CSC 260, Spring 1999, Answers to Second Mini-Test

1(a) A procedure for drawing $y = \log(x)$ for $x$ in the range 1 to 10:

```c
for x from 1 to 10 do
  y := log(x);
  plot_pixel(x, round(y));
od;
```

1(b) A procedure that does this (approximately) without computing logarithms directly:

```c
y := 0; # Initialize y to the correct value for x=1
for x from 1 to 10 do
  plot_pixel(x, round(y));
  # Set y to value that will go with the next value of x, by adding
  # the derivative of log(x) times the change in x (which is one).
  y := y + 1.0/x;
od;
```

1(c) A more accurate answer could be obtained by doing differential computation with a smaller step size. For instance, one could increase $x$ in steps of $1/2$, adding $(1/2)/x$ to $y$ each time. Pixels would be plotted only every other step, when $x$ is an integer.

2(a) Here is the new version with variables $xs$ and $ys$ that are $x$ and $y$ multiplied by $R$:

```c
xs := R*R;
ys := 0;
while ys >= 0 do
  plot_pixel(round(xs/R), round(ys/R));
  xs := xs - round(ys/R);
  ys := ys + round(xs/R);
od;
```

2(b) The new version will not be as accurate as the old (assuming the old version used floating-point with a reasonably large number of around significant digits). The first time through the loop, $xs$ and $ys$ are multiples of $R$, so the rounding operations don’t result in a loss of accuracy. This is true the second time through the loop too. In iterations after that, however, $xs$ and $ys$ may not be multiples of $R$, so accuracy is lost when $xs/R$ and $ys/R$ are rounded.
3 Here is the curve we are to find a parametric representation of:

Here are two of the infinite number of possible parametric representations (one on the left, one on the right):