(1) Integrate the function f(x) = x2 between 0 and 10 using a random sampling technique and counting the number of accepted vs rejected points. How many samples did you need to draw to get a reasonable estimate of the integral?

It took ~ 100000 to get an estimate of the integral of x^2 of 333.78999999999996 where the analytic value is 333.333… .

(2) Do the same for a trickier function: f(x) = sin(x). Integrate it from 0 to 2π. How does your integral compare to the analytical value? Do you think you'll ever be able to calculate the integral to be precisely equal to the analytical value? Explain why or why not.

The analytic value of the integral of sin(x) from 0 to 2π is 0. The Monte Carlo integration gives a value on the order of magnitude 10^{-16} for 100000. The integral approximation will likely never be zero because the number of points sampled above the x-axis will never be the same as those below, so the integral will never be precisely equal to zero.

(3) Explain how you might use the resulting sample of accepted points to create a weighted random sample from a probability distribution. For example, if you wanted to select a random point from a Gaussian (i.e., normal) distribution.

After you get the points under the curve, or your accepted values, if you only select from the accepted values you have a 100% probability of choosing points underneath the curve.