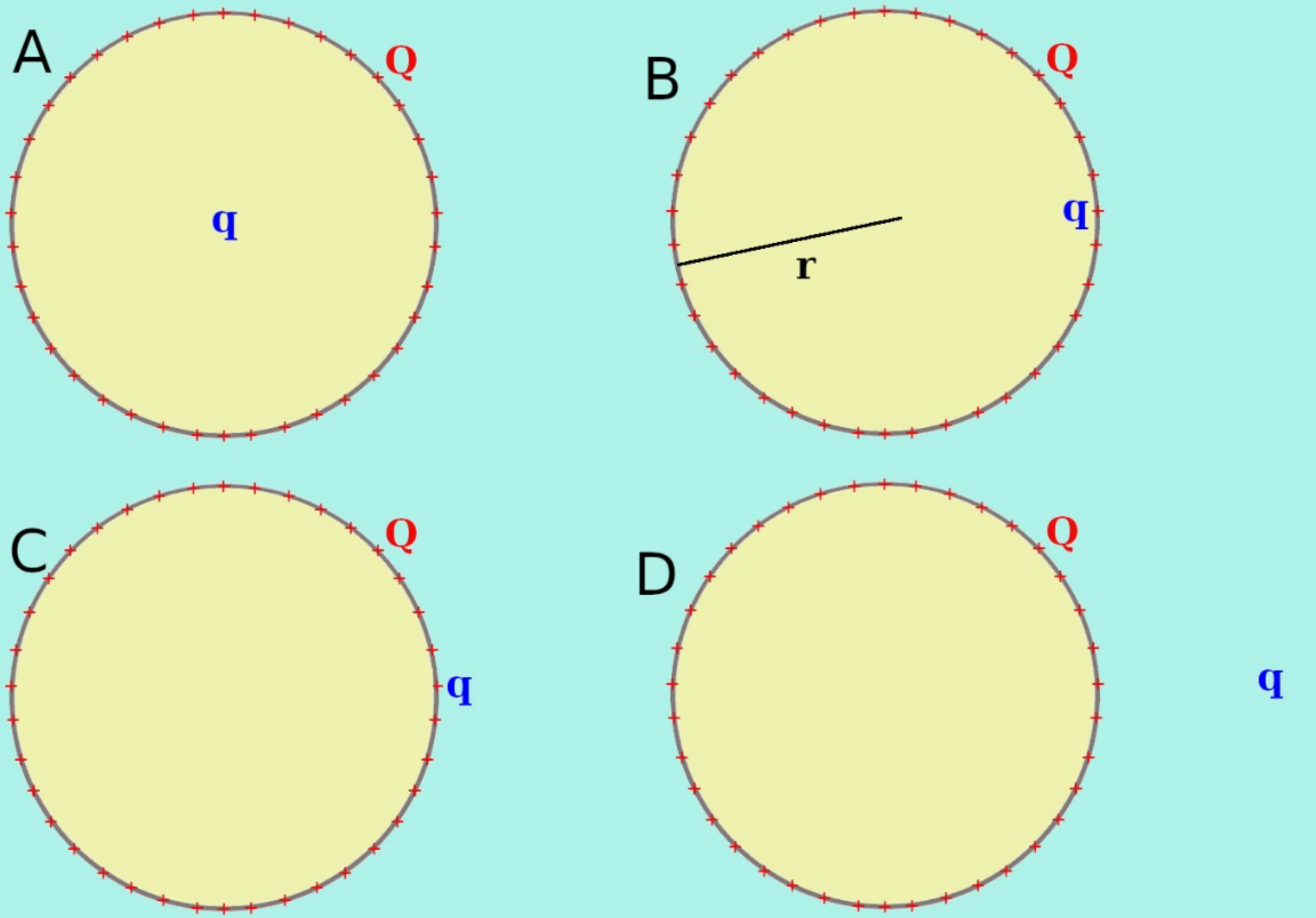
Lecture 19 outline:

- Demos Friday
- Return exam Friday
- Reading Questions
  - What's Electric pressure all about?
  - What if there aren't enough free electrons to cancel the field in a conductor?
- Relaxation method
- Separation of Variables
  - As a solution to physics – it's out of date
  - As an exposure to quantum mechanics, phase space, fourier space and modern electronics –it's au courant

What if there aren't enough electrons to cancel out the field?



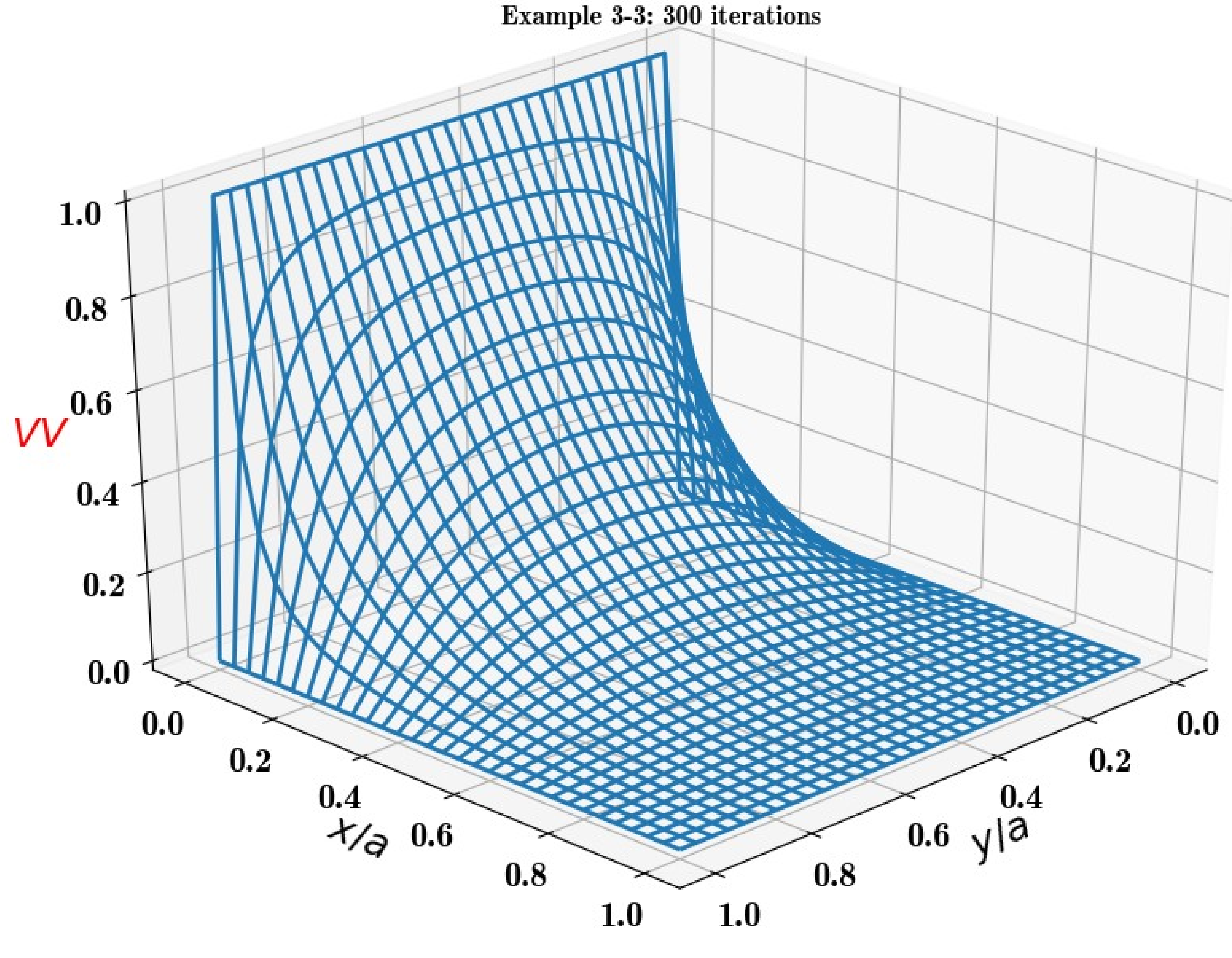
$(A)\ i: F=0,\ ii: F\sim 0,\ iii: F\sim 0,\ iv: F=kqQ/r^2$

$(B)\ i: F=0,\ ii: F=0,\ iii: F\sim 0,\ iv: F=kqQ/r^2$

$(C)\ i: F=0,\ ii: F=0,\ iii: F=0,\ iv: F=kqQ/r^2$

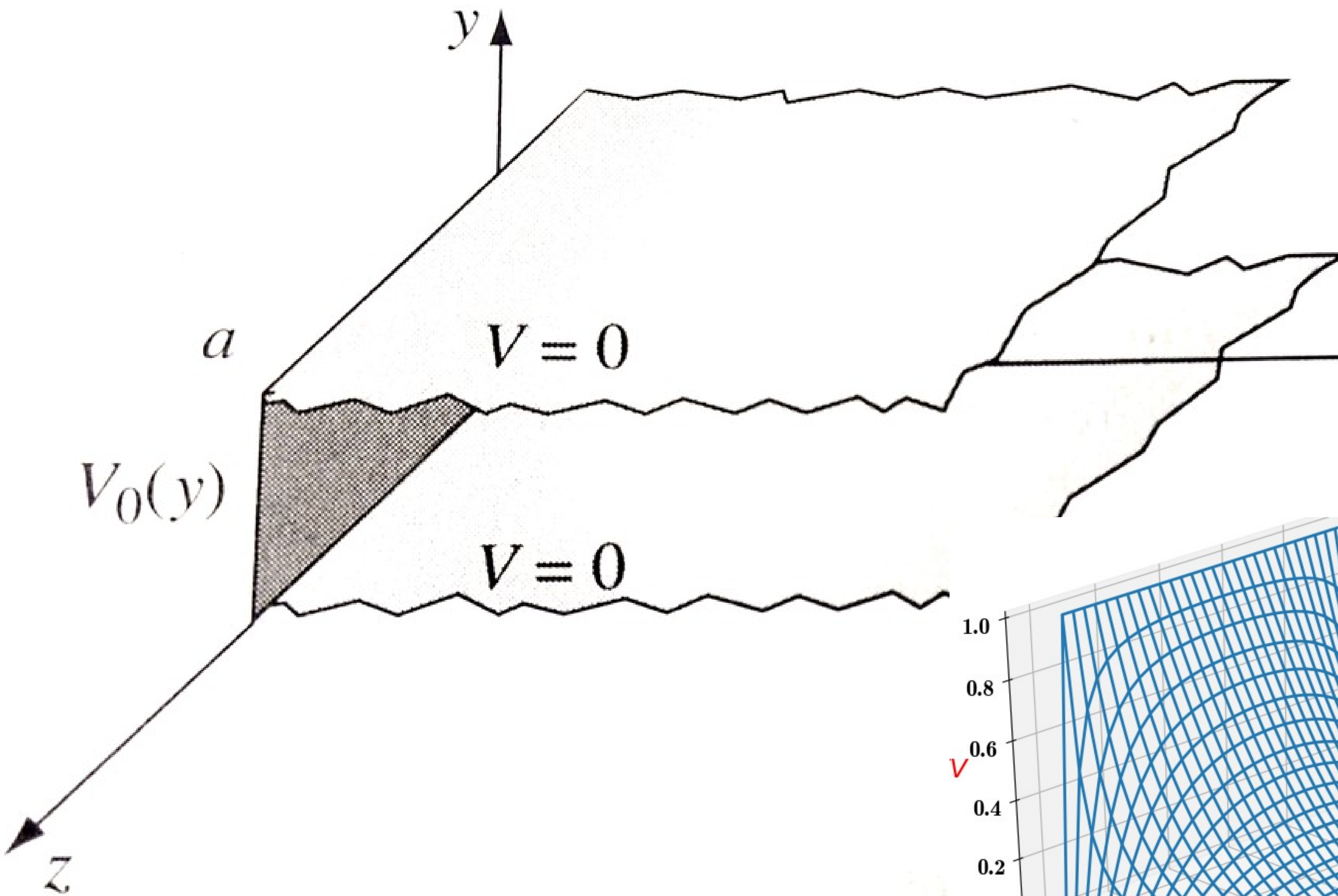
$(D)\ i: F=0,\ ii: F=0,\ iii: F=kqQ/r^2,\ iv: F=kqQ/r^2$

Relaxation Method



Separation of variables.

Example 3-3



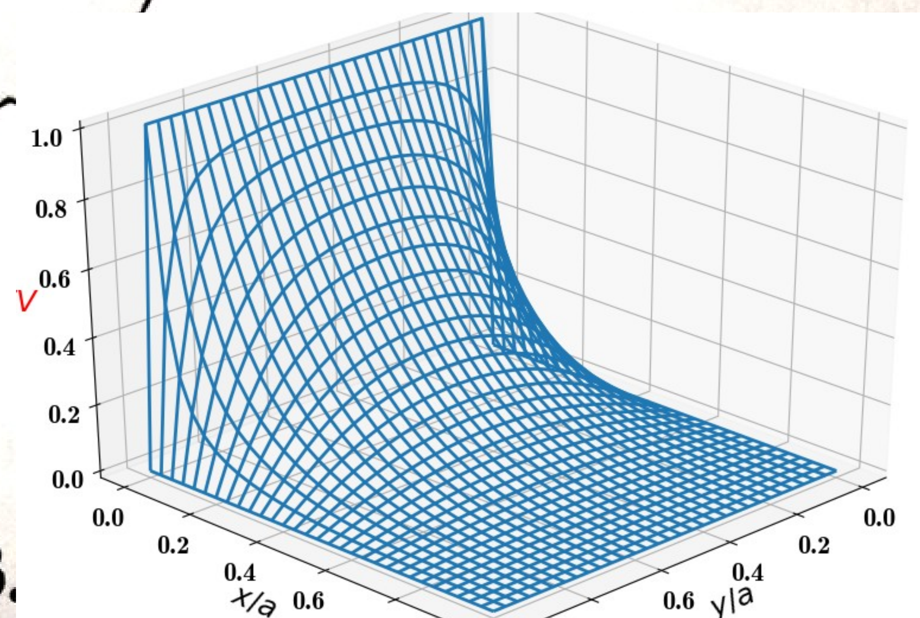


FIGURE 3.

Example 3-3

$(\mathrm{i})\ V = 0 \text{ at } y = 0$

$(\mathrm{ii})\ V = 0 \text{ at } y = a$

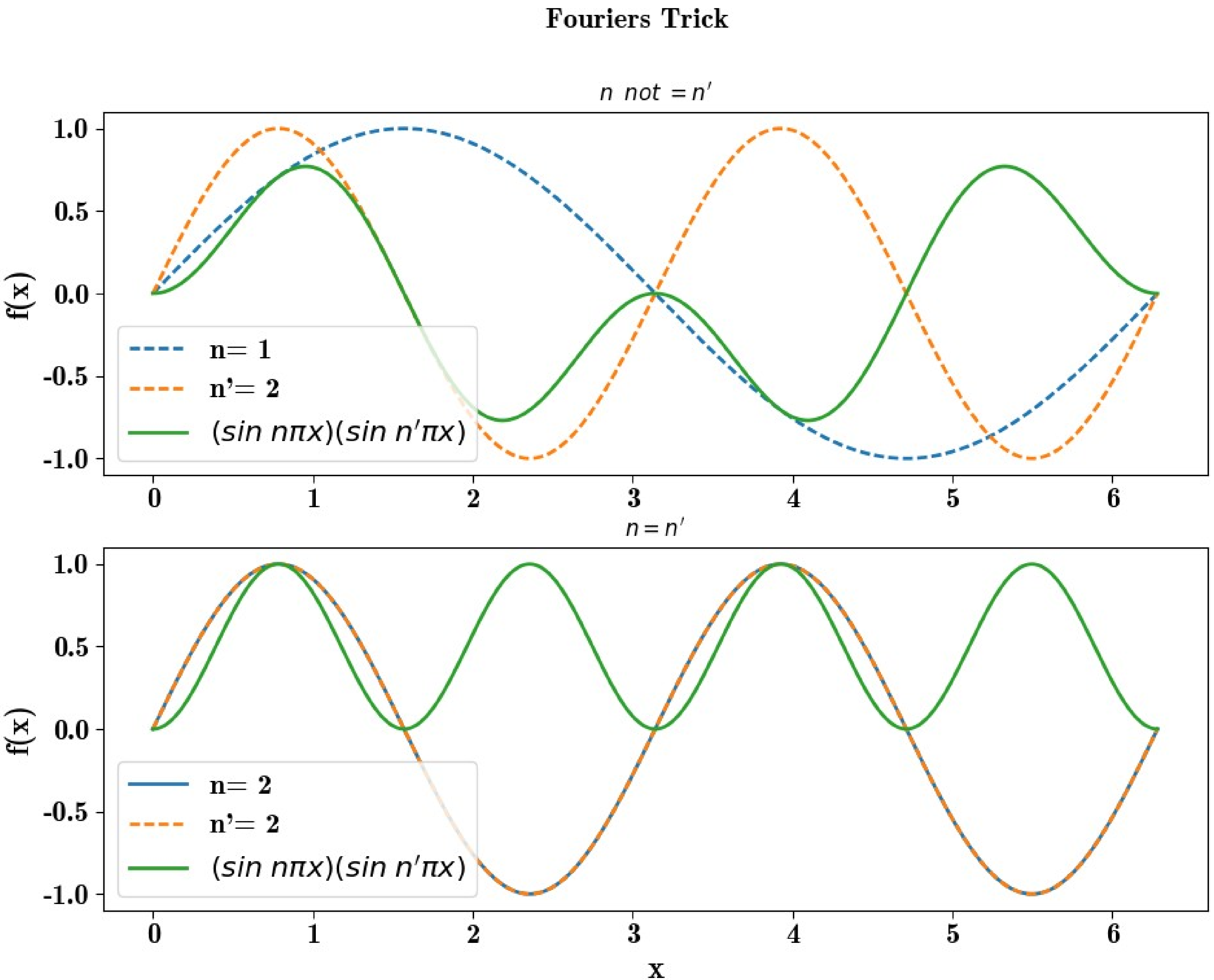
$(\mathrm{iii})\ V = V_0(y) \text{ at } x = 0$

$(\mathrm{iv})\ V \rightarrow 0 \text{ at } x \rightarrow \infty$

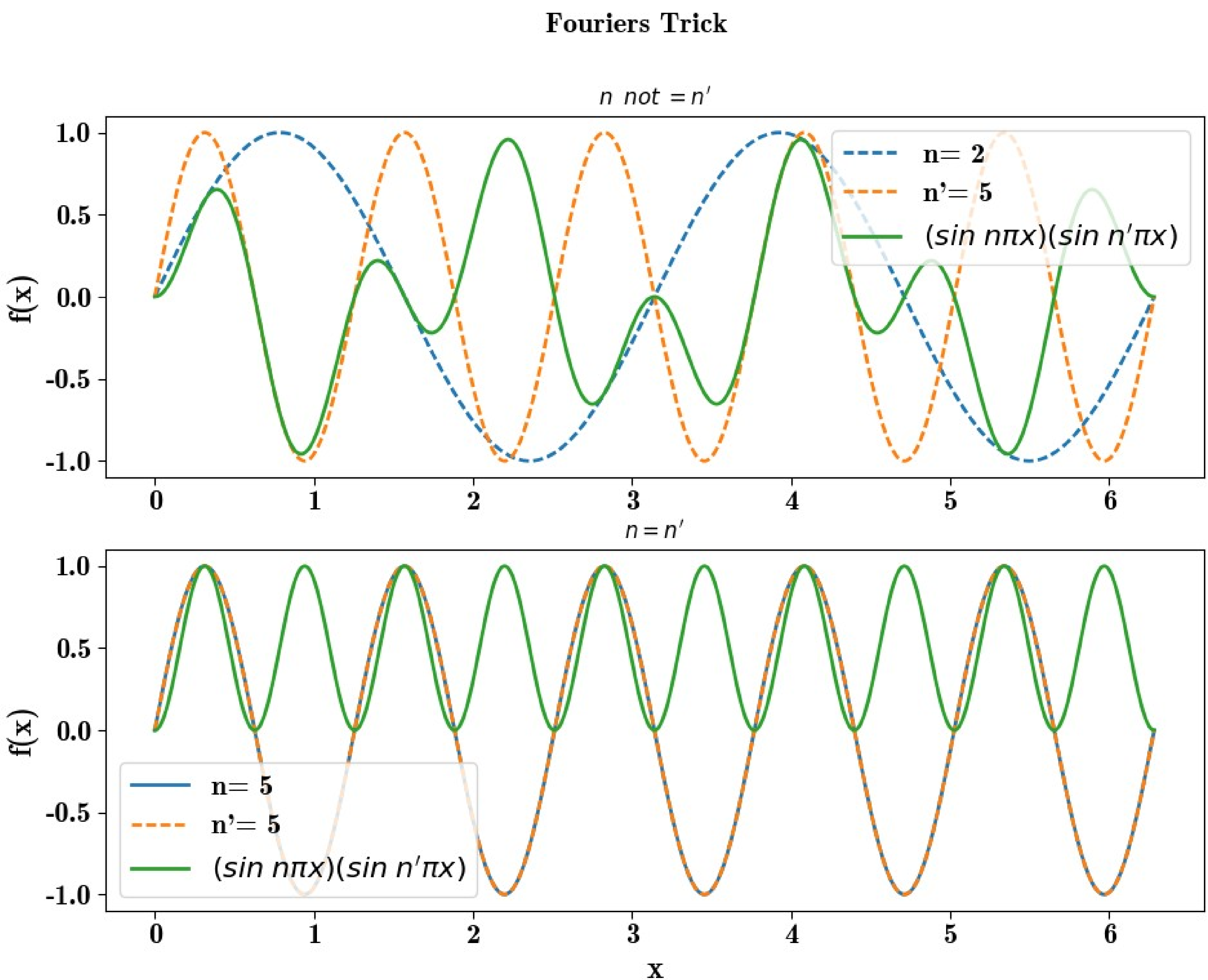
How to find the Cn?

$$V(x,y)=\sum_n C_n e^{(-n\pi x/a)} \sin\frac{n\pi}{a} y$$

$$\int_0^a V_0(y)\sin(n'\pi y/a)\,dy=\sum_n C_n \int_0^a \sin\frac{n\pi}{a} y \sin\frac{n'\pi}{a} y\,dy$$



Fouriers Trick
$n \ not = n'$
1.0
0.5
0.0
-0.5
-1.0
f(x)
0
1
2
3
4
5
6
n= 1
n'= 2
$(sin\ n\pi x)(sin\ n'\pi x)$
$n = n'$
n= 2
n'= 2
$(sin\ n\pi x)(sin\ n'\pi x)$
x


Fouriers Trick
n not $= n'$
n= 2
n'= 5
$(sin\ n\pi x)(sin\ n'\pi x)$
f(x)
$n = n'$
n= 5
n'= 5
$(sin\ n\pi x)(sin\ n'\pi x)$
f(x)
x

Griffiths Figure 3.19