^2 + \frac{2}{3}\,e\,(1+x)^3 - \frac{5}{24}\,e\,(1+x)^4 + \frac{1}{20}\,e\,(1+x)^5 - \frac{7}{720}\,e\,(1+x)^6 + \frac{1}{630}\,e\,(1+x)^7 - \frac{e\,(1+x)^8}{4480} + \frac{e\,(1+x)^9}{36\,288} - \frac{11\,e\,(1+x)^{10}}{3\,628\,800}$$

In[ ]:=
```
f[x_] = x * Exp[1]^-x
```

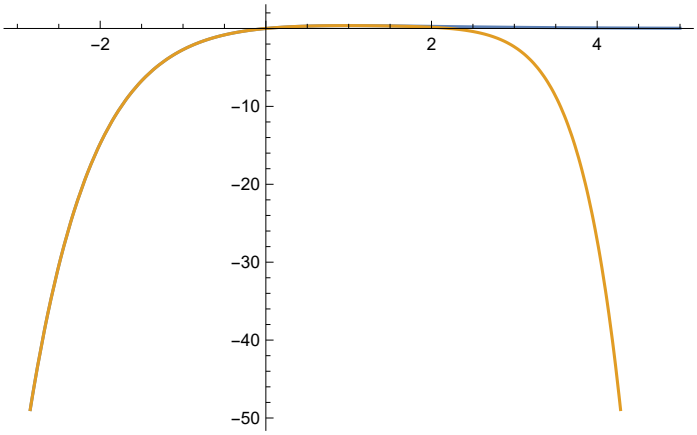
Out[ ]=
$$e^{-x}\,x$$

In[ ]:=
```
f[2]
```

Out[ ]=
$$\frac{2}{e^2}$$

In[]:=
```
Plot[{f[x], p1}, {x, -3, 5}]
```

Out[]=



In[]:=
```
f[3]
```

Out[]=
$$\frac{3}{e^3}$$

In[]:=
```
N[%]
```

Out[]=
```
0.149361
```

In[]:=
```
p1
```

Out[]=
$$-e+2e(1+x)-\frac{3}{2}e(1+x)^2+\frac{2}{3}e(1+x)^3-\frac{5}{24}e(1+x)^4+\frac{1}{20}e(1+x)^5-\frac{7}{720}e(1+x)^6+\frac{1}{630}e(1+x)^7-\frac{e(1+x)^8}{4480}+\frac{e(1+x)^9}{36288}-\frac{11e(1+x)^{10}}{3628800}$$

In[]:=
```
g[x_] = -e + 2e (1 + x) - 3/2 e (1 + x)^2 + 2/3 e (1 + x)^3 - 5/24 e (1 + x)^4 +
  1/20 e (1 + x)^5 - 7/720 e (1 + x)^6 + 1/630 e (1 + x)^7 - e (1 + x)^8/4480 + e (1 + x)^9/36288 - 11 e (1 + x)^10/3628800
```

Out[]=
$$-e+2e(1+x)-\frac{3}{2}e(1+x)^2+\frac{2}{3}e(1+x)^3-\frac{5}{24}e(1+x)^4+\frac{1}{20}e(1+x)^5-\frac{7}{720}e(1+x)^6+\frac{1}{630}e(1+x)^7-\frac{e(1+x)^8}{4480}+\frac{e(1+x)^9}{36288}-\frac{11e(1+x)^{10}}{3628800}$$

In[]:=
```
g[3]
```

Out[]=
$$-\frac{1753e}{2025}$$

In[]:=
```
N[%]
```

Out[]=
```
-2.35316
```

In[]:=
```
Clear[f, g, p1]
```

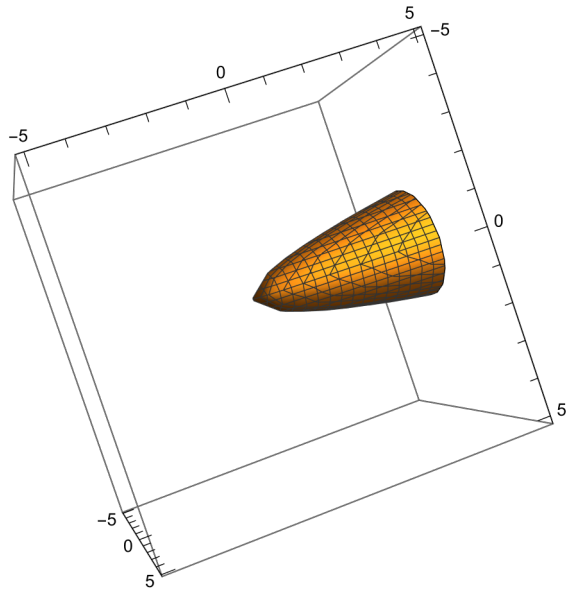
Question 7:

```
In[•]:= a = {-1, 4, 8}
Out[•]= {-1, 4, 8}

In[•]:= b = {12, 1, 2}
Out[•]= {12, 1, 2}

In[•]:= s = (a.b) / Norm[a]
Out[•]= 8/9

In[•]:= v = s (a / Norm[a])
Out[•]= {-8/81, 32/81, 64/81}

In[•]:= Clear[a, b, s, v]
```

Question 8:

```
In[•]:= ContourPlot3D[y == 2 * x^2 + z^2, {x, -5, 5}, {y, -5, 5}, {z, -5, 5}]
```

Out[•]=

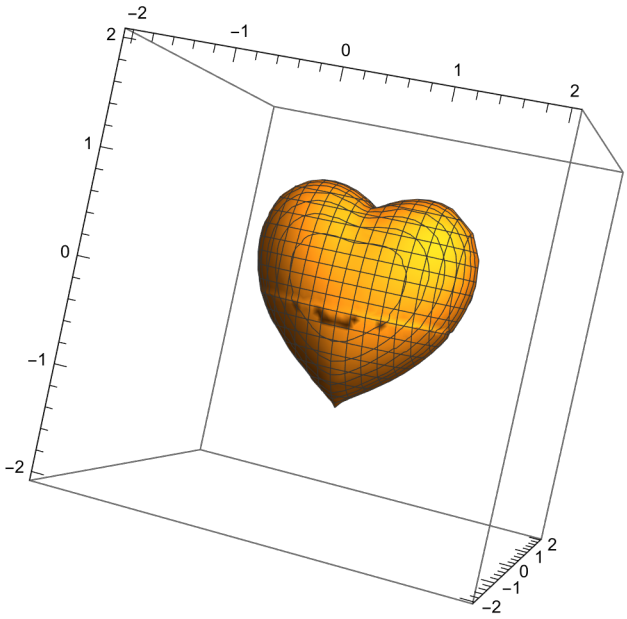


Elliptic Paraboloid

Question 9:

In[•]:=
```
ContourPlot3D[(x^(2) + 9 / 4 (y^(2)) + z^(2) - 1)^(3) - (x^2) (z^3) - 9 / 80 (y^2) (z^3) == 0,
 {x, -2, 2}, {y, -2, 2}, {z, -2, 2}]
```

Out[•]=



Question 10:

In[•]:=
```
r[t_] = {Log[t + 1], t * Cos[2 * t], 2^t}
```

Out[•]= $\{\text{Log}[1+t],\ t\,\text{Cos}[2\,t],\ 2^t\}$

In[•]:=
```
a = r'[t]
```

Out[•]= $\left\{\frac{1}{1+t},\ \text{Cos}[2\,t] - 2\,t\,\text{Sin}[2\,t],\ 2^t\,\text{Log}[2]\right\}$

In[•]:=
```
b = r''[t]
```

Out[•]= $\left\{-\frac{1}{(1+t)^2},\ -4\,t\,\text{Cos}[2\,t] - 4\,\text{Sin}[2\,t],\ 2^t\,\text{Log}[2]^2\right\}$

In[•]:=
```
Cross[a, b]
```

Out[•]= $\left\{2^{2+t}\,t\,\text{Cos}[2\,t]\,\text{Log}[2] + 2^t\,\text{Cos}[2\,t]\,\text{Log}[2]^2 + 2^{2+t}\,\text{Log}[2]\,\text{Sin}[2\,t] - 2^{1+t}\,t\,\text{Log}[2]^2\,\text{Sin}[2\,t],\right.$
$\left. -\frac{2^t\,\text{Log}[2]}{(1+t)^2} - \frac{2^t\,\text{Log}[2]^2}{1+t},\ \frac{\text{Cos}[2\,t]}{(1+t)^2} - \frac{4\,t\,\text{Cos}[2\,t]}{1+t} - \frac{2\,t\,\text{Sin}[2\,t]}{(1+t)^2} - \frac{4\,\text{Sin}[2\,t]}{1+t}\right\}$

In[ ]:= **a / Norm[a]**

Out[ ]= $$\left\{\frac{1}{(1+t)\sqrt{\frac{1}{\text{Abs}[1+t]^2}+\text{Abs}[\text{Cos}[2t]-2t\,\text{Sin}[2t]]^2+2^{2\,\text{Re}[t]}\,\text{Log}[2]^2}},\right.$$
$$\frac{\text{Cos}[2t]-2t\,\text{Sin}[2t]}{\sqrt{\frac{1}{\text{Abs}[1+t]^2}+\text{Abs}[\text{Cos}[2t]-2t\,\text{Sin}[2t]]^2+2^{2\,\text{Re}[t]}\,\text{Log}[2]^2}},$$
$$\left.\frac{2^t\,\text{Log}[2]}{\sqrt{\frac{1}{\text{Abs}[1+t]^2}+\text{Abs}[\text{Cos}[2t]-2t\,\text{Sin}[2t]]^2+2^{2\,\text{Re}[t]}\,\text{Log}[2]^2}}\right\}$$

In[ ]:= **Clear[a, r]**

Question 11:

In[13]:= **r[t_] = {t, Exp[1]^(-t), t * Exp[1]^(-t)}**

Out[13]= $\{t, e^{-t}, e^{-t}\,t\}$

In[14]:= **r'[t]**

Out[14]= $\{1, -e^{-t}, e^{-t}-e^{-t}\,t\}$

In[15]:= $\int_1^3 \sqrt{(r'[t])^2}\,dt$

Out[15]= $\left\{2, \frac{-1+e^2}{e^3}, \frac{-3+e^2}{e^3}\right\}$

In[17]:= **N[%]**

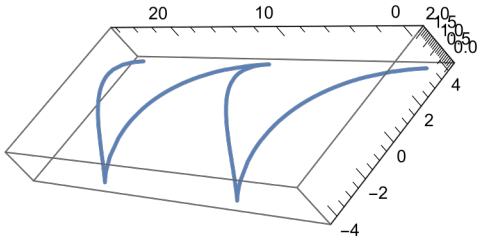
{2.`, 0.31809, 0.21851`}

In[18]:= **Clear[r]**

Question 12:

In[20]:= **ParametricPlot3D[{x = t - Sin[t], y = 1 - Cos[t], z = 4 * Cos[t / 2]}, {t, 0, 8 π}]**

Out[20]=



In[21]:=
```
r[t_] = {t - Sin[t], 1 - Cos[t], 4 * Cos[t / 2]}
```

Out[21]=
$$\left\{t - \text{Sin}[t],\ 1 - \text{Cos}[t],\ 4\,\text{Cos}\left[\frac{t}{2}\right]\right\}$$

In[22]:=
```
(Norm[Cross[r'[t], r''[t]]]) / ((Norm[r'[t]])^3)
```

Out[22]=
$$\left(\sqrt{\left(\text{Abs}\left[2\,\text{Cos}[t]\,\text{Sin}\left[\frac{t}{2}\right] - \text{Cos}\left[\frac{t}{2}\right]\,\text{Sin}[t]\right]^2 + \text{Abs}\left[\text{Cos}\left[\frac{t}{2}\right] - \text{Cos}\left[\frac{t}{2}\right]\,\text{Cos}[t] - 2\,\text{Sin}\left[\frac{t}{2}\right]\,\text{Sin}[t]\right]^2 + \text{Abs}\left[\text{Cos}[t] - \text{Cos}[t]^2 - \text{Sin}[t]^2\right]^2\right)}\right) \Big/ \left(\text{Abs}[1 - \text{Cos}[t]]^2 + 4\,\text{Abs}\left[\text{Sin}\left[\frac{t}{2}\right]\right]^2 + \text{Abs}[\text{Sin}[t]]^2\right)^{3/2}$$

In[23]:=
```
Simplify[%]
```

Out[23]=
$$\sqrt{\frac{\text{Abs}[1 - \text{Cos}[t]]^2 + 4\,\text{Abs}\left[\text{Sin}\left[\frac{t}{2}\right]\right]^6 + \text{Abs}\left[\text{Sin}\left[\frac{t}{2}\right]\,\text{Sin}[t]\right]^2}{\left(\text{Abs}[1 - \text{Cos}[t]]^2 + 4\,\text{Abs}\left[\text{Sin}\left[\frac{t}{2}\right]\right]^2 + \text{Abs}[\text{Sin}[t]]^2\right)^3}}$$

In[24]:=
```
Clear[r]
```

Question 13:

In[40]:=
```
r[t_] = {Cos[t], Sin[t], Log[Cos[t]]}
```

Out[40]=
$$\{\text{Cos}[t],\ \text{Sin}[t],\ \text{Log}[\text{Cos}[t]]\}$$

In[41]:=
```
T[t_] = (r'[t]) / (Norm[r'[t]])
```

Out[41]=
$$\left\{-\frac{\text{Sin}[t]}{\sqrt{\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2}},\ \frac{\text{Cos}[t]}{\sqrt{\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2}},\ -\frac{\text{Tan}[t]}{\sqrt{\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2}}\right\}$$

In[29]:=
```
T[π / 3]
```

Out[29]=
$$\left\{-\frac{\sqrt{3}}{4},\ \frac{1}{4},\ -\frac{\sqrt{3}}{2}\right\}$$

In[42]:=
```
n[t_] = (T'[t]) / (Norm[T'[t]])
```

Out[42]=
$$\left\{\left(-\frac{\text{Cos}[t]}{\sqrt{\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2}} + \left(\text{Sin}[t]\,\left(-2\,\text{Abs}[\text{Cos}[t]]\,\text{Sin}[t]\,\text{Abs}'[\text{Cos}[t]] + \right.\right.\right.$$

$$2\,\text{Abs}[\text{Sin}[t]]\,\text{Cos}[t]\,\text{Abs}'[\text{Sin}[t]] + 2\,\text{Abs}[\text{Tan}[t]]\,\text{Sec}[t]^2\,\text{Abs}'[\text{Tan}[t]]\Big)\Big) \Big/ \Big(2\left(\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2\right)^{3/2}\Big)\Bigg) \Big/ \Bigg(\sqrt{\Bigg(\text{Abs}\Big[-\frac{\text{Sin}[t]}{\sqrt{\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2}} - \Big(\text{Cos}[t]\,\Big(-2\,\text{Abs}[\text{Cos}[t]]\,\text{Sin}[t]\,\text{Abs}'[\text{Cos}[t]] + 2\,\text{Abs}[\text{Sin}[t]]\,\text{Cos}[t]\,\text{Abs}'[\text{Sin}[t]] + 2\,\text{Abs}[\text{Tan}[t]]\,\text{Sec}[t]^2\,\text{Abs}'[\text{Tan}[t]]\Big)\Big) \Big/ \Big(2\left(\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2\right)^{3/2}\Big)\Big]^2 + \text{Abs}\Big[-\frac{\text{Cos}[t]}{\sqrt{\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2}} + \Big(\text{Sin}[t]\,\Big(-2\,\text{Abs}[\text{Cos}[t]]\,\text{Sin}[t]\,\text{Abs}'[\text{Cos}[t]] + 2\,\text{Abs}[\text{Sin}[t]]\,\text{Cos}[t]\,\text{Abs}'[\text{Sin}[t]] + 2\,\text{Abs}[\text{Tan}[t]]\,\text{Sec}[t]^2\,\text{Abs}'[\text{Tan}[t]]\Big)\Big) \Big/ \Big(2\left(\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2\right)^{3/2}\Big)\Big]^2 + \text{Abs}\Big[-\frac{\text{Sec}[t]^2}{\sqrt{\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2}} + \Big(\text{Tan}[t]\,\Big(-2\,\text{Abs}[\text{Cos}[t]]\,\text{Sin}[t]\,\text{Abs}'[\text{Cos}[t]] + 2\,\text{Abs}[\text{Sin}[t]]\,\text{Cos}[t]\,\text{Abs}'[\text{Sin}[t]] + 2\,\text{Abs}[\text{Tan}[t]]\,\text{Sec}[t]^2\,\text{Abs}'[\text{Tan}[t]]\Big)\Big) \Big/ \Big(2\left(\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2\right)^{3/2}\Big)\Big]^2\Bigg)\Bigg),$$

$$\Bigg(-\frac{\text{Sin}[t]}{\sqrt{\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2}} - \Big(\text{Cos}[t]\,\Big(-2\,\text{Abs}[\text{Cos}[t]]\,\text{Sin}[t]\,\text{Abs}'[\text{Cos}[t]] + 2\,\text{Abs}[\text{Sin}[t]]\,\text{Cos}[t]\,\text{Abs}'[\text{Sin}[t]] + 2\,\text{Abs}[\text{Tan}[t]]\,\text{Sec}[t]^2\,\text{Abs}'[\text{Tan}[t]]\Big)\Big) \Big/ \Big(2\left(\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2\right)^{3/2}\Big)\Bigg) \Big/ \Bigg(\sqrt{\Bigg(\text{Abs}\Big[-\frac{\text{Sin}[t]}{\sqrt{\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2}} - \Big(\text{Cos}[t]\,\Big(-2\,\text{Abs}[\text{Cos}[t]]\,\text{Sin}[t]\,\text{Abs}'[\text{Cos}[t]] + 2\,\text{Abs}[\text{Sin}[t]]\,\text{Cos}[t]\,\text{Abs}'[\text{Sin}[t]] + 2\,\text{Abs}[\text{Tan}[t]]\,\text{Sec}[t]^2\,\text{Abs}'[\text{Tan}[t]]\Big)\Big) \Big/ \Big(2\left(\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2\right)^{3/2}\Big)\Big]^2 + \text{Abs}\Big[-\frac{\text{Cos}[t]}{\sqrt{\text{Abs}[\text{Cos}[t]]^2 + \text{Abs}[\text{Sin}[t]]^2 + \text{Abs}[\text{Tan}[t]]^2}} + \Big(\text{Sin}[t]\,\Big(-2\,\text{Abs}[\text{Cos}[t]]\,\text{Sin}[t]\,\text{Abs}'[\text{Cos}[t]] + 2\,\text{Abs}[\text{Sin}[t]]$$

```
                Cos[t] Abs'[Sin[t]] + 2 Abs[Tan[t]] Sec[t]^2 Abs'[Tan[t]])) /
            (2 (Abs[Cos[t]]^2 + Abs[Sin[t]]^2 + Abs[Tan[t]]^2)^(3/2))]^2 +

        Abs[-Sec[t]^2 / Sqrt[Abs[Cos[t]]^2 + Abs[Sin[t]]^2 + Abs[Tan[t]]^2] +
            (Tan[t] (-2 Abs[Cos[t]] Sin[t] Abs'[Cos[t]] + 2 Abs[Sin[t]]
                Cos[t] Abs'[Sin[t]] + 2 Abs[Tan[t]] Sec[t]^2 Abs'[Tan[t]])) /
            (2 (Abs[Cos[t]]^2 + Abs[Sin[t]]^2 + Abs[Tan[t]]^2)^(3/2))]^2)],

(-Sec[t]^2 / Sqrt[Abs[Cos[t]]^2 + Abs[Sin[t]]^2 + Abs[Tan[t]]^2] +
    (Tan[t] (-2 Abs[Cos[t]] Sin[t] Abs'[Cos[t]] +
        2 Abs[Sin[t]] Cos[t] Abs'[Sin[t]] + 2 Abs[Tan[t]] Sec[t]^2 Abs'[Tan[t]])) /
    (2 (Abs[Cos[t]]^2 + Abs[Sin[t]]^2 + Abs[Tan[t]]^2)^(3/2))) /
Sqrt[(Abs[-Sin[t] / Sqrt[Abs[Cos[t]]^2 + Abs[Sin[t]]^2 + Abs[Tan[t]]^2] -
        (Cos[t] (-2 Abs[Cos[t]] Sin[t] Abs'[Cos[t]] + 2 Abs[Sin[t]]
            Cos[t] Abs'[Sin[t]] + 2 Abs[Tan[t]] Sec[t]^2 Abs'[Tan[t]])) /
        (2 (Abs[Cos[t]]^2 + Abs[Sin[t]]^2 + Abs[Tan[t]]^2)^(3/2))]^2 +

    Abs[-Cos[t] / Sqrt[Abs[Cos[t]]^2 + Abs[Sin[t]]^2 + Abs[Tan[t]]^2] +
        (Sin[t] (-2 Abs[Cos[t]] Sin[t] Abs'[Cos[t]] + 2 Abs[Sin[t]]
            Cos[t] Abs'[Sin[t]] + 2 Abs[Tan[t]] Sec[t]^2 Abs'[Tan[t]])) /
        (2 (Abs[Cos[t]]^2 + Abs[Sin[t]]^2 + Abs[Tan[t]]^2)^(3/2))]^2 +

    Abs[-Sec[t]^2 / Sqrt[Abs[Cos[t]]^2 + Abs[Sin[t]]^2 + Abs[Tan[t]]^2] +
        (Tan[t] (-2 Abs[Cos[t]] Sin[t] Abs'[Cos[t]] + 2 Abs[Sin[t]]
            Cos[t] Abs'[Sin[t]] + 2 Abs[Tan[t]] Sec[t]^2 Abs'[Tan[t]])) /
        (2 (Abs[Cos[t]]^2 + Abs[Sin[t]]^2 + Abs[Tan[t]]^2)^(3/2))]^2)]}
```

In[32]:= **n[π / 3]**

Out[32]=
$$\left\{\left(-\frac{1}{4}+\frac{1}{32}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right)\Big/\left(\sqrt{\left(\text{Abs}\left[-\frac{\sqrt{3}}{4}+\frac{1}{32}\times\left(\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]\right)^2+\text{Abs}\left[-\frac{1}{4}+\frac{1}{32}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]^2+\text{Abs}\left[-2+\frac{1}{16}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]^2\right)\right),$$
$$\left(-\frac{\sqrt{3}}{4}+\frac{1}{32}\times\left(\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right)\Big/\left(\sqrt{\left(\text{Abs}\left[-\frac{\sqrt{3}}{4}+\frac{1}{32}\times\left(\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]\right)^2+\text{Abs}\left[-\frac{1}{4}+\frac{1}{32}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]^2+\text{Abs}\left[-2+\frac{1}{16}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]^2\right)\right),$$
$$\left(-2+\frac{1}{16}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right)\Big/\left(\sqrt{\left(\text{Abs}\left[-\frac{\sqrt{3}}{4}+\frac{1}{32}\times\left(\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]\right)^2+\text{Abs}\left[-\frac{1}{4}+\frac{1}{32}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]^2+\text{Abs}\left[-2+\frac{1}{16}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]^2\right)\right)\right\}$$

In[33]:= **Simplify[%]**

Out[33]=

$$\left\{\left(-16-3\,\text{Abs}'\left[\frac{1}{2}\right]+3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+48\,\text{Abs}'\left[\sqrt{3}\right]\right)\Big/\left(\sqrt{\left(\text{Abs}\left[16+3\,\text{Abs}'\left[\frac{1}{2}\right]-3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-48\,\text{Abs}'\left[\sqrt{3}\right]\right]^2+4\,\text{Abs}\left[64+3\,\text{Abs}'\left[\frac{1}{2}\right]-3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-48\,\text{Abs}'\left[\sqrt{3}\right]\right]^2+3\,\text{Abs}\left[16-\text{Abs}'\left[\frac{1}{2}\right]+\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+16\,\text{Abs}'\left[\sqrt{3}\right]\right]^2\right)}\right),\right.$$

$$\left(\sqrt{3}\left(\text{Abs}'\left[\frac{1}{2}\right]-\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-16\times\left(1+\text{Abs}'\left[\sqrt{3}\right]\right)\right)\right)\Big/\left(\sqrt{\left(\text{Abs}\left[16+3\,\text{Abs}'\left[\frac{1}{2}\right]-3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-48\,\text{Abs}'\left[\sqrt{3}\right]\right]^2+4\,\text{Abs}\left[64+3\,\text{Abs}'\left[\frac{1}{2}\right]-3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-48\,\text{Abs}'\left[\sqrt{3}\right]\right]^2+3\,\text{Abs}\left[16-\text{Abs}'\left[\frac{1}{2}\right]+\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+16\,\text{Abs}'\left[\sqrt{3}\right]\right]^2\right)}\right),$$

$$\left.\left(2\times\left(-64-3\,\text{Abs}'\left[\frac{1}{2}\right]+3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+48\,\text{Abs}'\left[\sqrt{3}\right]\right)\right)\Big/\left(\sqrt{\left(\text{Abs}\left[16+3\,\text{Abs}'\left[\frac{1}{2}\right]-3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-48\,\text{Abs}'\left[\sqrt{3}\right]\right]^2+4\,\text{Abs}\left[64+3\,\text{Abs}'\left[\frac{1}{2}\right]-3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-48\,\text{Abs}'\left[\sqrt{3}\right]\right]^2+3\,\text{Abs}\left[16-\text{Abs}'\left[\frac{1}{2}\right]+\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+16\,\text{Abs}'\left[\sqrt{3}\right]\right]^2\right)}\right)\right\}$$

In[34]:=
```
B = Cross[T[π / 3], n[π / 3]]
```

Out[34]=

$$\left\{-\left(7\Big/\left(8\sqrt{\left(\text{Abs}\left[-\frac{\sqrt{3}}{4}+\frac{1}{32}\times\left(\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]\right)^2+\right.\right.\right.$$
$$\text{Abs}\left[-\frac{1}{4}+\frac{1}{32}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]^2+$$
$$\left.\left.\left.\text{Abs}\left[-2+\frac{1}{16}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]^2\right)\right)\right),$$
$$-\left(\left(3\sqrt{3}\right)\Big/\left(8\sqrt{\left(\text{Abs}\left[-\frac{\sqrt{3}}{4}+\frac{1}{32}\times\left(\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]\right)^2+\right.\right.\right.$$
$$\text{Abs}\left[-\frac{1}{4}+\frac{1}{32}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]^2+$$
$$\left.\left.\left.\text{Abs}\left[-2+\frac{1}{16}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]^2\right)\right)\right),$$
$$1\Big/\left(4\sqrt{\left(\text{Abs}\left[-\frac{\sqrt{3}}{4}+\frac{1}{32}\times\left(\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]\right)^2+\right.$$
$$\text{Abs}\left[-\frac{1}{4}+\frac{1}{32}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]^2+$$
$$\left.\left.\text{Abs}\left[-2+\frac{1}{16}\sqrt{3}\left(-\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{1}{2}\right]+\frac{1}{2}\sqrt{3}\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+8\sqrt{3}\,\text{Abs}'\left[\sqrt{3}\right]\right)\right]^2\right)\right)\right\}$$

In[35]:= **Simplify[%]**

Out[35]=
$$\left\{-\left(56\Big/\left(\sqrt{\left(\text{Abs}\left[16+3\,\text{Abs}'\left[\frac{1}{2}\right]-3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-48\,\text{Abs}'\left[\sqrt{3}\right]\right]^2+4\,\text{Abs}\left[64+3\,\text{Abs}'\left[\frac{1}{2}\right]-3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-48\,\text{Abs}'\left[\sqrt{3}\right]\right]^2+3\,\text{Abs}\left[16-\text{Abs}'\left[\frac{1}{2}\right]+\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+16\,\text{Abs}'\left[\sqrt{3}\right]\right]^2\right)}\right)\right)\right.,$$
$$-\left(\left(24\sqrt{3}\right)\Big/\left(\sqrt{\left(\text{Abs}\left[16+3\,\text{Abs}'\left[\frac{1}{2}\right]-3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-48\,\text{Abs}'\left[\sqrt{3}\right]\right]^2+4\,\text{Abs}\left[64+3\,\text{Abs}'\left[\frac{1}{2}\right]-3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-48\,\text{Abs}'\left[\sqrt{3}\right]\right]^2+3\,\text{Abs}\left[16-\text{Abs}'\left[\frac{1}{2}\right]+\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+16\,\text{Abs}'\left[\sqrt{3}\right]\right]^2\right)}\right)\right),$$
$$16\Big/\left(\sqrt{\left(\text{Abs}\left[16+3\,\text{Abs}'\left[\frac{1}{2}\right]-3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-48\,\text{Abs}'\left[\sqrt{3}\right]\right]^2+4\,\text{Abs}\left[64+3\,\text{Abs}'\left[\frac{1}{2}\right]-3\,\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]-48\,\text{Abs}'\left[\sqrt{3}\right]\right]^2+3\,\text{Abs}\left[16-\text{Abs}'\left[\frac{1}{2}\right]+\text{Abs}'\left[\frac{\sqrt{3}}{2}\right]+16\,\text{Abs}'\left[\sqrt{3}\right]\right]^2\right)}\right)\right\}$$

In[45]:= **Clear[r, T, n]**