Needham, Chapter 5, Exercise 6, p. 258.
G. Palmer, December 29, 2015

In[5749]:=
```
Clear["Global`*"];

(* CONSTANTS *)

q = 0; (* center of concentric circles *)

dr = 1 / 3;  (* r distance between concentric circles *)

pr = 2; (* plot range *)

a = -1; (* A *)

b = 0;  (* B *)


(* FUNCTIONS *)

v[z_] := {Re @ z, Im @ z};  (* complex to vector *)

f[z_] := a I Log[z] + b;  (* the function of interest *)

SetAttributes[{v}, Listable];


(* CALCULATED POINTS *)

circleTemplate = Table[ Exp[I θ], {θ, Range[0, 4 Pi, .01]}];

circlePts = Table[r circleTemplate, {r, dr, 5 dr, dr}];

(* images of circles *)

linePts = Table[Table[f[z], {z, circle}], {circle, circlePts}];


(* rays *)

rayTemplate = Range[.01, 5 dr, .01];

rayPts = Table[Exp[I θ] rayTemplate, {θ, Pi / 6, 2 Pi, Pi / 6}];


(* images of rays *)

fRayPts = Table[Table[f[pt], {pt, ray}], {ray, rayPts}];


(* GRAPHICS OBJECTS *)

circles = Table[Line[v @ circle], {circle, circlePts}];
```

```
circles = {circles[[1 ;; 2]], {Dashed, Circle[v @ 0, 1]}, circles[[4 ;; 5]]};

(* images of circles *)

lines = Table[Line[v @ line], {line, linePts}];

lines = {lines[[1 ;; 2]], lines[[4 ;; 5]]};

(* image of unit circle *)

xAxisRHS = {Dashed, Line[v @ {-1.56 pr, 1.56 pr}]};


rays = {Blue, Table[Line[v @ ray], {ray, rayPts}]};

(* images of rays *)

fRayObjs = {Blue, Table[Line[v @ fRay], {fRay, fRayPts}]};


(* points for both sides of Figure 1 *)

ptSz = .03;

pointsLHS =
  {EdgeForm @ Black, FaceForm @ White, Table[Disk[v @ pt, ptSz], {pt, {0}}]};

pointsRHS =
  {EdgeForm @ Black, FaceForm @ White, Table[Disk[v @ pt, ptSz], {pt, {0}}]};


(* TEXT *)

small = 8;
default = 12;
large = 14;
lhsAngle = 0;
drop = .1 I;

txtLHS = {

   {"0", -.1 - .15 I, default},
   {"(a)", -1.1 I pr, default},
   {"Figure 1. f = iALog(z)+B, ∂θv ≡ 0", 2 pr - 1.4 I pr, large}
  };

txtRHS = {
   {"0", -.1 - .15 I, default},
   {"(b)", -1.1 I pr, default}
  };


labelsLHS = Table[

   Text[Style[item[[1]], item[[3]]], v @ item[[2]]] , {item, txtLHS}];
```

```
labelsRHS = Table[

   Text[Style[item[[1]], item[[3]]], v @ item[[2]]] , {item, txtRHS}];


(* numbering *)

shift = .1;

circleNumbers = Table[Text[Style[ToString[n], small],
    v[(n * dr) Exp[I lhsAngle] + shift + .1 I]], {n, Range[1, 5]}];

fCircleNumbers = Table[Text[Style[ToString[n], small],
    v[f[(n * dr) Exp[I lhsAngle]] + shift + (.25 - n .03) I]], {n, Range[1, 5]}];

rayNumbers = Table[Text[Style[ToString[n], Bold, small],
    v[5.3 dr Exp[I n Pi / 6]]], {n, Range[1, 12]}];

fRayNumbers = Table[Text[Style[ToString[n], Bold, small],
    v[f[5.3 dr Exp[I n Pi / 6]] - .1 I]], {n, Range[1, 12]}];


(* aggregate graphics objects for both sides of figure *)

figA = {circles, rays, labelsLHS, pointsRHS, rayNumbers, circleNumbers};

figB = Translate[ {lines, xAxisRHS, fRayObjs,
    pointsLHS, labelsRHS, fRayNumbers, fCircleNumbers}, {6, 0}];


(* PLOT GRAPHICS *)

Graphics[{figA, figB}, Background → White,
 PlotRange → {{-pr, 5 pr}, {-1.6 pr, 2.6 pr}}, ImageSize → Large]
```