Lösungen

1

```
Remove["Global`*"]

xVec[x_, y_] := {x, y};
mVec = {5, 4}; r = 2;
kreis[rVec_, r_] := rVec.rVec - r^2;
```

a) Pol und Polare

```
pol = {1, 1};
kreis[(xVec[x, y] - mVec), r] == 0
```

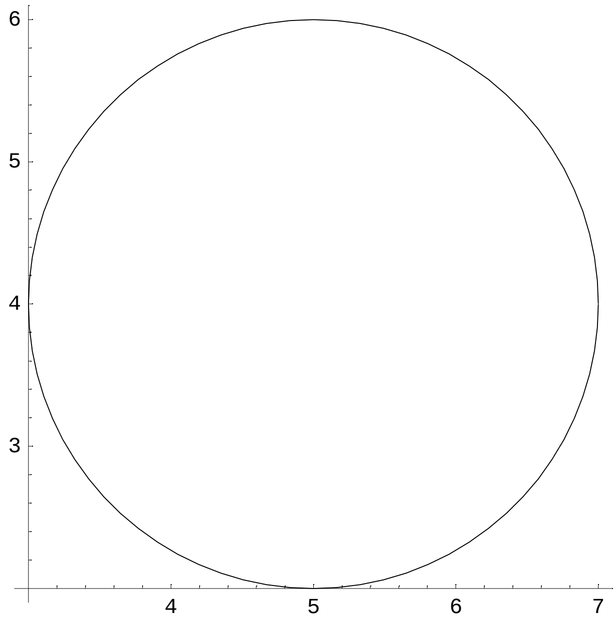
$-4 + (-5 + x)^2 + (-4 + y)^2 == 0$

```
Expand[kreis[(xVec[x, y] - mVec), r]] == 0
```

$37 - 10 x + x^2 - 8 y + y^2 == 0$

```
<< Graphics`ImplicitPlot`

kPl = ImplicitPlot[kreis[(xVec[x, y] - mVec), r] == 0, {x, 1, 8}];
```




```
polare[xVec_, mVec_, pol_, r_] := (xVec[x, y] - mVec).(pol - mVec) - r^2;
polare[xVec, mVec, pol, r] == 0
```

$-4 - 4 (-5 + x) - 3 (-4 + y) == 0$

```
Simplify[polare[xVec, mVec, pol, r]] == 0
```

28 - 4 x - 3 y == 0

```
solv = Solve[{polare[xVec, mVec, pol, r] == 0, kreis[(xVec[x, y] - mVec), r] == 0}, {x, y}]
```

$\left\{\left\{x \to \frac{1}{25}\left(109 - 6\sqrt{21}\right), y \to \frac{8}{25}\left(11 + \sqrt{21}\right)\right\}, \left\{x \to \frac{1}{25}\left(109 + 6\sqrt{21}\right), y \to \frac{8}{25}\left(11 - \sqrt{21}\right)\right\}\right\}$

```
solv1 = solv // N
```

{{x → 3.26018, y → 4.98642}, {x → 5.45982, y → 2.05358}}

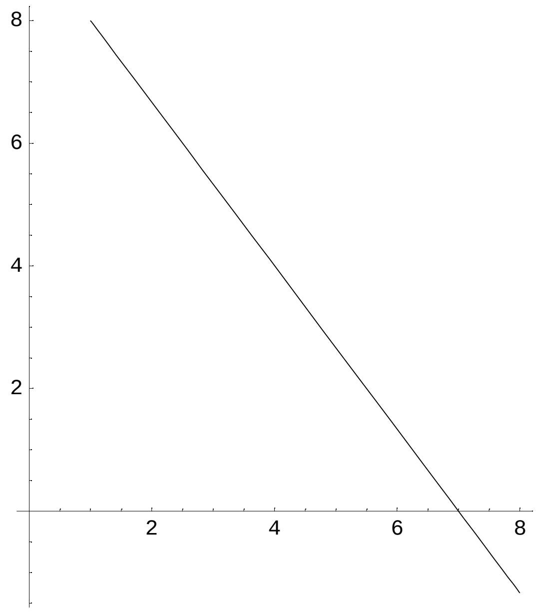
```
pT1 = {x, y} /. solv1[[1]]
```

{3.26018, 4.98642}

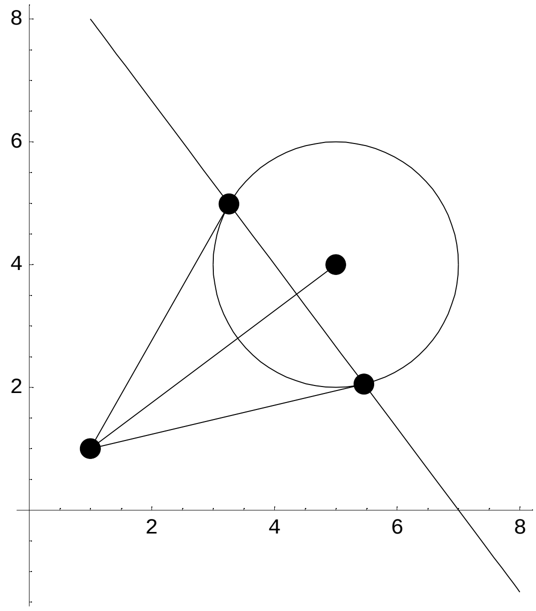
```
pT2 = {x, y} /. solv1[[2]]
```

{5.45982, 2.05358}

```
polarePl = ImplicitPlot[polare[xVec, mVec, pol, r] == 0, {x, 1, 8}];
```



```
Show[kPl, polarePl, Graphics[{PointSize[0.04], Point[pol], Point[mVec], Point[pT2],
    Point[pT1], Line[{pol, mVec}], Line[{pol, pT1}], Line[{pol, pT2}]}]];
```



```
pT1 + t (pT2 - pT1)
```

```
{3.26018 + 2.19964 t, 4.98642 - 2.93285 t}
```

b) Tangente

```
tangente[xVec_, mVec_, pT_, r_] := (xVec[x, y] - mVec).(pT - mVec) - r^2;
```

```
Chop[Expand[polare[xVec, mVec, pT1, r]]] == 0
```

```
0.753394 - 1.73982 x + 0.986424 y == 0
```

```
Chop[Expand[polare[xVec, mVec, pT1, r]] /. {x → 1, y → 1}] == 0
```

```
True
```

```
Chop[Expand[polare[xVec, mVec, pT2, r]]] == 0
```

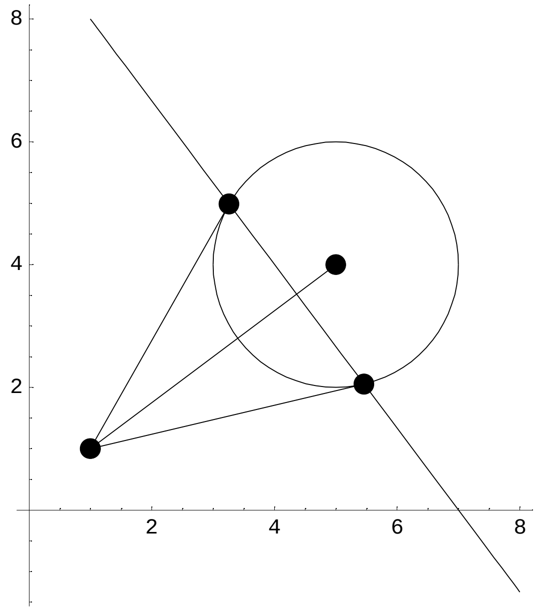
```
1.48661 + 0.459818 x - 1.94642 y == 0
```

```
Chop[Expand[polare[xVec, mVec, pT2, r]] /. {x → 1, y → 1}] == 0
```

```
True
```

Die Tangentialpunkte sind identisch mit den Schnittpunkten des Kreises mit der Polaren.

```
Show[kPl, polarePl, Graphics[{PointSize[0.04], Point[pol], Point[mVec], Point[pT2],
    Point[pT1], Line[{pol, mVec}], Line[{pol, pT1}], Line[{pol, pT2}]}]];
```




```
pol + t (pT1 - pol)
```

{1 + 2.26018 t, 1 + 3.98642 t}

```
pol + t (pT2 - pol)
```

{1 + 4.45982 t, 1 + 1.05358 t}

c) Mittelpunktsgerade zum Pol

```
senkr[v_] := {-v[[2]], v[[1]]};
geradePolM[xVec_, mVec_, pol_] := (xVec - mVec).senkr[pol - mVec];
```

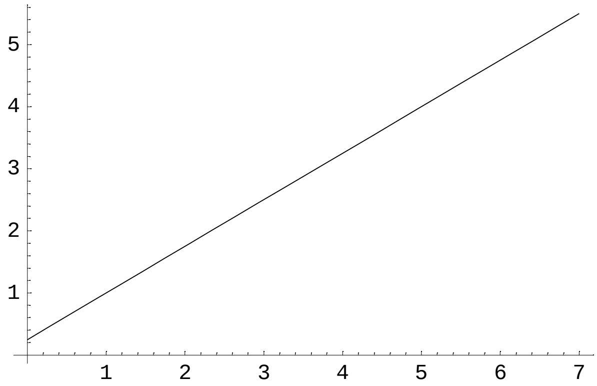
```
Expand[geradePolM[xVec[x, y], mVec, pol]] == 0
```

1 + 3 x - 4 y == 0

```
solvz = Solve[Expand[geradePolM[xVec[x, y], mVec, pol]] == 0, {y}] // Flatten
```

$\left\{y \to \frac{1}{4}\,(1 + 3\,x)\right\}$

```
yGer[x_] := y /. solvz;
gerPl = Plot[yGer[x], {x, 0, 7}];
```




```
Solve[{geradePolM[xVec[x, y], mVec, pol] == 0, kreis[(xVec[x, y] - mVec), r] == 0}, {x, y}]
```

$\{\{x \to \frac{17}{5}, y \to \frac{14}{5}\}, \{x \to \frac{33}{5}, y \to \frac{26}{5}\}\}$

```
solv2 = Solve[{geradePolM[xVec[x, y], mVec, pol] == 0,
    kreis[(xVec[x, y] - mVec), r] == 0}, {x, y}] // N
```

{{x → 3.4, y → 2.8}, {x → 6.6, y → 5.2}}

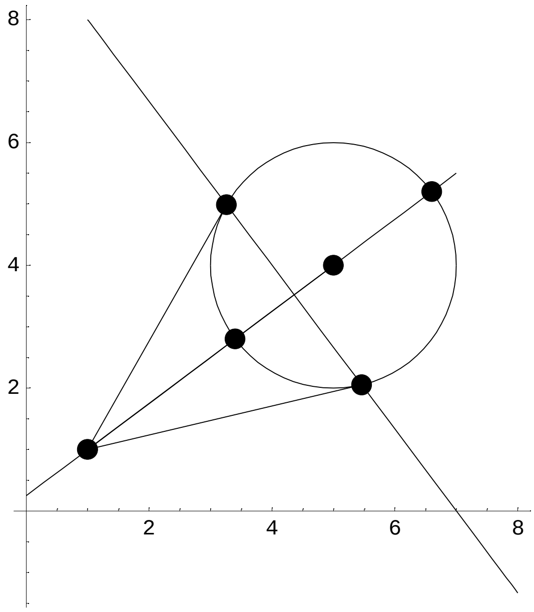
```
p1 = {x, y} /. solv2[[1]]
```

{3.4, 2.8}

```
p2 = {x, y} /. solv2[[2]]
```

{6.6, 5.2}

```
Show[kPl, polarePl, gerPl,
  Graphics[{PointSize[0.04], Point[pol], Point[mVec], Point[pT2], Point[pT1],
    Point[p1], Point[p2], Line[{pol, mVec}], Line[{pol, pT1}], Line[{pol, pT2}]}]];
```



```
pol + t (mVec - pol)
```

{1 + 4 t, 1 + 3 t}

d) Apollonius

```
Norm[p2 - pol] / Norm[p1 - pol]
```

2.33333

```
Rationalize[Norm[p2 - pol] / Norm[p1 - pol]]
```

$\frac{7}{3}$

```
Norm[p1 - pol] / Norm[p1 - {x, yGer[x]}] == Norm[p2 - pol] / Norm[p2 - {x, yGer[x]}]
```

$$\frac{3.}{\sqrt{\text{Abs}[2.8 + \frac{1}{4}(-1 - 3x)]^2 + \text{Abs}[3.4 - x]^2}} == \frac{7.}{\sqrt{\text{Abs}[5.2 + \frac{1}{4}(-1 - 3x)]^2 + \text{Abs}[6.6 - x]^2}}$$

```
solv3 = Solve[(Norm[p1 - pol] / Norm[p1 - {x, yGer[x]}]) ^2 ==
   (Norm[p2 - pol] / Norm[p2 - {x, yGer[x]}]) ^2, {x}]
```

{{x → 1.}, {x → 4.36}}

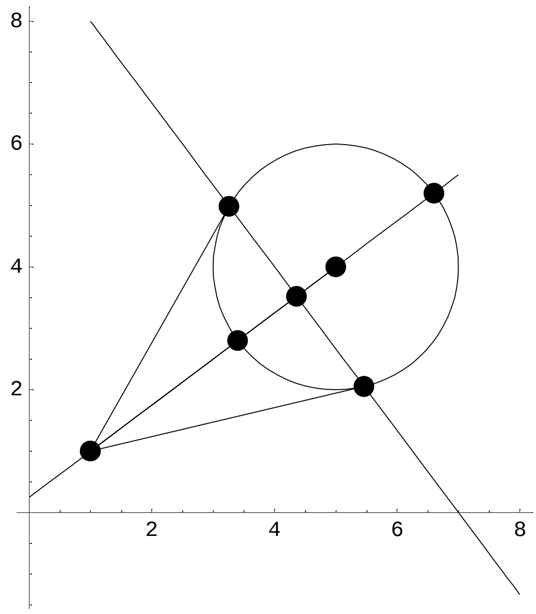
```
pol1 = {x, yGer[x]} /. solv3[[1]]
```

{1., 1.}

```
pol2 = {x, yGer[x]} /. solv3[[2]]
```

{4.36, 3.52}

```
Show[kPl, polarePl, gerPl, Graphics[
   {PointSize[0.04], Point[pol], Point[mVec], Point[pT2], Point[pT1], Point[p1],
    Point[p2], Point[pol2], Line[{pol, mVec}], Line[{pol, pT1}], Line[{pol, pT2}]}]];
```



e) Potenzgerade

```
kreis1 = (kreis[(xVec[x, y] - mVec), r] == 0)
```

$-4+(-5+x)^2+(-4+y)^2==0$

```
kreis2 = (kreis[(xVec[x, y] - pol), 2 r] == 0)
```

$-16+(-1+x)^2+(-1+y)^2==0$

```
potenz1[x_, y_] := kreis[(xVec[x, y] - mVec), r];
potenz2[x_, y_] := kreis[(xVec[x, y] - pol), 2 r];
```

```
Expand[potenz1[x, y]] == potenz2[x, y]
```

$37-10x+x^2-8y+y^2==-16+(-1+x)^2+(-1+y)^2$

```
? Reduce
```

Reduce[expr, vars] reduces the statement expr by solving equations or inequalities for vars and eliminating quantifiers. Reduce[expr, vars, dom] does the reduction over the domain dom. Common choices of dom are Reals, Integers and Complexes. Mehr...

```
Reduce[Expand[potenz1[x, y]] == potenz2[x, y], {x, y}]
```

$y==\frac{17}{2}-\frac{4x}{3}$

```
solv4 = Solve[Reduce[Expand[potenz1[x, y]] == potenz2[x, y], {x, y}], {y}] // Flatten
```

$\left\{y\to\frac{1}{6}(51-8x)\right\}$

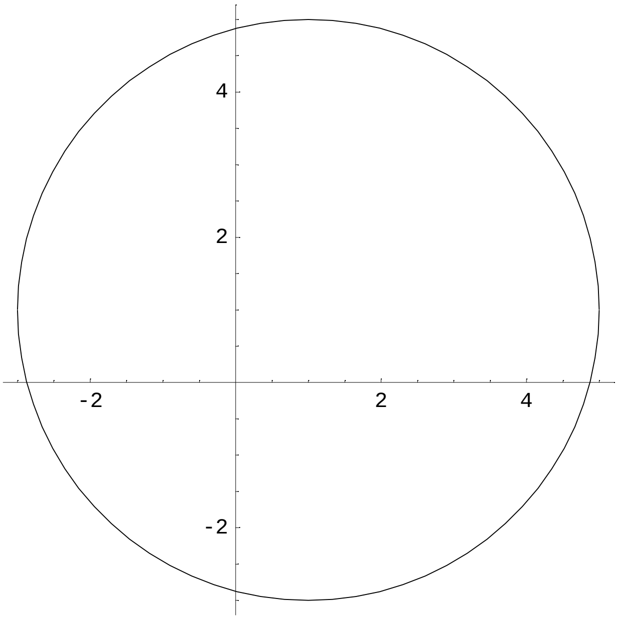
```
potenzGer[x_] := y /. solv4
```

```
potenzGer[x]
```

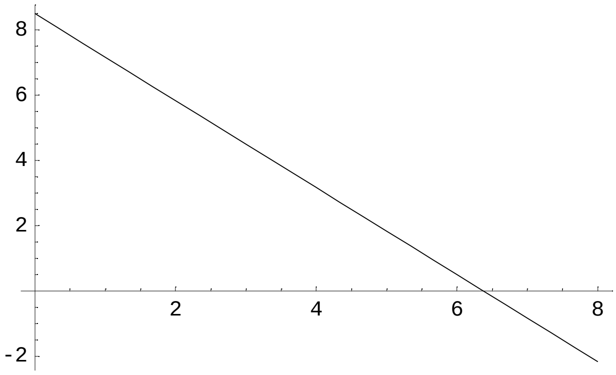
$\frac{1}{6}(51-8x)$

f) Schnittpunkte Potenzgerade mit Kreisen

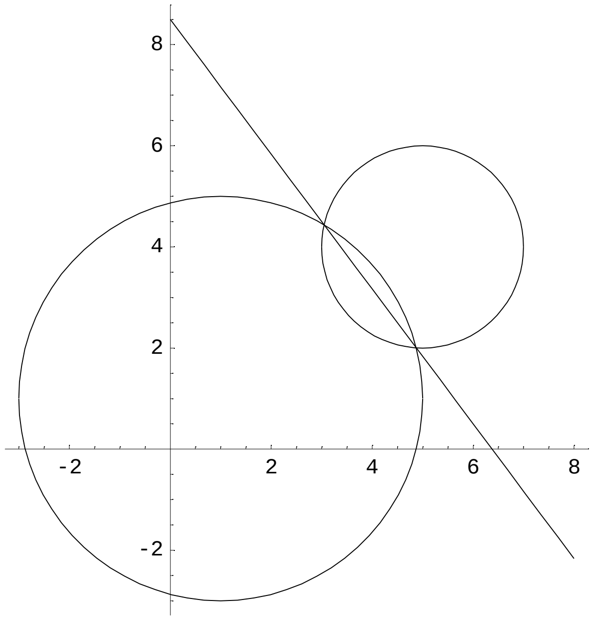
```
kPl2 = ImplicitPlot[kreis2, {x, -6, 8}];
```




```
plPotGer = Plot[potenzGer[x], {x, 0, 8}];
```



```
Show[kPl2, plPotGer, kPl];
```



Die Potenzgerade geht durch die Schnittpunkte der beiden Kreise.

```
solv11 = Solve[{y == potenzGer[x], kreis1}, {x, y}]
```

$$\left\{\left\{x \to \frac{3}{50}\left(66 - \sqrt{231}\right),\ y \to \frac{1}{50}\left(161 + 4\sqrt{231}\right)\right\},\ \left\{x \to \frac{3}{50}\left(66 + \sqrt{231}\right),\ y \to \frac{1}{50}\left(161 - 4\sqrt{231}\right)\right\}\right\}$$

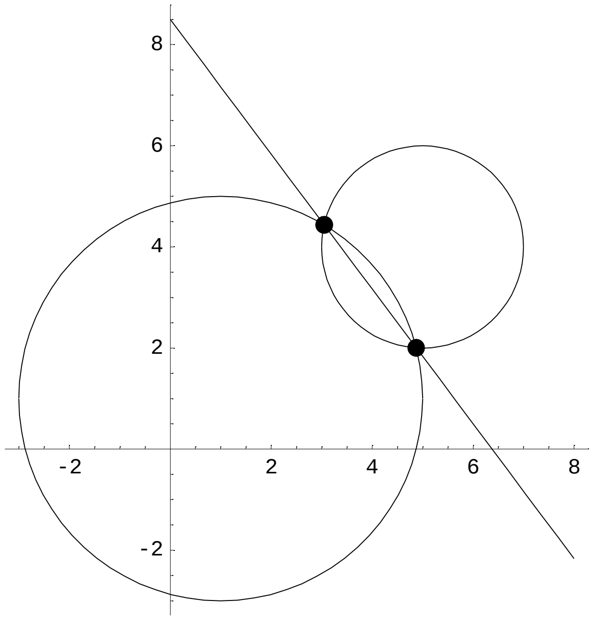
```
N[%]
```

$\{\{x \to 3.04808,\ y \to 4.43589\},\ \{x \to 4.87192,\ y \to 2.00411\}\}$

```
sS1 = {x, y} /. solv11[[1]];
sS2 = {x, y} /. solv11[[2]];
{sS1, sS2} // N
```

{{3.04808, 4.43589}, {4.87192, 2.00411}}

```
Show[kPl2, plPotGer, kPl, Graphics[{PointSize[0.03], Point[sS1], Point[sS2]}]];
```



2

```
Remove["Global`*"]
```

```
B = {{1, 1}, {3, 2}}; B // MatrixForm
```

$$\begin{pmatrix} 1 & 1 \\ 3 & 2 \end{pmatrix}$$

```
mD = {{1, 0}, {0, 2}}; mD // MatrixForm
```

$$\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$$

```
mD10 = {{1^10, 0}, {0, 2^10}}; mD10 // MatrixForm
```

$$\begin{pmatrix} 1 & 0 \\ 0 & 1024 \end{pmatrix}$$

```
mD^10 // MatrixForm
```

$$\begin{pmatrix} 1 & 0 \\ 0 & 1024 \end{pmatrix}$$

```
a = {1, 2}; b = {1, 3};
```

a

```
B1 = Inverse[B];
B1 // MatrixForm
```

$$\begin{pmatrix} -2 & 1 \\ 3 & -1 \end{pmatrix}$$

b

```
A = B.mD.Inverse[B];
A // MatrixForm
```

$$\begin{pmatrix} 4 & -1 \\ 6 & -1 \end{pmatrix}$$

c

```
A2 = A.A; A2 // MatrixForm
```

$$\begin{pmatrix} 10 & -3 \\ 18 & -5 \end{pmatrix}$$

```
A10 = B.(mD^10).Inverse[B];
A10 // MatrixForm
```

$$\begin{pmatrix} 3070 & -1023 \\ 6138 & -2045 \end{pmatrix}$$

d

```
Det[A]
```

2

```
Det[mD]
```

2

e

```
A.a
```

{2, 4}

```
A.b
```

{1, 3}

f

```
A. (λ a + μ b) // Simplify
```

$\{2\lambda + \mu, 4\lambda + 3\mu\}$

g

```
flaechenProdukt[a_, b_] := Det[{a, b}];
flaechenProdukt[a, b]
```

```
1
```

h

```
flaechenProdukt[λ a, μ b]
```

$\lambda\ \mu$

i

```
flaechenProdukt[λ a, μ b] / flaechenProdukt[a, b]
```

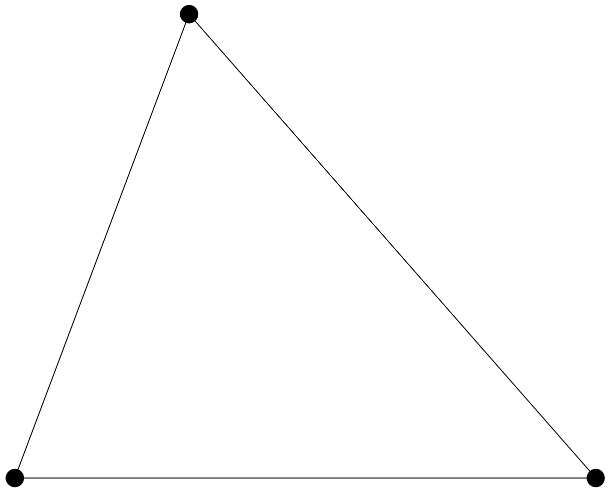
$\lambda\ \mu$

3

```
Remove["Global`*"]
```

```
OA = {0, 0};
OB = {10, 0};
OC = {3, 8};
```

```
Show[Graphics[{PointSize[0.03], Point[OA], Point[OB],
    Point[OC], Line[{OA, OB, OC, OA}]}], AspectRatio → Automatic];
```



a) Höhenschnittpunkt

```
AB = OB - OA;
BC = OC - OB;
CA = OA - OC;

BA = -AB; CB = -BC; AC = -CA;

normalV[x_] := {-x[[2]], x[[1]]};

nAB = normalV[AB];
nBC = normalV[BC];
nCA = normalV[CA];

hC[t_] := OC + t nAB;
hB[s_] := OB + s nCA;
solv3 = Solve[hC[t] == hB[s], {t, s}] // Flatten
```

$\left\{t \to -\frac{43}{80},\ s \to -\frac{7}{8}\right\}$

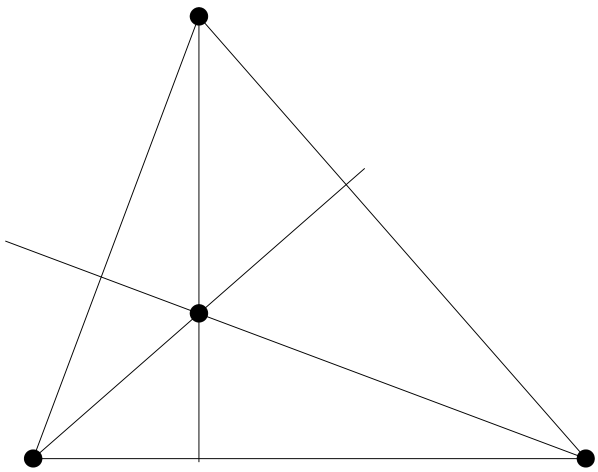
```
schnittH = hC[t] /. solv3
```

$\left\{3,\ \frac{21}{8}\right\}$

```
N[%]
```

{3., 2.625}

```
Show[Graphics[{PointSize[0.03], Point[OA],
    Point[OB], Point[OC], Point[schnittH], Line[{OA, OB, OC, OA}],
    Line[{OA, schnittH + (schnittH - OA)}], Line[{OB, schnittH + 0.5 (schnittH - OB)}],
    Line[{OC, schnittH + 0.5 (schnittH - OC)}]}], AspectRatio → Automatic];
```



b) Schwerlinienschnittpunkt

```
sC[t_] := OA + 1 / 2 AB + t (OC - (OA + 1 / 2 AB));
sB[s_] := OC + 1 / 2 CA + s (OB - (OC + 1 / 2 CA));
solve31 = Solve[sC[t] == sB[s], {t, s}] // Flatten
```

$\{t \to \frac{1}{3}, s \to \frac{1}{3}\}$

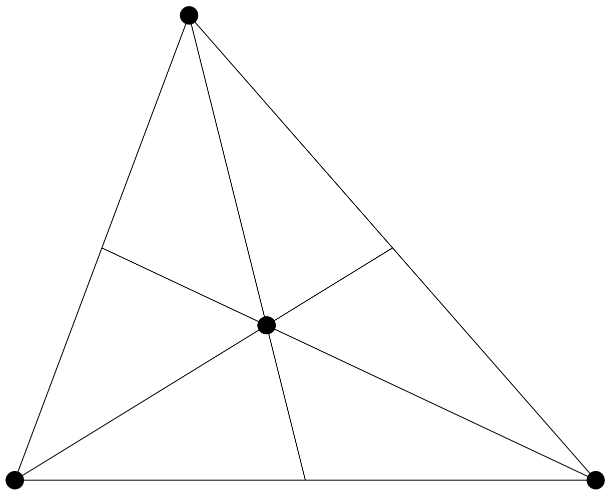
```
schnittS = sC[t] /. solve31
```

$\{\frac{13}{3}, \frac{8}{3}\}$

```
N[%]
```

{4.33333, 2.66667}

```
Show[Graphics[{PointSize[0.03], Point[OA], Point[OB], Point[OC],
    Point[schnittS], Line[{OA, OB, OC, OA}], Line[{OA + 1 / 2 AB, OC}],
    Line[{OB + 1 / 2 BC, OA}], Line[{OC + 1 / 2 CA, OB}]}], AspectRatio → Automatic];
```



c1) Umkreismittelpunkt

```
uC[t_] := OA + 1 / 2 AB + t nAB;
uB[s_] := OC + 1 / 2 CA + s nCA;
solve32 = Solve[uC[t] == uB[s], {t, s}] // Flatten
```

$\{t \to \frac{43}{160}, s \to \frac{7}{16}\}$

```
N[%]
```

{t → 0.26875, s → 0.4375}

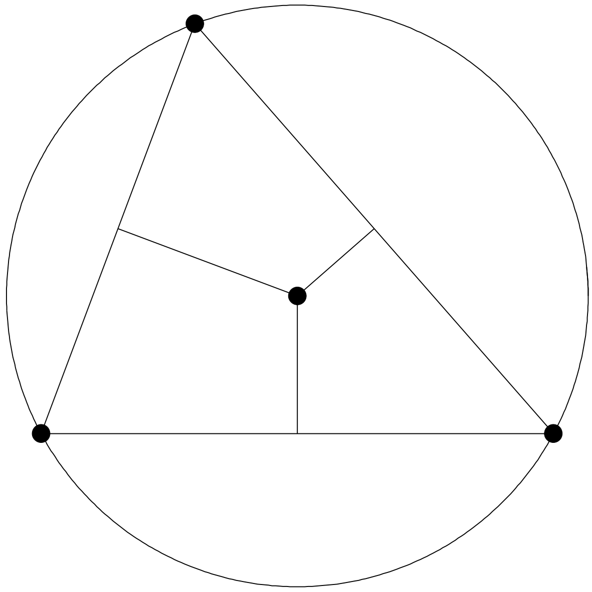
```
schnittU = (uC[t] /. solve32) // Simplify
```

$\{5, \frac{43}{16}\}$

```
N[%]
```

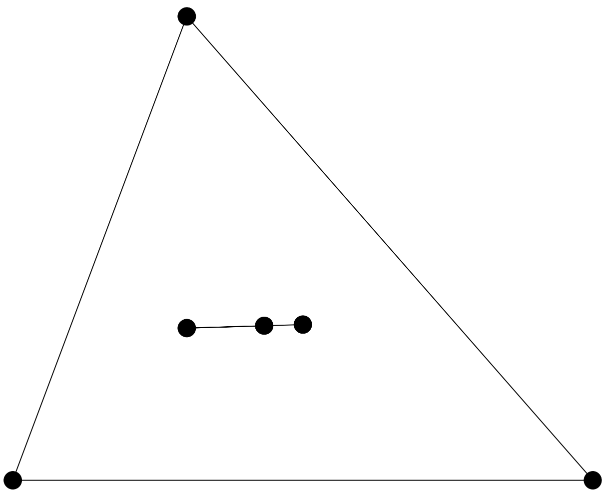
{5., 2.6875}

```
Show[Graphics[{PointSize[0.03], Point[OA], Point[OB], Point[OC],
    Point[schnittU], Line[{OA, OB, OC, OA}], Line[{OA + 1 / 2 AB, schnittU}],
    Line[{OB + 1 / 2 BC, schnittU}], Line[{OC + 1 / 2 CA, schnittU}], Circle[schnittU,
     Sqrt[(schnittU - OA).(schnittU - OA)]]}], AspectRatio → Automatic];
```



d) Lineare Abhängigkeit

```
Show[Graphics[{PointSize[0.03], Point[OA], Point[OB], Point[OC],
    Point[schnittU], Point[schnittH], Point[schnittS], Line[{OA, OB, OC, OA}],
    Line[{schnittU, schnittH, schnittS}]}], AspectRatio → Automatic];
```



```
Solve[schnittS - schnittH == λ (schnittU - schnittS), {λ}]
```

{{λ → 2}}

```
Solve[schnittS - schnittH == λ (schnittU - schnittH), {λ}]
```

$\{\{\lambda \to \frac{2}{3}\}\}$

Linear abhängig

e) Verhältnis

```
Solve[schnittH - schnittU == λ ( schnittS - schnittU), {λ}]
```

$\{\{\lambda \to 3\}\}$

c1) Inkreismittelpunkt

```
mC[t_] := OC + t (CA / Norm[CA] + CB / Norm[CB]);
mB[s_] := OB + s (BA / Norm[BA] + BC / Norm[BC]);
solve33 = Solve[mC[t] == mB[s], {t, s}] // Flatten
```

$\left\{t \to \frac{8249}{113\sqrt{73} + 73\sqrt{113} + 10\sqrt{8249}}, s \to \frac{1130\sqrt{73}}{113\sqrt{73} + 73\sqrt{113} + 10\sqrt{8249}}\right\}$

```
N[%]
```

{t → 3.11317, s → 3.64369}

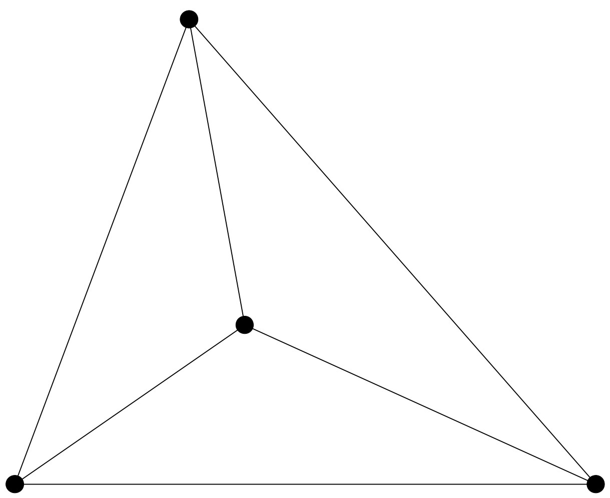
```
schnittI = (mC[t] /. solve33) // Simplify
```

$\left\{\frac{10\sqrt{113}\left(73 + 3\sqrt{73}\right)}{113\sqrt{73} + 73\sqrt{113} + 10\sqrt{8249}}, \frac{80\sqrt{8249}}{113\sqrt{73} + 73\sqrt{113} + 10\sqrt{8249}}\right\}$

```
N[%]
```

{3.95693, 2.74215}

```
Show[Graphics[{PointSize[0.03], Point[OA], Point[OB], Point[OC],
    Point[schnittI], Line[{OA, OB, OC, OA}], Line[{OA, schnittI}],
    Line[{OB, schnittI}], Line[{OC, schnittI}]}], AspectRatio → Automatic];
```



f) Der Ausdruck h

```
a = OA - schnittU;
b = OB - schnittU;
c = OC - schnittU;
h = a + b + c
```

$\left\{-2, -\frac{1}{16}\right\}$

```
N[%]
```

{-2., -0.0625}

```
s3 = h / 3
```

$\left\{-\frac{2}{3}, -\frac{1}{48}\right\}$

```
N[%]
```

{-0.666667, -0.0208333}

```
(schnittH + schnittS) / 2
```

$\left\{\frac{11}{3}, \frac{127}{48}\right\}$

```
(schnittH + schnittS) / 2 == schnittS + s3
```

True

g) Der Umkreis vom Dreieck SaSbSc

```
Sc = OA + 1 / 2 AB;
Sb = OA + 1 / 2 AC;
Sa = OC + 1 / 2 CB;
```

```
uSc[t_] := Sb + 1 / 2 (Sa - Sb) + t normalV[Sa - Sb];
uSa[s_] := Sc + 1 / 2 (Sb - Sc) + s normalV[Sb - Sc];
solve35 = Solve[uSc[t] == uSa[s], {t, s}] // Flatten
```

$\left\{t \to -\frac{43}{160}, s \to -\frac{3}{16}\right\}$

```
N[%]
```

{t → -0.26875, s → -0.1875}

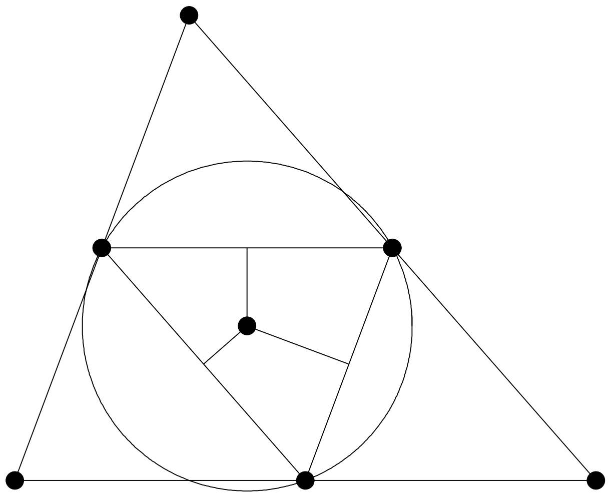
```
schnittSU = (uSc[t] /. solve35) // Simplify
```

$\left\{4, \frac{85}{32}\right\}$

```
N[%]
```

{4., 2.65625}

```
sh1 = Show[Graphics[{PointSize[0.03], Point[OA], Point[OB],
    Point[OC], Point[Sa], Point[Sb], Point[Sc], Line[{Sa, Sb, Sc, Sa}],
    Point[schnittSU], Line[{OA, OB, OC, OA}],
    Line[{Sa + 1 / 2 (Sb - Sa), schnittSU}], Line[{Sb + 1 / 2 (Sc - Sb), schnittSU}],
    Line[{Sc + 1 / 2 (Sa - Sc), schnittSU}], Circle[schnittSU,
     Sqrt[(schnittSU - Sa).(schnittSU - Sa)]]}], AspectRatio → Automatic];
```



```
rSU = Sqrt[(schnittSU - Sa).(schnittSU - Sa)]
```

$\frac{\sqrt{8249}}{32}$

```
N[%]
```

2.83825

h) Der Umkreis vom Dreieck HaHbHc

```
hC[t_] := OC + t nAB; seiteC[s_] := OA + s AB;
solv36 = Solve[hC[t] == seiteC[s], {t, s}] // Flatten;
Hc = seiteC[s] /. solv36
```

{3, 0}

```
hB[t_] := OB + t nCA; seiteB[s_] := OA + s AC;
solv37 = Solve[hB[t] == seiteB[s], {t, s}] // Flatten;
Hb = seiteB[s] /. solv37
```

$\left\{\frac{90}{73}, \frac{240}{73}\right\}$

```
N[%]
```

{1.23288, 3.28767}

```
hA[t_] := OA + t nBC; seiteA[s_] := OB + s BC;
solv38 = Solve[hA[t] == seiteA[s], {t, s}] // Flatten;
Ha = seiteA[s] /. solv38
```

$\left\{\frac{640}{113}, \frac{560}{113}\right\}$

```
uHc[t_] := Hb + 1 / 2 (Ha - Hb) + t normalV[Ha - Hb];
uHa[s_] := Hc + 1 / 2 (Hb - Hc) + s normalV[Hb - Hc];
solve39 = Solve[uHc[t] == uHa[s], {t, s}] // Flatten
```

$$\left\{t \to -\frac{4551}{13760},\ s \to -\frac{55}{96}\right\}$$

```
N[%]
```

{t → -0.330741, s → -0.572917}

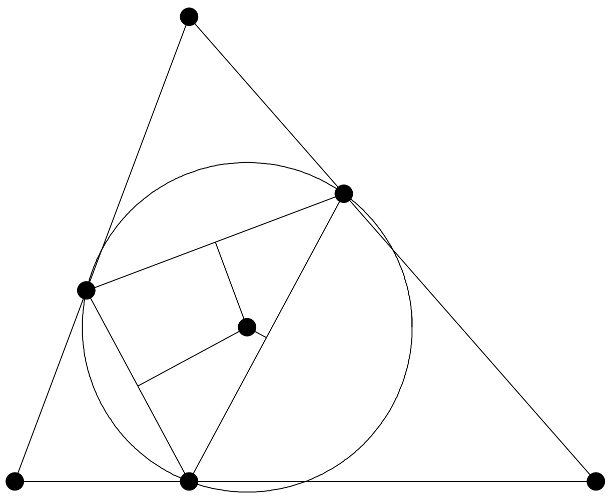
```
schnittHU = (uHc[t] /. solve39) // Simplify
```

$$\left\{4,\ \frac{85}{32}\right\}$$

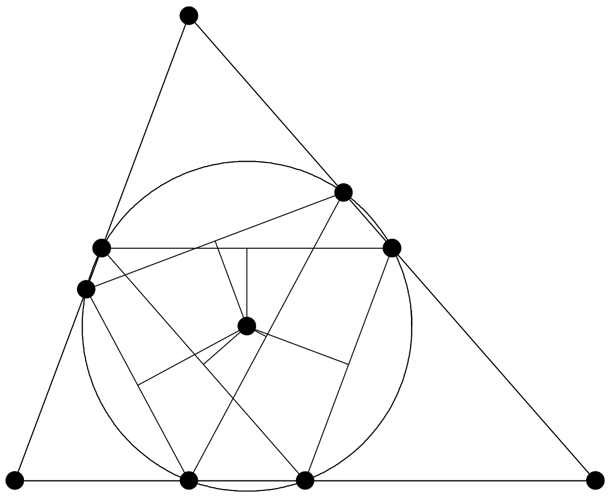
```
N[%]
```

{4., 2.65625}

```
sh2 = Show[Graphics[{PointSize[0.03], Point[OA], Point[OB],
     Point[OC], Point[Ha], Point[Hb], Point[Hc], Line[{Ha, Hb, Hc, Ha}],
     Point[schnittHU], Line[{OA, OB, OC, OA}],
     Line[{Ha + 1 / 2 (Hb - Ha), schnittHU}], Line[{Hb + 1 / 2 (Hc - Hb), schnittHU}],
     Line[{Hc + 1 / 2 (Ha - Hc), schnittHU}], Circle[schnittHU,
      Sqrt[(schnittHU - Ha).(schnittHU - Ha)]]}], AspectRatio → Automatic];
```



```
Show[sh1, sh2];
```



```
rHU = Sqrt[(schnittHU - Ha).(schnittHU - Ha)]
```

$\frac{\sqrt{8249}}{32}$

```
N[%]
```

2.83825

```
rHU == rSU
```

True

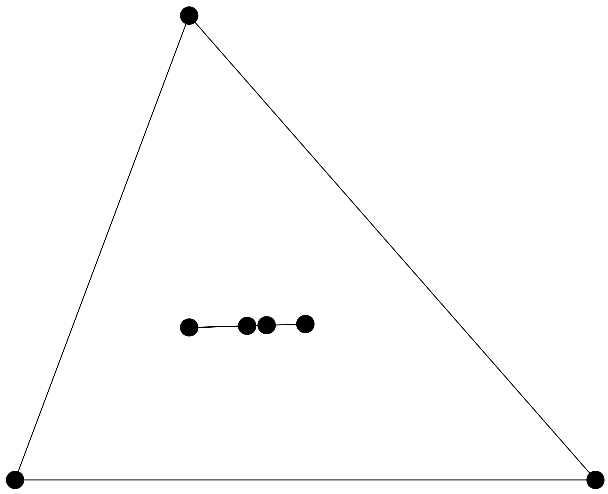
```
schnittHU == schnittSU
```

True

Gefunden ist derselbe Kreis. Dieser Kreis heisst **Feuerbachkreis**.

i) Lineare Abhängigkeit

```
Show[Graphics[{PointSize[0.03], Point[OA], Point[OB], Point[OC], Point[schnittU],
    Point[schnittH], Point[schnittS], Point[schnittHU], Line[{OA, OB, OC, OA}],
    Line[{schnittU, schnittH, schnittS}]}], AspectRatio → Automatic];
```



```
Solve[schnittU - schnittH == λ (schnittU - schnittHU), {λ}]
```

```
{{λ → 2}}
```

Linear abhängig

j) Das Verhältnis

```
verhaeltnis = Norm[schnittH - schnittU] / Norm[schnittHU - schnittU]
```

```
2
```

4

```
Remove["Global`*"]
```

```
OA = {0, 0, 1};
OB = {10, 0, 1};
OC = {3, 8, 3};
OD = {1, 2, 8};
```

a

```
volumen = 1 / 6 Abs[ Det[{OA - OD, OB - OD, OC - OD}]]
```

$\frac{260}{3}$

```
N[%]
```

86.6667

```
grundflG = Norm[Cross[OA - OC, OB - OC]] / 2
```

$10\sqrt{17}$

```
N[%]
```

41.2311

```
hD = 3 volumen / grundflG
```

$\frac{26}{\sqrt{17}}$

```
N[%]
```

6.30593

b

```
h[t_] := OD + t Cross[OA - OC, OB - OC];
h[t]
```

$\{1, 2 - 20\,t, 8 + 80\,t\}$

```
fG[λ_, μ_] := OC + λ (OA - OC) + μ (OB - OC);
fG[λ, μ]
```

$\{3 - 3\lambda + 7\mu, 8 - 8\lambda - 8\mu, 3 - 2\lambda - 2\mu\}$

```
solv4 = Solve[h[t] == fG[λ, μ], {t, λ, μ}] // Flatten
```

$\left\{t \to -\frac{13}{170}, \lambda \to \frac{201}{340}, \mu \to -\frac{11}{340}\right\}$

```
HD = h[t] /. solv4
```

$\left\{1, \frac{60}{17}, \frac{32}{17}\right\}$

```
N[%]
```

{1., 3.52941, 1.88235}

c

```
ODneu = OC + (OD - HD)
```

$\left\{3, \frac{110}{17}, \frac{155}{17}\right\}$

```
N[%]
```

{3., 6.47059, 9.11765}