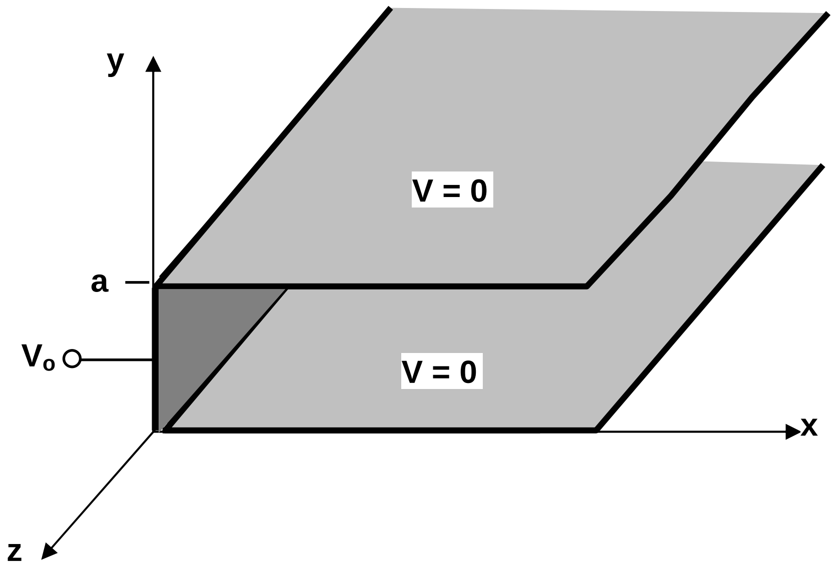
29:129 Electricity and Magnetism I

Griffiths Section 3.3.1—Two seni-infinite, conducting, grounded plates parallel to the x-z plane. An infinitely long conducting strip in the y –z plane is present on the left side of the plates and is biased to a potential V_o. We calculate the potential in the region between the upper and lower plates. The problem is two-dimensional, V = V(x,y)



$$V(x,y) = \frac{4V_o}{\pi}\sum_{n=0}^{\infty}\left(\frac{1}{2n+1}\right) e^{-(2n+1)\pi x/a} \sin\left(\frac{(2n+1)\pi y}{a}\right)$$

Griffiths Section 3.3.1 $(V_o = 1, a = 1)$ *n is replaced* **by** $2\,n + 1$ **then** *the sum goes* **from** 0 **to** *infinity*

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> restart;
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$$> V := (x, y) \rightarrow \frac{4}{\pi} \cdot \frac{\exp(-(2 \cdot n + 1) \cdot \pi \cdot x) \cdot \sin((2 \cdot n + 1) \cdot \pi \cdot y)}{2 \cdot n + 1};$$

$$V := (x, y) \rightarrow \frac{4\,e^{-(2\,n + 1)\,\pi\,x} \sin((2\,n + 1)\,\pi\,y)}{\pi\,(2\,n + 1)} \qquad \textbf{(1)}$$

Plot the potential V(x,y) for x = 0, where the boundary condition V=Vo = 1, for various numbers of terms in the expansion.
We notice that even with 100 terms, there are oscillations near y = 0 and y = 1, (corners) This is a phenomenon known to
occur with Fourier series and is known as "Gibbs Phenomenon". When more terms are included the effect moves closer
to the boundaries.

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>
> plot([sum(V(0, y), n = 0 ..0), sum(V(0, y), n = 0 ..5), sum(V(0, y), n = 0 ..10), sum(V(0, y), n
    = 0 ..100)], y = 0 ..1, color = [red, blue, green, black]);
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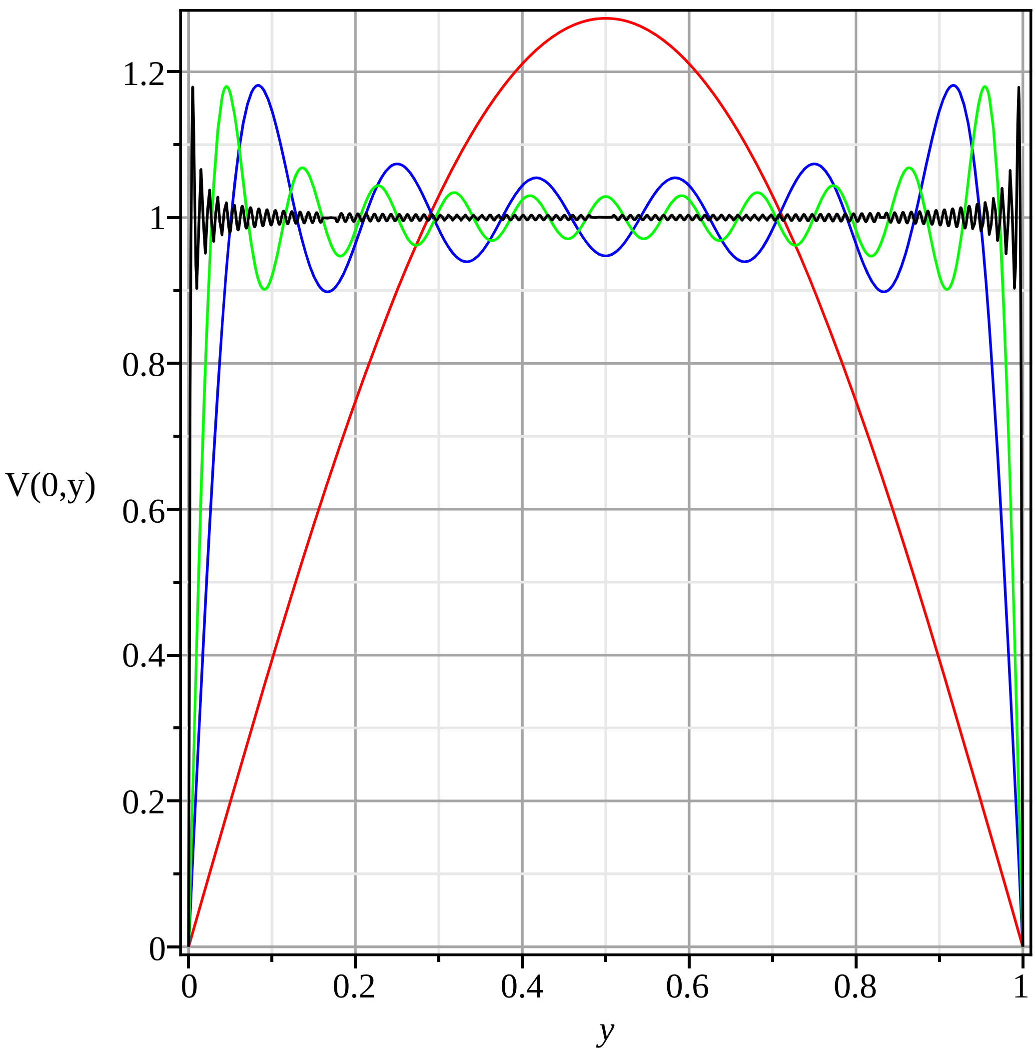
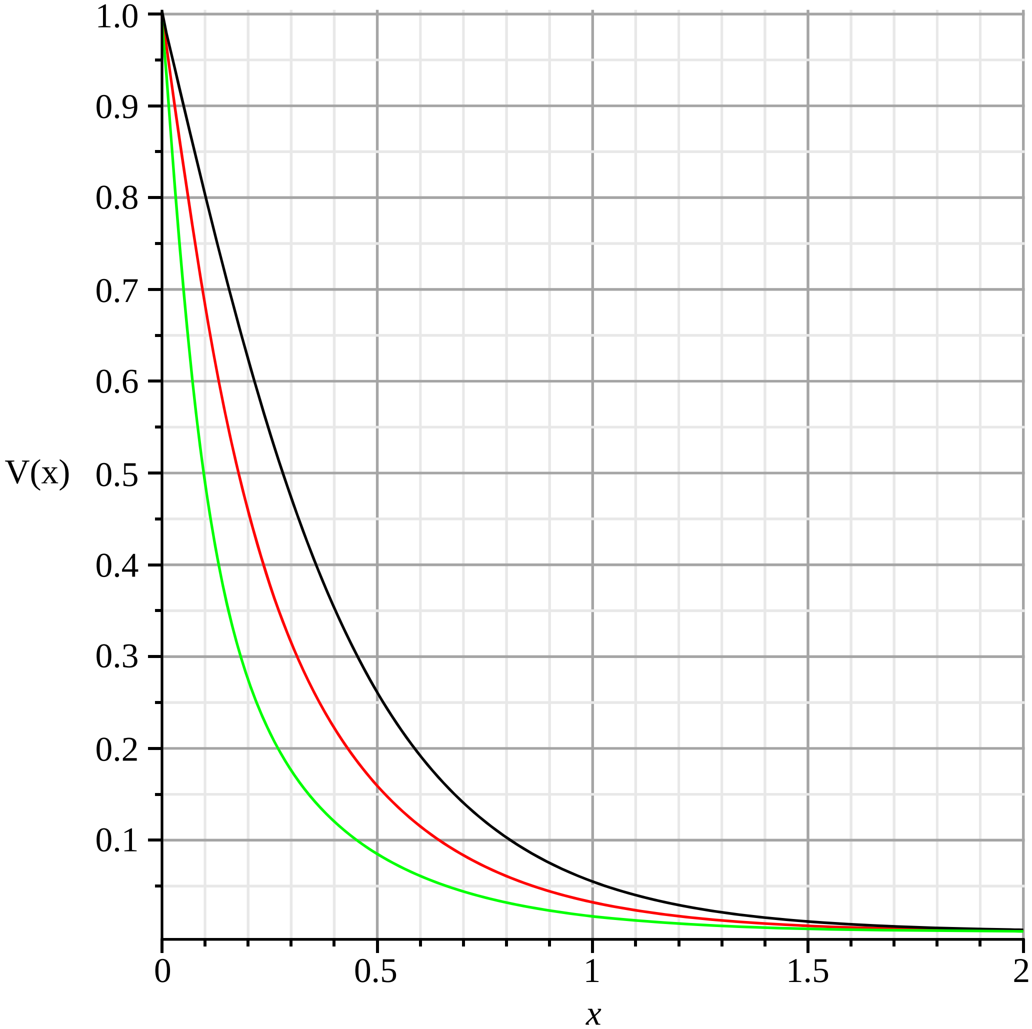


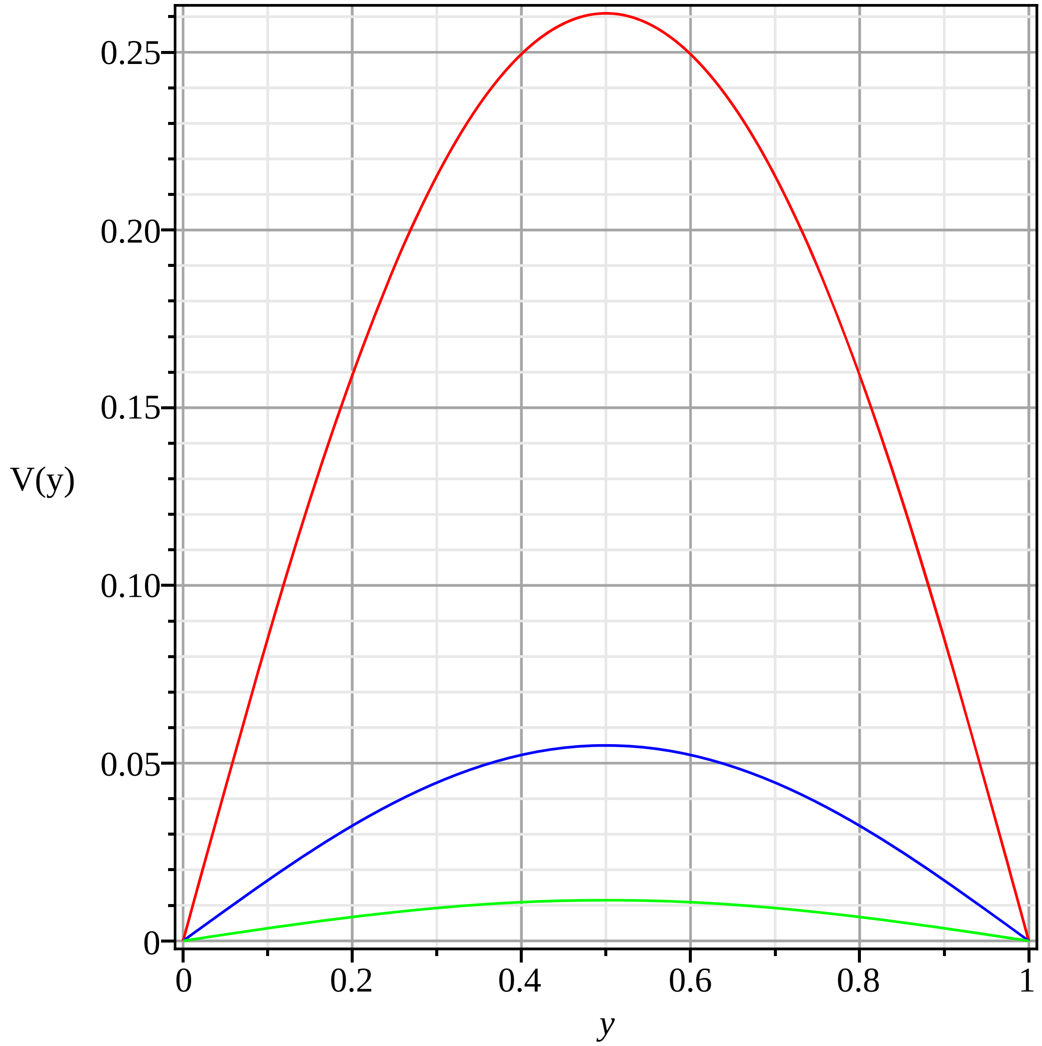
For specific values of y, plot V(x) --- the potential falls off exponentially with x

```
> plot([sum(V(x, 0.2), n = 0..100), sum(V(x, 0.5), n = 0..100), sum(V(x, 0.9), n = 0..100)], x
    = 0..2, color = [red, black, green]);
```



Plot V(y) for fixed x values (use 100 terms in the sum) The potential goes to zero at the boundaries

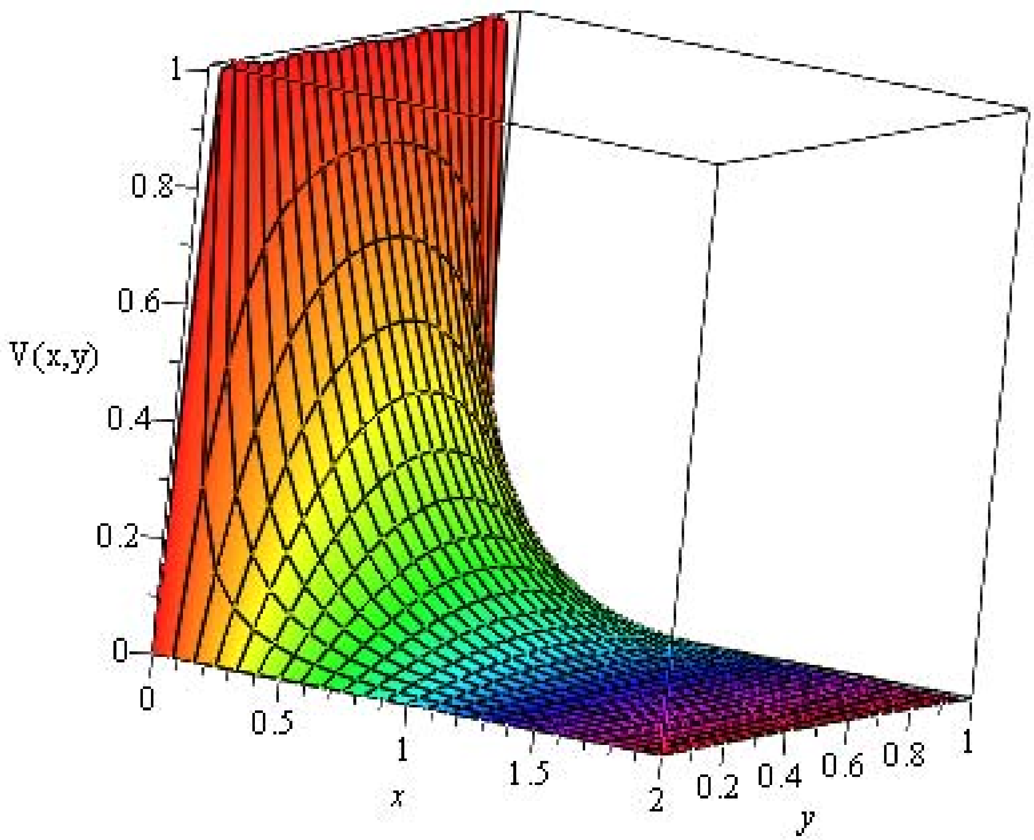
> $plot([sum(V(0.5, y), n = 0..100), sum(V(1, y), n = 0..100), sum(V(1.5, y), n = 0..100),], y = 0..1, color = [red, blue, green]);$



Show a "3D" plot of the potential (use 100 terms in the sum)

> $SUMV := sum(V(x, y), n = 0..100)$:

> $plot3d(SUMV, x = 0..2, y = 0..1, color = x)$;



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