

1. Khai báo biến cặp tọa độ (điểm). Vẽ đường thẳng



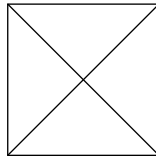
```
beginfig(1) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw A--B--C; endfig;
```

2. Vẽ đường kín qua các điểm có tọa độ



```
beginfig(2) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw A--B--C--cycle; endfig;
```

3. Khai báo biến mảng điểm



```
beginfig(3) pair A[]; A[0]:=(-1cm, -1cm); A[1]:=( 1cm, -1cm);
A[2]:=( 1cm, 1cm); A[3]:=(-1cm, 1cm); draw A[0]--A[1]--A[2]--
A[3]--cycle; draw A[0]--A[2]; draw A[1]--A[3]; endfig;
```

4. Vẽ (chấm) một điểm với nét bút vẽ đậm (khác mặc định)



```
beginfig(4) pair A; A:=(0,0); B:=(1cm,0); C:=(0,1cm); draw A
withpen pencircle scaled 4bp;
```

5. Vẽ với nét bút vẽ đậm



```
beginfig(5) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw A--B--C--cycle; draw A withpen pencircle scaled 4bp; draw
```

```
B withpen pencircle scaled 4bp; draw C withpen pencircle scaled
4bp; endfig;
```

6. Vẽ với nét bút đậm



```
beginfig(6) pair A, B, C, D; A:=(0,0); B:=(1cm,0); C:=(1cm,1cm);
D:=(0,1cm); draw A--B--C--D--cycle; draw A--C; draw B--D;
draw A withpen pencircle scaled 4bp; draw B withpen pencir-
cle scaled 4bp; draw C withpen pencircle scaled 4bp; draw D
withpen pencircle scaled 4bp; endfig;
```

7. Đường trung tuyến - Trung điểm đoạn



```
beginfig(7) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw A--B--C--cycle; draw 1/2[A,B] --C; draw 1/2[B,C]--A; draw
1/2[C,A]--B; endfig;
```

8. Xác định trọng tâm (tâm tỷ cự)



```
beginfig(8) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw A--B--C--cycle; draw 1/2[A,B] --C; draw 1/2[B,C] --A; draw
1/2[C,A] --B; draw 1/3 A + 1/3 B + 1/3 C withpen pencircle
scaled 4bp; endfig;
```

9. Vẽ đường với nét to



```
beginfig(9) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw A--B--C--cycle; draw A--B withpen pencircle scaled 2bp;
endfig;
```

10. Vẽ đường có màu



```
beginfig(10) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw A--B--C--cycle; draw A--B withcolor (green + red); endfig;
```

11. Đường nét đứt



```
beginfig(11) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw A--B; draw B--C dashed evenly; draw C--A dashed with
dots; endfig;
```

12. Vẽ đường cơ bản với nét to và nhạt



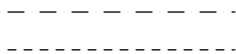
```
beginfig(12) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw A--B withpen pencircle scaled 2bp withcolor .8white; draw
B--C withpen pencircle scaled 2bp withcolor .6white; draw C--A
withpen pencircle scaled 2bp withcolor .4white; endfig;
```

13. Vẽ đường cơ bản gồm đường liền và đứt nét, chấm có màu (đỏ)



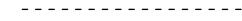
```
beginfig(13) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw A--B--C--cycle; draw 1/2[A,B] --C dashed evenly; draw
1/2[B,C] --A dashed evenly; draw 1/2[C,A] --B dashed evenly;
draw 1/3 A + 1/3 B + 1/3 C withpen pencircle scaled 4bp with
color red; endfig;
```

14. Các đường nét đứt



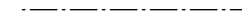
```
beginfig(14) draw (0,0)--(3cm,0) dashed evenly scaled 2; draw
(0,-5mm)--(3cm,-5mm) dashed evenly; endfig;
```

15. Các đường nét đứt



```
beginfig(15) draw (0,0)--(3cm,0) dashed dashpattern(on 2bp off
3bp); endfig;
```

16. Các đường nét đứt



```
beginfig(16) draw (0,0)--(3cm,0) dashed dashpattern(on 1bp off
2bp on 1bp off 2bp); endfig;
```

17. Đường có mũi tên ở đầu mút



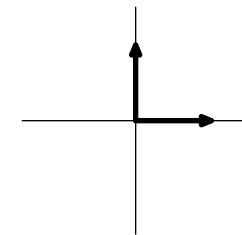
```
beginfig(17) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
drawarrow C--B--A; drawarrow A--C withpen pencircle scaled
2bp; endfig;
```

18. Đường có mũi tên ở hai đầu mút



```
beginfig(18) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw C--B--A--cycle; drawdblarrow A--C withpen pencircle scaled
2bp; endfig;
```

19. Các đường với mũi tên ở một đầu mút



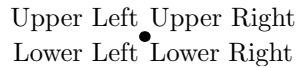
```
beginfig(19) draw (-1.5cm,0)--(1.5cm,0); draw (0,-1.5cm)--(0,1.5cm);
drawarrow (0,0)--(1cm,0) withpen pencircle scaled 2bp; drawar-
row (0,0)--(0,1cm) withpen pencircle scaled 2bp; endfig;
```

20. Các vị trí định trước: Đỉnh, Đáy, Phải và Trái của một vị trí



```
beginfig(27) pair A; A := (0,0); draw A withpen pencircle scaled
4bp; label.top(btex Top etex, A); label.bot(btex Bottom etex,
A); label.rt (btex Right etex, A); label.lft(btex Left etex, A);
endfig;
```

21. Các vị trí định trước: Trên Trái, Trên Phải, Dưới Trái và Dưới Phải của một vị trí



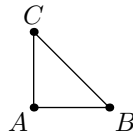
```
beginfig(28) pair A; A := (0,0); draw A withpen pencircle scaled
4bp; label.ulft(btex Upper Left etex, A); label.urt (btex Upper
Right etex, A); label.llft(btex Lower Left etex, A); label.lrt (btex
Lower Right etex, A); endfig;
```

22. Ghi nhãn A tại vị trí Trên Phải của điểm (0,0). Điểm được vẽ bằng chấm to (được đánh dấu)



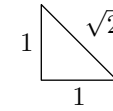
```
beginfig(29) pair A; A := (0,0); dotlabel.urt(btex A etex, A);
endfig;
```

23. Ghi nhãn A, B và C cho các đỉnh của một tam giác, các đỉnh được đánh dấu.



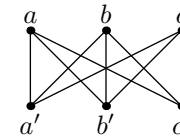
```
beginfig(30) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw A--B--C--cycle; dotlabel.llft(btex A etex, A); dotlabel.lrt(btex
B etex, B); dotlabel.top(btex C etex, C); endfig;
```

24. Ghi nhãn số cho các cạnh một tam giác



```
beginfig(31) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm);
draw A--B--C--cycle; label.bot(btex 1 etex, 1/2[A,B]); label.lft(btex
1 etex, 1/2[A,C]); label.urt(btex sqrt(2) etex, 1/2[B,C]); endfig;
```

25. Ghi nhãn cho các điểm. Một ví dụ minh họa



```
beginfig(32) u:=1cm; pair A,B,C,D,E,F,G; A := (-u,u); B :=
(0,u); C := (u,u); D := (-u,0); E := (0,0); F := (u,0); draw
A--D; draw A--E; draw A--F; draw B--D; draw B--E; draw B--
F; draw C--D; draw C--E; draw C--F; dotlabel.top(btex a etex,
A); dotlabel.top(btex b etex, B); dotlabel.top(btex c etex, C);
dotlabel.bot(btex a' etex, D); dotlabel.bot(btex b' etex, E); dot-
label.bot(btex c' etex, F); endfig;
```

26. Vẽ đường tròn đơn vị: Là đường tròn có tâm (0,0) đường kính bằng 1 đơn vị (mặc định)



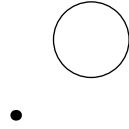
```
beginfig(33) draw fullcircle; endfig;
```

27. Đánh dấu góc tọa độ. Vẽ đường tròn tâm (0,0) đường kính 1cm



```
beginfig(34) draw (0,0) withpen pencircle scaled 4bp; draw full-
circle scaled 1cm; endfig;
```

28. Đánh dấu góc tọa độ và vẽ ảnh đường tròn đơn vị đường kính 1cm qua phép tịnh tiến vectơ $(1\text{cm}, 1\text{cm})$



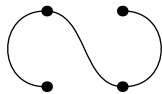
`beginfig(35) draw (0,0) withpen pencircle scaled 4bp; draw fullcircle scaled 1cm shifted (1cm,1cm); endfig;`

29. Đánh dấu các điểm bằng các khuyên tròn (hình tròn rỗng ruột). Chú ý thêm về các phép tịnh tiến.



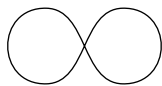
`beginfig(36) pair A, B, C; A:=(0,0); B:=(1cm,0); C:=(0,1cm); draw A--B--C--cycle; fill fullcircle scaled 4bp shifted A withcolor white; fill fullcircle scaled 4bp shifted B withcolor white; fill fullcircle scaled 4bp shifted C withcolor white; draw fullcircle scaled 4bp shifted A; draw fullcircle scaled 4bp shifted B; draw fullcircle scaled 4bp shifted C; endfig;`

30. Nối các điểm bằng các đường cong Bezier



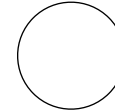
`beginfig(37) draw (0,0) .. (0,1cm) .. (1cm,0) .. (1cm,1cm); draw (0,0) withpen pencircle scaled 4bp; draw (0,1cm) withpen pencircle scaled 4bp; draw (1cm,0) withpen pencircle scaled 4bp; draw (1cm,1cm) withpen pencircle scaled 4bp; endfig;`

31. Vẽ đường số 8 nằm ngang



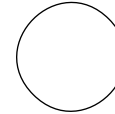
`beginfig(40) draw (0,0) .. (0,1cm) .. (1cm,0) .. (1cm,1cm) .. cycle; endfig;`

32. Một cách vẽ đường tròn khác



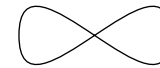
`beginfig(41) pair A, B, C, D; A:=(0,0); B:=(1cm,0); C:=(1cm,1cm); D:=(0,1cm); draw A..B..C..D..cycle; endfig;`

33. Một cách vẽ đường tròn khác nữa



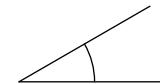
`beginfig(42) draw (0,0) .. (1cm,1cm) .. cycle; endfig;`

34. Một đường cong vẽ theo phương up



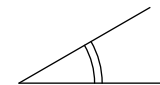
`beginfig(47) draw (0,0)up .. (2cm,0)up .. cycle; endfig;`

35. Góc và đường thẳng vẽ theo phương. Đánh dấu góc.



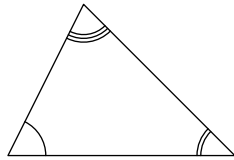
`beginfig(48) alpha := 30; draw (0,0) --2cm*dir 0; draw (0,0) - -2cm*dir alpha; draw 1cm * dir 0 dir 90 .. 1cm * dir alpha dir(90+alpha); endfig;`

36. Đánh dấu góc theo kiểu khác



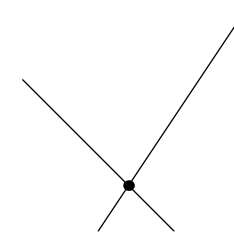
```
beginfig(49) alpha := 30; draw (0,0) --2cm*dir 0; draw (0,0) -
-2cm*dir alpha; draw 1cm * dir 0 dir 90 .. 1cm * dir alpha
dir(90+alpha); draw 1.1cm * dir 0 dir 90 .. 1.1cm * dir alpha
dir(90+alpha); endfig;
```

37. Tam giác. Định nghĩa hàm (macro) để xác định cách đánh dấu góc trong một tam giác. Một cách viết 'vòng lặp'



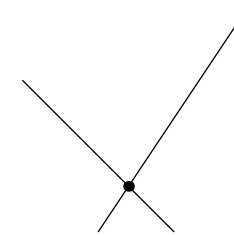
```
beginfig(50)
  def draw_angle(expr A, 0, B, n) =
    draw_angle_(A,0,B,5mm);
    if n>1 : draw_angle_(A,0,B,4.5mm); fi;
    if n>2 : draw_angle_(A,0,B,4mm); fi;
    if n>3 : draw_angle_(A,0,B,5.5mm); fi;
  enddef;
  def draw_angle_(expr A,0,B,d) =
    draw (0 + d*unitvector(A-0))
      { d*unitvector(A-0) rotated 90 }
    ..
    { d*unitvector(B-0) rotated 90 }
    (0 + d*unitvector(B-0));
  enddef;
  pair A, B, C;
  A := (0,0);
  B := (3cm,0);
  C := (1cm,2cm);
  draw A--B--C--cycle;
  draw_angle(B,A,C,1);
  draw_angle(C,B,A,2);
  draw_angle(A,C,B,3);
endfig;
```

38. Xác định giao điểm hai đường. (Khả năng giải hệ phương trình tuyến tính của MPost)



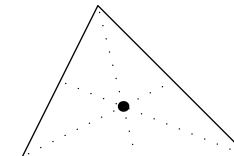
```
beginfig(69) pair A,B,C,D,M; numeric lambda, mu; A=(0,0);
B=(2cm,3cm); C=(1cm,0); D=(-1cm,2cm); M = lambda [A,B];
M = mu [C,D]; draw A--B; draw C--D; draw M withpen pencircle
scaled 4bp; endfig;
```

39. Xác định giao điểm hai đường thông qua biến mặc định whatever



```
beginfig(70) pair A,B,C,D,M; A=(0,0); B=(2cm,3cm); C=(1cm,0);
D=(-1cm,2cm); M = whatever [A,B]; M = whatever [C,D]; draw
A--B; draw C--D; draw M withpen pencircle scaled 4bp; endfig;
```

40. Xác định các điểm và giao điểm các đường.



```
beginfig(71) pair A,B,C,AA,BB,CC,G; A=(0,0); B=(3cm,0); C=(1cm,2cm);
AA = 1/2 [B,C]; BB = 1/2 [C,A]; CC = 1/2 [A,B]; G = whatever
```

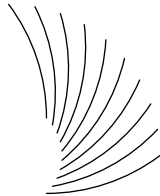
[A,AA]; G = whatever [B,BB]; draw A--B--C--cycle; draw A--AA dashed withdots; draw B--BB dashed withdots; draw C--CC dashed withdots; draw G withpen pencircle scaled 4bp; endfig;

41. Phép tịnh tiến. Vẽ các đường tròn ảnh của một đường tròn theo các phương (1mm,2mm)...



beginfig(72) path p; p := fullcircle scaled 5mm; draw p; draw p shifted (1mm,2mm); draw p shifted 2(1mm,2mm); draw p shifted 3(1mm,2mm); draw p shifted 4(1mm,2mm); draw p shifted 5(1mm,2mm); endfig;

42. Phép quay. Vẽ một cung tròn và ảnh của nó qua các phép quay (tâm quay là gốc tọa trục).



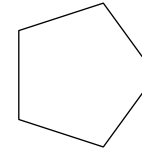
beginfig(73) path p; p := (5mm,-5mm) right .. (2cm,0); draw p; draw p rotated 10; draw p rotated 20; draw p rotated 30; draw p rotated 40; draw p rotated 50; draw p rotated 60; draw p rotated 70; draw p rotated 80; draw p rotated 90; endfig;

43. Phép co trục tung. Vẽ đường tròn đường kính 5mm sau đó dùng phép co dẫn để vẽ ảnh của đường tròn đó.



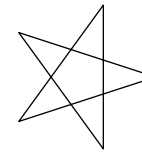
beginfig(74) path p; p := fullcircle scaled 5mm; draw p; draw p xscaled 2; draw p xscaled 3; draw p xscaled 4; endfig;

44. Dùng phép để vẽ một ngũ giác đều có đỉnh thứ nhất là (1cm,0)



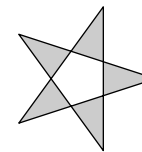
beginfig(75) pair A,B,C,D,E; A := (1cm,0); B := A rotated 72; C := B rotated 72; D := C rotated 72; E := D rotated 72; draw A--B--C--D--E--cycle; endfig;

45. Vẽ một ngôi sao 5 cạnh bằng phép quay



beginfig(76) pair A,B,C,D,E; A := (1cm,0); B := A rotated 72; C := B rotated 72; D := C rotated 72; E := D rotated 72; draw A--C--E--B--D--cycle; endfig;

46. Vẽ và tô màu cho một ngôi sao cho các miền kín sau khi đã xác định các miền đó



beginfig(77) pair A,B,C,D,E; A := (1cm,0); B := A rotated 72; C := B rotated 72; D := C rotated 72; E := D rotated 72; pair AA, BB, CC, DD, EE; AA = whatever [A, C]; AA = whatever [B, D]; BB = whatever [B, D]; BB = whatever [C, E]; CC = whatever [C, E]; CC = whatever [D, A]; DD = whatever [D, A]; DD = whatever [E, B]; EE = whatever [E, B]; EE = whatever [A, C]; fill A--C--E--B--D--cycle withcolor .8white; fill AA--BB--CC--DD--EE--cycle withcolor white; draw A--C--E--B--D--cycle; endfig;

47. Vẽ góc tạo bởi các trục và dùng phép co dãn trục z.



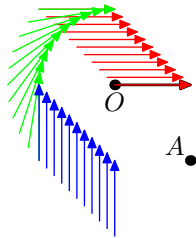
```
beginfig(78) path p; p := (0,0) --(1cm,0); drawarrow p withpen
pencircle scaled 2bp; drawarrow p zscaled (1,2); endfig;
```

48. Ví dụ về tích các phép quay và tịnh tiến (dùng phép quay tâm ...)



```
beginfig(79) u:=1cm; path p; p := (0,0) --(u,0); pair A; A :=
(u,-u); numeric a; a := 90; drawarrow p withpen pencircle scaled
1bp; drawarrow p rotatedaround( A, a ); drawarrow p shifted -A
rotated a shifted A withpen pencircle scaled 1bp dashed with
dots; endfig;
```

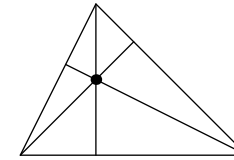
49. Một ví dụ cao cấp về việc dùng kết hợp các phép biến hình.



```
beginfig(80) path p; p := (0,0) --(u,0); pair A; A := (u,-u); nu
meric a; a := 90; drawarrow p withpen pencircle scaled 1bp; draw
A withpen pencircle scaled 4bp; label ulft ( btex A etex, A ); draw
(0,0) withpen pencircle scaled 4bp; label bot ( btex O etex, (0,0)
); for i=0 upto 10: drawarrow p shifted -(i*A/10) withcolor red;
```

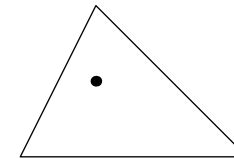
```
endfor; for i=0 upto 10: drawarrow p shifted -A rotated (i*a/10)
withcolor green; endfor; for i=0 upto 10: drawarrow p shifted -A
rotated a shifted (i*A/10) withcolor blue; endfor; endfig;
```

50. Trục tâm tam giác. Cách xác định hình chiếu của điểm trên một đường



```
beginfig(81) pair A,B,C,AA,BB,CC,H; A=(0,0); B=(3cm,0); C=(1cm,2cm);
AA - A = whatever * (B-C) rotated 90; AA = whatever [B,C];
BB - B = whatever * (A-C) rotated 90; BB = whatever [A,C];
CC - C = whatever * (A-B) rotated 90; CC = whatever [A,B];
H = whatever [A,AA]; H = whatever [B,BB]; draw A--B--C--
cycle; draw A--AA; draw B--BB; draw C--CC; draw H withpen
pencircle scaled 4bp; endfig;
```

51. Xác định trục tâm của một tam giác

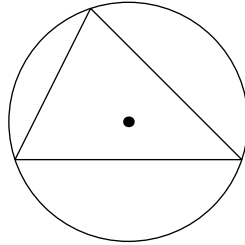


```
beginfig(82) pair A,B,C,H; A=(0,0); B=(3cm,0); C=(1cm,2cm);
H - A = whatever * (B-C) rotated 90; H - B = whatever * (A-
C) rotated 90; draw A--B--C--cycle; draw H withpen pencircle
scaled 4bp; endfig;
```

52. Xác định tâm đường tròn ngoại tiếp và vẽ đường tròn

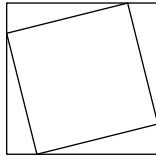
(c) Trương Văn Châu
vanchut@gmail.com

ngoại tiếp



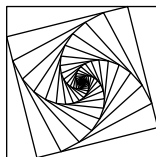
```
beginfig(83) pair A,B,C,O; A=(0,0); B=(3cm,0); C=(1cm,2cm);
O = 1/2[B,C] = whatever * (B-C) rotated 90; O = 1/2[A,B] =
whatever * (A-B) rotated 90; draw A--B--C--cycle; draw O with-
pen pencircle scaled 4bp; draw fullcircle scaled 2abs(O-A) shifted
O; endfig;
```

53. Ví dụ về một phép biến hình tự tạo. Định nghĩa một phép biến hình



```
beginfig(84) pair A,B,C,D; u:=2cm; A=(0,0); B=(u,0); C=(u,u);
D=(0,u);
transform T; A transformed T = 1/5[A,B]; B transformed T =
1/5[B,C]; C transformed T = 1/5[C,D];
path p; p = A--B--C--D--cycle; draw p; draw p transformed T;
endfig;
```

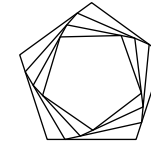
54. Một định nghĩa của phép biến hình khác



```
beginfig(85) pair A,B,C,D; u:=2cm; A=(0,0); B=(u,0); C=(u,u);
D=(0,u);
```

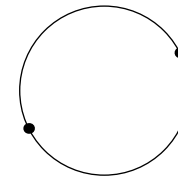
```
transform T; A transformed T = 1/5[A,B]; B transformed T =
1/5[B,C]; C transformed T = 1/5[C,D];
path p; p = A--B--C--D--cycle; for i=0 upto 100: draw p; p:=
p transformed T; endfor; endfig;
```

55. Ví dụ kết hợp của phép biến hình tự tạo và phép biến hình đã có (phép quay)



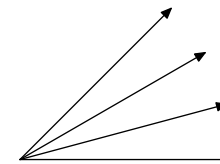
```
beginfig(86) u:=1cm; pair A,B,C,D,E; A := (0,u); B := A rotated
72; C := B rotated 72; D := C rotated 72; E := D rotated 72;
transform T; A transformed T = 1/5[A,B]; B transformed T =
1/5[B,C]; C transformed T = 1/5[C,D]; path p; p := A--B--C--
D--E--cycle; draw p; p := p transformed T; draw p; p := p
transformed T; draw p; p := p transformed T; draw p; endfig;
```

56. Hai đầu mút của đường kính đường tròn



```
beginfig(87) u:=3mm; fill fullcircle scaled 2u withcolor .8white;
fill fullcircle scaled u shifted (u*dir30) withcolor .8white; fill full-
circle scaled u shifted (u*dir150) withcolor .8white; endfig;
```

57. Các tia phát xuất từ một điểm và tạo với nhau những góc bằng nhau (dùng phép quay)

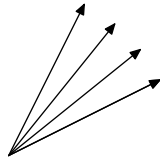



```

beginfig(100) pair A; A:=(2cm,2cm); drawarrow origin--A; drawar-
row (origin--A) rotated -1/3 angle(A); drawarrow (origin--A) ro-
tated -2/3 angle(A); drawarrow (origin--A) rotated -angle(A);
endfig;

```

58. Các tia phát xuất từ một điểm và tạo với nhau những góc bằng nhau (dùng phép quay)

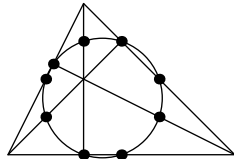


```

beginfig(101) pair A,B; A:=(1cm,2cm); B:=(2cm,1cm); numeric
alpha; alpha = angle(A) - angle(B); drawarrow origin--A; drawar-
row origin--B; drawarrow (origin--A) rotated -1/3 alpha; drawar-
row (origin--A) rotated -2/3 alpha; drawarrow (origin--A) ro-
tated -alpha; endfig;

```

59. Đường tròn Euler



```

beginfig(103) pair A,AA,B,BB,C,CC,O,H; A=(0,0); B=(3cm,0);
C=(1cm,2cm); AA = 1/2[B,C]; BB = 1/2[A,C]; CC = 1/2[A,B];
O = 1/2[BB,CC] = whatever * (BB-CC) rotated 90; O = 1/2[AA,BB]
= whatever * (AA-BB) rotated 90; draw A--B--C--cycle; draw
AA withpen pencircle scaled 4bp; draw BB withpen pencircle
scaled 4bp; draw CC withpen pencircle scaled 4bp; draw full-
circle scaled 2abs(O-AA) shifted O; pair AA,BB,CC; AA - A
= whatever * (B-C) rotated 90; AA = whatever [B,C]; BB - B
= whatever * (A-C) rotated 90; BB = whatever [A,C]; CC -
C = whatever * (A-B) rotated 90; CC = whatever [A,B]; draw
A--AA; draw B--BB; draw C--CC; draw AA withpen pencircle
scaled 4bp; draw BB withpen pencircle scaled 4bp; draw CC

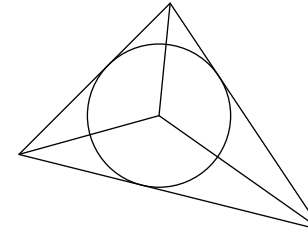
```

```

withpen pencircle scaled 4bp; H = whatever [A,AA]; H = whate-
ver [B,BB]; draw 1/2 [A,H] withpen pencircle scaled 4bp; draw
1/2 [B,H] withpen pencircle scaled 4bp; draw 1/2 [C,H] withpen
pencircle scaled 4bp; endfig;

```

60. Đường tròn nội tiếp và các phân giác trong

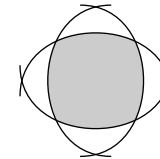


```

beginfig(104) pair A,B,C,M,h; u:=2cm; A=(0,0); B=(2u,-.5u);
C=(u,u); draw A--B--C--cycle; (M-A) = whatever * ( (A-C)
rotated 1/2( angle(B-A) - angle(C-A)) ); (M-B) = whatever *
( (B-A) rotated 1/2( angle(C-B) - angle(A-B)) ); draw M--A;
draw M--B; draw M--C; M-h = whatever * (B-C) rotated 90; h
= whatever[B,C]; draw fullcircle scaled 2 abs(M-h) shifted M;
endfig;

```

61. Hai elip



```

beginfig(109) u:=1cm; path a,b,c,d; a = (-u,-.2u)up .. tension
1.2 .. (u,-.2u)down; b = a rotated 90; c = b rotated 90; d =
c rotated 90; fill buildcycle(a,b,c,d) withcolor .8white; draw a;
draw b; draw c; draw d; endfig;

```

62. Vẽ hai đường tròn giao nhau có đánh dấu phần giao

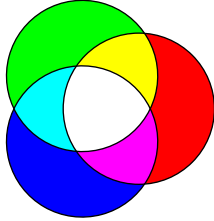


```

beginfig(110) u:=1cm; path c[]; c[1] := fullcircle scaled u; c[2]
:= c[1] shifted (0,.5u); draw c[1] dashed evenly; draw c[2] dashed
evenly; draw buildcycle(c[1],c[2]) withpen pencircle scaled 1bp;
endfig;

```

63. Ba đường tròn giao nhau có màu

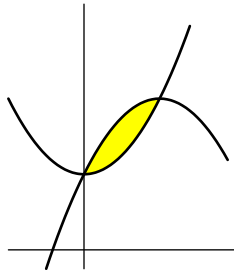


```

beginfig(111) path a,b,c; a = fullcircle scaled 2u shifted (.5u,0);
b = a rotated (360/3); c = b rotated (360/3); fill a withcolor
red; fill b withcolor green; fill c withcolor blue; fill buildcycle(a,b)
withcolor red + green; fill buildcycle(b,c) withcolor green + blue;
fill buildcycle(c,a) withcolor blue + red; fill buildcycle(a,b,c)
withcolor white; draw a; draw b; draw c; endfig;

```

64. Hai parabol cắt nhau trên Oy



```

beginfig(112)
def compute_curve(suffix f)(expr xmin, xmax, xinc) =
( (xmin,f(xmin))
for x=xmin+xinc step xinc until xmax:
.. (x,f(x))
endfor )
enddef;

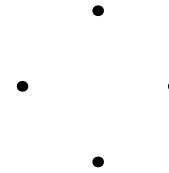
```

```

vardef f(expr x) = x**2 + 1 enddef;
vardef g(expr x) = 2 - (x-1)**2 enddef;
path p, q;
p := compute_curve(f, -1, 1.5, .1) scaled 1cm;
q := compute_curve(g, -.5, 2, .1) scaled 1cm;
fill buildcycle(p,reverse q) withcolor red+green;
draw p withpen pencircle scaled 1bp;
draw q withpen pencircle scaled 1bp;
draw (-1cm,0)-- (2cm,0);
draw (0,g(-.5)*1cm)-- (0,f(1.5)*1cm);
endfig;

```

65. Dùng vòng lặp để vẽ các điểm

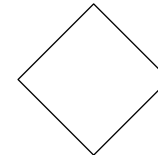


```

beginfig(118) for i=0 step 1 until 3: draw 1cm*right rotated
(i*90) withpen pencircle scaled 4bp; endfor; endfig;

```

66. Vẽ Hình vuông bằng vòng lặp

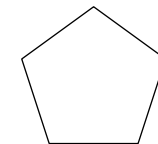


```

beginfig(119) draw for i=0 step 1 until 3: 1cm*right rotated
(i*90) --endfor cycle; endfig;

```

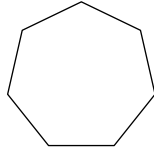
67. Vẽ Ngũ giác đều bằng vòng lặp



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 <vanchut@gmail.com>

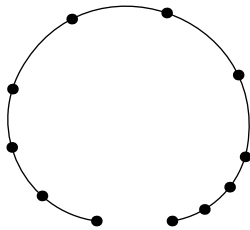
```
beginfig(120) n:=5; draw for i=0 step 1 until n-1: 1cm*up rotated (i*360/n) --endfor cycle; endfig;
```

68. Vẽ Lục giác đều bằng vòng lặp



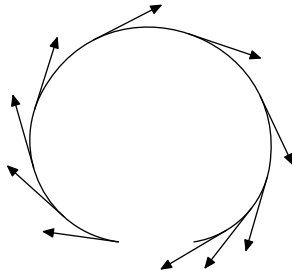
```
beginfig(121) n:=7; draw for i=0 step 1 until n-1: 1cm*up rotated (i*360/n) --endfor cycle; endfig;
```

69. Vẽ một cung tròn và xác định các điểm trên cung tròn đó



```
beginfig(122) path p; p = (0,0) .. (-1cm,2cm) .. (2cm,1cm) .. (1cm,0); draw p; n:=10; for i=0 step 1 until n: draw point (i/n*length(p)) of p withpen pencircle scaled 4bp; endfor; endfig;
```

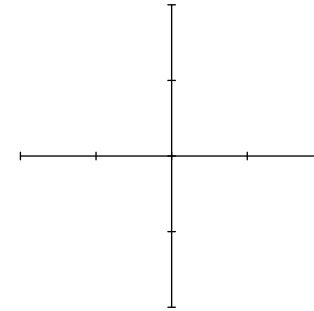
70. Vẽ một cung tròn và vẽ tiếp tuyến của cung tròn đó tại một số nơi



```
beginfig(123) path p; p = (0,0) .. (-1cm,2cm) .. (2cm,1cm) .. (1cm,0); draw p; n:=10; for i=0 step length(p)/n until length(p):
```

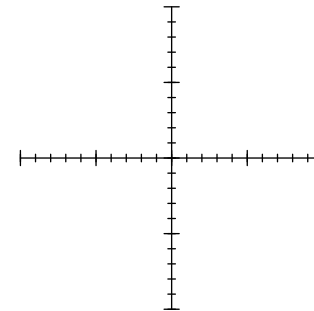
```
drawarrow (point i of p) --1cm * unitvector(direction i of p) shifted point i of p; endfor; endfig;
```

71. Trục có tickmark thưa



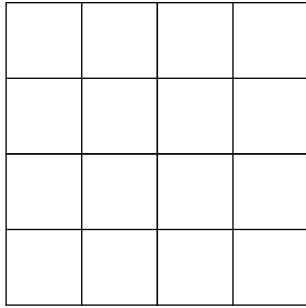
```
beginfig(124) u:=1cm; draw (-2u,0)--(2u,0); draw (0,-2u)--(0,2u); for i=-2u step u until 2u: draw (i,u/20)--(i,-u/20); draw (u/20,i)-(-u/20,i); endfor; endfig;
```

72. Trục có tickmark dày (dùng vòng lặp)



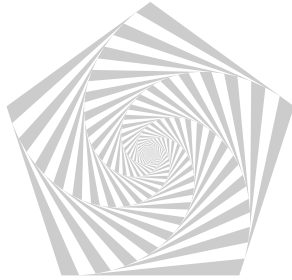
```
beginfig(125) u:=1cm; draw (-2u,0)--(2u,0); draw (0,-2u)--(0,2u); for i=-2u step u until 2u: draw (i,u/10)--(i,-u/10); draw (u/10,i)-(-u/10,i); endfor; for i=-2u step u/5 until 2u: draw (i,u/20)--(i,-u/20); draw (u/20,i)--(-u/20,i); endfor; endfig;
```

73. Vẽ lưới ô vuông (dùng vòng lặp)



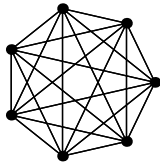
```
beginfig(126) u:=1cm; draw (-2u,0)--(2u,0); draw (0,-2u)--(0,2u);
for i=-2u step u until 2u: draw (i,2u)--(i,-2u); draw (2u,i)--(-2u,i); endfor; endfig;
```

74. Một hình trang trí.



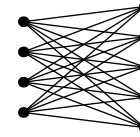
```
beginfig(131) transform T; u:=1cm; z1=(0,2u); n := 5; for i=1
upto n-1: z[i+1] = z1 rotated (360*i/n); endfor; z1 transformed
T = .1[z1,z2]; z2 transformed T = .1[z2,z3]; z3 transformed T =
.1[z3,z4]; path p; p = for i=1 upto n: z[i] --endfor cycle; for i=0
upto 100: fill p withcolor .8*white; p := p transformed T; fill p
withcolor white; p := p transformed T; endfor; endfig;
```

75. Giản đồ qua hệ nhị phân



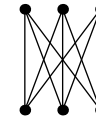
```
beginfig(132) u:=1cm; pair A[]; numeric n; n:=7; A[0] = (u,0);
for i=1 upto n-1: A[i] = A[0] rotated (360/n*i); endfor; for i=0
upto n-1: draw A[i] withpen pencircle scaled 4bp; for j=0 upto
n-1: if i<>j: draw A[i]--A[j] fi; endfor; endfor; endfig;
```

76. Giản đồ quan hệ



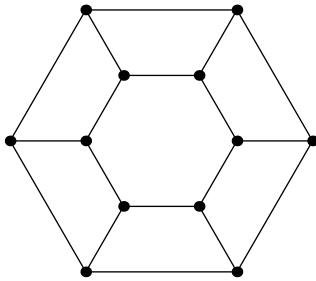
```
beginfig(133) u:=2cm; numeric n,m; n:=4; m:=5; pair A[], B[];
for i=1 upto n-1: A[i+1]-A[i] = (0,.2u); endfor; for j=1 upto m-1:
B[j+1]-B[j] = (0,.2u); endfor; (0,0) for i=1 upto n: + A[i] endfor
= (0,0); (0,0) for j=1 upto m: + B[j] endfor = (4u,0); for i=1
upto n: draw A[i] withpen pencircle scaled 4bp; endfor; for j=1
upto m: draw B[j] withpen pencircle scaled 4bp; endfor; for i=1
upto n: for j=1 upto m: draw A[i]--B[j]; endfor; endfor; endfig;
```

77. Giản đồ quan hệ



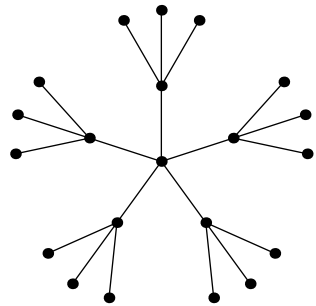
```
beginfig(134) u:=1cm; numeric n,m; n:=3; m:=3; pair A[], B[];
for i=1 upto n-1: A[i+1]-A[i] = (.5u,0); endfor; for j=1 upto m-1:
B[j+1]-B[j] = (.5u,0); endfor; (0,0) for i=1 upto n: + A[i] endfor
= (0,0); (0,0) for j=1 upto m: + B[j] endfor = (0,4u); for i=1
upto n: draw A[i] withpen pencircle scaled 4bp; endfor; for j=1
upto m: draw B[j] withpen pencircle scaled 4bp; endfor; for i=1
upto n: for j=1 upto m: draw A[i]--B[j]; endfor; endfor; endfig;
```

78. Một hình khảm, dùng mảng và phép quay



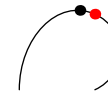
```
beginfig(135) pair A[], B[]; numeric n; n:=6; for i=0 upto n-1: A[i] = 1cm * right rotated (i*360/n); B[i] = 2cm * right rotated (i*360/n); endfor; A[n] = A[0]; B[n] = B[0]; for i=0 upto n-1: draw A[i] --A[i+1] --B[i+1] --B[i]; draw A[i] withpen pencircle scaled 4bp; draw B[i] withpen pencircle scaled 4bp; endfor; endfig;
```

79. Cây nhị phân



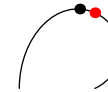
```
beginfig(136) numeric n; n:=5; pair O,A,B,C,D; O = (0,0); A = 1cm*up; B = 2cm*up rotatedabout(A,30); C = 2cm*up; D = 2cm*up rotatedabout(A,-30); for i=0 upto n-1: draw (O--A--C) rotated (i*360/n); draw (B--A--D) rotated (i*360/n); draw A rotated (i*360/n) withpen pencircle scaled 4bp; draw B rotated (i*360/n) withpen pencircle scaled 4bp; draw C rotated (i*360/n) withpen pencircle scaled 4bp; draw D rotated (i*360/n) withpen pencircle scaled 4bp; endfor; draw O withpen pencircle scaled 4bp; endfig;
```

80. Đường cong và xác định các điểm trên đó



```
beginfig(158) path p; p := (0,0)up .. (1cm,1cm) .. (1cm,0); draw p; draw point 1/2length(p) of p withpen pencircle scaled 4bp withcolor red; draw point (arctime (1/2 arclength(p)) of p) of p withpen pencircle scaled 4bp; endfig;
```

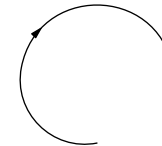
81. Đường cong và các điểm trên đó với các dấu mũi tên



```
beginfig(159) vardef milieu(expr p) = save l,i,tot,A,B; numeric l,tot,i; pair A,B; tot := longueur(p); l:=0; B := point 0 of p; for i:=0 step .01 until length(p): A := B; B := point i of p; l := l+abs(B-A); exitif l > 1/2 tot; endfor; 1/2[A,B] enddef; path p; p := (0,0)up .. (1cm,1cm) .. (1cm,0); draw p; draw point 1/2length(p) of p withpen pencircle scaled 4bp withcolor red; draw milieu(p) withpen pencircle scaled 4bp; endfig;
```

Chú ý: Chúng ta có dùng đến một vài macro định nghĩa trong file MACROS.MP

82. Đường cong và các điểm trên đó



```
beginfig(160) vardef milieu_time(expr p) = save l,i,tot,A,B,t; numeric l,tot,i,t; pair A,B; tot := longueur(p);
```

```

l:=0;
B := point 0 of p;
for i:=0 step .01 until length(p):
  t:=i;
  A := B;
  B := point i of p;
  l := l+abs(B-A);
  exitif l > 1/2 tot;
endfor;
t % Pas de point-virgule
enddef;

```

```

save arrowhead;
vardef arrowhead expr p =
  save A,u; pair A,u;
  A := milieu(p);
  u := unitvector(direction milieu_time(p) of p);
  A--(A - ahlength*u rotated 15) --
  (A - ahlength*u rotated -15) -- cycle
enddef;

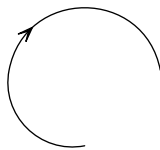
```

```

u:=1cm;
drawarrow (0,0) .. (-u,u) .. (u,u);
endfig;

```

83. Đường cong và các điểm trên đó



```

beginfig(161)
  save arrowhead;
  vardef arrowhead expr p =
    save A,B,u; pair A,B,u;

```

```

A := milieu(p);
B := p intersectionpoint
      (fullcircle scaled ahlength shifted A);
u := unitvector(direction milieu_time(p) of p);
A \noi (A - ahlength*u rotated 30) -- B --
      (A - ahlength*u rotated -30) -- cycle
enddef;

```

```

u:=1cm;
drawarrow (0,0) .. (-u,u) .. (u,u);
endfig;

```

84. Đường cong và các điểm trên đó

```

$$\epsfbox{metapost.162}$$
beginfig(162)
  save arrowhead;
  vardef arrowhead expr p =
    save A,u; pair A,u;
    A := milieu(p);
    u := unitvector(direction milieu_time(p) of p);
    A -- (A - ahlength*u rotated 30) -- A \noi
      (A - ahlength*u rotated -30) -- cycle
  enddef;

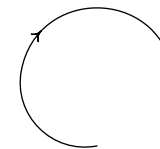
```

```

u:=1cm;
drawarrow (0,0) .. (-u,u) .. (u,u);
endfig;

```

85. Đường cong và các điểm trên đó



```

beginfig(163)

```

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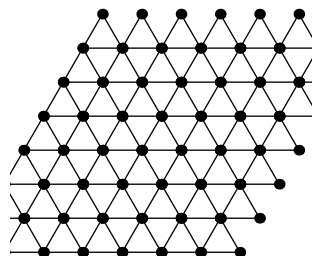
```

save arrowhead;
vardef arrowhead expr p =
  save A,u,a,b; pair A,u; path a,b;
  A := milieu(p);
  u := unitvector(direction milieu_time(p) of p);
  a := A{-u} .. (A - ahlength*u rotated 30);
  b := A{-u} .. (A - ahlength*u rotated -30);
  ( a & reverse(a) & b & reverse(b) ) -- cycle
enddef;

u:=1cm;
drawarrow (0,0) .. (-u,u) .. (u,u);
endfig;

```

86. Lưới chéo hình thoi (bình hành)

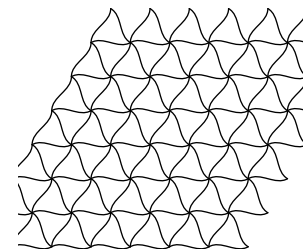


```

beginfig(164) pair A,B,C; C = 3mm*up; A = C rotated 120;
B = C rotated -120; picture pic ; pic:=nullpicture; addto pic
doublepath A--B--C--cycle withpen currentpen; addto pic dou-
blepath A withpen pencircle scaled 4bp; addto pic doublepath
B withpen pencircle scaled 4bp; addto pic doublepath C with-
pen pencircle scaled 4bp; for i=-3 upto 3: for j=-3 upto 3: draw
pic shifted( i*(B-A) + j*(C-A) ); endfor; endfor; clip currentpic-
ture to (-2cm,-2cm)--(2cm,-2cm)--(2cm,2cm)-- (-2cm,2cm)-- cy-
cle; endfig;

```

87. Lưới chéo bờ cong

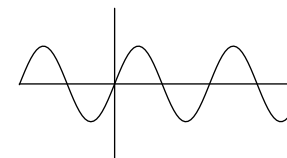


```

beginfig(165) pair A,B,C; C = 3mm*up; A = C rotated 120; B
= C rotated -120; picture pic ; pic:=nullpicture; path p; p :=
A(C-A) rotated 30 .. C(C-A) rotated 30; addto pic doublepath
p withpen currentpen; addto pic doublepath p rotated 120 with-
pen currentpen; addto pic doublepath p rotated -120 withpen
currentpen; for i=-3 upto 3: for j=-3 upto 3: draw pic shifted(
i*(B-A) + j*(C-A) ); endfor; endfor; clip currentpicture to (-
2cm,-2cm)--(2cm,-2cm)--(2cm,2cm)-- (-2cm,2cm)-- cycle; endfig;

```

88. Đồ thị hàm sin

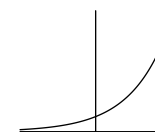


```

beginfig(166) ux:=2mm; uy:=5mm; numeric xmin, xmax, ymin,
ymax, M; xmin := -6.3; xmax := 12.6; ymin := -2; ymax := 2;
M := 100; draw (ux*xmin,0)--(ux*xmax,0); draw (0,uy*ymin)--
(0,uy*ymax); pair a[]; for i=0 upto M: a[i] := ( xmin + (i/M)*(xmax-
xmin), sind(180/3.14*( xmin + (i/M)*(xmax-xmin) )) ) xscaled
ux yscaled uy; endfor; draw a[0] for i=1 upto M:-a[i] endfor;
endfig;

```

89. Đồ thị hàm mũ

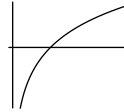


```

beginfig(167) ux:=5mm; uy:=2mm; numeric xmin, xmax, ymin,
ymax, M; xmin := -2; xmax := 2; ymin := -.1; ymax := 8;
M := 100; draw (ux*xmin,0)-(ux*xmax,0); draw (0,uy*ymin)-
(0,uy*ymax); pair a[]; for i=0 upto M: a[i] := ( xmin + (i/M)*(xmax-
xmin), mexp(256*( xmin + (i/M)*(xmax-xmin) )) ) xscaled ux
yscaled uy; endfor; draw a[0] for i=1 upto M:-a[i] endfor; endfig;

```

90. Đồ thị hàm loga

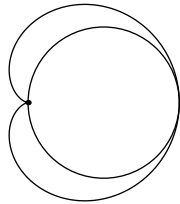


```

beginfig(168) ux:=5mm; uy:=5mm; numeric xmin, xmax, ymin,
ymax, M; xmin := .2; xmax := 3; ymin := -1.6; ymax := 1.2; M
:= 100; draw (ux*-.1,0)-(ux*xmax,0); draw (0,uy*ymin)-(0,uy*ymax);
pair a[]; for i=0 upto M: a[i] := ( xmin + (i/M)*(xmax-xmin),
(1/256)*mlog(( xmin + (i/M)*(xmax-xmin) )) ) xscaled ux yscaled
uy; endfor; draw a[0] for i=1 upto M:-a[i] endfor; endfig;

```

91. Hình vẽ đường elipsoid

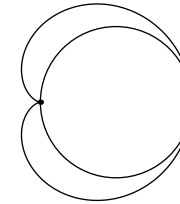


```

beginfig(169) path p; p = fullcircle scaled 2cm; z0 = (-1cm,0);
draw p; draw z0 withpen pencircle scaled 2pt;
pair A[]; for i=0 step length(p)/100 until length(p): pair M,N;
M = point i of p; N-M = whatever * direction i of p; N-z0 =
whatever * direction i of p rotated 90; A[i] := N; endfor; draw
for i=0 step length(p)/100 until length(p): A[i] .. endfor cycle;
endfig;

```

92. Hình vẽ đường elipsoid khác

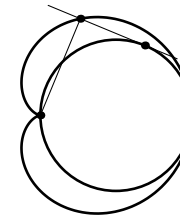


```

beginfig(170) vardef cardioid(expr p, O) = save i,M,N; numeric
i; for i=0 step length(p)/100 until length(p): hide( pair M,N;
M = point i of p; N-M = whatever * direction i of p; N-O =
whatever * direction i of p rotated 90; ) N .. endfor cycle enddef;
path p; p = fullcircle scaled 2cm; z0 = (-1cm,0); draw p; draw
z0 withpen pencircle scaled 2pt; draw cardioid(p,z0); endfig;

```

93. Hình vẽ elipsoid và các tiếp tuyến tại điểm ...

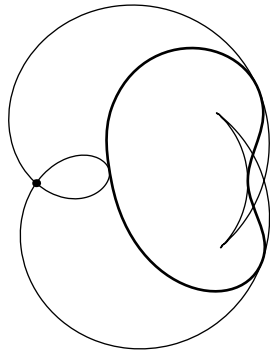


```

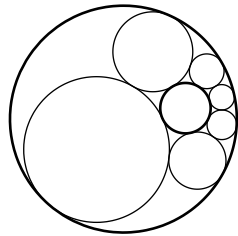
beginfig(171) vardef cardioid(expr p, O) = save i,M,N; numeric
i; for i=0 step length(p)/100 until length(p): hide( pair M,N;
M = point i of p; N-M = whatever * direction i of p; N-O =
whatever * direction i of p rotated 90; ) N .. endfor cycle enddef;
path p; p = fullcircle scaled 2cm; z0 = (-1cm,0); pickup pen-
circle scaled 1pt draw p; draw z0 withpen pencircle scaled 3pt;
draw cardioid(p,z0); pickup pencircle scaled .4pt pair M,N;
i:=1.5; M = point i of p; N-M = whatever * direction i of p;
N-z0 = whatever * direction i of p rotated 90; draw z0--N; draw
(-1/2)[N,M]-(3/2)[N,M]; draw N withpen pencircle scaled 3pt;
draw M withpen pencircle scaled 3pt; endfig;

```

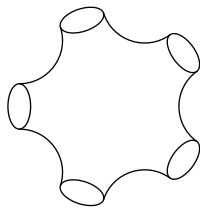

94. Hình vẽ nhiều đường elipsoid



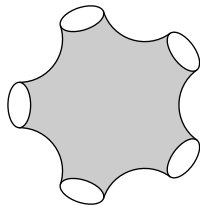
95. Đường tròn và nhiều đường tròn tiếp xúc



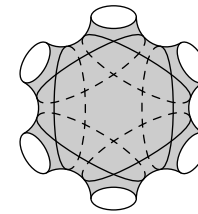
96. Hình vẽ cao cấp



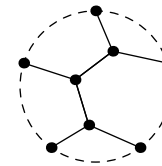
97. Hình vẽ cao cấp có tô màu



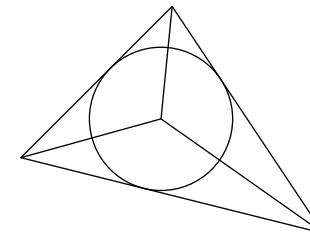
98. Hình vẽ cao cấp có tô màu và có...



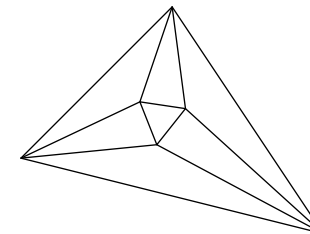
99. Hình vẽ quả bóng đá ...



100. Các đường đặc biệt trong tam giác: Phân giác, đường tròn nội tiếp

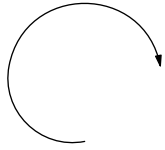


101. Các đường đặc biệt trong tam giác. Xây dựng từ phép biến hình đồng dạng...

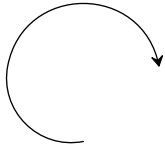


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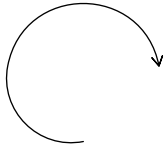
102. Đường cong có mũi tên



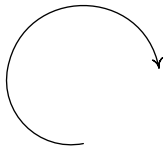
103. Đường cong có mũi tên



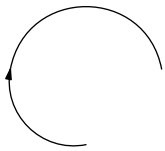
104. Đường cong có mũi tên



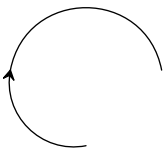
105. Đường cong có mũi tên



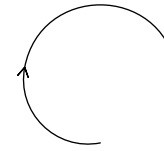
106. Đường cong có mũi tên



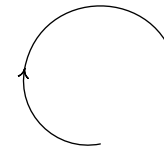
107. Đường cong có mũi tên



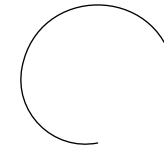
108. Đường cong có mũi tên



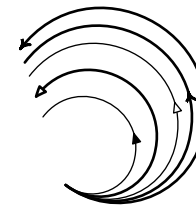
109. Đường cong có mũi tên



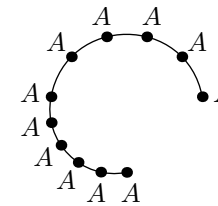
110. Đường cong có mũi tên



111. Đường cong có mũi tên

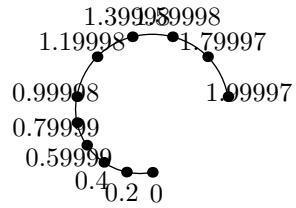


112. Đường cong và xác định các điểm trên đó

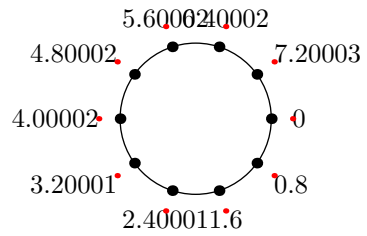


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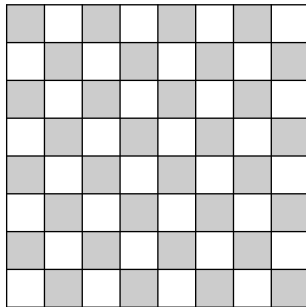
113.



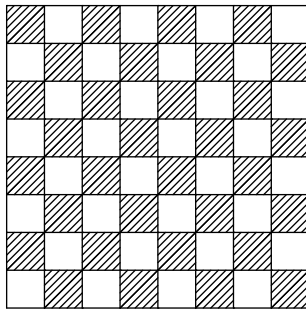
114.



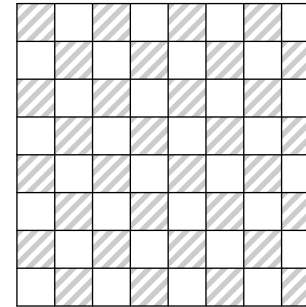
115.



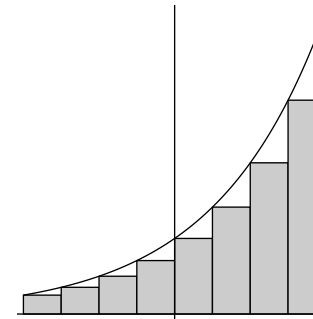
116.



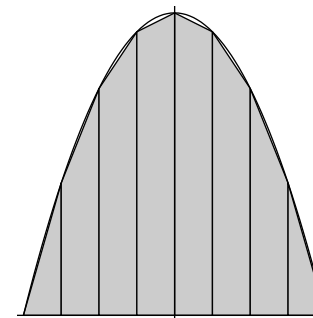
117.



118. Vẽ hình biểu diễn phép tính tích phân tổng Riemann

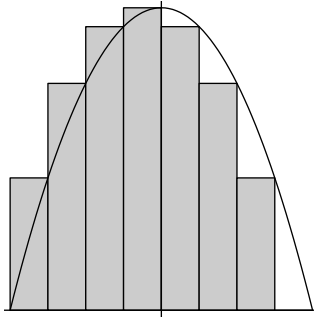


119. Vẽ hình biểu diễn phép tính tích phân tổng Riemann

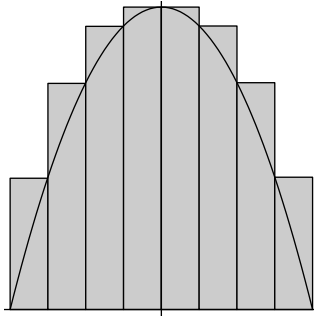


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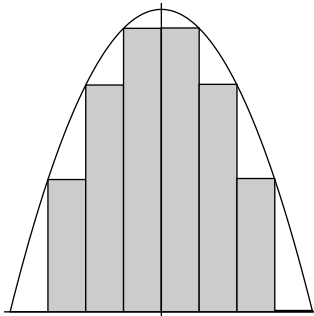
120. Vẽ hình biểu diễn phép tính tích phân tổng Riemann



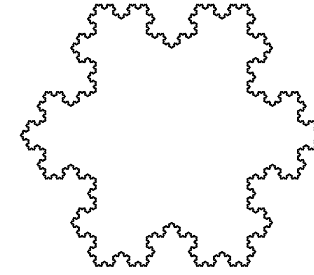
121. Vẽ hình biểu diễn phép tính tích phân tổng Riemann



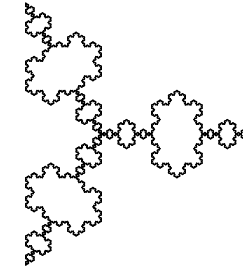
122. Vẽ hình biểu diễn phép tính tích phân tổng Riemann



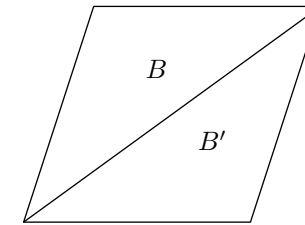
123.



124.

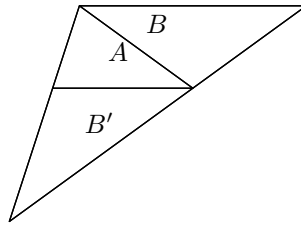


125. Vẽ các đường song song



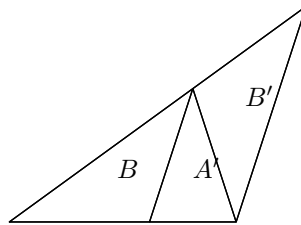
```
beginfig(203) pair A,B,C,D; u := 3cm; A := (0,0); B := (u,0); D
:= B rotated 72; C := (u,0) + D; draw A--B--C--D--cycle; draw
A--C; draw btex B' etex shifted 1/3 (A+B+C); draw btex B
etex shifted 1/3 (A+D+C); endfig;
```

126. Vẽ các đường song song



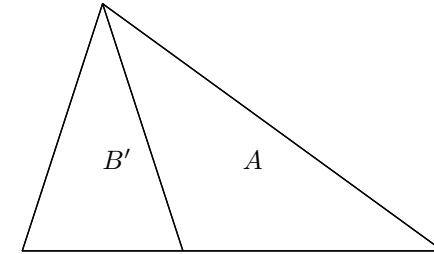
```
beginfig(204) pair A,B,C,D,E,F; numeric d[]; u := 3cm; A :=
(0,0); B := (u,0); D := B rotated 72; C := (u,0) + D; d[0] := 1;
d[1] := sqrt( 2*(1+cosd(72)) ); d[2] := sqrt( 2*(1-cosd(36)) ); A
:= A; B := C; C := D; draw A--B--C--cycle; E := (d1/(d0+d1))
[A,C]; F := (d0/(d0+d2)) [A,B]; draw E--C--F--cycle; draw btex A
etex shifted 1/3(E+C+F); draw B--C--F--cycle; draw btex B
etex shifted 1/3(B+C+E); draw E--F--A--cycle; draw btex B'
etex shifted 1/3(E+F+A); endfig;
```

127. Vẽ các đường song song



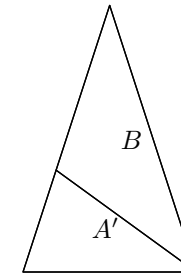
```
beginfig(205) pair A,B,C,D,E,F; numeric d[]; u := 3cm; A :=
(0,0); B := (u,0); D := B rotated 72; C := (u,0) + D; draw A--B--
-C--cycle; d[0] := 1; d[1] := sqrt( 2*(1+cosd(72)) ); d[2] := sqrt(
2*(1-cosd(36)) ); E := (d1/(d0+d1)) [A,C]; F := (d0/(d0+d2))
[A,B]; draw E--F--B--cycle; draw btex A' etex shifted 1/3(E+F+B);
draw E--A--F--cycle; draw btex B etex shifted 1/3(E+A+F);
draw C--E--B--cycle; draw btex B' etex shifted 1/3(C+E+B);
endfig;
```

128. Vẽ các đường có vị trí đặc biệt



```
beginfig(206) pair A,B,C,D,E,F; numeric d[]; u := 3cm; A :=
(0,0); B := (u,0); D := B rotated 72; C := (u,0) + D; d[0] :=
1; d[1] := sqrt( 2*(1+cosd(72)) ); d[2] := sqrt( 2*(1-cosd(36))
); A := A; B := C; C := D; E := (d1/(d0+d1)) [A,C]; F :=
(d0/(d0+d2)) [A,B]; B := 3*(C-E); C := 3*(F-E);
draw A--B--C--cycle;
D := (d0/(d0+d2)) [C,A]; draw B--C--D--cycle; draw btex A
etex shifted 1/3(B+C+D); draw B--D--A--cycle; draw btex B'
etex shifted 1/3(B+D+A); endfig;
```

129. Vẽ các đường có vị trí đặc biệt



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