**Names:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Activity#3**

**Applied Numerical Weather Prediction Due: Wed., Feb. 2, 2022**

**Math Review and Discretization of Simplified Governing Equations (cont.)**

**(3.1)** Create a program that computes the zonal wind component (*u*) at the ground of the following function:



as *x* varies from 15 to +15 using 1001 [from Activity#2], 101, and 11 grid points to make the calculations for the given analytic expression and plot the zonal wind component [*u*(*x*)] using your favorite plotting routine (e.g., MS Excel) with all three curves on the same graph.

Assume that this zonal wind component function represents surface zonal wind observations along a line of constant latitude and that the surface meridional wind component (*v*) along this line is everywhere zero.

**(3.2)** Plot three curves from 15 to +15 using 1001, 101, and 11 grid points on two graphs, [1] *du*(*x*)/*dx,* and [2] *d2u*(*x*)/*dx2*, using ***forward-in-space*** (a.k.a., forward, D&VK Chap. 4) differences for the first and second derivatives (NOT the analytic derivatives).

[q3.2.1] For which sample, if any, (N=1001, 101, or 11) is there a noticeable drop-off in amplitude in the three curves? Do the maxima and minima in zonal wind component occur at the same “x” location? [Assume that a “noticeable drop-off” is one in which the amplitude changes by more than 10% from one sample to another.]

[q3.2.2] Use the anelastic continuity equation to calculate the vertical motion 500 meters above the ground from -15 to +15 using the N=1001, 100, and 11 samples. Assume that vertical motion at the surface is zero and that the zonal wind expression given above is constant from the ground to 500 meters above the ground. Is there a noticeable drop-off in amplitude in vertical motion between the three samples? Which sample do you expect should compare most favorably with reality given the analytic function of zonal wind in Problem (3.1)? Why?