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:

```
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:

```
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.

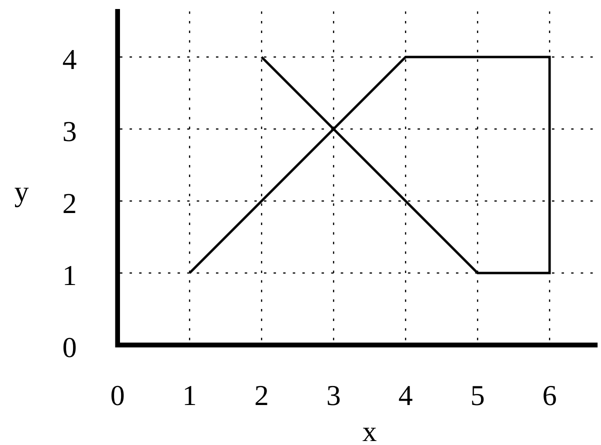
2(a) Here is the new version with variables `xs` and `ys` that are `x` and `y` multiplied by `R`:

```
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 ofaround 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):