The Method of Relaxation also works for Poission's equation (i.e., when there is charge!).

Given, $\nabla^2 V \approx \dfrac{V(x+a) - 2V(x) + V(x-a)}{a^2}$

Which equations describes the appropriate "averaging" that we must do:

A. $V(x) = \dfrac{1}{2}(V(x+a) - V(x-a))$

B. $V(x) = \dfrac{\rho}{\varepsilon_0} + \dfrac{1}{2}(V(x+a) - V(x-a))$

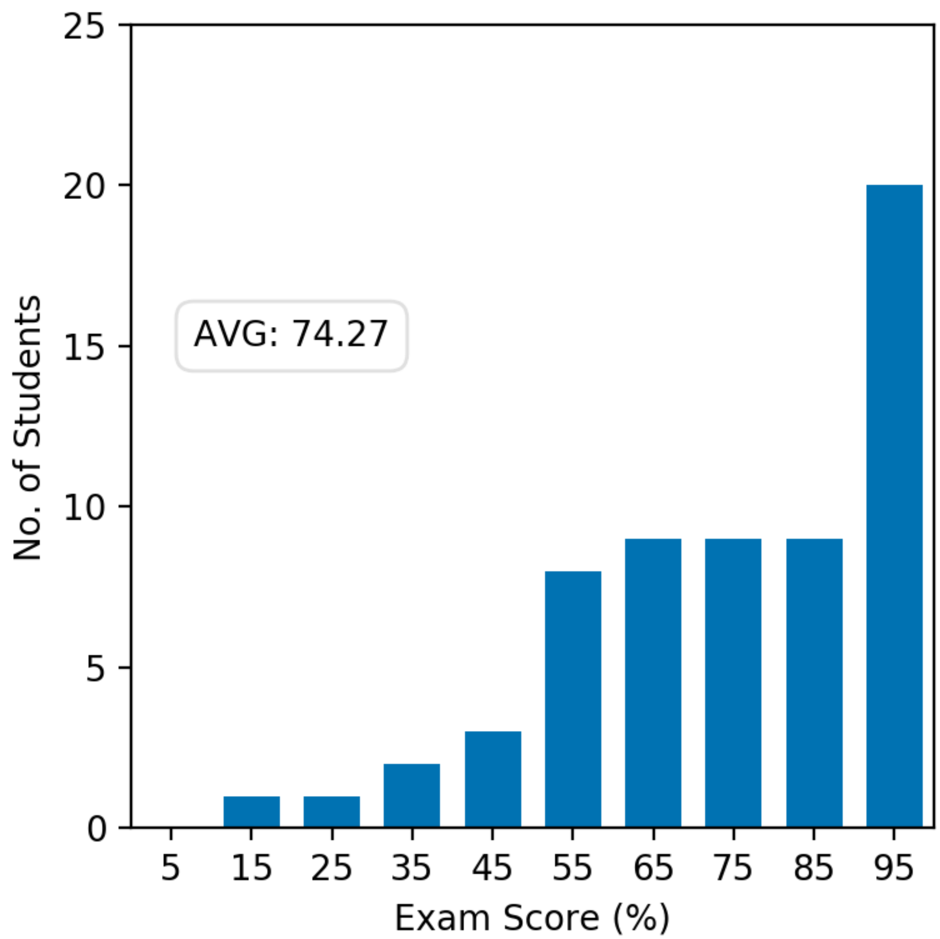
C. $V(x) = \dfrac{a^2\rho}{2\varepsilon_0} + \dfrac{1}{2}(V(x+a) - V(x-a))$

D. Something else

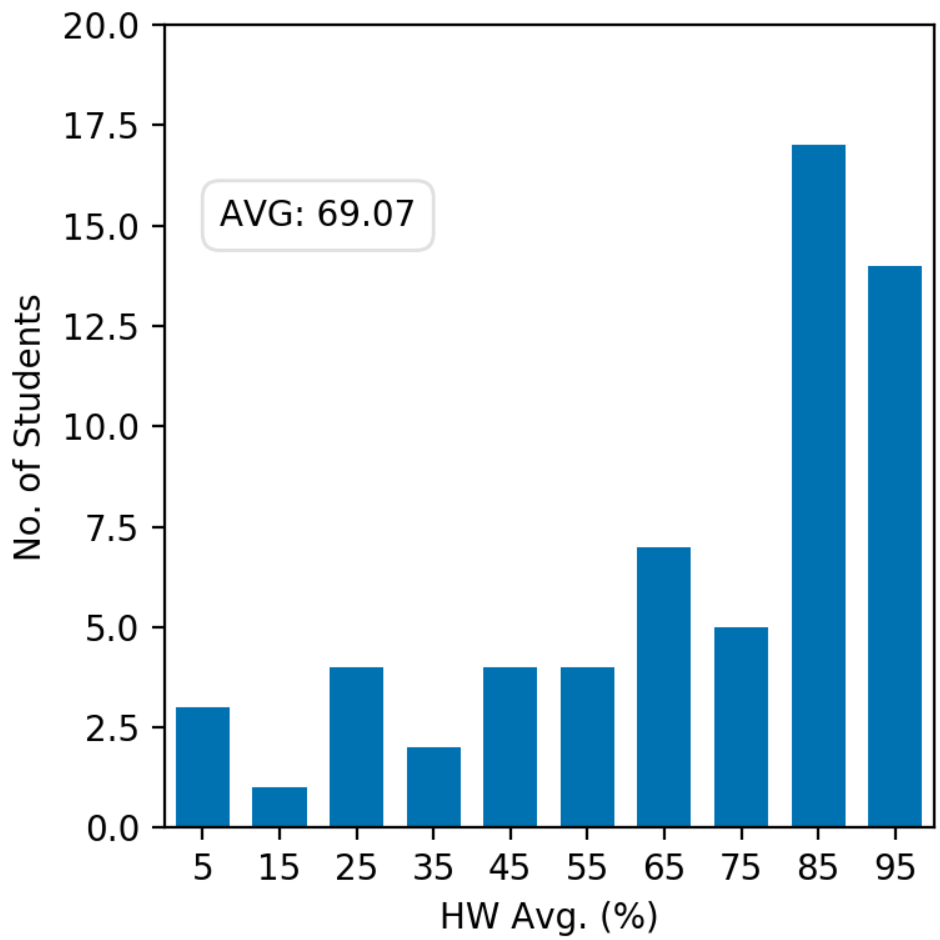
ANNOUNCEMENTS

- Exam 1 is graded
  - Should have received email this morning with updated grades
- Danny out of town Friday
  - Norman Birge will substitute

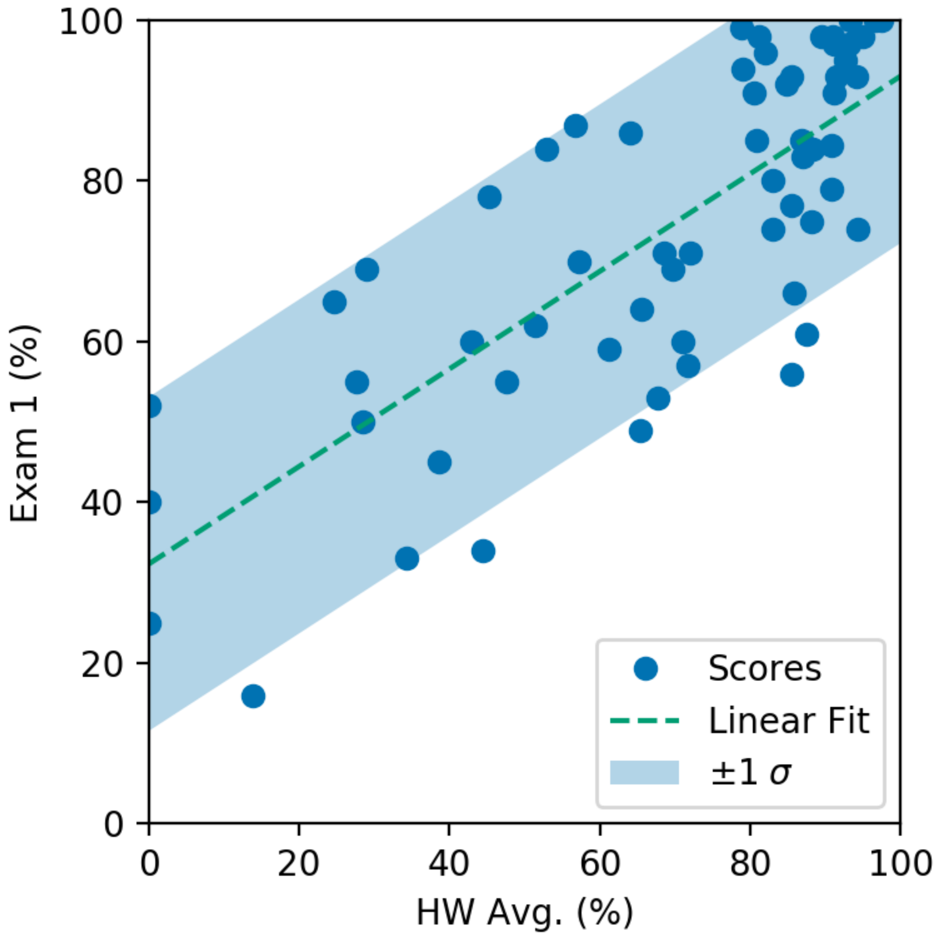
EXAM 1 GRADES



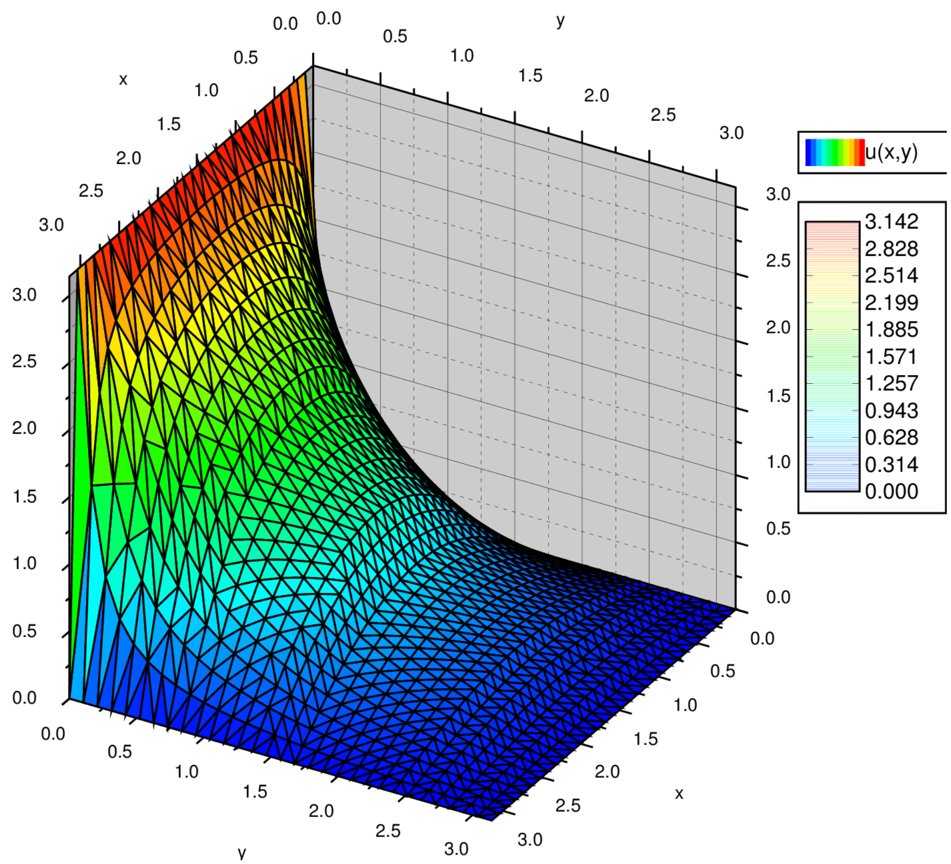
HOMEWORK AVERAGES



PLEASE DO YOUR HOMEWORK



SEPARATION OF VARIABLES (CARTESIAN)



Say you have three functions $f(x)$, $g(y)$, and $h(z)$. $f(x)$ depends on x but not on y or z. $g(y)$ depends on y but not on x or z. $h(z)$ depends on z but not on x or y.

If $f(x) + g(y) + h(z) = 0$ for all x, y, z, then:

A. All three functions are constants (i.e. they do not depend on x, y, z at all.)
B. At least one of these functions has to be zero everywhere.
C. All of these functions have to be zero everywhere.
D. All three functions have to be linear functions in x, y, or z respectively (such as $f(x) = ax + b$)

If our general solution contains the function,

$$X(x) = Ae^{\sqrt{c}x} + Be^{-\sqrt{c}x}$$

What does our solution look like if $c < 0$; what about if $c > 0$?

A. Exponential; Sinusoidal
B. Sinusoidal; Exponential
C. Both Exponential
D. Both Sinusoidal
E. ???

Our example problem has the following boundary conditions:

- $V(0, y > 0) = 0; V(a, y > 0) = 0$
- $V(x_{0 \to a}, y = 0) = V_0; V(x, y \to \infty) = 0$

If $X'' = c_1 X$ and $Y'' = c_2 Y$ with $c_1 + c_2 = 0$, which is constant is positive?

A. c_1
B. c_2
C. It doesn't matter either can be

Given the two diff. eq's :

$$\frac{1}{X}\frac{d^2X}{dx^2} = C_1 \qquad \frac{1}{Y}\frac{d^2Y}{dy^2} = C_2$$

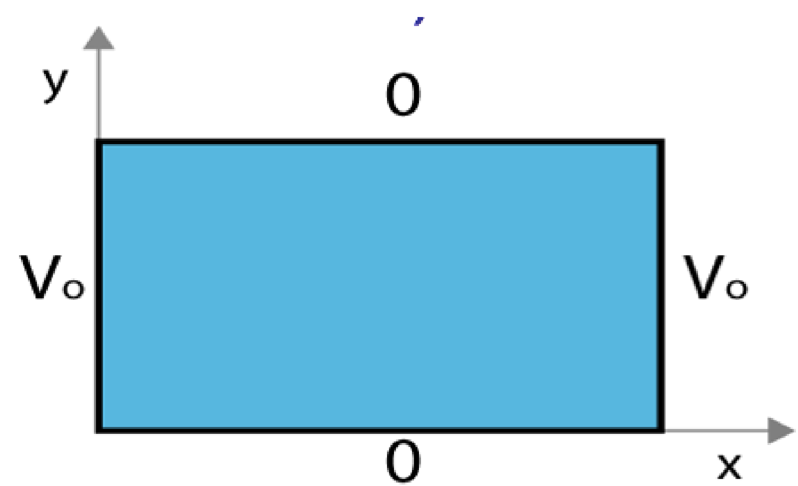
where $C_1 + C_2 = 0$. Given the boundary conditions in the figure, which coordinate should be assigned to the negative constant (and thus the sinusoidal solutions)?

A. x

B. y

C. $C_1 = C_2 = 0$ here

D. It doesn't matter.



Given the two diff. eq's :

$$\frac{1}{X}\frac{d^2X}{dx^2} = C_1 \qquad \frac{1}{Y}\frac{d^2Y}{dy^2} = C_2$$

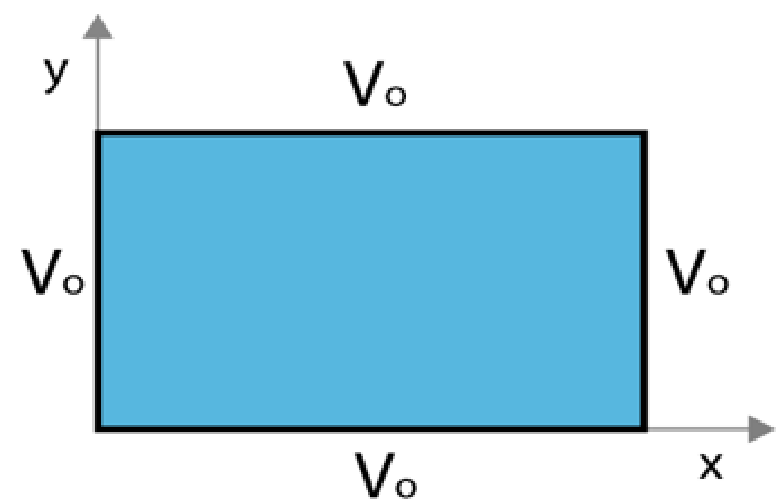
where $C_1 + C_2 = 0$. Given the boundary conditions in the figure, which coordinate should be assigned to the negative constant (and thus the sinusoidal solutions)?

A. x

B. y

C. $C_1 = C_2 = 0$ here

D. It doesn't matter.



When does $\sin(ka)e^{-ky}$ vanish?

A. $k = 0$

B. $k = \pi/(2a)$

C. $k = \pi/a$

D. A and C

E. A, B, C

Suppose $V_1(r)$ and $V_2(r)$ are linearly independent functions which both solve Laplace's equation, $\nabla^2 V = 0$.

Does $aV_1(r) + bV_2(r)$ also solve it (with a and b constants)?

A. Yes. The Laplacian is a linear operator
B. No. The uniqueness theorem says this scenario is impossible, there are never two independent solutions!
C. It is a definite yes or no, but the reasons given above just aren't right!
D. It depends...

What is the value of $\int_0^{2\pi} \sin(2x)\sin(3x)\,dx$?

A. Zero

B. π

C. 2π

D. other

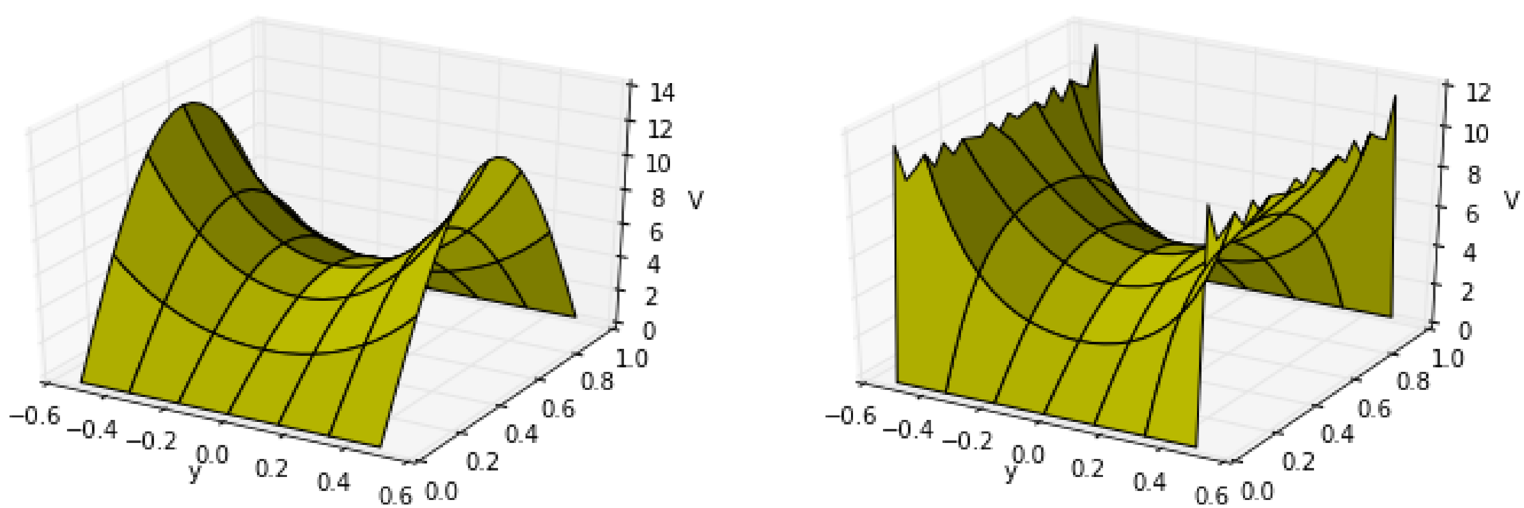
E. I need resources to do an integral like this!

EXACT SOLUTIONS:

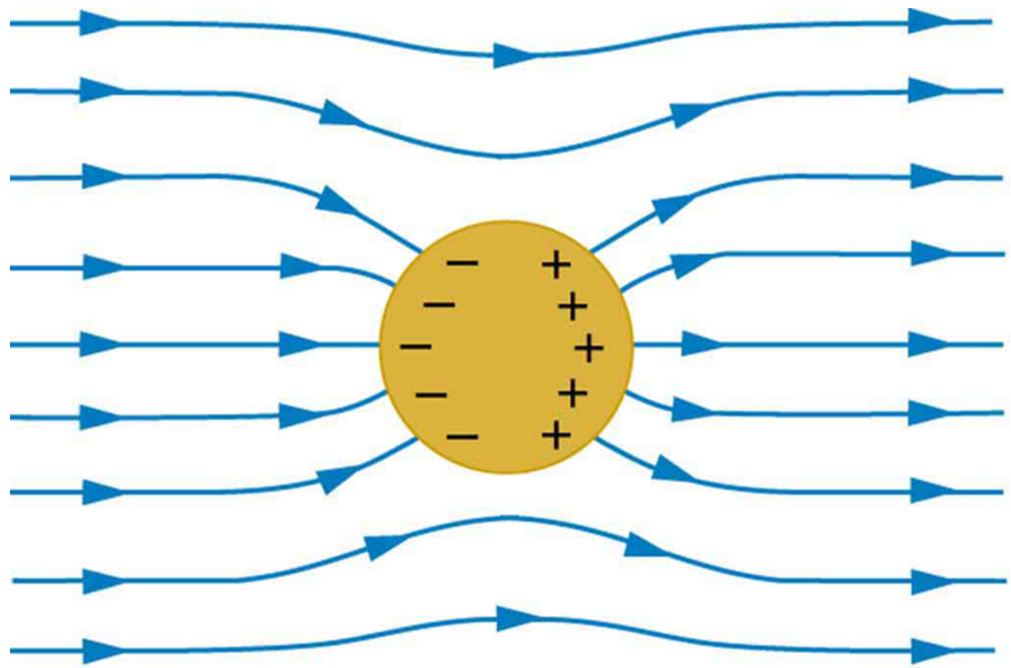
$$V(x,y) = \sum_{n=1}^{\infty} \frac{4V_0}{n\pi} \frac{1}{\cosh\left(\frac{n\pi}{2}\right)} \cosh\left(\frac{n\pi x}{a}\right) \sin\left(\frac{n\pi y}{a}\right)$$

APPROXIMATE SOLUTIONS:

(1 TERM; 20 TERMS)



SEPARATION OF VARIABLES (SPHERICAL)



Given $\nabla^2 V = 0$ in Cartesian coords, we separated $V(x, y, z) = X(x)Y(y)Z(z)$. Will this approach work in spherical coordinates, i.e. can we separate $V(r, \theta, \phi) = R(r)\Theta(\theta)\Phi(\phi)$?

A. Sure.
B. Not quite - the angular components cannot be isolated, e.g.,$f(r, \theta, \phi) = R(r)Y(\theta, \phi)$
C. It won't work at all because the spherical form of Laplace's Equation has cross terms in it (see the front cover of Griffiths)