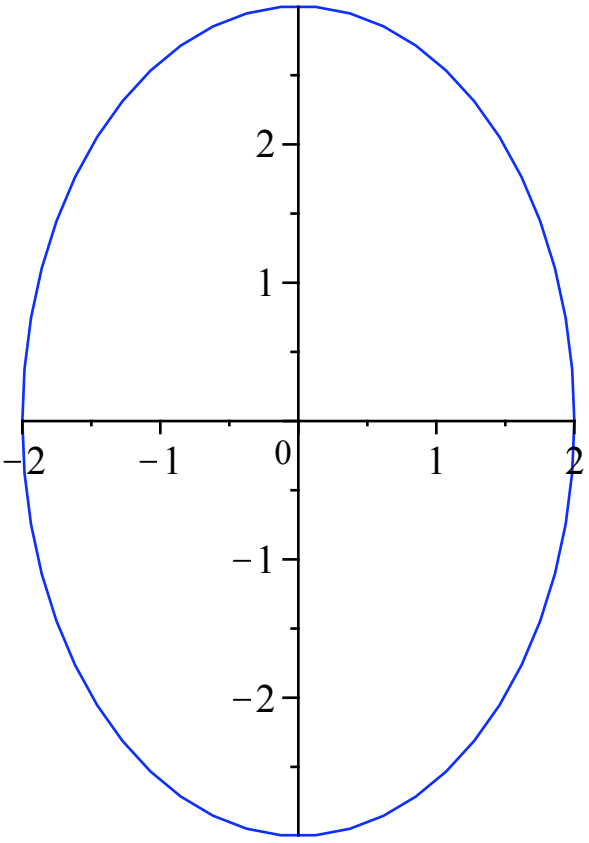
```
> restart;
> with(plottools);
```

[*arc*, *arrow*, *circle*, *cone*, *cuboid*, *curve*, *cutin*, *cutout*, *cylinder*, *disk*, *dodecahedron*, *ellipse*, *ellipticArc*, *hemisphere*, *hexahedron*, *homothety*, *hyperbola*, *icosahedron*, *line*, *octahedron*, *parallelepiped*, *pieslice*, *point*, *polygon*, *project*, *rectangle*, *reflect*, *rotate*, *scale*, *semitorus*, *sphere*, *stellate*, *tetrahedron*, *torus*, *transform*, *translate*, *vrml*] **(1)**

```
> with(plots);
```

[*animate*, *animate3d*, *animatecurve*, *arrow*, *changecoords*, *complexplot*, *complexplot3d*, *conformal*, *conformal3d*, *contourplot*, *contourplot3d*, *coordplot*, *coordplot3d*, *densityplot*, *display*, *dualaxisplot*, *fieldplot*, *fieldplot3d*, *gradplot*, *gradplot3d*, *graphplot3d*, *implicitplot*, *implicitplot3d*, *inequal*, *interactive*, *interactiveparams*, *intersectplot*, *listcontplot*, *listcontplot3d*, *listdensityplot*, *listplot*, *listplot3d*, *loglogplot*, *logplot*, *matrixplot*, *multiple*, *odeplot*, *pareto*, *plotcompare*, *pointplot*, *pointplot3d*, *polarplot*, *polygonplot*, *polygonplot3d*, *polyhedra_supported*, *polyhedraplot*, *rootlocus*, *semilogplot*, *setcolors*, *setoptions*, *setoptions3d*, *spacecurve*, *sparsematrixplot*, *surfdata*, *textplot*, *textplot3d*, *tubeplot*] **(2)**

```
> elli:= ellipse([0,0], 2, 3,color=blue):
  display(elli, scaling=constrained);
```




```
> ParEllipse:=proc(c,d,t)
  [c[1]+d[1]*(t+1/t)/2,c[2]+d[2]*(t-1/t)/(2*I)]
  end;
```

ParEllipse := **proc**(*c*, *d*, *t*)
[*c*[1] + 1/2 * *d*[1] * (*t* + 1/*t*), *c*[2] − 1/2 * I * *d*[2] * (*t* − 1/*t*)] **(3)**
end proc

ParEllipse := **proc**(*c*, *d*, *t*) [*c*[1] + *d*[1] * cos(*t*), *c*[2] + *d*[2] * sin(*t*)] **end proc** **(4)**

```
> TangentToEllipse:=proc(c,d,t)
```

```
   local P;
   P:=ParEllipse(c,d,t);
   diff(P[1],t)*(y-P[2])-diff(P[2],t)*(x-P[1])
   end;
```

TangentToEllipse := **proc**(*c*, *d*, *t*) (5)

   local *P*,

   P := *ParEllipse*(*c*, *d*, *t*); (*diff*(*P*[1], *t*)) * (*y* − *P*[2]) − (*diff*(*P*[2], *t*)) * (*x* − *P*[1])

end proc

```
> Pt:=proc(L1,L2)
   local q:
   q:=solve({L1,L2},{x,y}):
   normal(   [   subs(q,x)   ,   subs(q,y)   ])
   end:
> PointsBrianchon:=proc(c,d) local L,t,i,P:
   for i from 0 to 5 do   L[i]:= TangentToEllipse(c,d,t[i]):   od:
   for i from 0 to 5 do   P[i]:= Pt (L[i],L[i+1 mod 6]):  od:
   unapply([seq(P[i],i=0..5),P[0]],seq(t[i],i=0..5));
   end:
> PB:=PointsBrianchon([0,0],[2,3]);
```

$$PB := (t_0, t_1, t_2, t_3, t_4, t_5) \rightarrow \left[\left[\frac{2\,(t_0\,t_1+1)}{t_1+t_0}, -\frac{3\,\mathrm{I}\,(t_0\,t_1-1)}{t_1+t_0}\right], \left[\frac{2\,(t_1\,t_2+1)}{t_2+t_1}, -\frac{3\,\mathrm{I}\,(t_1\,t_2-1)}{t_2+t_1}\right], \left[\frac{2\,(t_2\,t_3+1)}{t_3+t_2}, -\frac{3\,\mathrm{I}\,(t_2\,t_3-1)}{t_3+t_2}\right], \left[\frac{2\,(t_3\,t_4+1)}{t_4+t_3}, -\frac{3\,\mathrm{I}\,(t_3\,t_4-1)}{t_4+t_3}\right], \left[\frac{2\,(t_4\,t_5+1)}{t_5+t_4}, -\frac{3\,\mathrm{I}\,(t_4\,t_5-1)}{t_5+t_4}\right], \left[\frac{2\,(t_0\,t_5+1)}{t_5+t_0}, -\frac{3\,\mathrm{I}\,(t_0\,t_5-1)}{t_5+t_0}\right], \left[\frac{2\,(t_0\,t_1+1)}{t_1+t_0}, -\frac{3\,\mathrm{I}\,(t_0\,t_1-1)}{t_1+t_0}\right]\right] \quad (6)$$

```
> h:=rand(0..1000);
```

h := **proc**( ) (7)

   proc( ) **option** *builtin* = *RandNumberInterface*; **end proc**(6, 1001, 10)

end proc

```
> choix:=proc()
   local T,S,i;
   for i from 0 to 5 do T[i]:=evalf(h()/1000*2*Pi) od;
   S:=sort([seq(T[i],i=0..5)]);
   print(S);
   S:=seq(exp(I*S[i]),i=1..6);
   T:=PB(S);
   [seq(map(Re,T[i]),i=1..7)]
   end;
```

choix := **proc**( ) (8)

   local *T*, *S*, *i*,

   for *i* **from** 0 **to** 5 **do** *T*[*i*] := *evalf*(1/500 * *h*( ) * Pi) **end do**;

   S := *sort*([*seq*(*T*[*i*], *i* = 0..5)]);

   print(*S*);

   S := *seq*(exp(*S*[*i*] * I), *i* = 1..6);

   T := *PB*(*S*);

   [*seq*(*map*(Re, *T*[*i*]), *i* = 1..7)]

end proc

```
> Points:=choix();
```

[0.9361946109, 1.413716694, 1.966637001, 2.990796207, 3.462035105, 5.491503959] (9)

Points := [[0.7936834076, 2.848834725], [−.2475961212, 3.096218438], [−1.808422235,

```
    2.117816988], [−2.049435436, −.2613860872], [−.8845215426, −5.526446083],
    [3.071502416, 0.3334852067], [0.7936834076, 2.848834725]]
> A:=plot(Points);
```

$$A := PLOT(\ldots) \tag{10}$$

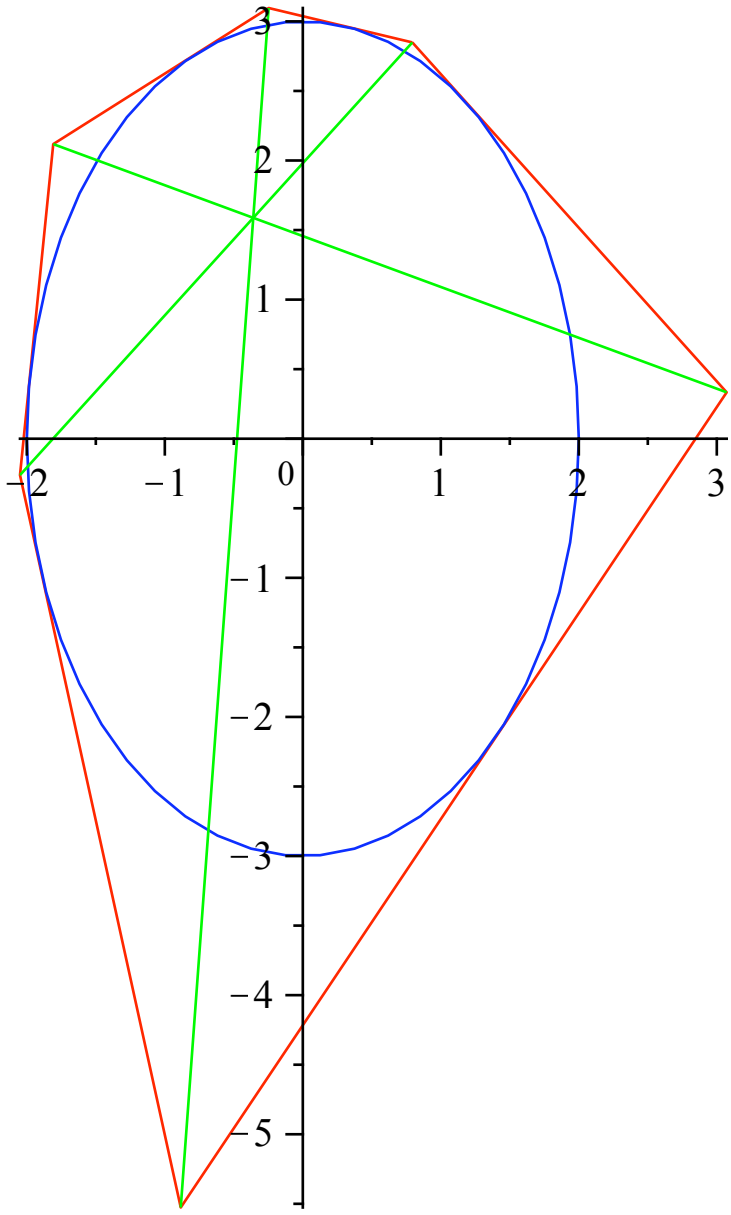
```
> B1:=plot([Points[1],Points[4]],color=green);
  B2:=plot([Points[2],Points[5]],color=green);
  B3:=plot([Points[3],Points[6]],color=green);
```

$$B1 := PLOT(\ldots) \tag{11}$$

$$B2 := PLOT(\ldots)$$

$$B3 := PLOT(\ldots)$$

```
> display(A,elli,B1,B2,B3,scaling=constrained);
```




```
> AREA:=proc(A,B,C):

  normal(expand(   (B[1]*C[2]-B[2]*C[1]-A[1]*C[2]+A[2]*C[1] -B[1]*
  A[2]+B[2]*A[1])/2   )):
```

```
   end:
> Le:=proc(A,B)

   AREA(A,B,[x,y]):

   end:
>
>
>
>
>
> Concurrent:=proc():
   not evalb(solve({args},{x,y})=NULL):
   end:
> Brianchon:=proc() local L,t,i,c,d,P:

   for i from 0 to 5 do   L[i]:= TangentToEllipse(c,d,t[i]):   od:

   for i from 0 to 5 do   P[i]:= Pt (L[i],L[i+1 mod 6]):  od:

   Concurrent (  Le (P[0],P[3])   ,   Le (P[1],P[4])  ,   Le (P[2],
   P[5])   ):

   end:
> Brianchon();
```

true **(12)**

```
>
>
```